Can A Firm Capitalize on Blockchain's Disruption?

Wout Meutstege s1013435

Supervisor: Dr. A.A.J. Smits

2nd Reader: Dr. R.A.W. Kok

Abstract

An application built on Blockchain technology remains unproven outside of the financial services industry. Nevertheless, Blockchain is nominated to possibly become the next disruptive innovation, an innovation that redefines performance metrics (Nagy, Schuessler, & Dubinsky, 2016), and has the capability to create entirely new marketplaces through improved simplicity, accessibility and affordability (Leavy & Sterling, 2010). This research prepares two applications of Blockchain technology and tests them as an ex ante case study within the context of a single firm. The Blockchain based applications are within the supply chain and identity management. This research investigates whether the subject firm can capitalize on Blockchain technology. This has two aspects, first, focus group research indicates that Blockchain based identity management could have a disruptive impact on the subject firm, if further research proves the capability of Blockchain to provide discontinuous technical standards, meaning that it offers more efficient or cheap operation that are impossible to achieve with current technology. Second, this research evaluates important aspects of innovation management for disruptive innovations within the subject firm of this case study. To develop disruptive innovation capabilities as an organization, every organization must have appropriate innovation management. The results of the research towards the subject firm's innovation management implicates the importance of context specific evaluations for disruptive innovations, an evaluation of firm strengths, and the recognition of disruptive innovation inhibitors. Furthermore, innovation management systems should be designed firm-specific, dependent on the individual firm's organizational structure and culture. Concluded is that the subject firm could face disruption from Blockchain applications, and that it should make adjustments to its innovation management if it wants to successfully face this disruption. Furthermore, the research finds the importance of ecosystem impact on disruptive innovation management, as disruptive innovations from outside and innovation systems looking at the firm from the inside often collide. Future research should focus on aligning ecosystem changes caused by disruptive innovations and innovation management systems.

Keywords: Blockchain, Disruptive Innovation, Radical Innovation, Innovation Management

Contact information of the author:
Wout Meutstege
Haarskamp 50, 7261ZD Ruurlo
w.meutstege@student.ru.nl

Introduction

Timely recognition of a disruptive technology or innovation can provide a firm with relevant and valuable information on necessary changes to its business model. In my paper, I research if Blockchain is a disruptive technology, if it could become a disruptive innovation for a firm, and whether a firm's innovation management system is capable of managing the disruption of Blockchain applications. Any firm must be ready to and capable of managing disruptive innovations, as disruptive innovations can transform an organization's business model (Nagy et al., 2016). An incumbent organization tends to have problems with reacting to disruptive innovations, as it is hampered by core rigidities (Leonard-Barton, 1992) and a large firm's inability to respond to small markets (Christensen, 1997). Furthermore, incumbents are constantly in fear of being too slow to react to innovations that revolutionize its business. Estimating the timing of substitution - the point where a new technology replaces the old technology - is difficult (Adner & Kapoor, 2016). Research towards identifying the next disruptive innovations has been extensive; however, literature yet lacks a clear understanding of when substitution takes place. Identifying the moment of substitution of an innovation is valuable for any firm, as lagging in adoption of a disruptive innovation could be destructive to a firm's operations. In my research; therefore, first, I investigate if Blockchain is a disruptive technology, and if it could potentially be a disruptive innovation, based on existing disruptive and radical innovation literature. I conduct my research within the context of Nedap Identification Systems, to be introduced below, and its industry. Timely recognition of the point of substitution that Blockchain could perhaps create, is valuable as it prevents Nedap Identification Systems from being at a competitive disadvantage. Second, I set out how and if Nedap Identification Systems could potentially create value with Blockchain. Important to note is that Blockchain is not yet confirmed to be a disruptive innovation, and the point of substitution seems to lay relatively far ahead of us. There are several areas in which Blockchain could enforce major changes, of which I have highlighted two: the supply chain and identity management. Last, I will determine whether Nedap Identification Systems has an appropriate innovation management system in place to manage potential disruptive applications. Thus, my research can indicate whether Blockchain applications will have a disruptive impact for a firm in the identification industry, in this case Nedap Identification Systems, and which aspects of an innovation management system are essential to allow an organization to be able to thrive on Blockchain applications. Furthermore, theoretical implications on overall disruptive innovations and how to align innovation management appropriately will be discussed.

Blockchain has been named as a potential disruptive technology (Rabobank, 2016). Thus, it is of societal relevance to research whether its technology can develop into a disruptive innovation for a specific marketplace. On the other hand, Blockchain is yet to be proven as a disruptive innovation, or even disruptive technology. The outcomes of this research could be an indicator of wider impact of Blockchain technology across more industries, if shown that it could be disruptive.

The academic relevance of my research is to improve incumbent firms' capabilities to recognize Blockchain as a potential disruptive innovation for their specific industry and investigating a firms' required capabilities to respond timely and appropriately. So far, the recognition of Blockchain as a definite disruptive innovation specific to an industry has not been made. Therefore, appropriate and timely responses have not been recorded, and an appropriate innovation system specific to Blockchain has not yet been developed, as innovation management is often designed with the firm as the central point. Furthermore, findings of this research could potentially be extended to the overarching literature of disruptive innovations and provide additional information on appropriate disruptive innovation management specific to a company's market. After all, although firms are resourceful in determining whether a new innovation poses a threat, most firms possess poor tools for knowing when such transition will take place (Adner & Kapoor, 2016).

This research is a first investigation towards Blockchain's value creating capabilities for Nedap Identification Systems. Being the first organization to learn is more important than being first to market, or first to finish a complete Blockchain network. After all, the launch of a study is merely the beginning of a conversation.

Nedap Identification Systems

My research is conducted with the assistance of Nedap Identification Systems. Nedap is a Dutch firm with its headquarters located in Groenlo, and its Identification Systems business unit focuses on the smart recognition of vehicles and persons. Nedap Identification Systems produces high-tech parking sensors (SENSIT) and reader systems for access control (TRANSIT). Nedap builds its access control systems using NFC and RFID technology and applies the Internet of Things (IoT), magnetic and infrared technology in their parking sensors. The parking sensors allow Nedap to inform customers on available parking spaces and increase value for the customer. These parking sensors submit a simple dichotomous variable to a server (0 – free, 1 – occupied), and this server communicates this information to the consumer.. The business unit has been involved in IoT systems for over a decade, and sees opportunity to

develop this segment of their revenue system, especially considering the rise of the Smart City movement (Proposition Manager SENSIT, personal communication, February 19, 2018), of which mobility is an essential pillar (Damiri, 2017). As mentioned before, Nedap Identification also produces reader systems for vehicle identification (TRANSIT). These readers conduct vehicle identification through a unique code assigned to each car and recognizes whether this vehicle has access to an (parking) area. Recently, Nedap Identification Systems has added MACE to its product line. MACE is an app that provides access through QR codes, NFC chips, or credentials on smartphones. Furthermore, Nedap Identification Systems has the MOOV proposition, specifically designed for vehicle entrances in cities, industrial estates and parking facilities.

Standing at the beginning of its supply chain, Nedap Identification Systems delivers its products to the end customers through its extensive network and distribution system. Nedap Identification Systems has the competitive advantage of offering the complete range of vehicle identification.

Disruptive Technology

Bower and Christensen (1995) first mentioned the concept of disruptive technology, and defined the concept as: a new technology, initially offering inferior performance relative to incumbent products or serving niche/low-end markets, but eventually disrupting the main market through diffusion of the innovation. A disruptive technology is not yet a disruptive innovation, which describes an innovation "changing performance metrics, or consumer expectations of a market by providing radical new functionality, discontinuous technical standards, or new forms of ownership" (Nagy et al., 2016, p. 122). A disruptive technology is often considered as a technology with the potential to become a disruptive innovation.

Blockchain's technology is considered a candidate to be a future disruptive innovation. Other possible disruptive innovations of the future include: Artificial Intelligence, Internet of Things, Virtual/Augmented Reality and 3D printing (Rabobank, 2016). However, Blockchain is not even proven as a disruptive technology in research. In the literature review, I will discuss aspects of Blockchain that could classify it as a disruptive technology, and will identify aspects that make it a potential disruptive innovation.

Blockchain

The disruptiveness of Blockchain, and Nedap Identification System's ability to facilitate Blockchain's potential disruption. Therefore, I introduce Blockchain. In the literature review,

I derive potentially disruptive characteristics. These characteristics are afterwards compared to traditional disruptive innovation literature.

Blockchain has acquired notoriety as the underlying network for the first cryptocurrency, Bitcoin. However, Blockchain's applications range wider than cryptocurrencies in itself (Abeyratne & Monfared, 2016; Abou-Rame, 2018; Kewell, Adams, & Parry, 2017; Nofer, Gomber, Hinz, & Schiereck, 2017; Swan, 2015). Blockchain is a digital, decentralized, public ledger which cryptographically records transactions. These transactions are, once recorded, extremely difficult to be altered. Blockchain allows for shared supervision and complete transparency of transactions, thus implying no one instance needs to control the system of record. There is no longer a need to reconcile disparate ledgers (Brakeville & Perepa, 2017). Therefore, Blockchain offers improved data security and transparency. According to Brakeville and Perepa (2017), Blockchain can (a) free up capital flows, (b) lower transaction cost, (c) accelerate processes and (d) provide security and trust for a firm. Logically, this has tremendous benefits for a firm.

However, Blockchain has been received with skepticism. Several authors have characterized Blockchain as an overhyped technology still searching for use cases (Glaser, 2017). However, Risius & Spohrer (2017) argue that those authors stating Blockchain as overhyped, come from a lack of understanding of where to create value, and how to create value with Blockchain. Value creation with Blockchain can be achieved through Blockchain's breadth of applications. A major beneficiary of Blockchain is the financial services industry, as Blockchain can assist in identifying asset ownership swiftly and correctly, provides an irrefutable transaction history, and removes costly and time intensive intermediaries. However, Blockchain's applications are certainly not limited to the financial services industry, and the non-financial services industries can also benefit from Blockchain (Nofer et al., 2017).

Research Question

Blockchain technology has gained notoriety as the main technology supporting the cryptocurrency bitcoin, and experts indicate that its technology has an almost unlimited amount of wider applications (Abeyratne & Monfared, 2016; Abou-Rame, 2018; Kewell et al., 2017; Nofer et al., 2017; Swan, 2015), with tremendous security, transparency (Brakeville & Perepa, 2017) and efficiency benefits (Omran, Henke, Heines, & Hofmann, 2017). Problem is, Blockchain's benefits are yet to be consistently proven in a traditional, existing marketplace. This due to the newness of technology and the radical changes that are required for implementation. Therefore, this research aims to establish the disruptiveness of Blockchain

applications and perform ex ante research to identify areas where Blockchain could develop from disruptive technology to disruptive innovation. This will inform incumbent firms about potential value creation with Blockchain. Capitalization on the value creating opportunity of Blockchain can potentially provide the firm with a competitive advantage. On the other hand, according to Tripsas (1997) disruptive innovations have the potential to devalue incumbents' complimentary assets and have a destructive impact on firms. Furthermore, it is important to manage and foster the development of a potential disruptive innovation. Whether an incumbent firm can appropriately manage the disruptiveness of Blockchain implications, and how its innovation management should be structured, must be defined. Based on the problem formulation above, the central research question answered is the following:

To what extent is Nedap Identification Systems able to capitalize on Blockchain technology?

Consisting of the following sub questions:

- *What are potential disruptive applications of Blockchain technology for Nedap Identification Systems?*
- *To what extent would Nedap Identification System's innovation management system be able to manage the development of Blockchain applications?*

Furthermore, from a more theoretical point of view, I set out to find out whether the findings of this research could potentially be extended to the overarching literature of disruptive innovations and provide additional information on appropriate disruptive innovation management specific to a company's market.

To answer the research question, I conduct a literature review to identify characteristics of a disruptive innovation. I also collected information on radical innovations, disruptive technologies and foundational innovations, as it helps in drawing a clearer picture of innovation classifications. I determine which prerequisites must be satisfied to implement Blockchain, considering findings in innovation management literature. Furthermore, I look at Nedap Identification Systems' market characteristics to establish Blockchain applications and potential disruptiveness for the firm and its industry. In the method segment, I outline the qualitative research strategy, before discussing the results and being able to answer both sub questions and; therefore, the research question in the discussion chapter.

Literature Review

In this segment I analyze established research on different typologies of innovations, aligned with Blockchain technology and identify areas for value creation with Blockchain for Nedap Identification Systems. In the overview, I collect literature of four innovation/technology typologies (disruptive technology, disruptive innovation, radical innovation and foundational technology). This is essential, because firms can't manage innovation effectively if it doesn't accurately grasps its nature (Christensen, Raynor, & McDonald, 2015). All typologies have aspects that could form a match with Blockchain characteristics. After providing the overview, and collecting information on Blockchain characteristics and potential, I argue for my judgement on Blockchain's innovation typology.

Disruptive Innovations

As mentioned before, a disruptive innovation extends beyond Bower & Christensen's definition of a disruptive technology (1995). A disruptive innovation redefines performance metrics (Nagy et al., 2016), and has the capability to create entirely new marketplaces, through improved simplicity, accessibility and affordability (Leavy & Sterling, 2010). Thus, disruptive innovations have the capability to redefine your business model. Bower & Christensen's (1995) theory discusses disruptive technologies, which initially underperform incumbent products, following the traditional s-curve trajectory (Foster, 1986). Timely recognition of disruptive innovations can be essential over time, because as the product diffuses (Rogers, 1995), the new product may outduel incumbent performance. The difference between disruptive technology and disruptive innovation is that innovation is a broader concept than the technology itself and covers business, institutional, and user-generated innovations (Kilkki, Mäntylä, Karhu, Hämmäinen, & Ailisto, 2018). Disruptive innovations; however, do originate from disruptive technologies, as a disruptive technology initially establishes itself in *low-end footholds*, providing low-end consumers with a product that is 'good' enough, or *new-market footholds*, creating markets where none existed. Innovations that disrupt business, but do not initially serve one of these markets, are not disruptive innovations (e.g. Uber)(Christensen et al., 2015). Furthermore, disruptive innovations reach mainstream customers only when its quality matches consumer standards. Therefore, a disruptive innovation must have been a disruptive technology at first. However, it was recognized that few technologies are intrinsically disruptive in character (Christensen & Raynor, 2003), and thus the concept of disruptive technology and disruptive innovation are oftentimes used interchangeably, and are definitely intertwined. Once recognized, two major issues accompany disruptive innovations in

organizations, according to theory:

1. Recognizing technology and determining if a technology will disrupt their organization

Established firms have historically led the industry in developing technologies – even radical ones – only whenever these technologies addressed existing customers' needs. Interestingly, those large firms often lack the awareness to recognize technologies that are not immediately useful to those organizations (Bower & Christensen, 1995). However, others argue that later recognition of a disruptive technology does not directly impact a firm's capability to successfully respond to a disruptive innovation. Argued is that large incumbent firms can adjust to disruptive innovations as long as it eventually makes appropriate investments in the new disruptive technology, the firm has the required technical capabilities, and most importantly and the firm possesses specialized complementary assets. Specialized complementary assets consist of a firm's network, brand value etc. valuable to the innovation. A firm will only be truly disrupted, or outcompeted, if its current specialized complementary assets devalue (Tripsas, 1997).

