Operational and Financial Implications of Implementing RFID in the Fast-Moving Consumer Goods Sector

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Abstract

As a result of digitalization, the food industry, along with the rest of the retail industry, faces many new challenges. With an increased customer demand for sales and a seamless experience through digital channels, larger companies, with a traditional store concept, need to adjust their business concept accordingly.

Some of world's most successful companies – Walmart and Amazon – has identified a need for implementation of digital tools in traditional supermarkets to meet new customer demands. One of the digital tools used is RFID, which is used to increase efficiency throughout the whole supply chain. Some companies have found the results of the technology to be satisfying, while some others have abandoned their projects, due to increased costs. The aim with this thesis is therefore to investigate if RFID could be the disruptive technology that ICA, the largest food retailer in Sweden, amongst others could use to stay attractive on the rapidly changing market.

Due to a more significant production of RFID-tags and new technologies, the price has dramatically decreased during the past ten years. The decreasing price has led to more considerable interest in the technology since the areas of usage can be increased, e.g., in the fast-moving consumer goods industry. The price of each tag is crucial, considering the enormous number of SKUs being processed every year. The technology is considered to both lower costs, increase revenue and to increase the shopping experience, hence the large interest of it. On the contrary, the technology is not to seldom referred to be a threat against the personal integrity - causing privacy issues.

Surveys indicate that out of all industries, the fast-moving consumer goods sector is the slowest adaptor to e-trading. The research of this thesis investigates if there is a social acceptance of the usage of RFID-technology among customers in grocery stores, which will be cross reference with previous research. Further, the aim is to identify how such a digital tool affects the daily operations of ICA-stores and how it affects the profitability of such businesses.

Preface

We want to thank Wiley Wakeman, who has been our supervisor during the project. Further, we want to thank the business owners; Claude Schaffert, Jesper Carlsson, Charlie Karlsson, and Per Paulsson, for participating in the interviews as well as sharing data. A big thank you is also directed to the business managers, Jesper Hägg and Adam Westerling, who also participated in the interviews and brought valuable insights from an operational perspective. Last but not least we want to thank the 367 people who made the quantitative study possible.

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1.0 Introduction

This chapter discusses the details, premises and interesting aspects of the question at issue. Furthermore, the complexity of the subject is discussed and presented, together with the approach methods that permeate the project. Due to the width of the question at issue limitations are introduced, in order to increase the accuracy and the scientific credibility, which are presented below. Lastly, the visual disposition of the report is presented.

1.1 Background and Problem Formulation

Retailers, as all business owners, continuously face new difficulties meeting and challenges, especially due to digitalization. The challenges can be due to external factors, where the technology creates a new kind of demand, or internal factors, where the technology creates new competitive opportunities. A recurring challenge for the retail industry has been to increase the self-service level in the store concept, which it historically has throughout different phases. The first paradigm shift in Swedish retail history took place during the 40s. Stores were restructured into self-service rather than being constructed for a shop owner to serve each customer over the counter, "*Centrum för Näringslivshi*storia".[1]

Further expansion of self service has led to the fact that we today can shop in stores completely without interaction with any staff through self-service checkout points. Dabholkar (1994) introduced the name TBSS (Technology Based Self-Service), which is the technology that these self-checkout points are based upon.[2] Some companies have, through digitalization, taken their store concepts even further. Tredgold and Reynolds (2016) describes the challenges that a retailer is facing due to the digitization and exemplifies some concept in line with technological development.[3] In the article, Desigual is mentioned as an example of a company which introduced a store concept without inventory. Instead, customers got the purchased products sent home via the online channel, arriving the same afternoon. Furthermore, Hointer, with a store concept completely without staff, is mentioned as an innovative example of real futuristic store concepts.

The development within the food industry is undeniable, which raises the question of what the value of such innovation is. It is furthermore also a fact that reducing the cost of staff, assuming everything else is constant, is lowering the overall cost of the company, giving it a competitive advantage. Online actors continue to increase their market share, were the growth level of the online food industry was among the highest of all industries in Sweden, with a growth rate of 19%.[4] This while conventional supermarkets are left with a rigid business model, with fewer possibilities to decrease expenses and re-allocate resources. This leaves the conventional supermarkets with a big question, what must they do to stay attractive in the rapidly changing market? According to Bower and Christensen (1995), large companies must embrace disruptive technologies in order to stay attractive compared to new emerging companies.[5] With this thesis and the assumption that conventional supermarkets need to change their business concept in order to compete with new actors, we intend to investigate whether RFID could be just that disruptive technology and enable ICA to live another 100 years.[6]

[1] https://www.ica-historien.se/artiklar/sjalvbetjaning-infors/ - [Accessed 16 March 2019].
[2] Dabholkar, 1994.
[3] Treadgold et al, 2016.
[4] https://dhandel.se/wp-content/uploads/2018/08/digitalmathandel-2018.pdf?fbclid=IwAR1Se9AfzlKGTkYpmnxXIhaS4OgL1wda83FVnDApFFRnT1MP_F2php2Mmw8 - [Accessed 10 May 2019].
[5] http://www.yildiz.edu.tr/~naydin/MI2/lectures/Reading/Disruptive%20Technologie%20Catching%20the%20Wave.pdf - [Accessed 4 May 2019].
[6] https://www.ica.se/ica100/ - [Accessed 8 March 2019].

1.2 Purpose and Question Formulation

The purpose of this report is to identify the effects if implementing RFID-technology into the traditional store concept, within the food industry. As an effect of the formulation of the question, this thesis will be divided into one main question, which will be answered by the critical effects of the operational challenges.

1. Is there a social acceptance of the usage of RFID-technology?
2. How will the technology, from an operational perspective, affect the retailers?
3. How will the technology, from an financial perspective, affect the retailers?
   - 3.a What is the cost of investment?
   - 3.b What is the net value of the investment

1.3 Traditional Identification Technology

The development of store concepts has been possible due to the development of technology during the same period. Technology creates the requisite for change. An example of a major technological development that increased and enables self-service was the introduction of Bar Codes (EAN-Codes), which is the standard identification technology used for consumer goods. According to Barcoding Inc., the technology originates from 1949, when Woodland and Silver applied for a patent for the technology.[7] A standardized labeling procedure for products, which by a machine could identify the products and its price, has been crucial for the in-store efficiency development. Goods no longer needed to be labeled individually with a price, but a price on the shelf edge became enough. Over the years, attempts have been made to develop this technology further; for instance, QR codes were developed. Partee (2011) believes that the advantages of these codes are that more data can be stored, and more combinations of codes can be created since QR can be seen as a two-dimensional bar code. However, this technology has not had the same impact on the retail industry as EAN codes.

1.3.1 Modern Identification Technology

A technology that many large retailers have tested or are currently using in their business is RFID (Radio Frequency Identification). The reason why the technology is especially attractive to retailers is due to its range of functionalities. Among these functionalities are, for example, the possibility to store data, such as price, date, production location, product information digitally. Furthermore, one fascinating aspect of RFID is the reading speed, which increases the overall efficiency due the ability to be read remotely, unlike barcodes that need to be read individually with visual contact. Since RFID could be the technology to substitute or replace barcodes, it is relevant to illuminate the limitation and usage of the current technology.

Image 1 Traditional Barcode

Image 2 QR-Code

Image 3 RFID-Tag

[7] https://www.barcoding.com/resources/barcoding-basics/the-history-of-barcodes/ - [Accessed 8 March 2019].

Today, the RFID-technology is used for a various of purposes. Hunt et el (2007) states that the technology is used to automate customs, identification of newly-born children, tracing goods and in various payment contexts.[8] The technology is currently used mostly in logistics, even though that the functionalities of the technology clearly states advantages that the retail industry should be attracted to. Hunt et al (2007) believes that this gap primarily exists due to the large investments and complexity of the implementation of the technology. The price level of passive RFID-tags was approximately 1,14$ / tag during 2005.[9] Today, ten years later, the technology is more advanced, but most importantly the cost and price of the RFID-tags have, according to the RFID Journal, decreased with more than 90%. The possible areas of usage for the technology has therefore increased.[10]

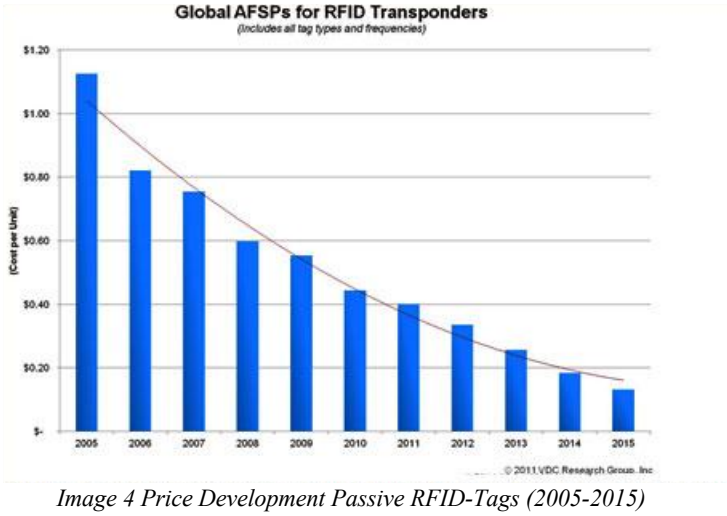


Image 4 Price Development Passive RFID-Tags (2005-2015)

One example of a large enterprise is Walmart, who previously tried to implement the technology in their supply chain. The conceptual idea was for the technology to both streamline deliveries, but also to increase efficiency within stores through individual labeling of goods. Initially, the technology was only used to increase the efficiency for controlling the quantity of goods delivered, tagging each pallet with a unique RFID-tag. Instead of counting all pallets and goods delivered, the RFID-tags were read and could instantly determine if any goods were missing. The project was later developed for each individual product to be labeled with an RFID-tag. The expansion increased and specified available inventory information for the staff, who now had real time information. With RFID-technology, the staff could see the exact inventory, with perfect sorting for sizes and SKU. Therefore, the technology improved ordering; correct products were ordered and lost sale opportunities, due to order mistakes, where minimized according to Bustillo (2010).[11]

Considering the changed circumstances, with particular focus on the fact that the technology is now both better and cheaper, this report examines whether there is an opportunity, but also interest, for the use of the technology in the FMCG-sector.

1.4 Limitations

The study was limited to investigate retail stores in Sweden, with an exclusive focus on the grocery industry. This gives a more detailed understanding of the issues and opportunities associated with the RFID-technology in the particular sector of the retail industry. The study solely focuses on the economic and operational consequences and prerequisite of the technology, but also weighs whether an implementation of the technology

[8] Hunt et al, 2007.
[9] https://www.rfidjournal.com/articles/view?9589/3#back-from-modal - [Accessed 9 January 2019].
[10] Ibid.
[11] Bustillo, 2010.

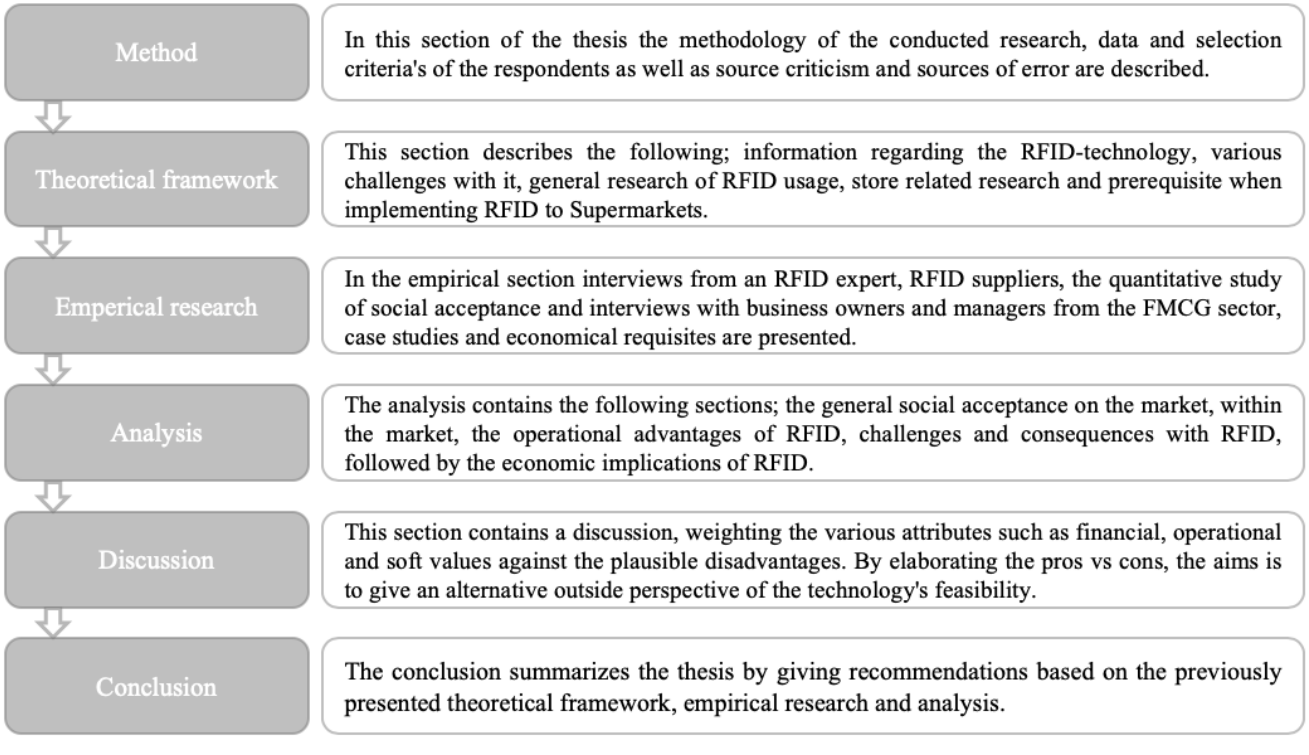
is possible from an intermediate level of ICA's supply chain. The implications of the technology are based upon that the implementation is possible. Further, the quantitative study only aimed to understand the attitude and social acceptance towards RFID and the intention to shop in a supermarket using such technology. A more comprehensive study of consumer behavior in association with the technology would need to be investigated, to ensure that the actual behavior correlates with the intentions.

1.5 Academic Contribution

The academic contribution of this thesis is complementing existing research of how technology can and will affect our economical society. Some researchers have provided evidence of how technological development increases the gross domestic product (GDP), but also decreases the demand for uneducated workforce leading to a decrease in private employment, i.e. a decrease in the relative private wealth. The phenomena were named *The Great Decoupling* by the researchers Brynjolfsson and Mcafee (2013).[12] This thesis provides evidence that even though technology might harm the private economy in long term, due to that the personal advantages are considered to be more important to the individual than the overall negative social implications. The consumer´s attitude towards technological development are in this thesis proven to not only be based upon lowered prices, improved quality and expansion of choice, but also the aspect of time-saving and convenience as motivating factors.

Further, the thesis contributes with aggregated analyzed data of consumer behavior and attitudes towards technological development. Among others, Fleming and Adkins (2016), compared *Millennials* to other generations in a study about data security risks.[13] This thesis provides evidence that the mindset towards data collection is not an absolute difference between millennials and older generations, but seems to steadily increase over time.

1.6 Disposition



[12] Brynjolfsson and Mcafee, 2013.
[13] Fleming and Adkins, 2016.

2.0 Method

This chapter contains a thoroughgoing structure, how information and data has been collected in order to answer the main question and sub questions, and the line of action when different methods has been applied. Furthermore, the methodical perspective and overall approach of the surveys is being explicated as well as a description of the processing of collected data through analysis and various data privacy aspects. Last but not least, this chapter questions the quality of the surveys and analysis of the thesis.

