

# Perception of the convenience of a digital data registration system in a food processing company

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## THESIS

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# Perception of the convenience of a digital data registration system in a food processing company

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## Preface and acknowledgments

In this document, you find the thesis that has been conducted during my fourth-year placement. In this thesis research is conducted on the perception of the convenience of a digital data registration system in a food processing company.

It was very interesting to see all the different aspects of changing from a paper-based registration system to a digital system. Being involved in this process made me realize how important it is to evaluate whether employees are willing to accept a change. The research helped to gain new insights into the difficulty of change management.

I would like to thank Ms. Olga Lis for her coaching in writing this report. Her knowledge and experience in the field of food safety are very appreciated. Secondly, I would like to express my appreciation to Ben & Jerry's Hellendoorn for providing the environment and support to accomplish this research.

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## Summary

Technology is widely available and there are many systems ready to be implemented into a company-specific production environment. In food production, digitization of data registration is an option, meaning that record keeping activities no longer have to be performed on paper. It is important to know if employees are capable of changing to a digital system. In order to evaluate this, research was performed on the perception of the convenience of a digital data registration system in a food processing company. A pilot was set up at a food processing company to replace the paper-based data registration by a digital system. The digital data registration system is used by means of an iPad. A survey was used to measure work-floor employees acceptance and answers the main- and sub questions.

During the research was investigated if there is a certain employee profile that is not ready for digitization. The research revealed that there is no specific group of employees less accepting digitization than others. Employees of all ages and with different digital knowledge background are accepting a digital data registration system, as long as the design of the system is good. The main advantages of the digital data registration system are improved efficiency and reduced paper hassle. The digital data registration system saves time and improved the workflow. Employees indicated that Wi-Fi connection should be well functioning at any time when using a digital system. Wi-Fi connection is debatable because the connection itself is important, however, employees can use this connection for other purposes than performing the registrations. The second improvement is that connections should be established with already existing systems in the production environment in order to exchange information and reduce the number of questions asked for. This will have a positive impact on the efficiency of the production process.

Based on the findings of this research it is recommended that companies implementing a digital data registration system design the system as easy and user-friendly as possible so that employees with different age and digital knowledge background are able to use the system. Food processing companies should evaluate the supporting factors such as the Wi-Fi connectivity and data exchange possibilities of their systems. It improves the implementation process of a digital data registration system.

To extend this research it is recommended to evaluate the possibilities of using more iPads during the pilot and extend the research to other food processing facilities. More registrations should be included in order to see if employees are also willing to use the system when they have to use it for several hours per day.

# 1. Introduction

Technology is widely available for the manufacturing industry and there are many systems ready to be implemented into a company-specific production environment. In food production, digitization of data registration is an option, meaning that record keeping activities no longer have to be performed on paper. The digitization of data registration in a food processing company is discussed in this research paper.

Many companies evaluate the possibilities of transforming their existing paper-based data registration system into a digital version. Digitization will have impact on the way employees are performing their tasks. This has raised questions at the management level of several food processing companies about if employees will accept the change and are willing to use a digital data registration system. It is therefore important to understand how employees value the digital system. In order to evaluate this, research will be performed on the perception of the convenience of a digital data registration system in a food processing company. Investigating the acceptance of a digital data registration system is important because implementing a new system is of no use when employees are not accepting it. A pilot has been set up at a food processing company to replace the paper-based data registration by a digital system. A survey is used to measure work-floor employees acceptance.

## 1.1 Documentation and record keeping in food safety management

Food safety is a major concern worldwide for the food producing sector. Food businesses implement a company-specific food safety management system (FSMS) to control the production process and ensure that food safety requirements are met (Luning & Marcelis, 2009). The food safety management system is an important part of quality management in food production. Organisations use a quality management system (QMS) to direct and control the implementation of quality policies and to achieve quality objectives. According to Manoj et al., (2013) quality management practices have a favorable impact on operational variables such as productivity, quality, delivery, and customer as well as employee satisfaction.

The food safety management system ensures regulatory compliance to required standards by actively controlling risks and hazards throughout the food production process. Significant biological, chemical or physical hazards are identified at specific points. Once identified, these hazards can be prevented, eliminated, or reduced to safe levels. Documentation and record keeping helps to maintain the food safety management system (Jacxsens et al., 2009).

“If it is not written down, it never happened”. This statement is the essence of record keeping and documentation (Stier, 2014). Documentation is aimed at storing knowledge and information, and record keeping is aimed at collecting the data (Luning et al., 2009). Without written or electronic records, a food processor cannot demonstrate that the foods, beverages, or ingredients they are manufacturing are safe, wholesome, and of high quality. Without procedures that describe how things are done, including protocols for gathering records, the facility would be chaotic (Stier, 2014).

Documentation and record keeping is a relevant part of the food safety management system because it verifies activities and ensures that implemented processes are effectively and consistently carried out. Record keeping of information about food safety activities is needed to judge performance and identify where improvements need to be made. It can be seen as the control of the effectiveness of the system (Luning et al., 2009). Examples of record keeping

activities include gathering information about metal detectors, foreign matter, the effectiveness of cleaning and temperature checklists. The records provide insight into information about production and who has been responsible for the performed tasks. It is important to measure the performance of production through monitoring and verification. Monitoring provides information for action within a specified time frame. Verification provides information for confirmation of conformity. Both monitoring and verification identify the needs for updating and improving procedures, identify trends which indicate a higher incidence of potentially unsafe products and confirms that the system meets the arrangements and food safety management system requirements established by the organization (ISO, 2018).

In order to store documentation and record keeping information, a document-control program is needed. A document-control program consists of procedures, work instructions, forms, and records. It may be electronic or hard copy. If an electronic system is adopted, then there must be controls to ensure that the system is tamperproof. The gathering of records is realized by having registration in production, which allows companies to have a record keeping and documentation system in place. It provides assurance that all essential tasks have been performed and allows companies to verify that quality and safety management procedures that are implemented are being followed (Stier, 2014).

