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Food Waste in fries, how to reduce it?

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Foreword

This report is written for our minor Food supply chain at the Aeres University in Dronten. There is a lot of interest in food waste, blockchain and supply chain management in the project group and this was the reason that we choose to research if food waste can be reduced with the use of blockchain.

This report contains everything that is needed to decide if blockchain can be a suitable solution to reduce food waste in the potato fries supply chain. In this report everything will be described about food waste, the supply chain and their environment. Thereafter there will be focused on the question what the possibilities for blockchain are in a food supply chain, the risks of implementing and the actual costs and benefits of this blockchain.

This report is intended to be for the Aeres University, so it can answer all these questions about blockchain in a food supply chain. It is also a great experience for us, an experience where we learn more about blockchain and food waste.

At last it is important to know that this report was not possible without the suggestions and help of the ASCM teachers. We give our special thanks to Pat Burgess and Pieter Vlaar for all the help and support they gave us. With their help it was possible to write down a perfect report which can be used as an example of implementing blockchain in a food supply chain, which can result on reducing food waste.

Dronten, Friday, January 29, 2021

Summary

Food waste is one of the biggest challenges in the world right now. 1.3 billion tons of food is wasted each year. Enough to feed all the people who are undernourished in this world. Reasons for this big amount of food waste are overproduction, damaging of the product during the production process, spoiled crops and discounts. In the Netherlands already 9,5 million tons of food waste is produced each year. 10% of this waste is from potatoes.

One of the possible solutions for this problem is blockchain. A blockchain is a system that can be used to share and save data. With blockchain there is no central system needed which results that it is impossible to hack the data. The most famous example of a blockchain is the bitcoin. The blockchain Is focused on two concepts: secure by design and decentralized consensus.

Interviews with important members of the supply chain will give some information on the goal. The goal is to research if blockchain can contribute to reduce the waste in the potato fries supply chain by researching what the requirements for the blockchain are, what the risks of implementing a blockchain are and the costs and benefits for having a blockchain in the potato fries blockchain. Costs can be financial, but it can also be costs into the reduction of privacy or the increase in communication.

The following results are very important:

- In the interviews transparency was a big issue that is needed to be solved.
- Communication between the different part in the chain is an issue that need to be solved.
- Food waste is a problem in the whole chain. However, most think the reduction of food waste can be gained at consumer level.

Several options for a blockchain are possible. However, due to the size of some parts in the chain, it is advised to make separate blockchains where needed. To reduce food waste before fries are sold to the consumer, it is advised to create a blockchain around the producer, distributor and supermarket.

With the creation of a blockchain or separate blockchains come risks. Think of trust issues, law issues, and high investment costs.

In general, blockchain is still a very new thing that needs a lot of research before in can be accessed by the biggest part of the companies in the world. The possibilities are endless, but it is also important to note that blockchain cannot solve everything. Food waste occurs for more than 60% at consumer level. However, the use of blockchain in the process before the product is sold can be a possibility.

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1.0 Preface

In this report the describing of the company, its supply chain and how to research if blockchain can be implemented are the main goals. To accomplish these goals, it is necessary to know how the company, and the environment of the company looks like. It is also important to know the basics of blockchain before an advice will be formed. This Advice will, together with a feasibility study describe if and how blockchain can be implemented in this supply chain

The supply chain that is researched is the potato fries supply chain. In the Netherlands fries are popular among consumers who fry at home but also in fast-food chains like Mac Donald's, restaurants, and the snack bars. Since the supply chain is for the biggest part visible in the Netherlands information will be more accessible for this project group. It is also more representative for any follow-up research.

First there was information collected from the company, their website, and sources from the internet & literature. This information was used to research food waste, the supply chain where this waste occurs and basic knowledge of blockchain. With this information it is clear if it is possible to implement blockchain in the supply chain. A feasibility study will describe in which way blockchain can be the best implemented in all parts of the supply chain so every part in the chain can benefit from blockchain an thus, reduce food waste.

The report consists of the following chapters:

- General information about food waste, to get a global view on food waste in supply chains.
- General information on blockchain, what it is, how it is used and the possibilities of blockchain.
- The supply chain of fries' potato with a visualisation of the supply chain, the stakeholders in this supply chain.
- The problems in this supply chain and the goals for this research.
- The project planning of this research
- The results of the interviews
- A vision of the blockchain in the supply chain of potato fries
- A feasibility study on the implementation of the blockchain
- The risks involved in the implementation of the blockchain

The report will end with a conclusion and advice for the continuation of the blockchain and some ideas on continuation of this research. The overall idea of this research is to give an overview of the potato fries supply chain, blockchain and what the possibilities for blockchain are in this supply chain. Primary goals are the reduction of food waste and benefits for every part in the supply chain.

2.0 General information on food waste

Food waste is everywhere in the world. From Europe to Africa and from Asia to America. The term food waste has many meanings. In this report the explanation of the FAO will be used:

"Food waste (which is a component of food loss) is any removal of food from the food supply chain which is or was at some point fit for human consumption, or which has spoiled or expired, mainly caused by economic behavior, poor stock management or neglect."

(FAO, 2017)

To come up with a solution it is first needed to have some knowledge on food waste itself. In this chapter food waste in general will be described together with current measures and problems with food waste with a result an overall view on the global food waste problem.

2.1 FOOD WASTE IN THE WORLD

Around the world the amount of food wase differs. The Swedish institute for food and technology researched food waste in each part of the world, see figure 1 (2011). Consumers in Africa and South & southeast Asia throw far less away than for example Europe and North America. Production/ retail differences are les different. While in developing countries the lack of good storage is a big problem, in the industrialized countries overproduction is the main issue.
(SIK & FAO, 2011)

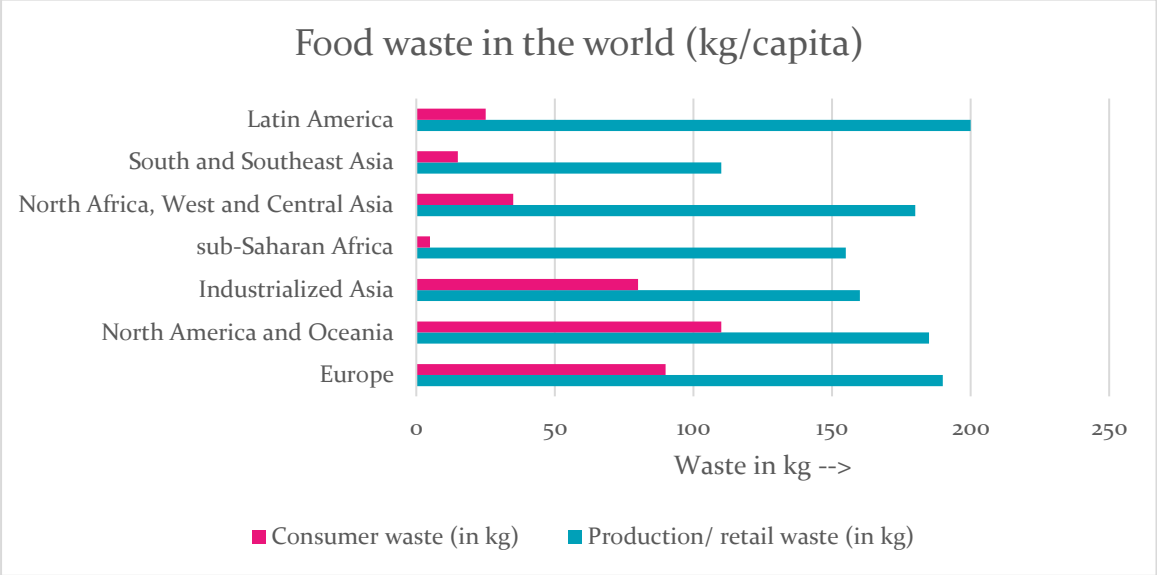

Figure 1 Food waste around the world.

The total amount of food that is wasted is estimated to be over 1.3 billion tons per year which is more than 5 time the annual food production of this sub-Saharan region, a region which already knowns undernourishment for decades.
(SIK & FAO, 2011) (FAO, 2017)

All different companies in the food supply chain have different reasons to throw food away. Some example of food waste in the supply chain are:

Food production Unharvested crops Spoiled crops	***Processing and distribution*** Damage the products Overproduction
Retail Overstocking Expiration date Selective consumers	***Households*** Oversized portions Spoiled/ruined Bulk purchases

Table 1 Food Waste

(Scott, Manchester, & Oliveira, 2011)

Food waste also is a direct cause to waste of packaging, transport, labor, and useable land. The FAO has estimated that around 30% of the available agricultural land in the world is used for produces but wasted food. This is 8% of the global greenhouse gas emissions. 250 km³ of water is used for wasted food which is the amount of water that flows through the Volga annually, the longest river of Europe. Therefore, it can be concluded that food waste is a global problem.

(FAO, 2011) (FAO, 2013)

2.2 FOOD WASTE IN THE NETHERLANDS, FOCUSED ON POTATOES

Wageningen University and Research concluded that the Netherlands lose or throw away 9,5 million tons of food in a year with a worth of 4,4 billion euros (2018). Around 35% of all food thrown away are potatoes, vegetables or fruit, as seen in figure 2. Milieucentraal adds that consumers are not enough informed about the guidelines of food safety. There are different dates to throw something away which result in throwing things away which are still in perfect quality condition. Since 2010 there is less food waste on vegetables and fruit but an increase in potato waste.

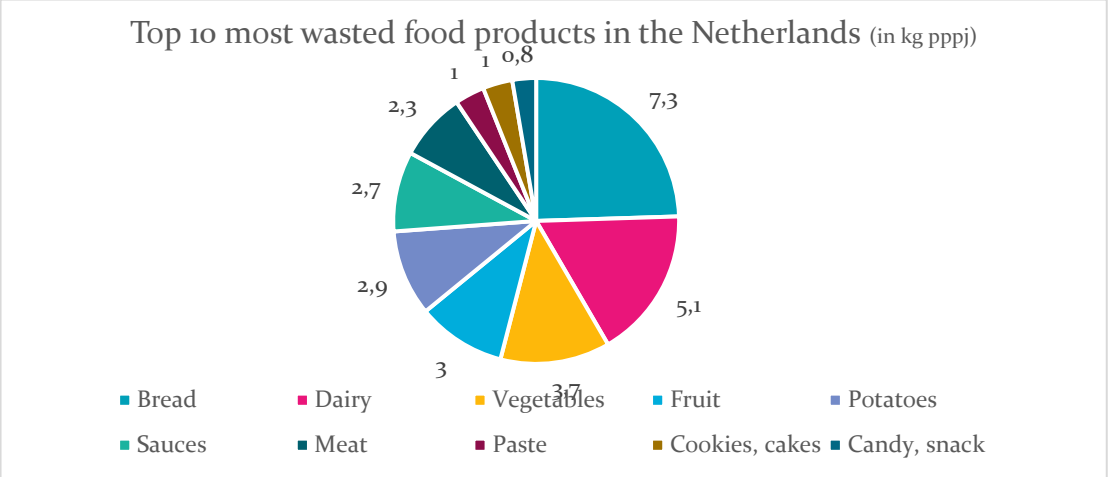

Figure 2 Top 10 most wasted food products in the Netherlands (2019).

(Rabobank, 2020) (Soethoudt & Vollebregt, 2020) (Mileucentraal, 2019)

2.3 CURRENT MEASURES AGAINST FOOD WASTE.

Already in the first world war there were measures to reduce food waste. In the current times governments mainly target consumers to reduce their waste with the idea: ''If they buy less, companies produce less''. Britain set up the ''love food, hate waste'' campaign in 2007 with a result to create more awareness and a reduction of 21% in consumer food waste. The Netherlands started a new campaign in 2020, informing consumers more about the separate date-systems and how to reduce food waste. The retailers also started to reduce food waste. Albert Heijn is researching dynamic pricing of products, the Lidl started to put nearly expired for sale for only 0,25 euro.