2.1 Methodology

The initial methodology was to identify the current situation in a specific research area and upon the situation identify a problem, which is relevant to investigate. In this case the currently almost non-existing technological development in consumer goods identification. The purpose of the study was to investigate the operational challenges and financial consequences of implementing RFID, which is accompanied by hard and soft values such as customer satisfaction. The primary purpose was then divided into smaller fragments of more specific issues. Furthermore, the study was limited to one area within the retail sector, the grocery industry, to make the subject manageable. In order to invigorate the results in the study, previous researches within connecting areas have been analyzed and compared with the current subject.

Information of the technology and data for the analysis was collected through qualitative interviews, quantitative surveys, literature, dissertations, scientific articles, journals, and internet sources to get a basis of theoretical character as well as an in-depth study and exploration of the subject at issue. Throughout the interviews, business owners and managers were selected in order to collect data to answer the question at issue. In cases where it was possible, information regarding economic and operational prerequisites was obtained. Furthermore, RFID-experts and manufacturers of RFID-systems were interviewed regarding the technical specification and functionality of the RFID-tags as well to get a clear understanding of the price level of the tags and associated components of the system.

A quantitative study was conducted in order to test the social acceptance for the technology, which is essential for an investment to be considered. Further information, needed to understand the possible operational challenges of such technology, was collected through qualitative interviews with store managers and business owners. Observations of consumer behavior in RFID-environment was not selected to be part of this study, due to the complexity of preparing a fictitious situation within the subject that can be performed repeatedly over time.

The qualitative interview questions were based on a standardized template, and the respondent was able to answer the questions without restrictions. The aim of the interviews was to obtain subjective expertise from within the sector, as well as knowledge of plausible operational challenges. Questions were simplified and clarified in order to facilitate the comprehension of the interview. Further, the interview followed a logical order, but depending on the answers of the respondent, a particular possibility to change the order of the questions was available. The template for the interviews can be found under the 9.1 under the attachment section.

In the quantitative study, the respondent was provided with information of the technology as well as a concept video of how the technology would affect the checkout area of the shopping experience, which was followed by nine statements and three questions and statements that the respondents shared their opinion about. The questions for the survey are presented in attachment 4.

2.1.1 Data Privacy

During interviews, primarily if sensitive or controversial information is obtained, it is essential to consider if the respondents might desire secrecy. Throughout this investigation, the only information that must be handled with confidentiality is the economic data from ICA Kvantum Åkersberga, which should not be shared with any unauthorized parties. All respondents were given a copy of the information obtained through their interview, which was corrected and approved by each respondent. The respondents were, before the interview, informed that the conversation was audio recorded and that it would to be deleted after usage. All interviewees permitted to the recordings and approved to be quoted by name, except for the manufacturers of RFID.

2.2 Criteria's for Selection of Actor Within the Retail Food Industry

2.2.1 Selection of Company

The selection of the company was primarily made by evaluating the availability and implementation possibilities of the technology at issue. The selected company needed to be able to gain a significant advantage. Furthermore, the selection was also based on comfort, meaning that the company chosen was easily accessible to the authors. There may be an advantage of targeting a company with a rather large market share since implementation in terms of involving suppliers increases with economies of scale. The investment cost to centralize and create a new standard for product labeling is a significant investment with large initial costs. Thus, the reasoning led to the selection of ICA as the central company for the investigation, with a particular focus on ICA Kvantum Åkersberga, whose data was obtained and should be handled with confidentiality as described in 2.2.1.

2.2.2 Selection of Retailers and Persons of Interest for the Qualitative Interviews

The selection of companies and people for interviews was based on the following three criteria:

1. The retailers primarily business area focuses on sales of food and related products
2. The retailer does not use an digital labeling instruments at article level in their store
3. The respondents would either be responsible for the operational activities in the store or be the business owner

The reason for the last criteria was chosen to obtain exciting aspects of people who have more extensive experience within the sector. This gives a better basis to evaluate and calculate the soft and hard values that the technology can generate, which increases the accuracy of the investment and its recommendations. In order to gather information about the technical feasibility and investment costs, a professional RFID-consultant in Stockholm was contacted and interviewed.

2.2.3 Selection of Respondents for Quantitative Study

Since the technology will be implemented into a traditional physical retail store concept, with a wide variation of customers, the respondents of the quantitative study were randomly selected with no respect to their demographic profile. Further, the survey was distributed online in forums and in the same network that ICA uses to measure their CSI. A total of 367 respondents conducted the survey, from which 242 were considered valid. More information about the quantitative study is presented under 4.3 in the empirical research section below.

2.3 Method of Analysis

The analysis of the empirical material was established by extracting essential and relevant information of the collected data and by cross-comparing it with, to the subject relevant, theoretical framework and theories. A sorting and compilation were performed in order to facilitate a connection of the information and the original purpose and question at issue. Furthermore, in order to obtain an understanding of the economic implications of the investment in a complete RFID-system, economic presumptions where made. Cost, savings and potential profit were based on information obtained in qualitative interviews with RFID-experts, business owners, managers and statistics from similar projects. The economic implications of the investment were calculated for ICA Kvantum Åkersberga, which is presented below in section 5.3. The cost-estimate is the base, which the calculation of present value (PV) of future cash was based upon. The calculations were made in order to determine the value and potential of the system from an individual business owner's perspective. Further, the calculations where exclusively based upon hard values. Soft values such as customer satisfaction, increased attractiveness and competitive advantage of the system has not been taken into account in the calculations.

2.4 Quality

The quality of the study was examined by evaluating its validity and reliability. Furthermore, a section of sources of errors for the study is presented below.

2.4.1 Validity and Reliability

The evaluation of the questions regarding validity and reliability is an essential prerequisite for the project to be considered to have scientific significance. The definition of validity is to have correct theoretical knowledge and method in order to investigate the problem.[14] Since the level of validity is measured throughout the whole process of the investigation, it is of great importance to have a consistent scientific approach. Hence, only relevant theoretical framework was used in all stages for the process.[15]

2.4.2 Quality of the Investigation

The initial determination of the quality of an investigation should be based upon credibility.[16] Respondents were given a printed copy of the information gathered from the interviews, which all respondents accounted for confirmed to be accurate and that they had been perceived correctly.

Since this study focuses on a smaller area, investigating only a handful of companies, it is crucial to investigate if the study can be adapted in other contexts, which increases the transferability of the investigation. Since technological development is changing the landscape of business owners almost every day, it is vital to keep in mind that this project is investigating opportunities and threats as of today. The research's transferability should be considered to be high enough to validate the usage of RFID within the whole Swedish FMCG sector.

2.4.3 Source Criticism

All the data collected has been reviewed critically, where the correctness, reliability, and relevance has been carefully reviewed.[17] In order for the data to be qualitatively satisfying, only well-known books and articles, as well as reliable homepages has been selected. Since the question at issue is based upon a fast-developing technology, it requires the usage of current information and data, hence the extensive usage of homepages.

[14] Trost, 2009.
[15] Patel and Davidsson, 2003.
[16] Bryman and Bell, 2007.
[17] Lundahl, 1992.

2.4.4 Sources of Error

In all investigations, there is always a risk that unreliable or incorrect information can influence the result. Most of the information about RFID is presented and produced by the manufacturer and users of the technology, in which the manufacturers might have beautified the functionalities of the technology. Further, it is hard to determine the objectivity of the empirical data, even though only significant results have been used. There is a risk that the interviewees have had an unproportionable, most likely positive, attitude towards the technology and/or branch performance. On the contrary, the awareness of this risk and the critical reviewing of the sources decreases the risk of wrongful information. Regarding the execution of the study and the collection of data, there is always a risk that alternative methods for data collection would have given different results or more comprehensive information.

The respondents in the qualitative study all live and work in Stockholm, which could affect their answers and attitudes towards such technology, leading to less varied opinions. Furthermore, the quantity of the qualitative interviews should be taken into account while reading the study; a larger sample size would increase the trustworthiness of the interviews. Furthermore, the quantitative study was distributed in online-sources, which could potentially differ from the population's actual opinion. The results, however, indicates the same as other, closely related, comprehensive studies. Some of the respondents are familiar with one of the authors, who did not participate in the interviews, but the familiarity might still have affected the outcome of the collected data.

3.0 Theoretical Framework

The chapter begins with a short description of the RFID-technology and a comparison of different types of RFID with its advantages and disadvantages. The technology that is used for the identification is then explained in a brief review, followed by an elaboration of the logistical advantages of the technology. Moreover, the primary variables of the technology, such as functions, areas of use and other previous research articles, are presented.

3.1 AutoID

A technology used to identify goods, products, animals or humans while in motion is called AutoID or "Automatic Identification".[18] Today, there are various techniques to enable the functionality of identification in different settings. Smartcards, Optical Character Recognition (OCR) and biometric identification such as finger, voice, and face recognition as well as RFID are the techniques that most often are mentioned within the AutoID segment. However, barcodes are one of the most commonly used AutoID technologies today. Barcodes became the most commonly used AutoID alternative due to its low cost, easy usage and the fact that it was the first available option. However, the limitations and disadvantages of barcodes have led to the development of alternative solutions, in order to meet higher standards of security and more abundant information storage.

Barcodes consist of binary code which is represented by black lines with various thickness and spacing. Each spacing and thickness of the lines represent a specific binary code, which is identified by an optical laser when it is directed towards the barcode.[19] Even though barcodes have been standardized over time, there is still some variation. The most common standard is called EAN (European Article Number), and the most common standard is called EAN 13 or EAN 15 (i.e., 13 or 15 digits in the series). Information that is represented in the EAN code is by a standard; country of origin, company, manufacturer's product number and the last control digit. The American correspondence to EAN is called UPC (Universal Product Code), with the same functionalities as the EAN code.[20] The advantages of the traditional barcode system, is as previously mentioned, that the technology is cheap and easy to implement. The disadvantages, however, are that barcodes only can contain a limited amount of information, they can only be read one at a time and that they depend on visual contact for the identification.[21]

3.2 RFID vs. Barcode

Radio Frequency Identification or RFID fulfills the same functionalities as traditional barcodes by sending information via radio waves.[22] The basic explanation of the data transportation is that a reader sends a radio wave in a specific direction, for example between two gate readers. The signal detects the RFID-chips, which then transcends the pre-set information such as identification number, price, expiry date, etc.[23] The technology is today commonly used in public transportation card, goods tracing and for opening doors.

[18] Finkenzeller, 2003.
[19] Ibid.
[20] Hunt et al, 2007.
[21] Finkenzeller, 2003.
[22] Ibid.
[23] Banks et al., 2007.

3.2.1 The History of RFID

The features of the RFID-technology did not emerge at any given time in history but has developed over time. The foundation of the technology was laid during the late 19th century with the increased understanding of electromagnetic energy, which led to the first radio and communication system.[24] The radar system was at first an anti-collision system and was therefore constructed to send and receive multiple signals simultaneously during World War II. Short thereafter, in 1947, the transistor was invented. This resulted in smaller and cheaper components, which is still the main reason for the deflation in cost for the tags. The following year, 1948, Harry Stockman detected that the radio wave could be transmitted to a non-electric tag, which was the foundation of the passive RFID-tags.[25] Further interest and research of the technology led to a broader area of usage, and was commercially used for the first time in the 1960s.[26] At the time, the tag was designed to yield a signal when it came close to a transmitter, which then was the first kind of alarm.[27]

A paradigm shift in the history of RFID was the invention of the first microprocessor in 1971. The tags could now be produced in smaller and more advanced versions. However, the commercialization of the technology including usage areas such as key/access cards, automatic tariffs, certain applications for rail transport and stock labeling emerged during the 1980s. During the 1990s and the dot-com bubble, RFID was subject for attention, primarily due to the overall technical developments that made it possible to put together and handle complex information. The impact of the technology was still limited due to relatively high material cost and the lack of standardization. In the early 21st century, the total cost for RFID-tags started to reach such a low level that becomes relevant for the retail industry in the context of replacing barcodes. The world's largest retailer, Walmart, and the US Defense, the world's largest supply chain have been demanding their suppliers to use RFID since the mid-2000s.

3.2.2 How Does the Technology Work?

An RFID-system consists of transponders/transmitters (RFID-tags), interrogators that read the signal and a controller. The controller is often a database on a computer, which defines the functionalities that are connected to specific events. The purpose of using middleware is to process large amounts of data, aggregate these data and send it to the business system to which the database is linked. The information received will then, depending on what the data indicates, automatically triggers different events, which in the retail context could be receiving price information.[28] An anti-collision system is required to prevent the tags' signals from colliding and cause errors in the system. Further, an authentication and encryption system are required to approve which tags that are used in the system and to protect the integrity of the information holder.[29]

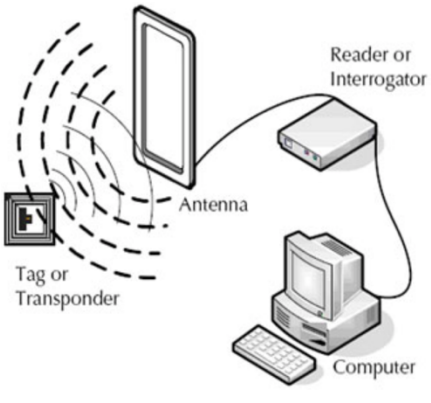


Image 5 RFID-System Hardware

The tags consist of a circuit board, a chip, and an antenna. In short, the circuit board acts as the body of the tag, holding the tag together. The material of the circuit board differs depending on the prospected usage area of the tag. The chip is the brain of the tag and consists of a collection of components required to store and provide information. The antenna allows the tag to communicate with a reader by receiving and returning radio signals.[30]

[24] Hunt et al., 2007.
[25] Banks et al., 2007.
[26] Hunt et al., 2007.
[27] Banks et al., 2007.
[28] Hunt et al., 2007.
[29] Ibid.
[30] Banks et al. 2007.

3.2.3 Active and Passive RFID-Tags

RFID-tags can be classified in active and passive tags. The main functionality is the same; to store and provide information to a responder. The main difference in functionality is that the active RFID-tag requires an internal energy source to send information, while as passive tags retrieve the energy needed from the reader when connected.[31] The active tags are therefore more expensive but can also provide higher accuracy and faster read from a longer distance than the passive tags. Other differences are that the active tag can hold more information, even though the differences have decreased with technological development. The positive aspects of the passive RFID-tag are its cost-advantage, smaller size and the fact that batteries never have to be changed.

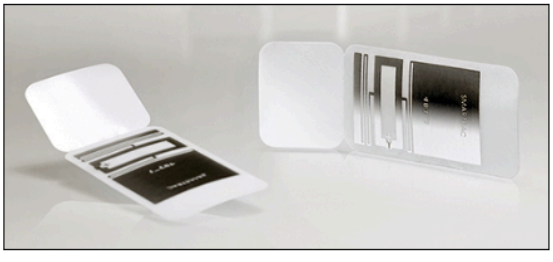


Image 6 Midas Flagtag (Passive RFID) [27]

Image 7 Midas Flagtag (Passive RFID) [28]

3.2.4 Vital Differences

The most crucial differences between the RFID-technology and the conventional barcode system is that barcodes can only be identified on at a time, while the RFID-technology can identify over a thousand tags per second.[33] Further, barcodes must be presented in front of a reader, while an RFID-tag can be identified from a distance.