The seemingly small technological developments in disruptive technologies (Bower & Christensen, 1995) have the possibility to develop into disruptive innovations, and large organizations should thus focus on recognizing the opportunity of these technologies. Recognizing these technologies can be vital for the success of an organization, when combined with an incumbent firm's resources, investments and specialized complimentary assets (Tripsas, 1997). Three indicators of disruptive innovations are *radical functionality, discontinuous technical standards* and *innovation ownership* (Thomond & Lettice, 2002). Adequate and timely recognition of these indicators could propel an organization towards a major competitive advantage going forward. *Radical functionality* describes an innovation enabling the user to undertake new behavior or complete a new task. Radical functionality creates new markets. *Discontinuous technical standards* describe the use of new materials in creating current technologies, oftentimes offering significantly improved cost-efficiency, and *innovation ownership,* an intangible innovation characteristic, describes the ownership model of an innovation. Alternative ownership models have the capability to overturn the status-quo in an existing industry (Schuessler & Nagy, 2014). If a firm possesses the capabilities to capitalize on the potential of a technology, ownership of an innovation is valuable and capable to cause disruption. However, if a competitor possesses the capabilities to capitalize on the technology's potential, it will pose as a serious threat to incumbent firms (Nagy et al., 2016).

2. Applying disruptive innovations to your industry

Disruptive innovations are hard to incorporate within incumbent organizations, because

novel strategic action within institutions is often constrained by those institutions in itself (van Dijk, Berends, Jelinek, Romme, & Weggeman, 2011). Their original core capability can become a core rigidity as the firm sticks to its current successful business model, ignoring the potential opportunity or threat of new business models. Adopting an innovation depends on five attributes of the innovation: relative advantage, compatibility, complexity, trainability and observability (Rogers, 1995). The extent to which the innovation satisfies these attributes, determines the potential of innovation adoption in the market. Therefore, if the innovation indeed has a relative advantage, is compatible for customers, low in complexity, and has trainability and observability, it is more likely to be adopted by the industry (Rogers, 1995).

In assessing whether an innovation could potentially disrupt an industry or organization, I utilize Nagy et al. (2016)'s 3-step method to determine potential disruptive innovations. These steps are: (a) identify the innovation and its characteristics, (b) identify where in an organization's value chain the innovation is used and (c) compare the potentially disruptive innovation with technologies currently used in the organization for that value chain segment. In the first step, the innovation and its characteristics are identified. The innovation's functionality, technical standards, and ownership are assessed. The second step is identifying where in an organization's value chain the innovation is used. Primary activities, which describe what the organization does, must be separated from support activities, the dimensions that primary activities draw upon (Nagy et al., 2016; Porter & Millar, 1985). Innovations to primary activities will be more likely to have a disruptive effect than innovations to secondary support activities. The third step is to compare the current situation with the predicted situation including the innovation. Aligning the innovation with existing technology should provide insight about how potentially disruptive an innovation might be to the organization (Nagy et al., 2016).

However, the disruptiveness of an innovation does not depend on the innate characteristics of the technology, but also on the organization and industry that the new technology operates in, and firm capabilities largely to capitalize on the innovation. Thus, the disruptiveness of an organization is dependent on its ecosystem (Adner & Kapoor, 2016), or the entire context in which it operates. Therefore, I consider this aspect as well.

Radical Innovations

The definition of a radical innovation differs from disruptive innovations. However, considering radical innovation is still important in conducting this research, as radical innovation literature can identify crucial aspects to consider when establishing a framework

for Nedap Identification Systems' ability to sustain or capitalize on developing innovations.

Radical innovations are innovations that offer a high newness of technology, and high customer need fulfilment. Innovations with high newness of technology, but lack the customer need fulfilment, are labeled as technological breakthroughs (Chandy & Tellis, 1998). However, risk and uncertainty associated with the opportunity of radical innovations is significant (Hill & Rothaermel, 2003). Firms that engage in radical innovations show high returns (Sorescu, Chandy, & Prabhu, 2003). The difference between a radical innovation and a disruptive innovation is not always clear, and even sometimes the definition is even relatively similar. For example, according to Garcia & Calantone (2002) radical innovations offer marketing and technology discontinuity. This is closely related to disruptive innovations. However, the difference is that disruptive innovations have the potential to create entirely new markets, and redefine performance metrics (Nagy et al., 2016). However, the development of the internet for example, is classified as a radical innovation (Garcia & Calantone, 2002), disruptive innovation , or even part of the development of a foundational technology (Iansiti & Lakhani, 2017).

Implementing a new innovation requires an organization's willingness to cannibalize, because firms have to be willing to sacrifice their current market share for the sake of their innovation (Assink, 2006; Hillebrand, Kemp, & Nijssen, 2011). Firms traditionally face inertia (Hillebrand et al., 2011), a traditional management problem stating that corporate rigidity causes an unwillingness to change. Cannibalization is the extent to which a firm is prepared to reduce the current or potential value of its investments for the sake of unconfirmed future sales (Chandy & Tellis, 1998). Willingness to cannibalize sales, routines and investments has a positive effect on radical product innovation (Chandy & Tellis, 1998), and overall firm innovativeness (Hillebrand et al., 2011), which implicates that a firm should be willing to cannibalize when attempting to capitalize on radical innovations. Future market focus has a positive relationship with willingness to cannibalize. Future market focus is a firm alertness to emerging needs, new customer segments and technological trends in the marketplace (Hillebrand et al., 2011).

Foundational Technology

Iansiti & Lakhani (2017) argue that Blockchain must be classified as a foundational technology. "It (Blockchain) has the potential to create new foundations for our economic and social systems. While the impact will be enormous, it will take decades for Blockchain to seep into our economic and social infrastructure" (Iansiti & Lakhani, 2017; p. 4). Two dimensions

affect how business cases develop for foundational technology: novelty and complexity. The newer an application is to the world (novelty), and the more ecosystem coordination required (complexity), the longer it will take to implement the foundational technology. Many barriers – technological, organizational, governmental, societal – will have to be broken down, before a complete embrace of Blockchain can be achieved (Iansiti & Lakhani, 2017). Blockchain depends on network externalities if it is to provide competitive advantages for firms and would most likely require the business' entire ecosystem to install Blockchain systems in order to provide a competitive advantage.

Iansiti and Lakhani (2017) established a framework to identify the opportunity of Blockchain for an organization. The article identifies four phases of foundational technology adaption. The first phase is (1) single use, an application with a low degree of novelty, and low amount of complexity and coordination. Single use application creates better, less costly, highly focused solutions. Thereafter, the second phase (2) is localization, with high novelty but low complexity and coordination. This does not yet require extensive network externalities to create value immediately. A company could build private online ledgers to process financial transactions, for example. Third (3) is the substitution phase. Its novelty is relatively low, but it requires high ecosystem complexity and coordination. These innovations become truly disruptive as they replace entire ways of doing business. For example, when third parties and partners all accept bitcoin. Last, the fourth (4) phase is called transformation. This phase has a high degree of novelty, and high degree of complexity and coordination. These applications could, if successful, change the very nature of economic systems. An example would be the aforementioned and fully functioning self-executing smart contracts. For most businesses, the right approach to implementation will be simple. Building single-use applications, that minimize risk due to their relative lack of novelty and low involved coordination with third parties. For the rise of TCP/IP, a single-use application was e-mail on the ARPAnet. For Blockchain, its equivalent could be enabling Bitcoin payments.

Blockchain

Blockchain is heralded as a potential disruptive innovation, partly because a promising application of Blockchain, as a Trustless Public Ledger, is that it allows the inclusion of Smart Contracts. Smart contracts are part of Blockchain 2.0 (Swan, 2015), the next tier in the development of the Blockchain industry. Smart contracts are self-executing lines of code, which can take different shapes, and thus have numerous applications (Fairfield, 2014). These smart contracts are written on the underlying Blockchain network, similar to applications

(Amazon, Netflix, Airbnb) currently functioning on the internet. Smart contracts are (a) *autonomous*, meaning that after development the contract and the initiating party does not require to remain in contact, (b) *self-sufficient*, in raising funds by providing services or issuing equity, and spending them on needed resources and (c) *decentralized*, meaning that a smart contract does not exist on a singular centralized server, but are distributed across network nodes (Swan, 2015). Essential is that the Trustless Public Ledger functionality of the Blockchain, which enables smart contracts, could be used to "register, confirm and transfer all manner of contracts and property" (Swan, 2015, p. 10). This has endless potential applications ranging from the financial services industry transforming financial transactions, to identification – driver's licenses, identity cards - and private records – signatures, contracts – applications (Swan, 2015). Smart contracts could minimize the need for trust in contractual obligations, as it removes the uncertainty of contract compliance or breach being at the judgment of human agents (Swan, 2015). In the event of contractual breach or failed contract compliance, the Blockchain ensures that the honest parties obtain fair compensation (Kosba, Miller, Shi, Wen, & Papamanthou, 2016).

Blockchain's innovation typology. After evaluation of the four potential typologies of Blockchain (disruptive technology, disruptive innovation, radical innovation, foundational technology), Blockchain's innovation typology will follow. If Blockchain is to be considered a disruptive innovation, it must to some extent satisfy the requirements of a disruptive technology. Blockchain originates in *new-market footholds* (Christensen et al., 2015). Currently, the most proven and acclaimed application of Blockchain is in cryptocurrencies, most notably in Bitcoin. Furthermore, the mainstream customer has not yet adopted cryptocurrencies, as it currently does not meet current customer requirements for payments. Therefore, Blockchain satisfies aspects of the disruptive technology definition. Christensen & Raynor (2003) recognized that few technologies are intrinsically disruptive in character. Blockchain's characteristics have the potential to truly create new markets, as proven in the cryptocurrency sphere. Therefore, I chose not to type Blockchain as a radical innovation. Furthermore, literature on foundational innovations is scarce, and clear indicators of foundational innovations have not been established aside from Iansiti & Lakhani (2017). Aspects of foundational innovations touch base with disruptive innovations. Applications built on Blockchain could be considered as separate disruptive innovations, and Blockchain itself could be considered the foundational innovation (Iansiti & Lakhani, 2017); however, one could also define Blockchain itself as a disruptive innovation.

Blockchain satisfies aspects of disruptive technology definitions. However, if Blockchain is a disruptive innovation, is not yet confirmed. Therefore, I follow Thomond & Lettice's (2002) indicators of disruptive innovations (*radical functionality, discontinuous technical standards and innovation's ownership*) - which grounds the disruptiveness in the technology, and not in the marketplace – in researching whether Blockchain can be classified as a disruptive innovation. *Radical functionality* describes the new function that an innovation offers to the user, both compared to the existing marketplace, and compared to an organization's current technological offerings. *Discontinuous technical standards,* or innovations utilizing new materials or processes in the creation of existing technologies, use less costly materials or more efficient processes. Both *radical functionality* and *discontinuous technical standards* appear relevant to a firm's established base of technological capabilities. Last, *innovation's ownership* concerns drastic changes to market expectations or within value chains due to new forms of ownership. The ownership model of an innovation has both external and internal impact on businesses (Schuessler & Nagy, 2014).

At first glance, Blockchain satisfies the condition of *radical functionality* as it provides the user to accomplish a new task, namely to have transparency of all transactions. Furthermore, it satisfies the condition of *discontinuous technical standards*, as it allows for more efficient processes, as Blockchain offers an advantage over traditional paper ledgers, which tend to be complex and time consuming. Smart contracts offer the opportunity to self-validate agreements and have the possibility to eliminate certain intermediaries from the process. However, scalability of a Blockchain network is highly questionable. Many nodes must be in the network for the network to run reliably and for an organization to truly build on the information of the Blockchain. Therefore, it is likely an expensive undertaking to develop a Blockchain network. The possibility to run on a third party's Blockchain network is also unclear. Furthermore, most transactions of cryptocurrencies are associated with transaction fees. Therefore, the true capability of Blockchain to provide discontinuous standards is impossible to assess. Last, Blockchain satisfies the condition of *innovation ownership*, as ownership is a disruptive factor associated with Blockchain's open source software, which has no definite owner. When utilizing Blockchain technology, there is no single owner of the technology. Thus, there is a drastically new form of ownership, completely decentralized amongst all nodes of the Blockchain network. Alternative ownership models can disrupt the industry power distribution (Schuessler & Nagy, 2014). Successful implementation depends on the capitalization on the available technology, and the firm's capability to successfully expand on the technology available (Nagy et al., 2016).

Therefore, Blockchain's technology in itself seems qualified to be a disruptive innovation. However, developing disruptive applications, and thus Blockchain's actual classification as a disruptive innovation depends on its ecosystem (Adner & Kapoor, 2016) or context. Extensive network externalities are required for Blockchain functionality, ecosystem coordination is vital, and novelty of the technology plays an essential role in the true disruption of the technology (Iansiti & Lakhani, 2017). Thus, Blockchain's disruptiveness does not depend merely on the technology, but rather on the application of the technology within the context of the organization.

Disruptive Innovation Management

Since Blockchain's technology in itself, disregarding the importance of organizational context, satisfies conditions for disruptive innovations, firms must reconsider its approach to innovation management when the disruption arrives. Preferably, a firm would have appropriate innovation management in place ahead of the arrival of disruption. To prepare for the disruption at hand, there is no room for extensive market research. After all, there is no market to perform research in, and previous trends are expected to be disrupted, thus useless for analysis. Furthermore, a firm must develop disruptive capabilities steadily, and not intensively commit too early, as taking steps that are too large or radical could backfire once the innovation fails (Leavy & Sterling, 2010). Two levels of problems are attached to the implementation of innovations: those affecting a project or product and those affecting the organizational context (Dougherty & Hardy, 1996).

