A Comprehensive Literature Review on the Blockchain Technology as an Technological Enabler for Innovation

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A COMPREHENSIVE LITERATURE REVIEW ON THE BLOCKCHAIN TECHNOLOGY AS AN TECHNOLOGICAL ENABLER FOR INNOVATION

Seminar paper

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1 Introduction

The theory of decentralized crypto-currencies (e.g. Bitcoin and Altcoins) have gained rapidly recognition (Coindesk, 2015), and are often associated with statements such as a glimpses into our future (Deloitte, 2015).

While the Bitcoin technology has been extensively studied, we believe that the concept of the blockchain provides a new perspective on the already existing literature by looking at the various appliances of the underlying technology in a socio-economical setting prior to its previous literary focus within finance and economics (e.g. fin-tech).

While blockchain represents a novel application on cryptography and information technology, researchers still lack to find the tipping point for the technology (Shelkovnikov, 2016). Researchers agree that the blockchain technology has certain features that is well applied within the financial industry (Kehoe et al., 2015), but still lacks to find the appropriate use of large scale blockchain usage within modern society (Shelkovnikov, 2016). This is further backed by researchers that points to the fact, that crypto currencies and blockchain has not yet reached mainstream IS research (Morisse, 2015).

However, technologies such as automation, computing, robots and ultimately the Internet have been contributing immensely to progression and wealth of economies and cultures (Manyika & Roxburgh, 2014) and thus expect that the blockchain technology will provide further contributions.

1.1 Objective of the paper

The goal of this paper is to conduct a literature review of the current literary landscape within the field of IS. We will look at the blockchain technology, and analyse prior literature in order to identify gaps in the current literature. Motivated by its technical and mathematical nature, previous research has focused exclusively on aspects of the technological infrastructure such as security, anonymity, scalability

(Reid & Harrigan, 2011; Eyal & Sirer, 2013) or the resiliency of consensus mechanisms (Karame et al., 2012). Due to the novelty of concepts and the underlying technologies, we provide a new overview on recent developments and related literature in this paper (Glaser & Bezzenberger 2015) and strive to explore the related concepts in the literature. Through exploration of the concepts, we dive into the blockchains utilization as a technological platform for an upcoming ecosystem of applications and software and look at the theoretical features of the technology as a foundation for this paper. Thus, we seek to enhance the understanding of the technology in other contexts throughout the literature and explore the current contributions to the literature.

This study has implications for both researchers and practitioners. For researchers we seek to identify a new branch of research that focuses on enablement of the blockchain as a platform-centric technology for ecosystems to flourish. For practitioners, we illustrate that it is crucial to keep developing on the technology, as research indicates that we have still not reached the tipping point of the technology.

Hence, this paper aims to answer the following research questions:

- *Is the Blockchain technology able to establish itself as a mainstream platform for ecosystems based on its current capabilities?*
- *Does the blockchain provide enough technical capabilities to be considered a sustainable platform and reach mainstream adoption?*

1.2 Structure of the paper

This paper is structured as follows: Section 2 contains a review of the theoretical background as well as the methodology of the paper. Section 3 analyses and synthesizes the key findings. Section 4 discusses the approach and the current findings. Section 5 concludes.

1.3 Definitions

In order to examine the idea of the three main concepts; blockchain, platforms and ecosystems, it is important to establish a common context in which the three concepts are described (Webster & Watson, 2002). The concepts are described as follows:

1.3.1 Blockchain

The Blockchain technology is defined as "[…] t*he technology underlying bitcoin and other crypto currencies—is a shared digital ledger, or a continually updated list of all transactions" (Morrison, 2016).* This definition aligns with the one used throughout the paper and is thus considered the general consensus used in this paper.

1.3.2 Platforms

For platforms, this paper uses the definition presented by Techopedia (2016) that defines a platform as *"[...] a group of technologies that are used as a base upon which other applications, processes or technologies are developed.".*

1.3.3 Ecosystems

For ecosystems, the author of this paper is using the definition provided by Dictionary (Dictionary.com, 2016) that describes an ecosystem within IS as "*any system or network of interconnecting and interacting parts, as in a business: The success of Apple's ecosystem depends on hardware/software integration.*".

Thus, by defining each of the concepts, we have established a common understanding of the main concepts used in this paper.

2 Theoretical Background

Following the theoretical introduction, this paper aims to further elaborate on the theoretical grounding in order to give a brief summary of prior research and furthermore to highlight potential areas for future research. Additionally, we seek to establish a common understanding of the theory within the field of IS, regarding the blockchain technology. Within the IS research area, Blockchain is still considered a novel innovation and has yet to become a part of the mainstream IS research (Morisse, 2015). This is furthermore supported by the general IS landscape, whose primary focus has been on the blockchain as a cryptographic economic system, e.g. Bitcoin (Beck et al., 2016; Glaser & Bezzenberger, 2015; Wörner et al., 2016). We also consider the amount of literature within the area as an important factor when evaluating the matureness of the concepts. We find that the concept of bitcoin has been explored more than 8 times as much as blockchain with only 320 results on Google Scholar (*See appendix A*). Thus, the author of this paper argues that there still exist significant gaps in the current literature on the blockchain technology, that is due to be explored within the field of IS research. Thus, this paper strives to provide a novel perspective on the blockchain technology by examining current research on blockchain and by combining this with the other IS concepts such as blockchain as a platform, ecosystems, innovations and technological features.

2.1 Methodology

A literature review can be described as a summary of summaries (Brocke et al., 2009 p. 4) that allows identification of research areas within a given subject field (Rowley & Slack, 2004). Within the field of IS research, we regard the seminal paper by Webster & Watson (2002) as the common approach to literature reviews (Wolfswinkel et al., 2013). Webster & Watson (2002) notes, that a literature review is concept-centric and determine the further framework of the review. Additionally, Brocke et al. (2009, p. 4) identifies, that in order to conduct literature reviews as a part of IS research, a rigorous process is essential for the success of the paper. Lastly, a literature review should not only examine past research, but also identify future research gaps (Hart 2009; Rowe 2014; Webster and Watson 2002).

This paper will have emphasis on reviewing articles of high quality, as commonly recommended (Rowley & Slack, 2004 p. 32; Brocke et al., 2009). Throughout the paper, we utilize best practices within IS research to identify research gaps and to investigate the previously proposed research questions. In the following sections, we will dive into the practical process of the literature review.

2.1.1 Literature Review Approach

The paper utilizes a combination of the approaches identified by Brocke et al. (2009), Webster & Watson (2002) and Müeller-Bloch & Kranz (2015). The combination of these literature review-frameworks will ensure both the rigour of the research contributions of this paper. The frameworks will also ensure the reproducibility of the results and conclusions drawn. We will use the framework by Brocke et al. (2009), that consists of five phases; In phase one, the scope of the review needs to be determined. In phase two, the topic of the paper should be conceptualized which includes creating definitions for the key terms. Third, the literature search needs to be conducted. In the fourth step, the literature is analysed and synthesized. Finally, in the last phase, we establish the research agenda, Thus, the identification of research gaps is included in the last step (Phase V) of Brocke et al.'s framework (2009).