## 1.2 Digitization and implementing digital record keeping

Since the beginning of the 90s, a phenomenal development is having its impact: the internet and later smartphone apps have changed almost every aspect of daily life. Similar to the way daily life has been transformed, digitization will have a profound impact on how a process or manufacturing industry conducts its business in the future (Isaksson et al, 2017). Nowadays, nearly all new information is created in a digital format (Xie & Matusiak, 2016). The relevance of digitization is confirmed through a standard designed by ISO (International Organization for Standardization). ISO/TR 13028:2010 shows the implementation guidelines for digitization of records. The standard is applicable for use in the design and conduct of responsible digitization by all organizations undertaking digitization (ISO, 2012).

The enabler for digitization is the Internet of Things (IoT). Internet of Things is the umbrella term for all devices that can be connected to the internet. It enables devices to connect and exchange data. Connecting these devices to the cloud makes information available at any location and with any device (Xia et al., 2012). Digitization of record keeping activities ensures that all data is available at one central place, accessible to many devices. It is preferred that all employees involved in the specific activity have access via an integrated system (Luning et al., 2009). It is important to realize that digitization can only be successful when the cloud and IoT solutions are able to guarantee the security of the data (Isaksson et al, 2017).

The implementation of digitization in food safety management can increase the efficiency of the system (Isaksson et al, 2017). Nowadays, nearly all new information is created in a digital format (Xie & Matusiak, 2016). Digitization is the future, however, many food businesses have paper-based record keeping activities. A recent research survey reported that 53% of manufacturers still rely on paper-based systems when it comes to quality management (Rowe, 2012).

The digitization of record keeping can help to make the process of measurement, analysis and improvement of the food safety management easier and information readily available, which is an important part of the improvement of the food safety management system and thus critical

in fulfilling customer and applicable statutory and regulatory requirements (ISO, 2015). The digital system captures and stores data in a structured format, improving the process of searching and analyzing. Information stored in the system becomes available at any time at any place, meaning that new information is available to anyone instantly, and no documents are lost. The digital system makes the archival processes easier because everything can be stored in the system. Folders are no longer necessary to store the papers.

An example of an industry that has implemented digitization is the healthcare industry. The benefits of digitization in this sector include improvements in the quality of care and reduction of medical errors. A research performed by Menachemi and Collum, (2011) on the benefits and drawbacks of electronic health record systems shows that on organizational level, financial and operational performance has increased, as well as satisfaction among patients and clinicians using EHR systems. Societal outcomes include being able to conduct research more effectively and efficiently achieving improved population health. Despite many advantages, there are also disadvantages related to the implementation. These include financial issues (costs related to the EHR system), privacy and security concerns and changes in the workflow (Menachemi & Collum, 2011).

The push towards implementation of digitization raises questions related to the acceptance of the technology. Changes in the work system can have consequences for the workflow. A research to the acceptance has been done in the case of Electronic Health Records. Research indicated that employees using the Electronic Health Records were more accepting the system at 12 months as compared to 3 months. The longer they were using the system, the more they realized the benefits and started accepting the change. A key characteristic of the change process is the ability of end users to participate effectively in the implementation process (Carayon et al., 2011).

### 1.3 Factors influencing the acceptance of digitization

The concept of digitization is difficult to understand in a world that still uses paper as a support for multiple social communications, advertising, financial and educational uses (Orantes-Jiménez et al., 2015). Causes are the initial rejection of changes and the belief that a printed document is more valuable than a digital one. The perception is that the process of digitization is complex (Orantes-Jiménez et al., 2015). Involving employees in the process of digitization is important. In the end, employees in production are dealing with the procedures and registrations on a daily basis. When they are given a chance to provide input into the design and implementation of a digital system, they are more likely to accept and use it (Carayon et al., 2011).

In order to implement changes at a company, it is important that management itself shows commitment. Motivating employees is the key to reaching organizational changes and it is important to show the usefulness of making a change (Howard et al., 1999). Many organizations are ready for change, but it is cultural adoption that makes the process of implementing a change difficult (Edge, 1990).

Digitization requires a change in how registrations in production are done. Before implementing digitization it is important to know if employees are capable of changing to a digital system. The perceived usefulness and ease of use have an impact on the adaption of technology. Decision makers need to know the issues that influence users' decision to adopt new technologies so they are able to take them into account during the implementation phase



(Taherdoost, 2017). Therefore it is important to gain knowledge about how employees experience the change to a digital quality system as well as working with the system once it has been established.

In order to evaluate the acceptance of a digital data registration system, the main research question has been established: *What is the perception of the convenience of a digital data registration system in a food processing company?*

The focus in this research will be on food processing companies that are keeping a record of production information on paper. Examples of production information are cleaning checklists, registrations of metal found in production, temperature logs, and training checklists. The research provides the food processing industry with information about the perception of the convenience of a digital data registration system, and thus the acceptance, in a time that technology is increasingly important. The perception of the convenience of a digital data registration system will be measured among the work-floor employees of a food processing company. This company, like many other companies, considers replacing its paper-based record keeping by a digital system. Digital data registration can be completed using different devices. The chosen device for this research is a tablet because it is convenient to take along in production. The research is limited to the perception of the convenience of digital data registration system at food businesses. No other industries are taken into consideration.

The sub-questions on the topic are:

- How do different work-floor employees judge the digital data registration system?  
To specify this question: Does the age and level of familiarity with new technologies affect employee's judgment of a digital data registration system?
- What are the advantages of a digital data registration system according to the work-floor employees?
- What are the disadvantages of a digital data registration system according to the work-floor employees?
- What points of improvement do work-floor employees think can be made to the digital system of data recording?