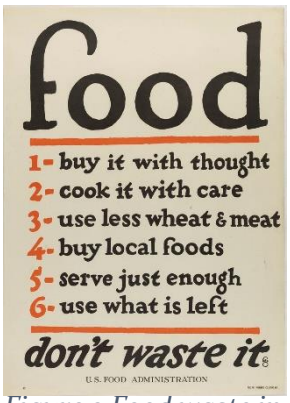

Figure 3 Food waste in the early days

(Eccleston, 2007) (Rijksoverheid, 2020) (Albert Heijn, 2019) (Schnelfaut, 2020)

2.4 PROBLEMS WHEN FACING FOOD WASTE.

There is some problem when trying to reduce food waste. Every part in the chain has its own issues according to the Rabobank. In the agricultural part of the chain advanced machines can result in less waste, but overproduction leads to waste. In the processing of food most companies make a cost-benefit analyse to see if the waste cost too much for the company. This is also the case for transport and storing of food. The retail aims to always have filled stocks to give the consumer the feeling that there is always enough supply, with more food waste as result. The consumer is still not fully informed about the effects of food waste and how to store products.

(Janssen & Hei, 2018)

In the Netherlands, some laws forbid companies to give eatable food to the people who really need it. The government want to initiate a ''good Samaritan law'' in which the government would take responsibility if people became sick when eating food that is given away. Companies also do not know where to donate their food and when they know it is often a big burden.

(Dik-Faber, 2020) (Ahmad, 2017)

3.0 Blockchain, what is it and where it can be used for?

A blockchain is a system that can be used to share and save data. With blockchain there is no central system needed what has as result that it is impossible to hack the data. The most famous example of a blockchain is the bitcoin. The blockchain Is focused on two concepts: secure by design and decentralized consensus.

(School of management Fribourg, 2019)

3.1 HOW IS BLOCKCHAIN CREATED?

The history of Blockchain started in 2008 when bankruptcy of an American company led to an estimated cost of trillions of dollars. As a result, multiple companies were sent into a recession or even a depression. Main reasoning for this to happen was the fact that a centralized payment system was used between sellers and buyers to take on the risk of defaults. Due to a lack of transparency and additional costs of clearinghouses, errors occurred which resulted in bankruptcy.

To prevent this from happening again, technological innovations where used (e.g. Bitcoin to settle payments between banks without the use entities which were centralized. This technological innovation was the first decentralized currency system operations worldwide. A so-called ledger contract is used in Blockchain to generate total transparency between buyers and sellers. The digital information in Blockchain is basically a scripted language which can be seen by all users but cannot be changed which generated ultimate transparency.

(Bernardo, 2017)

3.2 WHY IS BLOCKCHAIN CREATED?

It was created with the intention of finding an alternative solution to the traditional banking system, which was entering one of the biggest financial crises and which seriously undermines the confidence in this system. There is therefore a very close link between bitcoin (& other cryptocurrencies, see figure 4) and blockchain, among other things because blockchain is the underlying technology that supports cryptocurrencies and that guarantees their proper functioning.

blockchain is a technology for storing and transmitting info-mation. This technology offers high standards of transparency and security as it operates without a central controlled body. Besides that, the system keeps an overview of the information and the owner of this information.

(Lansky, 2018)

Figure 4 Various cryptocurrencies

3.3 HOW DOES BLOCKCHAIN WORK?

The new Blockchain technology allows users to share and record a system across a distributed network which generates transparency, reliability, speed, effectiveness, and trust amongst all users. Several examples in which Blockchain technology is applied are private distributed ledgers, smart contracts, Ethereum and Bitcoin.

(Meunier, 2018)

All entered information added in the Blockchain system will be cryptographed into a so called 'Hash' of letter and numbers. This is done to dismiss involvement of third parties over online transactions. The 'Hash' will be represented in the system as an online block. After approval of those in the network, the block will be linked to another block to create a Blockchain. When this has happened, the information in the 'Hash' cannot be changed or deleted. Each 'Hash' is protected through a digital signature, so both sender and receiver of the 'Hash' need to verify its really them with their so called 'Private Key'. This key allows them to receive and send information between stakeholders in the supply chain. See figure 5 for a summary of the process of creating a blockchain.

(Berkeley, 2016)

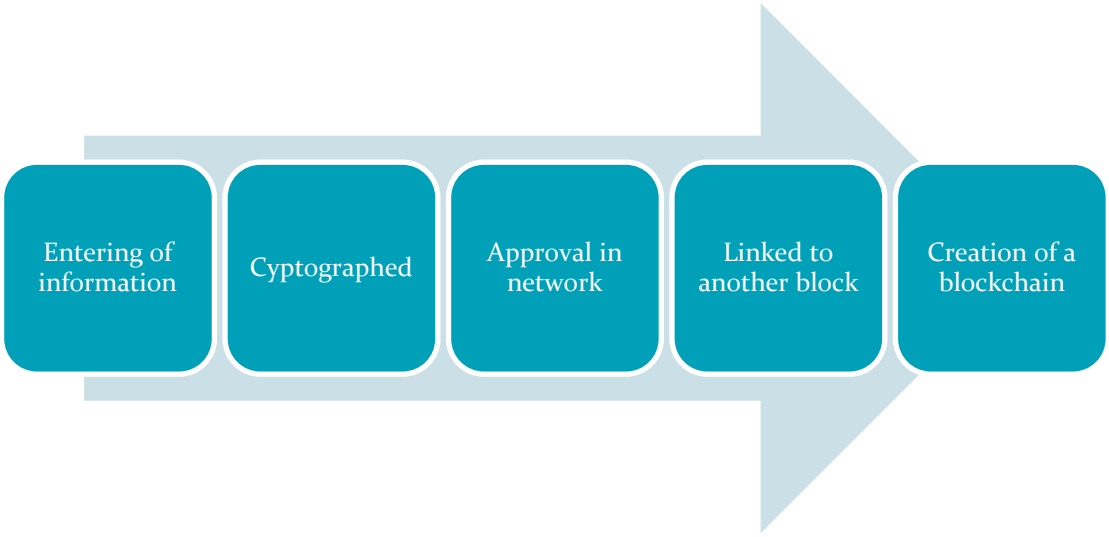

Figure 5 Creation of a blockchain

For example, a farmer produces 2000kg of fries potatoes, he will add this information in the Blockchain system. The '2000kg' will be transformed into a 'Hash', which will need to be approved by the stakeholders in the system. A block is posted anonymously, which results in more security because nobody knows who created the block. When this has happened, the 'Hash' will be sent to the receiver, which is in this example a potato processer. Additionally, all data will be saved in a ledger to keep records up to date. All shareholders in the potato supply chain can see that the farmer gave 2000kg of potatoes to the processor to create transparency and trust amongst stakeholders. This process will repeat itself until the final product has reached the end consumer, which result in a Blockchain focussed on potatoes.

3.5 WHERE IS BLOCKCHAIN CURRENTLY USED FOR?

Blockchain was mainly used in the beginning to create a decentralized environment in which no third party was necessary to make direct payments with e.g. a bank or a credit card company. Besides, third parties will need a fee to accomplish the payment. Therefore, Blockchain technology is created to make transactions possible without the use of a third party in a decentralized environment.

Bitcoin was the first cryptocurrency which introduced the Blockchain technology. Instead of paying your bills with money, which was transferred by a third party, users could send each other Bitcoins to verify payment.

(Hli-Huumo, 2016)

Blockchain can also play a huge role in the food supply chain for in the future. After implementation of Blockchain, all stakeholders throughout the whole chain will be able to track down the product from its origin. This will result in less food waste, decrease of economic losses, more trust amongst consumers and high amounts of transparency.

(Galvez, 2018)

Crypto currencies are still primary example of blockchain. Other examples where blockchain is used or can be used are:

- Smart contracts
- Financial services
- Video games
- Energy trading
- Domain names

(Innovation enterprise, 2016)

Examples of blockchain in the agri-food-sector are:

- Plus supermarket implement blockchain on Dole bananas.
- Albert Heijn used blockchain for oranges, now it is using blockchain on eggs.
- Siemens is researching possibilities to implement Blockchain in the potato chips industry
- Punjab, a Indian company, is implementing blockchain in the seed potato sector.

(Albert Heijn, 2019) (Punjab, 2019) (Siemens, 2020) (Gartner, 2019)

3.6 POSITIVE AND NEGATIVE THINGS ABOUT BLOCKCHAIN.

In this chapter some benefits and disadvantages will be described with the goals to have an overall overview of the blockchain concept.

Benefit #1: Tamper-proof data, traceability, and ownership:

Once an information is registered on a decentralized blockchain, it becomes in practice unfalsifiable. However, this is only valid when the blockchain in question is truly decentralized, that it is not controlled by a single entity but by many people independent of each other. (frontiere, 2020)

Benefit #2: Removal of Intermediaries:

Thanks to the emergence of Bitcoin, the first concrete case of the use of blockchain technology, it has been possible to carry out "dematerialised" transactions in pairs. It is now possible to exchange value in network (on the internet) without trusted third parties, and this is revolutionary. (frontiere, 2020)

Benefit #3: Protocol Security and Timeliness

If we take the example of bitcoin, it has never been hacked. All the scandals related to a theft of bitcoin took place either at the level of trading sites, or via scams. Indeed, to be able to reliably compromise the integrity of a protocol such as bitcoin, one would have to be able to control 51% of the computing power dedicated to mining this crypto asset. This is called a 51% attack. In addition to maximum security, transaction times are extremely low. When comparing a Bitcoin transaction to a SEPA transfer, the first is much faster. A transaction in Bitcoin is about a few minutes while a SEPA transfer takes at least several hours, even days. (berné, 2020)

Benefit #4: Creating a New Decentralized Digital Economy

Even if the blockchain does not allow a total elimination of intermediaries, it can play on decentralization and allow the emergence of a more decentralized economy. If you take the internet, only a few players control almost the entire web: Google, Facebook, Amazon, Apple... The web is now centralized. When you want to start an online business, you will have to create a website and reference it on search engines: Google, Bing, Qwant. You want to create an application; you will have to create it under iOS (Apple) and/or Android (Google). Your business is entirely linked to Google's goodwill. If the latter does not refer to your website or your application, it is better to tell you that you do not have the slightest chance. The advantage of this decentralization is that creators no longer have control over the companies/organizations they create. This can prevent censorship, collusion, the sale of data, changes in the conditions of use from one day to the next... (berné, 2020)

Disadvantage 1: Few people trained in this technology

The main flaw of this technology is that few people are still able to master this technology professionally. There is almost no institution yet to study cryptocurrencies. (berné, 2020)

Disadvantage number 2: Difficulty in adapting the general public

Like all technological developments, the blockchain will require society to adapt for the general public to use it. Today, as was the case with computers in the 1970s, the use of cryptocurrencies is the domain of enthusiasts and geeks. This is mostly a user experience issue: crypto assets have not yet been simplified enough in their use for everyone to use.

(berné, 2020)

Disadvantage number 3: Energy consumption

Energy consumption is considered a major problem for blockchain technology. The BTC transaction verification system consumes more energy than countries like Slovenia or Lithuania. However, this is to be compared with the security of the network, the billions of dollars that have passed through this technology and the energy spent in the traditional banking system.