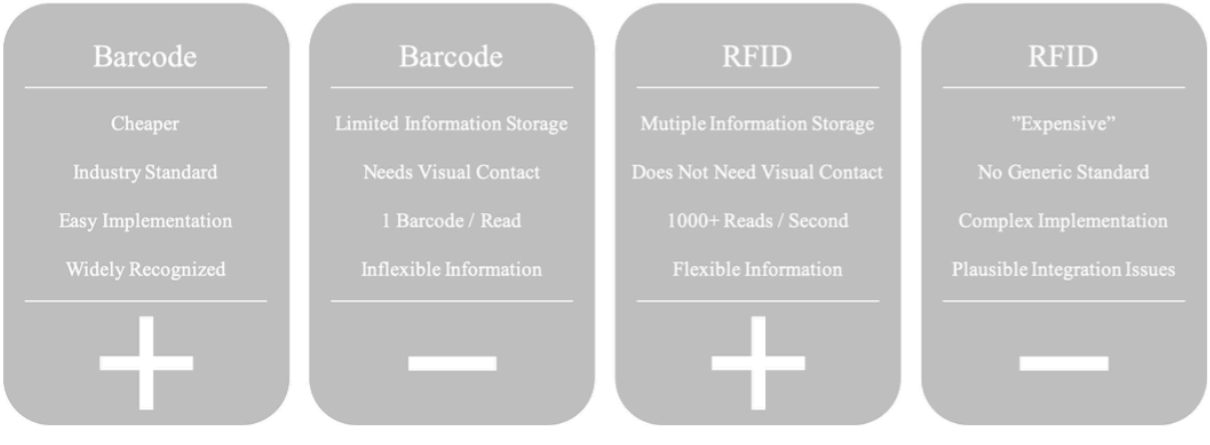


Image 8 - Comparison of Barcodes and RFID-technology

However, the RFID-technology does have some disadvantages. First of all, there is no industry standard of RFID-tags. Further, the implementation of the system can be complex, and the tags are more expensive than barcodes, even though the technology enables vast cost-saving possibilities.[34]

[31] Hunt et al. 2007.
[32] https://www.smartrac-group.com/midas-flagtag.html - [Accessed 11 February 2019].
[33] https://www.atlasrfidstore.com/impinj-speedway-revolution-r420-uhf-rfid-reader-4-port/ - [Accessed 28 April 2019].
[34] Banks et al, 2007.

3.3 Challenges with RFID

3.3.1 Technology Standardization

Since the technology has developed over time by different researchers, multiple standards for the technology has arisen. These standards indicate how the communication within the system is performed and what information the RFID-infrastructure provides.[35] As a result of the lack of standardization the tags communicate on different radio wave frequencies and therefore create troubles when used in the same system. Since 2010 there is an official standard for EPC, which is often used for the tags.[36] The problem today is that ISO standards provide a different standard and that it is still possible and widespread to use alternative configuration standards of the RFID-tags.[37] This leads to communication problems and slows down the development since third party innovations are restricted to one of the configurations. If the usage of the technology keeps increasing, it is plausible that a global standardization, restricting all RFID-tags to one standardization, which enables complete universal compatibility, will be implemented in the future.[38]

3.3.2 Privacy Aspects of RFID

Although RFID and other digital tools might have a positive spillover effect on the customer experience, some people consider the technology to be a threat against people's integrity. Givens (2004) conducted a study, which indicated that a combination of RFID's characteristics had woken this threat.[39] The following characteristics were presented;

1. The ability to mark and identify every single object in the world with an unique ID.
2. The fact that tags can be placed invisibly for the eye, but can be read from a distance without the consent or knowledge by the owner / carrier of the object.
3. The large amount of data that can be collected and used by the technology.

Walmart was probably one of the first actors to experience this concern when partly implementing RFID into their business. The issue that many lawyers expressed legal concern about was that the tags remain on the goods after the purchase was completed, which they argued to violate personal privacy. Besides, Carlsson (2004) expressed that some might fear that their integrity could be violated because of the monitoring of RFID tags.[40] An example, which has led to the nickname "spy chips", was a trial in a Tesco Supermarket in England. An RFID-system was tested to decrease stealth of razor blades. Each time someone took a package from the shelf and each time someone paid for a package a photo was taken. The photos could then be used to identify the people who took razor blades from the shelf without later paying for it.[41]

Further examples of integrity problems with RFID is its usage in public transportation cards, which tracks and saves information about people's travel patterns. This fact is hidden with the argument that it is used to plan the traffic better, but the companies collecting the data can identify and analyze individuals traveling behavior. In 2005, RFID was implemented in Swedish EU-Passports and driver's license, which makes it easier to identify people across national borders.[42] Some believe that unauthorized individuals can misuse personal information. The integrity question has been subject to concern even when the technology is associated with

[35] Banks et al. 2007.
[36] https://www.gs1.org/sites/default/files/docs/epc/Implementation_Guide_for_the_use_of_GS1_EPCglobal_Standards_in_the_Consumer_Electronics_Supply_Chain_-_May_2010.pdf - [Accessed 19 April 2019].
[37] Hunt et al. 2007.
[38] Ibid.
[39] Givens, 2004.
[40] Carlson, 2004.
[41] https://www.theguardian.com/business/2003/jul/19/supermarkets.uknews - [Accessed 14 May 2019].
[42] Albrecht, 2008.

less personal information. Furthermore, RFID-tags has been used on garbage bins to increase scavenging efficiency and accuracy, which potentially could be used by criminals to identify temporary empty homes.[43]

The privacy aspects are essential to consider and protect, as it potentially could be used against the free will of the consumer and potentially in various criminal activities.[44] One of the features required in the 2010 *EPC Global Standards* is for the information in the tags to be deleted after a purchase, which prevents some of the privacy concerns.[45] On the contrary, appose to the privacy issues that some researchers have expressed, many others assure that the risks are grossly excessive.[46]

Furthermore, the encryption of the information has and is still improving alongside the technological development. Chachra (2003) expresses that the privacy protection will have to be significantly improved before RFID would be commercialized on a consumer level.[47] What is important to consider, at the matter of data collection, is not only the regulations regarding the RFID-tags but also the legal action regarding how personal information can be stored and to what purpose it can be used. According to the General Data Protection Plan (GDPR), information about how the data is used must be communicated to the consumer. Consumers, if given consent, have the right to revoke their consent to the data storage, and most importantly, they have the right to be forgotten, e.g., can request all their personal data to be deleted. According to the regulation, there are strong restrictions on how the data can be collected and how it can be distributed to third parties and the data must in many cases be anonymized.[48] The regulation must be taken into consideration when using RFID, which prevents many of the privacy concerns.

3.4 General Research of RFID

Previous research has shown that RFID can significantly improve the efficiency of the whole supply chain, especially in the purchase process. Research also shows that RFID-technology could significantly increase the general level of customer service.[49] The technology is considered to provide information that can reduce wastage, both in terms of reducing human errors and by giving overall control over the inventory, reduce theft and streamline administrative work. The possible efficiency advantages if each product would be labeled on an article level are substantial. Reception of good is significantly faster as well as payment processes and inventory control, which means that resources can be saved or prioritized on more customer value-adding activities. One of the most considerable advantages with RFID-technology is that stock levels can be updated in real time with 100% accuracy, optimizing the stock keeping without having to take the margin of error into account when placing orders. Multiple researchers support the theory of RFID's advantages to optimize stock keeping, Zhu (2008) provided evidence that if the tags would be combined with RFID-readers on the physical shelf, stores would increasingly be able to order goods on time.[50]

Montauti (2006) is convinced, like many other researchers, that the cost of the tags is one of the main deciding factors when the technology is to be considered to be implemented in a business.[51] He also provides information about the development progress of the technology, which shows excellent decrease in size, increase in durability and improved capacity in data storage. Further, the research indicates a continuous decrease in price for the tags. This trend denotes, according to the author, that the usage areas of the technology will increase in correlation to the decreasing price. Knospe and Pohl (2004) supports the theory, but also emphasize the importance to overcome the technological barriers that exist; such as different standards, relatively short reading range and privacy aspects before the technology can reach its full potential.[52]

[43] Ström, 2007.
[44] Neumann and Weinstein, 2006.
[45] Ohkubo, 2005.
[46] Cline, 2004.
[47] Chachra, 2003.
[48] https://www.datainspektionen.se/vagledningar/for-dig-som-privatperson/for-medborgare---dina-rattigheter2/ - [Accessed 18 April 2019].
[49] Alexander et al., 2002.
[50] Zhu, 2009.
[51] Montauti, 2006.
[52] Knospe and Pohl, 2004.

Ferrer et al. (2010) conducted a study of 40 cases of RFID-usage, and selected 21 cases for his review in order to summarize the common effects of implementing RFID. The four primary advantages that most companies achieved was a reduce usage of resources through automation, a decrease cycle times, better customer service and lower wastage.[53] Furthermore, Roh et al. (2009), concluded three main reasons for business owners to implement RFID. The first reason is the expected positive benefits of the technology in terms of cost savings through less wastage, increased efficiency in the inventory work and through transparency in the supply chain. Moreover; pressure from customers, suppliers or competitors could lead companies to implement the technology. The final reason presented in the research was the fact that new business processes and products are created through RFID.[54] These positive aspects, presented by Ferrer et al. (2010) and Roh et al. (2009) are in accordance with previously presented research in this thesis.

3.4.1 Store Related Research of RFID

Although there are many positive aspects of using RFID-technology, the initial question to address is whether the consumers consider the technology to be attractive or not, e.g., if there is a social acceptance for the usage of the technology. Eckfeld (2005), points out the importance to gain social acceptance for the technology, especially among consumers. In order to gain acceptance, companies who use the technology need to provide evidence, empirical or statistical, that the consumer value of the technology exceeds the plausible integrity issues.[55] The social acceptance of such a technology is vital for RFID to be considered as an alternative to barcodes. In this thesis, social acceptance is referred to as the acceptance or tolerance of the technology, to such an extent that the plausible negative aspects are considered to not exceed the benefits. The results of the quantitative study of social acceptance for the technology is presented under 4.3 in the empirical section below.

In the report, *Den fysiska handelsplatsen i en digital värld*, presented by Svensk Handel, data of the most disturbing factors in the physical trading market and increasingly essential attributes for the physical stores were presented. If an innovation, no matter of what kind, would be implemented to solve the attributes presented in the report, it indicates that a majority of the consumers would appreciate the benefits of such innovation. If the implementation of the technology would solve some of the real disturbing factors, it could be the solution to gain social acceptance from the customers which is - as mentioned previously - crucial according to Eckfeld (2005) when implementing innovation into the traditional retail concept.

The most disturbing factors are presented as; queuing at checkout (37%), products in the assortment are missing (28%) and that there are too many customers in the store at the same time (27%).[56]

[53] Ferrer et al, 2010.
[54] Roh et al, 2009.
[55] Eckfeldt, 2005.
[56] https://www.svenskhandel.se/globalassets/dokument/aktuellt-och-opinion/vara-fragor/stads--och-platsutveckling/den-fysiska-handelsplatsen-i-en-digital-varld.pdf?fbclid=IwAR2TXjJFJYYRJXVMAnYAk7wKuhKAuMT7M5Z_sItWvUpm8loCUI84vWqCdKk p.30 f. - [Accessed 20 March 2019].

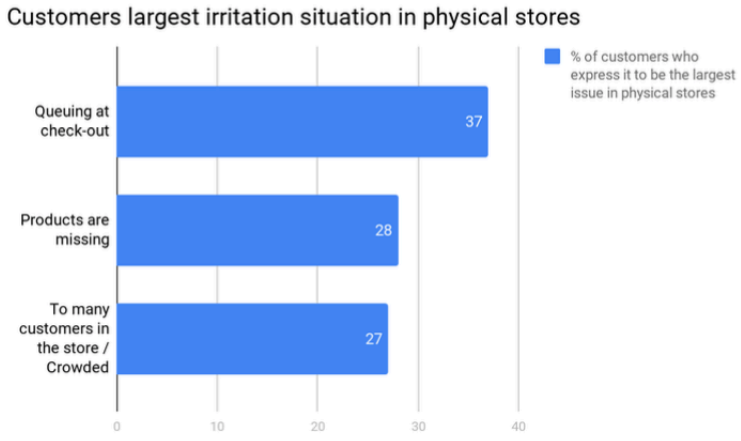


Image 9 – Most Disturbing Factors in the Physical Store

Furthermore, the report addresses that experiences and sustainability are two attributes requested by the consumer. Therefore, these attributes have become increasingly important for the physical store's attractiveness in comparison to substitutes, e.g., online-shopping. Experiences are defined, within the FMCG sector as; having tastings, seasonal adapted assortment and decoration, and to provide service that exceeds the customer's expectation.[57] Moreover, the time aspect has become imperative to acknowledge. As stated, long queues and waiting times is one of the most disturbing factors according to the report; customers have expressed a high willingness to streamline their purchase processes as much as possible.

IBM stated in a report from a six-week trial that the checkout process using RFID-technology was approximately seven times as fast than traditional cashiers and 15 times faster than self-checkout using barcodes.[58] The impact that RFID has on this matter is presented under the empirical section.

A comprehensive study, with over 71 000 respondents from 29 different countries, conducted by Gruen et al. (2002), addresses one of the most disturbing factors presented in Svensk Handels report - products in the assortment that are missing. According to the study, an average of 8,3% of the products that consumers planned to buy could not be found on its ordinary shelf space. The authors found that in 28% of the cases the problem derived from upstream in the supply chain and could therefore not be directly resolved on a store level. On the contrary, approximately 25% of the products were missing due to operational mistakes, the products were in stock but had not been restocked. The final 47% was due to incorrect orders and/or forecasts. The economic consequence of this phenomena, i.e., what consumers do when "their product" is missing, is also presented in the study. The data indicates that approximately 40% of all the cases result in a complete loss in sales, where consumers either do not purchase the item at all or buy it elsewhere. The remaining 60% of the consumers either buy a substitutional product or delay their purchase to another day in the same store.[59]

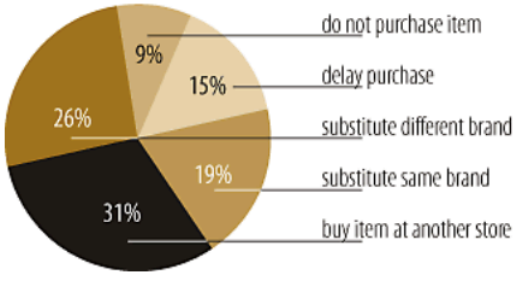


Image 10 – What consumers do when "their" product is missing

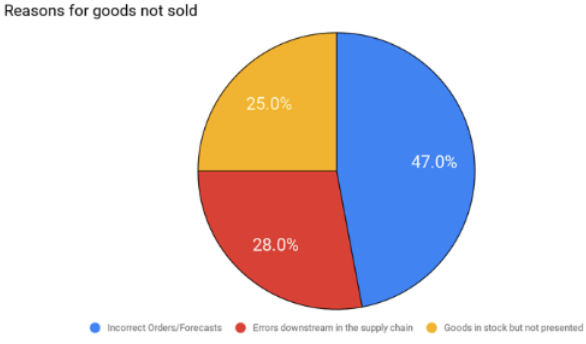


Image 11 – Reasons for products missing

[57] Ibid.
[58] https://www.ibm.com/blogs/think/2018/01/5-second-checkout/?fbclid=IwAR2a8NBN_mAE4aAGxvwryMzPiugmeuMr_dlOzE7L69xG5fj7y9Hy6YtirkU - [Accessed 12 March 2019].
[59] Gruen et al., 2002.

Rekik et al. (2007) focused their study on why orders and forecasts are incorrect, where the main reason presented is that products got misplaced in the stores, which as a consequence causes incorrect inventory levels.[60] The authors opine that RFID-technology could detect misplaced products, which therefore would increase the accuracy of the inventory levels and decrease the risk that products are out of stock. Gel et al. (2010) also expressed that RFID could increase the accuracy of the inventory levels. Their research, however, focused on accuracy at the point of sale (POS). They provide proof that many stores have incorrect inventory levels because products are sold under the wrong product code at POS, with the consequence that inventory levels do not decrease and therefore new products will not be ordered on time. They suggest that RFID would decrease or even eliminate this issue.[61] In a later study, Rekik et al. (2008) presented research of how RFID could decrease thefts, by adding an anti-theft functionality to the RFID-tag, just like in clothing stores. The functionality would, according to the study, decrease theft and therefore increase the accuracy of the inventory levels as well as decrease the external wastage.