Food businesses can take the outcome of the research into consideration when deciding to change from a paper-based registration system to a digital one. It demonstrates where to pay attention to during implementing and what could be the pitfalls of the implementation process.

## 2. Material and methods

In order to find out about the perception of the convenience of a digital data registration system in a food processing company, a pilot has been set up at a food processing company that produces ice cream. The company is a large-scale processor with many years of experience and is like many other food businesses concerned with innovation and implementing most recent technologies. During the pilot, the paper-based data registration system of the company is replaced by a digital system. The digital data registration system is used by means of an iPad. This device was chosen because it is easy to take along in production and allows to take pictures of non-conformities at the line. A survey was conducted to obtain information about work-floor employees thoughts. The survey existed of quantitative as well as qualitative research questions.

The focus during the pilot was on the registration of the metal detector. Foreign matter forms the single biggest cause of consumer complaints and may come from a wide variety of sources, including metals (Edwards, 2014). According to EU legislation 178:2002, all potential hazards must be eliminated or reduced to an acceptable level. Each food producing company in the EU is legally obliged to have foreign matter control in place, meaning that many companies do the same type of recording keeping. For all these companies the outcome of the research is useful for deciding what factors should be taken into account when moving towards a digital data registration system. The advantage of the registration of the metal detector is that the document is used often in the production facility of the ice cream company. This enabled work-floor employees to get used to the new way of record keeping in a short time period and to share their thoughts based on actual user experience.

The registration of the metal detector is done frequently. Every produced product goes through the metal detector. Each product is individually tested on the possibility of containing metal. The metal detector is set on a certain value, based on the density of the product. When the metal detector detects a higher value than the originally set value, a registration needs to be done in order to verify that no metal is found in the product. Sometimes ice cream is too soft, meaning that the density has changed. This is also a reason why the metal detector detects a higher value. Besides this reason, there are a few other possible reasons for a higher value. When work-floor employees perform the paper-based registration, they have to write down the needed product information and the reason why the value was higher. Employees also indicate whether or not metal was found in the product.

The registration of the metal detector was converted into a digital format to make it available on the iPad, after which it was introduced into the production facility of the company. The paper-based registration included some additional questions that were not useful anymore. These questions were removed when converting the registration. The difference between the paper-based and digital registration is shown in Appendix 1. Due to time limitations, it was not possible to translate the Appendix into English. However, the most important difference is the layout. The difference in layout between the paper-based and digital data registration can be noticed without understanding the content of the registration.

When selecting employees for the pilot, the age of the person and knowledge of digital systems was taken into consideration in order to assure that the group of respondents would represent a variety of work-floor employees. In order to fill in the registration of foreign matter, employees participate in a training module. The work-floor employees who were identified for the pilot have all successfully participated in the training module. A successful participation in the

training module demonstrates that the employee is capable of performing the registration of the metal detection.

The goal was to have 25 employees participating in the pilot and to measure the acceptance using a survey. This number was not reached, instead, 17 employees participated in the pilot, who have all completed the survey. The survey consisted of quantitative and qualitative research questions. The quantitative research questions helped to answer sub-question number 1:

- How do different work-floor employees judge the digital data registration system? To specify this question: Does the age and level of familiarity with new technologies affect employee's judgment of a digital data registration system?

The characteristics of the sub-question are a narrow scope and established categories for observation, meaning that quantitative research is the best fit. The qualitative research questions helped to answer sub-question 2, 3 and 4 and are open questions:

- What are the advantages of a digital data registration system according to the work-floor employees?
- What are the disadvantages of a digital data registration system according to the work-floor employees?
- What points of improvement do work-floor employees think can be made to the digital system of data recording?

The questions were asked to the work-floor employees in order to generate new ideas and insights. To these characteristics, qualitative research is the best fit (Baarda, 2014).

The survey is attached in Appendix 2. The first two questions were categorizing the age of the person and the knowledge about digital systems. It enabled to analyze the obtained data from question 3 and 4 according to the categories. Questions 3 and 4 were scaling questions, focused on acceptance and usage of the system. The above-mentioned questions enabled to answer sub-question number 1: *How do different work-floor employees judge the digital data registration system?*

A more positive attitude towards the digital system of data recording suggests to go ahead with implementing the system, a negative attitude indicates that additional training and support is needed. All scaling  $\geq 6$  indicate a positive attitude. All scaling  $< 6$  indicate a negative attitude. When the majority of respondents indicated a positive attitude towards the acceptance and usage of the system it can be said that the overall judgment of the digital system of data recording is positive. When the majority of respondents indicated a negative attitude towards the acceptance and usage of the system it can be said that the overall judgment of the digital system of data recording is negative.

Besides providing information about the overall attitude towards the digital system of data recording, the answers to the acceptance of the system were also analyzed based on age categories. According to Venkatesh et al., (2012) resistance towards technology increases with age. Therefore it is expected that employees in the category 35-49 and 50+ face more problems related to adoption than employees in the category  $\leq 34$ . In order to identify if this is true, a chi-

square test was performed, comparing age and overall acceptance of the digital data recording system. The chi-square test showed the relationship between the variables “age” and “acceptance” (Baarda, 2014). Based on the profile of employees within a company, a decision can be made on whether or not to implement a digital system of data recording, and if additional training is needed.

The relation between knowledge about digital systems and ease of using the system was also identified. The expectation was that the digital data recording system is easier to use when the knowledge about digital systems is good. In order to identify if this was the case, a chi-square test was performed, comparing knowledge about digital systems and usage of the digital data recording system. The chi-square test demonstrated whether the knowledge of employees about digital systems influenced the usage (Baarda, B. (2014). Based on employees’ knowledge it can be evaluated if extra support is needed.

In order to answer the remaining sub-questions, qualitative questions have been asked. The questions are:

- What are the advantages of a digital data registration system according to your experience?
- What are the disadvantages of a digital data registration system according to your experience?
- What points of improvement do you think can be made to the digital system of data recording (based on the difficulties you are now facing)?