(frontiere, 2020)

3.7 THE FUTURE OF BLOCKCHAIN

There is a prediction that Blockchain will grow rapidly within the near future due to more demand for the technology by big corporations which will be using Cryptocurrency. However, Blockchain technology will be harder to implement in the food supply chain due to several challenges which need to be solved in advance. It could occur that two stakeholders could become competitors from each other and therefore do not like to high transparent traceability system, which could result in a price war. Professionals are trying to solve this problem but they failed yet. Another problem with the Blockchain technology is the high costs, which are caused by the high consumption of electricity. High amounts of electricity are a necessity for creating an algorithm system for the 'Hash' and for the digital ledger which saves all the information within the food supply chain. The last main problem has to do with the fact that for most supply chains multiple countries are involved throughout the process. Creating a central authority will therefore be very hard due to little communication between different countries. New laws and regulations should be made and be implemented to prevent this problem for occurring.

(Lopez, 2019)

4.0 The supply chain of fries

In attachment 1 and figure 6 the supply chain of fries is displayed. Beginning at natural resources and ending at de consumer. Between the natural resources and the consumer, a lot of processes, quality checks, transports, and storage points are present. Besides the flow of goods there are also information lines and money transfers between different parts of the chain. Last two are not displayed in the supply chain.

The two main inputs to make fries are potatoes which are selected to be made into fries and the package. No other ingredients are added to the fries since each buyer has different wishes (restaurants put spices on it, consumers want to decide themselves how much salt they put on).

All storage points after the producing of fries are using freeze technology which is very energy consuming. Every day too long in the storage can be considered waste. Other examples of waste in this supply chain are too much transport movements, insufficient quality of potatoes and/or fries, expired products, and the use of pesticides/water if that is not needed.

In the next paragraphs a more detailed description of the most important parts in chain will be given. Most part of the supply chain also have a more in-depth flowchart with makes it clearer how the fries come to the consumer. And in which parts of the supply chain blockchain is already used.

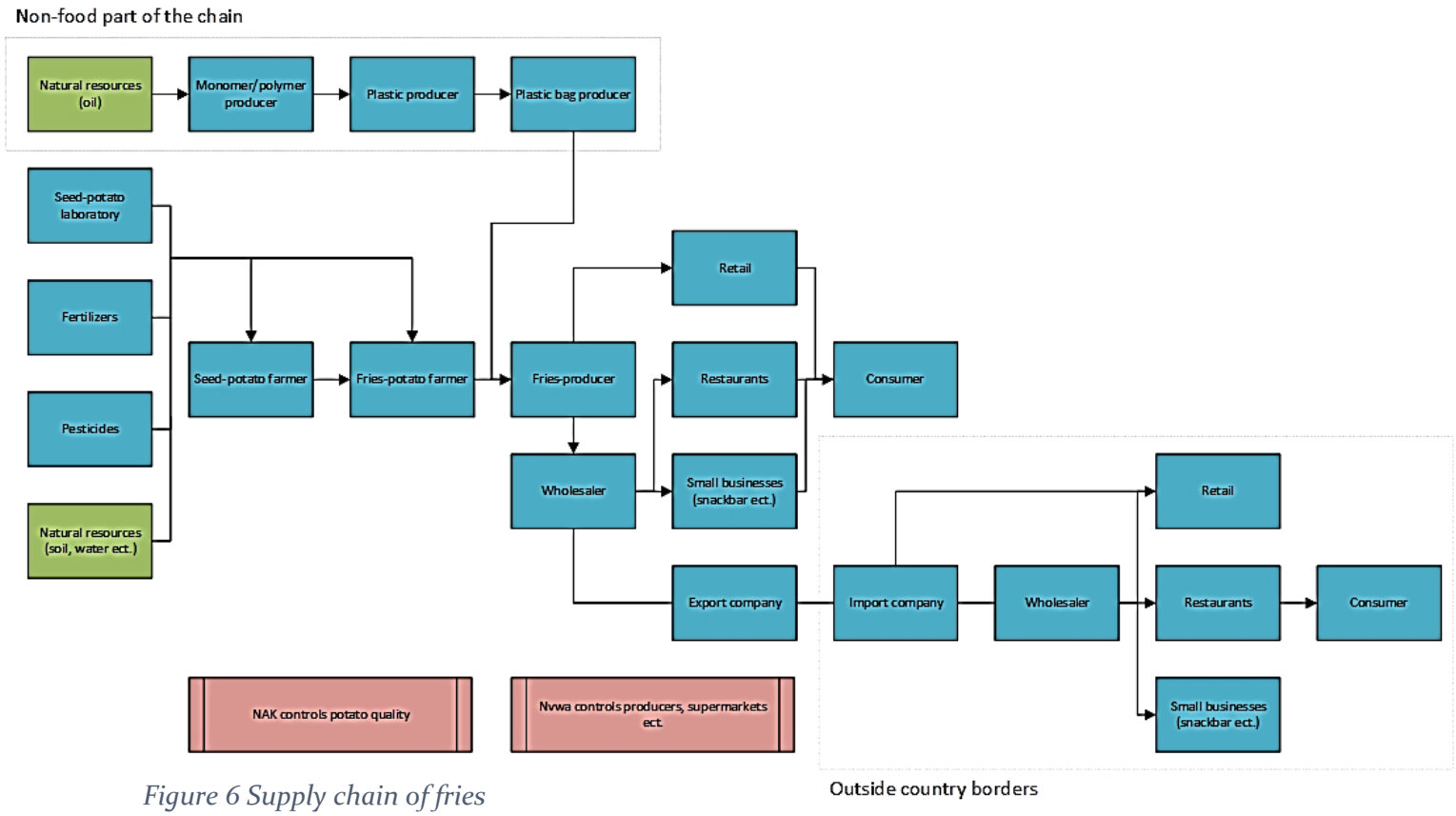

Figure 6 Supply chain of fries

4.1 THE POTATO FARMERS

There are two kinds of potato farmers in the fries' supply chain. Seed-potato farmers and fries-potato farmers. The seed-potato is planted a harvested for farmers which want to plant consumption- or fries-potatoes. Both need natural resources and fertilizer. The difference lays in the fact that the first seed-potatoes are laboratorial. This kind of potato receives the highest grade which also stand for the highest quality of potato and can be sold for the most money per kilo. The quality level is checked by the NAK every year on every farm which planted potatoes. Without certification the potato can be considered worthless.

According to the Agrofoodtech platform there are not many examples of blockchain integrated on the companies of farmers. However, the platforms see three major potential uses of blockchain that can be used in the agriculture:

- Tracking of origin and transparency.
- Mobile payments, credits, and reduced transaction costs.
- Real-time management of the finances.

(Agrifoodtech platform, 2017)

The Wageningen university described that the customer is concerned about the safety

and sustainability of food and therefore it required more information on agri-food chains. The consumer cannot communicate with the farmer directly which creates a lack of trust.

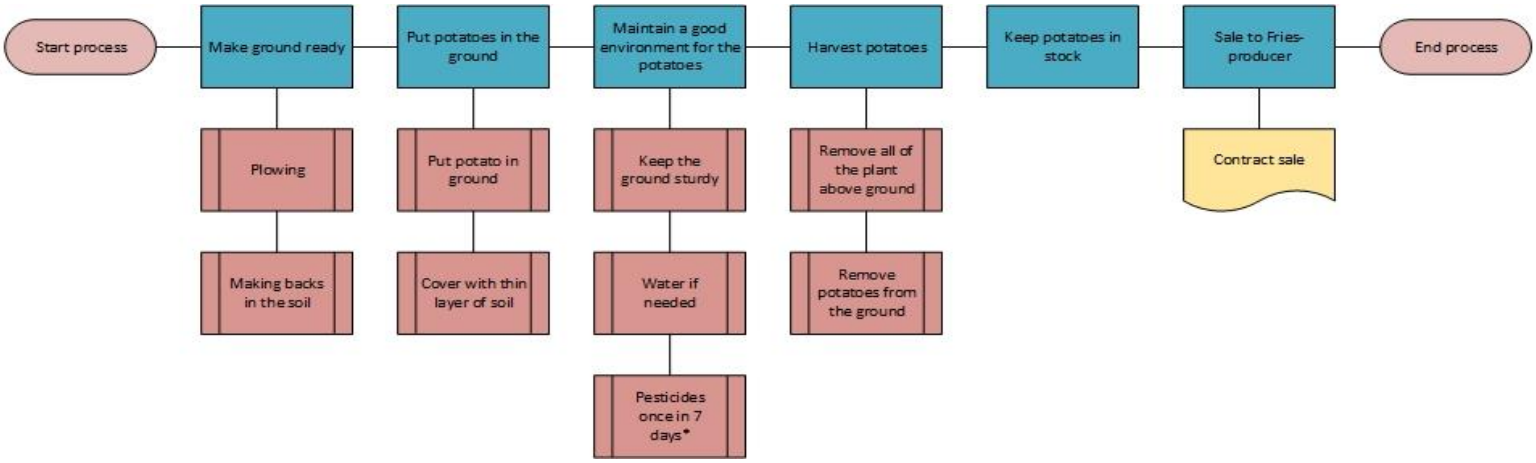

Figure 7 Process of a potato farmer (Wageningen Economic Research, 2017)

In the above figure the process of the average non-organic* potato-farmer is displayed. The average time for the process to complete can be up to 6 months. The farmers must wait a few more years till he can plant potatoes on the same soil again. This to reduce sicknesses in the soil and plants. With around 11.000 arable farmers in the Netherlands

there is enough potato to supply the next part in the chain. This supply is dependent on natural resources like rain and a good soil.

(Smit & Jager, 2018)

Punjab is one of the first companies to introduce seed potato traceability and certificating using a blockchain:

"By leveraging blockchain technology, the potato farmers would be able to trace the origin of the seeds they buy. Using technologies such as barcode and QR code, the software solution will allow the farmers to cross check whether they are buying the genuine seeds hailing from Punjab or not."

(Punjab, 2019)

4.2 THE FRIES PRODUCERS

The process begins with the arrival of the potatoes at the company by various logistics steps. Then the potatoes are peeled and washed opposite the sanitary. The potatoes continue their way on the production line to be cut. By two different processes he makes the potatoes more resistant, the first process is to cover it with sugar and finally the second process is to bathe it in sodium. Then the potatoes are cooked, heated to be more precise and then frozen. once frozen, they are packed in their packaging and then stored in a warehouse. Finally, the last step is the sale of their potatoes. (Jagtap, 2019). See attachment I for the process of producing fries.

Siemens works together with Atos IT to create the first tracking & tracing applications for potato chips. Blockchain will be combined with cloud-based programs and communication hardware.

(Siemens, 2020)

4.3 THE PACKAGING

The potato packaging process begins with loading polymer beads into the hopper. Then the balls melt until the desired state is reached. Then we print the bag with the different indications on it. Finally, the bags are stored and then sold to the potato companies to market their potatoes.

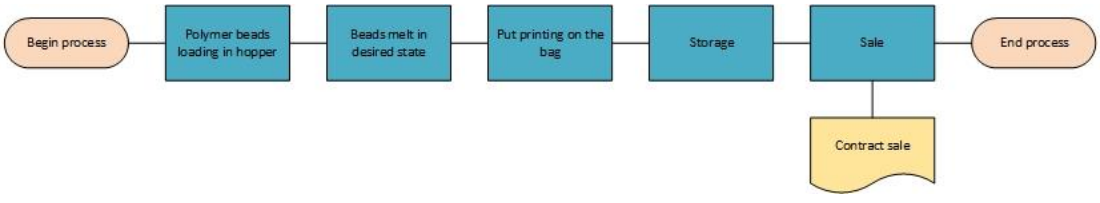

Figure 8 Packaging Steps

4.4 WHOLESALE

After processing and packaging of the fries, they will be transported to the wholesalers. They collect the final product and distribute these to its retailers. Individual wholesalers can buy all product in bulk which ensures them in paying a relatively low price per unit. The wholesaler will than sell its product further down the stream to retail stores, or wholesalers which are owned by a bigger corporation. Wholesalers require a license which allows them to sell the product to retailers, therefore these products in high quantities are not available for final consumers. Blockchain is not involved yet within this part of the supply chain, however it could be very beneficial due to transparency and security.

