RFID goes bananas

- Change management for implementing RFID technology

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Abstract

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Problem discussion: To achieve innovation, logistic companies could implement innovative technology such as Radio Frequency Identification (RFID) technology. However, implementing RFID technology involves a great deal of uncertainty and risk which induces specific requirements for successful implementations. The existing literature about implementing RFID technology often focus on the technological aspects of the implementation. The change management perspective is often neglected. What issues do company face when implementing RFID technology and is there a way to get prepared?

Purpose: The purpose of this thesis is twofold;

1. To develop a change management process model for RFID implementations.
2. To identify central components of change and their interaction within an RFID implementation.

Methodology: The systematic research approach has been used in this thesis, which suggests that components of the RFID system are mutually dependant and interacts with each other. An abductive scientific reasoning is used where observations and theoretical studies are conducted simultaneously. Furthermore, a descriptive case study method is chosen, which focuses on how things are done and based on participation analyse the situations and finally conclude a result.

Conclusion: Besides identified three components: *people-process-technology*, which we consider to be central during technical implementations, we have realized that the interaction among these factors is essential for a successful implementation. However, during RFID technology implementations, the uncertainty and lack of knowledge surrounding the technology affects the balance between the components negatively. The importance of change management also increases as the uncertainty of the technology can cause major set backs during the implementation.

By studying literature within *change management, pilot studies* and *risk management* and by conducting a case study at Nowaste Logistics, we have developed an RFID change management process model. Through our case study we have also concluded that Nowaste Logistics handles changes successfully and that they have an obvious and honest drive to improve. Nowaste Logistics manages the hard factors of change management very well. However, the soft aspects could be improved such as defining a clear vision, communication and documentation. Furthermore, the case study provides experiences of an RFID implementation within the fruit and vegetable industry and highlights the challenges of the RFID technology due to the products with high water content.

Key words: Innovative technology, Innovation, RFID, Change Management, Risk Management, Pilots studies, Technical verification, Implementations, Nowaste Logistics.

Sammanfattning

För att nå långsiktig framgång måste företag röra sig snabbare och anpassa sig bättre till omgivningen än sina konkurrenter. Ett sätt att göra detta är att ta del av innovativa teknologier för att skapa konkurrensfördelar. Nowaste Logistics som är en tredjepartsleverantör inom frukt och grönsaksmarknaden, beslutade år 2008 att införa RFID-teknologi för att öka spårbarheten på sina varor och på så sätt nå konkurrensfördelar. Radio Frequency Identification (RFID) är en teknologi för automatiserad identifiering som använder radiovågor för att sända data mellan en så kallad *tag* och en *läsare* utan fysisk kontakt. Nowaste Logistics beräknar att vara först med RFID-teknologi inom frukt och grönsaksbranschen i Sverige. I och med RFID har förändringar behövt göras i syfte att förbereda organisationen och processer för den kommande implementeringen.

Detta examensarbete har två syften;

1. Att ta fram en förändringsprocessmodell för RFID implementeringar.
2. Att identifiera centrala komponenter och interaktionen mellan dessa under en RFID implementering.

En ny etiketteringsprocessimplementering har studerats och deltagande observationer vid de tekniska testerna inför RFID-implementeringen har också genomförts. Med hjälp av litteratur och teorier inom Change Management, Pilots and Risk Management och RFID implementeringar tillsammans med en fallstudie på Nowaste Logistics har våra resultat konkluderats.

Genom att använda vår förändringsmodell, *RFID Change Management Process Model*, tror vi att Nowaste Logistics, såväl som andra företag, kan förenkla och strukturera sina RFID-förändringsprojekt på ett tydligare sätt. Förändringsmodellen som syftar till att guida projektledaren genom hela förändringsprocessen är designad för att vara lättförstålig och användarvänlig.

Förutom att ha identifierat tre komponenter: *People-Process-Technology*, som vi anser centrala att beakta vid tekniska implementeringar, så har vi insett att interaktionen mellan dessa faktorer är avgörande för en framgångsrik implementering. Vid RFID implementeringar är interaktionen än viktigare och vi har kommit fram till att behovet av Change management ökar i och med att osäkerheten för projektet ökat. Osäkerheten uttrycker sig till exempel genom att tekniken är obeprövad och att företaget inte säkert vet om tekniken kommer att fungera som planerat. Vidare är det viktigt att balansera uppmärksamheten mellan People-Process-Technology så att ingen av komponenterna blir lidande respektive får för mycket fokus. Det tycks vara vanligt att tekniken felprioriteras som följd av de osäkerhetsfaktorer som råder kring den. Som exempel, visade fallstudien att speciella utmaningar ställdes på RFID tekniken på grund av varor med hög vattenhalt vilket medförde att större fokus borde

lagts på tekniken i inledande faser. För att reducera dessa osäkerhetsfaktorer anser vi att företag bör inleda de tekniska testerna så tidigt som möjligt, arbeta aktivt med proaktiv riskhantering och genomföra pilotprojekt. Vidare anser vi att processdesignen bör hållas så flexibel som möjligt för att vara anpassningsbar för tekniska förändringar som kan vara nödvändiga under implementeringens gång.

Preface

This thesis was conducted at the Division of Packaging Logistics of Engineering of Lund University in cooperation with Nowaste Logistics AB.

We would like to thank our supervisors, Daniel Hellström and Per Magnus Andersson for their support during the process in conducting our master thesis. We would also like to give a special thanks to Robert Davstedt and Bill Larsson at Nowaste Logistics for showing interest, support and inspiring attitude along the entire process. It has been a very valuable time at Nowaste Logistics and thanks to Robert and Bill we have got to know the company well.

The last thank you is dedicated to Riad Haddouche who taught us how to drive a forklift. We will never forget to look towards the way we are driving!

Viktor Hebrand and Fredrik Swahn

Lund, May 2010

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1 Introduction

1.1 Background

> *To win in the long run, it is not the place you are in that matters it is the speed you are running at.*

To gain long term success a company needs to move faster than its competitors. This is why innovation is such a hot topic for many business leaders in today's industries. When it comes to long term success, instead of talking about current market share and position one should talk about innovation. Without innovation a company will soon get outrun by its competitors. So what is innovation?

> *"Innovation is the multi-stage process whereby organizations transform ideas into new/improved products, service or processes, in order to advance, compete and differentiate themselves successfully in their marketplace." (Baregheh et al., 2009)*

In logistics, innovation is often associated with process improvements. In the current business environment, process improvements are often supported by technology or IT-infrastructure. To be innovative one does not need to invent a new technology but can use existing technology in new profitable ways. As new technologies are constantly being developed, this provides opportunities for companies to increase efficiency in their processes. The companies that can embrace the new technology in profitable ways can often gain competitive advantages. For companies to be able to embrace new technology into their day-to-day business the organisation must manage the change that it will involve. Some organisation do this well while others struggle.

However, implementing innovative technology is often complicated and involves a great deal of risk (Gilmore, 2004). Except dealing with the organisational change factors, the company also needs to manage the risk associated with the technology. Many companies underestimate the risk and uncertainty which results in broken project plans and budgets. Implementing innovative technology requires careful planning and an organisation prepared for change (Smith and Merritt, 2002).

1.2 Problem discussion

To achieve innovation, logistic companies could implement innovative technology such as Radio Frequency Identification (RFID) technology. However, implementing RFID technology involves a great deal of uncertainty and risk which induces specific requirements for successful implementations. The existing literature about implementing RFID technology often focus on the technological aspects of the implementation e.g. Brown (2007) and Li et al. (2006). The change management perspective is often neglected and literature on change management during RFID implementations is scarce. What issues do company face when implementing RFID technology and is there a way to get prepared?

1.3 Purpose

The purpose of this thesis is twofold;

1. To develop a change management process model for RFID implementations.
2. To identify central components of change and their interaction within an RFID implementation.

1.4 Focus

Nowaste Logistics is a third party logistical provider within the fruit and vegetable industry with the aim of being an innovative company. They are just about to implement Radio Frequency Identification (RFID) technology, a technology for automated identification, in order to increase efficiency and quality in their outbound logistics process. RFID is a relatively new technology and Nowaste Logistics will be the first company within the Swedish fruit and vegetable market to implement the RFID technology (Davstedt, 2010). Therefore, RFID can be considered an innovative technology within the Swedish fruit and vegetable market. During the initial phases of the implementation a generic road map (Figure 1) was developed by Israelsson and Nordlund (2009) and the early phases was carried out; *Initiation*, *Assessment* and *Specification*.

This thesis focuses on the RFID implementation for outbound logistics at Nowaste Logistics' warehouse in Helsingborg, Sweden. The case study specifically focuses on the adoption phase of the RFID implementation since this is the phase that Nowaste Logistics is in. However, during the adoption phase tasks, such as integration, communication and training, which are not considered to be in the adoption phase, will be discussed. As a part of preparing for the pilot in this phase a new labelling process implementation have been carried out. The implementation does not involve RFID technology but is a step towards implementing the technology and is therefore considered to be a part of the adoption phase.

The focus of the study has been change management issues regarding organisational changes. However, issues regarding the technological and process changes have also been studied. Although the focus is on the RFID implementation, the thesis also discusses change management when implementing technology in a wider perspective.

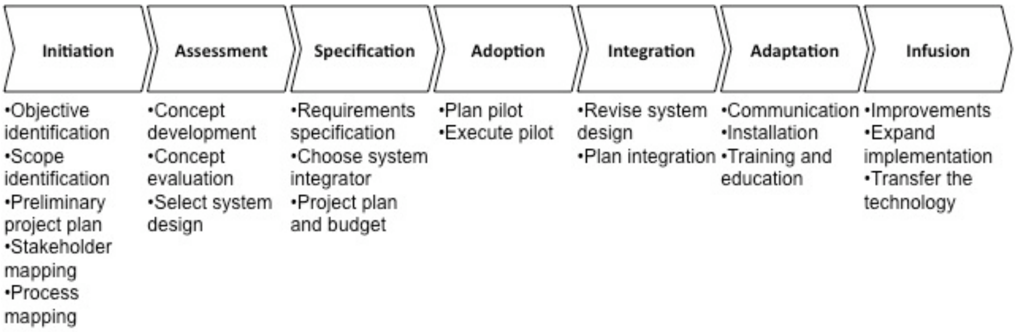

Figure 1.The generic road map developed by Israelsson and Nordlund (2009).

1.5 Target group

This thesis targets employees at Nowaste Logistics as well as employees at Everfresh and Total Produce Nordic AB. It also targets other groups are other supply chain actors such as GDL and CLAB. Furthermore, this thesis also provides valuable insight for other companies implementing innovative technology such as RFID.
In the academic community this thesis especially targets NGIL and the RFID community but it also targets students at Lund University with special interest in RFID technology and implementation management.

2 Methodology

2.1 Research approach

There are three main research approaches to study and interpret the reality; the *analytic approach*, the *actors approach* and the *systematic approach* (Arbnor and Bjerke, 1997). The systematic approach, in contradiction to the analytic, suggests that components of the system are mutually dependant and interacts with each other. Therefore the system cannot be broken into its components and analysed but needs to be systematically interpreted as a whole. (Churchman, 1979)

The approach used in this thesis is the systematic approach as the RFID system Nowaste Logistics is about to implement is related with the rest of the company. Furthermore, there is a close connection between the actions of the involved actors and the success of the implementation which makes a systematic approach appropriate.

2.2 Scientific reasoning

Abductive scientific reasoning is used in this thesis, which is a combination an inductive and a deductive method (Alvesson & Sköldberg 1994). Inductive scientific reasoning starts with empirical observations in order to form relevant theories. Deductive scientific reasoning starts with theory and than data are gathered to confirm or disapprove the theory. (Holme & Krohn 2000)

According to Kovács and Spens (2005), the abductive research process begins with pre perception and theoretical knowledge. This is not a research process step, but is rather the author's point of departure. The first research step is the real-life observation. The real-life experiences are then matched with theories, more observations are done and a loop is created between observation and theory matching. During the next step in the process a theory is suggested and final conclusions are made. Finally the conclusions can be applied on the real-life settings. Kovács and Spens argue that the abduction research process is well suited for development of new theories (Kovács and Spens, 2005).

2.3 Case study

According to Yin (2003), there are three different types of case studies; *Explanatory*, *Descriptive* and *Exploratory*. A descriptive case study method is chosen, which focuses on how things are done and based on participation analyse the situations and finally conclude a result. The case study, the RFID implementation, has two embedded units of analysis; The New Labelling Process and the RFID technical verification

(Figure 2). The context of the case study is Nowaste Logistics. During both units of analysis, direct observations and participant-observations have been used to collect evidence. Furthermore, interviews have been a big part of the information gathering and the authors have been conducting three types of interviews; *Open and Unstructured Interviews*, *Focused and Semi structured Interviews* and *Structured Interviews* (Yin, 2003). The third and last data source that has been fundamental for the case study is *Documents and Archives* provided by the RFID system integrator and Nowaste Logistics*.* The thesis written by Israelsson and Nordlund (2009) has also been an important source. By using three different types of data sources, data triangulation has been used to make conclusions and to analyse the RFID implementation at Nowaste Logistics.

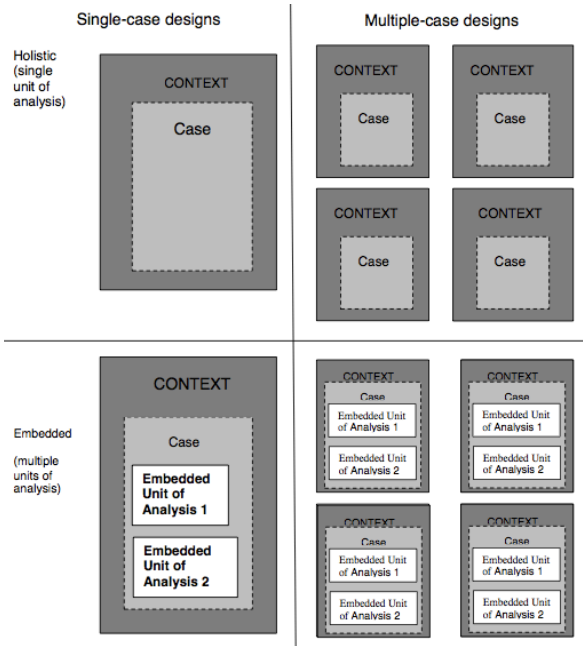

Figure 2. Basic types of design for case studies (Yin, 2003).

2.4 Data collection

Data have been collected during three months of active participation during the case study at Nowaste Logistics. During this time the authors have been a part of the RFID implementation project team and worked close to the project manager. Both quantitative and qualitative data collection methods have been used in this thesis. Quantitative or qualitative approach should be chosen depending on the problem statement and the purpose of the investigation (Jacobsen, 2002). A qualitative approach is applicable when the problem statement is vague or if the purpose is to identify under laying attitudes (Jacobsen, 2002). In the beginning of the case study, where the problem statement was vague, a qualitative approach was used to gain initial insights. As the case study progressed, both quantitative and qualitative methods were used to yield greater insights.