The answers to the qualitative questions were categorized based on similarities to gain new insights. The different categories were formulated into answers supporting the sub-questions. The different categories were established according to the answers given on the questions that were asked to the work-floor employees.

The pilot took place in one food processing company. This, together with the obligated training that is needed to execute the registration of the metal detector made the number of participants of the pilot limited. The research provided a general impression of the implementation process of a digital data registration system. It demonstrated where to pay attention to during implementing a digital data registration system and what are the possible pitfalls during the implementation process.

Based on a company’s employees’ profile a decision can be made on whether it is the right time to implement a digital data registration system. When a certain employee profile is not accepting the change, it might be better to wait or include extra training in the implementation process.

### 3. Results

During the research, work-floor employees were asked about their age and knowledge about digital systems. Employees indicated their acceptance of the digital data registration system, as well as the ease of using the system by rating it on a scale from 1 to 10. Employees were asked about the advantages and disadvantages, as well as the possible improvements that could be made. The obtained answers from the surveys are found in Appendix 3 and 4.

#### 3.1 Judgement of a digital data registration system

The overall acceptance, age in relation to acceptance, and knowledge of digital systems in relation to the ease of using the system was researched to discover work-floor employees' thoughts about the digital data registration system.

One of the goals was of the research was to judge the overall acceptance of the digital data-recording system by the work-floor employees. All the participants in the research rated the acceptance  $>6$ , meaning that it can be stated that the overall acceptance of the digital data registration system is positive.

The next goal was to research the age in relation to the acceptance of the digital data registration system. The results of the research were put in a cross table, and a chi-square test was performed. There were two possible outcomes for the research:

HO: Significance  $\geq 0.05$  = there is no relation between age and acceptance of the system

H1: Significance  $\leq 0.05$  = there is a relation between age and acceptance of the system

The chi-square test showed a result of 0.438, meaning that HO was adopted: there is no relationship between the age of work-floor employees and the acceptance of the digital data registration system,  $X^2(6) = 5,869$ ,  $p < 0,5$ .

Table 1 below also shows that it is not the case that work-floor employees in the age categories 35-49 and 50+ were giving lower ratings for the system. In fact, the age category of 50+ is the only category that has two ratings of 10.

Table 1: Age categories in relation to the rating of the acceptance of the digital data recording system

	<i>Count of: Acceptance rated with a 7</i>	<i>Count of Acceptance rated with an 8</i>	<i>Count of: Acceptance rated with a 9</i>	<i>Count of: Acceptance rated with a 10</i>
Age category $\leq 34$	0	3	1	1
Age category 35-49	2	1	2	1
Ace category $\geq 50$	0	3	1	2
<b>Total</b>	2	7	4	4

Another goal of the research was to investigate the knowledge of digital systems in relation to the ease of using the system. Work-floor employees have estimated their own knowledge about digital systems. These questions were asked in order to see if there is a correlation between knowledge of digital systems and their perceived ease of using the system. The results of the research were put in a cross table, and a chi-square test was performed. There were to possible outcomes for the research:

HO: Significance  $\geq 0.05$ = there is no relation between knowledge of digital systems and ease of using the system

H1: Significance  $\leq 0.05$ = there is a relation between knowledge of digital systems and ease of using the system

The chi-square test showed a result of 0.264, meaning that HO was adopted: There is no relationship between estimated knowledge of digital systems and perceived ease of using the system,  $X^2(8) = 10,021$ ,  $p < 0,5$ .

The chi-square test showed that there is no significant relationship between estimated knowledge and perceived ease of using the system. However, table 2 below does show that employees who have indicated that their knowledge about digital systems is good, tend to rate the ease of using the system with a 10. Employees who indicated that their knowledge is moderate, tend to rate the system with an 8. It is interesting that the employee who indicated poor knowledge of digital systems has rated the ease of using the system with a 9.

Table 2 Estimated knowledge about digital systems in relation to the perceived ease of using the system

	<i>Count of: Perceived ease of using rated with a 5</i>	<i>Count of: Perceived ease of using rated with a 7</i>	<i>Count of: Perceived ease of using rated with an 8</i>	<i>Count of: Perceived ease of using rated with a 9</i>	<i>Count of: Perceived ease of using rated with a 10</i>
<i>Estimated knowledge about digital systems: poor</i>	0	0	0	1	0
<i>Estimated knowledge about digital systems: moderate</i>	0	0	4	1	1
<i>Estimated knowledge about digital systems: good</i>	1	1	1	2	5
<b>Total</b>	1	1	5	4	6

### 3.2 Advantages of a digital data registration system

Work-floor employees were asked about the advantages of a digital data registration system in order to investigate what the advantages are compared to a paper-based registration process.

Table 3 demonstrates the answers that were given and the frequency. The answers were categorized based on similarities.

Table 3 Advantages of digital data registration system

Category	Answers	Frequency
<b>Efficiency</b>	Faster	8
	Digital is easier	5
	Optimisation of the production line	1
	Ticking boxes is easier than writing on paper	1
<b>No paper hassle anymore</b>	No paper hassle anymore (e.g. missing registrations)	5
	Less paper	3
	iPad ensures that everything is always readable	1
	Less printing of papers	1
<b>One device for data registration</b>	One device for data registration	1
<b>Understanding the language</b>	Easier for employees who's understanding of the Dutch language is not optimal	1

#### **Efficiency**

Fifteen employees indicated that the digital data registration system improved the efficiency. The most important reasons were that it is faster and easier in comparison to the paper-based registration process. The digital registration has multiple choice fields at which all the possible answers for registration of foreign matter are already given. This means that employees only had to tick the right box (see appendix 1 for clarification). One employee mentioned that this is easier than writing the answers on paper. The multiple-choice fields are also the reason for a faster and easier registration process. A more efficient registration process contributes to optimization in production, improving the overall performance.