Atalı et al. (2005), showed in his research that retailers who only take sold goods into account when forecasting sales and placing orders to suppliers would never meet the actual demand.[62] He insinuates that managers need to pay attention to wastage, in terms of theft, date expires and misplaced products, in order to meet the correct demand in their orders. He considers the technology at issue to have two main valuable attributes; providing visibility and more extensive information of the inventory since information about expiry date and location can be programmed into the RFID-tag. According to the author, this could lead to more accurate orders and more proactive work to prevent wastage.

Other research of RFID that focuses on a more holistic perspective, specifically on the plausible benefits for both the consumers and the retailers, was presented by Chappell et al. (2003).[63] The outcome for the retailers' was a less resource dependent daily operation by increased efficiency in receiving and replenishing of goods, inventory control, and payment processes in addition to significantly decreased shrinkage. The consumer value of the technology was summarized to decrease queuing time at the checkout, increased occupancy level of products that, alongside with fewer misplaced goods in the store, e.g., would decrease factors that harm the customer satisfaction. Customer satisfaction is considered to be a soft value, even though it often correlates with increased revenue.[64]

Twist (2005) is however more pessimistic to how the technology could be implemented. He is convinced that in order to achieve the full extent of the advantages, without having to pay a high price, the entire supply chain needs to be involved. However, the benefits for retailers is that wastage can be reduced by two-thirds using RFID.[65] In addition to the research performed on an aggregated level, Çakıcı et al. (2011) conducted a study concentrated on the retail pharmaceutical business. He confirms Twist's theory of the advantages of the technology, with the addition that he is convinced that the obstacles or concerns about the privacy issues are exaggerated and will disappear and when the technology is commercialized.[66]

3.4.2 Implementation of RFID

Several big actors on within the retail segment have already started to evaluate the usage of the technology. Walmart was one of the first companies to implement the technology to increase efficiency and to be able to track pallets at central warehouses. The RFID-tags were read upon arrival and departure to ensure a correct

[60] Rekik et al., 2008.
[61] Gel et al., 2010.
[62] Atalı et al., 2005.
[63] Chappell et al., 2003.
[64] https://smallbusiness.chron.com/revenue-client-satisfaction-correlation-36554.html - [Accessed 9 April 2019].
[65] Twist, 2005.
[66] Çakıcı et al., 2011.

stock keeping level and deliveries to the supermarkets.[67] While Walmart, as the largest food retailer in the world, obviously has great bargaining power, there are other examples of smaller retailers that have started to use the technology.[68] Smurfit Kappa is a company who produces cartons for retail usage, and they offer companies to choose their RFID-carton, to enable track and identification of the goods.[69] The most common segment, however, within the retail business, for the usage and testing of the technology is within the clothing business.[70] The RFID tags can be put inside the alarm tags, which clothing companies often use to enable tracking, inventory check, and payments by the RFID-"alarm".

However, the Nordic countries and Sweden have some pioneers as well. Teracci, a clothing company in Stockholm, has implemented the technology on article level containing information of both a unique ID and anti-theft system.[71] The trial showed that payments and inventory check are significantly faster (400 unique articles per minute vs. 40). The increased efficiency and accuracy lead to a decrease in cost for the checkout and a more agile stock keeping. The company has calculated a payback time on investment to be approximately one year.[72] Further, the Finnish company NP Collection implemented a similar system in their clothing business as well, experiencing the same advantages as Teracci.[73] NP Collection's system is a bit more advanced than Teracci's since they implemented RFID-readers inside the changing rooms as well. The data from the changing rooms indicates what clothes are visually attractive enough to be tried on and information about what clothes that look good on a hanger, whereas they do not fit good enough to be bought. The information is used to optimize future collection designs. Apart from the clothing industry, the technology has also been implemented in the IT-industry. A Danish company Computer City is an example of a company that uses the technology to optimize stock keeping on article level. The perceived advantages are; reduced wastage, more efficient inventories, and reduced administrative work.[74]

Image 11 – NP Collection uses RFID on all their clothes to track, increase efficiency in payments and optimize collections.[70]

The results of the pioneers indicate that the technology can be applied in various contexts and industries. The fact that the level of followers is relatively low, despite the positive result presented by the pioneers, could be due to the firm's various competitive tactics or difficulty to review and calculate the value of the investment.[75]

[67] Roberti, 2005.
[68] https://www.forbes.com/global2000/list/#tab:overall - [Accessed 9 April 2019].
[69] https://www.packagingnews.co.uk/features/comment/paul-foot-smurfit-kappa-anti-counterfeiting-packaging-10-05-2017 - [Accessed 30 March 2019].
[70] Bustillo, 2010.
[71] https://www.dagenshandel.se/article/view/324827/teknik_gjorde_herrklader_till_vinnare - [Accessed 21 March 2019].
[72] http://www.rfidsherpas.com/images/File/Zipping_Up_The_Benefits_June_1_2009_RFID_Journal_Print_Magazine.pdf - [Accessed 27 March 2019].
[73] Skalin, 2008.
[74] https://www.gs1.org/sites/default/files/docs/epc/Implementation_Guide_for_the_use_of_GS1_EPCglobal_Standards_in_the_Consumer_Electronics_Supply_Chain_-_May_2010.pdf
[75] Covin et al, 2000.

The cost of the investment, based on Impinj hardware, is approximately 2000$ for each antenna, where a checkout requires up to 4 antennas, and 500$ for the readers. Further, handheld readers cost approximately 1500-3000$ each.[76]

3.5 Evaluation of the Investment

There are numerous ways to calculate the value of an investment. The calculations in this thesis are based on Net Present Value (NPV) which represents the difference between future cash inflows and outflows, which are discounted to present value. The method is most commonly used to analyze the profitability of an investment or project. In the case of implementing RFID, the NPV of the hard values must be positive, since the soft values; less queuing, increased customer satisfaction, etc. are hard to estimate and should therefore not be considered as a positive value in the NPV, but rather a possible bonus that can be evaluated after the implementation. The uncertainty of future cash flows and how the lifetime of the investment is assessed increases the difficulty of the calculation.[77] In the calculations presented in the analysis section, the PV is based on a discount rate of 8%, an inflation rate of 2% and inflation of salary of 3,2% and investment lifetime of 7 years. For further information about the requisites of the investment, see section 4.4.1 for requisites of the investment lifetime and 4.6 for the requisites of the inflation and discount rates.

$$NPV = \sum_{t=0}^{n} \frac{Rt}{(1+i)^t}$$

Image 12 – NPV Formula

3.5.1 The Weighted Average Cost of Capital (WACC) and CAPM

The Weighted average cost of capital (WACC) is a commonly used calculation of the cost of capital for a company. The calculation weights each category of capital proportionately. All sources of capital, including common and preferred stocks, bonds, and any other short- and long-term debts, are included in a WACC calculation. Since the cost of equity is unknown, it is estimated using CAPM.

3.5.1.1 CAPM

The Company at investigation, for which the investment is evaluated has according to the annual report of 2017 and CAPM based on the average implicit asset beta and risk-free interest rate of ICA Gruppen AB and Axfood AB, presented by Handelsbanken Capital Markets (HCM) (2019).[78] The average implicit asset beta has been used by the stated companies, due to lack of availability of the implicit asset beta for Skutan Livs AB, hence it should be seen as an estimate.

Implicit asset beta of ICA Gruppen AB = 0,64
Implicit asset beta of Axfood AB = 0,77
Average Implicit asset beta = 0,705

Equity market risk premium = 4,5%
Risk-free interest rate = 2,0%

CAPM equation
$K_c = R_f + \text{beta} \times R_m$

[76] https://www.atlasrfidstore.com/impinj/?sort=bestselling&page=2 - [Accessed 7 March 2019].
[77] Skärvad and Olsson, 2016.
[78] Skogman, 2019.

Where
K_c = Risk-adjusted discount rate
R_f = Risk-free interest rate
R_m = Equity market risk premium

K_c = 0,0517

3.5.1.2 WACC

Equation

WACC= E/V * Re + D/V * Rd * (1-Tc)

Components
Re = Cost of equity
Rd = Cost of debt
E = Market value of the firm's equity
D = Market value of the firm's debt
V = E + D = Total market value of the firm's financing
E/V = Percentage of financing that is equity
D/V = Percentage of financing that is debt
Tc = Corporate tax rate

Re = 0,0517 (Based on CAPM)
Rd = 0%
E = 28 930 000
D = 21 692 000
V = E + D = 50 622 000
E/V = 0,5715
D/V = 0,4285
Tc = 21,4%

(0,5715*0,0517)+0,4285*0*0,786

WACC = 0,0295 = 2,95%

3.5.2 Cost Evaluation for RFID in a Supermarket

The initial investment for the set-up of RFID-system in a retail store can be derived into six categories; hardware, software, system integration, personnel, installation, and change in processes.

Image 13 – Cost Evaluation Categories

The hardware category includes RFID-readers, hand readers, cables and tags, whereas the software consists of middleware and programs and interface to control and maintain the hardware and interconnecting systems. The system integration assumes that the RFID-system needs to interact with other existing or new systems, e.g. Point of Sale (POS) and Customer Relationship Management (CRM). The extent of the system integration depends upon how the data collected from the RFID-system is planned to be used.

Furthermore, at an initial stage during the installation period, additional consultants may be needed to instruct the employees how the new system work. The cost of learning a new system might be reduced by having the

instructors in-house, but the cost cannot be avoided since the learning period will take time from ordinary operational tasks. Further, installation of readers, cables, and software, as well as a testing period, requires a certain time and cost. The magnitude of the cost and depends upon the contract with the supplier of the system. To what extent the business processes change depends upon the individual store, some might be interested in some of the features, whereas others might require a full integration. Based on previous retail examples, the functions requested are often associated with increasing the automatically handled information, which sometimes requires multiple integrations and therefore an extensive integration process.[79]

The economic value in terms of cost saving is important to consider when evaluating the cost of the investment. In Sweden, most retail employees have a collective contract, for which the minimum hourly salary is between 129,48 SEK to 144,72 SEK depending on experience within the business with the maximum requiring three years of experience and 18 years of age.[80] The actual cost for the companies increases with social costs of 31,42% and vacation salary of approximately 12%, which accumulates to a minimum cost of 185,70 SEK to 207,56 SEK. In addition to the minimum wage, it also increases with "Uncomfortable working hours compensation" which increases the employee cost with 50%-70% during weekday evenings and 100% during weekends.[81] Based on average salary cost from the interview with the business owners of ICA Kvantum Åkersberga, an average hourly salary cost of 244,18 SEK, including all cost except sick pay, can be established for their businesses and is assumed to indicate the market average.

A further cost that needs to be taken into account is the cost of theft and wastage, which have been obtained from *Svensk Handel*. The research from 2017 indicates an average 2,26% of the turnover or 7,362 billion SEK per year.[82] The wastage is divided into three categories, external theft, internal theft, and administrative wastage. The distribution within the categories is shown in the diagram, image 14.

Additional factors that may lead to increased profits and/or reduced cost associated with the technology is more effective stock keeping leading to increased availability, increased efficiency in freight handling and soft factors like better customer service and improved corporate image.[83]

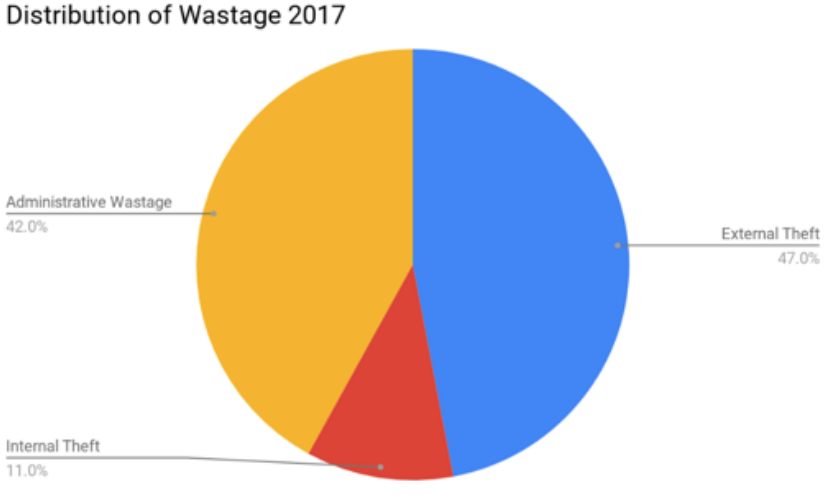


Image 14 – Distribution of Wastage on the Market

[79] Banks et al, 2007.
[80] https://handels.se/pa-jobbet/lagstaloner/ - [Accessed 19 March 2019].
[81] Ibid.
[82] https://www.svenskhandel.se/globalassets/dokument/verksam-i-handeln/sakerhet/svinnrapport/stolder-och-annat-svinn-i-svenska-butiker-2017.pdf - [Accessed 27 February 2019].
[83] Hunt et al, 2007.

4.0 Empiric Research

This chapter describes the results and calculations of the collected empirical data. The interviews were compiled in a structured form presented below.

4.1 RFID-Expert

To get further insights into the technology and a deeper understanding of the possible aspects and functionalities a leading RFID-expert, from Learning Well IT, was interviewed. Gunnar Ivansson, a leading consultant within the area, who has been involved in several large projects in the Swedish region. Projects including implementation of the technology in the Swedish railway system, several efficiency projects for manufacturers and wholesalers like Ahlsell. Currently, he is involved in a large CSR-project to increase recycling efficiency in the apparel industry, which is a corporation between some of the largest manufacturers; e.g., H&M and Zara.

An important insight from the interview was that the implementation and integration of the technology were possible, mainly due to recent development in the tag industry. The development includes better and faster readability, which is less dependent on surrounding materials. He also pointed out that the fact that the size of the tags has decreased significantly, which has led to better possibilities to tag smaller items. Furthermore, he confirmed that the price level of the tags, passive and active, has dramatically decreased, which increases the demand and market for the technology.

Gunnar Ivansson believed that the technology has become developed enough be used in the context of retailers tagging individual articles in order to increase efficiency, but also believed that adjustments and regulations regarding privacy concerns and standardization needs to be in place before commercialization.

4.2 RFID-Suppliers

In order to understand the technology and complexity in the technological set up as well as the requirements for the possibility of economies of scale, some of the world leading RFID-suppliers were contacted and interviewed.

4.2.1 Panasonic

The primary purpose of the interview was to obtain an understanding of the current corporation with Mae-store, further described in the case study in section 4.5.2. The outcome of the interview was that the project, which is still in its testing phase, has shown excellent results thus far. The company was pleased with the functionality of the technology, as well as the customer response. The communication manager was not able to share any data of the indicated results but was able to tell that the project will continue, and multiple new stores will open.

Furthermore, one concern before the implementation was if customers were to take off the RFID-tags from the products, which Panasonic now prevents by using smart cameras. Moreover, the store needs 60% less staff than conventional stores due to that products are re-stocked during night time and during day time no staff is needed in the stores. Currently, the tagging process is semi-outsourced to suppliers and manufacturers. The largest suppliers have added an RFID-tag in the production, whereas products from the smaller suppliers are tagged in the store. The ambition, when the project is expanding, is only to use suppliers that can deliver products that already have an RFID-tag implemented.

4.2.2 Impinj

Impinj is one of the largest manufacturers of the hardware and RFID-systems in the world, see image 15 below.