Scope

According to Bacharach (1989) & Whetten (1989), it is important to define the boundaries of a paper, including the scope. This paper focuses on the main IS contributions within the largest academic journals (AIS, IEEE, EJIS, MISQ etc.) and within the majority of IS conferences (ECIS, ICIS etc.). However, we will also look at the general research contribution on e.g. Google Scholar to establish a general baseline of the topic to identify all relevant literature, due to the novelty of the technology. With the identification of relevant literature, we will analyse and synthesize the results found in the literature in order to identify gaps and propose frameworks for future research (Müeller-Bloch & Kranz, 2015). Lastly, a conclusion will be established to provide researchers with the main contributions of the paper. However, in this paper, we will exclude the technological aspects of the technology, as previous research already has focused on aspects of the technological infrastructure in terms of security, anonymity, scalability e.g. (Reid & Harrigan, 2011; Eyal & Sirer, 2013; Karame et al., 2012).

Lastly, we will also exclude the economic use cases of the technology (e.g. Bitcoin) and focus solely on the technology behind, the blockchain.

Topic Conceptualization

The main concept of this paper is focalized around the blockchain technology, which we previously defined as a "[…] *shared digital ledger"*. Based on the blockchain, we will take a deeper look into two sub concepts; platforms and ecosystems to establish a common point of reference for our literature review. With this setting, we will look at how the current and previous literature describes the blockchain in a platform and ecosystems context. Hence, our main search will be aimed at finding literature that describes the blockchain as an enabler for ecosystems, or the blockchain as a future platform in mainstream research. Accordingly, we have chosen the keywords; Blockchain and Ecosystems for our literature search.

Literature search

Brocke et al. (2009) describes the third phase as the "literature search". In this phase we explain the methodological framework for conducting the literature search. According to Webster & Watson (2002) and Brock et al. (2009), the search can be conducted in different ways. Webster and Watson (2002) suggest starting the search for relevant literature in leading journals. However, the literature search in this paper was divided into four phases. First, we establish a common ground by searching generally for the concepts across various platforms to identify a knowledge base as the foundation for the literature review. As established above, the primary focus has been on the keyword "*blockchain*", due to the fact that extensive literature exists on both "*ecosystems*" and "*platforms*". Second, when the common ground has been established, we identify the primary drivers within the IS research field (Webster & Watson, 2002). We take foundation in the senior scholar's basket of journals, in which we identify the basket of eight, consisting of the essential journals within IS research. However, there exist various ways of identifying literature with high quality (Brocke et al., 2009). Additionally, we also identify other relevant journals, that is included in our database search. In step three, we conduct a forward- and backward search to ensure that we have exhausted the concepts within the area of interest (Webster & Watson, 2002). The literature found in step three is mapped into a customized version of Brocke et al.'s

(2009) backward/forward matrix. After we conclude that we have reached an exhaustive point of our research, we add the literature found in the forward/backward search to our original concept matrix to ensure a full overview of the topic. However, we note that due to the exclusion of technical papers, we cannot claim to be exhaustive, but note that we reach a point of theoretical saturation with the selected articles. Theoretical saturation is reached, when no new categories and properties emerge from the data (Glaser and Strauss 2008).

During our general search, we start out by searching for literature on Google Scholar to create a quick overview of the research topic. During this phase, we use a concept matrix approach (Webster & Watson, 2002; Salipante et al., 1982), where the concepts are identified and mapped in the matrix. This allows us to get a full overview of the research landscape within our topic of interest. After an overview has been established, we follow the guidelines by Brocke et al. (2009) by following a rigour search process by searching the main contributing journals within the IS field. However, as the topic is still considered novel, we also consider the main conference publications within IS to ensure that the topic has been exhaustively examined.

With the identification of the main contributing journals and conferences, we establish our journal overview by creating a database matrix to identify journals, databases, search, coverage, hits and literature reviewed (*see appendix B*). We map the found literature into our concept matrix. When all of the identified journals and conferences has been searched we continue to the next phase where we conduct a forward and backward search on all the found literature in the general search. As mentioned previously, we utilize a customized version of the framework by Brocke et al. (2009), in which we map each of the papers based on the following parameters; Number of article references, number of articles citing the original article, period covered, keywords, relevant backward search papers and lastly, relevant forwards search papers. We furthermore divide both forward and backward papers into two categories; new- and existing literature. Thus, with this customized matrix we get a quantitative overview of all the papers covered in the literature review.

Analysis and Synthesis

After having collected sufficient literature, the literature has to be analysed and synthesized (Brocke et al., 2009). For the analysis, we look at the identified concepts and matrices in order to draw conclusions and synthesize on the ideas at hand. By doing this, we allow the topic to be arranged, discussed and synthesized as proposed by Brocke et al. (2009).

Research agenda

With the analysis and synthesis in place, we form our research agenda which is the last phase (Phase V). We note that the synthesis of literature is expected to result in a research agenda (Brocke et al., 2009; Ahuja, 2002) to increase the effects on future research (Webster & Watson, 2002). The agenda forms a basis for extending the review and thus contribute to the literature base within the IS community.

3 Analysis and Synthesis

In this section, we present the results from our review. The analysis is divided into three layers; the first layer of the analysis focuses on identifying and discussing the main findings of the literary search from a high level perspective. The second layer breaks down the concept findings into categories, each focusing on its own distinct category of concepts. The third, and last layer, summarizes and synthesizes the findings.

We find from our review that the concept of the blockchain technology is still in a novel stage, as previously described by Morisse (2015). However, the literature points towards central themes and concepts within the technology that has achieved larger success within the literary landscape of Information Systems. We find that several of the identified concepts are of interest to this paper. However, in order to examine each of the concepts in-depth, a categorization approach helps in terms of analysing the identified concepts (Webster & Watson, 2002; Shuradze et al., 2015; Braun & Clarke, 2006). This approach allows us to combine one, or more concepts into a single category from which they can be identified, analysed and synthesized. In addition, we believe that the categorization provides a comprehensive view on the factors underlying the current research body of the topic.

In our search, we identify three distinct themes that appear more frequently in the current literature, and thus will function as a centre of focus for our analysis as stated by Webster & Watson (2002).

3.1 Overall observations

As seen in the concept matrix (*appendix A*), various concepts have arisen from the literary search. After the search, 38 concepts have been discovered within the literature. The obvious concepts have been excluded from the analysis, as these does not provide any value in terms of research insights (e.g. concepts as Blockchain, Bitcoin). The average paper contains 14 concepts, and each of the concepts is represented 17 times in average. We also see that the further we get in the search, and as more concepts arise, the mapping of the papers gets more extensive.

By looking at the main concepts, we find that "New innovation", "Decentralization" and "Digital Innovation" is amongst the most common concepts found in the literature. However, by categorizing the concepts, we discover four main themes mentioned in the general literature about the blockchain technology. It should be noted that some of the concepts are present within one- or more categories as these present ideas that fall outside one category. Hence, these will establish a foundation for our further analysis of the topic.

Technological features	Security, Signature, Scalability, Adoption, Trustlessness, Privacy, Crypto Currency
Innovation	Pegged Sidechains, Governance-as-a-serivce, Development on blockchain, Innovation, POC Prototype, Lawmaking, Algorithmic trading, Legal Automation, Smart Property, New Innovation, Virtual markets, Virtual teams, Digital innovation, Open Innovation, Bitcoin, Blockchain, Shipping, Accounting Systems
Decentralization	Virtual markets, Distributed Autonomous Organizations, Decentralized Consensus Systems, Virtual teams, Internet of things, Generativity, Decentralization, Trustlessness, Private Ledger
Ecosystems	Internet of Things, Distributed Autonomous Organizations, Cryptographic Economics Systems, Ecosystems, Private Ledger, Smart Contracts, Open Cloud Ecosystem, Private Ledger, Technological Platforms

Table 1 - Concept Categorization table

3.2 Technological Features

As stated earlier, this paper will not focus on the technological aspects of the technology. However, with the presence of 7 identified concepts in the literature, we will mention the implications of the identified technological features.

