Identifying Factors Affecting Blockchain Technology Diffusion

Completed Research

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Abstract

Blockchain technology will increasingly gain attention from both academics as well as practitioners and has the potential to disrupt traditional work methods in most industries. At least, that is what innovators and early adopters have promised. Published papers in the current body of knowledge are almost solely aimed towards technical aspects of blockchain technology. As far as the researchers are aware, no research has been conducted to identify factors affecting blockchain technology diffusion. Through grounded theory-based data collection and analysis, the factors affecting blockchain technology diffusion are identified in this research. Based on 18 semi-structured expert interviews, 13 factors affecting blockchain technology diffusion have been identified. The identified factors could be used as guidelines in the future when implementing or considering the implementation of blockchain technology. Future research should continue to focus on identifying additional factors. Additionally, the factors should be validated more thoroughly in future studies.

Keywords:

Diffusion, Blockchain Technology, Distributed Ledger Technology, Situational Factors.

Introduction

Blockchain technology will increasingly gain attention from both academics as well as practitioners and has the potential to disrupt traditional work methods in most industries. At least, that is what innovators and early adopters have promised (Mattila, 2016). However, it has not yet made its entry into our society, neither through usage in organizations or other initiatives like cryptocurrencies (Schatsky & Piscini, 2016). Many have called for additional investments to accelerate blockchain technology diffusion (Belbey, 2017; Pierce, 2017). Despite this, very few organizations have integrated blockchain technology.

Since September 2016, blockchain start-up funding has increased to 3.75 billion dollars, an increase of 1300% (Coindesk, 2018). In the same period, the popularity of the search term 'Blockchain' increased by 1000% (Google, 2018). Besides interest from the general public, several global business entities (including Bank of America, Merrill Lynch, Citigroup, Credit Suisse, Goldman Sachs, and JP Morgan) have combined their strength and formed consortia to explore blockchain technology. There are currently over 40 consortia, most of them being formed in the last 6 months (Deloitte, 2017; Hyperledger, 2018; R3, 2018). Because of this increase in interest one would expect an emphasis on research focusing the implementation of blockchain technology in new and existing organizations. However, literature reviews show a predominant focus on blockchain from a technology perspective (Yli-Huumo, Ko, Choi, Park, & Smolander, 2016), which emphasizes the need for research into blockchain technology diffusion. Factors hindering the diffusion are unidentified. Identifying such factors could accelerate blockchain diffusion and its integration into organizations. This problem statement led to the following research question: "*Which factors are currently affecting blockchain technology diffusion across various industries*?"

Previous contributions to literature have mainly focused on investigating the technical applications of blockchain, neglecting the non-technical aspects such as situational factors and functional challenges (Porru & Marchesi, 2017; Wörner, Von Bomhard, Schreier, & Bilgeri, 2016). This may cause the blockchain technology diffusion to be somewhat neglected from an academic perspective. Having this insight provides the opportunity to identify the factors affecting blockchain technology diffusion (Holotiuk, Pisani, & Moormann, 2018). This research aims to identify these factors by interviewing blockchain technology experts. These experts were interviewed using semi-structured interviews due to the maturity of the research domain. Besides the identification of these factors, this research also aims to inform and address practitioners and the academic community about these factors.

The next section introduces the definition of blockchain technology and discusses the current state of the research field. After this, the research method, together with the data collection and analysis is described. Next, the results of the research are presented and elaborated. The last section presents our conclusions and discusses the utilized research methods and results of our study, followed by possible directions for future research.

Background and Related Work

Blockchain technology, in the context of this research, is based on the definition of Tapscott & Tapscott (2016) and Nakamoto (2008): Blockchain technology, in cryptographic terms, is a chain of digital signatures. A signature is appended to the chain by a node connected to similar nodes which each uphold their own copy of the chain. When a node attempts to append a signature, it is becomes known as a transaction. This transaction is timestamped, hashed (with for example SHA-256 or SHA-128 hashing algorithms), signed, and broadcasted to the memory pool. The memory pool is composed of the available RAM memory of the network in which the nodes have to verify the transaction. After it passes verification (rules for verification depends on which software is running on the network), the transaction is queued to be processed by the miners. To prevent a node from duplication information (e.g., double spending) the earliest transaction is mined first. Every so often a collection of transactions is taken from the memory pool and mined. How the transaction is mined is defined by the software running on the network (e.g., Proof of Work or Proof of Stake). For example, when using Proof of Work, miners use computation power (e.g., CPU or GPU) to guess the hash of the transaction. When the transaction hash has been guessed, it is placed in a block. Once a transaction is placed in a block, it considered verified, after which nodes express their acceptance of the transaction being appended to their copy of the chain, creating the next signature.