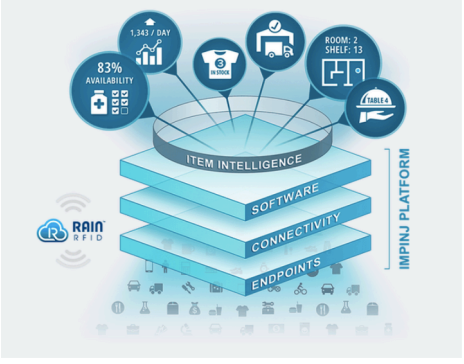


Image 15 – Impinj Platform

When interviewing the communications manager of Impinj, she confirmed that the system has been on a beta testing level in Cisco supermarkets, working well. She also mentioned that the test-stores have not been noticing any significant concerns about the privacy aspects that we brought to attention. However, the main issue has been that customers have been confused about the functionality and process when using the system for the first time, *"which of course was accounted for"* she added. The initial phase of the testing period required a lot of additional staff in order to explain how the system works.

The plausible difficulties that Impinj expresses about the retail sector, with particular emphasis on larger food stores, is that consumers remove the tags from the products. It is a problem that is unavoidable, and the system is estimated that, despite this aspect, decrease the total wastage significantly. This problem decreases when manufacturers use RFID-tags in the production site since they can be placed invisible for customers and impossible to reach without breaking the packaging of the products.

The cost of the investment for the hardware, based on Impinj's price list, is approximately 2000$ (19 022 SEK) for each antenna, where a checkout requires up to 4 antennas, and 500$ (4 755 SEK) for the readers. Further, handheld readers cost approximately 1500-3000$ each (14 267 - 28 533 SEK). [84]

4.2.3 Chinese Manufacturer ZDCARD

In order to get a more holistic perspective of the prices for primarily the RFID-tags, a Chinese manufacturer was contacted. The conclusion was that if a larger volume of tags where to be ordered, >10 million, the lowest price to be offered would be 0,018$ per tag. With the current exchange rate on Nasdaq rate from US Dollars to SEK, it equals to approximately 0,1712 SEK per tag.[85] Due to patentability, the tags would have a different visual presentation but have the same functionality as the original RAIN-RFID and Midas Flag Tag. Further, to confirm that the basic functionality of the replica tags, a batch of 50 tags was ordered and tested with an RFID-system purchased from Impinj. The test has not been taken into account in the results nor the research, but to confirm that the RFID-tags with the low-price level that ZDCARD indicated has the promised functionality. A link to the test is found in Attachment 5, where the tags were attached to products of various shape and material and read by the Impinj hardware.

4.3 Quantitative Study - Social Acceptance of RFID

The purpose of the quantitative study was to investigate the attitude towards usage of the technology in the grocery trade market and was answered by 367 respondents. The survey can be found under Attachment 1. Of these respondents, 125 survey responses were considered invalid, either because the response time was too short (<60 seconds), the age was too low/high (<10 or >95) or the entire questionnaire was not submitted. The total basis for the quantitative study was thus 242 respondents, of which 140 (57,8%) men and 102 (42,2%) women. The respondents were given positive and negative aspects of the technology, based upon previous

[84] http://www.nasdaqomxnordic.com/bonds/sweden/foreignexchangefixing - [Accessed 23 February 2019]
[85] Ibid

research presented above, shown a mock-up video of plausible customer experience and was then required to answer five questions regarding their attitude towards the technology. The answers were recorded on a scale 1-7, where the respondents indicated how well the statements accorded with their attitude. Finally, the respondents shared demographical data about their gender and age.

The two statements regarding positive and negative attitude towards the technology where combined, supported by a Cronbach's Alpha value of 0.830. The study indicated that the overall attitude towards the technology in the given context was 2.78, where one indicates the most positive attitude and seven the most negative. Furthermore, when comparing means of the attitudes towards the technology over different age groups (ten year span, 11-20 to 70+), the data indicates statistical significance ($p<0.001$) differences between the groups, presented in table 2 below.

Age	Respondents	Attitude Mean
11-20	58	1.71
21-30	87	2.59
31-40	42	3.83
41-50	24	2.74
51-60	14	3.13
61-70	6	4.92
71+	4	5.8
Total	**242**	**2.78**

Table 2 - Comparison of differences of attitude towards RFID over different age groups

Moreover, a Pearson Correlation test confirms a positive correlation between age and attitude. The two-tailed test shows a correlation coefficient of 0.507 with a significance at the 0.01 level. This indicates that older respondents tend to have a more negative attitude toward technology. Further, a positive correlation of age and intent to purchase can be found through the same kind of correlation test. The coefficient was found to be 0.328 and is significant at the 0.01 level, which indicates that younger respondents are more inclined to buy their groceries at a supermarket offering the technology than older people. Finally, a positive correlation with a coefficient of 0.136 (0.05 significance level) can be found between open-mindedness of the company's data collection and intent to purchase in RFID-stores.

4.4 Interviews FMCG (Fast-Moving Consumer Goods)

Business owners and managers were interviewed in order to get a better understanding of the operational difficulties and other unknown effects of the technology.

4.4.1 Business Owners

Name	Store Concept	Geographical Location	Yrs as business owner
Per Paulsson	MAXI ICA STORMARKNAD	Värmdö	14 yrs
Claude Schaffert	ICA KVANTUM	Åkersberga	20 Yrs
Charlie Karlsson	ICA KVANTUM	Enskede	6 yrs
Jesper Carlsson	ICA nära	Vallentuna / Kragsta	16 yrs

Table 3 - Business owners interviewed, their store's concept, geographical location and years as a business owner.

The business owners, presented above, were briefed of the technology and the possible functionalities of it prior the interview, according to the questionnaire presented in attachment 3. The purpose of the interview was to get an understanding of their perspective on the possibilities and challenges of the RFID-technology. Besides, the purpose was also to obtain other aspects that could be associated with the technology that outer parts have not thought about. Lastly, the business owners expressed what consumers are missing in their supermarket, in order to compare those with the disturbing factors that *Svensk Handel* presented in its report.

The main takeaways from all the interviews with the business owners were that they believe the technology to be an excellent complement to the current physical service offering and would be an investment to consider. Although they all agreed upon that the central management of ICA would have difficulties to implement it in the near time horizon. Further, they all expressed that the economic result and customer experience would be enhanced, mainly if their geographically closest competitors still used traditional checkouts. Paulsson, Schaffert, and Karlsson all associated the technology to when self-scanning was implemented, as they all acquired that technology. The overall tendency is that if customers start to use it and have been using it five to ten times, they tend always to use it afterward. It is a learning pattern Paulsson stated; "*as soon as you get comfortable and used to scan your groceries, why would you stand in a queue?*".

Mr. Paulsson, who is the business owner of a supermarket with the largest concept within the ICA concern, stated that the relative cost of checkout staff (minutes/customers) has decreased with new technology and concepts during his time as a business owner, and he is confident that it will continue to decrease. If RFID is the next groundbreaking technology in this matter or not, he could not say. He expressed that an automated inventory and checkout system would decrease the cost dramatically, which would leave him with multiple options on how to allocate those resources. Either, the service level could be increased, with more staff during late hours and weekends, for example, prices could be decreased due to the lowered costs, or the bottom line of the annual accounts would be more satisfying to look at. Furthermore, he stated in connection to the possible usage of resources, that since his store was rebuild and rebranded from a "Kvantum" to a "Maxi", customers seem to experience the prices as lower. This was an indication that lowering of prices would not necessarily be a competitive advantage, as he expressed that the actual price level is less relevant than the perceived price level. He thinks that the most important thing in conventional supermarkets nowadays, especially with the increasing online-sales, was to offer something out of the ordinary. In order to make it worth the while, to visit the store and not purchase the goods online, a better digital experience to the traditional store concept would increase those chances.

Mr. Schaffert is the business owner of an ICA Kvantum and an early adapter to new technology available on the market. He is currently involved in the computer and IT board of ICA, in which they discuss and confer different future technologies that could be implemented into supermarkets. The primary insight brought from the interview was first of all the complex IT-infrastructure of the ICA-concern, which makes new third-party innovations hard to adapt. He was convinced though, that if the economic potential could be proven and brought to the department's attention, enough resources could be used to implement a transfer from traditional barcodes to RFID-tags on a central level. Moreover, one of the most substantial issues that Mr. Schaffert brought to attention was the possibility of increasing efficiency in stock-keeping. It is not that the current technology is lacking in its sufficiency, but it is always a stress to see a list of 2-3 thousand SKUs that need to be checked for its inventory and knowing that it will require much work to accomplish.

Further, Mr. Schaffert expressed that *"if the inventory levels would to be more accurate, the hours for re-stocking would easily decrease with 10%, since the ordering system would have correct input data and order perfectly, so shelves never are overfilled or empty"*. The technology would, according to Mr. Schaffert, eliminate a lot of the "excuses" that a large proportion of the day and time allocated for that task has been used to help checkout staff during peak hours. Furthermore, an investment in the technology would be amortized over a seven-year period, which "*makes it a "no-brainer" to invest in, given that the technology works, of course*", Mr. Schaffert stated. The business owner stated that if an investment were made, the area of the checkout would be reduced by 80% to reduce queues still and to be able to meet an increased demand in the future. The area would be used to increase the depth of the assortment of high margin products with a bottom line of 12%. On the question on how the increased resources would be used, Mr. Schaffert said that it would be used to increase the service level, primarily because the competitive geographical landscape has gotten changed during the last decade. To be able to offer customers the full range of service, from having an in-house bakery to offer individual consultancy for meal options would, according to Mr. Schaffert, strengthen the businesses situated on the local market. Mr. Schaffert stated that the average hourly cost of employees was 244,18 SEK during 2017.

Mr. Karlsson is the business owner of a concept that combines the food experience at a Kvantum with a more extensive assortment of non-food products. The store concept differs a bit from the "normal" Kvantum-concept due to the larger assortment of household related interior design and electrical equipment. The main advantage that Mr. Karlsson thinks that RFID would generate at his business concept was the benefit of preventing thefts. He stated that the disadvantage of having a sizeable non-food assortment is that when customers steel, it gets expensive quite fast. In addition to the differentiated assortment, "*it does not help that the supermarket is allocated on two floors, which makes it harder to detect and prevent thefts"*. Mr. Karlsson mentioned that the possible additional revenue in terms of lowering costs would be used both to increase the service level in the store by adding additional services and offerings but also increasing the service-intensity. Secondly, the resources would be used to increase the employee satisfaction, *"They are my most important resource, and with an increase in profitability, I would want them to feel and understand that they are appreciated"*. He would do this by paying for more people to go to executive educations, increase salaries for managers and by having more social events.

Mr. Carlsson is the business owner of a smaller concept with a large focus on catering and special events. The store has a particular focal point on customer service offering a broad range of meat, fish, and culinary delicacy counters. At the moment, the store does not, indifference to the other business owners, offer self-scanning. "*The technology has not been adopted in the store since the customers who visit the store does it primarily due to the personal service level throughout the whole concept"*, Mr. Carlsson stated. He believes that the self-scanning would decrease the perceived personal service level and has therefore not acquired the system. In addition to the soft values, the economic profitability of self-scanning is limited due to the restricted space in the store. The new self-scanning system would still require approximately the same amount of staff for supervision. This implies that the variable cost for checkout supervision would not decrease significantly,

meaning that the payback time of the initial investment of such a system would be too long. Carlsson stated that if RFID would to replace barcodes and his store benefited from increased profitability, he would raise salaries for managers in order to attract and keep better knowledge in-house. He believes that a supermarket, even in his "average size" would benefit from having more highly educated staff. In addition to the salaries, he would also increase the service level in the store, in order to compensate for the loss of personal encounter at the checkout.

4.4.2 Management

Name	Store Concept	Geographical Location	Yrs of experience
Jesper Hägg	MAXI ICA STORMARKNAD	Häggvik	12 yrs
Adam Westerling	ICA Supermarket	Åkersberga	11 yrs

Table 4 - Managers interviewed with their current store's location and years of experience within the trade.

Due to that an integration of RFID in a retail concept requires a lot of changes on an operational level, it is vital to understand how this would affect the daily operations. The two store managers presented in table 4 above are from a larger supermarket, ICA Maxi, and a smaller concept, ICA Supermarket. The interviews were based upon the same questionnaire, and it can be found in attachment 3. The main takeaways from the interviews were that the daily operations are unique for each store and is developed upon the layout of the store with its unique concept. New technologies change how and when operational tasks are performed.

In the interview with Mr. Hägg, he mentioned that a change in the operational task is not an issue at any time, *"they are supposed to change"*. He is today responsible for the daily operations of one of the largest supermarkets in the Stockholm region, and to find new ways to increase efficiency without decreasing quality is the main objective at his position. Further, he also quotes that *"no operational change is impossible, it is only a question of how much money and time that can be spent on each activity*". On the question regarding what he thinks of the RFID-technology and if it would be suitable in a supermarket, he said that it would definitely decrease the time spent on the "*boring activities*", which he thought not only would benefit the hard economic values of the store but also increase the satisfaction among employees. Moreover, Hägg states that time-consuming activities in the store are when employees get interrupted in their current activity, which mainly is due to customer questions or that they temporarily need to assist the staff at the checkout. It is hard to plan how much staff is needed at the checkout at all times, since overstaffing cause unnecessary expenses whilst understaffing cause long queues. They tend to have minimum staffing at the checkout, and when necessary re-stocking staff assists during the prime times of the day. He thought that if the technology would to be accurate enough to replace barcodes, he would try to convince the business owner to invest in the technology.

Mr. Westerling currently works on both an operational level, but closer to the business owner in a smaller supermarket. He stated that the central dilemma in the supermarket that he works in is the high cost of employees, which limits the profitability in the store, especially since the supermarket is still a subsidiary ICA store. What this means is that the business owner has not yet managed to repay ICA for the initial establishing investment of the supermarket. The fact that the initial investment has not been repaid yet does not affect the operational tasks in a broader perspective but does limit the managers and owners from making more substantial investments. Mr. Westerling insinuates that digital complement investments are required to decrease the operational costs of the store. Westerling states that if the technology would be implemented, not only the costs would decrease, but resources could be allocated in areas that customers appreciate more, e.g., being able to give better and more qualitative customer service. He would not see it as a single solution to cut

costs but to allocate resources differently and enhance the experience in the store, which he thinks is the key factor for the store's concept. He quotes that *"Our customers choose to buy their food here, not because we have the best prices or assortment, but due to our service level and friendly staff"*. The primary advantage of the technology would, therefore, be to have resources to meet their customer demand regarding service, rather than only increasing profitability. Mr. Westerling did state that if the option would be brought to swap barcodes to EAN, he would, without doubt, argue for investing in the technology.

4.5 Case Study

Three examples of RFID-usage in the FMCG-sector are presented below, with information of how the technology was and is being used within the supermarkets and, if available, what the result of the RFID has been. The information is very brief and does only include the most vital information.

4.5.1 Walmart

Walmart was one of the first actors to implement RFID into their business strategy. The aim of the implementation was primarily to decrease cost further upstream in the supply chain. By sharing information with full transparency of the inventory in stores, suppliers and manufacturers would know how large the actual demand is and at what time an ordering demand would appear, e.g., decreasing or eliminating the "Bullwhip Effect".[86] In 2003 Walmart demanded its top 100 suppliers to replace the barcodes with RFID with a plan to have full integration of all suppliers by the end of 2006. During the given time, RFID-tags were almost ten times as expensive and less advanced than they are today, with a price tag of approximately 1,5$ and the limitation of not being able to be read through liquid and metal. The project was abandoned during 2009, due to that the cost exceeded the benefits for all parties involved.[87] Today, Walmart is using RFID on their apparel assortment, in order to keep better track of inventory and primarily different sizes of the same SKU.[88] The tags are put on the clothes size tag and are deactivated as soon as consumers have paid for their products. Walmart has not announced any data about how the RFID-technology has affected its sales or result.