Based on the features from the literature, we see that they all relate directly to the technological specifications of the blockchain (Glaser, 2016; Glaser & Bezzenberger, 2015; Norta, 2015; Giaglis & Kypriotaki, 2014). Research also points towards the technological features as becoming drivers for disruption and innovation for the

technology (Wörner et al., 2016; Zhang & Wen, 2015). Giaglis & Kypriotaki (2014) furthermore argues that "*such systems [decentralized peer-to-peer network systems, (security, signature, privacy) red.] lie at the heart of a transformative innovation that is currently under way and, if successful, will sweep across many diverse scientific fields, business practices, and our every lives in the years to come*" which is backed by researchers such as Swan (2015a).

Contributions within the IS fields specifically points at security and transparency as the being the main foundation for what makes blockchain a trust-free technology (Beck et al., 2016). Brandon (2016), argues that the technological features of the blockchain is a new revelation within the old security framework, the CIA triad (*Confidentiality, Integrity and Availability*) and furthermore adds that "*…there are no central point of failure*".

Although conversely, we see that some of the technological features identified points towards complications within the technology, such as scalability and adoption. Furthermore, when looking at the technological features from such a perspective, we know that the essential characteristics of data is symbolized by the three V's (*Volume, Velocity & Variety*). However, Beck et al. (2016), points out that *"One of the main issues of blockchain technology is scalability"* which is furthermore backed by researchers who argues that *"for assuring the theoretically achievable security of the blockchain, a large number of full nodes are required"* (Beck et al., 2016; Buterin, 2014). Thus, we see that problems arise to maintain the integrity of the three V's-concept.

Lastly, we look at the technological feature of adoption. We know from Shuradze et al. (2015) and Gawner & Cusumano (2014), that in order to be adopted, "*[...] platforms need to have an essential functionality in their larger technological system of the adopter*". This shows that the technical features are a necessity for the adoption of the blockchain technology. In addition, Gawner & Cusumano (2014) also mentions that the platforms "[…] *have to address important business problems of both users and the targeted industry*".

Thus, we see that the technical features are inevitability a requirement for the success and the adoption of the technology. However, platforms and ecosystems will be

analysed in-depth later they are categorized as an independent variable. Yet, we find that the blockchain is still in its novelty within the IS research field and note that the secure and trust-free blockchain-based transaction, none-the-less, has the potential to change numerous existing trust-based transaction systems (Beck et al., 2016).

3.3 Innovation

We start this paragraph by identifying the definitions underlying the term "*innovation*", as this is described numerous times and places in the current literature, with different meanings. We propose a definition that follow the broader definition from Thompson (1965 p. 2) & Wörner et al. (2016), where innovation is described as "*the generation, acceptance and implementation of new ideas, processes, products or services.*". Additionally, we note that the term "*innovation*" is context dependent and "*[...] incorporates divergent attributes, such as different process stages or underlying constructs*" (Baregheh et al., 2009). Hence, from research, we know that the purpose of an innovation process could be to change or improve products, services and business models (Wörner et al., 2016).

In the later years, novel varieties of innovation have come forward, particularly within the IS research field. Disruptive and radical innovation have received rising attention from scholars and practitioners alike who aims to describe innovations with a high degree of "innovativeness" (Wörner et al., 2016; Christensen et al., 2015; Latzer, 2009). Addtionally, we also see different innovation concepts described across the literary landscape, such as distributed innovation (Gregory et al., 2015), contemporary innovation (O'Leary & Cummings, 2007; Tiwana et al., 2010; Yoo et al., 2012; Gregory et al, 2015), crowd-enabled innovation (Boudreau & Lakhani, 2013; Crowston & Howison, 2006, Winter et al., 2014; Gregory et al., 2015), institutional innovation (Davidson et al., 2016), open innovation (Huhtamäki & Ruebens, 2016) and innovation ecosystems (Huhtamäki & Ruebens, 2016).

Hence, innovation can take place in various forms and context. From Duivestein et al. (2015), we also know that the pace of technological innovations are increasing and at the same time, *"[...] the speed with which innovations prove to be successful is increasing*" (Duivestein et al., 2015). However, we see that the formidable innovation introduced by the blockchain technology, is based on the fact that it provides new

technological features; an open network where participants do not need to know or trust each other in order to interact (Atzori, 2009). Davidson et al. (2016) furthermore argue that the "*blockchain technology makes possible new forms of institutional innovation*". Thus, security, privacy & trustlessness is the core of the technological innovation. Literature also notes that the blockchain may "*[…] represent a disruptive innovation for many varieties of contracts and business activities*" (Atzori, 2016; Foroglou & Tsilidou). Besides the innovation aspects of the technology, we also see that digital technologies have contributed to minimizing the costs by enabling a variety of new ways to structure distributed work (Gregory et al., 2015).

We see that disruption and innovation is mentioned in the literature as becoming a major game changer within the IS field, especially with the rise of technological innovations such as the blockchain. However, innovation is not necessarily an easy feature. Many researchers' points towards the fact that the process of innovation is complex and takes place in a complex world (Huhtamäki & Ruebens, 2016). It is also pointed out that "*regulation has caught up with innovation*" (Duivestein et al., 2015 on the ECB) which is hindering the disruptive innovation approach. Conversely, this construct is mentioned as being created by IT-specialists and financial operators who sees governments as "[…] *somewhat of an encumbrance – too slow, too corrupt, too lacking in innovation, and benefiting few*" (Paquet & Wilson, 2015, p. 21; Atzori 2009).

Research concludes that innovation can come from various places, but especially technological innovations have increased likelihood of disrupting markets and industries with the blockchain seen as the main technological innovation of bitcoin (Foroglou & Tsilidou, 2015). We see that these new digital technologies bridge the current gaps in existing modes of innovation and are organizing into newer forms, from which are enabled not by its reference organizations, but through information platforms (Boudreau and Lakhani 2013; Crowston and Howison 2006; Winter et al. 2014; Gregory et al., 2015). Hence, these new types of innovation are able to exceed the current limitations by leveraging innovation beyond the boundaries of the firm (Chesbrough, 2003). Examples of such leverage is seen in examples such as Netflix (Lohr, 2009) and GoldCorp (Tapscroot & Williams, 2008), both of which offered an economical incentive for external innovations, and now functions as "*prime examples of engaging wider participation in innovation rooted in digital platforms*" (Gregory et al., 2015).

Lastly, we discuss how innovation and disruption can be achieved in a complex world. Research has various approaches to identifying the underlying capabilities of the success of innovation. Swan (2015a) mentions that in order to achieve a sustainable success for the blockchain as an innovation enabler, the development of accessible data and API's, facilitate the success of the full potential of the blockchain. Others argue that creating measureable indicators for innovation, by breaking down the perceived components of innovation, will lead to superior innovation. Such examples are shown in the European Union Innovation Union Scoreboard and the Massachusetts Innovation Index (Huhtamäki & Ruebens, 2016). Furthermore, we see that research also mentions that an essential part of the innovation process is established by acquiring new knowledge, by setting up innovation labs and investing money in start-ups (Duivestein et al., 2015). By following these measures, we strive increase innovation and disruption, and in this case, to "*[...] get a better understanding of the blockchain and the bitcoin*" (Duivestein et al., 2015) in a business context.