Blockchain technology provides a means to transact in a trustless environment. In practice, for example, this technique can be used to provide a single point of truth in processes where trust is required from unknown network participants, since the chain can only be appended, not deleted. This can be, for example, leveraged when purchasing products from an unknown supplier. In this case, the unknown supplier can attach an RFID tag to their products containing a hash of the batch number. When the products arrive, the beneficiary can compare the batch number hash of the delivered products against the hash of the promised products (Tian, 2016). This concept can be leveraged in a multitude of use cases, for example: Internet of Things, agriculture, supply chain, data storage, healthcare, digital identity authentication, secure communication, financial messaging, asset transfers, and social networking (Christidis & Devetsikiotis, 2016; Pilkington, 2016; Tian, 2016; Tse, Zhang, Yang, & Cheng, 2017).

The current state of the research field gives insight into what research is already conducted and is used to give direction to this research. Literature analysis with regards to blockchain technology shows that a predominant amount of contributions is aimed towards the technical perspective of blockchain technology. Papers that did not aim towards the technical perspective, were either aimed towards a specific use case or a specific part of blockchain technology. These results show that current scientific research is mostly aimed towards technological theorization and, as far as the researchers is aware, no research has been conducted to identify factors affecting blockchain technology diffusion. This imbalance and knowledge gap shows that the maturity of the blockchain technology diffusion research direction is still nascent (Edmonson & McManus, 2007). However, comparisons can be drawn with previous literature on factors affecting diffusion of other technologies.

Previous literature indicated various factors affecting innovation. A study of Al-Jabri & Sohail (2010) focusing on the technical diffusion of mobile banking concluded that compatibility and observability of the software had the most positive impact on its diffusion. These findings are in line with Van Akkeren & Cavaye (1999). Furthermore, Becker (1970) concluded that involving and informing opinion leaders and key personnel as early as possible could accelerate diffusion of innovation on a more cultural level. Besides involving and informing, prestige value (importance a person attaches to something pure for the sake of proprietorship (Keasbey, 1903)) also seemed to impact the diffusion of innovation. These findings are in line with the research of Tolba & Mourad (2011) and Mumtaz (2000). Both the technical and cultural factors should be included when researching factors affecting blockchain technology because literature suggests blockchain technology has both technical as well as cultural consequences (Cani, 2018; Swan, 2015).

Research Method

The goal of this study is to identify factors affecting blockchain technology diffusion. The maturity of the blockchain technology research field, with regard to non-technological research, is nascent, as mentioned above. An appropriate focus of research in nascent research fields is thematic content analysis coding for evidence of constructs is an appropriate method (Edmondson & Mcmanus, 2007). Through grounded theory-based data collection and analysis, the factors affecting blockchain technology diffusion are identified. For research methods related to exploring a broad range of possible solutions to a complex issue -and combine them into one view when a lack of empirical evidence exists- qualitative open-ended data derived from semi-structured interviews is adequate (Myers & Newman, 2007) Two strategies have been used to promote the validity of the results. The first is data triangulation. This involves the use of multiple sources to help understand a phenomenon. Lastly, reliability coding is used, in which two entities discus each other interpretations and conclusions of the coding process (Johnson, 1997).

Data collection and analysis

The data for this study is collected over a four-month period, between September 2017 and December 2017, through 18 individual interviews, which is adequate for qualitative research (Baker & Edwards, 2012).

Expert interviews

Data collection for this research is conducted using a semi-structured interview approach. Semi-structured interviews are conversations which are led by a set of predetermined questions. These questions are open-ended and open to interpretation. Utilizing this type of interview, the data collection phase yielded data to identify factors influencing diffusion of blockchain technology (Miles & Gilbert, 2005; Neuman & Robson, 2014).

