Zuid-Holland

The Dutch Economy relies in considerable degree on Small and Medium Enterprizes, (SME's). 99% of the Dutch companies are SME's and together they produce 60% of the added value of the Dutch Economy.

Creating value for SME's with logistics applications based on blockchain

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Introduction

The Dutch Economy relies in considerable degree on Small and Medium Enterprizes, (SME's). 99% of the Dutch companies are SME's and together they produce 60% of the added value of the Dutch Economy. 61% of the revenues of Dutch SME's are generated by commerce, transport and warehousing www.staatvanhetmkb.nl, 2019). Also in logistics, new trends digitalization and automation can form a major challenge to SME's. Contrary to large companies such as Maersk and Amazon, who have the means to react promptly and benefit from the new technologies, most SME's miss the manpower, skills and knowledge to develop new strategies on such new trends. For this reason, RDM Knowledge Center Sustainable PortCities in cooperation with Windesheim University of Applied Sciences, applied for funds at the NWO, to investigate the opportunities for SME's in the logistics sector to benefit from logistics applications of blockchain. In the project the following SME's are involved: companies active in cold chains, the pharmaceutical industry, transport, forwarding and warehousing. The project is executed by students of the two universities. Next to desk research, they perform the empirical research at the companies and they are supervised together in a study group. The knowledge acquired by them is going to be aggregated disseminated at progress meetings and in publications. During the execution of the project the participating teachers keep encountering individual students at different educational programs, who acquired similar projects at SME's independent from the project. This confirms the relevance of the research. These students and their host companies are asked to join the project. The questions, that SME's ask and the students work on, are quite similar: *What is blockchain? What are the consequences of blockchain for their business model? What kind of knowledge should they have about the potential of blockchain? What does it mean for their business model and processes, if powerful companies, which have major power in supply chain management, implement blockchain? Can the implementation of blockchain technology push them out of the market? Could blockchain technology improve their logistic processes? How*

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can blockchain technology create added value for their company? Is it possible to create the same added value using an alternative technology? In case blockchain actually can generate added value, how to implement it?

In this paper the preliminary results of this research are presented. The central research question of this paper is, which user cases exist already and which opportunities do they offer for SME's to create value. After an introduction to blockchain the possible benefits of blockchain are explored and analyzed based on a literature study. Furthermore an analysis is performed on 52 user cases – not restricted to SME's - collected by students of the two participating universities The paper ends with a conclusion of the preliminary research.

Blockchain technology

Blockchain can be a disruptive technology for logistic and financial processes as it facilitates direct decentral transactions between parties in the supply chain, without the traditional cooperation of trusted third parties (Casino, Dasaklis, & Patsakis, 2019). This means that trust in intermediaries is replaced by trust in program code and consensus rules, including smart contracts, which make well applied blockchains safe (Capgemini, 2018). Blockchain is a part of the triangle which also includes Artificial Intelligence and Internet of Things, all creating and using Big Data, and therefore can be identified as a major technological development in the 21st century. These innovations, also called Data Driven Logistics, have a huge potential to improve supply chains.