#### **No paper hassle anymore**

An advantage of the digital data registration system is that employees no longer have to deal with missing and damaged papers, unreadable handwriting of other employees and printing. When employees are not able to read the registrations of others, it is not clear what was the reason for registration. Papers can get damaged when water is spilled during cleaning, meaning that employees have to fill in the forms again. The iPad ensured that this no longer can happen.

#### **Understanding the language**

One employee indicated that the iPad is easy for employees who do not have a full understanding of the Dutch language. Ticking the boxes means that employees do not have to worry about grammar and the correct use of words. This answer is elaborated on in the discussion of results.

### One device for data registration

One employee mentioned that using the same device for data registration, every time when needed is an advantage. There are many different registrations in production printed out on paper. Employees no longer have to search for the right one.

### 3.3 Disadvantages of a digital data registration system

Work-floor employees were asked about the disadvantages of a digital data registration system. Table 4 demonstrates the answers that were given and the frequency. The answers were categorized based on similarities.

Table 4 Disadvantages of digital data registration system

Category	Answers	Frequency
<b>Connectivity</b>	No Wi-Fi at the line	6
<b>Ease of using</b>	That older employees might not understand the iPad	1
	The paper-based registration process is faster	1
<b>The use of an iPad</b>	Small screen and small font, a computer is preferred	1
	That the registration needs to be done on an iPad, but the idea is good	1
<b>The device has no permanent place</b>	No permanent place for the iPad	3
<b>No disadvantages</b>	No disadvantages	4

#### Connectivity

In the production facility where the pilot took place, there is no Wi-Fi connection at every point in production. At the end of the day, all performed registrations must be synchronized in order to be stored in the online database. Employees experienced the bad Wi-Fi connection as a major disadvantage of the digital data registration system.

#### Ease of using

One employee indicated that the paper-based registration process is faster. Another employee indicated that the iPad was easy to use, but that he was not sure whether older employees will understand the iPad as well. However, both the employees who provided these answers did rate the ease of using the system with an 8 and 9.

#### The use of an iPad

Two employees indicated that they like the digital way of data registration, however, they would rather perform the registration on a computer screen. It was mentioned that the iPad screen is small comparing it to the screen of a computer and that a computer would be more convenient because it is used at the line for monitoring and control of the machines.



### **The device has no permanent place**

Three employees mentioned that it is a disadvantage that the iPad has no permanent place. The difference with a computer is that a computer needs power and therefore has a fixed place at a desk. The iPad only needs power for charging. Due to this feature, the iPad can be put and used at any place in production. The 3 employees would rather see that the iPad also has a fixed place in production.

### **No disadvantages**

Four employees indicated that they experienced no disadvantages from the iPad at all.

### **3.4 Points of improvement for a digital data recording system**

Work-floor employees have been asked about the points of improvement for the system. Table 5 demonstrates the answers that were given and the frequency. The answers were categorized based on similarities.

Table 5 Possible improvements for a digital data registration system

<b>Category</b>	<b>Answers</b>	<b>Frequency</b>
<b>Connectivity</b>	Connect with the metal detector	4
	Wi-Fi connection	5
<b>Ease of using</b>	Reduce the number of questions asked for	2
<b>The iPad</b>	That the registration can be performed on a computer or via the metal detector system	2
<b>Permanent place</b>	Design a permanent place	3
<b>No possible improvements</b>	Nothing	1

#### **Connectivity**

Many employees indicated that the most important possible improvement is establishing a good Wi-Fi connection in production. Making Wi-Fi available in production can have both a positive and negative influence. This is explained in the discussion of results. Employees also indicated that they would like to see a connection between the digital data registration system and the metal detector.

#### **Ease of using**

Two employees would like to see a reduced number of questions asked for. Four employees indicated that the iPad should be connected to the metal detector. Connecting to the metal detector reduces the number of questions asked for because the connection ensures that more information will already be available on the iPad, reducing the number of questions. This possibility will be discussed in a next chapter of the thesis.

#### **The iPad**

The employees who indicated that the disadvantage of the digital data registration system was the iPad, have also indicated this as a possible improvement.

**Permanent place**

According to one employee, the most important possible improvement is to design a permanent place for the iPad.

**No possible improvements**

Three employees indicated that there are no improvements possible.

## 4. Discussion of results

This chapter provides the discussion of the results of the research. The used research method is discussed to uncover any shortcomings during the research process.

The main objective of this research was to gain insight in the acceptance of a digital data registration system and to provide an impression of the implementation process of a such a system. The relation between age and acceptance of the digital data registration has been researched, as well as the relation between knowledge of digital systems and the ease of using the system. The advantages, disadvantages, and improvements provide insight into the possible pitfalls during the implementation process in a food processing facility. Other companies can use the outcome of the research when deciding to change from a paper-based registration system to a digital one. The more complex paper-based registration is simplified with the use of an iPad. The research is particularly interesting for companies having a metal detector in place because the focus was on this specific type of registration.

### 4.1 Judgement of a digital data registration system

The most important question when implementing a new system is whether employees are willing to use it and are accepting the change. The result of the measurement of the overall acceptance of the system by work-floor employees was unexpectedly high. The positive attitude towards the digital system by all of the employees suggests to go ahead with implementing the system and that no additional training is needed. This specific conclusion can only be drawn for the company where the pilot took place because there are many variables that can impact the perception of the convenience of the digital data registration system. The result could have been different if the work environment and used software were different and if another type of registration was chosen. However, the results can indicate that the overall acceptance of a digital data registration system may be positive in case of food businesses who are considering introducing similar changes as the food processing company where the pilot took place.