Eighteen Dutch blockchain technology experts were interviewed during a four-month period (September 2017 to December 2017). In total, six industries were covered by our participants, five from the government industry, four from the insurance industry, three from the education industry, three from the IT industry, two from the finance industry, and one from the healthcare industry. On request of the subject-matter experts, anonymous reporting is applied in this paper. Each interview lasted approximately 1 hour.

The participants were selected using the Snowball Sampling method. During the interviews, participants were asked to name the industry they thought would be most affected by blockchain technology and reference possible participant(s) from named industry. The subsequent interview was then arranged with the referenced participant(s) (if applicable) in the named industry (Goodman, 1961). The first participant was selected based on current occupation(s), previous occupation(s) and estimated knowledge of blockchain technology.

During the interviews, an interview protocol has been used. The interview protocol was designed in collaboration with a professional qualitative researcher who has approximately 20 years of experience conducting semi-structured interviews. The interview protocol has been separated into three different sections. Section A describes the participant's background. Section B describes the participant's expertise and was partly used to determine whether the participant had sufficient knowledge about blockchain technology (in addition to the initial screening). Section C describes the perspective of the participant on the factors affecting the diffusion of blockchain and gave the direction of which sectors should be contacted for further interviews. Section D was used to talk about subjects the researchers or the interviewee thought were not discussed in section A, B, or C.

Data analysis

As each interview was completed, the main findings were summarized. All interviews were transcribed and coded using the qualitative data analysis tool NVivo 11.0. The factors were distilled from the interviews using Strauss & Corbin's (1990) process of 1) open, 2) axial, and 3) selective coding. After all the interviews were concluded, open coding was conducted, involving the analysis of significant participant quotes. During the open coding process, the researchers tried to identify what Boyatzis (1998) refers to as 'codable observations'. Here, the researchers coded the data by identifying sentences in which challenges were discussed. The participants described the factor from their perspective. For example, one of the codable observations was as follows: "*Bureaucratic structures perform very well when it comes to long-term goals. However, it performs very badly when it comes to the changes that we are confronted with in the present day*."

The open coding was followed by axial coding, in which factors the participants experienced and how the participants reasoned these factors are coded. The Toulmin (2003) framework is utilized, which consist of three elements, 1) claim, 2) ground, and 3) warrant. For example, the following claim-ground-warrant relationship was coded: Claim - "*Bureaucratic structures perform very well when it comes to long-term goals. However, it performs very badly when it comes to the changes that we are confronted with in the present day*"; Ground - "*In the past, we could reflect on the changes and look around us: 'how is the business world doing?' If you were to do that now [as our organization], you are just too late. Things will just happen to you instead of you anticipating these events*", Warrant - "*Authority, - the reliability and validity originated from a presumed expert source*". While coding, anything that was affecting blockchain technology diffusion, whether this effect was negative or positive, was coded. Therefore, the identified factors do not necessarily represent a specific effect. For example, implementation method was recorded to have a positive effect when the correct implementation method was exercised, but when an incorrect method was used, it was interpreted as having a negative effect.

Lastly, selective coding was applied to categorize the identified factors that were the output of the axial coding process. This process required inductive as well as deductive reasoning. The inductive reasoning was applied to reason from concrete factors to general situational factors. Multiple participants reported different reasons for the investment hesitations of their organizations, for example, risk averseness, the presence of legacy systems, and a lack of demonstrated viability. In this case, all different statements were coded as the investment hesitation of these organizations. Deductive reasoning has been applied to reason from general situational factors to specific cases. For example, one participant stated that there was a lack of demonstrated viability. When asked why this mattered, the participant explained that the change readiness among the employee's decreased when there was a lack of demonstrated viability. Therefore, the factor was assigned to the lack of change readiness in the organization.

Additionally, to further ensure the validity of the analysis, reliability coding has been performed on three separate occasions. The reliability coding was executed by coding individually and sample-wise comparing the outcomes of the coding instances, no formal process was followed. The reliability coding process showed several misconceptions about the framework among both parties. For instance, there was a disagreement on whether the warrant section was to be coded as a "parallel case" or an "authority". For example, when the parallel case turned out to not exist, but the train of thought is correct and easily distilled from the case, it was coded as an "authority". The reasoning behind this is that the train of thought is what identifies the factor, not the parallel case.