(Glossary, 2020)

4.5 RETAIL, RESTAURANT ECT.

Supermarkets are being delivered by their wholesalers. The product first goes to the warehouses of the supermarkets to be distributed to the individual supermarket. The same concept is done by restaurants etc. With the only exception they do not own the warehouse. The supermarkets are being checked by the NVWA on product quality each year. The date is for the quality check is always unknown for the supermarket.

Gartner inc. Described that 20% of the supermarkets will have blockchain implemented before 2025. The blockchain of the supermarket mainly focusses on food safety and trackability.

"Blockchain can help deliver confidence to grocer's customers, and build and retain trust and loyalty," said Joanne Joliet, senior research director at Gartner. "Grocery retailers are trialing and looking to adopt blockchain technology to provide transparency for their products. Additionally, understanding and pinpointing the product source quickly may be used internally, for example to identify products included in a recall."

(Gartner, 2019)

Walmart was the first supermarket which demanded that their suppliers of lettuce were going to use blockchain. In the Netherlands Albert Heijn was the first one with eggs and oranges (However, the orange blockchain is offline now). The aim of Albert Heijn is to give consumers more transparency of their products. With the blockchain there came an application which the consumers could use to see where their eggs were coming from. The most recent example is the banana blockchain of the supermarket chain Plus which also aims to give customers more transparency.

(Gartner, 2019) (Slagter, 2019)

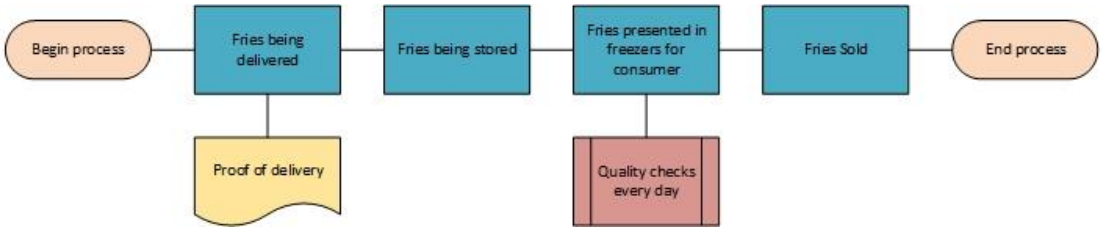

Figure 9 Process of the retail

4.6 EXPORT

When the potatoes have been harvested, they could either be exported right away of first being processed and then exported. The Netherlands has an annual export quantity of 628.000 tons, most of these go to Germany, France, and Belgium. All required papers, licenses and prove of quality should be present before starting the process of exporting the product. The country which imports the potatoes should own the same papers to obtain transparency. When the potatoes arrive at the country of destination, they will be processed to eventually end up in the supermarkets to become accessible for consumers. (Akkerwijzer, 2018)

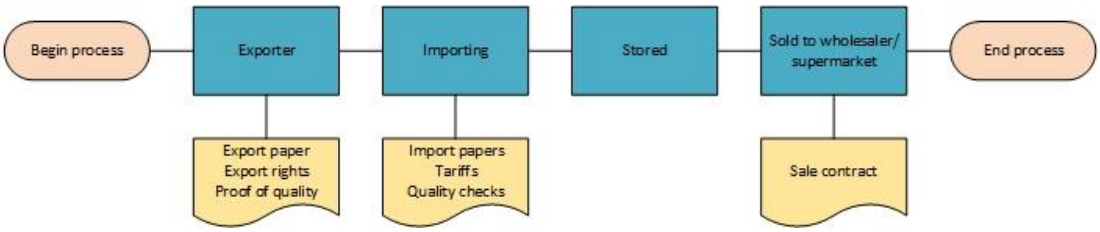

Figure 10 Export Steps

4.7 CONSUMER

Consumers have the biggest influence in the supply chain because they decide the demand for certain products. The consumers basically pull the product towards themselves which creates a pull supply chain. throughout the years, consumers have created an increased variety of demand which results in product development within the food sector. The potato sector has therefore a wide variety of product to satisfy consumers because not every potato consumer has the same taste. (Leeman, 2010)

Figure 11 Consumer Steps

4.8 QUALITY CHECKS

Big quality checking organisation the fries supply chain is the NVWA and the NAK, as seen in figure 6. The NVWA has much influence on quality in Dutch companies. This organisation checks the quality standards set by the national and EU goverments. This quality certainty is value adding and therefore added in the supply chain.

"The NVWA, because we stand for the safety of food and consumer products, animal welfare and nature."

(NVWA, 2020) (Voedingscentrum, 2020) (Nieuweoogst, 2019)

The same can be said about the NAK. Without the sigil (see figure 12) of the NAK on fresh potatoes, these can be considered worthless, the potatoes will go to the feed-industry against a low price. (Sometimes the farmers even pay to get rid of these low-quality potatoes.) The sigil of the NAK is known around the world and are value adding for seed-potatoes. This because it guarantees that there are no sicknesses in the potato and that the potato is of a certain grade. (NAK, 2019)

Figure 12 NAK sigil example

5.0 The problems in the supply chain

The problems in the supply chain can be the best described in an Ishikawa diagram, see figure 13. The Ishikawa diagram can be used to find the reasons behind the problem, what are the reasons that the whole supply chain throws away food? When all problems are clear it is possible to research if blockchain can be a solution for these problems.

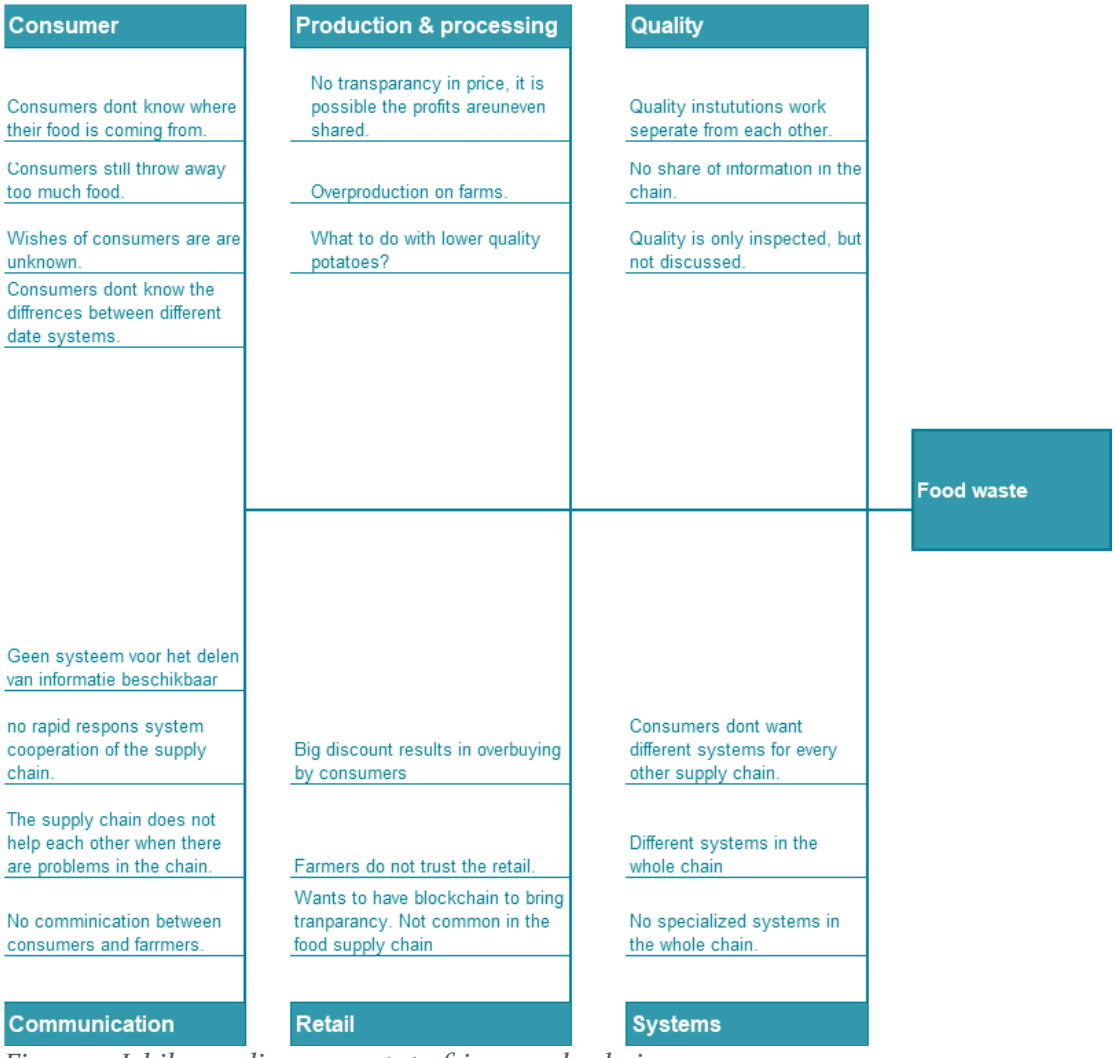

Figure 13 Ishikawa-diagram potato fries supply chain

In figure 13 it is shown that consumers do not know where their food is coming from, the connection between the consumer and the farmer is big and the consumer is uninformed about food quality. Besides that, the production and processing are not transparent which results in overproduction on farms and a price with no information how this price is built up. The quality checks of the government working with their own systems which are not sharing information with the supply chain. This results in the lack of insights where problem in the supply chain occurs and how to solve these problems. The retail uses many discounts which results in overbuying by consumers and thus food waste. Farmers do not trust the retail because the accuse the supermarkets of unfair pricing. However, supermarkets want to bring transparency in the supply chain.

Right now, there is no main system in the supply chain. Every part in the chain has its own systems, most cannot work together. Besides that, consumers do not want a new system for every separate food supply chain and therefore one system is the only solutions.

To solve the problems which are described, this research will be focused on implementing a blockchain system in the food supply chain. As an example, the supply chain of potato fries will be used throughout the whole report. Since there are not yet big examples of a blockchain system in the food supply chain this research will be relevant for all parts of the supply chain.

The following goals are described for this research:

- Researching the possibilities for blockchain in the supply chain of potato fries.
- Researching what all parts in the chain needs to do before implementing a block chain system.
- Analyze the risks involved in the creating of a blockchain system for the whole supply chain
- Calculating and determine the costs and benefits of a blockchain in the supply chain of potatoes.

To summarize, the goal is to research if blockchain can contribute to reduce the waste in the potato fries supply chain by researching what the requirements for the blockchain are, what the risks of implementing a blockchain are and what the costs and benefits for having a blockchain in the potato fries blockchain are.

This goal results in a clear example of blockchain in a food supply chain. This report can be used as an example for other food supply chains. The final result is to reduce food waste in the whole supply chain, from farmer to consumer.

6.0 The method and planning of the project

This chapter will describe the method to answer the goals described in chapter six. Besides that, a planning will be created so that the project group have a goal to work for.

During the feasibility study the project group will have several interviews with different members involved in the food supply chain of potato fries. These members are the experts in this chain and are therefore the best suited to know if blockchain has a possibility to succeed in this chain. With this strategy it is also possible to find input of the different part in the chain. A farmer has different ideas on the blockchain concept than the retail or the consumer. For a working system it is important that everyone in the chain can work with it.

After the feasibility study it is important to research the risks of implementing a blockchain in the supply chain of potato fries. Some risks will be found by interviewing experts. Other risks will be found in literature study. Together the risks will be put in a matrix in which it is visible which risks are too big to ignore.

It is also important to see the costs of a blockchain system. Not every part in the chain is able or does not want to pay a high price for a blockchain system in there are not enough benefits for them. The costs will be researched by literature study while benefits can be gathered from literature study and the information gathered by parts of the supply chain.