The development of blockchain fits into a timeline which started in the 1990's with the Internet of Information, followed by a transition in the 2010's to an Internet of Content. Blockchain is expected to develop further into and interoperable Internet of Value. It is even predicted that it will eventually lead to a programmable economic and societal model after 2026 (Furlonger & Kandaswamy, 2018). However, at the moment, according to the Gartner Hype Cycle of emerging technologies, Blockchain is situated at the hype of inflated expectations, which means that it will probably take 5 to 8 years until the technology will be applied on a large scale. On the curve it is approaching the through of disillusionment, which is supported by the negative publicity that it has received lately (Gartner Hype Cycle, 2018). See Figure 1 A report of Capgemini (2018) enforces this. According to this report in 2018 the majority (87%) of the Blockchain projects were no more than proofs of concepts (Capgemini, 2018). Most of the projects eliminate the role of the intermediaries because Blockchain allows direct communication between the distributed partners. As SME's often act as intermediaries, their business model could be endangered by blockchain (Beije, 2016). That is why blockchain is seen by SME's as a challenge and they are motivated to explore the possibilities that this technology has to offer.
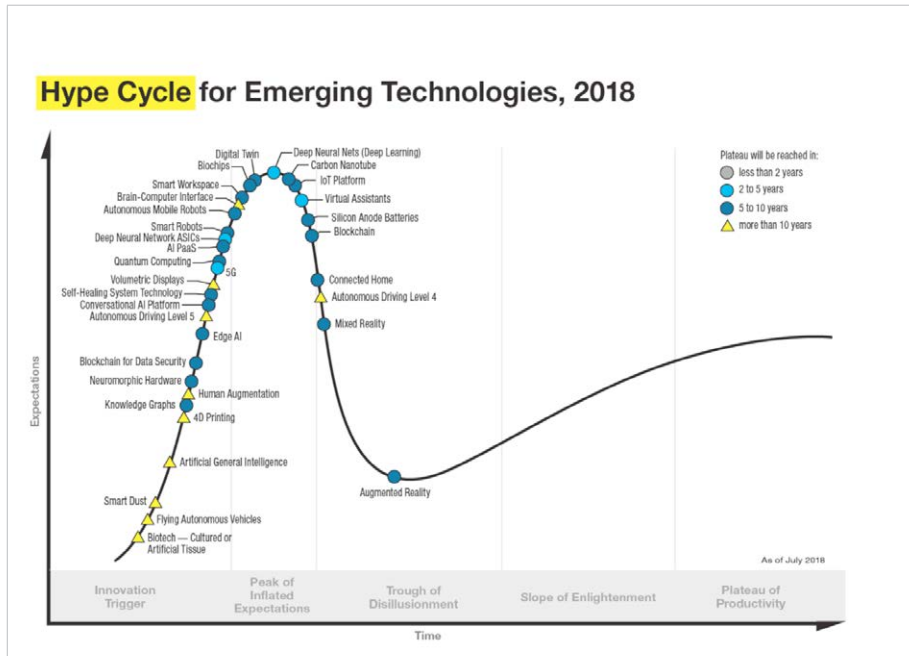
Figure 1 Gartner's hype cycle of emerging technologies
Source: (www.gartner.com/smarterwithgartner/top-trends-from-gartner-hype-cycle-for-digital-
government-technology-2018/, sd)

Blockchain is a distributed database of transactions based on Distributed Ledger Technology
(DLT). At each consequent transaction a block is made, which has a time stamp. The
ledger is secured by cryptography. Blockchains can be public or private, permissioned
or permissionless. The best known example of a public blockchain is Bitcoin and other
cryptocurrencies. Public applications are open and can be used by millions of participants.
In order to keep the transactions secure, an enormous amount of algorithms need to
be calculated. This is done by the so called miners, who offer computing capacity for
rewards (Pilkington, 2017). Private applications involve less participants. Consequently, the
transactions are less complicated and there are no minors needed to help execute them. For
logistics applications the private permissioned systems are used most often, however open
systems are expected to be used in the future (Dutch Blockchain Coalition, 2019).

Logistic Applications of Blockchain

Blockchain has numerous applications, in health, education, privacy and security, business and industry, data management, financial, integrity verification, governance and internet of things. In this typology Supply chain applications are mentioned under business and industry solutions (Casino, Dasaklis, & Patsakis, 2019). In spite of the fact that it is a relatively new technology, in the literature there is a consensus about the prospects of blockchain technology to make logistic processes more efficient. For example for port applications it can be used for cargo documentation transactions, substituting the paper flows, in combination with Internet of Things applications for process traceability, for trade finance and again in combination with Internet of Things Technology combined with Smart Contracts for automatization of processes (Francisconi, 2017).

In this section a number of cases are analyzed in a similar fashion as Khsetri did in his well cited article Blockchain's roles in meeting key supply chain management objectives (Kshetri, 2018). Khsetri explored 11 user cases of blockchain applications. The applications he discusses are mostly meant for food security, the tracking of meat, fish, coffee and quality wine. Furthermore, the well-known Maersk case creates efficiency by digitalizing and putting the paperwork of transport documents in the blockchain. Two companies are involved in the cooling of medicine and there is one company that uses the advantages of Blockchain for securing 3D print patterns of parts of military equipment. In these cases the companies benefit from the following attributes of blockchain: the time stamp, the trusted storage of documents, the trustworthiness of information. Based on this cases, Khsetri (2018) identifies the benefit of the application of blockchain in the supply chain as costs, speed, dependability, risk reduction, sustainability and flexibility. Most of these companies were from the major players in the United States or the global world. Only some of the cases were small startups and there were only two European cases.