Thus, we see that research has many definitions of innovation, of which many applies to the concept of the blockchain technology as a technological enabler. Furthermore, we have identified several benefits of using the digital innovations of the technology such as cost optimizations, synergies and increased distributed innovation. We also identify several practical key areas for increasing innovation within an organization, for example by acquiring knowledge, setting up innovation labs or buying start-ups.

Hence, we conclude that research identifies many areas in which the blockchain functions as an enabler for both technology and innovation.

3.4 Decentralization

After more than six years from its launch we see that the concept of decentralization and the functionality of decentralized transaction ledgers can be used not only for crypto currencies, but to register and confirm any kind of contract, monetary system or property (Forte et al. 2016). Research furthermore describes the bitcoin as being the advent for the era of decentralization (Zhang & Wen, 2015). Additionally, some practitioners describe decentralization as "*We stand at the edge of a new digital revolution. The Internet is beginning a new phase of decentralization*"

(Wright & Filippi, 2015). However, before diving into the concept of decentralization, it is important to define the construct to establish a common understanding. In this paper we will follow the definition proposed by Benkler (2006), that describes decentralization as "*describes conditions under which the actions of many agents cohere and are effective despite the fact that they do not rely on reducing the number of people whose will counts to direct effective action."*.

Prior to the invention of the blockchain, the main concept focused on a centralized authority to manage and organize businesses and states, and for centuries, banks acted as central accountants for the inflow and outflow of wealth (Wright & Filippi, 2015). Centralized businesses were in the centre of of production, aggregation, distribution of resources and services (Wright & Filippi, 2015). Hence, there is no need for a centralized organ. However, with the introduction of blockchain, smart contracts and digital currencies, some practitioners suggest that the world of commerce and finance may soon be re-invented (Wright & Filippi, 2015; Swan, 2015a; Wörner et al., 2016).

It has become evident that the blockchain technology has abilities to disrupt outside its current boundaries (Forte et al., 2016). We see notions in the research about various types of decentralization; decentralized autonomous organizations (Swan, 2015a; Glaser & Bezzenberger, 2015; Brenig et al., 2016), decentralized consensus systems (Fairfield, 2014; Brenig et al., 2016; Glaser et al., 2015) & decentralized transaction ledgers/systems (Swan, 2015a; Glaser & Bezzenberger, 2015). Furthermore, we perceive that the blockchain technology is one of the "*Blockchain technology is one of the first identifiable large implementations of decentralization models that have the potential to reorganize all manner of human activity […]*" (Forte et al., 2015). Hence, we see that such systems lie at the heart of a transformative innovation, which is currently underway (Giaglis & Kypriotaki, 2014).

We see from the research that the idea of decentralization is far from new (Garcia & Hoepman, 2005). However, with the recent advancements within technology, we realize that innovations in applications of cryptographic methods and peer-to-peer networks have been pushing the general concept forward (Glaser & Bezzenberger, 2015; Davidson et al., 2015). Such advancements have enabled the possibility of creating trusted, private and purely decentralized network systems "*that can function as disintermediated transaction ledgers of all kinds*" (Giaglis & Kypriotaki, 2014).

Furthermore, we see that Giaglis & Kypriotaki (2014) conclude that such ledgers, or systems, will affect users of many applications, computer-mediated or not. Practitioners are back this statement, as the decentralized nature of the blockchain offers many new advantages and possibilities (Foroglou & Tsilidou, 2015). We also see, that from a user perspective, decentralization can be used as a mean to solve users' issues such as not having enough disk space and bandwidth, where decentralization is a possible solution (de Jong, 2015). De Jong furthermore argues that three technologies can be used to create fully decentralized applications (BitTorrent, Distributed hash tables and blockchain).

In the literary landscape, we understand that regulation also plays an important role in the decentralization technology. Moreover, we see examples on authorities who are solely focusing on the decentralized cryptocurriencies and unregulated marketplaces, like the notorious drug marketplace, Silk Road (Glaser & Bezzenberger, 2015; Wright & Filippi, 2015). However, it will be difficult for governments to control and regulate a truly decentralized network (Wright & Filippi, 2015).

Thus, we see that the idea of decentralized networks built on the blockchain can be of truly valuable character, if implemented correctly. However, some of the greatest strengths of decentralization, might also be its greatest weaknesses with the lack of regulation and control being the main concern. This is somewhat argued as being grounded in the lack of knowledge with the area, as we are not used to decentralized political authority and autonomy (Swan, 2015a). Furthermore, we see mentions in the research that "*practitioners as well as interdisciplinary researchers [are] not familiar with [complex] cryptography, network protocols or decentralized networks are struggling to find access to these concepts and grasp their potential*" (Glaser & Bezzenberger, 2015). However, with the expansion of digital currencies and decentralized P2P systems, practitioners note that it will reinforce the transition and help the information systems discipline to further extend its reach and potential (Giaglist & Kypriotaki, 2014).

Hence, we still acknowledge that the general literature mentions numerous benefits of decentralization and a high value of decentralized networks and describes it as "*blockchain as decentralization is a revolutionary new computing paradigm*" (Swan, 2015a.)

3.5 Ecosystems

We see that the general research within ecosystems is categorized into various fields with many definitions alike. We see that the literature talks about various types of ecosystems; technology ecosystems, *business ecosystems; digital ecosystems, industry ecosystems, platform ecosystems, innovation ecosystem, blockchain ecosystem, money ecosystem, digital currency ecosystem, software ecosystems, generative ecosystems, virtual market ecosystems* (Henningson & Hedman, 2014; Gregory et al. 2015; Godsiff, 2015; Glaser, 2016; Giaglis & Kypriotaki, 2014; Eck & Uebernickel, 2016; Burn & Hackney, 2000). However, there does not seem to exist a commonly materialized definition within the field. To get an overview of the research field, Huhtamäki & Ruebens (2016) points out that in order to show the big picture, it is important to identify the interconnectedness of the concepts and ecosystems. Hence, we will try to establish an overview by looking at some of the most prominent theories and definitions within the ecosystem research field.

3.5.1 General observations on Ecosystems

We see from research that, as users discover and exploit an ecosystems' various opportunities, developers will likely seek to support the needs of the users, which in turn is likely to create new opportunities in the ecosystem (Woodard et al., 2013; Arthur, 2009; Eck & Uebernickel, 2016). However, this is based on the assumption that an ecosystem attracts a multitude of developers who contribute to the platform as well as users who engage in an ecosystem (Eck & Uebernickel, 2016). Ecosystems are fluidly defined as *„[...] a coopetitive technology environment in which symbiotic relationships are formed to create mutual value for its members"* (Basole, 2009; Selander et al., 2010). We also see that new technologies, such as the blockchain, are creating fundamental changes and are a part of reshaping the traditional innovation logic, as business processes become intertwined with surrounding innovation ecosystems (Basole, 2009; Selander et al., 2010). Practitioners also point at the fact that little research have been conducted on ecosystem relationships in terms of organizational benefits (Adner & Kapoor, 2010; Selander et al., 2010). Selander et al. (2010) furthermore argues that „*a closer examination of such relationships is central for appreciating ecosystems in a digital innovation era*". Practitioners, however, also concludes that engaging in an innovation ecosystem also includes new risks for

companies by delegating control and dealing with uncertainties (Adner & Kapoor, 2010; Selander et al., 2010). Examples of ecosystems in the common everyday is mentioned in the literature as the mobile phone industry, in which different actors coexist and influence each other (Selander et al., 2010). However, most practitioners agree that research may contribute to the area with a more detailed analysis of ecosystems and furthermore get a better understanding of the impact of the sharing economy (Puschmann & Alt, 2016).