In the case study, first and second hand data have been used. The first hand data have been collected trough observations, interviews and meetings. The second hand data has been collected from documents and archives.

2.4.1 Participant observations

Based on experiences from an RFID implementation, Pålsson (2007) suggests that participant observations should be used more frequently in logistical research. According to Pålsson, using participant observations in logistics results in significant and detailed findings, which would be difficult to achieve with other methods. Both qualitative and quantitative data collection have been made through participant observations during the case study. The quantitative data is primarily collected during the RFID technical verification, while the rest of the observations have been more qualitative. During most observations, notes and pictures have been taken in order to properly remember the situation. As an example of the active participation, among other tasks, a poster was developed and presented to the organisation as one way to inform about the RFID implementation (Appendix 1).

2.4.2 Meetings

The authors have participated in regular meetings with the project manager and the project team. During the meetings the authors have been actively participating in the discussions. Notes have been taken during all meetings to ensure proper documentation both for the project progress and the thesis.

2.4.3 Interviews

During the project several interviews have been conducted to gather qualitative information. Most interviews have been conducted in a semi-structured way where initial questions have been asked and sometimes follow up questions have borderlined to dialogues (Yin, 2003). During the interviews, notes have been taken and the interview has sometimes been recorded so that nothing should be misunderstood. An initial interview was held with Israelsson and Nordlund, the authors of a master thesis regarding the initial phases of the RFID implementation at Nowaste Logistics. During the interview, valuable information was received about the background of the project and the company.

2.4.4 Documents and archives

During the case study, the authors have received quantitative and qualitative data through documents and archives from Nowaste Logistics and the RFID system integrator. There is a risk that this second hand data is not objective. In most cases the archives and documents have been verified by using alternative objective sources. In those cases when verification has not been possible, the material has objectively been validated by the authors to analyse if it seems reasonable.

2.4.5 Tutor meetings

Regular meetings have been held with the academic tutors as well as the tutor (the project manager) at Nowaste Logistics. The tutors have mainly guided the authors in which path to take but also recommended relevant literature sources. The guidance has been of great help as inspiration and has increase the effectiveness of our work.

2.5 Process of investigation

The process of investigation began by a literature review of implementation processes including theories about change management, RFID-implementations, project pilots and risk management (Figure 3). After the literature review, the empirical data was gathered through the RFID implementation case study. The case study began with Nowaste Logistics implementing a new labelling process, followed by the technical verification of the RFID system. During the case study, complementary literature studies were made to support the empirical data observations. Nowaste Logistics' change management process during the RFID implementation was analysed with take-off from change management literature. The analysis were conducted by separately looking at the different components of the change management literature and based on the empirical data evaluate Nowaste Logistics' performance within those components. Based on the case study findings from the analysis the models were developed.

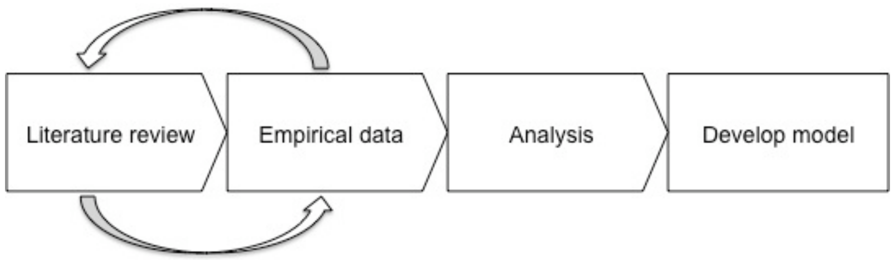

Figure 3. Process of investigation of the thesis.

3 Literature review

This chapter presents relevant literature that will be used during this thesis. First well known change management models will be presented as these have been central parts of this thesis. After this, RFID technology is described and with a specific focus on the technology Nowaste Logistics is about to implement. RFID implementation process models are also presented with a basis from the road map Nowaste Logistics have used. Finally relevant literature on risk management and pilot studies is presented as both these areas play an important role when implementing innovative technology such as RFID.

3.1 Change Management

Existing well known literature within the change management field is presented in this sub-chapter. The focus will be on Kotter's eight step model and the DICE framework as they provide practical advices on how to work with change management. Some further literature has been studied to provide additional insight into the change management field where as the most enlightening for this study are being presented.

3.1.1 Kotter's eight-step model for leading change

John Kotter has formed an eight-step model for leading change in organisations. Each step represents a set of actions which together form a successful change (Kotter, 1995);

1. Establishing a Sense of Urgency
2. Forming a Powerful Coalition
3. Creating a Vision
4. Communicating the Vision
5. Empowering Others to Act on the Vision
6. Planning for and Creating Short-Term Wins
7. Consolidating Improvements and Producing Still More Change
8. Institutionalising new Approaches

Kotter means that "the most general lesson to be learned from the more successful cases is that the change process goes through a series of phases that, in total, usually require a considerably length of time"(Kotter, 1995). Kotter also claims that by skipping any steps just gives the organisation an illusion of a faster change process but never produces a satisfying result at the end. Another lesson that Kotter mentions is that critical mistakes during any of the eight steps could have serious impact on final results of the change.

Step 1. Establishing a Sense of Urgency
This step usually begins with an individual or a group identifying that a change needs to be made; for example, due to revenue drop, technological trends, marked position or financial performance. Kotter explains this phase as very crucial which prepares and lays the foundation for the rest of the change process. The phase demands plenty of effort to be put on communicating the sense of urgency to management and Kotter means that no less than 75% of the managers should, honestly, agree that a change is required. If not, this could produce serious problems later in the process. General mistakes are for example managers' underestimating of people's ability to move outside their comfort zones. Another problem is the lack of leaders within the organisation. Kotter argues that "Mangement's mandate is to minimize risk, and to keep the current system operating. Change, by definition, requires creating a new system which in turn always demands leadership".

Step 2. Forming a Powerful Coalition
At the beginning there are often only a couple of people that starts the renewal program. Kotter experienced that the most successful changes were driven by powerful coalitions in terms of titles, information and expertise, reputation and relationships. Depending on the size of the organisation the coalition could consist of five up to 50 members with one thing in common; top management forms the core of the group. Kotter claims that "Companies that fail in phase two usually underestimate the difficulties of producing change and thus the importance of a powerful guiding coalition". Kotter continues by discussing the lack of team-work experience at top management and therefore undervalue the importance of this type of coalition. A coalition which do not have enough power could make some short term progress but in the long run, the opposition will gather and prevent the change.

Step 3. Creating a Vision
This phase suggests the coalition to create a uniform vision that every single member of the group supports. It is a very important step in the change process owe to the fact that the vision will be communicated to the entire organisation. It is therefore central that the vision is easy to understand and absorb. Kotter means that if you can not explain your vision in five minutes and receive a reaction that signifies both understanding and interest, you are not done with this phase.

Step 4. Communicating the Vision
Kotter describes three patterns in communicating the vision to organisations. The first pattern is about companies that has developed a fairly good vision but communicates it badly by just informing employees during a single meeting. The second pattern is when the head of the organisation spends plenty of time holding speeches and information meetings. It is still difficult to make the employees understand, it is not very surprisingly owe to that the vision captures about .0005% of the yearly communication. The third pattern describes how the vision is spread through news-

letters, hand outs and speeches but some of the senior executives does not accept the vision and act against the vision. This results in a lower belief in the vision. Kotter goes further and explains that "transformation is impossible unless hundreds or thousands of people are willing to help, often to the point of making short-term sacrifices". In successful cases the management have communicated with both words and deeds. Kotter argues that the latter is the most powerful.

Step 5. Empowering Others to Act on the Vision
"The more people involved, the better the outcome" Kotter says. He also describes how employees within organisations that want to improve the change progress feel like there are obstacles making it harder for them to help. These obstacles could for example be bureaucratic rules and organisation structures but in some cases also managers who have not accepted the vision from phase four. All obstacles have to be prioritised and removed. In those cases when the obstacles are a person, Kotter means that he or she must be treated fairly "and in a way that is consistent with the new vision". Kotter continues. "...action is essential, both to empower others to maintain the credibility of the change effort as a whole".

Step 6. Planning for and Creating Short-Term Wins
Kotter mentions the urgency level as an issue that could drop in case of absence of short-term wins. He also thinks that the pressure that is put on managers to produce short-term wins is good for the company and contributes to the change effort, despite the managers complaints. It is important for an organisation to show short-term wins and especially in change programs that last for a couple of years. Kotter writes "without short-term wins, too many people give up or actively join the ranks of those people who have been resisting change".

Step 7. Consolidating Improvements and Producing Still More Change
When short-term wins has been revealed it is central for the steering coalition not to see the change program as completed. It is a big difference between celebrating a win and declaring that war is won. Both pro-change people and resistors seek an end of the change but with different objectives. The resistors will take any chance of stopping the change while a pro-change person would like to celebrate a successful change. Kotter discusses the importance of having an enough powerful coalition to prevent such an outcome and also point out that "instead of declaring victory, leaders of successful efforts use the credibility afforded by short-term wins to tackle even bigger problems.

Step 8. Institutionalising new Approaches
Kotter has identified two factors that matters in institutionalising the new approaches. Firstly, people need to realise the right connections between new behaviours, approaches, attitudes and actions. Secondly, top management has to secure that the next generation managers personify the new approaches. This could for

example be shown in new requirements for promotions and other value based actions that are in line with the change. Kotter also mentions the big responsibility top management has in institutionalising new approaches and how one bad decision from top management could undermine many years of hard work. It is central that the whole steering coalition is in agreement until all new approaches are institutionalised.

3.1.2 The DICE framework - hard factors of change management

Sirkin et al. (2005) have developed the DICE framework to provide a common language of change. The framework consists of four factors; *Duration, Integrity, Commitment* and *Effort*. All factors bear three distinct characteristics; they should be possible to *measure*, *communicate* and *influence*. Sirkin et al. call these factors "the hard factors of change" and discuss the importance to not only focus on soft factors during changes. The DICE framework helps businesses to diagnose the status of their change process and to visualise it.

Duration
Companies tend to think that the shorter a project is, the greater the chance for succeeding. Sirkin et al., though, argues that it is the time between reviews during the project which is the key factor. In fact, studies have shown that a longer project in fact is more likely to be successful than short, if reviews are done regularly. Deadlines and milestones is another important aspect within the duration factor.

Integrity
"By performance integrity, we mean the extent to which companies can rely on teams of managers, supervisors, and staff to execute change projects successfully" (Sirkin et al. 2005). Sirkin et al. argue that change projects with dedicated and motivated people have a better chance to be successful. Therefore, companies have to free up some of the best people for the change initiatives. Further is the team leader a very important person during the change process and there are six criteria which Sirkin et al. have determined to be key criteria. Team leaders should have problem-solving skills, be result oriented, methodical, organisational, willing to accept responsibility and highly motivated. The Integrity factor is therefore a lot about how managers prioritize change projects within the organisation.

Commitment
The Commitment factor is divided into two different groups of people which the company must give support and attention to in order to make a successful change. The first group consists of managers and the second consists of people who will practice the new system and routines. Companies tend to underestimate the role of managers in showing their commitment to the change, to people at the operational level. Sirkin et al. therefore mark the importance in top management showing their

engagement in the change process to make the affected operators engaged and committed to the change initiative.

Effort

The Effort factor is about how much effort and extra time workers need to put in to achieve the change. Sirkin et al. mean that top management many times forget that the change process comes on top on an already heavy workload. Sirkin et al. thinks that a change project should not increase employees' workload by more than 10 % to have the right prerequisites. If a change initiative demands more effort, companies need to allocate more resources to the project. Sirkin et al. suggest that a few projects should be prioritized and if this is not enough, companies could hire extra workers during the change period.

A DICE score can be calculated by asking several question on the factors and based on the answers each factor gets a score between 1-4 where 1 is best and 4 is worst. Based on the results from over 225 projects, Sirkin et al. have created three different zones where companies could be in. Depending on the DICE-score, the company will be in either the *win*, *worry* or the *woe* zone (Figure 4). Change projects that get in the win zone, are most likely to succeed, in the worry zone the outcome of the project is hard to predict. If the project gets placed in the woe zone, this "implies that the project is totally unpredictable or fated for mediocrity or failure" (Sirkin et al. 2005).

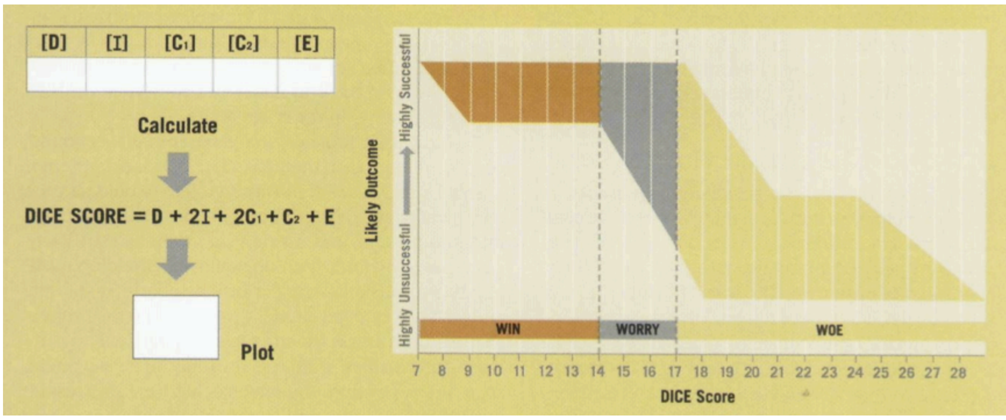

Figure 4. DICE score and its zones (Sirkin et al. 2005).

The DICE framework is an easy tool that Nowaste Logistics can use to *evaluate the current situation*, *identify areas of improvements* and *raise discussions* in the project group. The DICE score gives an understanding of the current situation and the probability for the project to be successful. If regular evaluations are done, the score also reflects how the project develops over time. The DICE framework can also be used to identify areas of improvements. The factors that are given high scores needs to be prioritised so that they can be improved. Finally, the DICE framework is perfect as a foundation for discussions within the project group. By letting all project members answer the DICE questions the differences between the answers can be discussed. It is often very valuable to discuss why different team members perceive the situation different.

3.1.3 Lewin's freeze phases

Lewin (1951) identified three stages of change that all people go through during changes; *unfreeze, change* and *freeze*. Lewin's theory was developed during the 1950's and has, for a long time, been a well used and quoted model.

Unfreeze
According to Lewin, people tend to seek a context where they feel safe and have a sense of control. They tend to attach their sense of identification to their environment. Therefore, any change will cause a sense of discomfort. Talking about the future is not enough to get people out of their “frozen” state and therefore significant effort needs to be put to “unfreeze” the organisation. However, the effort that people needs to unfreeze often differs widely among different people. There are various methods to unfreeze the organisation. According to Lewin, it is important to communicate the urgency of the change and to let people understand and accept the need of change. It is also essential to inform people how the change is likely to affect them and to create a common vision for the organisation.