The age in relation to the acceptance of the system and the knowledge of digital systems in relation to the ease of using the system were researched to investigate if there is a certain employee profile that is not ready for digitization. According to Venkatesh et al., (2012) resistance towards technology increases with age. However, during this research, it turned out that there is no specific group of employees less accepting digitization than others. The chi-square tests revealed that there is no relation between age and acceptance, and knowledge of digital systems and the ease of using the system. Older employees are accepting the change as much as the younger employees and they are as willing as the younger employees to use the digital data registration system. This implies that a company's employee profile is not necessarily an indication of whether or not to implement a digital data registration system. A possible reason for this outcome is that the chosen software was very easy in use. The perceived ease of using influences the acceptance of technology. According to Chung et al., (2010) technology users, whether they are young or old, are more willing to use online systems when they are easy and useful.

Possible reasons for the unexpectedly good acceptance of the digital data registration system are the design of the system and the ease of using, as well as the formulation of questions (see appendix 1). Employees only have to click the right document and fill in the information, after which the iPad can be put away until the next time a registration needs to be performed.

Everything is saved automatically and there are no options in the system that can cause confusion (like different ways of saving for example). Employees only see the registrations that have to be done that day, meaning there is no confusion in which one to choose. The registration of foreign matter on paper included many questions that were not applicable anymore. However, employees were obligated to answer them because they were part of the document. In the digital version of the registration, these questions were removed and formulated in a better way, making the document easier to understand. It is very important to convert a paper-based registration into a digital version in a good manner. When a digital data registration system is user-friendly and the registration has been well converted, employees with different age and knowledge backgrounds are able to use the system (Chung et al., 2010). Carayon et al., (2011) performed research to “ICU nurses' acceptance of electronic health records”. During the research, the acceptance of the change to electronic health records technology was assessed. This research also revealed that factors related to technology design have strong effects on the acceptance.

It was not expected that the older employees would accept the system as well as younger employees. A possible explanation of why the acceptance did not differ based on age is that also older people are forced to use technological means because in some cases there are no alternatives available (Peek, S., 2017).

It could be questioned whether the number of participants in this research was sufficient to have fully reliable outcomes of the chi-square tests. According to Hackshaw, A., (2008) there is nothing wrong with conducting small studies; they just need to be interpreted carefully. There was not much variance in the responses of the employees who took part in this research. This is confirmed by the fact that all participants indicated a positive acceptance of the system. If there would have been much variance in the responses, it would have been more difficult to formulate answers supporting the sub-question. Also, employees with different backgrounds were taken into consideration, increasing the relevance of the outcomes. The number of respondents in the research was limited due to the fact that there were not many employees allowed to perform the registration of the metal detector in production, however, the majority of this small group of employees has been part of the research. Another factor that influenced the research was that it was not possible to have more than one iPad in production or to run the pilot in other food processing companies. If this would have been possible, more registrations could have been included in the pilot, increasing the number of the respondents. It is unfortunate that these factors and limitations were part of the research.

For a next time, the opportunity of introducing more iPads at the same time in production, or including more companies in the pilot, should be evaluated. More registrations should be included, in order to evaluate whether employees also accept the system if they have to use it several hours per day and for purposes other than the metal detector. It will also demonstrate how employees experience sharing the device with others, and how this will turn out when many more registrations have to be performed each day, using the same device. During this research, it was not possible to include more registrations due to limited available time.

#### 4.1 Advantages of a digital data registration system

The advantages of a digital data registration system were discovered by asking work-floor employees about their user experience. Their answers showed what the main advantages are and how this has contributed to the acceptance of the system.

The answers to this question were categorized, however, many of the answers are related to each other. The categories showed that the main advantage of a digital data registration system is the improved efficiency. The reduction of paper hassle was the second big advantage. The advantages are related because the reduction of paper hassle influences the efficiency.

Because almost all the answers are in some way focused on efficiency, this can be named as the most important reason for acceptance of the system. Work-floor employees experienced in real-life that it saves time, even though some of the employees were quite skeptical about if the digital data registration would improve anything at all.

As already mentioned in the results, one employee named that the iPad is easy to use for employees who do not have a full understanding of the Dutch language. At many companies in the Netherlands employees of non-Dutch origin are employed. At the food processing facility where the pilot took place, this is also the case. The employee told that the digital registration system has positive effects on her registration process because it limits the amount of typing. However, it depends on the type of registration. One registration may require much typing while another might include only ticking off the options. The feedback indicates that the digital data registration system could possibly be helpful for food processing companies where many employees of non-Dutch origin are employed.

#### 4.3 Disadvantages and related possible improvements

Employees have been asked about the disadvantages of the system. Their thoughts show what the disadvantages are and also indicate the pitfalls during implementation. It reveals the difficulties related to the acceptance of a digital data registration system. The disadvantages are related to the possible improvements.

The main disadvantage mentioned by employees is connectivity. Employees explained that if management would like to implement a digital data registration system, the Wi-Fi connection should be well-functioning at any time. The Wi-Fi connection in production was not thought about prior to the start of the pilot. Throughout the pilot, this has been discovered and experienced as a pitfall of the implementation process. When there is a bad Wi-Fi connection, employees get frustrated. The synchronization takes longer/ cannot take place at all, meaning that the registration will not be sent to the online database that is connected to the application on the iPad. A negative influence of Wi-Fi in production is that employees will have access to the internet via the iPad. During the pilot, it was discovered that employees had been looking at news websites. This is not desirable in a production facility because it means that employees are using the iPad for other purposes than work. It indicates that there are both advantages and disadvantages related to the Wi-Fi connection. A Wi-Fi connection in production is a possible improvement, however, it should be decided whether the benefits of the Wi-Fi connection in production outweigh the disadvantages.

There is a possibility of connecting already existing systems in production to the digital data registration system. Information is gathered from the system and automatically sent to the iPad.