O'Connor (2008) established a framework on how to manage *Major Innovations*, composed of 'radical and really new innovations'. Utilizing such framework can help a firm in assessing its innovation management system currently in place, and identify areas to improve in order to face the inbound innovation, since we know little about the management of radical innovation product development process (McDermott & O'Connor, 2002). O'Connor's (2008) research identifies seven elements that form a management system to nurture radical innovations. These elements are (1) an identifiable organization structure, there should be a dedicated infrastructure to structure and manage innovations; however, this infrastructure should not be isolated from exogenous influences. Major innovations cannot be developed or discovered in a natural environment, where flexibility and consensus building characterize the day-to-day operations for accomplishing tasks and reaching certain goals. (2) Internal and external interface mechanism, clear linkages of the team with internal and external relations of the firm, and its close relatedness with the firm's overall corporate strategy. (3) Exploratory

processes, to obtain innovation-specific knowledge (O'Connor, 2008), although project risk should appropriately be managed (McDermott & O'Connor, 2002). (4) Requisite skills, a set of routines to minimize the need for choice, distinctive competencies (Assink, 2006) and talent development, the identification and nurturing of appropriate talent (5) governance and decision-making mechanisms at the project, allowing for constant reflection and reconfiguration (6) appropriate performance metrics, specific to and appropriate for the risky and uncertain nature of major innovations, accompanied with a realistic revenue and ROI expectation, to successfully sense and foresight the market (Assink, 2006). (7) Appropriate culture and leadership context, which recognizes the importance of the major innovation system (O'Connor, 2008). After all, leadership roles and team composition are traditional issues within the people site of radical innovation (McDermott & O'Connor, 2002). Interesting note about this research is that comes from of systems theory; therefore, it includes all interactive elements within an organization. Innovations are often mismanaged (O'Connor, 2008); therefore, establishing a management framework to overcome traditional faults can be a valuable guideline for the firm. However, these elements must comprise a system, and not a simple list. Therefore, we can measure an organization's system readiness for major innovation implementation along this list, meeting four requirements: (a) The system is identifiable and elements are interdependent, (b) the system is greater than the sum of its parts, (c) the system interacts with its environment to achieve a balanced system, (d) the major innovation system has purpose in the larger system in which it operates (O'Connor, 2008). Important to note is that the goal of an innovation management system is to pursue dualism, functioning efficiently whilst innovating effectively (Paap & Katz, 2003).

For successful incorporation of innovations in organizations, resources, processes, value and meaning of the innovation are of importance. Successful product innovation is powered by the middle and operational levels of the organizational hierarchy. Therefore, senior managers must alter their organizational systems of power if it sets out to become capable of sustained product innovation (Dougherty & Hardy, 1996), and provide authority to the middle and operational levels of the organizational hierarchy. To build perception of such power amongst employees, firms should invest in employee training and retaining of experienced employees with exhaustive networks. Furthermore, managers should prioritize innovativeness ensuring that cost cutting does not stand in the way of innovativeness, and encourage conversation between senior and middle managers in which both can provide input on product innovation (Dougherty & Hardy, 1996). A deliberate design of looser, non-traditional structures can be favored over installment of an innovation team or department (Smith, Sutherland, & Gilbert,

2017). Design thinking, which places humans at the center of innovation, has attributes and tools useful for developing a thriving ambidextrous organization. Design thinking in innovation management begins with data gathering on user needs, thereafter idea generation and testing take place (Liedtka, 2015).

To increase an organization's ability to facilitate innovations, organizations must pursue some extent of differentiation. Pierce & Delbecq (1977) propose that there is value in constructive conflict, as the absence of a single professional ideology seems to stimulate the initiation of innovation proposals. Furthermore, a sense of decentralization and lack of formalization can improve innovation initiation. Formalization or an unwillingness to deviate from standard practices, and an inability to unlearn past practices namely hampers innovation development (Assink, 2006). Innovation adoption and implementation are also proposed to be influenced by differentiation, as well as environmental uncertainty, size, resources and employee intrinsic motivation (Pierce & Delbecq, 1977).

O'Connor's (2008) research is focused on *major innovations*, relatively similar to the consensus definition of radical innovations (innovations with high promise, risk and uncertainty (O'Connor & DeMartino, 2006)). I attempt to theoretically derive whether such management system would be appropriate for the management of disruptive innovations as well. Three competencies are required to develop a mature radical innovation capability. (I) *Discovery*, involves the creation, recognition and elaboration on radical innovation opportunities, which requires exploratory and abstraction skill to poach for opportunity. (II) *Incubation* activities to mature the opportunity of radical innovation towards business proposals. Reduces market and technical uncertainty due to experiments and extensive on-site learning. (III) *Acceleration* allows the innovation to stand on its own when compared to other business platforms, building some sense of predictability in sales (O'Connor & DeMartino, 2006).

It is difficult to acquire backing for radical projects in incumbent firms, where internal culture and performance pressure drives more low risk, immediate reward, incremental projects (Assink, 2006; McDermott & O'Connor, 2002). Novel strategic actions within firms are often obstructed by those firms in itself (van Dijk et al., 2011). The paradoxical challenge of dualism thus remains challenging. The installment of an innovation management structure, or adherence to a set of requirements in theory, does not necessarily equal successful firm dualism. Problematic organizational dualism is a traditional inhibitor of organizational innovativeness (Assink, 2006). Innovation management systems are widely discussed, but a counter argument for detailed and complex innovation systems is that it provides teams with

too much time and too much resources to truly create a disruptive innovation (Leavy & Sterling, 2010). Excessive bureaucracies could originate from detailed and complex innovation systems, reducing an organization's ability to react swiftly and innovatively (Assink, 2006).

Blockchain & Nedap Identification Systems

In this segment, I utilize theory to explore applications of Blockchain useful to Nedap Identification Systems going forward. This review is by no means exhaustive, and limited by time constraints of my thesis, and knowledge constraints of the technological specifications of the technology. I have identified two areas of effect for Blockchain. First, I will introduce the impact of Blockchain on these specific areas, before analyzing the potential effect that it could have on Nedap Identification Systems' operations.

Although adoption of a disruptive innovation does not necessarily lead to the creation of a new product or service, I find two areas of significant impact for Blockchain implementation in Nedap Identification Systems: The supply chain and its identity management. These implementations are not exhaustive, but simply most apparent, and due to the limitations of this paper, these are the only implementations that I will discuss.

1. **Blockchain for the supply chain.**

Catalini and Gans (2017) discuss the possibility of Blockchain technology leading to decreased 'cost of networking' in their research. Cost of Networking is every organization's constraint to operate in a market place in which it is influenced by traditional intermediaries (financial, legal and governmental institutions). These traditional intermediaries have historically reduced information asymmetry and the risk of moral hazards. This information asymmetry and risk of moral hazards may be decreased due to smart applications of self-validating automated smart contracts, and decreased cost of networking could have major long-term implications on the outlook of a firm's supply chains and network. *Cost of networking* is reduced by combining distributed ledger technology combined with a cryptographic token, which can be used as an incentive to grow a platform. In this case, users of the platform will be rewarded with cryptographic tokens. This allows a firm to bootstrap an entire marketplace without costly intermediaries, because utilizing the Blockchain network without intermediaries can increase competition, lower entry barriers and lower privacy risks increases market efficiency (Catalini & Gans, 2016). An improved supply chain built on Blockchain technology, e.g. allowing for complete transparency of stocking and ordering, including automated smart-contracts, could provide a firm with a competitive advantage (Casey & Wong, 2017). With a

Blockchain based network, transactions are automatically verified by the network of nodes, and the need of a verifying third party is no longer. The verification process is traditionally accompanied by fees. Catalini & Gans (2016) name this cost the *cost of verification*. This cost will decrease when completing transactions via the Blockchain network.

In addition, a supply chain may require disclosure of sensitive information from the involved parties, at the risk of data breaches must the security of the intermediary be compromised. These data breaches are prevented by storage on the distributed ledger (Swan, 2015). Blockchain provides secure data exchange and a tamper proof repository. However, limitations to Blockchain's technology do exist. Its proof-of-work protocol is computationally wasteful by design. The proof of work protocol is a process where the *verifier* asks the *prover* to complete a calculation before granting access to the Blockchain (Palomar, De Fuentes, González-Tablas, & Alcaide, 2012; Swan, 2015). This process is energy intensive because the calculation is often tough to complete and; therefore, demands tremendous computing power from the *prover*. The protocol is necessary for validating transactions, and reducing *cost of verification* (Catalini & Gans, 2016), but its wastefulness still provides question towards the technology's actual current cost saving capacities. As the Blockchain grows longer, more computational power is required (Nofer et al., 2017), which is called increasing block size (Swan, 2015). Consequence of increasing block size is that it slows down transaction speed and processing. For example, VISA can verify approximately 2000 transactions per second, and as much as a maximum of 50.000 transactions per second at peak functionality, whereas Bitcoin can only verify 3-7 transactions per second (Croman et al., 2016). Blockchain's computational efficiency must be increased significantly before being able to challenge incumbents.

Another drawback is that the technology is not immune to security breaches. Blockchain platforms could be vulnerable to 51 percent mining attacks (Swan, 2015). Theoretically speaking, one miner or mining pool could possess a majority of network hash rate. The threshold of controlled hash power is 51 percent (Swan, 2015). If one entity has the controlled hash power, it could alter data on the Blockchain (Bitcoin, n.d.). However, practically speaking it is nearly impossible to possess 51 percent of hash power of Bitcoin. When creating a new platform, accompanied by a new token, this danger would rise, as there is not a large total supply of a token. A 51 percent attack could be dangerous in this case, as records could be falsified.

A promising application built on the Blockchain are the aforementioned smart contracts. Smart Contracts are digital agreements between entities, written in code and deployed on the

Blockchain, where it self-executes when certain thresholds are met (Swan, 2015). Smart Contracts have the capability to improve (a) transparency, (b) traceability and (c) efficiency in the supply chain (Catalini & Gans, 2016; Omran et al., 2017; PricewaterhouseCoopers, 2016). Blockchain based smart contracts can allow inventory to be tracked through each step in the supply chain (Omran et al., 2017). Furthermore, Blockchain improves transparency (Beck & Müller-Bloch, 2017) as it records the provenance of goods and provides assurance of quality, and transparency amongst distributors and retailers is also improved. Currently, information on the status of goods is locked in organizational silos. Blockchain can allow for building a distributed permission-based platform accessible by the supply chain ecosystem, designed to exchange event data and handle document work flows. It can create a global, tamperproof system that digitizes trade work flow and tracks flow of goods from end to end (Churchill, 2017). Blockchain allows members of the supply chain to be identified as credible and are to be trusted in executing a task, because reputation and reliability can be recorded on the Blockchain as well (Abeyratne & Monfared, 2016; Buterin, 2014). Furthermore, Blockchain allows inventory to be tracked through every step in the supply chain (Omran et al., 2017). This will allow supply chain managers to make better and faster decisions, reduce delays and keep the supply chain agile. In case of product recalls or safety incidents, the Blockchain becomes useful, as resulting brand damages can be reduced to a minimum (Casey & Wong, 2017).

Furthermore, Blockchain can enhance *process* and *cost efficiency*. *Process efficiency* is improved as smart contracts executed on a distributed ledger help to simplify the multiparty systems present in typical supply chains. Given their self-executing nature, smart contracts can be used to automatically execute contractual rights and agreements, including the terms for payment and delivery of goods and services. This reduces time inefficiency. By programming the smart contracts to certain thresholds, parties can also be more trusting towards another, as it does not have to worry about unfulfilled obligations. *Cost efficiency* is achieved through reliance on easily customizable computer code to execute contractual agreements, disregarding the need for physical documents to be maintained by each party's accounting and legal departments. A database that easily verifies reputation and identity saves cost associated with certification and building new trusted business relationships.

Blockchain improves supply chain transparency (Beck & Müller-Bloch, 2017) because it has the capability to record provenance of goods stored in an unique signature (hash) (Swan, 2015). Furthermore, it provides quality assurance and transparency amongst distributors and retailers. Therefore, customers are aware of the origin of the product, e.g. whether component

parts from a supplier are produced from raw materials sourced from sustainable mines, and the steps in the value chain the product has progressed through. This information, for certain products, could prove valuable in confirming or denying the Corporate Social Responsibility (CSR) policy of an organization. The product's ledger, stored on the Blockchain; therefore, provides transparent and accurate data on the factual sustainable footprint of the product.

Furthermore, Blockchain allows actors in the supply chain to be identified as credible and trustworthy in executing a task, because reputation and reliability can be recorded on the Blockchain as well (Abeyratne & Monfared, 2016; Buterin, 2014). Therefore, if actors in the supply chain behave inappropriately, this harmed reputation will be available for everyone to see on the Blockchain, and thus have a negative impact on the company itself due to the severe consequences brand damage can cause (Casey & Wong, 2017). This would enforce all entities in the supply chain to adhere to at least some environmental and social standards.

2. Blockchain for identity management.

Blockchain can create a decentralized digital repository to verify identity (Swan, 2015), and build a trusted digital identity (Brakeville & Perepa, 2017). Nedap Identification Systems' current products allow it to verify parties and consequently provides or denies these parties from accessing a property. Therefore, building trusted digital identities (Brakeville & Perepa, 2017) and creating a decentralized repository to verify identity (Swan, 2015) would dramatically change aspects of Nedap Identification Systems' core business. According to Porter's (1985) value chain, this is a primary activity for Nedap Identification Systems.

Ethical issues are currently associated with identity management, due to the vulnerability of the information shared with organizations, often reluctantly or unknowingly by the customer. Arguments exist for personal being not to be trusted in the hands of third-parties, where they are susceptible to attacks and misuse (Zyskind, Nathan, & Pentland, 2015). When providing access to a certain area, information on the identity of the accessor is required. The required information is currently stored on a server. However, once newly formed digital identities are stored on tamperproof decentralized digital repositories, the vulnerability of identity storage will decrease. Theoretically, everyone could manage the access to his or her own identity individually, and to some extent temporarily transact access to his or her identity purely for the purpose outlined by the third party requesting identity access.

Building a digital identity has benefits for identity owners, issuers and verifiers. As identity verifier, you can simplify and reduce time to know your customer, engage in relationships with more trust, and ensure compliance with regulations. Furthermore, you can issue standardized

digital identities and credentials. These can be issued, updated and revoked swiftly (IBM, n.d.).

A new model for privacy-preserving identities is needed if Blockchain systems are to operate at a global scale. It must allow entities in the ecosystem to (a) verify the "quality" or security of an identity, (b) assess the relative "freedom" or independence of an identity from any given authority (e.g. government, businesses, etc.), and (c) assess the source of trust for a digital identity (Shrier, Wu, & Pentland, 2016).

Bitcoin-fueled smart contracts can be used by automated software agents to protect customers' identity from theft and automatically enforce their contractual preferences (Fairfield, 2014). This provides prevention from identity fraud, as your identity is secured like cryptocurrencies in a bitcoin address/wallet. Every individual can store his/her digital identity on a smartphone, and temporarily provide access to his/her identity to the firm that requests access. Blockchain can be modeled into an automated access-control manager that does not require trust in a third party (Zyskind et al., 2015). After the firm has acquired the desired information, the digital identity is safely transferred back to the owner. The firm will no longer have access to the identity. Building an identity management system on Blockchain technology also allows for building additional services, as real-time advice on mobility solutions, routes to take, places to park etc. can be made possible.

Research Model

Combining the aspects of the literature review, the research model consists of two parts, each covering one sub research question. Together, they will form the answer to the general research question.