After the coding process was completed, the results are sorted into three different categories, namely: strategic level issues, tactical level issues, and operational level issues (as shown in Table 1). Strategic level encompasses activities of executive level employee's, organizational positioning, the organizational frame of reference, and governance issues. Tactical level encompasses factors as employee capabilities and work methodology. Operational level refers to factors encompassing the innovation from a technical perspective and the processes they include. This approach is used to specify the context of the factors and help practitioners understand which factors might be applicable to their situation (Saiq, Indulska, Bandara, & Chong, 2007).

Results

In this section, a summary of the factors affecting blockchain technology diffusion derived from our data collection and analysis are presented and structured. The factors are categorized in Table 1. The order of the challenges presented does not reflect their relative importance. Below follows the explanation of each factor.

Strategic	Tactical	Operational
1. Necessary collaboration 2. Necessary paradigm shift 3. Market position adoption 4. Compliance 5. Sector pressure 6. Organizational size 7. Investment hesitation	8. Knowledge deficit 9. Viable use cases 10. Implementation method 11. Change readiness	12. Technical shortcomings 13. Process maturity

Table 1: Factors affecting blockchain technology diffusion

Factors at strategic level

Factor 1) Necessary collaboration: This factor has two sub-factors: 1) External collaboration and 2) Internal collaboration. External collaboration refers to collaboration with different organizations. Thirteen participants stated that to successfully implement blockchain technology, organizations are required to collaborate in an extensive manner. Organizations need to align their business processes, data models, and their decision making. They should become a group of independent organizations that use various methods of coordination to appear as a larger entity. For example, one participant stated: "*Blockchain technology is a technique that enables network organizations. Actually, it is the technology that is missing to make network organizations work*." Another participant added: "*Blockchain is a pure collaboration technique*."

Internal collaboration refers to the internal business and IT alignment of the organization. There needs to be a certain degree of collaboration between these entities before interaction with external competing entities can commence. For example, one participant stated: "*Business-IT alignment needs to be well executed in your organizations. If everyone communicates and everything works well, it helps enormously with an implementation.*"

Factor 2) Necessary paradigm shift: A paradigm refers to the general way of thinking. Currently, most IT departments uphold an introvert paradigm (Jones & George, 1998). Eight participants stated that this paradigm needs to shift to an extravert paradigm in which the IT department shares information and makes unanimous decisions with competing entities. Blockchain enables this paradigm shift by removing the need for trust amongst these competing entities.

Besides the way organizations operate, the employees also need to shift paradigms. Currently, IT is designed to exclude others. This design needs to shift to include others, making them participants instead of subordinates, clients, or users. This requires a vastly different way of thinking. However, blockchain technology enables this paradigm by removing the trust factor needed in the required paradigm. For example, when discussing the change process, one participant stated: "*[the employees] are all really interested, but the way I describe it: 'it is kind of an invisible force, a kind of fear'. People are scared that things are going to change, that they will be pushed outside of their comfort zone. That is creating resistance.*"

Factor 3) Market position adoption: This factor has two sub-factors: 1) Market function adoption and 2) Revenue model adoption. Nine participants stated that organizations might have to adopt a different market position. Market position adoption refers to the shift of an organizations position in the market. For example, if blockchain technology were to remove the need for trust in the world of notaries, the position of a notary would shift from a trust enabler to an advisor. In this new position, the notary would still provide a sense of trust by informing and advising his clients, but he/she would no longer be required to facilitate the trust factor during the actual transaction. The consensus among the participants is that there will be no position disappearance, merely a function adoption. This holds especially true for traditional organizations who have long fulfilled an intermediary function. These organizations would most likely shift towards an advisory function. For example, one participant stated: "*It is, of course, very traditional businesses and organizations who have always had kind of an intermediary function between others [that will adjust their market function]. Their old function kind of fades away*"

Some organizations rely solely on an intermediary function to create revenue. This function could be mitigated when blockchain technology is integrated into the concerned sector. These organizations will have to attempt to create new revenue streams to stay profitable. Besides existing organizations adopting a new revenue model, new organizations can emerge with new revenue models which do not rely on pre-existing structures, standards, of interests. For example, one participant stated: "*I could also see startups entering the market and displace existing entities*"