In case of the registration of foreign matter, information from the metal detector will automatically appear in the registration that employees have to perform. This connection reduces the number of questions asked for during the registration and increases the efficiency. Employees explained that they think that the digital data registration system will function at its best when connections such as mentioned above are established, especially when more registrations will be digitalized in the future.

During the research, two employees mentioned that they would rather perform the registration on a computer screen. This is a possibility, however, the iPad is easier when registrations have to be performed at more than one place in production. It is a multi-purpose device and ensures uniformity in the method of performing registrations. This uniformity is desirable for creating and maintaining a standardized registration method.

Employees indicated that they feel that a disadvantage of the digital data registration system is that there is no permanent place for the iPad. A possible reason for this answer is that usually, all information employees have to take a look at is displayed on a computer screen. The iPad requires a completely different way of working. A permanent place should be designed for the iPad so employees know where to put the iPad for charging and when changing shifts. This ensures other can find the iPad and that people do not leave the iPad somewhere behind in the factory. It ensures that the iPad will not get lost when several employees are using it.

One employee indicated that he was not sure whether older employees would understand the iPad. The results of the age in relation to the acceptance show that it is not the case that older employees experience more problems understanding the iPad compared to younger employees.

Many employees have given the same answers to the questions. This makes the answers more reliable, even though the number of respondents was limited. During the analysis, it was visible what where the most important disadvantages and the related possible improvements.

## 5. Conclusions and recommendations

The perceived usefulness and ease of use have impact on the adoption of technology. In this research, both of these aspects were measured in order to evaluate the perception of the convenience, and the acceptance of a digital data registration system at a food processing company. The research provided an impression of the implementation process of a digital data registration system. It demonstrated where to pay attention to during implementing a digital data registration system and what are the possible pitfalls during the implementation process. Food businesses can take the outcome of the research into consideration when deciding to change from a paper-based registration system to a digital one. During the research, the focus was on the registration of the metal detector. This makes the research of particular interest for companies having a metal detector in place.

One of the goals of the research was to find out how work-floor employees judge a digital data registration system. The age in relation to acceptance of the system and knowledge about digital system in relation to ease of using the system was researched. The research demonstrated that employees of all ages and with different digital knowledge background are accepting a digital data registration system, as long as the design of the system is good. The system should not cause any confusion, meaning that the design should be easy and functional. When deciding to change to a digital data registration system, existing paper-based registrations should be well converted, ensuring that only necessary information is asked for.

Another goal of the research was to find out what the advantages are of a digital data registration system, compared to a paper-based registration system. Employees indicated that the most important advantages of the digital data registration system are improved efficiency and reduced paper hassle. Employees have experienced in real-life that it saves time and improves the workflow.

Besides finding out what the advantages are, another goal was to discover the disadvantages of a digital data registration system and the possible improvements related to it. The connectivity has revealed a possible pitfall during implementation. Wi-Fi in production is important when implementing a digital data registration system and should be well functioning at any time. However, it is not desirable that employees in production have internet access at all times because they can use it for other purposes than performing registrations. Companies considering digitization of their registration system should decide whether they think the benefits of a Wi-Fi connection in production outweigh the disadvantages. When implementing a digital data registration system, connections should be established with already existing systems. The systems can exchange information, reducing the number of questions asked for. Employees indicated that they think that a digital registration system will function at its best when such connections are established, as it increases the efficiency and reduces the number of questions asked for.

The above-named goals contributed to achieving the main goal of the research: discovering the perception of the convenience of a digital data registration system at a food processing company. The research showed that the perception of the convenience is very good. This was confirmed by the 100% acceptance rate of the digital data registration system by the employees that took part in the pilot.

The limitations of this research were the number of employees that took part in the pilot, as well as the available time for performing the research. 17 Employees were part of the pilot, due

to the nature of the company where the pilot took place, as well as the chosen registration that was used during the pilot. During the research, it was noticed that there was little variance in the answers provided by the employees. This was beneficial for providing answers on the main- and sub-questions.

Based on the findings of this research it is recommended that companies implementing a digital data registration system design the system as easy and user-friendly as possible. There should be no difficult options that cause confusion and employees should only see the registrations that have to be performed that day. The registrations should be well converted and ensure that only useful information is asked for. Food processing companies should evaluate the supporting factors such as the Wi-Fi connectivity and data exchange possibilities of their systems. It improves the implementation process of a digital data registration system.

It is recommended for food business that consider replacing their paper-based data registration system by a digital one, to take the research that has been performed on the topic into consideration before starting the implementation process. The implementation process is different for each company. Different software might be chosen, and different registrations might be in place. However, the results of research provide a general idea about what factors to take into consideration before implementing a digital data registration system, and how employees are accepting the change. To follow up on this research it is recommended to evaluate the possibilities of using more iPads during the pilot and extend the research to other food processing facilities. More registrations should be included in order to see if employees are also willing to use the system when they have to use it for several hours per day. Including more iPads and extending the research to other food processing facilities will also increase the number of respondents. It is recommended to measure the perception of the convenience among 100 employees. It allows to have at least 25 employees of every age category and to have different digital knowledge backgrounds included.