In figure 14 the planning of the research is shown. Deadlines are added so the project group can easily work toward to its goals with less worrying about the time.

Goals:	Tasks:	Deadline:
Researching the possibilities for blockchain in the supply chain of potato fries.	Interviewing (Aeres researcher?)	22-11-20
	Search more literature about blockchain in food supply chains	29-11-20
Researching what all parts in the chain needs to do before implementing a block chain system.	Interviewing different parts in the supply chain about the systems they have and what they know about blockchain	20-12-20
	Research what is needed for blockchain in literature	6-12-20
Analyze the risks involved in the creating of a blockchain system for the whole supply chain	Summarize risks mentioned in interviews and literature research	27-12-20
Calculating and determine the costs and benefits of a blockchain in the supply chain of potatoes.	Summarize costs from earlier research and interviews	10-01-21
	Summarize benefits from earlier research and interviews	10-01-21
	Determine whether blockchain has more benefits than costs	17-01-21
	Concluding if blockchain has a future in the food supply chain	24-01-21

Figure 14 Planning of the research

Question are asked with qualitative interviews. See figure 15 for the questions:

Blockchain, applied in the supply chain for potato fries

The supply chain is a good supply chain to take as example for the implementation of blockchain. All parts (think of the farmer, the fries producer and the supermarket) are based in the Netherlands. However, in the agrifood-chains blockchain is barely used. Reasons are not yet known.

In this questionnaire we ask to you to answer questions about your part of the supply chain. About problems and how to solve these problems. There are also question about implementing a blockchain in the supply chain. A short summary of blockchain is given below this research.

1.Which problems do occur around communication in the supply chain?

2.Which problems do occur around transport in the supply chain?

3. Which other problems are there in the supply chain?

4.Where are you proud of in the supply chain?

5. What in the supply chain is needed to change right away?

6.Which part of the supply chain creates the most waste in your opinion, why?

To make the supply chain of potato fries more efficient a blockchain solution is researched. The goals of this blockchain can be in transparency in for example price and quality, optimal communication between farmers, supermarkets and the consumer and a view of where waste occurs in the supply chain.

7. Which things need to be in the blockchain program at minimum? Name five

8. A blockchain can cost much time, money and effort. Do you think it is possible for every company in the supply chain to invest in this blockchain? If no, why?

9. Can blockchain in your opinion be implemented in the supply chain of potato fries?

We thank you for your time and effort.

Name:
Education:
Job:
Years of experience:

All your personal details will only be used for this research and will not only be shared among thirds.

A blockchain is a system that can be used to share and save data right away. Everyone in the chain can access this data with the result that problems can be recognized early, and these problems can be solves quickly. With blockchain there is no central system needed what has as result that it is impossible to hack the data. The most famous example of a blockchain is the bitcoin.

(School of management Fribourg, 2019) (Hli-Huumo, 2016)

Figure 15 Qualitative question list

7.0 Results of the interviews

In this chapter the results of the interview will be described. The full interviews are added as attachments. Each question will be described in separate paragraph. As a result, there will be a clear view of the problem in the chain, possible solutions and an opinion about blockchain implemented in the potato fries supply chain.

7.1 QUESTION 1

Which problems occur around communication in the supply chain?

The interviewed businesses stated that communication is actually an issue, besides that the lack of information sharing is mentioned. The supermarket stated that even in the own business environment it is unclear when new products are coming in and delays are not always communicated.

com	Communication issue	7
inf	Information issue	7

Figure 16 Responds Question 1

7.2 QUESTION 2

Which problems do occur around transport in the supply chain?

Transport issues occur repetitive in the potato supply chain, which can be linked to a lack of information flow between stakeholders and food waste. Most food waste withing the stakeholders is due to the fact it has reached the expiration date or the products doesn't look good anymore. Potato's exported to the UK will have more delay nowadays due to Brexit which will result in more food waste.

inf	Information issue	7
fow	Food waste	6

Figure 17 Responds Question 2

7.3 QUESTION 3

Which other problems are there in the supply chain?

Several problems have a negative impact on the potato supply chain such as sickness in the potato, issues regarding the law and an imbalance in the supply chain. However, by far the biggest problem is a severe lack of transparency in the supply chain. All the people who have been interviewed stated that externally and even internally the transparency is missing. This should be improved to create a more efficient and transparent potato supply chain.

sip	Sicknesses in potato	1
lai	Law issue	3
inb	Inbalance in the chain	2
tra	need of transparancy	9

Figure 18 Responds Question 3

7.4 QUESTION 4

Where are you proud of in the supply chain?

All answers stated that they are very proud of the high end quality they offer to meet customer demand, and that they believe they add value to the end product. They also explained they are proud on the long term relationship which have been created over the past years.

reg	Relation among other member is good	4
goq	Good quality	3

Figure 19 Responds Question 4

7.5 QUESTION 5

What in the supply chain needs to change right away?

Communication, need of recognition and transparency need to be changed in the supply chain right away if possible. All businesses which have been interviewed explained why transparency and communication is highly important, in both internal and external practices. Currently most mistakes which occur are in line with bad communication and very little transparency. More communication and transparency will result in more trust amongst stakeholders in the chain.

com	Communication issue	7
rec	need of recognition among buyers	4
tra	need of transparancy	9

Figure 20 Responds Question 5

7.6 QUESTION 6

Which part of the supply chain creates the most waste in your opinion?

According to the interviews most waste is being created during examination of the potato's and actions involved during the process steps to produce the fries. The

potato's peels are considered waste as well as 'ugly fries' which will be thrown away. Therefore the manufacturer has the most waste in the supply chain, besides of course the end customer.

7.7 QUESTION 7

Which aspects need to be in a blockchain program at minimum?

Most participants didn't specifically say what should and shouldn't be implemented in the blockchain program. They did mention that the program should develop the transparency between stakeholders. However, Celavita gave some interesting aspect which should be considered for implementing in the blockchain program. Software which makes it easier to create long term forecasts would be a really nice tool for Celavita. It should also have software which shows information regarding quantity's, return in investment which motivates workers and it should be easy in use. One aspect which can't be shown are prices. Reasoning is that most potato farmers supply to multiple companies, when prices are displayed they will continue to only supply to the buyer who pays the most.

tra	need of transparancy	9
Nei	Need of information sharing	4
For	Forecasting long term	2
Vol	Volume/Quantity	1
ROI	Return on Investment	1
Sys	Internal System Used	1
Easy	Easy In Use	1

Figure 21 Responds Question 7

7.8 QUESTION 8

A blockchain can cost much time, money and effort. Do you think it is possible for every company in the supply chain to invest in the blockchain?

All participants said only the bigger corporations like Albert Heijn or Jumbo are able to invest in blockchain at the moment due to the high costs involved. It could happen in the future that big corporations are demanding from its supplier to implement blockchain in their operations.

7.9 QUESTION 9

Can blockchain in your opinion be implemented in the supply chain of potato fries?

The majority of interviews concluded that blockchain will not become a success in the supply chain of fries. The first season which defends this statement is the fact that trust amongst stakeholders is currently very little. Therefore sharing information in a blockchain wouldn't be appreciated by the majority of stakeholders. Another reason

can be explained with the high costs to implement blockchain. Little information is known on how to divide costs because blockchain technology is very expensive. There is also little information available regarding already existing blockchain implementations in the food sector. Therefore it is hard to convince stakeholders that blockchain will have any added value for their practices.

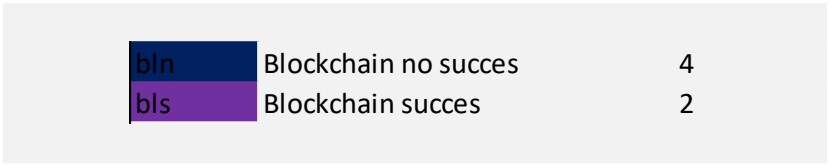

Figure 22 Responds Question 9

8.0 The look of the blockchain

According to the interviews described in the earlier chapters and the attachments, a vision of the blockchain can be described.

When interviews are compared several subjects can be of interest:

- In the interviews transparency was a big issue that is needed to be solved.
- Communication between the different part in the chain is a issue that need to be solved.
- Food waste is a problem in the whole chain. However, most think the reduction of food waste can be gained at consumer level.

Besides that, it is also important to note that all people who have been interviewed have doubt about implementing a blockchain in the whole supply chain.

The blockchain can be used by for example the supermarkets, distribution and production part in the chain. More or less the same number of companies are active in each part of this chain. The problem occurs when consumer or farmers need to be added to the blockchain. There are already 12.000 farmers who harvest potatoes in the Netherland, and even more consumers. With consumers added it can be a problem to share information that is not meant for these consumers.

The connection between consumer, supermarket and farmer can be established by a separate blockchain which can include the origin of the potato, used pesticides, organic certification, CO_2 footprint etc. The connection between farmers and their buyers could also be a blockchain that shares information like certification info, average yields, tips for higher yields when it is visible farms have lower yields ect.

Options like smart contracts are currently researched. When this needs to be implemented a separate blockchain is advised. Think of it like a excel document with different tabs. The document is the management program, the tabs the blockchains.

Most food waste occurs at consumer level. However, still a considerable amount is wasted at production and distribution. Blockchain can help to reduce this food waste by making it visible where in the supply chain most potatoes are wasted. By focusing on reduction of this waste, another one can pop up as new source of food waste. By working together in the chain and when worked with continuous improvement it is possible to reduce waste that is made before the product is sold to the end-consumer.

Food waste can be reduced with blockchain too. Most suitable would be the supply chain of producer, distributor and retail of the potato fries. Together it can be possible to extent expiration dates, better packaging (and less packaging) and efficient transports. It is also possible to look together which potatoes can be sourced. Fries do not need the highest quality of potatoes. Therefore, it is possible to give a good destination to lower quality potatoes. Fries can also be frozen which means that the expiration date can be extended very easily, but against high energy costs of the freezers where the fries need to be stored in to.

9.0 Feasibility Study

In this chapter possibilities for the blockchain are discussed. The first paragraph describes the cost of the blockchain. The second part will describe benefits for the supply chain of potato fries. The third part will describe how achievable it is to implement the blockchain described in chapter 8.

9.1 COSTS OF BLOCKCHAIN

There are different costs in every blockchain. To keep a clear overview the following costs will be described:

- The rates of blockchain developers.
- The development costs of blockchain.
- The costs after the implementation of the blockchain.

Since Blockchain is still in a growing phase, clear numbers on costs are scares. However, the average rates are estimated to be on 81 to 100 USD. The median is estimated to be on 61 to 80 USD. This rate is paid per hour. Also in blockchain, labor is the highest cost. Offshoring is one of the possibilities. The most common development offices are based in Belarus, Ukraine, Poland and India. The prices can be cut in half then. The average hourly rate in Belarus already starts from 40 USD.

(Azati, 2020)

It is very difficult to estimate an exact price to the creating of a blockchain for the supply chain of potato fries. Every blockchain is different and required different amounts of development time. A blockchain app starts at 5000 USD and can even go higher than 200.000 USD.