Change
The change phase is where the real change is occurring. Lewin points out that it is important to consider the change a journey rather than a simple step. A common mistake that managers make is that they spend plenty of time with their own journey and then expect everyone else to accept the change directly. Change requires strong leadership, coaching counselling and other support. The first step in creating change is often the hardest and therefore needs focus.

Refreezing
The refreezing phase is when the change should be stabilised. In practice, this may be a slow process that ends gradually as supposed to a sudden stop. Key aspects in this phase are to ensure the acceptance of the change and to routines the new system. This step also demands taking care of the organisation's culture.

3.1.4 Three dimensions of strategic change

Pettigrew and Whipp (1991) identified three dimensions for change; *content, process* and *context*. According to Pettigrew and Whipp, the success of change is a result of the interplay of these three dimensions. They argue that there should be continues interplay between the dimensions and that they need to be aligned.

- *Content* - answers to the question *what* and involves the objectives, purpose and goals of the change.
- *Process* - answers to the question *how* and involves the implementation of the change.
- *Context* - answers to the question *where* and describes the internal and external environment of the change.

Further, Pettigrew and Whipp identify five central factors for successful change;

- *Environmental assessment* – Open learning systems should be used to continuously monitor the internal and external environment.
- *Leading the change* – The leaders needs to support the change and must mover the organisation towards change. This should be doe by creating the right climate for change.
- *Human resources as assets and liabilities* – The organisation must give responsibilities to their employees. The employees needs tom be seen as valuable and trustworthy and the leaders should let them know this
- *Linking strategic and operational change* – By combining strategic and operational changes this might lead to new positive changes.
- *Overall coherence* – The change initiatives must be consistent with clear objectives that are aligned with the environment. The objectives and goals should create a competitive environment and be feasible.

Each of the five central factors has seven to ten sub-elements that are divided into primary conditioning features and secondary mechanisms. The primary features are elements that have to be in place before the secondary mechanisms can take place.

3.2 Radio Frequency Identification technology

Radio Frequency Identification (RFID) is a technology for automated identification, which uses radio waves to transport data between a *tag* and a *reader* without any physical contact (Hellström, 2007). As supposed to barcodes, the RFID can identify the tag without requiring line-of-sight and many tags can be identified simultaneously (Sheffi, 2004). According to Finkenzeller (2003), the RFID system is made up of two components; the transponder and the reader. The transponder, often referred to as the tag, is located on the object to be identified. The reader consists of a radio frequency module, a control unit and an antenna (Finkenzeller, 2003). The tag communicates with the reader, which further often communicates with a *data handling software* (Figure 5). The reading distance can vary from some centimetres to a couple of meters depending on the frequency used and the surrounding environment (Brown, 2007). However, the tag cannot be read through or if they are applied directly at metallic objects or objects with high-water content (Hydbom, 2010). Finkenzeller (2003) provides more information regarding the functionality of RFID technology and its physical principles. Sheffi (2004) discusses the advantages of RFID identification compared to barcode systems. The following sub chapter will focus on the technology that Nowaste Logistics has chosen to implement.

Figure 5. RFID tag, reader and data handling software (Picture of tag; Picture of reader; Picture of computer)

3.2.1 Tags

The RFID tag that Nowaste Logistics has chosen to use is a passive UHF Write Once – Read Many (WORM) tag with EPCglobal's Tag Data Standard (EPCglobal, 2008). The passive tag does not have an internal energy source. Therefore, the tag can be made very thin and integrated with a label. Through induction, the tag gets enough energy from the readers and can transmit the information (Finkenzeller, 2003). The transmitted information is stored in the tag's 96-bits memory. The information is stored according to the EPCglobal standard, where the 96 bits on a tag are allocated as follows (Li et al. 2006);

- 8 bits in the header to identify the EPC version number
- 28 bits to identify the manufacturer
- 24 bits to identify the SKU (the object class)
- 36 bits to identify the unique product item (the serial number)

Ultra High Frequency (UHF) means that the tag operates over the frequency range from 860 – 960 MHz (EPCglobal, 2008). Write Once - Read Many means, as the name implies, that the tag can only be stored with information once but can be read multiple times. (Brown, 2007)

EPCglobal is an organisation that develops and provides standards to simplify the interface for RFID throughout the value chain. EPCglobal has developed the numbering scheme called Electronic Product Code (EPC) in the tags and a standard for the air interface. Air interface is the interaction between the RFID tag and the readers. The EPCglobal standard Nowaste Logistics is going to use is called Class-1 Gen 2 UHF Air Interface Protocol (EPCglobal, 2008). In 2006 the Gen 2 standard became a part of ISO/IEC 18000-6 standard (Israelsson and Nordlund, 2009). The Gen 2 standard is currently the most frequently used standard within RFID technology (EPCglobal, 2008).

3.2.2 Readers

The readers consist of a radio frequency module with transmitters and receivers, a control unit consisting of a microprocessor or digital signal processor and an antenna (Finkenzeller, 2003). The radio frequency module generates a radio field that activates the tag and supplies it with power. The module is responsible for transmitting information to the tag as well as demodulates the signals received from the tag. The radio frequency is transmitted through the antennas that can be shaped in different ways. The control unit is responsible for encoding and decoding the signals sent and received between the tag and the reader (Brown, 2007).

Nowaste Logistics will have one stationary reader for each outbound loading dock, i.e. 22 readers. The readers will communicate with the enterprise system through a software handling system (

Figure 6). The readers will also be connected to an access card reader, touch screen, traffic lights and a sound system. The readers also need to support the Gen 2 standard.

3.2.3 Data handling software

The control unit communicates with the data handling software, which can be either integrated in the reader or in an external pc/database (

Figure 6). Since Nowaste Logistics will have stationary readers they will communicate with an RFID database. The RFID database contains all the information associated with the tag and communicates with the warehouse management system.

The EPC offers a complete system for integrations between different companies within the supply chain. The RFID database communicates with EPC Information System (IS). The communication between companies is handled by Discovery Services (DS). DS allows users to access the information available on other companies IS. The communication takes place via the infrastructure Object Naming Service (ONS) that is based on the same structure as the Internet. This interaction allows firms to communicate throughout the supply chain and thereby utilising the benefits of RFID. (Israelsson and Nordlund, 2009)

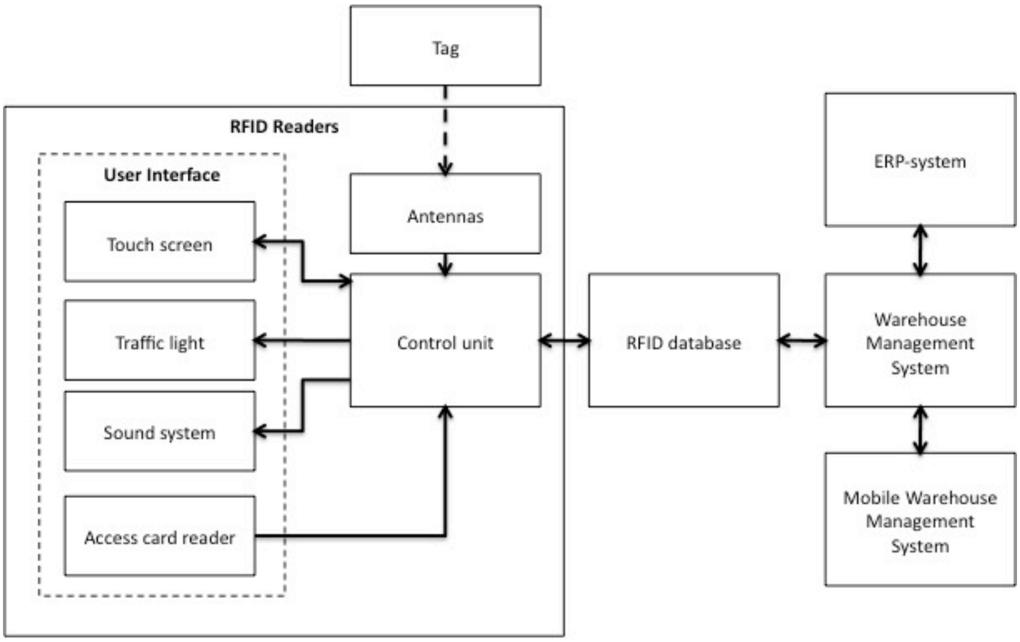

Figure 6. Interaction between ERP-system system, Warehouse Management System, RFID database, RFID readers and Tags.

3.2.4 Critical Aspects of implementing RFID technology

According to Li et al., one should consider the following six aspects when implementing RFID technology; *cost, standard, tag and reader selection, data management, system integration* and *security*. The risk that is associated with the aspects of RFID technology can be reduced by having a technical verification phase (Gilmore, 2004). In this sub chapter, the risk associated with the six aspects will be presented and how it can be reduced by having a technical verification.

Cost
According to Li et al. (2006), RFID is associated with high costs. In the technical verification phase, it is therefore important to find the most cost efficient system that corresponds to the specifications. The number of tags needed used for each pallet and the number of antennas used will have a large effect on the ROI for the project. During the technical verification the costs of the system needs to be evaluated against the functionality.

Standards
Li et al. (2006) discusses the lack of standards for RFID as a technical issue. It is important to choose a system that communicates with other systems. During the last years, standards have been developed and the EPCglobal standard is frequently used. However, further developments are necessary to keep the standards updated so that implemented systems can be upgraded without having to change entire sys-

tems. During the technical verification the system should be tested to be compatible with the EPCglobal GRAI protocol (Hydbom, 2010). GRAI is the standard for Svenska Retursystem's (SRS) plastic pallets with integrated RFID tags. The reader also needs to be tested so that it is compatible with the EPCglobal standard Low Level Reader Protocol (LLRP). If the reader is not compatible with LLRP there is a risk that one gets locked in with that specific system integrator (Hydbom, 2010).

Tag and reader selection

Tag and reader selection is one of the major events during the technical verification phase. The system needs to be thoroughly tested in order to reach a good readability. If the readability is not high enough of costly work associated with handling errors that will occur (Hydbom, 2010). According to Hydbom (2010), the following tests need to be conducted during the technical verification in order to reach a sufficient readability rate:

- The optimal antenna design (circularly polarised antenna often gives the best result since it can read the tag regardless of the tag orientation)
- Placement and number of antennas
- Direction sensing
- Tags passing at different heights and widths
- Tag placement
- Number of tags per pallet
- Many tags passing at the same time
- Other unknown interfering tags
- Tags passing outside the gate not registered
- Tags passing in neighbouring gate should not be registered
- Passing speed
- Tag at goods with high water content

Data management

With a new RFID system there will be a massive amount of data generated and it is therefore central to consider how this data should be handled. One way to do this is to involve all stakeholders to specify how the data should be used. (Li et al., 2006)

System integration

Integrating the RFID system, and the data it generates, with other functional databases and applications is one of the biggest concerns in an RFID implementation (Li et al. 2006). According to Hydbom (2010), the system integration should start as early as possible in the project. However, during the technical verification the RFID system should not be integrated with the ERP system to reduce the interference with day-to-day work.

Security
Many RFID systems face security issues that need to be considered. Examples of security issues are hacker attacks, fraudulent tags or other attempts to steal or manipulate information.

3.3 RFID implementation process

RFID implementations involve a number of complexities that requires proper knowledge by the user in order for the implementation to be successful. Although RFID has been used during many years, the industry knowledge about the technology is limited and therefore the implementation is associated with risk and uncertainty. However, there is plenty of documentation on the RFID implementation process. In this sub chapter, the implementation processes that Nowaste Logistics is applying will be presented. Furthermore, a specific focus will be put on the adoption phase as this is the next step for Nowaste Logistics in their implementation process.

3.3.1 Israelsson and Nordlund's generic road map

In the master thesis by Israelsson and Nordlund (2009), a generic road map for the RFID implementation process at Nowaste Logistics was developed (Table 1). The road map was developed based on theories developed by Brown (2007), Hellström (2007) and GS1 (EPCglobal, 2005); it is developed so that it would suite the implementation at Nowaste Logistics. For further information on RFID implementations by Brown, Hellström and GS1, please see Appendix 2, 3 and 4.

Table 1. Israelsson and Nordlund's generic road map (Israelsson and Nordlund 2009).

Phase	Stage	Activity description
Initiation	**Objective identification**	Determine the objective for the project by identifying expectations and demands
	Scope identification	Determine the scope for the project through interviews and discussions
	Preliminary project plan	Map out each stage of the implementation and estimate their duration
	Stakeholder mapping	Identify the stakeholders, their interest and level of power
	Process mapping	Define the current supply chain processes and map their product and information flow
Assessment	**Concept development**	Develop different concepts of how to reach the objectives
	Concept evaluation	Establish criteria for the evaluation and use these to evaluate the concepts and identify a prevailing concept
	Select system design	Perform a Gap-analysis to determine the system design, describe the design and create a preliminary budget
Specification	**Requirement specification**	Compile a requirement specification for the selected system design
	Choose system integrator	Evaluate and choose system integrator based on their deliverability and quotes
	Project plan and budget	Revise the preliminary project plan and budget in cooperation with the system integrator
Adoption	**Plan pilot**	Establish the objectives, system requirements and strategy for the pilot
	Execute pilot	Test the technology and put it through its working environment in order to verify that it works as anticipated
Integration	**Revise system design**	Improve the system design based on pilot results and feedback from pilot participants
	Plan integration	Plan in which steps RFID technology should be integrated into the company's processes
Adaptation	**Communication**	Communicate with all involved organisation about the use and implication of the new system
	Installation	Expand the pilot in steps until the projected system design is reached
	Training and education	Inform, train and discuss with end-users about the use and usefulness of the system
Infusion	**Improvements**	Perform installation changes to accommodate users' needs and improve system performance
	Expand implementation	Expand the implementation outside the scope of the project
	Transfer the technology	Use the knowledge attained to generate spin-offs in other applications and business areas

3.3.2 Adoption phase

The Adoption phase includes conducting a pilot study, a trial or both. According to Israelsson and Nordlund (2009) the pilot aims to gain understanding in the technology, functionality, performance, standards and influential factors. Their adoption phase is inspired by Brown's pilot phase and it is very similar to Brown's process. Israelsson and Nordlund divide the adoption phase into three steps; *form RFID core team, plan pilot* and *execute pilot.*

Hellström (2007), states that an RFID trial is an important activity when adopting RFID. The trial gives a possibility to experience and understand the complexity of the RFID technology. Carrying out a trial facilitates the understanding of the technology and gives valuable insights into system components, functionalities, performance, standards and influential factors. Hellström also suggests that the trial helps to spread the awareness of the RFID implementation through the organisation and thereby increases the possibilities to further expand the technology into other areas.

Form RFID core team

The pilot starts with forming an RFID core team consisting of sponsors, assessment team members, representatives from affected departments, a project leader and the system integrator. The core team has the operative responsibility during the RFID implementation. The project team should invite stakeholders of the project. These could be warehouse workers, customers etc (Israelsson and Nordlund, 2009).