Factor 4) Compliance: Being compliant proposes certain limits to blockchain technology applications. Seven participants stated that compliance is affecting the blockchain technology diffusion. One participant noted that startups, especially those in traditional industries, have a hard time being compliant. So, to some degree, being compliant implements a set of (sometimes) untenable rules. However, consensus among the participants concluded that, in time, regulation will shift and enables blockchain technology to fulfil its currently unserved potential. Although there seems to be a discrepancy between the frame of reference of regulating bodies (e.g. European system of financial supervision and U.S. Securities and Exchange Commission) and that of the early adopters. For example, one participant stated: "*It would be good if [regulating bodies] would give direction instead of warnings*." Another interesting frame of reference was introduced by one of the participants, which stated the following: *"If there were no regulations, Bitcoin would have never been created*." By saying this, the participant is arguing that without the pre-existing regulations there would have been no need for Bitcoin to be invented.

Factor 5) Sector pressure: Sector pressure refers to the pressure organizations are sensing from competing entities. Five participants stated sector pressure is affecting the diffusion of blockchain technology. When a competing entity starts developing blockchain technology, other organizations in that same sector are pressured to do the same. They fear they might be missing out on future revenue streams if they don't. They also fear to be obsolete in the future because they might not be able to compete against organizations who have integrated blockchain technology into their business processes. For example, one participant stated: "*At the least, you will avoid falling behind. It is quite simple: when you offer a product in the market and ask a €100 premium, and the competitive entity offers the same product, but in a blockchain, for a €20 premium, those companies who offer it for a €100 premium will be pushed out of the market*."

Factor 6) Organizational size: This factor has two sub-factors: 1) Too much complexity and 2) Lack of capacity. Three participants stated that the organizational size is affecting the diffusion of blockchain technology. When an organization has high complexity in its structure, IT systems, and decision making, it is harder for them to integrate blockchain technology into their business processes because of the required collaboration and coordination. This aggregated factor coincides with factor 1, as more complexity is introduced, the need for collaboration increases. Organizations with high complexity tend to have trouble orchestrating change throughout the entire organization. For example, one participant stated: "*Inside large organizations, they say: we have to innovate. But they are just not suitable, not in their DNA or in their culture, to innovate*." When an organization has a lack of capacity, it does not have enough resources to educate their employees or invest in blockchain technology outright. For example, one participant stated: "*Small companies do not innovate, I understand, they do not have the capacity*."

Factor 7) Investment hesitation: Five participants stated that organizations are hesitant to invest in blockchain technology. One participant said organizations might not think the technology has proven itself yet, are risk-averse, have recently invested in new digital infrastructure, or have existing legacy systems delaying the introduction of new technology. This might also be caused by the investing entities current acceptance of blockchain technology or the group/ organization it is embedded in. For example, one participant stated: "*Organizations with existing processes are often more cautious with the purchase of new innovations*."…"*They cannot just suddenly change. If they would like to do that would raise all kind of questions about how to change and how they are going to change. These questions raise all sorts of acceptance challenges"*

Factors at tactical level

Factor 8) Knowledge deficit: This factor has three sub-factors: 1) Lack of available knowledge, 2) Lack of blockchain curricula, and 3) Lack of domain and technical knowledge. Fifteen participants stated that the knowledge deficit is affecting blockchain technology diffusion. When a participant noted that actors in the organization had no knowledge of blockchain technology, it was coded as Lack of available knowledge. This factor is the predecessor of factor 9, as a lack of knowledge leads to a lack of being able to use that knowledge. Decision makers seemed to have a consequent lack of knowledge. This was due to how complex they perceived blockchain technology to be, thus not taking the time, or not having the time, to educate themselves. For example, one participant stated: "*For projects, we start with awareness sessions for the* *decision makers. Often they have read about it but it only gave them a headache.*" This lack of knowledge also let most participants being forced to consider outsourcing this knowledge. However, one participant noted that: "*We do not want to [hire a third party] with [knowledge of] a new technology but [we want to] understand how it works, the technique the data etc. Because if you do not understand [the technology], you also do not know what to hire.*" This confirmed a trend during the interviews. Most participants noted that their organizations did not want to outsource projects because that would mean they would not learn anything about the technology, leading to them being dependent on third-party organizations and being prone to a vendor lock-in.