4.5.2 Lawson Panasonic-Mae Store

Starting in December 2016, Lawson and Panasonic conducted an experiment in accordance with a future store concept with Midas flag tag RFID-chip and smart cameras. The store concept is built upon that customers enter the store, takes one of the specially designed baskets, shops as usual and then puts the basket in the dedicated checkout counter. The RFID-tags on the products where read simultaneously as the products automatically were packed into plastic bags. The system is dependent upon the vertical movement of the products when they are dropped into the plastic bags in the machine. The drop separates the products from each other and therefore increases the readability of the tags. The tags are then being read by the antennas, and the information is sent to the database, where the product price is fetched and then shown to the customers at POS. The supermarkets are operated without any employees during business hours, which cuts costs dramatically. The system has been proven to work well in the given context.[89] Further, Panasonic expanded its corporation network and opened its first store incorporation with FamilyMart in Japan during the 2nd of April 2019.[90] The store concept is based upon a smaller size supermarket, with a very strict grid-layout and covering the entire selling space with 600 smart cameras, preventing theft and analyzing customer behavior.[91]

[86] Forrester, 1991.
[87] https://www.forbes.com/sites/paularosenblum/2014/05/22/walmart-could-solve-its-inventory-problem-and-improve-earnings/ - [Accessed 13 April 2019].
[88] https://spectrum.ieee.org/riskfactor/computing/it/walmart-to-track-clothing-with-rfid-tags - [Accessed 5 February 2019].
[89] https://news.panasonic.com/global/topics/2017/46190.html - [Accessed 27 February 2019].
[90] https://news.panasonic.com/global/topics/2019/67598.html - [Accessed 22 March 2019].
[91] https://news.panasonic.com/global/topics/2018/55288.html - [Accessed 25 March 2019].

Image 16 – Products and check out in Panasonic Mae-store

4.5.3 Amazon Go

The online-giant announced and tested its concept Amazon-Go for its employees during 2016. The concept is built upon smart cameras with an advanced AI-program that is keeping track of all the customers in the store. When a customer picks something off the shelf, the cameras will see it and by using face-recognition, adding it to the specific customers virtual shopping bag. If an item were to be placed back (even if it is on the wrong spot), the item would be deleted from the shopping bag again.[92] During 2017, the technology of the concept was expanded to include RFID-chips, due to the limitation of smart cameras, especially when the shop was bustling or if the line of sight would be cut off. The usage of RFID was supposed to complement the smart cameras in order to increase accuracy.[93]

The conclusion of the case studies is that the RFID-technology is developed enough to be used in the FMCG sector, even though some issues remain to be solved. The case studies do, however, confirm the feasibility of the technology in the given context.

4.6 Economic Requisites ICA Kvantum Åkersberga and Kvantum Segment

ICA consists of business owners, who own and controls their supermarket. The central management has very little control over the individual store's operations. The organizational structure of ICA and other business within the food industry will come to affect the possibility of implementation of the RFID-technology. Most of the major actors within the industry act as a retailer by providing a broad and deep assortment of products, breaking bulk and provide service for their customers. By assembling third-party products in physical - and in some cases - digital sales channels the food retailers must construct a complex distribution network. ICA does, according to their annual report of 2018, state that the number of distributors explicitly for ICA's private label (PL) amount to approximately 2935. This is a strong indication of how complicated the distribution network ICA and other companies within the food industry must master in order to create value for their customers. Hence "*ICA-Handlarnas Förbund*" themselves can decide which products to store, at the same time as they must provide a basic assortment due to the agreement between them and ICA Gruppen Sverige AB.[94]

In order to estimate the economic value of an RFID-system more comprehensible, the financial data from 2017 was collected from ICA Kvantum Åkersberga. The supermarket has 3156 square meter sales area and had a turnover of 289 MSEK (2017) with an average gross margin of 28,31%. The level of increased efficiency is based upon the above-presented research and data collected from interviews. The cost items of interest, used as an input to calculate the economic value of the usage of the RFID-technology, is presented in table 5 below.

[92] https://www.idtechex.com/research/articles/will-amazon-go-win-the-war-between-computer-vision-and-rfid-in-retail-00010463.asp - [Accessed 6 March 2019].
[93] http://www.itechautomation.com/2017/01/31/amazon-go-provides-new-shopping-experience-through-rfid-technology/ - [Accessed 19 April 2019].
[94] https://www.ica.se/ica100/?fbclid=IwAR2xZCBENllGbp_nhpMC31sHmecrlfLK--TMqeBdrsR28DMkr3m-Igp_qGA - [Accessed 10 May 2019].

Cost Item	2017
Products sold per year	15 131 534
Annual Cashier Hours	28 797
Cost Per Sold Product	0,545
Annual Cost Cashier	**8 249 189**
Sick-Pay Hours / Year	2 482
Annual Cost Sick-Pay Cashier	**497 756**
Re-Stocking Hours / Year	31 276
Annual Cost Re-Stocking	**7 636 974**
# Products For Inventory Check	15 297
Minutes / Product and Inventory Check	0,34*
Cost / Inventory Check	8,74
Inventory Checks / Year	3
Annual Cost Inventory Check	**401 066**
External Wastage	1 462 991**
Internal Wastage	342 402**
Administrative Wastage	1 307 354**
Annual Cost Wastage	**3 112 747**
Total Annual Cost	**19 897 732**

Table 5 - Economical inputs for ICA Kvantum Åkersberga

* Based on 260 annual inventory hours

** Distribution based on *Svensk Handels Report* (47% external, 11% Internal and 42% administrative)

Further, of all the sales processed in 2017 approximately half of the consumers (42,76%) used self-checkout, whereas the rest (57,24%) paid in traditional POS. The POS area is today, according to the business owner, 360 square meters. Moreover, the cost of employees has during the past 20 years had average annual inflation of 3,1%, which was presented in *Arbetsgivarverkets* report from 2018. [95] A continuous increase in salary cost should, therefore, be accounted for in the economic calculations of the technology.

The Swedish market for FMCG measured 263 Billion SEK during 2017, according to HUIs annual report presented in *Dagligvarukartan*. Of the total sales, ICA Kvantum contributed with accumulated sales of 32,354 Billion. The supermarket at issue has a market share within its own segment equal to 0,89%, which is just above average since there are a total of 126 ICA Kvantum in Sweden (each store should represent 0,79% each (1/126)).

[95] https://www.arbetsgivarverket.se/nyheter--press/fakta-om-staten/loner/loneutveckling/ - [Accessed 8 April 2019].

4.7 Soft Value Requisites Fast Moving Consumer Goods

4.7.1 Privacy Protection and Data

Privacy issues are as previously mentioned as one of the biggest concerns of the consumers in the economy. In 2018 the European Union made a new regulation to constrain company's collection and usage of data; the regulation was called GDPR (General Data Protection Regulation).[96] The regulation was created in order to make citizens feel comfortable regarding the protection and usage of their private information.

Furthermore, Forbes (2017) presented a study, "*Millennials, Trust and Internet Security"*, that addressed general differences on the market regarding how different age groups feel about internet and data collection.[97] According to the article, younger generations, so-called Millennials, are less likely to be concerned about data security but are more aware of plausible data security risks. Furthermore, millennials trust businesses more than older generations to keep their data secure whereas they tend to trust social media companies less than older generations.

4.7.2 Happiness

A study conducted by the HR-concern Wise Group, in which 5000 Swedish people participated, provided evidence of what factors are most important for happiness. According to the study, health and financial stability in the household are the two singulars most important factors for happiness, followed closely to work-related reasons.[98] The most important work-related factors, primarily to have fun while being at work, is more critical for the general happiness than having a family or partner. The study concludes that work, which is often considered to be an intrusion for happiness, is one of the most important factors for happiness and the fact should be taken seriously.

[96] https://eugdpr.org/ - [Accessed 6 April 2019].
[97] https://www.forbes.com/sites/sarahlandrum/2017/06/28/millennials-trust-and-internet-security/#2dc786ba5555 - [Accessed 16 March 2019].
[98] https://www.svd.se/roligt-pa-jobbet-viktigt-for-lyckan - [Accessed 18 March 2019].

5.0 Analysis

This chapter takes the empirical results into account and cross-reference it to the previous studies presented above. First, there is an assessment of the social acceptance of the RFID-technology, followed by the advantages and disadvantages with it. Lastly, the economic implications of ICA Kvantum Åkersberga are presented as well as an estimate of the net present value for all the 126 ICA Kvantum stores in Sweden.

5.1 Social Acceptance of RFID

In order for the technology to even be considered within the grocery trade in Sweden, a social acceptance for the technology and the new shopping experience is essential. Without social acceptance among consumers, the risk of consumers choosing substitutes and/or competitor increases, which harms the business. Just as Eckfeldt claimed, the benefits of the RFID-technology must exceed the disadvantages of it, in order to gain social acceptance. The technologies plausible limitation of the consumer's privacy integrity is the common denominator that previous researchers have mentioned to be the central issue. Retailers must overcome these challenges in order to persuade consumers that the benefits are greater than the disadvantages, which as a consequence would help the retailers to gain that social acceptance. In order for ICA to gain social acceptance, in accordance with Eckfeldt´s theory, they need to present statistical data of the customer value to the target audience. The technology is creating customer value by addressing some of the most FMCG sectors most disturbing factors, presented by *Svensk Handel*. FMCG actors, who plan to implement RFID-technology, should therefore communicate the benefits of RFID in association to those disturbing factors in order to gain that social acceptance of the technology.

The attitude towards the technology, in terms of privacy concerns and social acceptance, is discussed below first from a holistic perspective for the entire market and then focuses on the differences over the customer segments on the market, primarily dependent on the age/year of birth of the consumer.

5.1.1 General Attitudes Towards Data Collection and RFID in the Market

There are multiple examples of how data, collected with the technology, can be used in order to optimize the consumer experience and at the same time increase the efficiency of the business. The main issue and concern about the collected data is the risk of it being accessed by unauthorized people, who can abuse it or even use it for criminal activities. In order words, consumers are anxious about insufficient data protection and lack of caution when handling the data. Privacy issue is an essential subject and if the outcome would be in accordance to the stated concerns, which would be devastating. However, the research presented by Çakıcı, indicates that the subject in the matter is exaggerated. He states that social acceptance will continuously increase when the technology is commercialized.

Naturally, the privacy aspect can be discussed in all eternity, but the fact remains that personal integrity must not be restricted. Furthermore, what is important to remember when discussing RFID in the given context are two things;
First, what is the real effect of the data collected with the RFID-technology compared to the current solutions and commercialized technology that is already being used today? Companies like ICA are already collecting a substantial amount of data, connected to personal membership cards, to increase the customer experience, their sales and attractiveness. The retailers do already have information about individual customers buying behavior. By analyzing the collected data, they can identify what products and brands that the consumer prefer, what days of the week and at what times they usually shop, demographic variables of the customers, and they can also estimate the size and age of the family, and of course, they know where the individuals live. The real effect of using RFID-technology to replace barcodes is not substantial in terms of data collection; it just makes

it more accessible. The accessibility might be the largest issue in this context because it gives a broader transparency to what information companies have access to. This makes the challenge of gaining social acceptance more related to communication and restriction of who has access to the information, rather than the actual functionalities of the technology.

The second thing to remember is the fact that there are no technical limitations in terms of what information that can be gathered, as well as who has access to it. Having that said, each retailer could choose what data that should be collected and who has access to it. This indicates that digitalization and technological development comes with great responsibility towards the customers when implementing digital tools into the traditional store concept. The technology could be limited and set up to prevent all unauthorized people from accessing information, as well as making sure all data is encrypted and deleted after the payment has been processed, to prevent any risk of violation of privacy issues. The option to exclusively use RFID to increase efficiency in the daily operations, i.e., stock-keeping, inventory check, decrease wastage and checkout, might be good enough, since consumer data can be collected using alternative methods. The economic implications of the technology, presented in section 5.3, should be incitement enough to implement RFID, even if the potential is larger.

In the quantitative study presented in the empirical section, the respondents seem to have a relatively positive attitude towards the usage of RFID in the FMCG sector. The results could be interpreted in different ways, either the consumers are positive towards the technology itself or the attributes that it is promised to be accompanied by. However, the data also confirmed the previously mentioned concern of the data collection. Furthermore, the issue of privacy concerns related to RFID-technology is not a new phenomenon.

EPS Standard started to address the issue meanwhile creating a standard for RFID-tags, almost eight years ago. The standard included a requirement of the functionality for data to be deleted after a certain action, e.g., after a checkout in a grocery store. Whereas the functionality requirement in the EPS Standards enables the possibility of reducing the privacy issue concerns, the regulations within the EU addresses the actual allowed collection and usage of data. GDPR restricts companies on how and to what purpose data can be collected, clarifying that data cannot be used if consent has not been given from customers. By combining the EPS standard, the GDPR regulation together with the assumption that retailers want to gain social acceptance by communicating and acting accordingly, it is intuitive to think that such development is necessary in order to enable the investment of technological innovation.

Privacy issues due to digitalization and implementation of new technology will continue to be one of the major concerns in our society, but history has shown that consumers do get used to it. Furthermore, studies have shown that there are differences among consumers depending on their demographic profile, primarily age/year of birth.

5.1.2 Differences Within Customer Segments

The fact that there are differences in the market depending on age/year of birth of the consumer is not surprising, especially when the significant technological development in recent years is kept in mind. According to the empirical study, there are significant differences between the age groups with a clear correlation of younger age / later year of birth and a positive mindset to RFID-technology in general. The correlation exists regardless if the company would collect data in association with the technology. Moreover, a more positive mindset towards technology also correlates with the intention to buy groceries in a store that has implemented such technology. The data of younger people being more open-minded to innovative digital tools and data collection is closely related to the study "*Millennials, Trust and Internet Security"* that Forbes presented. The study indicated that younger people have more confidence that companies will keep their data secure and only use it for expressed purposes than older people.

The data collected both in the quantitative study and the data presented by Forbes can be interpreted in different ways. One way to interpret the result is that the mindset is dependent upon the age of the respondent. If this way of interpreting the result is correct, it would mean that the mindset of people changes to become more pessimistic with higher age. This may be due to increased awareness of the privacy risks of data collection and would explain the effect of differences in different age groups. The alternative way of interpreting the data and the mindset of privacy issues is that it is related to the year of birth rather than current age. The main difference of this interpretation is that the mindset of the customers then would not become more pessimistic with higher age. Instead, the general mindset of the population would get more positive as its proportion of millennials, increase. This interpretation does at some point assume that the mindset is dependent upon that millennials have grown up in a digital era, and are therefore used to data being collected, whereas the older generations are not.

5.2 Operational Advantages, Challenges and Consequences

An investment in RFID leads, like many other investments, to changes in daily operations, which all the managers and business owners expressed in the in-depth interviews. However, the importance of operational challenges is whether the project is feasible or not, which is thus the first thing discussed below. Furthermore, the advantages and disadvantages of the investment, from an operational perspective, will be discussed.

5.2.1 Feasibleness

According to the interviews, all six persons from the FMCG sector who participated shared a homogeneous opinion that everything is possible from an operational perspective. It seems to only be a matter of how much resources that are needed to realize such a project. The main question to address is whether the positive aspects of the technology can exceed the resources needed for the implementation and daily operations.