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## Appendix 1. Metal detector registration




### Appendix 1.1. Paper-based metal detector registration

De geprinte versie is 7 dagen geldig		Registratie vreemde delen	
Printdatum : 24-jul-18		0703163	
Metaaldetector vul in: A, B			
PRIMAIRE ACTIE : <b>Productie</b>		Lijn :	
Productiedatum:		Vriezer Nr.:	
Productcode:		Mixtank Nr.:	
Productnaam:			
Tijd uitstoot metaaldetector :			
Lotcode van de pot:			
Tijd van de pot:			
Uitstoot veroorzaakt door:			
<b>A. ontdooide potten</b>		<b>B. Anders</b>	
Acties:		Acties:	
1. Bij een serie uitstoten van ontdooide potten 2 potten uitzeven, <b>bij regulier proces boven threshold uitzeven</b>		1. Verdacht product uitzeven	
Daarna mag de metaaldetector i.o.m QA manager of MWD verhoogd worden tot 1000 (hoger dan 1000 op blokkade zetten)		2. Onderdeel B van dit formulier invullen en formulier inleveren bij teamleider ( of lijnassistent bij afwezigheid teamleider)	
2. Onderdeel A + B van dit formulier invullen en formulier inleveren bij de teamleider.		3. In geval van meerdere uitstoten: Teamleider of shift coördinator (of shift coördinator bij afwezigheid teamleider)	




<b>A. Ontdooid potten</b>	
Instelwaarde verhoogd: JA / NEE	
Nieuwe instelwaarde:	
Begin en eindtijd nieuwe instelwaarde:	
<b>Let op: De instelwaarde mag niet worden verhoogd zonder toestemming QA manager of manager van Dienst (max. 1000)</b>	
<b>B. Anders</b>	
<b>Gegevens metaaldetector: terug te lezen op het vispro scherm onder kop controle</b>	
Instelwaarde:	Uitwerpwaarde 1:
Voorwerp gevonden : JA / NEE	Uitwerpwaarde 2:
Magnetisch : JA / NEE	<i>Plak hieronder gevonden voorwerp</i>
Lijkt gevonden voorwerp op eerder gevonden voorwerpen: JA / NEE	
Wat kan dit gevonden voorwerp zijn? Eventueel laten zien aan TD	
Wat kan de oorzaak zijn (bijv. schoonmaak/repairatie)? Eventueel checken met TD	
Opmerkingen:	
Vervolg Acties Nodig : JA / NEE	

## Appendix 1.2. Digital metal detector registration




**Nieuw** **Metaaldetectie**

☐   




Tijd(en) van uitstoot

☐   




Tijd van de pint

☐   


Vul de productcode in




☐   

Vul de naam van het product in


☐   

Wat zijn de uitwerpwaarde(s)?



☐   

Wat is de reden van registratie



Maak een keuze

Annuleren

opties

Fotocel geblokkeerd >

Zacht product >

Product vast onder metaaldetector >




Test zonder pv test te activeren >

Hand onder metaaldetector >

Geen productie/schoonmaak >

Geen product in opvangbak >

Onbekend >

☐   

Wat is de vervolgactie?

Nieuw

Metaaldetectie

Tijd(en) van uitstoot

tekst

Tijd van de pint

tekst

Vul de productcode in

tekst

Vul de naam van het product in

tekst

Wat zijn de uitwerpwaarde(s)?

?

tekst

Wat is de reden van registratie

?

Maak een keuze

Wat is de vervolgactie?

Maak een keuze

Annuleren

opties

Product opnieuw door metaaldetec... >

Zeven 

i

 >

Meerdere potten: 2 potten zev... 

i

 >

Weggooiden >

Geen actie >

## Appendix 2. Survey for work-floor employees

1. Age
  - <34
  - 35-49
  - 50+
2. Estimation of own knowledge about digital systems (tablets, smartphones, smartwatches, digital computer systems)
  - Poor
  - Moderate
  - Good
3. Overall acceptance digital data recording system  
On a scale from (1) dislike very much and don't want to use to (10) like very much and eager to use it.  
(1) (2) (3) (4) (5) (6) (7) (8) (9) (10)
4. Digital data recording system in use  
On a scale from (1) Difficult to (10) Easy.  
(1) (2) (3) (4) (5) (6) (7) (8) (9) (10)
5. What are the advantages of a digital data registration system according to your experience?
6. What are the disadvantages of a digital data registration system according to your experience?
7. What points of improvement do you think can be made to the digital system of data recording (based on the difficulties you are now facing)?



### Appendix 3. Quantitative data collected by the surveys

<b>Respondent</b>	<b>Age</b>	<b>Estimation of knowledge digital systems</b>	<b>Acceptance of system</b>	<b>Ease of using the system</b>
<b>1</b>	35-49	Moderate	10	10
<b>2</b>	35-49	Moderate	7	8
<b>3</b>	35-49	Moderate	7	8
<b>4</b>	50+	Good	10	10
<b>5</b>	≤34	Good	9	10
<b>6</b>	≤34	Moderate	8	9
<b>7</b>	≤34	Good	10	9
<b>8</b>	50+	Poor	8	9
<b>9</b>	≤34	Good	8	9
<b>10</b>	50+	Good	8	7
<b>11</b>	35-49	Good	8	5
<b>12</b>	50+	Good	9	10
<b>13</b>	50+	Good	10	10
<b>14</b>	≤34	Good	8	8
<b>15</b>	35-49	Moderate	9	8
<b>16</b>	35-49	Good	9	10
<b>17</b>	50+	Moderate	8	8

## Appendix 4. Qualitative data collected by the surveys

<b>Advantages</b>	<b>Frequency</b>
Faster	8
Less paper	3
Ticking boxes is easier than writing on paper	1
Optimisation of production line	1
Digital is easier	5
No paper hassle anymore (e.g. missing registrations)	5
iPad ensures that everything is always readable	1
Less printing of paper	1
One device for data registration	1
Easier for employees who's understanding of the Dutch language is not optimal	1
<b>Disadvantages</b>	<b>Frequency</b>
Small screen and small font, a computer is preferred	1
The paper-based registration process is faster	1
No Wi-Fi at the line	6
That the registration needs to be done on an iPad, but the idea is good	1
That older employees might not understand the iPad	1
No permanent place for the iPad	3
No disadvantages	4
<b>Possible improvements</b>	<b>Frequency</b>
That the registration can be performed on a computer or via the metal detector system	2
Reduce the number of questions asked for	2
Connect with the metal detector	4
Wi-Fi connection	5
Design a permanent place	3
Nothing	1