For this paper students have gathered and analyzed 52 blockchain user cases. The cases are from different countries, mostly European and the half of them are from the Netherlands. The companies vary form multinationals, Dutch companies, technology startups and technology providers. Only a few of them are SME's, for example NBK, a forwarder. The companies are active in the following industries: energy, healthcare, humanitarian, insurance, mining, sales, pharma, car, port, technology, food, finance and transport industries, the majority being finance and transport. For the distribution of the companies over the different industries, see Figure 2.
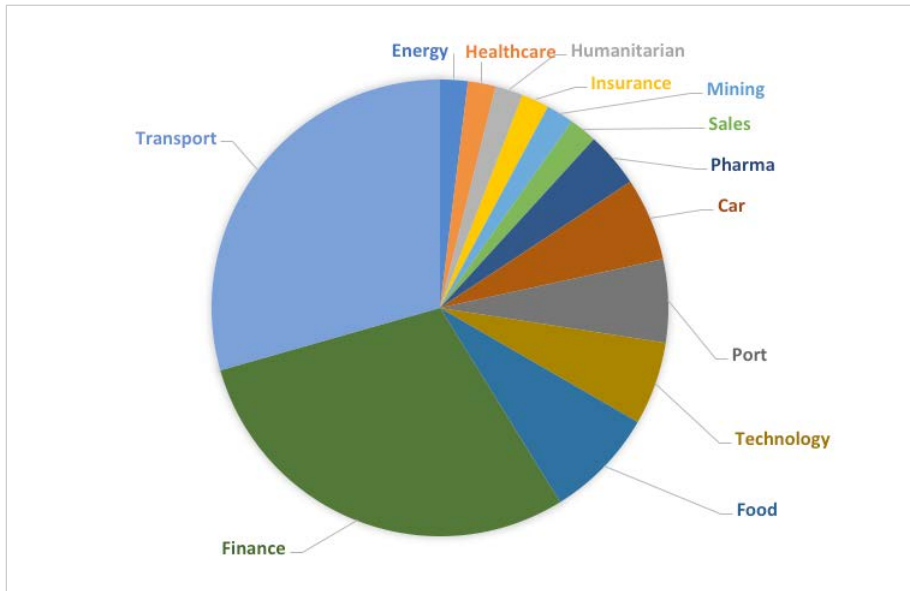
Figure 2 The distribution of industries in the cases   63

The use of the applications varies from CO_2 tracking, customs, energy, identification, reputation, safety, standardization, efficiency, invoicing, data sharing, eliminating the paperwork, enabling transactions and tracking. See Figure 2. The last three, eliminating paperwork, enabling transactions and tracking form the majority. Eliminating paperwork has to do with the fact that a lot of the companies are involved in transportation, where the paperwork forms a major problem. Enabling transactions mostly refers to financial transactions, because of the numerous financial applications. Tracking is important because of the food, beverage and pharma industries as food safety is an increasing challenge.
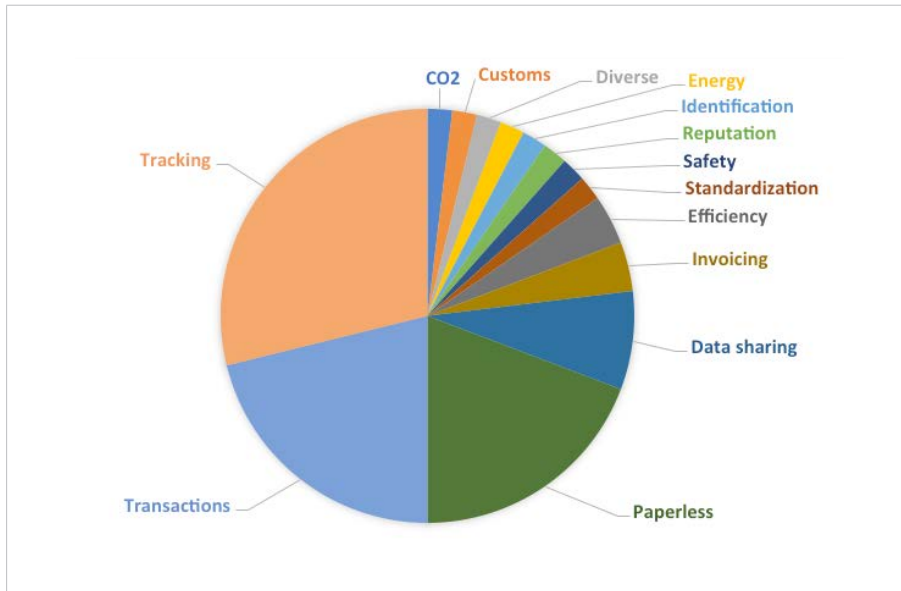
Figure 3 The use of the applications in the cases