According to Brown (2007), the core team needs to include the following skills;

- Project manager - responsible for planning, coordination and communication
- RFID knowledge
- Current best practise in your field
- Your company's internal processes
- Your company's IT networks and standards

Plan pilot

After the core team has been formed the pilot should be planned. The objectives need to be stated as well as the scope of the pilot. If the hardware is not pre-tested, a hardware trial needs to be planned and executed before the execution of the pilot. The IT-system should not be integrated in the pilot to avoid disturbance of the daily work flow. It is also important to inform, train and discuss the change process with stakeholders in order to avoid that negative images about the project are created (Israelsson and Nordlund, 2009).

According to Brown (2007), the way of approaching the pilot study is a common mistake project teams make during pilot studies. Project teams tend to approach the pilot study as a time and place for making mistakes and to gather information at the first time. This results in insufficient planning which makes the pilot delayed and could lead to a disappointing outcome of the study and in worst case, lead to project shut down. Instead, Brown argues that the project team should take its time and plan the pilot thoroughly. The pilot is not the time for making mistakes. Documents including for example, o*bjectives, work flows, software description, tag selection, training, project plan* and *budget* should be created before the pilot starts (Appendix 5).

Execute pilot

The technology should be thoroughly tested so that a high readability is reached in its working environment. Furthermore, the software should be developed and tested by its end users. The system should not communicate with the IT-system to avoid disturbance to the daily work flow. However, the communication between the tag, reader, middleware and IT-system should be tested so that it works properly (Israelsson and Nordlund, 2009).

According to Brown, the following activities should be done during the execution of the pilot;

- Conduct a Radio Frequency site survey
- All stakeholders briefed; issues logged and dealt with
- Vendor partner selected, briefed and scheduled; issues logged and dealt with
- Readers tested and configuration settings documented
- Antenna tested and settings documented
- Tag tested and procured
- Static testing completed
- Dynamic testing completed
- User training completed

When all activities are conduced the pilot needs to be thoroughly evaluated. All lessons learned from the pilot need to be captured and documented. Based on this information, the preliminary assessment of the next phase, technical integration, needs to be done (Brown, 2007).

3.3.3 Gilmore's Phases of an RFID Pilot

Gilmore (2004) has conducted a four-phased process to move the RFID-based systems from concept to pilot (Appendix 6). The process differs from the adoption phase presented earlier and is therefore presented separately. The process is based on summarised results of extensive interviews with end users, consultants and RFID technology providers specifically on the subject of pilot studies. According to Gilmore, the need of testing or piloting the technology is a consistent theme that runs through all observations of RFID implementations. The following four phases should be conducted;

Phase I: Application Definition/Business Case Development
Phase II: Technology Immersion
Phase III: Product Testing
Phase IV: Production Pilot

Phase I - Application Definition/Business Case Development
This phase generally takes about one to three months and usually involves consultants. The two main goals are to define the new RFID process and to calculate the Return On Investment (ROI) on the future implementation. Gilmore presents a couple of key mistakes that usually are in connection with this phase; for example, underestimating the issues of change management, costs and time. According to Gilmore, there is always a gap between the theoretical results and the results in the reality.

Phase II - Technology Immersion
During this phase, the main objective is to get a deeper understanding in the RFID-technology. This is usually done by testing the equipment in laboratories and how it works in the target areas. Gilmore mentions the lack of "moving forward" to the more detailed testing phase (phase III), as the major problem during this phase. Phase II lasts for about a month.

Phase III - Product Testing
This is the phase where the detailed testing begins, especially the readability on the RFID tags. This includes testing on the products itself, pallets, packaging configuration etc. Both operators and IT is involved during the phase. Depending on the complexity of the trail, it will take between two and eight weeks to finish. The central issues discussed at this point are the importance of testing the equipment in an area that is representative for the complete implementation. Further, the recording of data is a very important task where many companies fail in their lack of accuracy.

Phase IV - Production Pilot
This is where the RFID technology is tested in a real production environment. It is during this phase the decision of abortion or approval will be taken. One frequently occurred problem during the fourth phase is the underestimating in time to adjust and refine antennas, readers and tags. Further, a main issue is that companies tend to fail at aligning the RFID technology along with their business processes. Instead, too many firms are focusing on the performance of the technology and do not prioritise the business processes.

Key observations
According to Gilmore, there are a couple of key observations that could be helpful for companies to consider before going into a pilot phase;

- The pilot often takes more time than expected

- The time to pilot an application depends on how much experience your vendor has. More experience often significantly decreases the time.
- Remember that the vendors' recommendations often focus on the type of business they come from. A consultant is likely to focus on building a business case and systems integration, while a software vendor focuses on the details of the application software.
- ROI is often based on insufficient real life data. The high level “vision” is good to get executives excited but to create ROI, more detailed process mapping and operating analysis is necessary.
- Integrating barcodes will be the reality for many still more years. Using barcodes might be the best way of collecting data in some cases.
- It’s worth looking into off site product testing facilities although it has some obvious disadvantages.

3.4 Pilot studies and risk management

According to Korecky and Trkovsky (2009), risk management plays an essential part in coping with uncertainty and risk in projects with high innovative content. Their studies have shown that value is added to innovative projects that actively use risk management. One way of coping with risk and uncertainty is to conduct a pilot or a trial before the full-scale implementation. All RFID implementation processes presented in the previous sub chapter includes a pilot, a trial or both. Experiences from RFID implementations show that RFID needs to be tested in a real production environment. This sub chapter aims to describe how risk management and pilot studies can be used to reduce risk and uncertainty when implementing innovative technology.

3.4.1 Project risk management

> *"As applied to a project, a risk is the possibility that an undesired outcome or the absence of a desired outcome-disrupts your project. Risk management, then, is the activity of identifying and controlling undesired project outcomes proactively." (Smith and Merritt, 2002)*

All technological projects carry risk, and an essential task for the project manager is to manage these risks (Brown 2007). According to Smith and Merritt (2002), the most common pitfalls for companies managing risk is the lack of cross-functional teams and pro-activeness.

Smith and Merritt (2002) use a five step process for managing risk in projects. The following sub chapter will describe this process further. The first four steps are typically done once, while the last step is ongoing. However, during the project the project team needs to regularly check for new risks that might have occurred over the course of the project. The five steps are;

1. *Identify risks:* Start early in the project and brainstorm all possible risks and their impact.
2. *Analyse risks*: Analyse the key drivers, probability and total loss for each risk.
3. *Prioritise and map risks:* Prioritise risk based on expected loss, map them in an impact/probability matrix and choose which risks needs to be managed. Expected loss is a function between impact and probability.
4. *Resolve risk:* Plan actions to proactively prevent the prioritised risks from occurring.
5. *Monitor risk:* Regularly assess the status of the risks and identify new risks.

According to Brown (2007), the following risks needs to be considered during an RFID implementation;

- Company reputation might suffer
- The technology might not work as planned
- Project might take longer than expected
- Unforeseen costs might arise
- Workers might be unable to execute as required
- External data sources might be insufficiently accurate
- Successful pilot project might not scale
- Interface might be more costly and time consuming than planned

3.4.2 The objectives of pilot studies

Pilot studies may be defined as "small-scale versions of the planned study" (Prescott and Soeken 1989). A pilot's primary objective is to reduce risk and to trial the suggested change in a smaller scale. The benefits of running a pilot, before making a full-scale change, are therefore to check if the proposed changes meet up to the expected goals. (Turner, 2005) Another reason why pilots are used is "to discover possible problems while there is still time to remedy them" (Sanders and Pinhey 1983). According to Turner (2005), pilots add value to projects through three main areas;

- Risk migration
- Reduction of uncertainty
- Organisational learning

Risk migration
According to Turner (2002) pilots are used to help to choose the appropriate risk migration strategy. Additionally, by understanding how pilots contribute to these strategies, a better understanding about the risks associated with the project is also developed. The risk migration strategies and how they relate to pilots are;

- *Reducing uncertainty of estimate*s - a pilot can help reducing the uncertainty of estimates, such as sales figures.

- *Avoiding risk* - a pilot study may be conducted to gain knowledge about the likelihood and the impact of the risk so that the risk can be appropriately managed.
- *Abandoning the project* - a pilot study can help reducing the sunk costs when the best migration strategy is to abandon the project.
- *Reducing the likelihood or impact of risk* - a pilot study can reduce either the likelihood or the impact of risks involved in the project.
- *Transferring risk* - a pilot study can help assessing the right transfer strategy. If the likelihood of the risk is high and the impact is low the best strategy is often to transfer the risk to a contractor. If the likelihood is low and the impact is high it is normally better to insure the risk.
- *Accepting risk* - a pilot study can help one determine whether or not a risk can be accepted.
- *Creating a contingency plan* - a pilot study conducted to create and a contingency plan and determine the efficiency of it.

Reduction of uncertainty

The uncertainty in projects often relates to the goals that should be reached or the process that should be used to reach the goals. This is especially true in innovative projects. By conducting a pilot study the uncertainty of the goals and process can be reduced (Turner, 2005). Depending on the type of innovative project, the role of the pilot in reducing uncertainty differs. In an RFID implementation the pilot can add value through revising the goals set for the project. However, the most important aspect in reducing uncertainty related to the implementation process.

Organisational learning

A side effect of both risk migration and reduction of uncertainty in pilot studies is the organisational learning that it induces. By conducting a pilot study the organisation gains knowledge which will be valuable in the future. (Turner, 2005) The knowledge gained in the pilot should be communicated if the project involves people that were not involved in the pilot project. Key people in the project team should preferably be involved in the pilot study as well.

3.4.3 Conducting pilot studies

According to Pal et al. (2008), pilot studies are usually conducted in a scaled down fashion and without all entities. The obvious question is though, which entities should get selected and which should not. There are no definite guidelines for choosing the "correct" entities or population within an organisation. According to Babar et al. (2006) and Liang et al. (2006), a "judicious attempt should be made to include representative sample(s) from the population". Furthermore, if the population is diverse and/or has small economic resources the pilot should be adjusted after those circumstances. For example, the population could be divided into segments and samples of these segments could be targets for the pilot study. In Figure 7, Pal et al description of a pilot process is presented.

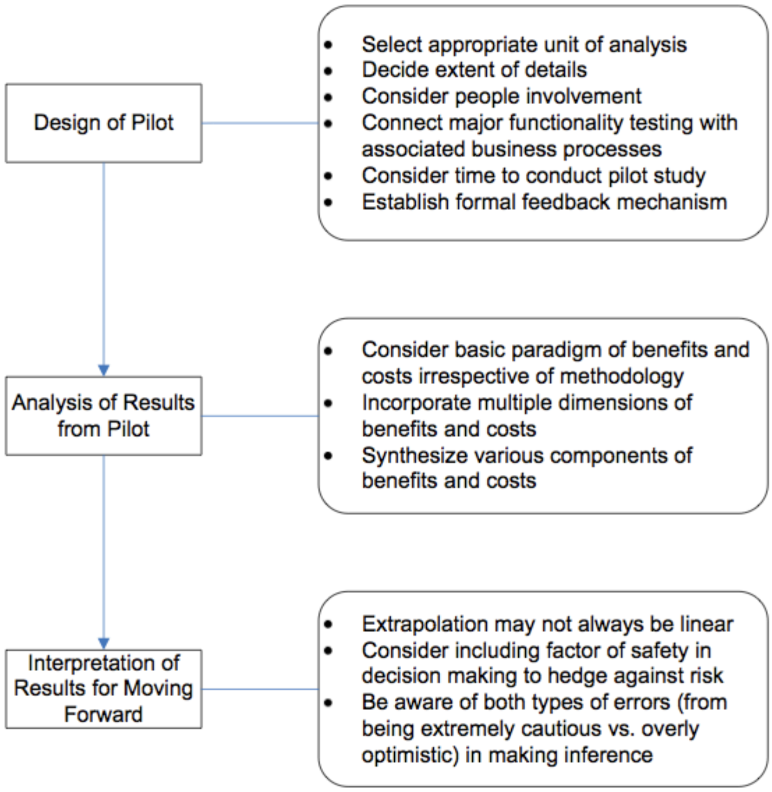

Figure 7. Description of a pilot process (Pal et al. 2008).

Extent of detail, Involvement of people, *Testing functionalities*, *Time* and *Feedback* are five crucial areas which Pal et al. argues should be discussed before conducting a pilot. Lancaster et al (2004) claim that a well crafted balance is needed while discussing the extent of details in a pilot. With a more detailed pilot, a better accuracy will be reached but in the same time, more resources have to be added to the process. "Testing functionalities should be made in unison with business processes" (Pal et al. 2008) and Kasunic (2004) argues that functionalities that are not aligned with the firm's processes should be avoided during the pilot. The Time aspect is another important issue. Havestein (2006) explains that all extra time that is put on the pilot "is like lost opportunity cost". This basically means that it is central to run the pilot in as short time as possible, otherwise more employees have to be allocated to the pilot which results in rising costs. Feedback is the last area that, according to Pal et al., should be considered. This contains all experience from the pilot; difficulties, glitches as well as positive experiences. This information is essential for the upcoming full-scale implementation to be successful.

4 Nowaste Logistics RFID Implementation

4.1 Introduction to the case study

In the beginning of 2010, Nowaste Logistics was right in the middle of implementing RFID at their warehouse in Helsingborg, Sweden. The new labelling process had successfully been implemented which was a necessary step before starting with the RFID implementation. Now the organisation was finally ready to adopt the RFID technology as they had wanted for a long time. The expectations on the new innovative technology were high across the organisation. Top management expected to gain competitive advantages, increase delivery reliability and cut costs. Initial budgets for the project were positive showing fast payback time on the large investment. Among the warehouse workers positive voices could be heard regarding the change. The new system should simplify the daily work flows and many workers were interested in the new technology.

Nowaste Logistics is a company that is not afraid to make changes and the employees are used to adapting to a changing environment. A strong "get it done" mentality is spread across the organisation. One might say that the company really lived up to its value of being an "innovative" company. However, the fast pace of change did have its setbacks. According to some workers, change initiatives where often communicated when everything was done and ready to be rolled out. The employees seldom have any information about the change initiatives that is going on and certainly does not get any chance to influence the change.

Robert Davstedt, the project manager of the RFID implementation, realised the importance of engaging the employees in the project to successfully implement RFID. How should Nowaste Logistics work with change management to maximise the probability of success for the RFID implementation?