Since the FMCG sector mainly consists of buying and selling pre-packaged goods, stores are strongly dependent upon suppliers in their supply chain, in order to enable goods for their consumers. Today, those goods are almost exclusively labeled with barcodes. In order for the investment to be feasible, it is therefore required to involve suppliers and producers in the process to label the products with RFID-tags as a complement to the barcodes. Considering ICA's large market share in Sweden, it is reasonable to assume that suppliers would find interest in meeting such a demand and that ICA would have strong bargaining power in such negotiations. It is, however, reasonable that the change would come with a cost to cover the additional labeling cost of the RFID-tags. This much like when Walmart and Lawson integrated RFID in their supply chain, as presented in the case studies. The complexity of such a negotiation is, however, not to be underestimated. With almost 3000 production sights for PL exclusively, it is reasonable to belief that it will take time.

5.2.2 Advantages

The consequence of technology can be divided into both hard and soft values. Hard values are easy to quantify, whereas soft values are harder to put an economic value to. The hard values can further be derived from lowered employee cost for checkout, inventory check, goods receipt and partly in the re-stocking process. In addition to the increased efficiency, the technology is also estimated to increase sales due to better product availability for customers. These aspects have a massive impact, absolutely and relatively, on the financial result of each store, especially when considering the retail sector's commonly known low margins. The increased revenue would strengthen the supermarkets financial capacity to increase the customer experience in the store, which is what *Svensk Handel*, claims to be vital for the survival of the physical trade market. The aspect of using the additional resources to enhance the customer experience is what all the business owners expressed in the interviews, which thus create those soft values for the consumers.

If parts of the additional resources would be used to increase the customer experience, e.g., by adding additional services, increasing staff-intensity, increased opening hours, etc., customers should experience the

store to be more attractive, according to *Svensk Handel*'s report. Besides, regardless of if and how the increased resources are used, the customer's shopping experience becomes faster with less queues at the checkout and with higher availability of products. *Svensk Handel* provided proof that those addressed factors are what 37% respectively 28% of customers consider to be the most disturbing factors in the physical trade market. That being said, there are concrete and clear indications that RFID would contribute to increased customer value, even if no additional resources were to be spent on improving the customer experience.

Further soft values of the technology would be for the employees in the stores. Even if the technology would decrease the number of hours needed for the daily operations, it brings value to those who still works in the store. There is an ergonomic aspect for the checkout staff, who no longer needs to scan every item, which reports have shown to be a very repetitive and straining task leading to injuries. RFID would eliminate that particular activity and therefore improve the checkout staff's well-being. Furthermore, Mr. Hägg expressed goods receipt, inventory check, and checkout to be "boring activities", which all would be streamlined with RFID-technology. With less time being spent on those activities, the overall workday should be experienced by employees to be more fun. The aspect of having more fun at work has been proven by Wise Group to be more important than family in terms of overall happiness, as presented above. Moreover, some business owners expressed that parts of the additional resources would be used to educate their staff, which also was indicated to increase happiness according to Wise Group's report.

5.2.3 Disadvantages

By investing in RFID, which completely changes both the daily operation and the entire customer experience, there are plausible negative effects. Firstly, it is totally unknown how consumers will react to the change, even though there are research and data on how they should react, there is nothing that guarantees a specific result. That being said, there is, a vast financial risk of making an investment like this. The risk of the investment increases both in terms with its proportion, but also since the PV of the investment is based on a positive response from the customers. If customers reacted negatively to the change, it would affect the payback-time to be longer or even cause bankruptcy if a large proportion of the customers would stop shopping in the supermarket. The risk especially increases when the investment calculation, like this one, is based on estimates obtained from established research and empirical studies, rather than specific cash flows.

There is always a certain margin of error and nothing can ever guarantee a particular outcome in the future, even though a majority of the entire market expresses a certain demand for technology like RFID. It is, however, not certain that they would use it. Furthermore, one of the company's touchpoints would decrease as the cashiers will have less staff. Customers who appreciate that particular touchpoint might get disappointed when the time at the checkout is reduced by about 90%, leading to dissatisfaction among those customers.

5.3 Economic Implications ICA Kvantum Åkersberga

5.3.1 Economic Requisites

The economic implications are based upon the research presented of the effects of RFID. In order to increase the accuracy of the calculations, only hard values have been accounted for. One could argue to include some of the soft values in the calculations, especially since the soft values in terms of increasing customer experience and satisfaction often correlates with increased sales. However, the estimate of how much the satisfaction and sales would increase is nearly impossible to estimate, hence it is not included. Initially, the cost overview of ICA Kvantum Åkersberga is presented, followed by the economic implications of the technology, summing up in PV of future cash flow and costs. The initial year of the investment is further referred to as year 0.

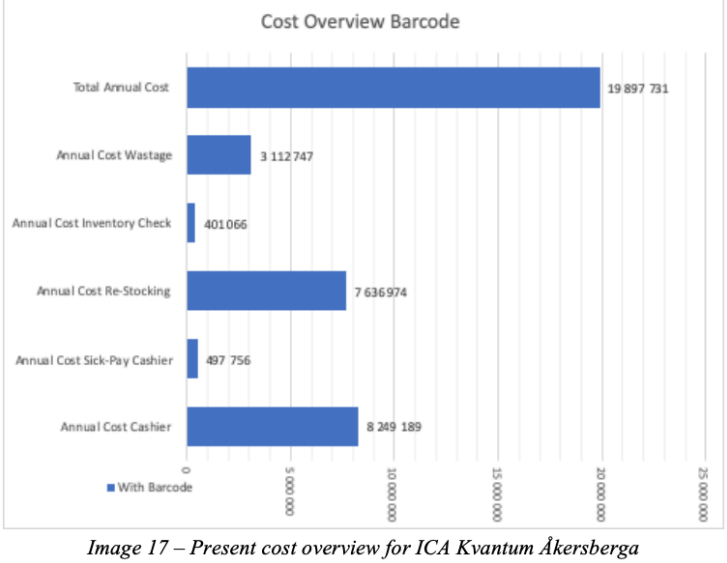


Image 17 – Present cost overview for ICA Kvantum Åkersberga

The hard values of the investment can be derived from three factors; decreased staff hours, decreased wastage and increased sales. The decrease in staff hours is based upon both the data presented in previous research and the confirmed results from previous trials. According to Panasonic and IBM, RFID is 700% faster than a traditional cashier checkout and 1500% faster than a traditional self-checkout. Given the ratio of self-checkout and traditional check-out that the store has today (42,76% / 57,24%), the overall increase in efficiency is 1042% (15*0,4276+7*0,5724) and reduction of cost of 90% (1-1/10,42). The annual sick-pay of cashiers is assumed to decrease linearly with the decreased checkout hours. Further, the cost of inventory check is estimated to decrease with 90% in accordance with the results Teracci presented from their implementation of RFID. The reduced cost for re-stocking (10%) is based upon the information given by Mr. Schaffert in the qualitative interview.

Furthermore, the initial investment is assumed to have a lifetime of seven years in the calculations, accordingly with the amortization time that Mr. Schaffert stated. Further, the calculations below are based on a discount rate of 8%, the inflation rate of 2% and salary inflation of 3,2% as *Arbetsgivarverket* presented in their report.

5.3.2 WACC

As a result of the fact that Skutan Livs AB does not have any cost of its debt, the WACC is lower than the equity market risk premium. Since an investment in the technology would change the whole business model of the company, it is arguable that the discount rate should exceed the equity market risk premium. Due to this fact, the present values have been estimated with a discount rate of 8%.

5.3.3 Present Value of Reduced Costs and Increased Revenue

The total annual cost for the checkout, amounted to 8 746 945 SEK during 2017. During year 0, the cost would decrease with 7 907 507 SEK (90%) to a total cost of 839 438 SEK. The cost for inventory check is estimated to decrease with 360 959 SEK (90%) to a total cost of 40 107 SEK for the same year. Furthermore, the cost of re-stocking is estimated to decrease to 6 873 276 SEK due to a 763 697 SEK (10%) reduction from the original 7 636 974 SEK. The total cost reduction for staff, when summing the above savings, is 9 032 163 SEK as of year 0. The annual saving is then discounted and adjusted according to the inflation rate stated above, the PV of the future cash flows of the cost saving sums up to a total of 64 820 939 SEK, see table below.

Staff Reduction							
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**
FV	9 032 163	9 321 192	9 927 293	10 911 136	12 376 240	14 487 292	17 501 103
PV	9 032 163	8 630 734	8 511 054	8 661 611	9 096 906	9 859 808	11 028 663
Accumulated	9 032 163	17 662 897	26 173 951	34 835 562	43 932 468	53 792 276	64 820 939

The PV of the decreased cost for employees assumes that the staff can be minimized, meaning that the queues for the payment are the same, but that fewer employees are needed to handle the same number of customers. The PV presented above thus implies that the customer experience in terms of waiting time at the checkout is not enhanced in terms of waiting time, but by a more convenient checkout process. The store managers/owners then have two options, either they decrease the checkout area to keep the same average queueing time (e.g., decrease the area with approximately 90%), or they enhance the customer experience by only partially reducing it, which of course will reduce the PV of the investment. The business owner of the supermarket at issue stated that he probably would decrease the area partly, to have the capacity to decrease the waiting time with about 50%, but also to be able to meet a possibly higher demand in the future. To have the capacity to meet these demands, the maximum reduction of the checkout area is approximately 80% or 288 square meters (0,8*360).

The increased sales area would, if the sales are assumed to have the same turnover as today (turnover per square meter), increase the annual turnover by 26 372 448 SEK for year 0. With the estimated bottom line of 12%, the increased sales area would generate a total of 3 164 694 SEK in profit year 0. If sales are assumed to be constant, the PV of the increased sales is 18 958 463 SEK, as indicated in the table below.

Increased Selling Space							
Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**
FV	3 164 693	3 264 000	3 329 280	3 395 866	3 463 783	3 533 059	3 603 720
PV	3 164 693	3 022 222	2 854 321	2 695 748	2 545 984	2 404 540	2 270 955
Accumulated	3 164 693	6 186 915	9 041 236	11 736 984	14 282 968	16 687 508	18 958 463

Previously presented research furthermore indicate that RFID increases the accuracy of stock-keeping levels, which would increase the availability of the products. According to the research conducted by Gruen et al., presented above, customers miss 8,3% of their shopping list. Further, in 72% of the cases, the products are missing due to human errors (orders and re-stocking). With RFID-technology, supported by all the research presented above, these human-errors could be eliminated. Furthermore, in 40% of the cases, consumers either buy the product elsewhere or not at all, e.g., a lost sale for the supermarket. When applying the same figures, and assuming that RFID could reduce human errors by 90% (even though a 100% might be more realistic) the economic benefit from this perspective would be an additional 8 635 320 in sales (0,083*(0,9*0,4)*289M). With the average gross margin of 28,31%, the contribution margin equals to approximately 2,45 MSEK year 0. The PV of the increased sales accumulates to a total of 14 510 403 SEK during the seven-year period, see table below.

Increased Availability							
Year	0	1	2	3	4	5	6
FV	2 444 659	2 493 552	2 543 423	2 594 292	2 646 178	2 699 101	2 753 083
PV	2 444 659	2 308 845	2 180 575	2 059 432	1 945 019	1 836 963	1 734 909
Accumulated	2 444 659	4 753 504	6 934 079	8 993 511	10 938 531	12 775 494	14 510 403

The final hard value associated with the technology is the reduction of wastage. Twist presented an estimate of decrease in wastage of two-thirds (67%). The current level of wastage, 3 112 747 SEK, would decrease with 2 085 540 SEK (67%) during year 0. Over a seven-year period, the total present value of the reduced wastage is 12 225 210 SEK, as presented in the table below.

Wastage Reducement							
Year	0	1	2	3	4	5	6
FV	2 085 540	2 095 502	2 137 412	2 180 161	2 223 764	2 268 239	2 313 604
PV	2 085 540	1 940 280	1 832 487	1 730 682	1 634 533	1 543 725	1 457 963
Accumulated	2 085 540	4 025 820	5 858 307	7 588 989	9 223 521	10 767 247	12 225 210

5.3.4 Present Value of Required Investments

The technology does require an initial investment as well as an increased cost when labeling the products with the RFID-tags. The current market price for tags of the required functionality can be bought in large quantities for 0,1712 SEK. If we assume that the supermarket has to pay a higher price for the products when purchasing RFID labeled products, the cost of the tags should be included in the investment calculation. ICA Kvantum Åkersberga sold 15 131 534 consumer products during 2017. The labeling process of the SKU's would then generate a cost of 2 590 519 SEK year 0. One could argue that the prices of RFID-tags are continuously decreasing, which should be indicated in the calculation. The price of the RFID is, however, assumed to be constant in the calculation since an estimate of a price decrease is vague due to high fluctuations of the average decline in price, as presented above. The PV of the increased cost would be negative 15 374 026 SEK, see table below.

RFID Tags							
Year	0	1	2	3	4	5	6
FV	- 2 590 159	- 2 641 962	- 2 694 801	- 2 748 697	- 2 803 671	- 2 859 745	- 2 916 940
PV	- 2 590 159	- 2 446 261	- 2 310 358	- 2 182 005	- 2 060 782	- 1 946 294	- 1 838 167
Accumulated	- 2 590 159	- 5 036 420	- 7 346 778	- 9 528 783	- 11 589 565	- 13 535 859	- 15 374 026

Furthermore, the investment also requires an initial investment in hardware. Based on Impinj's pricelist, the price for such an investment, assuming that the supermarket would need 3 RFID-checkouts and 10 handheld readers, would be approximately 228 264 SEK for 12 antennas, 14 265 SEK for 3 readers and approximately 280 533 SEK for the handheld readers (needed for inventory check etc.). The PV of the initial investment is thus 523 062 SEK.

Moreover, if the cost for re-stocking per product is assumed to be linear with the turnover, the re-stocking cost should increase linearly with 2,98%. The increased re-stocking results in a cost of 204 824 (0,0298 * 6 873 276) for year 0. Applying the same requisites as in the other calculations, the PV for the increased re-stocking is negative 1 469 956.

Increased re-stock							
Year	0	1	2	3	4	5	6
FV	- 204 824	- 211 378	- 225 123	- 247 434	- 280 658	- 328 531	- 396 876
PV	- 204 824	- 195 721	- 193 007	- 196 421	- 206 292	- 223 593	- 250 099
Accumulated	- 204 824	- 400 545	- 593 551	- 789 972	- 996 265	- 1 219 857	- 1 469 956

The total NPV for the investment at ICA Kvantum Åkersberga, including all above calculations is hence **93 671 033 SEK** (64 820 939 + 8 958 463 + 14 510 403 + 12 225 210 -15 374 026 - 1 469 956).

5.3.5 Estimate for Present Value of All ICA Kvantum

With the assumption that the presented metrics of the supermarket at issue is representative for the entire segment of ICA Kvantum stores and that it can be quantified by dividing the PV by its segment market share, the PV for the Kvantum segment would be equal to positive **10 524 835 169** SEK (93 671 033/0,0089).

6.0 Discussion

The economic implications of the technology are undeniably large. There is a vast potential for profitability in streamlining retail processes, regardless whether the efficiency is achieved by RFID or other innovation. This fact, of course, is not unknown knowledge, otherwise increasing efficiency in the retail sector would not be discussed.

RFID has been a well-spoken of topic for over a decade, probably due to the plausible effects that it might have on streamlining processes and increasing customer experience. However, regardless of the characteristics of an innovation technology or the usage of it, the customer's social acceptance of such technology must be examined. This is especially important since all calculations and economic implications are based upon such an acceptance, enabling the supermarket for consideration to the customer. As presented above, there are numerous researchers addressing the privacy aspect of RFID. Research both implicating the privacy aspect to be a hindrance for the technology to be commercialized, and those who think that the concerns are exaggerated. The fact that there is a risk, however, that personal privacy would be violated in connection with the technology is an intuitively attractive thought. The easiest solution, in order to increase the chance of succeeding in creating confidence in the technology, would simply be not to use the features that might violate personal privacy. Even though the technology can create value in more ways than "just" streamline operational processes, it may not necessarily, especially not from an economic perspective. Costumer data can be collected with alternative methods, which indicates a limited value adding of RFID from the data collection perspective. If this would to increase the chances of gaining social acceptance for the innovation, it might be worth to have this approach, at least for the technology's introduction phase. Furthermore, it seems to be important how the usage and implications of RFID is communicated. If the companies would to use the function to delete the tags after a completed payment, which is form of requirement in the EPS and ISO standards, and would communicate this accordingly, chances to gain social acceptance should increase. If ICA, in a transparent way, would communicate exactly what information is gathered and to what purpose, where large scale data collection is not recommended, chances of gaining social acceptance should increase as well.