(Azati, 2020)

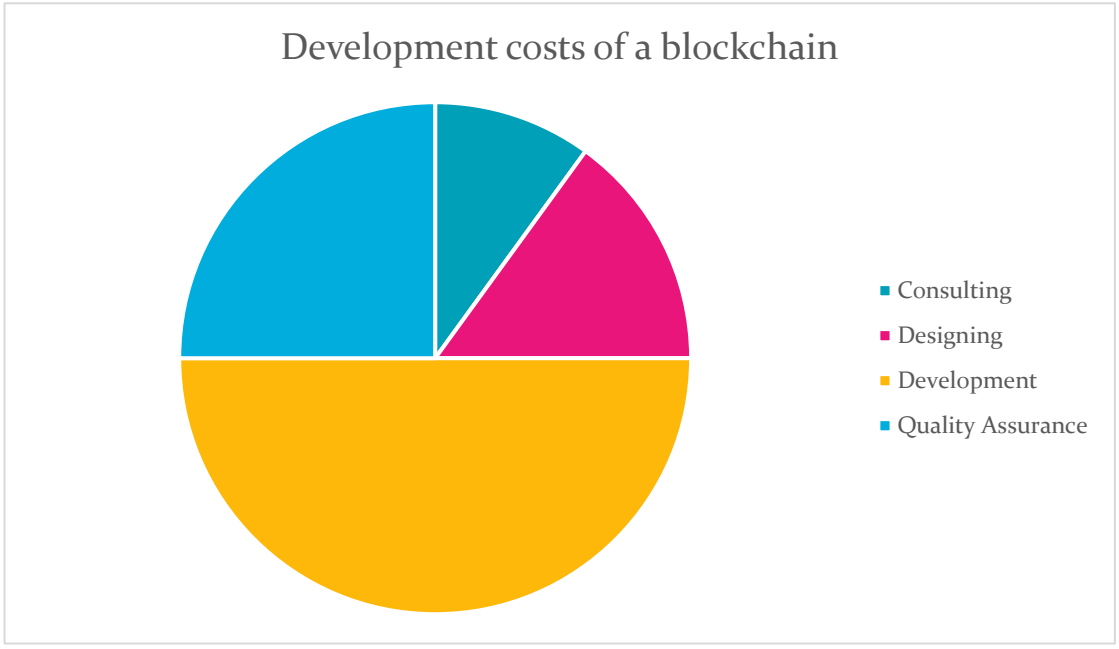

Figure 23 Development costs of a blockchain

In figure 10 some costs are displayed in percentages. The development process, think of coding and make the base program really work, will cost the most. Designing, which included the appearance and user friendliness for example, cost way less. It is therefore important that when a new tool will be implemented, there is knowledge of the costs that include this new tool. The design costs can be low, but the development cost can make this tool too expensive to implement.

(Leeway Hertz, 2020)

Some additional costs can be described, these costs will come when the blockchain is in use. When there will be worked with transactions (think not only of money transaction but also transactions in documents or other information) a transaction fee is in place. The transaction fee is estimated at 0,01 USD per transaction. There is also the cost of maintenance when the blockchain is finished. Think of updates to keep the blockchain accessible and secure. Maintenance costs are estimated to be between 15% and 25% of the overall project cost.

(Leeway Hertz, 2020)

9.2 BENEFITS OF BLOCKCHAIN

The supply chain of potatoes could keep track of their transactions and obligations with their buyers, suppliers and other stakeholders. Indeed, the blockchain makes it possible to anchor transactional data in an immutable and searchable manner between the different stakeholders. This system would maintain a relationship of trust between the farmer and the buyer by providing more transparency and minimizing the risk of fraud thanks to the register serving as indisputable proof.

(Sharma, 2020)

The blockchain would make it possible to record all the stages in the life of the potato fries involved in the agricultural supply chain, allowing the end consumer to have access to a reliable history of the journey of the fries that are found on their plates, traceability and transparency are key for the consumer acceptance of the blockchain. A survey of SAI Global concluded that there is a growing lack of trust in companies by consumers. The consumer is worried about their privacy, traceability, and ethical & sustainable matters.

(SAI Global, 2019)

The blockchain can help to fulfill the desire of the consumer to have transparency in the chain. By offering a good connection to the consumer it is possible to give the Customer the information they demand, 82% of the customers are doing research on a company before they will buy something from it, according to the earlier described survey.

(SAI Global, 2019)

Financial transactions between farmers and buyers could benefit from automated payment upon delivery, compared to several weeks today in most cases. Smart

contracts allow automatic payments to take place under certain predefined conditions. The settlement process would then be simplified for farmers, buyers and banks.

(Sharma, 2020)

9.3 THE FEASIBILTY OF THE DESCRIBED BLOCKCHAIN

At the moment, the implementation of blockchain technology is not feasible. Reasoning for this is the fact that there is too little information available to really convince stakeholders that blockchain is an added value. Besides this, costs regarding investing in blockchain are very high as well. A single farmer will not be able to spend any savings, on a still quite unfamiliar investment, without any future references from comparable food supply chains. The risk is just too high so as a result it is not manageable at the moment.

10.0 Risk Analysis

With a new technology as blockchain, many risks are possible. To give an overview of the most important risks of implementing a blockchain in the potato fries supply chain, a risk matrix build, see figure 12.

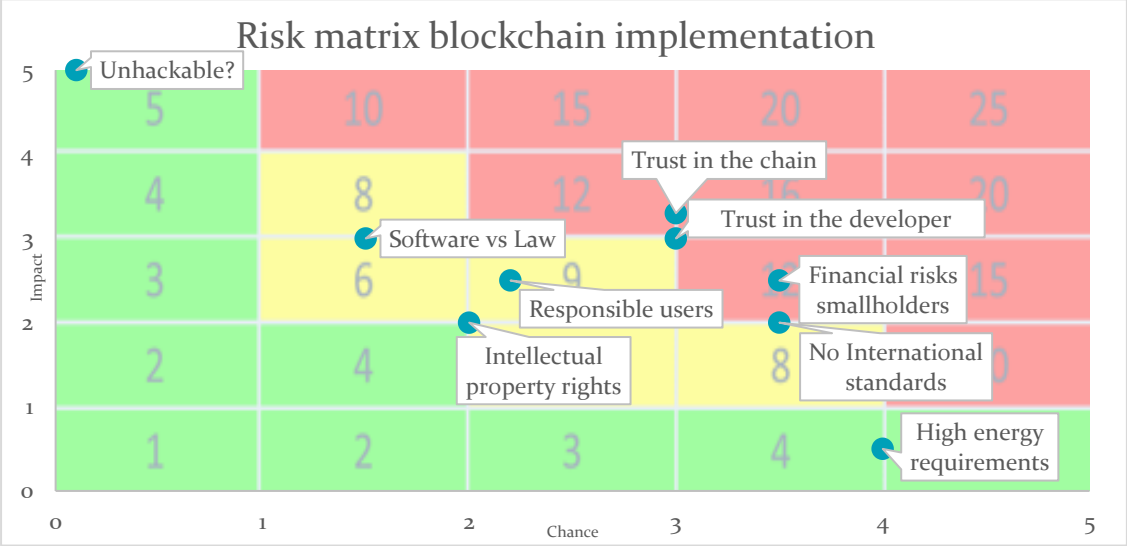

Figure 24 Risk matrix of blockchain implementation

The FAO conducted a research in the implementation of blockchain in the agriculture. The results included concerns from the agricultural sector when asked about blockchain, which is visible in attachment VII.

One of the concerns is that it is unclear which law needs to be used when using the blockchain. Is it enough to trust the software code or are extra laws needed from the government. When this is still unclear it is possible that, when the government decides to implement law, the whole blockchain needs to be changed because of that. This happened with the online currency called Ethereum, comparable with bitcoin. The community behind the currency had disagreements among each other about several issues. In the end Ethereum needed to split up in several smaller currencies to keep everyone in the community happy. In agriculture smart contract are thinkable. If the contract has no legal entity, it is possible that there will be disputes among buyers and suppliers.

(FAO & ITU, 2019) (Murck, 2017)

Also, standards are not yet fully developed. There are many coding languages which make it difficult to communicate between different blockchains. Besides that the FAO stated that the absence of standards carries risks related to lack of interoperability, privacy, security and lock-in of customers.

(FAO & ITU, 2019)

The energy consumption of a blockchain is large. A large blockchain like bitcoin uses more electricity than the whole country of Ireland. This will harm of the main goals of the blockchain in the potato fries supply chain. A result can be the reduction of waste, but at the cost of a very high energy consumption. Choices need to be made here.

(FAO & ITU, 2019)

Blockchain has no central authority, this put the responsibility on the user. Every user has a key that cannot be replaced like a lost password. And when, by accident, a key is shared the blockchain can be damaged from that shared key. It is also very difficult to change something when it is entered into the blockchain. It is needed to train the every employee which can put a lot of pressure on the financial resources of the chain.

(FAO & ITU, 2019) (Murck, 2017)

Lack of trust is also a risk that should be worked out. In the interviews most responded that blockchain is not ready for the supply chain yet. Besides that there is trust in a developer, the one who will create the blockchain. That person is probably from outside the chain, no one in the chain know this person. It is very unlikely that the supply chain will agree on a developer right away when their financials are at stake. And then there is also the problem of trust between the different parties inside the supply chain. The farmer can lack trust to supermarkets and distributors and the supermarket also can lack trust in a lower quality potato which can still be in demand at the consumer level. It is needed to inform the whole chain and the consumer about the blockchain. Trust can only be gained when everyone in the chain will have their benefits, from farmer to consumer.

(Chia, 2017)

There is also a financial risk for smallholders such as the potato farmers. The individual farmer has a tiny part of the supply chain under control, is small in size and has relatively low financial resources when compared to the distributors and the supermarkets. The blockchain can have high costs to implement based on the size and complexity of it. These costs need to be paid by someone in the chain. And when this financial burden lays too much on the smallholders, the result can be that smallholders can go bankrupt more easily due to the already small financial reserves.

(FAO & ITU, 2019)

The final question is who owns the blockchain. Since it is a untouchable thing law will mostly come from intellectual property law. Dutch IP law states that the one who creates a thing, also owns it. In this case a developer would own the blockchain. But law also stated that if this developer works for a company, the company gains these laws. IP rights can also be transferred, but to which part of the chain? If the supermarket gets the rights, farmers will not be pleased and vice versa.

(Mamoria, 2017)

11.0 Conclusion

According to the results there are doubt that blockchain can be a success to reduce food waste in the potato fries supply chain on the short term. There are questions about the costs and who has access to which information.

However, blockchain can still have a change when the chain knows how this platform will look and what is needed to make it work. In the results problems like lack of transparency, communication issues and a bad information sharing system are mentioned. These problems can be solved by blockchain on the long term, when the parts in the blockchain know what awaits them.

It is very difficult to estimate an exact price to the creating of a blockchain for the supply chain of potato fries. Every blockchain is different and required different amounts of development time. A blockchain app starts at 5000 USD and can even go higher than 200.000 USD. It is important to know what is exactly needed in the blockchain, from the interviews things like forecasting, more transparency, information sharing and information of which systems are used are examples of aspects that can be included in the blockchain for potato fries.

Most food waste occurs at consumer level. However, still a considerable amount is wasted at production and distribution. Blockchain can help to reduce this food waste by making it visible where in the supply chain most potatoes are wasted. By focusing on reduction of this waste, another one can pop up as new source of food waste. By working together in the chain and when worked with continuous improvement it is possible to reduce waste that is made before the product is sold to the end-consumer. Blockchain can be of help.

Important to note is that it is not needed to create a blockchain for every process in every company. Blockchain is a tool, not the answer to every problem. Transparency issues and food waste are two different subjects and it can be better to create separate blockchains or to create a blockchain for the one subject with the most potential for blockchain.

In general, blockchain is still a very new state of technology that needs a lot of research before in can be accessed by the biggest part of the companies in the world. The possibilities are endless, but it is also important to note that blockchain cannot solve everything. Food waste occurs for more than 60% at consumer level. However, the use of blockchain in the process before the product is sold can be a possibility.

12.0 Recommendations

Based on this report several recommendations will be given by the project group. This advice can be used for new research and to give ideas how the blockchain can look.