4.2 Company descriptions

4.2.1 Nowaste Logistics

Nowaste Logistics is a third party logistical provider focusing on intensive logistic work flows. Nowaste Logistics almost exclusively handles fruit and vegetables within their warehouses but they intend to expand the business into other industries as well. Nowaste Logistics aims to live by their name "NoWaste" and they want to do this by being innovative and cost efficient. The annual turnover is around 170 million SEK and they have around 280 employees (Davstedt, 2010). The company has warehouses situated in Helsingborg, Stockholm and Copenhagen. The largest warehouse is situated in Helsingborg along with the main office. The warehouse in Helsingborg has around 180 employees and handles around 100 000 secondary packages each day. The work flow is intense with an inventory turnover of approximately 1.6 days. (Israelsson and Nordlund, 2009)

Nowaste Logistics is a sister company to its largest customer, Everfresh AB. Everfresh handled the warehouses themselves until 2008 when Nowaste Logistics was formed so that they could serve other companies as well. Nowaste Logistics handles all logistics within the warehouse but external logistic is handled by external haulers. GDL carries out most of the outbound transportation for Nowaste Logistics. GDL have employees within Nowaste Logistics warehouse to manage and optimise the loading of their trucks. Approximately 40 trucks from GDL are loaded at the warehouse in Helsingborg each day. (Nowaste Logistics, 2010)

4.2.2 Everfresh AB

Everfresh serves wholesalers and retailers all over Sweden with fresh fruit and vegetables. Everfresh defines them selves as a market orientated company that aims for a cost efficient supply chain in cooperation with the customers. Everfresh's business model includes being "just in time" with the right information, at the right price, in the easiest and cheapest way. Their values are cost consciousness, innovative and commitment. Everfresh AB is owned by Total Produce Nordic AB, one of Europe's leading companies within the fruit and vegetable industry. On the Nordic market, Total Produce is market leaders when it comes to delivering fresh fruit and vegetable. (Everfresh, 2010)

Everfresh AB was founded 1987 as a family company that imported fruit from overseas. In 1993 Everfresh AB bought AB Citrusfrukter and in 1995 they formed Lime Frukt & Grönt AB. A new distribution centre was opened in Helsingborg 1999. At that time, all warehouse activities for AB Citrusfrukter and Lime Frukt & Grönt AB was incorporated under the parent company Everfresh Group AB. However, the banana import and maturing remained under the name AB Citrusfrukter. (Nowaste Logistics, 2010)

Everfresh's largest customer is Coop and most of the fruit and vegetables delivered to Coop are handled by Nowaste Logistics. Coop is Sweden's second largest retailer chain and they have a market share of 21.4 %. Coop has around 700 stores all over Sweden, from small convenient stores to large hypermarkets. Around 60 % are owned by KF Group while 40 % are freestanding cooperatives with the freedom to choose their suppliers. (Israelsson and Nordlund 2009)

4.3 Supply chain processes

This sub chapter describes the processes within Nowaste Logistics' supply chain, from customers placing their orders to their products receiving at the retail stores (

Figure 8). Nowaste Logistics and Everfresh work close together in these processes and constant communication appears across the both companies. For example, the inbound logistics at Everfresh is located in Nowaste Logistics office in order to simplify the integration between inbound logistics and receiving of the products. The processes are described according to a process mapping done in the early phases of the RFID implementation and only apply to the warehouse in Helsingborg. For a more detailed description we refer to Israelsson and Nordlund (2009).

The process starts within the purchase and sales department at Everfresh. The purchasing department purchases products from producers and Everfresh's customers order the products from Everfresh's sales department. The first process within Nowaste Logistics' warehouse in Helsingborg is the receiving process where the purchased products are received. The products are then stored and when an order is released where the products are needed, they are replenished. The next step in the process is the picking process which can be described as the core of Nowaste Logistics' process. The picked orders are then labelled and put on the outbound loading fields. The haulers are then responsible for the process and the orders are hauled from Nowaste Logistics' warehouse. The last step in the process is the receiving process where the customer receives the products at the retail stores.

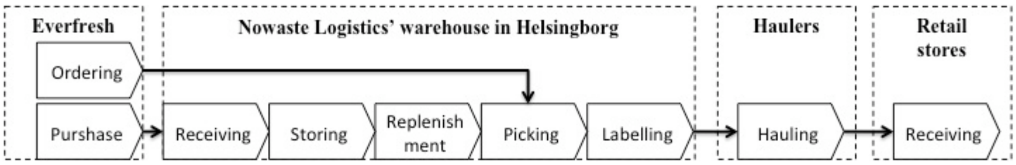

Figure 8. Processes within the Nowaste Logistics' supply chain.

4.3.1 Hauling process

The hauler is contracted by the customers to deliver the products from Nowaste Logistics' outbound loading fields to the retail stores. The most frequently used hauler is GDL and its subsidiaries. The communication with haulers is done through a web service called Transportalen. Information that is sent from ASW to Transportalen mainly consists of the weight. The haul order is created by the hauling company and sent to the hauler. However, haulers never know exactly the number of pallets before arriving at the warehouse since the number of orders can increase until the time of departure. When the haulers arrive, they visit the warehouse office where they get the information about which loading dock and which loading field their order is placed at.

The haulers then start to load the truck which often takes from one to two hours depending on the size of the order. Sometimes, the orders are not completely picked when the hauler comes to the warehouse and therefore new pallets can receive at the outbound loading fields during the hauling process. When the order is completed the truck drivers return to the warehouse office where the waybill is controlled and printed. The hauling companies uses cross docking terminals where the pallets are reloaded into other trucks in order to optimise the logistics.

4.3.2 Receiving process

Customers receive the products at retailer stores several times per week depending on the size of the store. Coop is by far the biggest customer for Everfresh. The receiving process is initiated when the trucks arrive at the retail stores. The pallets are unloaded and the quality and the temperature of the products are controlled. The waybill is compare with order placed in On-Lime (or fax if the order was made by phone). If the receiving staff approves the delivery the waybill is signed.

5 New labelling process implementation

The new labelling process implementation is the first unit of analysis in our case study. The implementation is one step towards a fully functional RFID system at Nowaste Logistics. As of today, the products are only registered to an order, not to a specific pallet. The main purpose with the new system is to register each product to the specific pallet that it is on. This enables Nowaste Logistics to track exactly which products that are leaving the warehouse into which truck when the RFID system is put into work.

The idea for the project was raised during discussions about the RFID implementations, regarding how to get traceability for the products. The new labelling process implementation had the following objectives;

- One step towards establishing traceability
- Establish pallet identification
- Prepare process prior for the RFID implementation

The objectives where communicated to the pickers during the information meetings prior to the implementation. However, the objectives where never documented. Pallet identification means that each pallet has a unique pallet identification number. The RFID implementation is dependent on pallet identification and the new labelling process implementation is therefore a necessary preparation for the RFID implementation.

5.1 System design

The system design was established during the initial phases of the RFID implementation by Robert Davstedt, Israelsson and Nordlund. The design was documented in the thesis by Israelsson and Nordlund. A schematic description of the labelling process implementation is described in Figure 9.

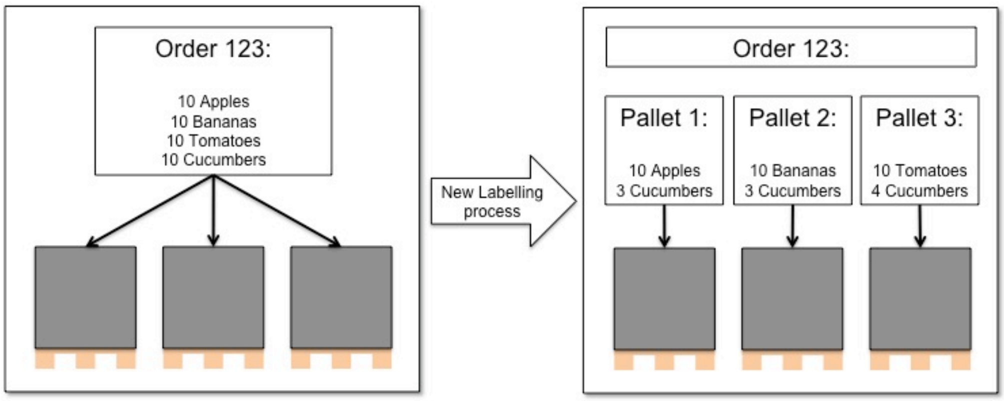

Figure 9. A schematic description of the new labelling process change.

For example, in the current system an order containing 10 bananas, 10 apples, 10 tomatoes and 10 cucumbers are split among three pallets. However, the system does not know which pallet contains which product and the labels only contain the order information. In the new system, the picker registers a pallet every time a new pallet is taken. Since the picker only picks on one pallet at a time, the system registers the products on the right pallet. Therefore, the system knows that 10 bananas and 3 cucumbers are on pallet number 1, 10 apples and 3 cucumbers are on pallet number 2 and 10 tomatoes and 4 cucumbers are on pallet number 3. The new label contains the order information and a pallet number.

5.1.1 Picking process

The changes in the labelling process affect the picking process and therefore the pickers and the haul managers. Each time a picker retrieves an empty pallet the picker should specify and register it in the forklift computer. The picker specifies the position of the pallet (bottom or middle pallet) and the type of pallet (EUR B or Mixed pallet). Each time a pallet is registered the system assigns a unique pallet identification number. All products that is picked and registered when this pallet is "active" are registered on that pallet. Therefore, the picker always needs to make sure that the "active" pallet in the system is the one that he/she is physically picking on.

5.1.2 Labelling Process

When the pallet is ready for labelling the picker chooses printer. All pallets that the picker has registered but not printed are shown in a new dialogue window. The printed labels are attached to the correct pallet. The picker needs to be observant that the correct label is attached onto the correct pallet. This is a new process since the old labelling process had the same labels for all pallets on the same order. The layout of the label is also changes as it contains new information such as pallet identification number and position in pallet stack.

After the labelling, the pallets are wrapped in stretch plastic film and driven to the correct outbound loading fields in the same way as before. When the pallets are placed at the outbound loading fields, the picker registers this with a check digit for each pallet. If the type or position of pallet needs to be changed, the picker can do this before entering the check digit. However, this information is only changed in the system and not on the label.

When the pallets are in the outbound loading fields, Nowaste Logistics' load managers control them. They control that each pallet have the correct type (bottom or middle pallet) and position. The load managers access and change the information stored in W-man Cen if pallets are wrongly registered.

5.2 System development

The system development was initiated during December 2009 in corporation with Consafe Logistics. The development was incorporated within a bigger project concerning an update of the warehouse management system and was raised as a change request (Robert Davstedt 2010-03-30). The project was initially planned to be ready in February. The project plan could be described as flexible owe to the fact that it only consisted of a specific amount of hours set off for Consafe Logistics, and no specific dates or deadlines. The IT-developments of the project was initially seen as quite easy. However, during the project the scope of the project was extended. Many small errors were discovered in the system and the project manager decided to solve these as well, which lead to a bigger scope than expected. This in combination with unforeseen circumstances resulted in a delay for the development.

During the development the issue list was used to document technical issues. During the course of the project approximately 400 issues were raised and resolved (Davstedt, 2010).

The biggest risk was identified as the lack of live-test-environment, which caused concerns of how the system would work in an operation environment. Although many issues were raised, Robert Davstedt was concerned that the operating environment could cause errors in the system that was not identified. The impact of a system failure at Nowaste Logistics is catastrophic. The production can only stop for approximately three hours during the morning before deliveries have to be cancelled. The same number is approximately only one hour if the production failure happens during the afternoon. Cancelled deliveries could lead to a loss of the customers (Davstedt, 2010). As a proactive risk activity, the system was designed so that it could easily be switched back to the current labelling system, which would prove very valuable.

The system testing was done in a test environment by Robert Davstedt. He tried to test every possible situation that the system should be able to handle. Errors are reported back to Consafe Logistics who debugs them.

5.3 Communication and training

5.3.1 Initial information

During December 2009, information about the new labelling process was communicated to the organisation for the first time. The information was a part of Israelsson and Nordlund's presentation of their master thesis concerning the RFID implementation. The purpose of the new labelling process and how it would work was described during the presentation. There were participants from Nowaste Logistics office, the warehouse office, load managers and supervisors.

5.3.2 Training and information to supervisors

In late February the system was developed, tested and ready to be rolled out. The project plan had been delayed and it was important to start the roll-out as quick as possible and to avoid delay on the upcoming RFID implementation. On the 26th of February, an introduction to the new labelling process was held to the warehouse supervisors and load managers. The presentation consisted of a demonstration of the printing routines and finished up with a session where the participants could ask questions about the change. A short introduction to the RFID implementation was also given.

The supervisors had to make a decision if they where ready to roll-out the new printing routine on the 2nd of March, the following Tuesday, or if they wanted more time for education and information prior to the roll-out. The group of supervisors agreed in making the change at the scheduled day. The general opinion about risks during the implementation was that pickers would not understand the new routines. Some feedback was given on the system design where a few supervisors thought that it could be more user friendly. Handouts were given to the warehouse supervisors to get familiar with the new system. This was important since the warehouse supervisors should assist the pickers during the roll-out.

5.3.3 Training and information to pickers

On the day of the roll-out, the 2nd of March, an information meeting was held with the pickers during the regular morning meeting. For some of the pickers this was the first time they got informed about the change. Since the pickers are divided into different shifts that start at different times, the first team, Shift A, got informed at 08.00 am and the second team, Shift B, at 09.00 am. During the information session the pickers were given handouts, which described the new routines. Robert Davstedt held the meeting and explained the new routine step by step. The pickers were also informed that warehouse supervisors and other supervisors would be available in the warehouse during the day to answer questions. Only a few questions where asked during the information session.

Nowaste Logistics have meeting every day before a shift is started that lasts for approximately 10 minutes. During the meeting the warehouse supervisors inform about relevant daily information. These meetings are a perfect channel to communicate with the warehouse workers.

5.4 The first roll-out

The new labelling process went live at 09.45 on 2nd of March. Shift A had already begun their picking so they were instructed to finish the orders they were picking prior to switching to the new system. Shift B began picking when the new printing process was turned on. When the new system was turned on, all pickers had to reboot their forklift computers. Almost immediately, the pickers discovered that the F1 button, to register pallets, was not working properly. This was communicated to the warehouse office where Consafe Logistics representatives made some adjustments to the system. 09.56 the new version was turned on and the forklift computers were once again rebooted. The new version worked properly and the pickers continued working.

Plenty of questions were initially asked to the supervisors regarding how to handle the system. Most of the questions were about transferring pallets, too many registered pallets and collecting goods at SPC. One big issue was that the SPC pallets that were picked before the new system was turned on had no pallet identification. Therefore, they could not be transferred or continue to be picked at. This caused a lot of confusion among pickers. To solve this problem, the pickers had to pass the warehouse office where they could register the pallet in the system. This in combination with the unaccustomedness of the new system resulted in a significantly slowed down work flow.

At 11.00 am, printers stopped working. This resulted in that pickers could not print any labels. The Consafe Logistics representative and Robert Davstedt tried to find the problem but could not find what was causing it. The pickers were initially told to manually write labels until the problem was solved. The problem was causing lots of confusion and the production flow was even more slowed down. After several attempts to solve the printer issue, Robert Davstedt finally decided to shut down the new system and switch to the old printer system. This occurred at 11.25 am.

It later was discovered that a programming bug in the system caused the printer issue. Each time a label was printed, a printer connection was opened. However, this connection was not shut down. In production this resulted in endless numbers of opened connections, which slowed down the system until it could no longer function. "This is a typical example of something that is hard to test in a test environment", Robert Davstedt said. The same thing had happened when Robert Davstedt was testing the system, but it was never discovered since only a limited numbers of connections were opened.