3.5.2 Blockchain ecosystems

Research on the ecosystems in the blockchain indicates that the majority of literature looked at, and examined cryptocurrency ecosystems (Morisse, 2015). Additionally, Morisse (2015) points out that "*It is a possible future research area to understand the motivation of the entrepreneurs and merchant to participates, which business models they use and which approaches they use to form the ecosystem"*. Practitioners points out that there are need for a decentralized ecosystem surrounding the blockchain itself for full-solution operations, such as the Ethereum (Swan, 2015a; Korpela et al., 2016). Research also shows that many of the properties of each of the individual ecosystems (*innovation, platform, distributed etc.)* can be applied to- or build directly on the blockchain (Eck & Uebernickel, 2016; Swan, 2015a; Giaglis & Kypriotaki, 2014; Atzori, 2015).

Within the blockchain, Ethereum is one of the prominent theories, that has its own distributed ecosystem, which is envisioned for file serving, messaging and reputation vouching (Swan, 2015a). The interesting functionalities of the Ethereum platform, is its foundation based on top of the blockchain, thus making the Ethereum a part of the overall blockchain ecosystem. However, research still shows that the ecosystems building on the blockchain is in its novel stage, as approximately 91% of all funding to the blockchain and bitcoin start-up ecosystem has come since 2014 (Allen, 2016). However, we expect that ecosystems built on the blockchain will evolve exponentially over time with the capitalization on large groups of users and developers and move the ecosystem forward in unanticipated ways (Eck & Uebernickel, 2016).

Thus, we conclude that the fusion of new technologies with digital ecosystems are transforming the way ecosystems work, along with the innovations and transformations

within the business landscape that leads to radical disruption and innovation (Evans et al., 2006; Yoo et al., 2008; Henningson & Hedman, 2014).

3.6 Synthesis

Research indicates a number of approaches to assess the current capabilities of the blockchain technology. We have found that the general IS field identifies a series of important concepts within the research, and thus, based on the research, we have categorized this into three main areas of focus. All the research has been condensed to establish these three concepts, but does however exclude papers with a technical view, as stated earlier in this paper. Thus, the three concepts will work as a foundation for our discussion and be used to assess the potential for future disruptive technologies.

4 Discussion

In this paper, we explored the literary contributions within the IS field regarding the blockchain technology. We found that the current literature still lacks a thorough theoretical foundation for future IS research (Morisse, 2015). However, we acknowledge that this could be due to the novelty of the subject. Furthermore, we investigated the main concepts revealed in the literature and analysed each of the concepts to provide an overview of the research field. We saw that much of the previous literature indirectly mentions concepts that can now be explored due to the introduction of the technological innovations of the blockchain (*decentralized, distributed and secure platforms).* We found that researchers lack to comprehend the technology and encourages IS practitioners to contribute more resources to the field (Glaser & Bezzenberger, 2015).

We discovered that the concepts of *security, privacy, distributed systems and decentralization* is mentioned as essential tools for disruptive innovation in the research prior to the blockchain (Glaser, 2016; Glaser & Bezzenberger, 2015; Norte, 2015; Giaglis & Kypriotaki, 2014; Wörner et al., 2016; Zhang & Wen, 2015; Swan, 2015a). We also notice a significant paradigm shift in the literature where the concept of centralization, which previously have played an important role in the modern society, has been challenged by the decentralized blockchain technology. However, we find that the blockchain is still considered in its novelty, and has yet to reach the conventional IS research (Morisse, 2015).

Hence, an obvious problem with the blockchain still originates from its novelty, and research thus points out that there still exist many issues prior to mainstream adoption of the technology. However, many of the limitations of the blockchain is founded in the technical concepts, which are not covered by this paper as stated earlier.

By looking at the previously stated research questions, we find that the blockchain technology is currently already underway to establish itself as a platform for ecosystems with innovations as Ethereum and Ripple (Swan, 2015a). Furthermore, by looking at the research, we find that practitioners propose many areas of which the blockchain possibly will have a disruptive effect, for example information and communication (Swan, 2015a; Kosba et al., 2015). We also find that the blockchains capabilities, in

combination with customized crypteconomies (Bitcoin, altcoin etc.), may be able to cover many of the technical obstacles mentioned across the literature, and are thus able to support many varieties of ecosystems.

For future research, we propose a framework for IS researchers that builds on the proposed framework from Selander et al. (2010). From the research, we find that there exist three essential factors that's affecting the mainstream adoption of the blockchain and new technologies. We propose a framework that can be used to identify the basic success factors for disruptive technologies to reach their breakthrough point.

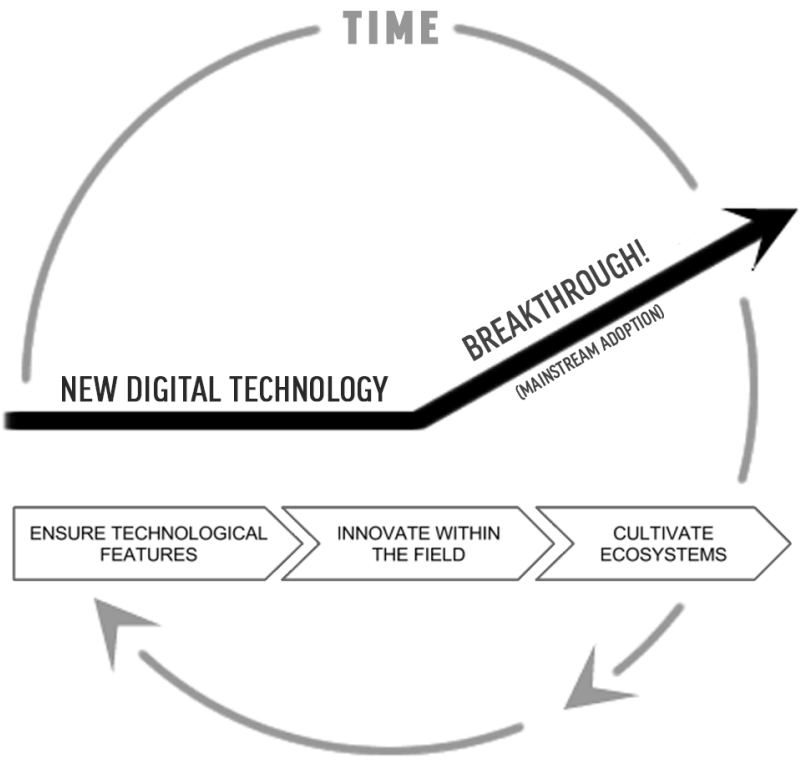

Figure 1 - Framework for success factors for disruptive technologies

Our framework proposes three factors that drive the breakthrough of the technology, and thus mainstream adoption. First, ensure that the technology lives up to the technological features mentioned in the literary landscape. This guarantees that the technology has no shortcomings in terms of technological features or capabilities, e.g. *security* and *privacy* in the case of the blockchain technology. Second, establish innovation within the field. In this case we make sure that both researchers and practitioners work together to innovate within the field and thus extends the knowledge

base of the technology to promote success, and three, cultivate the current ecosystem by supporting developers and users of the platform through strategic initiatives such as incentives or the like. With these three factors identified, we ensure that the capabilities for success is increased drastically and find that the technology will get closer to its breakthrough into mainstream adoption. However, it is noted that time also plays an important role in the framework, as mainstream adoption isn't achieved overnight.

4.1 Ensure technological features

Under this subject, we identify the driving technological features of the technology, and ensure that these are present. We also argue that issues within the technological features should be identified and mitigated in order to ensure the success of the technology. We find that the technological features of any new digital technology is the drivers for success.