12.1 KNOW HOW THE BLOCKCHAIN WILL LOOK

In chapter 8 it was described that it is important to know who the blockchain is going to use, what the blockchain contains and how it will benefit the parts in the supply chain. Before this is done, it is nearly impossible to give an estimation on for example price and who in the supply want to use the blockchain. It is necessary to make a model of the blockchain. A concept in which its features are described, its possibilities, to which part in the chain it is aimed and how it will benefit these parts. After a concept is made it is possible to give close estimations of costs and the concept can also be showed to potential partners which can give their opinion about it.

12.2 INCLUSION OF FARMERS AND CONSUMERS

The supply chain of potatoes is uneven. With 12.000 famers and even more consumers on one side and a handful of supermarkets, distributors, and producers on the other side, it can be difficult to create a blockchain where all information can be shared. Farmers can be afraid that prices for their potatoes will go down. The supermarket can be afraid that competitors see valuable information. It is therefore advised to exclude farmers and consumers from the blockchain that is aimed at reducing food waste to create a platform with a handful of businesses. When this works it is possible to research possibilities of including for example farmers.

12.3 UNDERSTANDING THE ADDED VALUE OF BLOCKCHAIN

The goal of this report was to find a way of reducing food waste in the potato supply chain by implementing blockchain technology. However very little knowledge has been done on finding the actual added value blockchain will have on the stakeholder. Therefore, a recommendation could be to research more regarding the added value of blockchain amongst the end consumer. If a company has implanted blockchain in their supply chain to create transparency amongst stakeholders, it doesn't mean it automatically results in more customer demand. It would therefore be very interesting to research more, regarding the end customer perspective on the implementation of blockchain in the food supply chain.

12.4 GENERAL KNOWLEDGE OF BLOCKCHAIN

Blockchain technology is relatively new so therefore it could be confusing amongst stakeholders. Nowadays the majority of people associate blockchain automatically with bitcoin and not directly to a supply chain in general. This could also be the reason on why stakeholders hesitate to invest in blockchain technology. More research could be done regarding the general knowledge of blockchain to increase customer awareness. Marketing blockchain technology intensively could become key in this process. This will result in more awareness regarding the endless capabilities of blockchain, which hopefully generates more acceptance towards blockchain.

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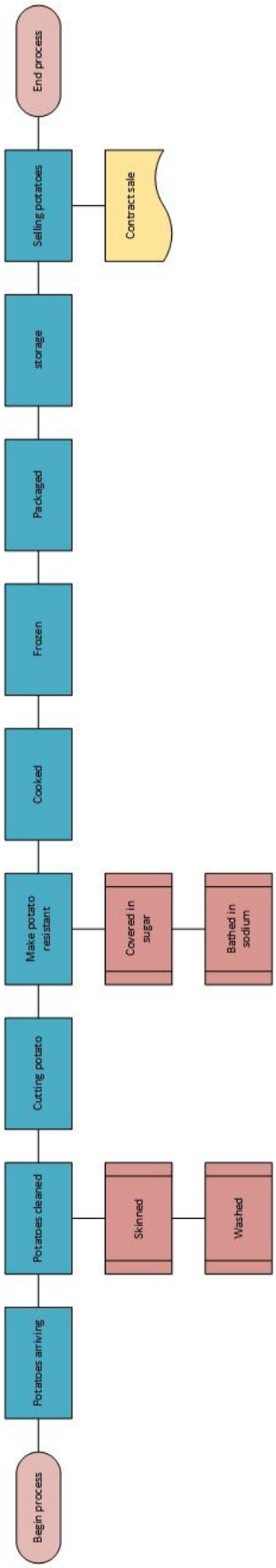
Attachments

Attachment I Fries production



Attachment II Interview farmer

Data about the interviewed person:

Name: Josien Binnema (and father)
Education: Management & Agrifoodbusiness
Job: Farmer seed-potatoes
Years of experience: 40 years

1.Welke problemen zijn er rondom de communicatie tussen bedrijven in de supply chain?

De communicatie binnen de NAK en de afnemer kan soms misschien verbeterd worden. Een voorbeeld is als je bijvoorbeeld ritnaalden hebt wat volgens de NAK niet mag, dus de aardappels worden afgekeurd terwijl het voor de consumptieboeren waar de aardappelen heen zouden, helemaal niks uit maakt of die erin zitten.

Hier heb je dan al eigenlijk te maken met voedselverspilling?

Ja, inderdaad, je kan die aardappels prima eten. Ze kunnen ook [prima gebruikt worden als pootgoed voor consumptieaardappelen.

2.Welke problemen zijn er rondom transport in de supply chain? Is er veel afval?

Er is niet veel afval door klasse verlagingen. Alleen als de partij wordt afgekeurd is dit afval. Daarnaast als er echt een hele slechte partij is en er genoeg pootgoed is, wordt er af en toe wel eens een partij opgeruimd.

3.Kent u nog andere problemen binnen uw deel van de supply chain?

Er zijn eigenlijk problemen met de partijen.

Wat zijn deze problemen?

Bijvoorbeeld ziekten als phytphothora, fusarium en rizotohnia.

Ah, je bedoelt dan partijen aardappels?

Ja, tussen de partijen gaat het best goed.

4.Waar bent u trots op in de supply chain?

Dat we hoogwaardig pootgoed kunnen afzetten in vergelijking tot andere landen.

5.Duidelijk, en wat moet eigenlijk gelijk veranderen in de supply chain?

Betere communicatie tussen consument en teler over bijvoorbeeld gewasbescherming en de meer bekendheid over het product in de winkel.

Wat voor bekendheid zou u graag zien?

Bijvoorbeeld waar de aardappel vandaan komt, wat er gebruikt is om het te telen, de prijs die de teler krijgt, ik zeg maar wat.

6.Duidelijk, en welk gedeelte in de supply chain creëert het meeste afval denkt u? En waarom?

Bovenmaatse aardappelen omdat de consumptietelers deze niet graag poten, dit zorgt namelijk voor een lagere opbrengst.

Duidelijk!

Om de supply chain van aardappelfriet efficiënter te maken, wordt de mogelijkheid om blockchain te implementeren onderzocht. Het doel van deze blockchain kan transparantie in prijs & kwaliteit zijn, en bijvoorbeeld optimale communicatie tussen boer en supermarkt. Ten slotte zou er een overzicht gegeven kunnen worden waar product wordt verspild.

7. Welke dingen zou u graag terugzien in een blockchain voor aardappelfriet?

Transparantie tussen consument en teler

En dan wat u eerder zei?

Bijvoorbeeld ja, ik vind dat de afstand tussen de consument en de boer te groot is.

8. Een blockchain kan veel tijd, geld en moeite kosten. Denkt u dat uw deel van de supply chain hier klaar voor is?

Ik denk het niet omdat aardappelen gewoon een natuurproduct zijn en je dus niet zomaar de kwaliteit en opbrengsten over een paar jaar kunt voorspellen.

En als het bijdraagt aan oplossingen voor bijvoorbeeld de grote afstand tussen consument en teler? Het hoeft niet perse over voorspellingen te gaan.

Dan zit je nog wel over de kosten in, wie gaat dat betalen?

Dat hebben wij nog niet onderzocht, vanzelfsprekend is dat dit eerlijk verdeelt moet worden.

Laten we dat hopen

9. Denkt u dat er een kans is voor blockchain binnen de keten van aardappelfriet?

Nee voorlopig niet. Er zal eerst wat meer duidelijkheid moeten zijn over bijvoorbeeld de kosten en hoe dit verdeeld gaat worden.

Dat begrijp ik, ik bedank jullie voor de tijd en moeite. Als er nog vragen zijn naar aanleiding van dit onderzoek dan hoor ik dat graag!

Afsluiting…

NAK

1.Welke problemen zijn er rondom de communicatie tussen bedrijven in de supply chain?

Wij hebben voornamelijk te maken met regelement van de overheid, en de agrariërs. Het is belangrijk dat wij ons werk goed uitvoeren. Omdat er veel agrariërs zijn en maar weinig controleurs, heeft dit tot resultaat dat wij eigenlijk alleen controleren en niet echt advies kunnen geven.

Maar jullie zijn ook puur voor controles toch? Zal advies niet bij een advieskantoor thuishoren?

Deze hebben niet dezelfde informatie tot de beschikking als wij, je loopt dan langs elkaar heen.

Ah, juist. Hier zou je een verbeterpunt kunnen zien?

Exact

2.Daar kunnen we wat mee, welke problemen kent u betreffende tansport en afval in de supply chain?

Bij ons is er geen afval, wij controleren alleen maar. Wel kan er afval ontstaan als wij iets afkeuren.

3. Duidelijk. Kent u nog andere problemen binnen de supply chain?

Je ziet vaak op bijvoorbeeld de TV dat de boeren protesteren bij de overheid en distrubutiecentra. Over oneerlijke prijzen wordt al jaren gesproken.

Transparantie dus?

Ja, ik denk dat de keten hier echt van op kan fleuren.

4. Dat denk ik ook, waar bent u trots op in de supply chain?

Doordat wij controleren zorgen we voor kwalitatief goede aardappels, De NAK zegel is door de hele wereld bekend en voegt ook echt waarde toe.

5. Duidelijk, en wat zou er direct moeten veranderen in de supply chain volgens u?

Meer communicatie, we praten langs elkaar heen.

Hoe wordt er nu gecommuniceerd dan?

Via de mail, soms via de telefoon. Als ik al iets weet dan vertel ik dat ook aan de teler zelf.

Maar dat is dan alleen tussen u, de nak zeg maar, en de teler. Niet verder in de keten?

Nee, daar hebben wij niet veel mee te maken.

6. duidelijk, en als we het over afval hebben, waar denkt u dat het meeste ontstaat in de keten?

Persoonlijk denk ik dat dit bij de consument gebeurt. Maar aangezien ik voornamelijk werk met telers heb ik niet veel kennis van de rest van de keten.

7. Alsnog bedankt voor uw antwoord, welke dingen zou u graag terugzien in een blockchain voor aardappels?

Persoonlijk zou ik hier alle informatie op willen delen. Dit maakt het in ieder geval efficiënter voor ons.

Als de Nak?

Ja

8. Ah juist, Denkt u trouwens dat deze blockchain wel toepasbaar is binnen de keten van aardappels? Denk bijvoorbeeld aan de kosten.

Het lijkt mij een dure klus voor de boeren. **Voor de Albert Heijn zal het geen probleem zijn haha.**

9. Snap ik, denkt u dan dat de blockchain nu toepasbaar zal zijn?

Nu direct zou ik nee zeggen. **We weten er nog niet zo veel van af en als ik er nog niet veel van af weet dan zou ik nee zeggen.** **Ik raad je aan om te zorgen voor een goede informatievoorziening voordat er ook maar wat gedaan wordt aan de het ontwikkelen van de blockchain.**

Bedankt voor de tip, dat gaan we zeker meenemen.

Afsluiting

Attachment IV Albert Heijn Voorhof interview

Name: J. Vosselman
Education: Detailhandel
Job: Manager supermarket
Years of experience: 10 years

1.Welke problemen zijn er rondom de communicatie tussen bedrijven in de supply chain?

Ik zou zeggen dat de communicatie overal wel verbeterd kan worden, zelfs met het eigen distributiecentrum is het soms lastig om te communiceren. Vrachten komen te laat of niet en die wordt dan pas achteraf gecommuniceerd.

Kent u ook andere delen van de supply chain waar verbeteringen mogelijk zijn dan?

We zitten natuurlijk met de protesten. En met de lonen van de werknemers in de sector.

Dat is bekend inderdaad.

Dit zou volgens u allemaal wel verbeterd kunnen worden op korte termijn?

Ja exact.

2.duidelijk, welke problemen kent u betreffende tansport en afval in de supply chain?

Zelf gooien wij aardig wat weg, het overgrote deel hiervan zijn verse artikelen als groente en zuivel.

Waardoor komt dit?