5.5 Revising the system

After the first roll-out a troubleshooting was conducted in order to find the problem described above. When the reason was found the programming bug causing the printer issue was resolved. In addition to manage the printer issue, feedback was collected from co-workers in order to identify possible improvements for the next roll-out. Five pickers and two warehouse supervisors were interviewed regarding the first roll-out. Important feedback was collected about the roll-out and the system design. The following improvement potentials were raised by many of the interviewed;

Roll-out

- Start the new printer system directly in the morning so that no labels from the old system is activated
- More training in the new system before the roll-out
- Have support at pre-decided areas so that everyone know where to find support

System design

- Improve features for transferring pallets
- Enable the F9 bottom to also show pallet content

Many of these improvements were already discussed by the project team, but some new thoughts were brought up and were helpful. Based on the gained knowledge, Robert Davstedt decided to add the following functions to the system;

- A simplified function for *transferring* pallets and *continuing* picking on an existing pallet. The picker did not have to type in the pallet ID; instead he/she could choose them from a list.
- Bigger font size for the pallet ID on the labels.
- A suggested pallet was added to the "Pick pallet" field in the check-out-dialogue window so that the picker does not have to enter the pallet ID manually (The suggestion is based on which pallets the truck operator has printed labels for but not checked out yet)
- The *loading field* is mentioned at the, "Utskrift kolliplock" and the "Dispatch" dialogue windows.

5.6 The second roll-out

The second attempt to implement the new printer routines occurred on the 8th of March. Based on the experience from the first roll-out, the new system was turned on directly in the morning before the first team had started to work. By doing this, there would only be labels from the new system active in the warehouse. The roll-out was planned so that the same workers that was working during the first roll-out was working.

Team A had an information session at 08.00 with a power-point presentation about the changes of the system. The pickers were also informed where the supervisors would be standing in case of support. A hand out with the PowerPoint slides was given to all participants. At 09.00 the same presentation was held for Team B. A couple of questions were asked during the meetings.

After the information session, the supervisors spread out over the warehouse at three main areas where pickers could go to get assistance. Some pickers initially experienced problems with the handling of the system but the support worked efficient and as the time went by, the number of questions was reduced. As the pickers gained more knowledge it was obvious that they also helped each other out. Some minor problems were identified; for example, the status light was not updating properly. This caused some confusion among the pickers. The problem was communicated through the loudspeakers and was resolved within a half hour by the Consafe Logistics representative. At around 11 a.m., a load manager discovered that the system had registered two pallets with the same ID. This was noticed and it was later discovered that it was the crane that was causing the doubling. After lunch the new system was working properly and the support was gradually decreased. At 16.00 the same presentation was held to the night shift before they began to work.
The overall feedback of the new system was that the changes that had been made from the first roll-out had made it much easier to handle. The roll-out was considered successful and went much smoother compared to the first one. However, there were still some issues remaining at the end of the day. During the afternoon it was discovered that many labels were attached on the wrong pallets. There was also a concern from Robert Davstedt, about pickers not physically seeing the SPC pallet that they were transferring. In addition, the pallet type could not be changed before the label was printed.

5.7 System improvements

During the following weeks, additional improvements were added to the system. The first update was rolled out on the 23rd of March. Prior to the roll-out the pickers were informed about the change during a regular morning meeting. The roll-out of the new version was successful. The feedback from the pickers indicated that new version simplified their work.

On the 15th of April a second updated version was rolled out. This update was planned from the beginning but the project team had earlier decided to wait with this change until the new printer system was up and running. The pickers received information during a morning meeting. The roll-out was considered successful.

On the 21st of April, a new update was rolled out. This update was also planned from the beginning but the project team had decided to wait until the registration of the products was accurate enough.

5.8 Measuring the outcome of the new labelling implementation

When measuring the success of the project three areas have been investigated; EUR pallet wastage, delayed of pallets with goods and productivity. The measures were not established prior to the roll-out and were not used by Nowaste Logistics to identify further actions.

5.8.1 EUR pallet wastage

In the budget for the RFID implementation the project team had calculated a 65 % decrease in wastage of EUR pallets. Since the RFID tags will be integrated within the label and not in the EUR pallet, this gain will only come from the new labelling process. By registering each pallet when the products are picked and having one label tied to each pallet, Nowaste Logistics hopes to reduce the number of lost EUR pallets.

Therefore, there is an interest in measuring if the loss of EUR pallets has in fact decreased after the new labelling process implementation. Nowaste Logistics make a daily inventory of the EUR pallets. The loss in pallets can be calculated each day by knowing the ingoing balance, the inflow of pallets, the outflow of pallets and the outgoing balance. However, the numbers of pallets that contain goods are estimated in the inventory, which can be a possible source of errors. In Figure 10, the difference in EUR pallets are displayed from 2010-01-01 to 2010-03-31 based on numbers from the daily inventory. The black line shows a six days sliding average. The variation of lost pallets is unrealistically high from day to day and is probably caused by insufficient inventory methods. No specific trend can therefore be seen in Figure 10.

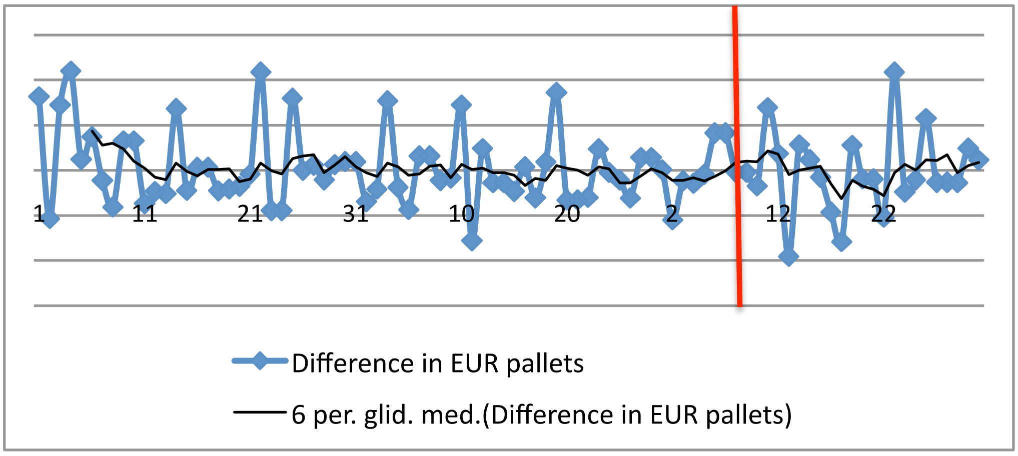

Figure 10. The daily gain/loss in empty EUR pallets (Nowaste Logistics, Daily inventory, 2010).

Instead, an average of lost pallets per day before the implementation compared to an average after the implementation can be used. The average number of lost pallets has decreased after the implementation.

The number of changed pallets, by the truck drivers, was expected to decrease after the implementation. The reason for this suspicion was that pallets could have been registered wrong before the implementation and that this inaccurate registration would end after the implementation (Davstedt, 2010). After the implementation the corrected pallets were actually increasing (Figure 11). This showed that the registration was probably fairly correct prior to the implementation.

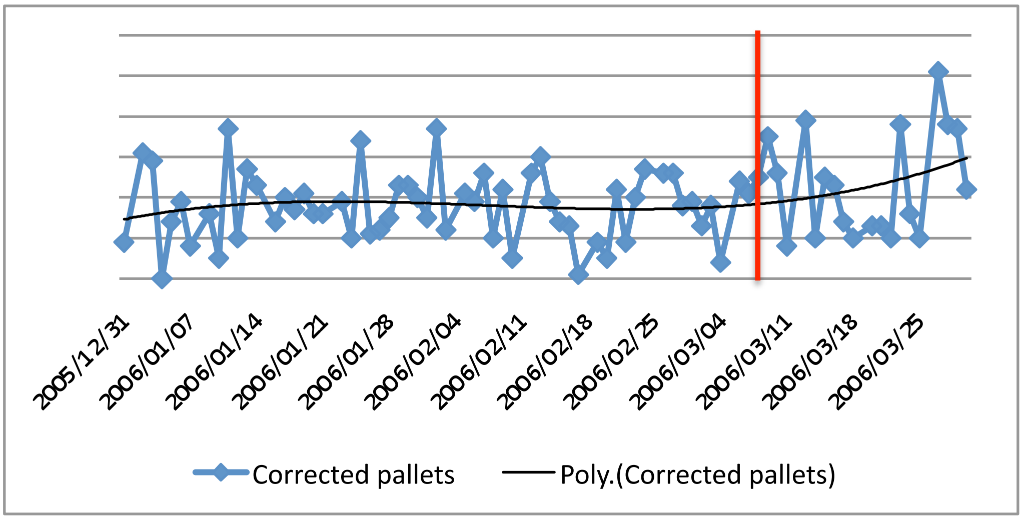

Figure 11. Total corrected pallets per day by the haulers (Nowaste Logistics, Corrected pallets, 2010).

5.8.2 Delay of pallets with goods

After the change at SPC was implemented, the delay of pallets with goods can be expected to decrease. The delay of pallets with goods refers to the pallets that for some reason are left behind at the warehouse in Helsingborg and therefore do not reach the customer on time. According to the warehouse office staff, the SPC pallets that are left behind each day have significantly decreased after the change was implemented.

5.8.3 Productivity

One concern before the new labelling implementation was that the productivity among pickers would decrease due to the new process. Nowaste Logistics keeps track of each worker. However, the productivity varies a lot depending on different factors. For example, if there is a lot to do the workers are told to work extra hard, which often results in better productivity. On the day of the second roll-out, the 8th of March, the productivity was unusually low (Figure 12). However, the productivity recovered fast and no consistent change in productivity could be seen.

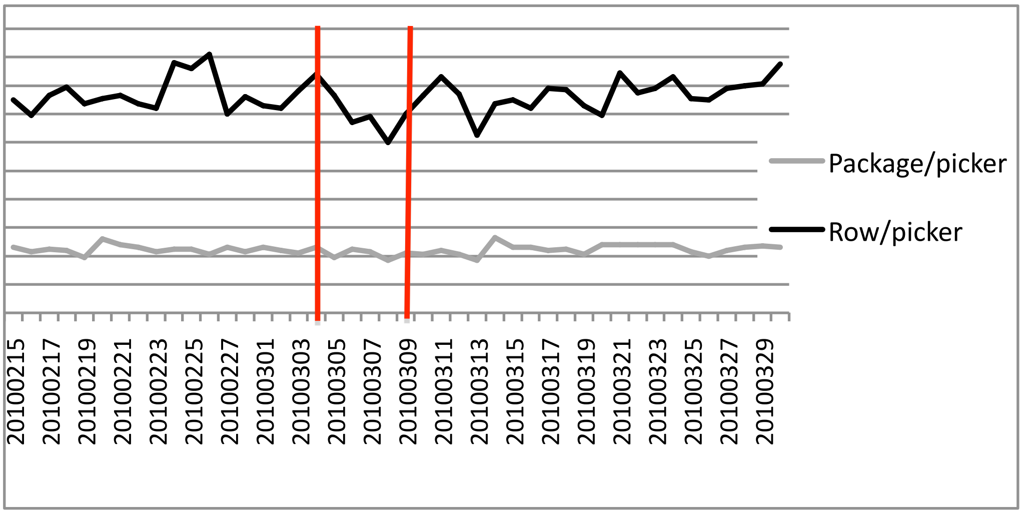

Figure 12. Average productivity per picker and day (Nowaste Logistics, Productivity, 2010)

On the two days of roll-out, the productivity was low in the beginning of the day but recovered fast (Figure 13). This implies that the workers had problems initially but learned to manage the system quickly.

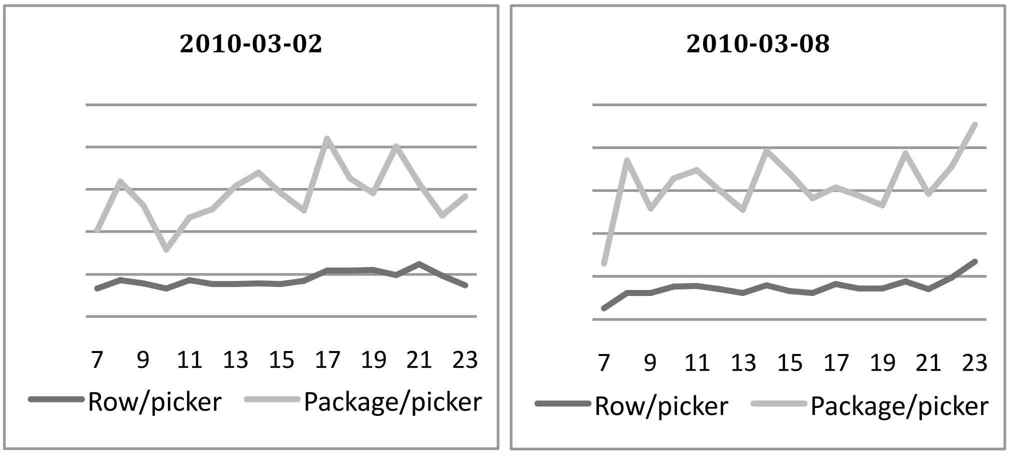

Figure 13. Average productivity per picker during the first and second roll-out (Nowaste Logistics, Productivity, 2010).

6 RFID Technical verification

The RFID technical verification is the second unit of analysis in our case study. During the technical verification the aim is to decide the optimal gate construction for Nowaste Logistics, develop and test the user interface, install one gate and develop the interface specifications. This section will start with a brief description of previously conducted phases in the RFID implementation at Nowaste Logistics. Thereafter follows a description of the continuing work with the RFID implementation, which is the technical verification.

6.1 Previously conducted phases

As mentioned earlier, Nowaste Logistics is a company that wants to be innovative and cost effective. In the beginning of 2009, Nowaste Logistics decided to look into the RFID technology to improve process performances, gain knowledge about the technology, achieve traceability and gain competitive advantages. A recent tractability program has been initiated in Norway, by the Norwegian Government, forcing the Norwegian fruit and vegetable industry to enforce traceability in their supply chain (FGS, 2008). In Norway a pilot program has been started using barcode identification according to the GS1 protocol standards (FGS, 2008). Nowaste Logistics believes that a similar legislation will be enforced in Sweden within a close future and therefore wants to be prepared for it.

The idea to implement RFID was originally initiated a couple of years ago by Rickard Nilsson, the CFO at Everfresh. However, the cost associated with an RFID system was too high for the implementation to be profitable at that time. In 2009, the cost of tags had decreased enough and a master thesis at Lund University by Jessica Israelsson and Mia-Maria Nordlund was initiated in order to look further into RFID technology and investigate how to implement the technology. A road map for implementing RFID was developed and included the following phases (Israelsson and Nordlund, 2009);

- *Initiation* – Define objectives and scope; conduct initial project planning, stakeholder analysis and process mapping.
- *Assessment* - Develop system design through concept evaluation and gap-analysis.
- *Specification* – Develop specifications, chose system integrator, update project plan and develop budget.
- *Adoption* – Plan and conduct a pilot installation
- *Integration* – Plan the full scale installation of the RFID system
- *Adaptation* – Conduct the full scale installation
- *Infusion* – Improve and extend the RFID system

The initiation, assessment and specification phases were performed by Israelsson and Nordlund. The initial planning of the pilot during the adoption phase was also conducted. However, the adoption planning was considered temporary since the system integrator was not chosen at this stage.