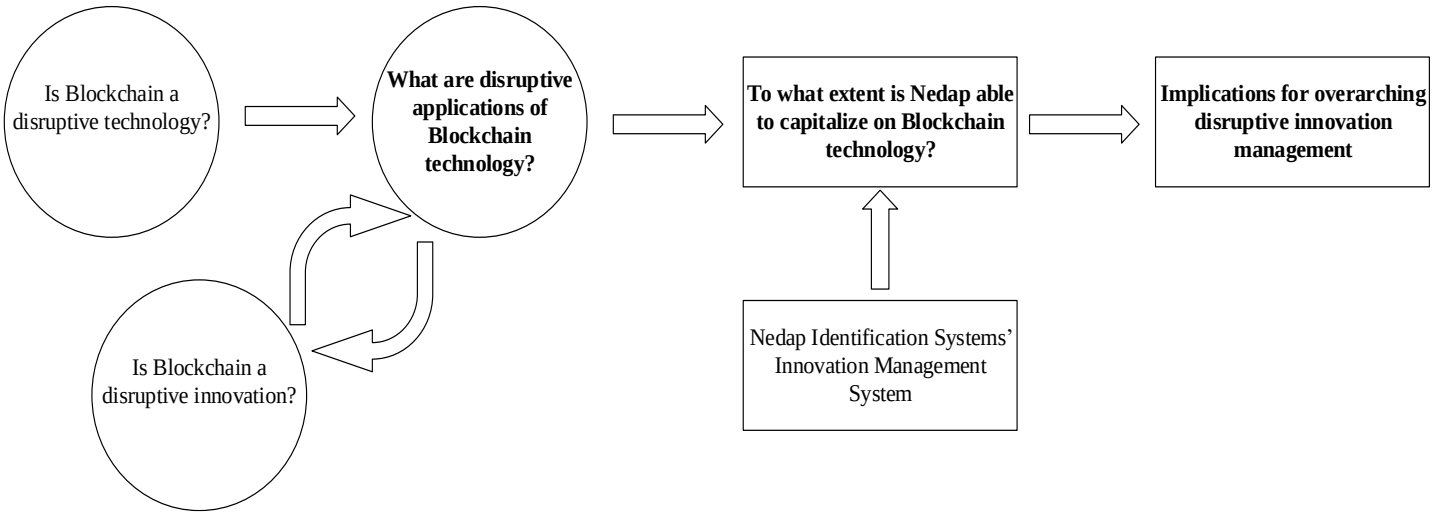

Fig. 1: Research Model

The framework involves six questions to be answered in order to answer the central research question. Bolded are the two sub questions and the implications for generalizability, the surrounding questions must be answered in order to be able to answer the sub question. The circular relationship between disruptiveness of Blockchain and disruptive Blockchain applications can be explained as an interdependent relationship, as disruptive innovations are by theory defined by their application, and a disruptive application can only exist if there is a disruptive innovation. Afterwards, I find implications for overarching disruptive innovation management literature to deliver an additional academic contribution. The graphical framework has the sole purpose of clarifying the structure of my research.

Method

Answering the research question will be done in two separate steps, sequentially answering both sub questions. Afterwards, I conclude on the influence on the overarching disruptive innovation literature. I conduct qualitative empirical research, and the answer to the research question will mainly serve as a contribution to the practical case of Nedap Identification Systems. However, its implications could be extended and explored in future bodies of research. This body is a practice-focused research, which is the product at the intersection of intervention and research (Vennix, 2009). Furthermore, due to my focus on implications for Nedap Identification Systems, this research has characteristics of a case study. Goal of a case study is that it can be replicated and broadened in future research, as long as its results are novel, testable and empirically valid (Eisenhardt, 1989). Case studies are considered most appropriate as tools in the critical, early phases of a new management theory (Eisenhardt, 1989; Gibbert, Ruigrok, & Wicki, 2000; Yin, 1994). Disruptive innovation theory is not necessarily a new management theory, but it has rarely been combined with Blockchain technology. Therefore, the argument for a case study is justified. However, because of the research's place early in Blockchain and disruptive innovation literature, and because this case study is conducted in interaction with practitioners, concerns regarding methodological rigor must be taken into account, or relevance cannot be claimed (Gibbert et al., 2000). In business administration, intervention in company processes is the object of research. Intervention includes all governance (in public organizations) and management (in companies) activities. In intervention cases, actions set out to change specific situations are discussed. Theory focused research sets out to understand what is yet unknown. In the context of a firm, the manager manages the intervention cycle, and will hire a researcher to expand his knowledge in areas yet unknown (Vennix, 2009). This is the situation in which this research finds itself, I was

instructed to inform the firm with knowledge of Blockchain's disruptiveness, and its disruptive applications. Furthermore, I evaluate Nedap Identification Systems on its capabilities to manage Blockchain's disruptive applications. The form of research, in which I perform an evaluation of Blockchain alternatives and evaluate its prospected management system, is named ex-ante research. The function of a typical research paper is to teach the reader something he/she did not know beforehand, whereas an intervention sets out to change a certain current situation (Vennix, 2009).

Research Strategy

To research the disruptiveness of Blockchain for a certain firm or market, and extend findings of this research to the overarching literature of disruptive innovations and provide additional information on appropriate disruptive innovation management specific to a company's market, I must find firms that potentially have its market disrupted by Blockchain. The internship granted by Nedap Identification Systems allows me to have access to experts in the industry, whom have experienced the developments in their specific market and have in depth knowledge of possible implications for the firm and its market positioning. I chose to focus my sample on employees of Nedap Identification Systems for a couple of reasons. First, I have access to a wide range of experts in different departments of the field. When collecting surveys from separate sources, I would have to vet all interviewees on their knowledge and experience, whilst this process is not as complicated when including Nedap Identification Systems employees only. Furthermore, due to the time constraints of this research, I cannot accumulate an exhaustive sample of experts from all arrays of the industry; therefore, I chose to acknowledge sampling bias and provide advice for implications to other firms looking to potentially work with Blockchain or adjacent disruptive innovations. In case study research, common practice is to use focus groups and/or interviews to collect data (Essers, 2017; Ritchie & Lewis, 2003). For this research I chose to do both, separately collecting data on the respective sub research questions.

Selection of research strategy depends on two factors, the aim of the research and the phenomenon of interest (Yin, 1994). The aim of the research depends on the research question, or sub research questions in this research. The aim of my research is explorative, which leaves all preferred research strategies available (Yin, 1994). The phenomenon of interest, or the complexity of the object of study, also impacts research strategy. As the topic is relatively complex and vague, extensive interaction is required (Calder, 1994). Therefore, I perform

qualitative research in the form of a focus group with company experts, which deems the most appropriate research strategy to answer the first sub question. To answer the second research question, employees are interviewed across all divisions and layers of Nedap Identification Systems, to gather information about its innovation management capacity.

The research will mainly have practical contributions specific to Nedap Identification Systems; however, these contributions could potentially be extended to other industries, firms, or marketplaces, and have implications for disruptive innovation management theory.

Nedap Identification Systems

Nedap Identification Systems is one of eight business units in Nedap N.V., Groenlo. The business unit acts independently as its own corporation. The business unit employs 50 people, mainly located in Groenlo, but also has 24 employees spread over the globe, working in one of Nedap N.V.'s international offices. The business unit is concerned with the production, development, marketing, and support system of four propositions: parking sensors (SENSIT), vehicle reader systems (TRANSIT), and city traffic management (MOOV). Recently, Nedap Identification Systems has developed MACE, which provides access control through QR codes on smartphones. Nedap Identification Systems provides mobility solutions across the globe, with customers on almost every continent.

Data Sources

In order to collect data and determine disruptive Blockchain applications and define Nedap Identification System's innovation management system, I will conduct two separate interviews, first exploring disruptive applications of Blockchain technology, afterwards discussing Nedap Identification Systems innovation management system.

Research Operationalization

The first interview will be conducted as an organized focus group session, organized to discover the *radical functionality, discontinuous technical standards,* and *innovation ownership* (Schuessler & Nagy, 2014; Thomond & Lettice, 2002) characteristics of Blockchain in the supply chain, and in its identification management. First, the respondents will argue whether a primary or secondary activity (Nagy et al., 2016; Porter & Millar, 1985) is impacted by the proposed application. The purpose of the focus group is to reach a consensus on Blockchain application and its disruptiveness for Nedap Identification Systems and come

to a consensus on a possible disruptive Blockchain application that can be developed on a short-term basis. Including employee and industry representatives makes this research participative (Vennix, 2009), meaning that representatives of the organization and industry are involved in the research. Hereafter, I can conclude on the disruptiveness of Blockchain applications, and draw conclusions from my findings to be discussed in the discussion chapter. A concern from this form of information extraction is *groupthink* (Vennix, 2009). Groupthink describes the psychological phenomenon of people in a group, whom find conformity in its groups members; therefore, making irrational decisions. Some antecedents of groupthink are group cohesiveness and homogeneity of group members' background (Miranda, 1994). Therefore, I acknowledge the possibility for groupthink in my data collection and consider meeting behaviors that may be used to counter affect the effect of antecedent conditions. I attempt to limit the impact of the group's cohesiveness and homogeneity through using public screens, having a clearly structured process and allowing written input (Miranda, 1994).

Focus group. For the establishment of a successful focus group, it is of importance to make a strong and appropriate selection of participants. The sample for my research consists of Nedap Identifications Systems employees, originating from different departments whom have some knowledge of the capabilities of Blockchain technology. Inadequate recruitment is a common mistake in constructing focus groups (Morgan, 1997).

Focus Group #	**Position**
1	General Manager
1	Software Developer TRANSIT
1	Product Manager SENSIT
1	Product Manager MOOV
2	Global MarCom Manager
2	Business Dev. Eastern Europe/Russia
2	Product Manager MACE
2	Operations Manager
2	Developer Radio Frequency and UHF

Table 1: Focus Group – Disruptiveness of Blockchain applications

Furthermore, I considered alternatives for session structuring, the size of each group and the number of groups in the project. Not all traditional rules of thumb for focus groups can be met in this research, for example, it is impossible to use homogeneous strangers as participants for interfirm research. The rules of thumb for focus groups are by no means definite but rather

a summary how focus groups are often conducted (Morgan, 1997). I developed an appropriate structure and utilized moderating skills to steer the discussion. I conducted research in two focus groups of four and five participants, respectively.

In selecting participants, it is vital to minimize sample bias. This is more important than achieving generalizability. The bias from the selection of participants from one firm as a source, is only a problem if ignored. The result of the selection bias in this research is that data from the sample does not represent the full spectrum of experiences and opinions. Traditionally, when considering interfirm focus group research, one must carefully regard hierarchy. The hierarchy of Nedap Identification Systems is relatively flat; however, the overarching general manager is a part of the focus group. Careful moderation will have to break routine patterns of what participants usually do and do not discuss with their company superior (Morgan, 1997). Furthermore, rule of thumb prefers strangers for focus group selection. However, I selected acquaintances, colleagues even, to form a discussion, which is inevitable in intrafirm focus group research. The advantage is that acquaintances usually converse more readily (Agar & MacDonald, 1995).

The focus group will have a 'less structured' nature (Morgan, 1997). Moderator involvement steers the discussion, and although the focus group will originate from a standardized presentation with questions, the discussion can flow freely. This serves the exploratory, ex-ante purpose of this research.

The focus group is structured to discuss the two pre-determined potential applications for Nedap Identification Systems with experts of the organization's technology and market. It is designed to question the disruptiveness of both applications specific to Nedap Identification Systems market. After all, the context ultimately determines whether Blockchain will be a disruptive innovation for Nedap. The predetermined indicators of disruptive innovations, to be individually discussed are: (1) Primary or Secondary Activity (Nagy et al., 2016; Porter & Millar, 1985), (2) Radical Functionality, (3) Discontinuous Standards and (4) Innovation's Ownership (Thomond & Lettice, 2002). Afterwards, the participants will provide their insight on the conclusion: will Blockchain in the supply chain, or Blockchain based identity management be a disruptive innovation for Nedap Identification Systems? A final discussion point is the application of Blockchain on a short-term basis, to identify a first step towards Blockchain implementation for the business unit.

Interview on innovation management.

Participant's Position	Firm division
Product Manager SENSIT	Sales/Product Management
General Manager	General Manager
Product Manager MACE	Product Management
Global MarCom Manager	Marketing
Product Manager MOOV	R&D/Product Management
Software Developer	R&D
Developer RF & UHF	R&D
Software Developer TRANSIT	R&D

Table 2: Semi-Structured Interview – Innovation Management

The second part of the research is a semi-structured interview with individual Nedap Identification Systems employees to give an indication of its innovation management in place and find areas to improve before integration of a disruptive innovation in its business model. A loose guideline in the interview is O'Connor's (2008) framework of evaluating organizational readiness for major innovations. I perform semi-structured interviews to gauge each aspect of O'Connor's (2008) innovation management system within Nedap Identification Systems, where after I can conclude on Nedap Identification Systems' capability to manage disruptive Blockchain applications.

Semi-structured or in-depth interviews are intended to combine structure with a degree of flexibility. The interview is interactive in nature and answers can be fully probed with the purpose to explore all factors explaining an interviewee's answers (Legard, Keegan, & Ward, 2003).

For the initial interview guideline, I formed a list of eighteen questions. These questions were formulated largely based on O'Connor's (2008) aforementioned framework for major innovation management. Furthermore, I added questions regarding the incubation and acceleration of potential disruptive innovation due to the contributions of O'Connor & DeMartino (2006). The full list of questions is available in Appendix A, and in the operationalization segment.

Constructs. To develop questions regarding innovation management practices within Nedap Identification Systems, I explore constructs that innovation management literature regards as important. First, O'Connor's (2008) dimensions can be boiled down to nine overarching theoretical constructs. The first construct is *Organizational Structure* which embodies the division and cooperation of tasks and departments within the organization. This

construct must be measured due to the requirement of a sufficient major innovation management system to have an identifiable organizational structure and to have interface mechanisms with the mainstream organization (O'Connor, 2008). However, disruptive innovations can be hampered by a innovation management system that is too detailed as well (Leavy & Sterling, 2010). Furthermore, authority to middle and operational level employees can propel innovative input and thus a firm's innovative success (Dougherty & Hardy, 1996). Differentiation and decentralization within an organization can create constructive conflict, which according to some authors can enhance innovativeness (Pierce & Delbecq, 1977). The second construct, *Innovation Management Structure*, is the division and cooperation of tasks and departments within the organization specifically related to innovation projects, this does not only matter for the interface mechanisms with the mainstream organization, but also because the major innovation management system must have governance and decision-making mechanisms at the project, and have an appropriate leadership context. The third construct, *Innovation Exploration*, describes the organization's activities towards exploring and researching new innovations, due to O'Connor's (2008) valuation of exploratory processes. Design thinking implicates the importance of gathering information on user needs (Liedtka, 2015). *Innovation Testing* describes the testing procedure of researched innovations and is measured due to the importance of appropriate performance metrics, requisite skills and talent development. Furthermore, *Innovation Metrics* describes the appropriateness of these measurement indicators for an innovation. *Organizational Culture* describes the overall beliefs, values and attitudes contributing to the unique dynamic of an organization due to the importance of appropriate culture and leadership culture (O'Connor, 2008). *Innovation Development*, concerns the development of innovations after the research and testing phases. The innovation system in itself is not enough to necessarily develop an innovation into a new product. Therefore, a firm must have appropriate measures to perform acceleration of the innovation towards a tangible product (O'Connor & DeMartino, 2006). *Innovation Commitment* describes the commitment shown by the organization towards innovative activities. Pierce & Delbecq (1977) argue that firm size has a positive impact on innovation adoption and initiation, where Tripsas (1997) argues that extensive investments in innovative projects can overcome a late reaction to a certain innovation. When the organization might be relatively late to respond to a certain innovation, firm commitment towards the new development can even the playing field. Therefore, firms should display a willingness to invest in innovative projects. The last construct, *Disruptive innovation experience,* describes whether

the firm has ever engaged in disruptive innovations, or structurally discusses the impact of potential disruptive innovations on the horizons for the business unit.