Of course, the attitude towards the technology is something that ICA, both at an aggregated level for the entire market and for the individual store's customer groups, must examine carefully. Both in order to minimize the risk of the investment, but also to gain more significant insights into where and by whom any resistance to the technology might exist. The results presented by Forbes and the quantitative study might be representative for the entire market. The resistance would then be highest among older generations, but this must be ensured by further investigations. If the investigations would confirm the thesis, the different segments must be analyzed from an economic perspective. The purchasing power of the pessimistic segment must be compared to the positive segments'. This step of the analysis is especially important since it may be that the segment who has the most substantial purchase power also has the highest resistance for the technology, which obviously would harm the value of the investment. What on the other hand support that a social acceptance for the technology exists is the fact that the current younger generation, according to Forbes, tends to have higher confidence for companies to respect their data. The interpretation could be that people who have grown up in a more technologically developed society are more open minded to innovations and thus also RFID-technology, as partly proven by Fleming and Adkins (2016), when comparing millennials attitude towards data collection with older generations. If the research is proven to correspond with the population, it would mean that the proportion of people, within the target audience, who are favorable to the technology would grow over time in correlation with the population's proportion of millennials. On the contrary, one could also argue that if the technology would streamline the FMCG sector and less employees are needed, the current and plausible future employees would be resistant to the technology. With this aspect and considering the commonly known fact that many young people have their first job in the FMCG sector, the social acceptance might decrease with this reasoning. However, the quantitative study provides evidence of a correlation between age and attitude towards the technology. The correlation indicates that younger people tend to care less about the negative

aspects of such a technological development and thus prioritize the personal advantages presented; time-saving and convenience, over the negative societal aspects; decrease employment ratio in the FMCG-sector. This would indicate that the factors presented by Brynjolfsson and Mcafee (2013) does not collectively exhaustively explain the consumer advantages with technological development.

If one assumes the existence of social acceptance and furthermore presupposes that it is possible from a purely operational perspective of the individual stores, the question whether it is possible to persuade suppliers and producers to label the goods with RFID during the manufacturing process remains. The calculations below are based on that the labeling process does not require additional working time, i.e. money. The calculations therefore only take the price of the RFID-tag into account, since the labeling process is assumed to be outsourced further upstream in the supply chain. The assumption is based on the fact that there are other actors who have succeeded with this outsourcing. However, it would be imperative to believe the outsourcing would not require a large quantity of those RFID-products. From this aspect, it is therefore reasonable to assume that the possibility to convince manufacturers to implement this type of change would increase if, for example, all Kvantum-stores would to implement the technology simultaneously, hence the NPV estimate for all 126 Kvantum-stores. However, if all 126 Kvantum-supermarkets would to agree to the implementation, would it be possible to come to an agreement with thousands of suppliers and manufacturers?

The NPV of an investment for all 126 stores, approximately 10.5 billion SEK, gives a clear indication of the maximum size of the initial investment. The investment could, for example, in order to make the project feasible, be to rebuild or build a new central warehouse that would distribute RFID-products to the 126 Kvantum-supermarkets. Furthermore, a central warehouse with the intend to distribute RFID-products, could also be automated to increase efficiency at a completely different level thanks to the RFID-tags. If the cost to rebuild or build this warehouse would to be calculated to cost less, including both the initial investment and increased operational costs, the investment should be made. Again, of course, the investment still requires a social acceptance of consumers and agreement with the suppliers. Furthermore, when the stores are owned by individual business owners, it is of course necessary for the revenues be distributed in a way so that all parties involved would have a financial incentive large enough to make the project as good as possible.

A risk, that should not be forgotten, is the possibility of differences within the same store concept, just like Mr. Carlsson insinuated. This would reduce the number of stores interested, given that all technology is not applicable in Kvantum-supermarkets. Again, this would create difficulties in achieving the economies of scale required to involve suppliers and manufacturers in the project. Furthermore, when involving a large number of actors in a negotiation, it can be assumed that it will take a very long time, if even at all, to reach an agreement of how to implement the innovation and reform to RFID. On the other hand, the economic benefits indicate that it would be possible to unite many different wills in a change like this. In addition, since the technology addresses the most disturbing factors mentioned by *Svensk Handel*, it is reasonable to believe that the interest from ICA business owners in finding an agreement would increase.

Moreover, depending on how the increased resources would to be allocated in the supermarkets, it would entail soft values for the employees as well. With the premise that Mr. Hägg's statement is true, and that many of the "boring" tasks would be minimized in association with the technology, it should increase the employee's well-being, since research provides a positive correlation of well-being and having fun at work. As a result, it is not entirely inconceivable that staff, industry organizations and / or health institutions would advocate a change in the grocery trade. The latter would probably also advocate the change due to reports indicating that the traditional checkout-work is extremely strenuous, both physically and psychologically.

Although investments are generally based on hard values only, it is nevertheless intuitive to think that even soft value would have an impact on the decision-making process. It is not impossible that the reports of happiness at work and the strenuousness of traditional checkout might lead to further legal restrictions in the

area. The legal restrictions might lead to additional incentives to change these parts of the business in order for it to become more ergonomic, which will probably be through technological innovations and maybe RFID.

7.0 Conclusion

If the stated assumptions are proven to be correct in a more in-depth analysis and broader investigation, then it would not be economically defendable not to carry out the implementation of RFID. However, what should be added when it comes to an organization like ICA, where the stores are not owned and controlled by central management, is the complexity to conduct such a massive reformation. This particular complexity might be the reason why actors, who have significant bargaining power and are capital strong, i.e., Amazon and Walmart, have chosen to investigate alternative innovations in order to increase the efficiency in the retail sector. The alternative innovations, such as smart cameras, does not require suppliers to be involved in the reformation. The advantage would be that fewer actors would be involved in an already complex negotiation. The alternative innovation does, furthermore, not require economies of scale in order to be feasible.

The essence of the whole reasoning is that data suggests that there is social acceptance among customers, which is likely to increase with a relatively larger proportion of millennials. Furthermore, the research of this thesis indicates that an investment in RFID-technology from major actors within the food industry, due to the reduced costs of the RFID-tags, is economically feasible.

A large part of the aspect of whether the technology confines to personal integrity is also likely to be more related to communication than functionality, which indicates that such implementation requires clear and honest communication. Besides, an actor like ICA should, carefully consider using the technology only to streamline the internal processes, rather than to facilitate and adopt extensive scale data collection, to reduce barriers of gaining social acceptance. Furthermore, the technology is developed enough for the project to be possible from a technical perspective, confirmed by both statements from an RFID-expert, suppliers of the technology and the case studies. The major hindrance for the introduction of the technology is whether it is possible to involve enough stores to achieve the required economies of scale and to reach an agreement with suppliers.

The conclusion is therefore that major actors within the food industry should consider other possibilities to streamline these processes, as other large retailers have done. The scope of the project seems to be too complex to implement. This, in combination with the fact that the risk that exists, to completely change an established business concept, e.g. ICA in the Swedish Market. The risk of investing in RFID-technology and to change the existing business concept should therefore be considered to be too high.

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9.0 Attachments

9.1 Qualitative Study Interviews

9.1.1 Attachment 1 - Template Interview RFID expert

- For how long have you been dealing with RFID technology?
- Have you been involved with different projects, including RFID?
- How does the technology work?
- What is the difference between a passive and active RFID tag?
- How much information can a single tag store?
- Are there different tags more or less suitable to different products?
- Does the shape and construction of the antenna affect the reading capacity?
- Can the tags be attached to any kind of surface?
- What's the maximum reading capacity of the antennas?
- By looking at the trend of a decreasing price level of the tags, how much do you estimate the price per tag to be in the future?
- What do you estimate the prices of the antennas to be?
- In which industries do you see RFID technology to be a good fit?
- What are the possible challenges that one would find if implementing RFID technology into the food industry?
- What benefits can you identify with the technology?
- What are the challenges with the technology?
- Why do you think no one has done it yet?
- What was the reason why Walmart didn't succeed in their trial?
- What would have to be done differently in order to make the RFID-technology work today?

9.1.2 Attachment 2 - Template Interview RFID Suppliers/Manufacturers

- Which RFID tags do you recommend for the retail industry with the following functionalities;
    - Reading capacity up until two meters
    - The tags must be able to store three different data sets
    - The information of the tags must be deleted/erased after completed purchase
    - The tags must be easy to include or to label the products, are there an existing scalable solution?
- Which antennas to you recommend for the retail industry with the following functionalities;
    - Reading capacity up until two meters
    - The antennas must be durable and easy to store
- What's the price for the RFID-tags?
    - Per tag
    - In bulk, approx. 15 million tags / year
- What's the price for the antennas?
- What's your maximum capacity of production in one year?
- Do you have a collaboration with other factories in order to meet high demand

9.1.3 Attachment 3 - Template Interview FMCG Business Owner/Manager

- What's you background within ICA
    - What's your position?
    - For how long?
- Have you previously worked at different store concepts?
- Can you describe your target audience?
- Do you think your customers would appreciate digital products to assist them at the store?

- Do you believe that there's a need for digital complementary products in the traditional store concept?
- Which digital products have you previously considered to be a good investment?
- Are there any reasons why such products would be good alternatives?
- Have you made any reason investments of digital tools / products to your business concept?
    - If yes, what was the major effects of the complementary product, both financially and operationally?
    - If no, what was the reason why you didn't invest in the technology?
- Which are the biggest barriers when implementing innovations to an ICA store?
- Does the organizational structure of ICA prevent or limit you from investing in such technology?
- Do you have self-scan checkout today at your store?
- If yes, has it been a good investment considering soft and hard values?
- If no, to what extent have to investment not fulfilled the expectations?
- Before today, had you previously heard of the RFID technology?
    - If yes, where from?
- From a technical point of view, would it be possible to implement the technology and integrate it to your current systems?
- Which operational challenges do you identify with the technology?
- Can you identify pros and cons with using RFID?
- How do you think ICA's customers would benefit from implementing the technology?
- Can you identify possibilities for cost and operational efficiency with the technology?
- Can you estimate the possible cost savings of implementing RFID-technology?
- How much would the technology approx. come to affect the yearly financial result at:
    - One ICA Kvantum?
    - All ICA Kvantum?
- Given the possible PV of the investment and the soft values, do you think ICA would be ready to implement the technology from a central part of the organization?

Link shown about a mock-up concept: https://www.youtube.com/watch?v=xFNGiTGyQzk

9.2 Attachment 4 - Quantitative Study of Social Acceptance

Information given of the technology:

Link shown about a mock-up concept: https://www.youtube.com/watch?v=xFNGiTGyQzk

Advantages:

1. RFID Checkouts does not require scanning of all products individually, but all can be identified with a distance read. Approximately 7-15 times faster than existing checkout systems.
2. RFID can be used to prevent products to run out of stock - e.g. increase availability of products in the assortment due to better inventory control.
3. Can be used to ensure that no products are sold that have expired.
4. The shopping experience could be enhanced on a personal level since the supermarket could collect more detailed data of the consumers.

Disadvantages:

1. Could affect the privacy integrity due to;
    a. The ability to mark and identify every single object in the supermarket with a unique ID.
    b. The fact that tags can be placed invisible for the eye but can be read from a distance without the consent or knowledge by the consumer/carrier of the object.
    c. The large amount of data that can be collected and used through the technology.
2. The data could end up, if not protected, in wrong hands, which could lead to criminal activities.
3. Less checkout staff, so that personal interaction is limited.

Statements

The respondents were asked to rate the statements below on a scale of 1-7 depending on if they agreed or disagreed with the statement. 1 indicated a total consent, whereas 7 indicated the opposite. Each number was clarified with a description of what it indicates:

1. Totally agree
2. Agree
3. Partly agree
4. Neither
5. Party do not agree
6. Disagree
7. Totally disagree

Statements:

1. RFID is constraining the personal integrity
2. RFID constrains the personal integrity if data is collected
3. RFID does not constrain the personal activity
4. I do not want supermarkets to collect data of my purchases
5. I do not care if data is collected of my purchases
6. I am convinced that my data would be protected by the company
7. I think the company would abuse my data
8. I think the advantages outweigh the disadvantages
9. I think the disadvantages outweigh the advantages

One alternative question:

Imaging two supermarkets, both identical in every aspect and with the exact same distance from your home. One supermarket has traditional checkout, and the other uses the same technology as in the video shown. Which store would you select:

a. The RFID store regardless if they collect data
b. The RFID store if they protect the collected data
c. The RFID store if they do not collect data
d. The conventional store regardless of data collection
e. I do not know

Year of birth:_____ (only numerical answers accepted)

Gender

- Male
- Female
- Other
- Do not want to reveal

9.3 Attachment 5 Video of Readability Confirmation

Link to functionality test of RFID tags: https://youtu.be/jGqyWuReA6w

10.0 Glossary

Active RFID-tag:
An RFID-tag using a small battery as the energy source in order to send a signal to the RFID-readers and antennas.

AUTOID
A technology that is used to identify goods in motion, e.g. automatic identification.

Bar codes (EAN codes)
A binary code which consist of black lines in various thickness, spacing and patterns, giving the individual code a specific identification. Is being read by an optic laser.

CRM (Customer Relationship Management)
A system that companies can use to handle customer data.

CSI (Customer Satisfaction Index)
A key metric used to measure customer satisfaction.

Fast-moving consumer goods (FMCG)
Goods and products sold in supermarkets, associated with food and nearly related products.

GDPR
The General Data Protection Regulation, a regulation in EU law on data protection and privacy for all members within the European Union and the European Economic area.

Internet of Things (IoT)
The extension of internet connectivity into physical devices and everyday objects.

ISO standards
ISO is an independent non-governmental international organization whom promotes worldwide proprietary, industrial and commercial standards.

Midas flag-tag
Is a well-used RFID-tag produced by Smartrac.

Optical Character Recognition (OCR)
Is widely used as a form of information entry from printed paper to data records.

Passiv RFID-tag
An RFID-tag that uses the energy of the radio wave, instead of an internal energy source, in order to re-send the signal back to the RFID-readers and antennas.

QR-codes
QR-codes or “Quick Responds Codes” is a machine-readable optical label (a matrix barcode or a two-dimensional barcode), that contains information.

RAIN RFID
An RFID-tag with significantly better readability through metals and liquids.

RFID-antenna
The transmitting part of the RFID-tag that receives and sends information back and forward from the RFID-system.

RFID-chip
The heart, storage and memory base of the RFID-tag.

RFID-readers
RFID-readers are being used to encode and read information from the RFID-tags.

RFID-tags
The tag consists of three parts; the label, the antenna and the chip. Together they compose the RFID-tags that can contain, send and receive information that has been encoded.

RFID-technology
An identification system that uses electromagnetic fields to automatically identify and track tags.

Smart cameras
Smart cameras identify objects by machine learning.

Social Acceptance
The perception, shared by the society, that the benefits exceeds the plausible negative aspects.

Technology-Based Self Service (TBSS)
A self-checkout system that is commonly used within the food industry. The system uses a laser to read the information of the barcodes.

Universal Product Code (UPC)
UPC is a barcode symbol commonly used in the United States, Canada, New Zeeland, United Kingdom etc.