6.1.1 Initiation

During the initiation phase the following objectives were set (Israelsson and Nordlund, 2009);

- Technology understanding
- Competitive advantage
- Decrease occurrence and cost of missing pallets by increasing traceability
- Reduce the administration connected to outbound pallets
- Decrease empty EUR pallet shrinkage

It was decided that RFID will initially be implemented in the outbound logistics due to its highest potential for cost savings and to limit the scope of the project. A preliminary project plan (Table 2) was developed along with a stakeholder map. A process mapping was performed of the processes in Nowaste Logistics' supply chain.

Table 2. Preliminary project plan (Israelsson and Nordlund 2009)

		Duration															
Phase	Stage	2009							2010								
		Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Initiation	Objective identification	■	■		■												
	Scope identification	■	■		■												
	Preliminary project plan	■			■												
	Stakeholder mapping		■		■												
	Process mapping		■		■												
Assessment	Concept development				■												
	Concept evaluation				■	■											
	Select system design					■											
Specification	Requirement specification					■											
	Choose system integrator		■		■	■											
	Project plan						■	■									
Adoption	Plan pilot						■	■									
	Prepare pilot						■	■	■								
	Execute pilot									■	■	■					
Integration	Revise system design											■	■				
	Plan integration												■	■			
Adaptation	Communication												■	■			
	Installation													■	■	■	
	Training and education													■	■	■	
Infusion	Improvements													■	■	■	■
	Expand implementation																■
	Transfer the technology																■

6.1.2 Assessment

During the assessment phase, a number of conceptual system designs were developed and evaluated according to Ulrich and Eppingers (2008) concept evaluation method. Three main concepts were developed and the payback time was calculated. The chosen system design was to install one stationary reader at each outbound loading dock, i.e. 22 readers. The reader should support the Gen 2 standard. A passive UHF Write Once – Read Many (WORM) tag with EPCglobal's Tag Data Standard that will be integrated in the label was chosen. The new RFID system will affect the labelling and hauling process at Nowaste Logistics' warehouse in Helsingborg; the new processes are described below. The idea to have readers at cross docking stations and retailer stores was dismissed due to a longer payback time.

Labelling process
The labelling process will be affected in the sense that one out of the three labels will be printed from an RFID printer and contain an RFID tag. The main changes in the labelling process were done during the new labelling process implementations. Therefore, the RFID Adoption implementation will not have a major impact on the labelling process.

When a picker chooses to print a label, the printing process is initiated. For each pallet, two regular labels and one smart label containing the RFID tag are printed. The SSCC number, pallet type and place are updated in the RFID database. The pickers will be informed where the smart label should be attached which will be decided during the technical verification. The pallet is wrapped in stretch film and put on the outbound loading field just like they do prior to the implementation.

Hauling process
The hauling process will be affected in the way that the new RFID system will register all outgoing pallets automatically. This will be a major change affecting mainly the truck drivers and the load managers.

The hauling process starts when the truck driver arrives at Nowaste Logistics' warehouse. The truck driver uses their access card to identify themselves. This is done in a computer with a touch screen that is connected to reader and is located next to the outbound loading gate. They also have to enter the registration number of the compartment that they will load the products in. After the registration, they will be able to choose the customers that they want to load from a list. When the customers are chosen a list will be shown with the customer, total number of pallets for each customer, pallets loaded and the outbound loading field where the pallets are at. When the truck driver loads the truck they receive feedback from the system through a traffic light and a sound system. When the loading is finished the truck driver can choose to print the waybill. If not all pallets are loaded, a warning comes up on the screen with information about the pallets that have not been loaded. The truck driver can choose to leave the pallets behind but then a confirmation is necessary from the warehouse office for the waybill to be printed.

6.1.3 Specification

During the specification phase, a requirement specification was established that described the system design so that the system integrators can conduct quotes. Vilant, IBM, LearningWell AB and Logopak System AB was presented as possible system integrators. The suitability of the system integrators where discussed and Vilant was suggested as the preferred partner. The main reason why Vilant was recommended was because they have collaboration with Consafe Logistics who is the warehouse management system supplier.

Vilant and IBM were the main two integrators that were contacted. After reviewing the quotes Vilant was chosen as system integrator. However, the process took longer time then expected. The negotiations with the system integrator was planned to be done by the end of November 2009 but it was not until the end of February 2010 that the final agreement was meet.

Vilant is a Finish based company focusing their business in turn key process improving RFID implementations at manufacturing companies. Vilant is a rather young and small company with only around 30 employees. They deliver their own database application and client software with third party hardware. Along with the installation, Vilant also provides project management and support. Vilant have partnerships with well known companies such as SAP, Microsoft and IBM. Since the company was founded in 2002, they have performed over 100 RFID project at companies such as ABB, Nokia and STX Europe. (Vilant, vilant.com, 2010)

6.1.4 Adoption

Israelsson and Nordlund's adoption phase includes three steps; *form RFID core team, plan pilot* and *execute pilot*. However, since no system integrator was contracted the adoption phase was only initiated and could not be fully conducted. The RFID core team was never formed due to the absence of a system integrator. The planning of the pilot was done but was considered preliminary. The pilot was designed to include three outbound gates; gate number 3, 4 and 5. Two handheld readers should be tested and one printer should be installed. The RFID system was not planned to be integrated with the warehouse management system and should instead communicate with a mirror of W-man Cen. A number of tests were established to gain knowledge about the chosen RFID system.

6.2 Forming the RFID project team

The authors of this thesis entered the RFID implementation in the beginning of 2009. By the end of February when the system integrator was finally contracted the technical verification, which is a part of the adoption phase, could be initiated. The first step of the technical verification was to form an RFID project team.
People from different departments were involved to form a cross-functional project team. However, there was no documentation of the project team. After kick-off meeting with Vilant, the project team was documented in an e-mail (Figure 14).

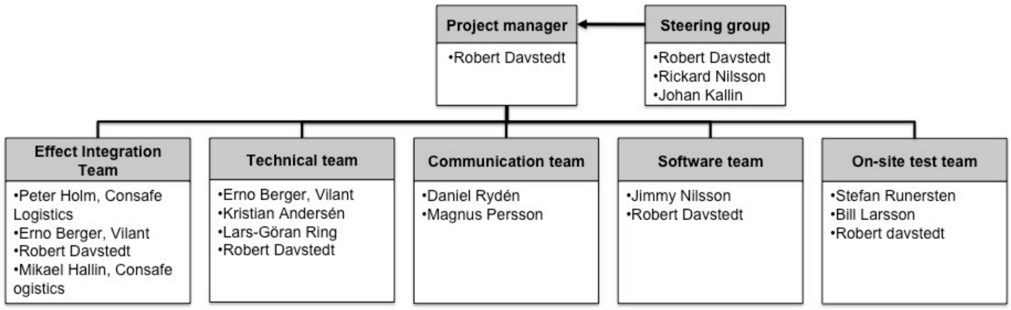

Figure 14. RFID implementation project team.

The Effect integration specification group's responsibility was to specify and develop the integration between the RFID database and Effect (Nowaste Logistics' warehouse management system). The technical team's responsibility is the technical parts of the implementation such as establishing networks and the database. The communication team's responsibility is to conduct the communication with the internal and external stakeholders of the project. The software team's responsibility is to learn how to handle the new software. The on-site test team is responsible for conducting the technical verification at the warehouse in Helsingborg.

6.3 Planning the technical verification

The next step in the technical verification phase was to plan the technical verification. This step included a kick-off meeting with the system integrator where the project plan was established, a review of the vision and objectives and creating the project documents.

6.3.1 Kick-off meeting with System integrator

A kick-off meeting was held at the 3rd of March with Vilant. Two representatives from Vilant, one representative from Consafe Logistics and almost everyone from Nowaste Logistics that is in the project team were attending the meeting. A brief description of the project was held to introduce everyone to the project and project plan was presented (Table 3). The pilot project plan is divided into two different phases; Pilot phase 1: Technical verification and Pilot phase 2: Functional system. As mentioned earlier this unit of analysis will only describe the technical verification part of the pilot. The plan for the technical verification differed slightly from the preliminary planning made by Israelsson and Nordlund. The technical verification will only be performed at dock 4 where different gate setups and tag position will be tested. The system will not be connected to Effect during the technical verification. However, during the functional system phase it will and therefore the interface specification needs to be developed during the technical verification. Furthermore, no handheld readers will be tested during the technical verification.

Table 3. RFID pilot project plan (Vilant, Project plan, 2010).

Week	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Phase 1																			
Kickoff and project starting	■																		
Server changes specification	■																		
Test planning	■																		
Effect interface specification		■																	
Server UI creation		■	■																
Server installations				■															
Hardware shipping					■														
On-site test week							■												
Phase 2																			
Access card integration planning								■											
Interfaces implementing								■	■										
Changes implementing to server									■	■	■								
Off-site integration tests to Effect											■	■							
Internal tests and enhancements											■	■	■						
Hardware shipping												■							
On-site integration tests to Effect														■					
Go-Live															■	■			
Support & Pilot monitoring																	■	■	■

6.3.2 Vision and objectives

During an interview with Robert Davstedt (2010-03-30), the objectives for the RFID implementation that was stated in the beginning of the implementation process was confirmed (see 6.1.1 Initiation). Robert Davstedt seemed to have a good understanding of what Nowaste Logistics was trying to achieve with the RFID implementation. However, he stated that he was not sure that everyone into the steering group had the same view on the objectives. Therefore, he said that he will discuss the objectives with the rest of the steering group during their next meeting.

The following objectives where stated in the quote by Vilant as objectives for the technical verification phase (Vilant, Offer, 2010);

- Verify use cases
- Verify user interface
- Test different gate setups for cost efficient gate solution
- Test preliminary label positioning and how different pallet stack combinations affect the reading rate
- Create interface specifications

6.3.3 Project documents

Apart from the project plan, the following documentations have been developed and used during the project;

- Risk log
- Issue log
- Communication plan

- On-site test plan
- User interface specification
- Interface specification

The risk log was used to identify the major risks involved in the project. The risk log was developed by the author of this thesis in collaboration with Robert Davstedt. The issue log was developed to keep track of all issues that was evolved in the project and to plan actions accordingly. The communication plan was developed to plan the communication in the project and will be described further in the communication and training section.

The on-site test plan was developed by Vilant in order to plan the tests and prepare Nowaste Logistics' staff for the tests that would be done. Nowaste Logistics also developed a test plan where they listed all tests that they wanted to conduct. The test plan was developed based on the technical risks that Nowaste Logistics had identified. By comparing the two test plans to each other Nowaste Logistics asked Vilant to conduct some more tests which resulted in that they received three hours in the test plan for various tests. The user interface specification documentation was used in the communication between Nowaste Logistics and Vilant in the development of the user interface. The user interface stated was visualised which simplified the understanding of it.

The interface specifications were used to document the interface. This documentation was created during a meeting where the Effect interface specification team was participating.

6.4 Communication and training

The communication team held an initial meeting at the 7th of April to discuss the communication and training that was necessary. Except the communication team, Robert Davstedt and the authors of this thesis also participated. First, the communication that needs to take place before the technical tests was discussed. The group agreed that the warehouse supervisors, load managers, sales staff at Everfresh and GDL needed to be informed before the technical tests.

Furthermore, it was decided that the pickers needs to be informed how to put on the RFID label prior to the pilot. Load manager and warehouse supervisors should be trained in the new system. The haulers will receive training on site by the load managers and it is therefore important to communicate how this training should be conducted. In addition to this, general information will be put up on Transportalen so that customers and haulers can gain initial information about the project.

Discussions should be initiated with initially GDL and CLAB regarding how they benefit from the RFID system when the system is up and running. Later the same discussion should be initiated with the customers. The aim in the future is that both haulers and customers start using the RFID system and that information will be available throughout the entire value chain. However, the project team agreed that this is a later issue and that the system should work properly before such discussions are started. The communication events that were discussed during the meeting were documented in a communication plan.

6.5 Executing the technical verification

The last step during the technical verification phase is to execute the technical verification according to the plan. The execution of the technical verification is done in two main steps; off-site and on-site testing. In addition, Nowaste Logistics will need to conduct some further tests since the objectives were not met after the on-site test.

6.5.1 Off-site testing

The technical tests started with off-site tests at Vilant. Vilant tested two methods for direction detection; Impinj and Vilant device manager. The pallet reading results showed 100 % readability (Appendix 7). The Impinj direction detection did have some readability problems for the direction detection; the readability varied from 86 % to 100 %. The Vilant devise manager direction detection had better results with 100 % direction accuracy.

6.5.2 On-site testing

The on-site technical testing took place at gate 4 in the warehouse in Helsingborg the 13th and 14th of April. The haulers at this gate were informed prior to the tests and the impact on the day-to-day work was limited. The objective of the tests was to determine the optimal gate solution for Nowaste Logistics. This included the location of the antennas, how many antennas that was necessary and which direction sensing method to use. The test also aimed to decide the tag type and placement. Two representatives from Vilant were responsible for the test. The authors of this thesis, Bill Larsson, Stefan Runersten and Robert Davstedt participated from Nowaste Logistics. For a detailed description of the on-site tests, please see Appendix 8.

The findings can be summarised as follows;

- Impinj direction detection was preferred due to a more simple and economically solution and comparable readability
- Readability varies a lot with the type of products. Flag tags or distance between tag and product will be necessary to receive satisfying readability.
- Read range is affected a lot when the tag is put on a pallet.

- More antennas with different position might be necessary to get closer to the tag.
- SRS pallet readability is satisfying
- The tag is robust enough to cope with insensitive treatment
- The tag needs to be put in a horizontal position (assuming the antenna position is not changed)
- Tag selection does not affect the readability enough to be economically defensible. The cheapest tag will therefore be used
- Tags cannot be read when they are put on top of each other.
- Impinj direction detection has a limit of 15-20 tags loaded at the same time.

6.5.3 Further tests and revise system

Because the on-site tests was unsatisfying, further tests needs to be conducted and the hardware needs to be revised accordingly. The on-site tests did not fulfil the objectives of the on-site test as the optimal gate solution and tag was not found. Vilant will do further off-site testing and then the on-site testing needs to be conducted once more. The tests will initially involve different kinds of flag tags. The problem with the flag tag is that it cannot be used underneath the stretch film since it will not keep the distance to the product. Therefore, different alternatives of how to get a distance between the tag and the product needs to be thought through and tested. In addition to looking into different tags it might be necessary to use more antennas per gate to decrease the distance between the tag and the antenna. This also needs to be thoroughly tested. The user interface that was supposed to be tested according to the on-site test plan was not tested. Therefore, the user interface needs to be tested during the next test

The unsatisfying outcome of the testing phase, lead to a delay in the project plan. New tests need to be conducted but have not been scheduled. Therefore, the length of the delay is unknown. Hopefully, the issues that occurred during the testing can be resolved with some modifications to the tag and the antenna placements. However, if the issue remains the steering group will have to make decision if they should proceed with the RFID implementation. If sufficient readability cannot be met, the system design needs to be revised. In that case, Nowaste Logistics might have to look into using SRS pallets or even abandon RFID technology and use barcode identification instead.