Operationalizing interview questions. To construct variables and translate theoretical language to empirical language (Vennix, 2008). I identified dimensions, aspects of the theoretical construct that can be measured individually, and indicators, observable variables directing towards the theoretical construct. The indicators are (parts of) the question construction. The results can be seen in the operationalization table (Table 3). In this segment I will explain the thought process behind the development of every question in the interview guideline.

To address the first construct, the interview guideline has four questions. The first introductory question of the interview is:

1. *What is your position at the firm?*

This question is meant to display the credibility of the interviewee. Furthermore, an interviewee might describe his day-to-day obligations, which could give the first implications of the organizational structure.

2. *How many employees work at Nedap Identification Systems?*

The second question is meant to analyze the full spectrum of Nedap Identification Systems organizational context. Pierce & Delbecq (1977) stated the importance of firm size, as did Tripsas (1997). The amount of employees can provide an indication of firm size.

3. *How many managers and layers are present within the business unit?*

The answer to this question will give an implication of the organizational structure, the number of managers, hierarchical layers and the sense of decentralization within the organization. O'Connor (2008) and Dougherty & Hardy (1996) implicate the importance of a clear organizational structure, and a sense of decentralization, respectively. Excessive bureaucracies can hamper innovativeness, and little management turnover is desirable when pursuing innovative projects (Assink, 2006).

18. *To what extent is the adoption of innovations by Nedap Innovation Systems affected by its corporate headquarters?*

Nedap Identification Systems is part of the overarching Nedap N.V. Therefore, the influence of Nedap N.V.'s corporate management on decision making regarding innovations must be considered. Furthermore, top management support is often critical for the success of innovative projects. Top management often actively supports product champions (Hillebrand et al., 2011), but if an innovation system is to be successful, it must actively support innovation projects.

The following questions address the second construct: *innovation management structure.*

4. *In the organization, is there a team/individual/task connected to discovering or developing potential disruptive innovations for the company?*

This question is designed to find out whether the organization employs people with tasks related to innovation, or teams related to innovation. Division and cooperation of tasks and departments within the organization specifically related to innovation projects, matter for the interface mechanisms with the mainstream organization (O'Connor, 2008). Teams or employees with tasks related to innovation could implicate the distinction.

5. *Are these teams/employees/tasks clearly distinguished?*

Innovation is to be taken seriously and must be clearly distinguished as an activity or responsibility, comparable to other tasks for the employees. It must have governance and control to be held responsible (O'Connor, 2008). Teams or employees with tasks related to innovation could implicate the distinction.

7. *In the case of an inbound innovation, is there a team/individual in charge of and specialized in decision making regarding implementation of the innovation?*

Governance and control at the innovation project is essential for innovation success and an organizational willingness to pursue an innovation (O'Connor, 2008). Thus, there should be a position with authority to make decisions related to innovation.

8. *How is the discovery and development of innovations coordinated within the organizational strategy?*

Radical or disruptive innovation activities should be incorporated in the organizational strategy in order to be successful, and cannot consistently originate from regular corporate activities and questions from the market (O'Connor, 2008). Official statements or reports regarding the role of innovations could indicate such incorporation.

10. *Is there a standard process surrounding the recognition and application of innovations?*

A standard process surrounding innovation activities suggest a clear and defined innovation management structure. Disagreement surrounds the value of a structured innovation management strategy. A sense of decentralization is supported by Dougherty & Hardy (1996), where O'Connor (2008) values the defined structure of an innovation management system. This measures the sense of decentralization within the innovation management system, and finds reports or routines regarding innovation. Furthermore, an unwillingness to deviate from standard practices and an inability to unlearn can hamper innovativeness (Assink, 2006).

The third construct, *Innovation Exploration,* is covered by the following questions.

6. How does the business unit research potentially influential innovations?

Whether the firm has knowledge of potential impactful innovations, or gathers data on user needs regarding innovations, can implicate whether the business unit researches potential influential innovations. Structured innovation research can identify impactful innovations for the business early on.

11. Does the organization ever rely on external experts for innovation research?

Hiring of expertise regarding innovations or new technologies can extend the organization's knowledge of the innovation. An organization cannot be expected to always be aware or, more importantly, knowledgeable about every innovation.

The fourth construct, *Innovation Testing* is covered by one question:

9. How does the business unit test new innovations?

The testing process must be structured and comprehensive in order for an organization to release a successful product to the market. If there is an employee tasked to and specialized in testing new innovations, this could enhance the quality of performed tests, and thus the success of the innovation once released in the finished product.

The fifth construct, *Innovation Metrics* is answered with the following question:

14. How does the organization measure the potential of innovations?

According to O'Connor (2008), an organization must have predefined metrics to determine the potential of an innovation. However, predicting the success of innovations cannot be completely attributed to appropriate metrics. Realistic revenue and ROI expectations attributing for the high risk and uncertainty of disruptive innovations are vital (Assink, 2006). Organizational complimentary assets (Tripsas, 1997), its experience with innovation, and appropriate culture can also provide a better projection of the future and allow to provide better measurement of innovations. Market sensing, foresight and distinctive competencies in the market can be valuable in measuring the potential of innovations due to experience and extensive knowledge of the market (Assink, 2006)

The sixth construct, *organizational culture*, is measured by the following question:

15. How is the organizational culture and attitude of the organization towards new innovations and developments?

Organizational culture is arguably one of the most important, intangible motivators of innovative activity. Culture should recognize the importance of the innovation system (O'Connor, 2008) or innovative activities in general. Internal culture and performance pressure that drives more low risk, immediate reward, incremental projects will hamper innovative performance (Assink, 2006; McDermott & O'Connor, 2002). A risk averse climate will hurt

an organization's disruptive innovation capability (Assink, 2006). To measure the organizational culture each interviewee is asked to provide his opinion on the overall company attitude towards innovation.

The seventh construct is innovation development. The development and acceleration of an innovation towards a respectable product indicates the company's ability to capitalize on inbound technologies.

13. *Does the organization have the capacity and capability to discover and develop multiple innovation simultaneously?*

Capacity to research or develop innovations is essential as the organization should have the freedom and capacity to research innovative projects (O'Connor, 2008), as limited capacity due to a lack of specialized employees or time constraints could cause an organization to refrain from developing a promising innovation or suffer from prioritizing the wrong technology. Problematic organizational dualism is a traditional inhibitor of disruptive innovation capabilities (Assink, 2006).

16. *What happens when the innovation is fully developed and ready to stand on its own two feet?*

The process of an innovation before and after maturity during the development of an innovation process is vital. Incubation activities to mature the opportunity of radical innovation towards business proposals can determine the success of the eventual product. Successful acceleration towards a finished product allows the innovation to stand on its own when compared to other business platforms, building some sense of predictability in sales (O'Connor & DeMartino, 2006). Therefore, the interviewee's description of the development process of innovations before and after maturity is valuable. Does the organization build a business or development plan for the technology, is the organization willing to propel the innovation towards an independent proposition? Furthermore, it measures whether the organization willing to cannibalize sales of current products for the sake of innovative products (Assink, 2006; Chandy & Tellis, 1998; Hillebrand et al., 2011), next to the importance of adequate follow through after recognition of the innovation, testing and prototyping (Assink, 2006)

The eighth construct, *Innovation commitment*, describes an organization's behavior towards new innovations, and describes the willingness to commit to new projects.

12. *Does the business unit invest in innovative projects?*

Organizational commitment is largely attributed to the commitment of resources. The budget or monetary spending on innovation projects displays true commitment to a project.

Furthermore, hiring of new employees could implicate innovation commitment. This is answered through a combination of the previous questions (4, 11).

The last construct, *Disruptive innovation experience* is answered by one question.

17. *Does Nedap Identification Systems discuss innovations outside of its traditional market?*

This displays actual efforts of Nedap Identification Systems towards development and research towards innovations outside of the business' traditional boundaries.

Theoretical Construct	Question	Dimensions	Indicators
Organizational Structure	1,2,3,18	Structure	Number of Managers Number of Employees Hierarchical Layers Sense of Decentralization Influence of corporate management
Innovation Management Structure	4,5,7,8,10	Structure	Employees with tasks related to Innovation Teams with tasks related to Innovation Function with authority to make decisions related to innovation Capacity to develop multiple innovations simultaneously
		Relation to Org. Structure	Statements, reports or routines regarding innovation
Innovation Exploration	6,11	Structuring	Employees with tasks related to new innovations unknown to organization
		Research Process	Acquiring expertise regarding the innovation Knowledge of potential impactful innovations Gathering data on user needs
Innovation Testing	9	Testing Process	Employees with tasks related to testing new innovations
Innovation Metrics	14	Measuring Innovation	Ability to project innovation's potential
Organizational Culture	15	Attitude	Employee's attitude towards new innovations
Innovation Development	13, 16	Before Maturity	Building of business plan for innovation
		After Maturity	New innovation products standing next to existing business lines
Innovation Commitment	12	Spending	Investments towards innovative projects or products
		Hiring	Employees hired for or assigned to innovation projects
Disruptive Innovation Experience	17	Discussion	Official meetings about innovations outside of traditional marketspace

Table 3 – Operationalization

Research Ethics

In this research I am the sole author, being supervised by Dr. Armand Smits of the University of Nijmegen. Furthermore, I was granted an internship by Nedap Identification Systems to conduct this research specific to the context of their organization and utilizing its employees and network as data sources. I will preserve confidential information of the organization and will truthfully represent the statements of interviewees. Names of interviewees, product and competitor info, and the organizational chart are only available to the first and second reader. Any interviewee can withdraw from the process at any time, and the anonymity of interviewees will be guaranteed if it is what the interviewee desires. Findings will be communicated with the University of Nijmegen and Nedap Identification Systems. The thesis will be stored in the digital repository of the University of Nijmegen, with permission granted by Nedap Identification Systems.

Whilst conducting the focus group, I respect the privacy of all participants, not show the recordings of the interviews to anyone, and safely store them in my possession. The names of interviewees will be protected to ensure the confidentiality of the employees. Furthermore, participants might be constrained from providing all information due to the presence of others in the room during the interviews or particularly focus group sessions, e.g. due to discussions partners with whom they might not be comfortable (Morgan, 1997).

Concerns about the ethics of including only Nedap Identification Systems' employees are, to some extent, grounded. Ideally, I would include a consensus of a broad sample of firm representatives. However, Nedap Identification System offered access to company resources and employees, where I can conduct a thorough process across the scope of the entire business division. I choose to acknowledge my sampling bias, and the purpose of this research to contribute to the overarching disruptive innovation literature and its implications for firms, can be achieved after careful consideration of the impact that sampling bias has on the data collection.

Validity. When performing qualitative research, a researcher must preserve internal and external validity. This research, due to its focus on the practical case of Nedap Identification, acknowledges limited external validity. However, problems regarding the adoption of disruptive innovations, or more specifically, Blockchain, can be extended to other organizations. Therefore, the findings of this research and general theoretical and managerial applications can be extended once interpreted carefully. The extent to which the findings can be extended is called theoretical generalizability. Theoretical generalizability refers to the extent to which the results of this research are valid outside of the research. It is not a condition

for the quality of the research (Smaling, 2009). In order to achieve theoretical generalizability, I elected to pursue satisfying variation covering generalizability. This was achieved through triangular sourcing and sampling from all layers and divisions of the business unit. The sample size could have been larger, but the sample was representative of Nedap Identification Systems' employees. Not all variations in opinions; therefore, are covered, and thus all findings cannot be completely generalized. However, by selecting from all divisions and layers, the collection of variation in opinions within the business unit is maximized (Smaling, 2009) considering the time constraints of the research, relevant sources were pre-identified and with the purpose to generate varying results. Furthermore, I rely on participative generalizability (Gibbert et al., 2000; Smaling, 2009), which includes that stakeholders participate in the empirical research, as their expertise of the company strengths and market knowledge is explored in focus group sessions. The participants have knowledge of firm-specific, contextual, situational and personal factors influencing corporate decisions or market movements (Smaling, 2009).

Case studies often focus on external validity, but internal and construct validity must be accounted for equally. Several strategies exist to solve this rigor problem (Gibbert et al., 2000). Internal validity is improved through several measures. Firstly, through member checks. This means that the interview and data collection process are transcribed, and that the information in the transcript is confirmed with the interviewees that the transcriptions originate from. Furthermore, triangular sourcing is applied in the selection of participants for the interviews and focus groups (Gibbert et al., 2000; Yin, 1994). This means that participants originate from all layers and departments of the organization, to acquire a complete consensus of the organization. Furthermore, aspects of the *major innovation* model of O'Connor (2008) and other sources in the literature review have been tested and tried, improving the validity of the research. I provided a research framework to demonstrate the interrelations of topics tested (Gibbert et al., 2000), and I pursued theory triangulation by adopting a perspective of literature review combined with focus group and semi-structured interview research (Yin, 1994). Construct validity was addressed by providing an extensive operationalization of the relevant concept. An operationalization table is included and the operationalization of interview questions, originating from the nine constructs from the literature review is explained. This allows the reader to asses to what extent this study investigates what it sets out to investigate. Construct validity is also achieved by providing the transcripts to both the first and second reader (Gibbert et al., 2000).