Lack of blockchain curricula was stated by four participants who had gone through the process of trying to educate their employee's, their colleagues, or themselves. Two participants noted they are intensively trying to create this blockchain curriculum, as they also noticed the current demand for blockchain curricula. For example, one participant stated: "*I think the hard part is the education because there are few people with a lot of blockchain knowledge.*"

Lack of domain and technical knowledge refers to having knowledge available of both blockchain technology and the sector/process is it to be implemented in. For example, one participant noted that they needed to collaborate intensively with business units because their blockchain team lacked the knowledge of the processes of these business units. This led to their blockchain team not knowing which data had to be registered and which external partners had to be contacted. For example, one participant stated: "*To be able to properly assess and oversee what the possibilities of blockchain are [in a certain area], you need knowledge of that area.*"

In an effort to enhance the practical relevance of the research, the researchers reached out to Christian Decker, Core Tech Engineer at Blockstream. Christian Decker is partially responsible for Bitcoin Core, the reference client for Bitcoin, and for the Lightning Network, a controversial off-chain scalability measure for Bitcoin. Christian Decker (2018) stated that: "*lack of knowledge, as well as fundamental misunderstandings about the tradeoffs of blockchains, is a central problem with the industry as it stands today. There are just too few people that can objectively evaluate the usefulness of blockchains for the proposed use-cases, which contributes to the hype and ultimately increases the need for knowledgeable people.*"

Factor 9) Viable use cases: This factor has two sub-factors: 1) Uncertain forward outlook and 2) Solution-before-problem thinking. Ten participants stated that viable use cases is affecting blockchain technology diffusion. Use cases are situations, processes, or applications in which blockchain technology can be used. Lack of viable use cases refers to the imagination and knowledge needed to create viable use cases. For example, one participant stated: "*We overestimate what new technologies bring us in two years and we underestimate the impact this technology has had on our society in ten years.*"

Participants noted that many organizations do not know what their future market function will be. Because of this, they do not know which use cases will be viable in the long-term. This creates a solution-before-problem thinking environment. Solution-before-problem thinking means that organizations will try to integrate a blockchain in business processes where it offers little to no practical benefit. They use blockchain as a solution for which no problem has been found yet. For example, one participant stated: *"[Blockchain technology] is the new hammer for all nails. For example, I had a meeting at (company name) with the same idea. They told me their problems and asked how blockchain fix these problems."*

***F*actor 10) Implementation method**: Thirteen Participants stated that organizations were experiencing with different implementation methods to innovating their core business processes. If the continuity of the organization is dependent on these core business processes, it is hard to alter them because of their constant up-time. The way these organizations tried to introduce innovation into their business processes was by creating a sandbox environment to experiment in. If these experiments are successful they would slowly introduce them to the business processes in small steps. They generally no longer change their business processes radically, in order to promote a successful implementation. For example, one participant stated: "*It is not in the DNA of big organizations to innovate.*"…"*What does works is organizing innovation separately from the main company and then introduce it slowly into the company.*"

Factor 11) Change readiness: Change readiness is defined as the attitude of an individual towards the acceptance of a certain change. Five participants stated that change readiness is affecting blockchain technology diffusion. The reason this factor has been separated from factor 2, which is quite similar to factor

11, is that participants referred to change readiness as the acceptance of a certain change, while a paradigm shift refers to the shift of the general way of thinking. For example, one participant stated that: "*The moment you have 3000 people ready to carry out a process, you cannot just change the whole process*."

Before blockchain technology can be successfully integrated into business processes, the people working with the new systems have to accept the technology. Since the current introvert paradigm does not allow for a lot of change readiness towards blockchain technology, this factor is especially important after the shift towards an extrovert paradigm.