4.2 Innovative within the field

We see from research that it is important to achieve a diverse view within the IS landscape in terms of innovation and disruption. By encouraging innovation from both researchers and practitioners, we see new solutions that extends the current capabilities within the technology. Within the blockchain technology, we find that innovations such as Ethereum has contributed significantly to the innovation within the field.

4.3 Cultivate ecosystems

Lastly, we find it important that the technology has established a core group of both users and developers that can facilitate and cultivate ecosystems within the technology to achieve mainstream adoption. We find that it is important to reach a substantial mass of ecosystems and backers before the technology is considered as a success. However, as mentioned previously, we find that time also plays an important role in all of the concepts identified.

Thus, we argue that these three key aspects will help push the breakthrough of the technology, and thus the mainstream adoption.

5 Conclusion

We find that prevailing IS research paradigms cannot remain static in a complex and ever changing world, where technology is governing the biggest disruptions of our time. Furthermore, we see that the digital currency phenomenon provides a fertile ground both for future blockchain technology, but as well as IS research methods in general. In this paper we identified the success criteria for the mainstream adoption of the technology and found that three prevalent factors are governing the success.

Sufficient to say, we find that the technology will definitely be a disruptor for many fields, as well as an enabler for technological ecosystems built on the blockchain technology. However, we conclude that the technology in its current state still has some way to go before the technology will reach a state where it will be considered sufficient enough for mainstream adoption.

5.1 Outlook/future work

As stated previously in the report, this paper does not look into the technical attributes of the technology and thus, does not evaluate the practicalities of the technical implementation of the key features. We propose, that researchers utilize the three identified concepts from this paper for future research within the IS field to evaluate the practical implementations of key features such as *security, privacy* etc. We find that researchers still lack to find the main area of interest for the technology, and see researchers such as Swan (2015a) who proposes a multitude of various approaches and appliances for the technology. Thus, we conclude that the technology has various appliances, but still lacks to find it's core functionalities within IS research as well as the mainstream society.

5.2 Contribution for practitioners

This study has implications for both researchers and practitioners. For researchers, using the concepts identified in the literature facilitates a richer understanding of the effective use of the blockchain technology. For practitioners, we illustrate the crucial points of the technology in order to achieve mainstream adoption.

We find that the research in this paper will provide a new view on the current IS landscape and provide researchers with specific points of interest within the technology. The contribution of this paper also aims to provide researchers with a guideline of the key concepts within the current research landscape and thus enable future research to focus solely on the innovate functions of the blockchain technology.