Reliability. To maximize reliability, I provide transparency and replication. The paper is grounded in literature on disruptive innovations, radical innovations, Blockchain technology,

and other forms of supporting literature. To enhance reliability of data collection and the research, I provide transcripts of all interviews. Furthermore, I attempted to optimize internal and external reliability (Zwieten & Willems, 2004). The internal reliability is maximized, as I am the sole author, uninfluenced by co-authors. Internal reliability was hampered as I did not use software to code the interviews, and the collection of data was not automated. Internal reliability was improved by utilizing focus groups and semi-structured interviews, adding participative observations. External reliability describes the replicability of the research. Replicability is difficult, due to the specific case and information provided by employees of Nedap Identification Systems, and the impact that the specifications of the organization and its market have on the practical implications of this research. Therefore, I provided the outline of the semi-structured interviews and the transcripts to provide an audit trail (Zwieten & Willems, 2004), or a clear chain of evidence (Gibbert et al., 2000; Yin, 1994). The transcripts are only visible for the first and second reader for Nedap Identification Systems' sake of confidentiality.

Results

After careful analysis of both the focus group and interview transcripts, I will provide the findings in this chapter. Results of the qualitative research are used to answer the two sub research questions, followed by the overarching research question. Afterwards, we can conclude on this case's implications for the overarching literature of disruptive innovations and provide additional information on appropriate disruptive innovation management specific to a company's market and identifies aspects of a technology to consider when evaluating an innovation.

Focus Group

The purpose of the focus group was orchestrated to discuss the two pre-determined potential applications for Nedap Identification Systems with experts of the organization's technology and market. It was designed to question the disruptiveness of both applications specific to Nedap Identification Systems' market.

Blockchain for the supply chain. The supply chain, according to the results of the focus group, is a secondary activity for Nedap Identification Systems. This was arguably the most important finding of the focus group discussion on this application, due to its implications on Nedap Identification Systems' role in the development of Blockchain systems, and to what extent it should pioneer this development for the viability of its business.

> *"Within Nedap Identification Systems, I've witnessed a change in the past ten years. I would have called it a primary activity in the past, but nowadays, we primarily focus on providing marketing, sales and service. Therefore, I think the supply chain is a secondary activity for us."*- Operations Manager

The majority of the participants stated that the business unit's lack of focus on the supply chain implicated that it indeed a secondary activity. This decision was made after careful evaluation and discussion regarding the classification of primary and secondary activities specific to Nedap Identification Systems (Porter & Millar, 1985). After all, one explanation all participants could support was the following:

> *"The supply chain being a secondary activity does not implicate that it is not important for the viability of the business unit, it must continue to exist for the business' viability."*- Product Manager MACE

After which another participant added:

> *"I agree. It's just that we simply do not focus on the supply chain. There is a reason that large parts of our distribution channels are outsourced."* – Global MarCom Manager

Eventually, the participants concluded that the supply chain was indeed a secondary activity for Nedap Identification Systems. This had its implications on the participants' opinion of the application's disruptiveness at a later stage.

A major share of the participants did think that a Blockchain based supply chain could offer radical functionality for Nedap Identification Systems and that, once implemented, the system could provide a competitive advantage. Especially the ability to create transparency and real-time provenance of goods was considered by the participants to be a radical functionality of a Blockchain based supply chain. One respondent mentioned the opportunity to store a quality guarantee, and record reputation encrypted in the Blockchain as radical functionality. However, the radical functionality is not necessarily something an eventual initiator of Blockchain based supply chains can immediately profit from.

> *"The added value of a Blockchain based supply chain is apparent when the entire chain has switched to Blockchain. If a player in the chain does not wish to cooperate, it could prove problematic."* – Product Manager MACE

Moreover, extensive network externalities are required for a successful Blockchain based supply chain. However, this is only the first of the concerns the participants showed regarding the immediate disruptiveness of this application.

Another concern that the participants shared is that it is at this point impossible to determine the degree to which Blockchain offers discontinuous technical standards, according to the participants. At face value, Blockchain seems to have the technological capability to enhance efficiency in the supply chain. However, the transaction costs associated with a Blockchain network are not to be ignored, and largely depend on the network that one choses to use; therefore, this is a major unknown aspect of the Blockchain based supply chain. Furthermore, if Nedap Identification System would have to build a separate Blockchain platform, specific to the firm's ecosystem, it would require major resource allocation. Looking at discontinuous technical standards through the lens of transaction cost theory, the participants cannot come to a definite conclusion, due to the absence of a real-world example of a Blockchain based supply chain that proves to be more efficient than its conventional counterpart.

> *"You cannot determine whether it would be more or less expensive than the current situation. How do we deal with the network's energy efficiency? Who is going to be the architect of the network? Even if we disregard the investment needed to create a Blockchain network, I cannot say that a Blockchain based supply chain would certainly be more efficient."* - Business Developer Eastern Europe/Russia

An aspect of Blockchain technology in the supply chain that will certainly have consequences, is the innovation's ownership. This was the concept toughest to grasp or define for the participants. Who the new owner of the technology or innovation will be, was hard to determine. Some participants argued for partners being owner of their own data, as they determine which party can view which data. However, other participants argued that the architect of the Blockchain network will be the owner of the technology. What the participants do agree on, is that the ownership model will change. The real-world application is yet to be proven, and a first step in that direction is made by IBM (Churchill, 2017). The core of Blockchain technology; however, is decentralization and transparency. Therefore, the ownership model of the innovation will be altered as a supply chain transitions to a Blockchain based network. The actual outlook is yet unknown.

When discussing a final conclusion, the respondents agreed that disruption, although likely, will not occur on short term basis. Furthermore, the conclusion that the supply chain is a

secondary activity, leads the participants to state that Nedap Identification Systems, or Nedap N.V. in general, does not have to be a pioneer in building Blockchain based supply chains.

> *"If you consider what its technical capabilities are, I have a comparable feeling with the first phase of the Internet. We still don't exactly know how it will establish itself. Looking at this application, I am convinced it will happen. A Blockchain based supply chain will happen. However, the question is: who will be the architect? I don't think that has to be us. We will have to see it coming, and at that point we must react appropriately."* – General Manager

Blockchain for identity management. Identity Management and access control, according to the results of the focus group, are primary activities for Nedap Identification Systems. Participants unanimously agreed that identity management is a core activity for Nedap Identification Systems. Therefore, the participants find that this is a development that should be closely monitored by the business unit.

> *"We are involved with the identification and authentication processes, this could be a logical next step in the industry."* – General Manager

Managing identities or allowing access through Blockchain systems offers radical functionality according to participants, as it allows for not only improved security and privacy of the digital identity evaluation process, it could possibly also allow the authenticating party to extend or withdraw credentials faster and correctly. Furthermore, participants indicated that it could allow for trustworthy authentication at distance. However, this proposition assumes the adoption of digital identities, a development that is far from completed.

> *"It will probably take some time for all cards in your wallet to become unnecessary. Until then, we can employ Blockchain in different ways for identity management or access purposes."* – Global MarCom Manager

Participants indicated that discontinuous standards are difficult to determine due to a lack of knowledge of the actual viability of building a Blockchain platform and allowing it to efficiently function in the context of the organization. Identity management based on Blockchain could improve the security and efficiency of authentication and identification according to participants. However, the costs associated with transitioning the current authentication protocol towards a Blockchain protocol are unknown. Furthermore, indicated was that not only readers and authentication software will have to migrate to the Blockchain platform, this is something Nedap Identification Systems could do, but mobile devices or other

carriers of digital identities will also have to be adjusted. Digital identities will have to be adopted at a relatively large scale for the device to be viable and work through the Blockchain. The first steps towards digital identities have been made, as the participants indicated that a major competitor is providing chips in American passports and drivers licenses as the first step towards digital identities. A major advantage of Blockchain based identity management however, is in the key management of credentials. This process now becomes less complicated, as the complex access portal can now be simplified in smart contracts and automatically executed by these smart contracts. This would dramatically increase the efficiency of access control, as the smart Blockchain platform will not need the same monitoring as the current key management system.

Innovation ownership is a similar discussion compared to the first application. The participants foresee that the ownership model is going to change, as Nedap Identification Systems is perhaps no longer owner of accessor data. Indicated was that the identity could be stored with the owner of the identity, and the reader only temporarily views this identity. However, Nedap Identification Systems can build a network that can authenticate digital identities and allow or deny access as a result. This would be close to their current systems. Nedap Identification Systems already builds readers, and these would only need software updates to accommodate Blockchain functionality.

> *"It would be ideal if we would be the owner of our own Blockchain based Identity Management system"*- General Manager

Then, as digital identities become popular and acquire notoriety, Nedap Identification Systems already has some knowledge of Blockchain technology and can expand its services to meet customer needs, according to the participants.

> *"This is a different situation than Blockchain in the supply chain. In that case, you are dependent on network externalities and your ecosystem. However, as Nedap we could offer this technology if we would create the appropriate platform."*- Product Manager MACE

Concluding, the participants expect that identity management or access control via a Blockchain network will be a disruptive innovation for Nedap Identification Systems. It would cause all current authentication protocols to be unnecessary. It would impact a primary activity, with radical functionality and different ownership models. If Blockchain technology can prove to indeed perform access control more efficiently and provide discontinuous technological

standards, the participants conclude that disruption is likely to occur from identity management with Blockchain, answering the first research sub question.

Furthermore, concluding on the overall meaning for disruptive innovation literature, specific to company context, the guidelines of Thomond & Lettice (2002) prove valuable and to an extent capable of determining disruptive innovations impact for a specific organization. Adding the evaluation of where in the value chain the disruption impacts the business (Nagy et al., 2016), and whether it is a primary or secondary activity that is impacted (Porter & Millar, 1985) also proved important. Depending on the character and culture of the organization - Nedap Identification Systems' being characterized as followers on many aspects, yet a market leader that the competition looks towards for the direction of the market – organizations can decide whether it should incorporate disruptive innovations with disruptive implications directly to their market, provided that it influences a primary activity to the organization. A summary of the findings in focus groups is represented in Table 4 below.

	Supply Chain	**Identity Management**
Primary/Secondary	Secondary	Primary
Radical Functionality	√	√
Discontinuous Technical Standards	?	?
Innovation's Ownership	√	√
Conclusion	Not disruptive for Nedap	Disruptive

Table 4 – Focus Group's Judgement on Disruptiveness of Applications

Innovation Management

After concluding that there is at least one application that would be disruptive for Nedap Identification Systems' business, it is important that Blockchain is managed, developed and accelerated properly within the business unit. Therefore, I evaluated the business unit on its capability to do so through the predetermined list of indicators through semi-structured interviews with employees. Every organization that would be looking to engage with a disruptive innovation, will have to evaluate itself on these criteria to some extent. What follows is an assessment of Nedap Identification System's capability to cope with innovations. In the discussion segment, the consequences of this assessment and the implication towards further research will be expanded.

The first construct, *organizational structure*, should theoretically have major consequences for a firm to cope with disruptive innovations. Literature discusses both the advantages and

disadvantages of elaborate innovation management structures or systems (Leavy & Sterling, 2010; O'Connor, 2008; Paap & Katz, 2003). The interview transcripts show a common sense of decentralization within the business unit. Unanimously, the employees indicated that the business unit had only one manager, whom oversees the business unit's operations. Furthermore, the relationship with the manager is described as professional, but relatively informal. One interviewee stated that Neap's organizational culture revolves around employee intrapreneurship, and this is fitting for the sense of decentralization that employees generally seemed to display.

> *"At Nedap, we strongly believe in entrepreneurship, and we provide our employees with the freedom and opportunity to form decisions independently, as they are the experts in their field."*- General Manager

Employees experience few layers within the organization. The employees have an obligation to report towards the general manager of the business unit, and the general manager is responsible for the operational results towards corporate managers. However, the business unit feels little influence of corporate management. Employees state that there is indeed an official responsibility towards corporate management, and that corporate management has the authority to influence business decisions, and thus decisions on innovation projects. However, Nedap Identification System's responsibility towards the corporate headquarters is mainly limited to a responsibility regarding appropriate profits or operational result. Interestingly, corporate management has expressed a willingness to endure disappointing operational results from business units that show promise in the innovativeness of their product or service lines. The disappointing results of these business units must then be covered by better results of other business units, to satisfy shareholders. The business unit has appointed a new sales manager, starting in July 2018. This will form an extra organizational layer in the business unit, and cause sales employees to be obliged to report to this manager.

The second construct, *innovation management structure*, largely originated from O'Connor's (2008) valuation of a clearly defined major innovation system. The difference between that defined system and the functionality of Nedap Identification Systems' operations is striking. Nedap Identification Systems purposefully chooses not to clearly structure its innovative activities.

> *"At Nedap Identification Systems, when discussing innovation management or innovation managers, I think that you are, by definition, not acting*

> *innovatively. We have our own development team, which causes that innovation and development is in your blood."* – General Manager

The business unit does not have employees or teams that are specifically assigned to researching or developing innovative technologies. The recognition and development of innovations is a responsibility of the developers, but this responsibility is not officially recorded on paper. Some developers devote a certain amount of time every week to research innovations, and most developers seem to indeed have an affection with innovative projects.

> *"We have developers whom deliberately free times of day to research innovations with a potential impact for Nedap Identification Systems. These innovations do not necessarily have to be tied to our current propositions. This freedom certainly exists. And I think every developer likes to look into innovations and new developments."*- Software Developer TRANSIT

The authority to make decisions regarding innovations lies with the general manager. Employees expressed the opportunity to pitch innovative projects, new technologies or new ideas to the general manager, and the ability to pursue such project once argued for constructively. Moreover, this speaks for the business unit's valuation of intrapreneurship. A problematic aspect of Nedap Identification Systems' business unit is sheer capacity. The amount of FTE that is available for innovation research or innovation development seems to be lacking. If the company faces several developments at once, difficult choices will have to be made. Several interviewees indicated the capacity problem.

> *"Our disadvantage is that our capacity is relatively limited, we do not have many employees to test innovations. Dependent on the succession chance, decided by the general manager or proposition manager, we will assess whether we should free capacity or budget."* – Developer RF & UHF

> *"There is a continuous battle between selling now and developing innovations for long-term continuity. This is an ongoing conflict." – Product Manager MOOV*

Furthermore, official statements or reports regarding the role or pursuit of innovations are lacking. The business unit does express a desire to be or remain leading in its markets. To do so, the business unit is very aware that its current propositions are not necessarily future proof.

> *"We have the ambition to be market leader. Not only in revenues, but also in content, solutions and technical capabilities. We want the market to view*

> *us and follow us as an indication of what the major developments in the market are."* – General Manager

When analyzing the results of the questions addressing the *innovation exploration* construct, the capacity problem remains impactful. There are no employees assigned to discover innovations unknown to the organization. Innovation research is informal, and often focused on innovations close to the current offerings, with practical applications.

> *"As developers, we find it fun and interesting to research new technologies or innovations. However, it almost always has to have direct applications. Not only our sales department feels this way, the developers realize that our research has to have tangible results. We must truly define what the new technology can do for us."*- Developer RF & UHF

The only matter of research conducted outside of the organization is by interns, whom write a thesis on a certain technology, design new applications, or provide contributions in other ways. However, when it is decided that an innovation or technology is interesting for the business' proposition, and perhaps requires extended research, the business unit is willing to hire experts, visit seminars, business fairs, and go the extra mile to gain the desired knowledge. The business unit is aware that it does not possess all knowledge and shows willingness to rely on third party knowledge when required. Knowledge of potential innovations is often pretty elaborate when it is close to the business' current propositions. The business unit expresses a desire to listen to movements in the markets. The support employees receive questions and critiques from customers and adjust products accordingly. It collects data on user needs, and combined with information on competitors, solutions are presented. Ties to customers are relatively short, and information flows relatively fast from consumer and partner back towards the business unit.