At this point in the research the 5 factors of Khsetri (2018), costs, speed, dependability, risk reduction, sustainability and flexibility are allocated to the cases. For the attributes of the individual cases see Table 1. Due to the lack of deep insight into the cases, this has been done quite speculatively. A deeper insight could have been achieved by performing in depth interviews with the companies. During the project such interviews are planned to take place.

According to the present knowledge the attributes are allocated as follows. Firstly, costs must have played a major role in the considerations to choose for a blockchain application. However, the other four factors have major influence on the costs. In the list, cost is mentioned, when it is clearly an essential objective of the application. 36 cases are indicated, mostly data sharing, paperless and financial applications. Speed was mentioned 31 times. It must have played a major role in the data sharing, customs, efficiency, invoicing, paperwork eliminating and transactions enabling applications. Dependability and risk reduction seemed to be important at all 52 cases. Sustainability can be attributed to applications that aim to eliminate paperwork or in case of the food chain the purpose of tracking is ensuring the environmental friendly production of food products, which is true for 22 user cases. The role of flexibility is difficult to assess based on the available information. In case of data sharing, paperwork eliminating and transaction enabling applications it is likely that they lead to flexibility, in case of the tracking applications it is not. It was attributed to 9 cases.
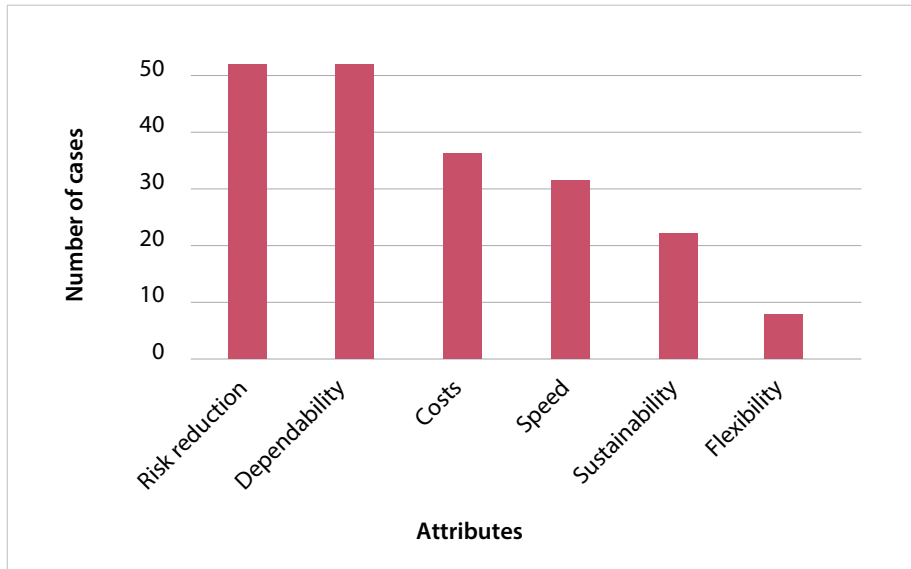
	Name case		Costs	Speed	Depen-dability	Risk reduc-tion	Sustai-nibility	Flexibi-lity
Transport	Paxos algoritme	CO2	x		x	x	x	x
Transport	Tata	Customs	x	x	x	x		x
Healthcare	Philips	Data sharing	x	x	x	x		x
Technology	CargoSnap	Data sharing	x	x	x	x		x
Transport	Ishare	Data sharing	x	x	x	x		x
Transport	Solas VGM	Data sharing	x	x	x	x		x
Technology	KPN	Diverse	x	x	x	x	x	x
Technology	Blocklab scal-ability	Efficiency	x	x	x	x		
Transport	Fedex	Efficiency	x	x	x	x	x	x
Energy	Siemens	Energy	x		x	x	x	
Humanitarian	Eyepay irisscan	Identification	x		x	x		
Finance	Raab Karcher Bucaroo	Invoicing	x	x	x	x		
Finance	Earth Bootz 22	Invoicing	x	x	x	x		
Car	Mercedes	Paperless	x	x	x	x	x	
Finance	Schenker De-claree	Paperless	x	x	x	x	x	
Port	Port Authority	Paperless	x	x	x	x	x	
Port	Maersk	Paperless	x	x	x	x	x	
Transport	Koopman	Paperless	x	x	x	x	x	
Transport	Albert Heijn	Paperless	x	x	x	x	x	
Transport	CargoLedger	Paperless	x	x	x	x	x	
Transport	Wave	Paperless	x	x	x	x	x	
Transport	Transfollow	Paperless	x	x	x	x	x	
Transport	LeenBakker	Paperless	x	x	x	x	x	
Finance	Coupit	Reputation			x	x		
Insurance	TVM Insurance optimalization	Safety	x		x	x		
Car	Car industry	Standardization	x			x		
Pharma	DHL	Tracking			x	x		
Beverage	Heineken	Tracking			x	x	x	
Car	Volkswagen	Tracking			x	x		