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Appendix A – Concept Matrix

Researchers	Name of paper	Date	Year	Journal	Search Engine	Search metric	Theories used	Empirical Methodology	Concept	Blockchain	Bitcoin	Pegged Sidechains	New innovation	Security	Signature	Decentralization	Scalability	Adoption	Trustlessness	Smart contracts	Privacy	Crypto currency	Private ledger	Development on blockchain	POC Prototype	Cryptographic Economic System	Autonomous Organizations (DAO)	Ecosystem	Internet of Things	Decentralized Consensus Systems	Sharing Economy	Lawmaking	Algorithmic trading	Legal Automation	Smart Property	Open Cloud Ecosystem	Governance-as-a-service	Generativity	Digital Innovation	Open Innovation	Technological Platforms	Virtual Markets	Co-Evolutionary	Virtual Teams	Organizational Structure	Accounting Systems	Shipping
Back, Corallo, Dashjr, Friedenbach, Maxwell, Miller, Poelstra, Timón, Wuille	Enabling Blockchain Innovations with Pegged Sidechains	22/Oct	2014	Blockstream	Google Scholar	Overall	-	-		x	x	x	x	x	x	x	x	x	x			x		x															x								
Kosba, Miller, Shi, Wen, Papamanthou	Hawk: The Blockchain Model of Cryptography and Privacy-Preserving Smart Contracts*		2015	Individual Research, University of Maryland and Cornell University	Google Scholar	Overall	-	-					x	x		x				x	x	x	x	x																							
Wright, A. & De Filippi, P.	Decentralized Blockchain Technology And The Rise Of Lex Cryptographia	10/Mar	2015	Social Science Research Network	Google Scholar	Overall	-	-		x			x	x		x	x	x		x	x	x					x		x																		
Swan, M.	Blockchain - Blueprint for a new economy	22/Jan	2015	O'Reilly Media	Google Scholar	Overall	-	-		x	x		x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x		x				x	x	x	x		x	x		
Beck, R., Czepluch, J. S., Lollike, N. & Malone, S.	Blockchain – The Gateway To Trust-Free Cryptographic Transactions		2016	Association for Information Systems. Twenty-Fourth European Conference on Information Systems (ECIS), İstanbul,Turkey, 2016	AISeL	Overall	-	Design Science		x	x		x	x		x			x		x	x		x	x	x	x	x																			
Wörner, D., Von Bomhard, T., Schreier, Y.P., Bilgeri, D.	The Bitcoin Ecosystem: Disruption Beyond Financial Services?		2016	Association for Information Systems. Twenty-Fourth European Conference on Information Systems (ECIS), İstanbul,Turkey, 2016	AISeL	Overall	-	Case studies		x	x		x			x						x	x	x		x		x	x										x								
Glaser, F. & Bezzenberger, L.	Beyond Cryptocurrencies - A Taxonomy of Decentralized Consensus Systems		2015	Association for Information Systems. Twenty-Third European Conference on Information Systems (ECIS), Münster, Germany, 2015	AISeL	Overall	-	-		x	x		x			x		x			x	x					x	x		x																	
Eck, A & Uebernickel, F.	Untangling generativity: two perspectives on unanticipated change produced by diverse actors	15/Jun	2016	European Conference of Information Systems 2016 Proceedings	AISeL	Overall	-	-		x	x		x			x						x		x				x		x	x							x		x							
Puschmann, T. & Alt, R.	Sharing Economy		2016	Association for Information Systems. Business Information Systems Engineering 58(1):93–99	AISeL	Overall	-	-		x			x	x		x		x	x									x			x																
Godsiff, P.	Bitcoin: Bubble or Blockchain		2015	Springer International Publishing: Agent and Multi-Agent Systems: Technologies and Applications Volume 38 of the series Smart Innovation, Systems and Technologies pp 191-203	SpringerLink	Overall	-	-		x	x					x			x		x							x	x		x								x								
Kõlvart, M., Poola, M., Rull, A.	Smart Contracts		2016	Springer International Publishing: The Future of Law and eTechnologies	SpringerLink	Overall	-	-		x			x		x				x	x	x					x					x	x	x	x	x												
Gigalis, M. G. & Kypriotaki, N. K.	Towards an Agenda for Information Systems Research on Digital Currencies and Bitcoin		2014	Springer International Publishing: Business Information Systems Workshops Volume 183 of the series Lecture Notes in Business Information Processing pp 3-13	SpringerLink	Overall	-	-		x	x		x	x		x	x					x	x			x	x	x		x																	
Norta, A.	Creation of Smart-Contracting Collaborations for Decentralized Autonomous Organizations		2015	Springer International Publishing: Perspectives in Business Informatics Research Volume 229 of the series Lecture Notes in Business Information Processing pp 3-17	SpringerLink	Overall	-	-		x	x		x			x		x		x	x	x				x	x				x					x	x										
Zhang, Y. & Wen, J.	The IoT electric business model: Using blockchain technology for the internet of things	16/Mar	2016	Springer International Publishing: Peer-to-Peer Networking and Applications	SpringerLink	Overall	-	Case studies		x			x	x		x			x			x				x	x	x	x	x						x											
Kraft, D.	Difficulty control for blockchain-based consensus systems	14/Apr	2015	Springer International Publishing: Peer-to-Peer Networking and Applications	SpringerLink	Overall	-	-		x	x			x		x	x				x	x		x			x			x																	
Huhtamäki, J. & Ruebens, N.	Exploring Innovation Ecosystems as Networks: Four European Cases		2016	Hawaii International Conference on System Sciences 2016	IEEE	Overall	-	Case studies					x			x		x	x									x		x	x								x	x							
Korpela, K., Kuusiholma, U., Taipale, O. & Hallikas, J.	A Framework for Exploring Digital Business Ecosystems		2013	Hawaii International Conference on System Sciences 2013	IEEE	Overall	-	Emperical study, framework oriented		x			x			x		x	x		x							x		x	x								x	x							
Selander, L., Henfridsson, O. & Svahn, F.	Transforming Ecosystem Relationships In Digital Innovation		2010	International Conference of Information Systems	AISeL	Overall	-	Case studies					x			x	x	x										x											x	x					x		
Woodard, J. C. & Clemons, K. E.	Modeling the Evolution of Generativity and the Emergence of Digital Ecosystems		2014	International Conference of Information Systems	AISeL	Overall	Agent-based Modelling	-					x	x		x	x	x			x							x	x	x	x					x		x	x						x		
Shuradze, G., Wagner, H-T. & Wagner, D.	Technological Platforms and Innovation: Review, Integration, and Extension		2015	Americas Conference on Information Systems	AISeL	Overall	-	Literature review					x	x		x	x	x	x		x							x			x							x	x	x	x						
Burn, M. J. & Hackney, A. R	Strategies for I-Business in Virtual Markets: A Co-Evolutionary Approach		2000	Americas Conference on Information Systems	AISeL	Overall	-	-					x					x										x											x			x	x		x		
Gregory, A. T., Berente, N. & Howison, J.	Digital Technologies and Patterns of Distributed Innovation		2015	Americas Conference on Information Systems	AISeL	Overall	-	-					x	x		x	x	x	x									x		x										x			x	x	x		
Hackney, R., Burn, J. & Salazar, A.	Strategies for value creation in electronic markets: towards a framework for managing evolutionary change	01/Feb	2004	Journal of Strategic Information Systems	DirectScience	Overall	-	-					x	x		x			x									x											x		x	x	x	x	x		
Glaser, F.	Pervasive Decentralisation of Digital Infrastructures: A Framework for Blockchain enabled System and Use Case Analysis		2016	Hawaii International Conference on System Sciences 2017	AISeL	Overall	Descriptive theories	-		x	x		x	x	x	x	x	x	x	x	x	x		x		x	x			x									x		x						
Brenig, C., Schwarz, J. & Rückeshäuser, N.	Value Of Decentralized Consensus Systems – Evaluation Framework	15/Jun	2015	European Conference of Information Systems 2016 Proceedings	AISeL	Overall	-	-		x	x		x			x			x	x		x		x			x			x									x		x				x		
Lyytinen, K., Yoo, Y. & Boland Jr., R.	Digital product innovation within four classes of innovation networks		2016	Information Systems Journal	-	Backward	-	Case studies					x			x		x										x	x										x	x	x			x			
Henningson, S. & Hedman, J.	Technology-based Transformation of Digital Ecosystems: The DETT Framework		2014	International Conference on Information Resources Management	-	Backward	-			x	x		x	x		x						x				x		x											x		x	x					
Morisse, M.	Cryptocurrencies and Bitcoin: Charting the Research Landscape		2015	Twenty-first Americas Conference on Information Systems, Puerto Rico, 2015	-	Backward	-	Literature review		x	x		x	x		x	x	x		x	x	x		x			x	x		x									x		x	x			x		
Buehler, K., D. Chiarella, H. Heidegger, M. Lemerle, A. Lal, and J. Moon	Beyond the Hype: Blockchains in Capital Markets		2015	McKinsey Working Papers on Corporate & Investment Banking	-	Backward	-	-		x			x	x		x						x				x				x			x									x				x	
Taylor, S.	Blockchain: understanding the potential		2015	Barclays Corporate	-	Backward	-	-		x			x	x		x		x		x		x		x		x				x		x	x		x				x		x	x		x			
Duivenstein, S., van Doorn, M., van Manen, T., Bloem, J. & van Ommeren, E.	Design to disrupt: Blockchain: cryptoplatform for a frictionless economy		2015	Sogeti Labs: VINT Publication	-	Forward	-	-		x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x		x	x	x				x		x	x			x		
Davidson, S., De Filippi, P. & Potts, J.	Disrupting governance: The new institutional economics of distributed ledger technology	16/Jul	2016	Social Science Research Network	-	Forward	-	-		x	x	x	x			x	x			x	x	x	x	x		x	x	x		x									x		x						
Allen, D. W. E.	Disovering and Developing the Blockchain Cryptoeconomy	27/Jul	2016	Social Science Research Network	-	Forward	-	-		x	x	x	x	x		x	x		x	x		x		x		x	x	x	x	x	x								x		x	x					
Badzar, A.	Blockchain for securing sustainable transport contracts and supply chain transparency: An explorative study of Blockchain Technology in Logistics	24/May	2016	No Journal - Master Thesis, Lund University	-	Forward	-	-		x	x		x			x	x	x		x	x	x		x		x		x	x		x				x				x		x						
Korpela, K., Mikkonen, K., Hallikas, J. & Pynnönen, M.	Digital Business Ecosystem Transformation: Toward Cloud Integration		2016	Hawaii International Conference on System Sciences 2016	-	Forward	-	-					x	x		x	x	x	x		x							x	x	x									x		x						
Swan, M.	Blockchain thinking: The brain as a dac (decentralized autonomous organization)		2015	Texas Bitcoin Conference 2015	-	Forward	-	-		x	x	x	x	x	x	x	x	x		x	x	x					x			x	x								x								
Peters, GW., Panayi, E. & Chapelle, A.	Trends in crypto-currencies and blockchain technologies: A monetary theory and regulation perspective	18/Apr	2015	Social Science Research Network	-	Forward	-	-		x	x		x	x		x			x	x	x	x	x	x		x	x	x		x	x		x						x			x					
Davidson, S., De Filippi, P. & Potts, J.	Economics of Blockchain	08/Mar	2016	Social Science Research Network	-	Forward	-	-		x	x		x	x		x				x		x		x		x	x	x		x	x						x		x		x		x	x	x		
Atzori, M.	Blockchain Technology and Decentralized Governance: Is the State Still Necessary?	01/Dec	2015	Social Science Research Network	-	Forward	-	-		x			x	x	x	x	x	x	x		x						x			x		x		x			x		x						x		
Forte, P., Romano, D. & Schmid, G.	Beyond Bitcoin – Part I: A critical look at blockchain-based systems	01/Dec	2015	Academia.edu	-	Forward	-	-		x	x	x	x	x		x		x	x	x	x	x	x	x		x	x	x	x	x	x	x	x		x				x			x	x		x		
de Jong, L.	Decentralized Link Sharing, Towards a Framework for Decentralized Applications	17/Aug	2015	No Journal - Master Thesis, University of Groningen	-	Forward	-	-		x			x	x		x	x	x	x		x						x	x		x							x		x		x		x		x		
Huckle, S., Bhattacharya, R., White, M. & Beloff, N.	Internet of Things, Blockchain and Shared Economy Applications		2016	Procedia Computer Science 98: International Workshop on Data Mining in IoT Systems (DaMIS)	-	Forward	-	-		x			x	x		x	x	x	x		x			x			x	x	x	x	x								x	x	x		x				
Brandon, D.	The BLOCKCHAIN: The Future of Business Information Systems?		2016	International Journal of the Academic Business	-	Forward	-	-		x	x		x	x		x			x		x	x		x		x	x			x									x			x				x	
McConaghy, T. & Holtzman, D.	Towards An Ownership Layer for the Internet	24/Jun	2015	No Journal - Ascribe.io	-	Forward	-	-		x			x	x		x	x	x	x		x			x			x			x	x	x		x	x				x		x						
Ghaffari, Z.	On the application areas of blockchain	Spring	2016	No Journal - Master Thesis: Faculty of Technology and Society, Department of Computer Science, Malmø University	-	Forward	-	-		x	x		x	x		x					x	x		x		x	x	x	x	x	x	x		x	x				x		x	x		x	x	x	
Foroglou, G. & Tsilidou, AL.	Further applications of the blockchain	May	2015	12th Student Conference in Managerial Science and Technology	-	Forward	-	-		x			x	x		x			x		x			x			x	x	x	x	x	x		x	x				x		x	x					x