When it comes to the *innovation testing* construct, the team of hardware and software developers in house has a large benefit. These employees have technical experience and knowledge; therefore, they are often capable of testing functionality of new products and technologies. Tests are often conducted in or around the office. Furthermore, the business unit delivers prototypes to customers, and allows the customer to test the product functionality, and report back to Nedap Identification Systems on short lines. The product and service offerings are continuously improved and updated through consumer and market feedback.

> *"A first test towards the strength of our communication protocol was after a sale of only 10 sensors. After feedback, we placed 30 more in Hamburg, and faced different problems. Along the way, we become wiser and we develop*

> *our product. That is how our testing process usually works."* – Product Manager SENSIT

Innovation Metrics is the most intangible construct tested. Employees were asked to provide their insight on how the business unit estimated the potential of an innovation. Once again, it deemed clear that this process does not follow a definite structure. There are no predetermined metrics, thresholds, or requirements that an innovation or technology has to meet before release. Nevertheless, every innovation is carefully considered and evaluated although gut feeling, and intuition seem to play an equally important role.

> *"Often, some research institute publicizes extensive research about a technology, and presents all kinds of numbers or figures. At small scale, through startups, the technology is brought into practice based on gut feeling. I think it's important to find a symbiosis. You need the numbers, but you also have to be able to logically project the impact on your market. We see that our projections are often right, it's the timing of an innovation taking over that seems hardest to project."* – General Manager

Organizational Culture gives an impression of the actual feeling and openness towards innovations. The culture within the business unit is focused on sales and revenues first. Innovations that have a direct application are prioritized. However, the business unit's employees are open to innovations, and intrapreneurship is encouraged. When possible, creative solutions are presented. However, generally innovations seem to come second to the business' obligation to turn in positive operational results and generate revenue. There is a general responsibility the employees feel towards remaining the continuity of the business unit.

Innovation development tested the presence of business plans for innovations, and the willingness of the business unit to release an innovation and develop it into a full -fledged proposition. Apparent was, after the interview, that Nedap develops a plan for the innovation's development process per project. It does not necessarily maintain a standard implementation protocol but does carefully consider which functionalities must be satisfied and when a project should be finished. Furthermore, there is a product release committee, a combination of sales, marketing and R&D employees, which evaluates the development process and fine-tunes the product before releasing the new innovation next to existing business lines. Although the product is never truly finished at Nedap, there is a willingness to release a new product with improved or different technical specifications next to existing business lines.

> *"The Product Release Committee is a combined group of sales, marketing and R&D employees. When decided that an innovation will be pursued, the release committee evaluates whether all necessary steps are undertaken. These steps of product development are determined beforehand; therefore, we know exactly what we must do with a new technology to develop a new product."* – Global MarCom Manager

Innovation commitment can give an implication to what extent the willingness to innovate and develop new technologies is put into practice. Nedap Identification Systems is willing to invest in innovations once there is a strong argument made by either the developer, a sales employee, one of the proposition managers or the general manager. The business unit has the autonomy to do so and does not necessarily have to rely on authorization of corporate management. Multiple developers indicate that a budget is made available when necessary. There is no specified budget for innovation purposes beforehand, but there is a seemingly appropriate amount of capital available.

> *"Usually, budget is freed when you have a good idea."* – Software Developer TRANSIT

Hiring employees assigned to innovation projects is something that Nedap Identification Systems is willing to do. It happens regularly, the business unit collaborates with universities, talks to experts from the industry, employs interns to research technologies, or outsources app development.

Disruptive innovations are innovations that are generally more impactful than incremental innovations and harness the capability to alter the current business model. From the previous answers and discussed constructs, we can argue that Nedap Identification Systems has experience with incremental innovation. Blockchain; however, would not be an incremental innovation, but due to applications offering radical functionality, discontinuous standards and different innovation ownership (Thomond & Lettice, 2002) a disruptive innovation. *Disruptive innovation experience* would be ideal for an organization looking to engage with an organization that is not in the direct marketplace of the organization. However, the employees unanimously agreed that there were no official meetings about innovations outside of its traditional marketplace. Informal conversations take place, and interns research the impact of innovations outside of our marketplace. This allows the organization to become more knowledgeable about these developments, and form educated decisions regarding the potential of these developments. Several interviewees indicated that there is room for more collaboration

between business units, to create cross-fertilization of ideas and developments regarding more disruptive or radical innovations. The first initiative in this area, the Nedap Spark Sessions are to be released soon, and are meant to educate all business units which technology every business unit is developing individually, and possibly form as a foundation for cross-fertilization between business units.

> *"Other business units have initiatives to share their knowledge. I think we could do more of this. Formally, this is not facilitated, and that is unfortunate. Sometime, there is a lack of cross-fertilization between business units."*- General Manager

To summarize and conclude on the findings of the interviews, there is a clear trade-off within the business unit between a necessity to remain competitive now, and its willingness and desire to remain competitive in the long-term future. The business unit has certainly conducted efforts to research innovations, but these research projects are often towards innovations in the direct context of the organization and limited to quick practical implications. This focus on current business and limited capacity to research innovations outside of the traditional market space of Nedap Identification systems leads to an inability of Nedap Identification Systems to be able to successfully incorporate the disruptive applications of Blockchain technology as it is now. In order to do so, innovation management structure must be improved. Research capacity has to be expanded, as the current team of developers is too occupied with current operations. Furthermore, truly devoting its time towards developing an application or researching an application that is radically different from the business unit's current operations, is likely not viable must the business unit decide to truly pursue a Blockchain application. The innovative nature and willingness to innovate is certainly harvested, and a strong aspect of Neap's organizational structure is its employees' sense of empowerment and decentralization. Furthermore, Nedap Identification Systems has the resources, backed by Nedap N.V. and potentially other business units, to invest in Blockchain technology and allow for development of a successful application with potential for long-term disruption in Nedap Identification System's market, or in all markets of Nedap N.V. A summary of the findings is provided in Table 5 below.

Indicator	Judgement
Organizational Structure	Few layers, one manager, high sense of decentralization, little dependence on corporate management
Innovation Management Structure	No employees/teams dedicated to innovation, clear authority in decision making, problems regarding capacity to develop multiple innovations, no official statements or reports regarding role or pursuit of innovations
Innovation Exploration	No employees assigned to discover innovations unknown to organization, willing to hire experts, knowledge of technologies close to market, gathers data on user needs
Innovation Testing	Developers tasked to test innovations
Innovation Metrics	No defined protocol to measure innovation's potential, rely on combination of research and gut feeling
Organizational Culture	Open towards innovations
Innovation Development	Some standardized protocols, willing to release new products originating from innovation projects
Innovation Commitment	Willing to invest, budget freed when necessary
Disruptive Innovation Experience	No official meetings about innovations outside of marketplace

Table 5 – Interviewee's Judgement on Innovation Management

Concluding, Nedap Identification Systems has aspects of an innovation management system that is capable to capitalize on disruptive applications of Blockchain technology. However, there is certainly room for improvement, but due to the company's existing familiarity with identity management and access control, the developments in the market can be closely mentored. According to focus group results, Blockchain will be disruptive in the business unit's context, if its ability to provide discontinuous technical standards proves in practice. To answer the research question; therefore, once the business unit is committed, with the resources that Nedap Identification Systems and Nedap N.V. have at their disposal, it should be able to capitalize on the disruptive applications that Blockchain technology offers, provided that it makes significant changes to aspects of its innovation management, to be discussed in the next chapter. A definite decision on whether there is indeed a disruptive application of Blockchain technology, and whether Nedap can cope with the disruption, is

subject to further research. Thus, Nedap is capable to capitalize on a potential disruptive application of Blockchain technology, but it must decide if it will truly commit in doing so.

Discussion

Blockchain's Disruption

Being able to conclude that a technological innovation is likely to disrupt an organization's business model should be an alarming observation to any firm. The mere definition of disruptive innovations utilized in this paper describes an innovation that can propel your performances to unforeseen heights, impossibly achieved with previous technology (Nagy et al., 2016), and has the capability to create new marketplaces through improved simplicity, accessibility and affordability (Leavy & Sterling, 2010). It significantly alters the demands and needs of a current marketplace and disrupts the past's important players (Thomond & Lettice, 2002). In the literature review, two potential applications of Blockchain technology were discussed, specific to Nedap Identification Systems. However, Blockchain in the supply chain is an alternative applicable to practically every organization. Focus group research has pointed out that organizations with primary supply chain activities could face disruption of Blockchain technology, especially if discontinuous technical standards from utilizing Blockchain technology could prove scalable. The collaboration between IBM and Maersk (Churchill, 2017) should provide an implication of how serious this development is, as two market leaders pioneered a joint venture to explore the possibilities of Blockchain based supply chains. Blockchain for identity management is a more specific application that has disruptive characteristics for Nedap Identification Systems, but also for other firms that cope with digital identities, authorization, access control, privacy and security management. Therefore, this application spans beyond the boundaries of Nedap Identification Systems as well. More importantly; however, the results of the focus group indicate that the technology seems capable of transforming several industries in different ways, and enable firms to achieve radical functionality, innovation ownership and potentially discontinuous technical standards on a primary activity relevant to the firm. This answers the first research sub question. There are potential disruptive applications for Nedap Identification Systems, namely in identity management. Expanded research towards the discontinuous technical standards that Blockchain offers will decide whether this application is truly disruptive.

If an innovation is indeed capable of propelling business performance, an organization being aware of this innovation would be acting irrational if not at least opting not to continue investigating the innovation, researching an array of possible implementations and expanding

the knowledge of the organization regarding the innovation. Results of the focus group indicate that disruption from Blockchain for identity management is likely. However, the participants lacked the expertise on Blockchain technology to successfully estimate the extent to which the technology would offer discontinuous technical standards. Therefore, if further research proves the opportunity for discontinuous standards, Blockchain, with its technology satisfying the conditions of radical functionality and new innovation ownership, should be a disruptive innovation in this industry, according to the criteria of Thomond and Lettice (2002). Meaning that there are disruptive Blockchain applications for Nedap Identification Systems if its potential to provide discontinuous technical standards proves in practice.

Disruptive Innovation Management

Implementing a disruptive innovation is not a realistic undertaking for each organization. Disregarding the requirements of appropriate resource disposal, technical capabilities, and a general willingness to innovate, disruptive innovations often require an overhauled business model to accommodate the innovation. The proposition on which a firm builds its operational results, will be disrupted. Therefore, appropriate innovation management systems are hold in high regard by many researchers. Nevertheless, an elaborate and complex innovation management system is not appropriate to each organization in its own (Assink, 2006; Leavy & Sterling, 2010). Dependent on the organizational structure, culture, and environment, literature review has shown that either some type of *major innovation* system (O'Connor, 2008) or a system with a large sense of decentralization can positively impact an organization's disruptive innovation capabilities.

The specific danger of a disruptive innovation, compared to incremental or even some radical innovations; however, lies in its technological potential to devalue specialized complimentary assets (Tripsas, 1997). Practically speaking, if a firm's entire ecosystem changes due to the interference of a disruptive technology and the disruption of previously key partners (Thomond & Lettice, 2002), the old system of partners, clients, distributors and suppliers might prove less valuable. In the case of specialized complimentary asset devaluation, a fast, appropriate response is required to prevent devastating impact on firm operational results. Therefore, awareness of the innovation is essential. Nevertheless, large firms often fail to recognize or develop disruptive innovations. Failure to develop disruptive innovations amongst others often originate from adherence to routines, or dominant design with proven results (Assink, 2006). If intention to engage with innovation exists within the firm, as is evidenced in Nedap Identification Systems by the interviewee's responses displaying valuation

of intrapreneurship, sense of decentralization and a willingness to invest in innovative projects, there is still a gap that remains between intention and actual disruptive innovation capability. Distinctive capabilities must be developed as they are integral for a firm facing potential disruption. Traditional inhibitors of disruptive innovations are problematic organizational dualism, excessive bureaucracy, unwillingness to deviate from standard practices, inabilities to unlearn, lack of distinctive competencies, lack of realistic revenue and ROI expectations, high risk and uncertainty, risk averse climate, unwillingness to cannibalize, lack of market sensing and foresight, senior management turnover and lack of adequate follow through (Assink, 2006; Chandy & Tellis, 1998; Hillebrand et al., 2011; Leonard-Barton, 1992; Paap & Katz, 2003). O'Connor's (2008) *major innovation* system is, to some extent, designed to prevent these inhibitors from hampering your innovative capacity. However, one could also argue that the system fosters excessive bureaucracies and a certain extent of unwillingness to deviate from standard practices. The *major innovation* system is designed to cope with radical innovations. In this research, pointed out are the differences between radical and disruptive innovations. Radical innovations often originate from a single market, where disruptive innovations are not necessarily driven by the market, but impact several industries or markets at once. Every firm should evaluate inhibitors within their organization, as it significantly impacts the organization's capability to cope with a disruptive innovation.

The second sub research question was to what extent Nedap Identification System's innovation management system would be able to manage the development of Blockchain applications. After examination of the innovation management strategy of Nedap Identification Systems, it is impossible to say that it is immediately ready to face a disruptive innovation. Most striking is the capacity problem, which many interviewees indicated. Problematic dualism is a traditional inhibitor of disruptive innovation capability development, and must be improved. If discontinuous technical standards can be achieved with Blockchain, it is likely that the market will be disrupted. In case of disruption, the organization must pursue the innovation. Dualism will have to improve, as current market needs cannot be satisfied with Blockchain technology, and future market needs cannot be satisfied with current technology. Therefore, an organization looking to pursue disruptive innovations, likely needs to free capacity for research and development of the disruptive innovation. Currently, no employees or teams were assigned to innovation development. However, before addressing the capacity problem and the issue of team specification, the business unit must perform additional research towards innovations that develop outside of the firm's marketplace. Structural meetings or conversations about long-term continuity of the business unit are likely to improve

organizational awareness. Although Nedap Identification Systems has displayed value of its specialized complimentary assets (Tripsas, 1997), allowing it to follow developments in the market and react as an early adopter, and not an initiator, the danger of devalued specialized complimentary assets must be taken seriously. Therefore, it cannot be too cautious in addressing Blockchain technology, or other disruptive innovations that could impact the firm in the long run.