Factors at operational level

Factor 12) Technical shortcoming: This factor has three sub-factors: 1) Adequate Data Model, 2) Need for standardization, and 3) Supportive Tooling. Fifteen participants stated that technical shortcoming like the scalability of blockchain technology and security of, for example, smart contracts on the Ethereum platform, are negligible. However, as one participant noted, organizations need to have a certain level of data quality before integrating blockchain technology into your business processes. For example, one participant stated: "*You should not think that a blockchain will solve the mess in your data*"…"*The principle 'garbage in, garbage out' still stands. The data has to be available, your systems should work well, and your processes should be well established, only then you should start using blockchain technology to innovate*"

Need for standardization could be an inherent part of the software development cycle. It refers to the usage of standard methods and usages when working with blockchain technology. For example, one participant noted that the influx of different smart contract protocols made it difficult to decide which of these protocols would be most fit-for-use. For example, one participant stated: "*You see that there is a need to think about it: we have to standardize certain things at protocol level*."

Supportive tooling refers to the need for tools which enable the business to work with blockchain technology. This includes governance tooling, visualized process modelers, and simplified smart contract modelers.

Factor 13) Process maturity: Two participants stated that the process maturity of an organization must be adequate before integrating blockchain technology. Blockchain technology requires a standard data model and digitalization of certain information. If the process maturity of an organization is not adequate, it will interfere with the implementation of blockchain technology. The collaborating organizations should first align the process maturity of the process utilizing blockchain technology before attempting integration. This also means that the collaboration between the entities trying to make use of blockchain technology has to be of a certain level before they can align their process maturity. For example, one participant noted: "*There are many organizations whose processes are still not mature enough to be able to integrate a blockchain*."

Discussion and Conclusion

This research aims to find an answer to the following research question: "*Which factors are currently affecting blockchain technology diffusion across various industries*?" To answer this question, 18 expert-interviews were conducted in a study that, to the knowledge of the author, has not been conducted before in this research domain (concerning blockchain technology diffusion).

The factors affecting blockchain technology diffusion are useful from a practical perspective. The factors could be used as guidelines in the future when implementing or considering the implementation of blockchain technology. Additionally, it should trigger dialogue between competing entities who are interested in making use of the advantages of blockchain technology. The dialogue should function as an initial step towards the necessary collaboration. These early collaborations could also be used to form initial standardization efforts such as best practices. These findings are in line with the cultural factors identified in previous literature (Keasbey, 1903; Tolba & Mourad, 2011; Mumtaz, 2000). The findings of Al-Jabri & Sohail (2010) and Van Akkeren & Cavaye (1999) were found to be neglectable (see factor 12 in particular). Therefore, the cultural and technical perspectives in these studies have not been addressed in this study. Instead, the approach of Sadiq et al. (2007) has been applied in addition to the specifying the content of the factors and aid practitioners. From a theoretical perspective, the research contributes 13 identified factors that affect blockchain technology diffusion. The gained insights provide knowledge to better understand the factors affecting diffusion of blockchain technology. Furthermore, it enables further exploration of blockchain technology diffusion.

The research has several limitations. There is reason to argue that 18 subject-matter experts are a sufficient sample to conduct explorative research on the current factors affecting blockchain technology diffusion (Baker & Edwards, 2012). Future research should focus on including more participants. Besides this, the sample contained only participants with mostly non-technical backgrounds. Therefore, the technological perspective was limited to only a few participants. Furthermore, since the sample contains only Dutch participants, the results might not be representative towards an international context. The same argument could be used when attempting to compare the results to industries that were not included during the research. The results might not be representative for these industries. While most participants had occupational experience with international organizations, thus making the results somewhat representative towards an international context, future research should attempt to generalize the results on an international or technological level. This would further validate identified factors and make possible best practices for better generalizability. Furthermore, future research could attempt to draw commonality between factors affecting diffusion of other technologies (i.e., collaborative technologies or financial blockchain applications). Additionally, future research could focus on how organizations cope with these factors, to mitigate the challenges that arise or to benefit from the opportunities the identified factors present. This would further increase the practical usage of the results. Lastly, the qualitative research method introduced a certain degree of bias when conducting and coding the interviews. All interviews were conducted by the same researchers. Therefore, the interviews may have been perceptive towards leading questions and wording bias, in which the interviewer unconsciously uses specific words or phrasing that affects the answer of the interviewee, and the halo effect, in which the researcher might see the interviewee in a specific light because of certain interviewee attributes (Podsakoff, MacKenzie, & Podsakoff, 2012). However, this was, as much as possible, mitigated by using reliability coding during the coding process. Future work should focus on removing this bias by validating the results by utilizing a quantitative research approach.

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