	Name case		Costs	Speed	Dependability	Risk reduction	Sustainibility	Flexibility
Finance	Validaide	Tracking			x	x		
Food	Walmart	Tracking			x	x	x	
Food	Carrefour	Tracking			x	x	x	
Food	Food industry	Tracking			x	x	x	
Food	Bait to Plate	Tracking			x	x	x	
Mining	BHP Billion	Tracking			x	x		
Sales	Hyperledger Fabric	Tracking			x	x	x	
Pharma	SophiaTX	Tracking			x	x		
Port	Transledger	Tracking			x	x		
Transport	Unilever	Tracking			x	x	x	
Transport	Blockchain primeur voor Koopman Logistics	Tracking			x	x		
Transport	Provenance	Tracking			x	x	x	
Finance	Dutch Banks	Transactions	x	x	x	x		
Finance	Rabobank	Transactions	x	x	x	x		
Finance	BBVA	Transactions	x	x	x	x		
Finance	Transdoclink	Transactions	x	x	x	x		
Finance	Third	Transactions	x	x	x	x		
Finance	NBK	Transactions	x	x	x	x		
Finance	Ayden	Transactions	x	x	x	x		
Finance	Voordegroei	Transactions	x	x	x	x		
Finance	Arnoldus Logistiek and Voldaan	Transactions	x	x	x	x		
Finance	Tallysticks	Transactions	x	x	x	x		
Transport	Post NL	Transactions	x	x	x	x		

Table 1 The Blockchain applications at companies with their attributes

To sum up, the most important attributes for the cases are dependability and risk reduction (52), followed by costs (36), speed (31), sustainability (22) and flexibility (9). An overview of the frequency of the attributes is to be seen at Figure 4.

Figure 4 An overview of the frequency of the attributes

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Advantages

According to Shetri (2018), the major benefits of costs, speed, dependability, risk reduction, sustainability and flexibility. The analysis has shown that dependability and risk reduction are the most common attributes of the cases, while all the four attributes influence costs. From this it could be concluded that blockchain is used most often, when there is a trust issue. This is in line with the literature. By its immutability a blockchain application can create trust an eliminate trusted third parties. In these cases a trusted third party can be customs, insurance, inspectors, a bank or a debt collector. This, SME's participating in the project can be advised to scrutinize the user cases, to see, which of these benefits they could use. As the participating companies are involved in the cold chain, the pharmaceutical industry, transport, forwarding and warehousing, the transport, data sharing, paperwork eliminating and tracking solutions could be useful for them on the logistic field, and they could also consider supply chain finance solutions. However, an initial questioning of the companies has shown that there is an additional factor that plays a role in the popularity of blockchain, namely image. When defining the project, the companies motivated their project by their wish to be seen as smart and a few of them indicated that they intend to use that image to enhance their market position. This is closely connected to the fact that blockchain still has a hype status. It remains to be seen what happens when it sinks deeper into the Through of Disillusionment of the Hype Cycle of Gartner.