Appendix B – Database Matrix

Type	Journal	Database	Keyword (Primary/Secondary)		Search	Coverage	Hits (Primary/Secondary)	Relevant Papers Reviewed
Other	Association for Information Systems (AIS)	*AISeL*	*Blockchain*	-	*All fields*	-	*14*	*4*
	Springer International Publishing	*SpringerLink*	*Blockchain*	*Blockchain, ecosystem*	*All fields excl. Preview only*	*Since 1842*	*168 / 43**	*4*
	Springer International Publishing	*SpringerLink*	*Blockchain*	*Blockchain, ecosystem*	*All fields excl. Preview only, excl. Books*	*Since 1842*	*27 / 5**	*2*
Journals	Association for Computing Machinery	*ACM DL Digital Library*	*Blockchain*	-	*All fields*	*Since 1951*	*13*	*6*
	IEEE Computer Society	*IEEE Xplore Digital Library*	*Blockchain*	-	*All fields*	*Since 1971*	*45*	*0*
	MIS Quarterly	*MISQ*	*Blockchain*	-	*All fields*	*Since 1977*	*0*	*0*
	Journal of Information Technology	*SpringerLink*	*Blockchain*	-	*All fields*	*Since 1986*	*0*	*0*
	Information Systems Research	*ISR*	*Blockchain*	-	*All fields*	*Since 1990*	*0*	*0*
	European Journal of Information Systems	*SpringerLink*	*Blockchain*	-	*All fields*	*Since 1992*	*0*	*0*
	Journal of Information Systesm	AAA Digital Library	Blockchain	Ecosystem	*All fields*	*Since 1999*	*0 / 12*	*0*
	Journal of AIS	AISeL	Blockchain	Ecosystem	*All fields*	*Since 2000*	*0 / 17*	*0*
	Journal of Strateic Information Systems	ScienceDirect	Blockchain	Ecosystem	*All fields*	*Since 1991*	*0 / 16*	*1*
	Journal of Management Information Systems	Taylor & Francis Online	Blockchain	Ecosystem	*All fields*	*Since 1984*	*0 / 26*	*0*
IS Conferences	European Conference of Information Systems	AISeL	Blockchain	-	*All fields*	*Since 2000*	*7*	*3*
	Hawaii International Conference on System Sciences	*IEEE Computer Society*	Blockchain	Ecosystem	*All fields*	*Since 1988*	*0 / 14*	*2*
	International Conference on Information Systems	AISeL	Blockchain	Ecosystem	*All fields*	*Since 1980*	*0 / 196*	*2*
	American Conference on Information Systems	AISeL	Blockchain	Ecosystem	*All fields*	*Since 1995*	*2 / 289*	*3*
	Pacific Asia Conference on Information Systems	AISeL	Blockchain	Ecosystem	*All Fields*	*Since 1993*	*2 /153*	*1*
	*Google Scholar***	***for reference only***	*Blockchain / Bitcoin / Ecosystem*		*Title only*	***for reference only***	*320 / 2550 / 151.000*	***for reference only***

*1st search included "blockchain", 2nd search included "blockchain" and "ecosystems"
**Google Scholar is used as a reference

Appendix C - Backward/Forward Matrix

Journal	Article	(Number of) Article references**	(Number of) Article citations***	Period Covered	Keywords	(New/Existing) Relevant backward search reviews		(New/Existing) Relevant forward search reviews	
Blockstream	Back et al. (2014)	35	30	1997-2013	-	0	0	1	0
-	Kosba et al. (2015)	63	-	1986-2015	-	0	0	-	-
SSRN	Wright and De Filippi (2015)	>50*	12	1982-2015	-	0	0	2	0
ECIS	Roman et al. (2016)	31	-	1992-2015	+	0	0	-	-
	Wörner et al. (2016)	58	-	1980-2015	+	1	1	-	-
	Glaser and Bezzenberger (2015)	54	2	1992-2015	+	0	2	0	2
	Brenig et al. (2016)	100	-	1991-2016	+	0	0	-	-
	Eck and Uebernickel (2015)	87	-	1977-2016	+	0	0	-	-
AIS	Puschmann and Alt (2016)	34	12	2008-2015	+	0	0	0	0
SIP	Godsiff (2015)	55	1	2011-2014	+	0	0	-	1
	Kõlvart et al. (2016)	26	-	1998-2015	+	0	0	-	-
	Gigalis and Kypriotaki (2014)	24	5	2002-2014	+	0	0	0	1
	Norta (2015)	34	5	2004-2015	+	0	0	0	1
	Zhang and Wen (2016)	20	-	2000-2015	+	0	0	-	-
	Kraft (2015)	20	3	1955-2014	+	0	0	1	0
HICSS	Huhtamäki and Ruebens (2016)	42	-	1988-2014	-	0	0	-	-
	Glaser (2016)	44	-	1983-2016	-	2	1	-	-
	Korpela et al. (2013)	33	4	1954-2012	-	0	0	1	0
ICIS	Selander et al. (2010)	43	32	1983-2010	-	1	0	1	0
	Woodard, and Clemons (2014)	54	3	1950-2013	+	0	0	0	0
AMCIS	Shuradze et al. (2015)	43	-	2000-2014	+	0	0	-	-
	Burn and Hackney (2000)	31	-	1985-2000	-	0	0	-	-
	Gregory et al. (2015)	59	-	1967-2014	+	0	0	-	-
O'Reilly	Swan, M. (2015)	196	56	1997-2014	+	0	1	11	3
JSIS	Hackney et al. (2004)	47	45	1993-2003	-	0	0	0	0

*Approximation; References included in footnotes, not seperable
**The amount of article references in the article bibliographh
***The number of articles citing the original article

Affidavit

I hereby declare that I have developed and written the enclosed bachelor / master / diploma thesis entirely on my own and have not used outside sources without declaration in the text. Any concepts or quotations applicable to these sources are clearly attributed to them. This bachelor / master / diploma thesis has not been submitted in the same or substantially similar version, not even in part, to any other authority for grading and has not been published elsewhere. This is to certify that the printed version is equivalent to the submitted electronic one. I am aware of the fact that a misstatement may have serious legal consequences.

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Mannheim, November 7, 2016

Stefan K. Johansen