The strength of Nedap Identification System needs to be emphasized, being the employees sense of decentralization, the few layers within the organization, the intrapreneurship of employees, having an in-house R&D department with short ties to the other departments, and an organizational culture open to innovations, how to profit from these strengths combined with the previously defined weaknesses, is elaborated upon in the practical implications. Each firm should evaluate its own innovation management procedures, evaluate inhibitors in its own organization, and eliminate or minimize their impact if it wants to successfully face disruption.

Once carefully evaluating the inhibitors and problems with innovation management within Nedap Identification Systems, and realizing that creating a disruptive innovation capability is not something that can be accomplished without severe commitment, Nedap Identification Systems is capable to capitalize on Blockchain technology to at least some extent.

Theoretical Implications

General implications regarding disruptive innovation management learned from the Blockchain case can be drawn from this research. This paper implicates firstly that Blockchain can be a disruptive innovation, but that it depends on the proposition of a firm. A couple of innovations that have previously unanimously been considered to be disruptive are the internet, electricity, and the steam engine. Rabobank (2016) classifies Blockchain as a potential disruptive innovation, amongst others. The true disruption that the innovation will cause for your firm, or your specific market, depends on the context the firm operates in. Furthermore, the disruptiveness of an innovation likely depends on the position your firm has in the ecosystem, and the importance of the activity affected, as seen in the case example of Nedap Identification Systems.

Furthermore, the last objective of this research was to find out whether the findings of this research could potentially be extended to the overarching literature of disruptive innovations and provide additional information on appropriate disruptive innovation management specific to a company's market. A couple of findings of this research are important for disruptive innovation literature, and combining it to specific company markets. There is an existing

disengagement in literature between disruptive innovations, the technology that could disrupt markets or entire industries, and organizational incorporation, which is often focused on the circumstances within the firm. The impact of disruptive innovations lies in that it changes the ecosystem of the firm (Adner & Kapoor, 2016). Therefore, innovation systems should have attributes addressing the alignment of changing ecosystem with corporate practices. O'Connor (2008) does describe external interface mechanisms, but these are linkages of the team with external relations of the firm. The current relations might be altered drastically, an area to be addressed going forward.

Based on this case, the value of an explicit innovation system has not only been proven once again to be questionable and largely dependent on every organization's structure and culture. Prerequisites for successful disruptive innovation management are not generalizable. There is not necessarily one single, working, innovation management system, as this simply might not suit the strength of every organization. Some organizations can suffer if the organization is too focused and too committed to creating the next major innovation (Leavy & Sterling, 2010). Nevertheless, disruptive innovation capability is a skill not every organization possess. If your organization sets out to be a true market leader and wants to future proof its business, one must learn the capabilities necessary to develop disruptive innovation capabilities, and diminish the impact of disruptive innovation inhibitors (Assink, 2006).

The case study displayed the importance of evaluating primary and secondary activities (Porter & Millar, 1985), and the meaning it has for the actual disruption caused by an innovation, as was previously implicated as an important factor by Nagy et al. (2016). The focus group participants did not deem it as the obligation of the business unit to pursue aspects of a disruptive innovation that do not directly influence the day-to-day operations. For most organizations, that could be the case. A disruptive innovation is intriguing, and business should strive to be aware of disruptive technologies. However, if the organization does not have the specialized complimentary assets in the area impacted by the disruptive innovation, it is not always in the firm's best interest to become a pioneer in this new field. It should; nevertheless, stay aware of the development of disruptive technologies due to its potential to develop into a disruptive innovation and transform an organization's ecosystem.

Practical Implications

Practical implications of this research are specific to the case of Nedap Identification Systems studied in this paper. Within Nedap Identification Systems, some of the inhibitors for disruptive innovation capabilities (Assink, 2006) seem to be present, as discussed above whilst

answering the second sub research question. This will be discussed in further detail. The traditional inhibitors (Assink, 2006) that are seen within Nedap Identification Systems are, to differing extents, organizational dualism, high risk and uncertainty, unwillingness to cannibalize and unwillingness to deviate from standard practices. Problematic organizational dualism was; moreover, an issue most apparent from the interviews. Several respondents indicated that capacity and time constraints hamper the innovative capacity of the business unit. Being too concerned with current operations hampers the time spent on innovative projects. Disruptive innovations demand time, and the identification of Blockchain as a disruptive innovation for Nedap Identification Systems should serve as an alert for the business unit to create capacity and time for at least further investigation towards the disruptive possibilities of Blockchain applications. Furthermore, high risk and uncertainty are associated with investments in any disruptive innovations, as many are unproven, and initially underperform current technologies or rely extensively on network externalities. The absence of these externalities in the initial phase might hamper the development of a disruptive innovation. Absence of network externalities was identified as potential inhibitor for adoption in the focus group discussions, as other devices will have to be appropriated for Blockchain technology. Unwillingness to cannibalize and unwillingness to deviate from standard practices are inhibitors of less significance, yet they certainly have their impact. Interviewees indicated that the business unit falls back on routines and common practices when developing improved versions of existing products. Related to organizational dualism is the organization's willingness to cannibalize. Strong performance by Nedap Identification Systems in recent years, relying on its four propositions and improving market positioning through incremental innovations, can pose as a threat for a firm's ability to be future proof as the firm could be unwilling to cannibalize current sales and revenues for the sake of long term uncertain profits. This could prove damaging once the disruption arrives, and a business fails to react in time due to a continued focus on existing products with strong performance.

However, on the positive side, Nedap Identification systems shows little bureaucracy, indicated by the employees' valuation of their sense of decentralization within the organization. Informal ties to the general manager, lack of layers and a flat hierarchy prevent extensive bureaucracy slowing the development process. Therefore, if Nedap Identification Systems decides to pursue Blockchain applications, it should be capable of acting swiftly and efficiently. Furthermore, corporate management has shown a willingness to assign realistic revenue and ROI expectations towards other business units that pursue more innovative, high-risk projects. Executive management has experienced disappointing operational results as a

consequence of innovative practices and tolerates these results due to the presence of other, well performing business units. Organizational dualism, as discussed before could; therefore, be achieved by the firm. If Nedap Identification Systems decided to invest in Blockchain application development, and sacrifice aspects of current revenue patterns, other business units within Nedap N.V. would have to compensate these losses. Convincing corporate management is a first concern, but if proven successful, organizational dualism should be achievable due to the aforementioned realistic revenue and ROI expectations. Furthermore, Nedap Identification Systems embraces a climate that is willing to take risks to a certain extent, displayed in the past by being the first developer of UHF based sensors. Interviewees attributed to the business unit's ability to sense and forecast the market as one of its strengths and reasons for continued market excellence. Furthermore, the business unit, and Nedap N.V. in general experiences low senior management turnover, essential for acquiring vital top management support.

Implementing Blockchain for identity management deems as an action in line of Nedap Identification System's strategy, as a tech firm striving to be market leading. Therefore, the disruption that is expected by focus group participants should be taken seriously. The business unit must invest in further research regarding the technological possibilities and limitations of establishing a Blockchain network. Major questions surround the possibility to acquire discontinuous technical standards, a question that must be resolved. Also, a Blockchain network relies extensively on network externalities, as the amount of nodes guarantees the security of the network. If the network does not have enough nodes, the transcript of record could be falsified, and Blockchain would not provide an advantage over current technologies. Furthermore, Nedap Identification Systems should research compatibility concerns. Whether current product lines are going to be affected by Blockchain technology depends on the technological specifications that the Blockchain requires. The business unit must decide where it sets out to utilize Blockchain. It could use Blockchain to protect and store data, to provide access or credentials, to store reputation and identity, or to safely transfer identity. In order to develop a successful proposition based on Blockchain, some of these options must be evaluated. It must carefully monitor competition, and analyze the steps competitors have undertaken towards Blockchain research. There might be a potential partner in the environment or network of the organization that could assist in providing additional information, knowledge and technical capabilities. Nedap Identification Systems must use its network of partners to educate itself on the possibilities that Blockchain offers and the feasibility of a Blockchain project that could lead to a competitive advantage.

Managing the disruption of Blockchain will equally have its implications. The aforementioned weaknesses in traditional inhibitors of disruptive innovation developments will have to be addressed. Organizational dualism is impossibly achieved due to the occupancy the business unit has with current business. Nedap Identification Systems' current positive results lead to a certain unwillingness to cannibalize current revenue for the sake of long-term capitalization on Blockchain technology. In researching Blockchain applications and discovering the details of a Blockchain based identity management system, Nedap Identification Systems could choose to hire an intern or professional with experience and knowledge of the technological aspects of the technology. If this research proves fruitful, capacity will have to be created as disruption has to be met with considerable investments. Nedap Identification Systems would have to consider assigning several developers, or a certain team towards developing an access control and identity management system based on Blockchain technology. "Disruptive innovation development is not a one-time effort; it requires a continuously developing absorptive capacity to improve the overall innovation capability of firms" (Assink, 2006; p. 227). Nedap Identification systems has shown a capability to consistently innovate and improve products, and in the past developed Ultra High Frequency (UHF) based propositions that were certainly a radical change (Developer RF & UHF, personal communication, 22 May 2018) to previous operations. A last point of advice would be, if opting to follow a Blockchain based identity management, to carefully re-evaluate the successes and flaws of the introduction process of UHF technology.

Limitations

Time constraints limit the exhaustiveness of this paper. Therefore, the sample size of both the focus group and interviews are limited, as I was subject to a strict due date. Choosing to do both focus groups and interviews, to test both sub research questions independently, combined with time constraints, further limited the sample size. Future research should focus on expanding the interviews, expanding the criteria for disruptive innovation management, and conduct research on start-ups, SME's and large corporations, to be able to draw conclusions on the impact of Blockchain technology on current business for each organizational form.

Furthermore, I as the author, have limited knowledge of computing technology and IT systems as a Business Administration student. Therefore, in depth review of Blockchain functionality and technical elaborations might, to some extent, be lacking. Limited knowledge of computing technology and Blockchain systems in real time also hampers the possibility to provide projections on the feasibility of Blockchain network architecture, transaction costs, and

the extent to which externalities are difficult to incorporate. This paper is limited by the newness of technology. Few incumbents have successfully developed Blockchain applications that provide them with a competitive advantage. Therefore, I performed ex ante research, which's findings are always grounded in literature, but yet unproven in practice.

The design of the focus group may have suffered from an inexperience with conducting focus groups, which could hamper the design of the sessions (Morgan, 1997).

The sample consists of only Nedap Identification Systems employees, drawing concerns about the generalizability of the research. The concerns regarding the sampling bias are grounded; therefore, the implications must be carefully regarded by readers. Data from the limited sample does not represent the full spectrum of experiences and opinions. In future research, the respondent pool should be expanded. Experts with knowledge of Blockchain technology would have to provide their vision on the possibilities of both applications, and their opinion on the extent to which the technology could offer radical functionality, discontinuous technical standards, and how ownership models would be altered. The sample size is also relatively small, due to the time constraints of the paper, it was possible to only interview nine employees. Therefore, I tried to optimally perform triangular sourcing, sourcing employees from different departments and layers of the organization. There were only 9 participants in the Focus Groups, which is limited largely due to needing some information on Blockchain technology and potential beforehand, and not all employees possessing the appropriate knowledge base.

Future Research

To increase the significance of the findings in this paper, further research must be conducted. Blockchain's most notorious application, Bitcoin and other cryptocurrencies, are facing significant pushback as of the date of publication. Currency values are down, and several governments have threatened to interfere in Blockchain operations. Not all instances benefit from Blockchain's decentralizing aspect; therefore, pushback will continue to exist. Time will have to tell whether this could severely hamper scalable introduction of Blockchain technology outside of the financial services industry.

Furthermore, future research should design an innovation management system specific for disruptive innovations. The findings of this research can be used to design such system. How an organization can cope with the changing ecosystem caused by a disruptive innovation, is crucial for an organization that faces disruption, for example from Blockchain applications. The current perspective of innovation management, and even large parts of this research, places

the organization as the central point of view. Future research should consider the context and the ecosystem of the organization, as these theoretically dramatically change.

The limitations of this research should also be addressed. Researchers with knowledge of Blockchain technology must shed their light on the viability of both applications, and the possibility to achieve discontinuous technical standards. Experts with Blockchain or in the IT industry should weigh in on the feasibility of discussed applications. Furthermore, sampling of both focus groups and interviewees should be expanded, to provide a broader overview of the industry, or perhaps of other industries.

Conclusion

The reader of this paper should come away with the sense that Blockchain is indeed a prominent candidate to be an impactful disruptive innovation. This research indicates how it can be determined whether an innovation satisfies the conditions for disruptive innovations, depending on the ecosystem of the firm looking to implement the innovation. It should be a goal for an organization bound to be impacted by Blockchain disruption to have an appropriate organizational structure and culture in place to cope with the disruption of the technology. The disruption, namely, is both promising and threatening. Once recognized timely, a firm could create a competitive advantage from capitalizing on Blockchain disruption. However, capitalizing on a disruptive innovation is not possible for every organization. An organization must carefully consider its design of an innovation system. This innovation system should be firm specific and appropriate to firm culture. Traditional inhibitors that prevent disruptive innovation development capability should be examined with an organization looking to integrate disruptive innovations within their business model and should be dealt with accordingly in order to even be able to capitalize on the disruptive opportunity that Blockchain technology offers. Preparation of an innovation management system and recognition of the disruptiveness an application of a potential disruptive technology should be a primary activity for every firm looking to maintain long-term competitiveness. The case of Nedap Identification Systems was central in this case. Readers should carefully consider the implications, but also consider the limitations of this research when extending the findings to other markets and industries. Nedap Identification Systems faces a decision, whether it believes discontinuous technical standards can be achieved with Blockchain technology, and if this is the case, how it will cope with the disruption that the technology could cause. Furthermore, it should consider which actions to undertake in order to eliminate inhibitors for creating disruptive innovation capabilities for the firm.

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Appendix A

Interview Guideline

1. What is your position?
2. How many employees work within Nedap Identification Systems?
3. How many managers and layers are present within the business unit?
4. In the organization, is there a team/individual/task connected to discovering or developing potential disruptive innovations for the company?
5. Are these teams/employees/tasks clearly distinguished?
6. How does the business unit research potentially influential innovations?
7. In the case of an inbound innovation, is there a team/individual in charge of and specialized in decision making regarding implementation of the innovation?
8. How is the discovery and development of innovations coordinated within the organizational strategy?
9. How does the business unit test new innovations?
10. Is there a standard process surrounding the recognition and application of innovations?
11. Does the organization ever rely on external experts for innovation research?
12. Does the business unit invest in innovative projects?
13. Does the organization have the capacity and capability to discover and develop multiple innovation simultaneously?
14. How does the organization measure the potential of innovations?
15. How is the organizational culture and attitude of the organization towards new innovations and developments?
16. What happens when the innovation is fully developed and ready to stand on its own two feet?
17. Does Nedap Identification Systems discuss innovations outside of its traditional market?
18. To what extent is the adoption of innovations by Nedap Innovation Systems affected by its corporate headquarters?