Distadvantages

Even though the literature mostly praises blockchain technology for its benefits, it does have disadvantages too. Here three are discussed, the security issue, the vicious circle of trust and the fact that blockchain is not a solution to all problems. Firstly, even though a blockchain is secured by encryption and it is a distributed system using a majority algorithm, just as any ICT solution, it has security issues. These issues occur at the blockchain programming, network and infrastructure, operational and organizational or at the management level (Dutch Blockchain Coalition, 2019).Secondly, while according to the literature blockchain can enable trust between the parties in the supply chain, at the same time in order to create a blockchain, parties need to trust each other's to a certain extent, in order to enter negotiations. These negotiations can be painstakingly long (Kshetri, 2018). Furthermore, there should be a basic trust that the parties will provide reliable data for the system (Oude Weernink, Engh, & Franciscioni, 2017). Thirdly, Blockchain is known as a solution looking for a problem and it is definitely not a solution to all problems. In many cases there are better software alternatives for it. For these reasons, there are different frameworks developed to assess, whether blockchain is the best solution for a particular problem or not. Two examples of this are the model are the Oxford Blockchain Strategy Framework or the framework suggested by the Dutch Blockchain Coalition (Dutch Blockchain Coalition, 2019). Thus, SME's are advised to familiarize themselves with these. Furthermore, it is better to address the question, what the problem is, and how should it be solved, than how should a company implement blockchain. Thirdly, In case of a blockchain implementation these factors need to be considered.

Conclusion

Blockchain is an emerging technology which is at the moment going down on the hype cycle on its way to a phase, when it probably will be applied widely, according to Gartner, in 5-8 years. Major parties, which have great influence of the supply chain already have made serious efforts to use blockchain technology to improve their supply chains. It is important for SME's to see what kind of consequences the fact that these companies embrace blockchain has for their business models and how they can add value by using this application themselves. In order to help them with these issues, the Rotterdam and the Windesheim University of Applied Sciences have started an NWO founded research to help SME's to acquire this knowledge. This paper presents the preliminary findings of the project. The central research question of the paper is, which user cases exist already, and which opportunities do they offer for SME's to create value. In the paper the question is answered by a literature study and an analysis of 52 user cases, collected by the students of the two universities in different companies, different industries. According to the literature, the most important benefits of blockchain applications are costs, speed, dependability, risk reduction,

sustainability and flexibility. The analysis has shown that dependability and risk reduction are the most common and most important attributes, that finally influences the cost factor. Costs and speed played a less important role, followed by sustainability and flexibility, which appeared to have minor influence. These attributes can be used for SME's as KPI"s to make their processes more efficient by blockchain applications. However, for the applicability the scale of the original application needs to be considered and the business model calculated. The literature and the analysis both show that blockchain is a possible solution for problems involving trust issues and it can help eliminating trusted third parties, such as customs, insurance, inspectors, a bank or a debt collector. The advice to SME's in the project is to look into the transport, data sharing, paperwork eliminating and tracking applications and they could also consider supply chain finance solutions. When defining the research project, a number of companies indicated that they see an added value of blockchain in giving them the image of being smart and innovative. This is based on the frequent news on major companies applying blockchain and the hype status of the application. For this reason, they expect that it would give them competitive advantage. When considering the application of blockchain the downsides of blockchain need to be taken into consideration. Firstly, the security issue, which is in spite of the fact that because of its encryption is considered a safe system, is a threat on different levels. Secondly, the vicious circle of trust, meaning that in order to create trust between parties using blockchain an initial trust is needed. Thirdly, it should be seriously considered, whether blockchain is the right solution and there is no better ICT solution for the given problem. For this there are diverse frameworks to be used. Further research should look into which applications are interesting to which companies and assess how these examples that are applied at major companies can de downsized to SME's and quantify how much value can be created using the different applications and calculate business models.

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