Dat is verschillend. De ene keer is het product over datum, de andere keer ziet het product er niet meer zo smakelijk uit. Wat ik wel jammer vind is dat soms producten over datum gaan maar nog perfect zijn voor verkoop. Dit zou ik een probleem over afval kunnen noemen.

3. Duidelijk. Kent u nog andere problemen binnen de supply chain?

Nee, ik denk dat dat het wel was.

4. Duidelijk, waar bent u trots op in de supply chain?

Dat we bijvoorbeeld onder de verschillende filialen veel informatie uitwisselen. Denk hierbij aan probleem, maar ook oplossingen hiervoor en inspiratie voor bijvoorbeeld een mooie presentatie in de winkel .

5. Duidelijk, en wat zou er direct moeten veranderen in de supply chain volgens u?

Transparantie tussen iedereen. Klanten komen vaak naar ons toe voor bepaalde producten die er dan iet zijn. De reden is dan bijvoorbeeld duidelijk bij de boeren, slecht weer bijv.

6. duidelijk, en als we het over afval hebben, waar denkt u dat het meeste ontstaat in de keten?

Als ik naar ons kijk vind ik dat we al veel afval maken en dat is één winkel. Wel is dit procentueel gezien erg weinig. Ik gok op de consument.

7. Bedankt! welke dingen zou u graag terugzien in een blockchain voor aardappels?

We hebben al een systeem binnen AH dat beschrijft waar de aardappel vandaan komt tot op het bedrijf. Die geld alleen voor Nederland, dit zou voor overige landen eigenlijk ook moeten gelden. Communicatie kan op dit moment ook stukken beter.

8. Ah juist, Denkt u trouwens dat deze blockchain wel toepasbaar is binnen de keten van aardappels? Denk bijvoorbeeld aan de kosten.

De AH kan het wel betalen, geen twijfel over mogelijk, ik vraag me wel af of boeren dit willen en kunnen opbrengen, zeker met de afgelopen protesten.

9. Snap ik, denkt u dan dat de blockchain nu toepasbaar zal zijn?

Nee, het vertrouwen is er gewoonweg niet

Duidelijk, bedankt, dit waren de vragen.

Afsluiting

Attachment V Celavita interview

Name: Jannes Schuiling
Education: Agri bedrijfskunde in Dronten
Job: potato Agri Manager bij Celavita
Years of experience: 25 years

1.Welke problemen zijn er rondom de communicatie tussen bedrijven in de supply chain?
Concurrenten zijn er altijd, hierdoor is het belangrijk om je eigen markt beschermen. Het beter zijn en worden dan de competitie, is hierin belangrijk. Weinig transparantie tussen de verschillende afdelingen in het bedrijf, wat soms kan leiden tot miscommunicaties. Hierin is persoonlijke interpretatie een belangrijk onderdeel. Men denkt het goeie te doen, wat uiteindelijk niet klopt met alle gevolgen van dien. Forecast op korte en lange termijn heel belangrijk, omdat wij werken met verse producten. Schakelen tussen processen in de productie hal moet zo kort mogelijk zijn, dus zo effectief werken al mogelijk. heel belangrijk.
2.Welke problemen zijn er rondom transport in de supply chain? Is er veel afval?
In principe gaat dit goed, geen verlies. Alleen de kosten zijn wat hoger als de leverancier verder weg zit, deze keuze wordt toch gemaakt voor verspreiden van risico's.
3.Kent u nog andere problemen binnen uw deel van de supply chain?
Complexer. Effectiviteit kan soms omhoog door een te lange schakelprocedure in de productie hal. Tijdens deze schakelmomenten produceer je niets en verdien je dus ook niets, waardoor dit duur uitpakt. Verder hebben wij veel verschillende aardappelproducten, dus is de productie soms complexer.
4.Waar bent u trots op in de supply chain?
Wij zijn een flexibel bedrijf die altijd in staat zijn op te producten te leveren. Er is een ruim aanbod, met een goede prijs kwaliteit (verse) verhouding.
5.Wat moet eigenlijk gelijk veranderen in de supply chain?
De Forecast op lange termijn is erg belangrijk en zou beter kunnen in mijn optiek.
6.Welk gedeelte in de supply chain creëert het meeste afval denkt u? En waarom?
Celavita produceert geen afval (99%). De schillen en beschadigde producten worden verwerkt tot veevoer. Afval water wordt ook hergebruikt in de vorm van de productie tot biogas. Dit wordt al 30 jaar gedaan dus Celavita is een voorloper op duurzame oplossingen.

7. Welke dingen zou u graag terugzien in een blockchain voor aardappelfriet?
De dag en lange termijn planning moet overzichtelijk zichtbaar zijn, net als de voorraden en volumes. Verder moet rendement er in komen, wat medewerkers motiveert. Prijs kan er niet in, reden hiervoor is het feit dat boeren meestal meerdere leveringscontracten hebben waardoor ze potentieel alleen nog gaan leveren aan de inkoper met de hoogste prijs. De aardappel sector is een vrije markt (ong. 30 euro per ton).
8. Een blockchain kan veel tijd, geld en moeite kosten. Denkt u dat u deel van de supply chain hier klaar voor is? Waarom wel/niet?
Vandaag de dag zijn we er nog niet klaar voor, omdat we niet de mensen op de juiste plek hebben. Momenteel gebruiken we SAP, waar ook al veer informatie in kan worden verwerkt. Interne processen veranderen gaat veel tijd in.
9. Denkt u dat er een kans is voor blockchain binnen de keten van aardappelfriet?
We bedanken u voor uw tijd en moeite
Ja, alleen de aardappel sector is traditioneel en redelijk terughoudend. Misschien is het wel goed voor vernieuwing in de toekomst.
Afsluiting

Attachment VI Researcher interview

Name: Ayella Spaapen
Education: Aeres University of Applied Sciences
Job: Researcher Aeres University
Years of experience: 5 years

1.Welke problemen zijn er rondom de communicatie tussen bedrijven in de supply chain?
Het grootste probleem wat we zien met data is dat de verschillende systemen echt wel een probleem is. Bedrijf A gebruikt bijvoorbeeld een ander intern format dat bedrijf B en dat is niet handig. Boeren zelf willen ook niet alles delen. Hierin kunnen zeker verbeteringen plaatvinden.
2.Welke problemen zijn er rondom transport in de supply chain? Is er veel afval?
Dat weet ik niet precies want ik zit er niet zo diep in. Wat ik wel weet is dat de nieuwe Brexit regels voor vertraagd transport kunnen zorgen wat resulteert in meer voedselverspilling. Temperatuur regulatie tijdens transport kan ook verbeterd worden voor vermindering van voedselverspilling.

3.Kent u nog andere problemen binnen uw deel van de supply chain?

Bij de verwerkers vindt het meeste voedselverspilling plaats, bijvoorbeeld de schillen van de aardappels en al het water wat wordt gebruikt. Een ander probleem kan gelinkt worden aan de matige transparantie vanuit de retailers. Transparantie tussen stakeholders is het grootste probleem op dit moment.

4.Waar bent u trots op in de supply chain?
Niet van toepassing
5.Wat moet eigenlijk gelijk veranderen in de supply chain?
De transparantie moet echt beter, want dit resulteert in meer vertrouwen tussen de stakeholders in de supply chain van aardappelfriet. Voornamelijk bij geïmporteerde

aardappels is de transparantie ver te zoeken. Dit kan worden uitgelegd door het feit dat bedrijven weten wat en mis gaat intern, en dit liever niet delen met de buitenwereld wat best logisch is.

6.Welk gedeelte in de supply chain creëert het meeste afval denkt u? En waarom?

De verwerkingsindustrie produceert het meeste voedselverspilling in het begin van de keten. Over de hele keten produceert de eindconsument het meest voedselverspilling. Blockchain zou een middel kunnen zijn om de algemene voedselverspilling te verminderen. Echter er zou ook een platform kunnen komen die boeren gelijk in contact zet met de eindconsument (Short Supply Chain).

7. Welke dingen zou u graag terugzien in een blockchain voor aardappelfriet?

De oorsprong van het product is belangrijk om een beter beeld te krijgen over de algemene voedselketen van aardappelfriet. Verder is het interessant om te zien onder welke omstandigheden het is gemaakt, Bv datum poten en rooien, om te kunnen bewijzen dat een product vers is of niet. Hierbij is transparantie weer noodzakelijk voor reductie van de voedselverspilling.

8. Een blockchain kan veel tijd, geld en moeite kosten. Denkt u dat u deel van de supply chain hier klaar voor is? Waarom wel/niet?

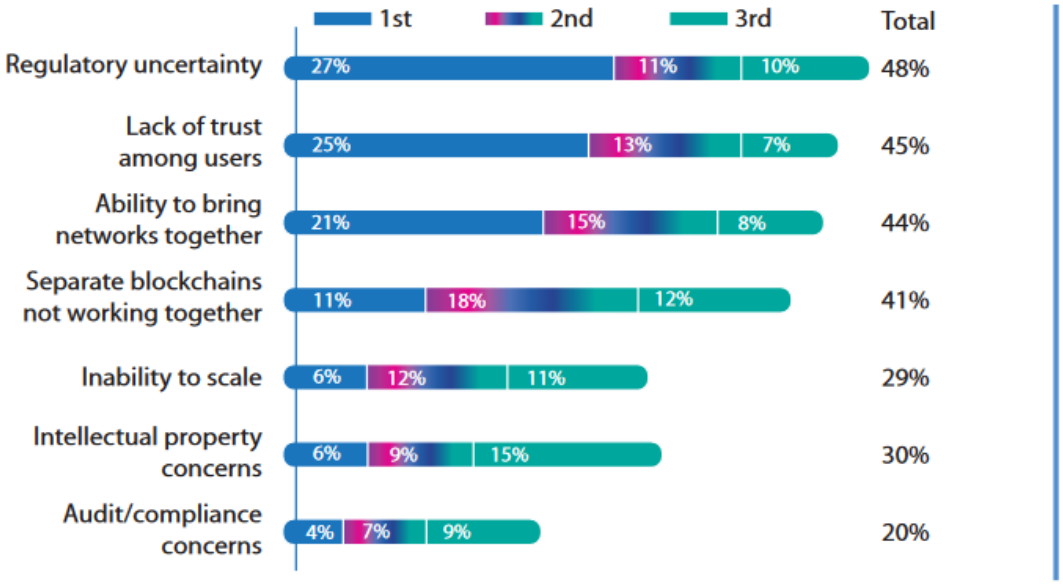
Voornamelijk de grote bedrijven zijn er klaar voor, alleen ik denk dat de boeren en niet echt op zitten te wachten. Het moet voor de boeren een simpele oplossing zijn wat in praktijk misschien niet zo is. Als de grote afzetters de boeren in de toekomst gaan eisen dat je je producten op een blockchain zet, moet je dit dus wel toepassen voor de voortzetting van je bedrijf. De blockchain moet echter wel een meerwaarde vormen voor de boeren. Als het initiatief van de boeren komt, wordt het waarschijnlijk gevormd door een coöperatie of een samenwerkingsverband.

9. Denkt u dat er een kans is voor blockchain binnen de keten van aardappelfriet?

Op dit moment is het nog te vroeg. Veel mensen associëren blockchain gelijk met bitcoin wat hedendaags nog niet echt heel betrouwbaar is. Er moeten meer voorbeelden komen van blockchain in de voedselsector, om er voor te zorgen dat het ooit kan worden toegepast in de keten van aardappelfriet. Er is op dit moment nog te weinig informatie beschikbaar over blockchain in de keten om geaccepteerd te worden. Marketing is hierbij erg belangrijk.

Afsluiting

Attachment VII Blockchain risks



The biggest barriers to blockchain adoption

(Respondents' top three challenges)

Source: PwC blockchain survey