When this thesis was written the technical verification was still not fully completed due to the delay cause by the unsatisfying test results.

6.6 Interface specifications

The interface specification is not considered a normal technical verification activity. However, the technical verification plan for Nowaste Logistics included both user interface development and Effect interface specification.

During the technical verification, the interface specifications were made and the technical development was initiated by the system integrator. The user interface and the Effect interface will be used in the pilot and therefore the development process needs to be started during the technical verification phase. The user interface specifications actually started before the kick-off meeting. Vilant developed the user interface specification based on the requirement specifications. The user interface was supposed to be tested during the on-site test but the tests were never conducted due to delay.

The Effect interface specifications were discussed during a meeting on the 12th of April with the Effect interface specification team. During the meeting the specifications were set and documented. When Nowaste Logistics made adjustments to the specifications, it was primarily Robert Davstedt that made them but input was also given by the authors of this thesis and Bill Larsson from Nowaste Logistics' office.

7 Developing a change management process model

This chapter handles the first part of the purpose; to develop a change management process model for RFID implementations. In order to develop a change management process model the case study has been analysed with take-off from existing change management models. This have generated input to the applicability of the existing models and what we believe is missing in these models for Nowaste Logistics to successfully work with change management. The change management process model is therefore a combination of existing models but it also has new elements incorporated. The model is developed based on the RFID implementation which should be considered when using it. However, it is developed so that it could be used in other change initiatives at Nowaste Logistics and at other companies. The model will be described based on how Nowaste Logistics can use it to successfully work with change management.

7.1 Change management at Nowaste Logistics

This sub chapter presents findings on how Nowaste Logistics works with change management. To present the case findings we have used Kotter's eight step model and the DICE framework. In addition, some further reflections are made to capture all change management aspects of the RFID implementation. Kotter's eight steps attempts to measure the soft factors of change management while DICE focuses on the hard factors. The other change management models presented in the literature review have also been considered when analysing how Nowaste Logistics works with change management. However, we found that these models did not provided any additional input that Nowaste Logistics could profit from that was not already highlighted by Kotter's or DICE.

7.1.1 Kotter's eight steps applied at Nowaste Logistics

Step 1. Create a sense of urgency

There are two different statuses at Nowaste Logistics; it is either full speed or no speed. The new labelling process implementation was initially proceeding very slowly. When the RFID technical verification was forcing Nowaste Logistics to make the implementation fast, plenty of work was put into the change initiative and the change was implemented within a few weeks. One reason why this was happening might be that there was no clear project plan with deadlines that needed to be followed. To create a sense of urgency, Nowaste Logistics needs to establish project plans with tollgates that should be done by a predetermined date. By dividing the change initiatives into smaller parts and setting clear deadlines Nowaste Logistics will be able to create a sense of urgency even in longer change initiatives.

Kotter also states that at least 75 % of all top managers need to agree that the change is necessary and urgent before the change initiative is started. Nowaste Logistics does have strong top management support on the studied change initiatives. The reason for this seams to be good communication between the project leader and top management due to the small office where everyone is located close to each other.

Step 2. Forming a powerful coalition

Robert Davstedt has the position as project leader for all warehouse projects at Nowaste Logistics. He is considered a very good project leader within the organisation and is highly valuable for Nowaste Logistics' projects. According to Consafe Logistics staff, the strengths of Robert Davstedt's leadership are that he has knowledge both about the IT-system infrastructure and the production processes. Often the project leaders within warehouse management system implementations are either CIOs with knowledge about the IT-system or production managers with knowledge about the production processes.

The RFID team is a cross-functional team where many various expertises are gathered. However, the RFID project is one out of many projects and for most of the team members, this project is a small part of their total workload. Therefore it does not get as prioritised as desired and on top of this, the structure of the project team is not well communicated. Further, the roles and responsibilities among the team members are poorly defined.

Step 3. Create vision

The project leader has a clear vision but it is not documented or stated anywhere. Since the vision is not documented, it might change over time and over the team members. The vision also needs to be agreed upon across the project team. As of today, team members have different opinions about the vision, which could lead to confusion.

Step 4. Communicate vision

The communication of the vision and other information about ongoing change initiatives to the rest of the organisation could be improved. Many workers express their frustration over that top management never communicates the changes that are about to. Not only does the lack of communication prevent the change from running smoothly, the knowledge within the organisation is not used. Nowaste Logistics needs to become better in communicating change initiatives so that feedback could be received from the organisation. It seems to be a culture at Nowaste Logistics where top management does not want to inform about change initiatives prior to roll-outs. This culture affects change initiatives negatively.

Step 5. Empowering other to act on the vision

This step is central in sharing responsibility and authorisation to people with key roles to act on the vision. This especially affects the supervisors, which should get the power to make decisions that is in line with the vision. The supervisor's decisions are more of the operational kind and are important to get a good flow in the processes. Without giving the power to supervisors, small decisions could have big impact and lead to a bureaucratic organisation, which will slow down the change process. It is therefore important to delegate responsibility and authorisations not only to top management.

Step 6. Planning for and Creating Short-Term Wins

Nowaste Logistics communicated that the new labelling process implementation had been successful this far after the second roll-out. However, since there were no measurements established before the implementation it was hard to support the statement with data. If Nowaste Logistics could establish measures before the implementation it will become easier to communicate short-term wins. Measures should be easy to understand and relate to the vision and objectives of the change initiative.

When the RFID implementation is rolled out it is important that Nowaste Logistics communicates the short-term wins so that the involved people will perceive a positive attitude towards the new system and be inspired to continue with the change initiative. After the technical tests a positive result should be communicated. Before the pilot measures should be established and after the pilot, the results should be communicated if Nowaste Logistics chooses to proceed with the full-scale roll-out.

Step 7. Consolidating Improvements and Producing Still More Change

During the labelling process, Nowaste Logistics worked really hard to establish the change in the first hours of the roll-out. However, once the new system started to work properly the workflow decreased rapidly. This might have worked fine for the new labelling process since the change process was rather short but it is important that Nowaste Logistics does not do the same mistake during large change initiatives, such as the RFID implementation. The project team needs to keep working and identify new challenges in order to fully implement the RFID system. For example, when the system is working properly in Nowaste Logistics' warehouse, they need to start influencing haulers and customers to establish a working RFID system throughout the entire supply chain.

One step towards producing more change is to establish proper feedback channels so that the project team can capture all problems the organisation is facing. Nowaste Logistics did this very well in the new labelling process implementation. The routine with regular morning meetings and warehouse supervisors is a perfect way to establish communication between top management and warehouse workers.

For example, after the first roll-out feedback was given that the process of transferring pallets was too complicated and time consuming. The project leader acted on the feedback and the process was changed to the next roll-out. Nowaste Logistics should continue working like this and it is important for the project team to take advantage of feedback to encourage the organisation to give further feedback.

Step 8. Institutionalising new Approaches
Kotter mentions the big responsibility top management has in institutionalising the new approaches and how this final step concludes the change process. Top management needs to continue communicating and act according to the vision to root the new approaches that the change induces. Management can use measures and feedback to secure that the results of the change is lasting. When the new approaches have been institutionalised the project should be closed and the performance needs to be evaluated.

7.1.2 DICE applied at Nowaste Logistics

The DICE framework attempts to measure the hard factors of change management. DICE has developed a very simple way of measuring the hard factors by asking some questions on each factor. To analyse the change management process during the RFID implementation at Nowaste Logistics, the DICE framework questions were asked during multiple interviews across the organisation. The results were then compiled to form a score for the RFID implementation (Appendix 9).

Nowaste Logistics' score was 11.2, which places them in the middle of the "win" zone. Projects within the win zone have a high probability to be successful. Some remarks to the scores can be seen below:

- *Duration* – The steering group regularly reviews the project.
- *Integrity of performance* – The project leader is considered to be very capable. The project group has the right skills but the responsibilities are not communicated properly, which lowers the score. Some team members did not know that they where part of the project team.
- *Senior management commitment* - Are devoted but lacks in the regular communication to the organisation.
- *Local level commitment* – People within the organisation are open to change and very few are worried about the change. In addition, many have shown interest in the new RFID system.
- *Effort* – The workload so long in the RFID implementation is limited and people have not resisted the change

As seen above, there are areas that need improvements in the RFID implementation. The communication across the project group seems to be lacking. Some project members that where interviewed did not know that they where part of the project and had limited knowledge about the project. One reason might be that it is still early in the project, but if the project should be successful the responsibilities needs to be communicated much better. Another area of improvement is the lack in communication from top management. Most of the interviewed stated that the information was not regular and that the organisation was not told about most change initiatives.

7.1.3 Identified potential improvements

When analysing the change management process at Nowaste Logistics it appears that there are some factors that they could improve. In this sub chapter, the identified potential improvements based on the case findings are presented. In addition, some further potential improvements that were not identified within the Kotter's eight step model and the DICE framework will also be discussed.

Documentation
The documentation was insufficient during the new labelling process implementation. Most of the information is in the project leaders mind and was not documented anywhere. Within small projects this might be okay, but in larger projects like the RFID implementation, more documentation is necessary to keep everyone informed. However, too much documentation can prevent change from happening in a small organisation like Nowaste Logistics. Therefore, Nowaste Logistics needs to find the perfect compromise. If the documentation is kept simple, it can be very valuable for the projects' success at Nowaste Logistics. The document can be a simple project plan including vision, objectives, time plan, project team structure, and risks that is regularly updated.

Feedback and continues improvements
Nowaste Logistics could gain much from establishing sufficient feedback channels from the warehouse workers to the project team. Warehouse workers should be encouraged to give feedback to the supervisors on the new system. By establishing a routine of giving feedback across the organisation continues improvements to the new systems will be much easier.

Information and feedforward
The information flow at Nowaste Logistics is sometimes limited. Few people knew about the new labelling process and the time between the first information session and going live was very short. If the warehouse workers had known about the upcoming change they could have contributed with thoughts and possible improvements, feedforward, before the new process went live. By not sharing thoughts within the organisation, this could lead to a lower commitment from co-workers and could result in people not feeling involved in change initiatives. There are however a very fine line between how much information that should be communicated and which that should not. The balance is significant owe to the fact that too much information could lead to information surplus and give co-workers a hard time screen-

ing the most important information. Despite this fact, we still think that Nowaste Logistics could increase their communication flow and begin encouraging feedforward and opinions from co-workers at all levels.

External communication

The external communication with haulers is another important issue that has to be dealt with. The RFID project aims, in the long run, to be integrated within the complete value chain. It is therefore essential to begin inform haulers and customers about the RFID project and its objectives. Important customers and haulers should, in some way, get informed about the vision with RFID to get prepared for the new traceability approach and its new routines.

Project team communication

The communication across the project team during the RFID implementation has not worked satisfying. The responsibilities and project team structure should have been communicated better to all team members. In addition, Nowaste Logistics needs to have regular project meetings to keep the project members informed and engaged. This will be even more important in bigger change initiatives where the project group is much larger.

Map risks and plan how to avoid them

Supervisors mapped the biggest risk as pickers not understanding the new printer routines. With this in mind, plenty of effort should have been put on minimising this risk. The actual effort that was put on avoiding this risk was very reductive. Nowaste Logistics could be better on identifying the risks that is occurring and plan for minimising them.

Vision statement

The vision needs to be defined, accepted and documented by the project team. By writing the vision down less room for construction is given and the risk for misunderstanding within the team gets lowered. Nowaste Logistics could be better in stating their vision for the project.

Project assessments

After institutionalising a change Nowaste Logistics could be better at summarising the change and document the winnings and possible improvements to be considered for the next change project. This could be done through a standardised assessment session where project stakeholders attend.

Measurements and Key Performance Indicators

By using Key Performance Indicators Nowaste Logistics could get a better picture of the results of the implementation. Measurements in general are central in changes and by quantifying the results, firms will have an easier time communicating results to the wider organisation. Another aspect of using KPIs is the enabling of long term comparisons between similar implementations. Nowaste Logistics could be better in measuring their results and using Key Performance Indicators.

7.2 RFID change management process model

By combining the literature studies with empirical observations from Nowaste Logistics RFID implementation, an RFID change management process model has been developed. The model is based on the findings from applying Kotter's eight steps and the DICE framework on Nowaste Logistics. This provided input in the important factors of the existing frameworks as well as factors that was missing in a change management model for RFID implementations. In addition, input from literature in risk management and RFID implementations have been integrated. The model includes eleven steps and aims to take the project from concept design to an implemented change (Figure 15). The process starts when a pre-study has been performed and a decision has been made to continue implementing the change initiative. If applicable, the system integrator or other external parts should have been contracted. The model is designed as a process to highlight that it is a chain of activities that repeatedly refines input to output, from change idea to a successful transformation.

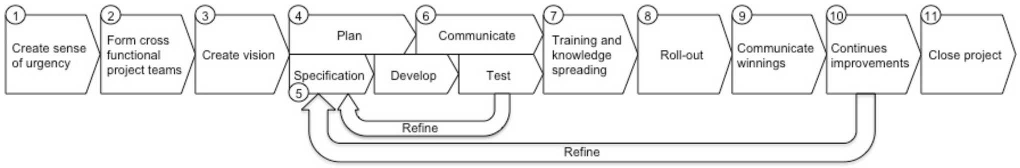

Figure 15. Change Management process model.

1. *Create sense of urgency:* The first step is to convince the top managers that the change is necessary and that it is urgent to conduct it. According to Kotter (1995), at least 70% of top managers should be positive to the change.
2. *Form cross functional project team:* The project team should include employees from different functions within the organisation in order to capture all aspects of the change.
3. *Create vision:* A vision should be created that is easy to understand and communicate.
4. *Plan:* A project plan needs to be established so that includes all aspects of the change initiative. One of the most important parts of an RFID implementation is to map the risks and plan actions accordingly. Measures should also be established that can be used to evaluate the performance of the new system.
5. *Technology development cycle:* The technology development cycle includes specification, development, test and refine. The cycle should be conducted until the technology works satisfying.

6. *Communicate:* The vision needs to be communicated to the affected organisation as well as appropriate information about the change. This is done to prepare the organisation before the roll-out takes place.
7. *Training and knowledge spreading:* During this step the affected employees should be trained in the new system. Most people learn best through practical training and the training should therefore preferably be done as practical as possible. Further, an important part of this step is to spread knowledge about how the employees should report errors, give feedback and find support.
8. *Roll-out:* Before the roll-out takes place it is important that it is thoroughly planned. The roll-out should be documented and support needs to be in place for the users of the new system.
9. *Communicate winnings:* Short after the roll-out short-term winnings should be communicated to encourage the organisation. The winnings can be based on measures but can also be less quantitative statements such as "the roll-out was successful".
10. *Continues improvements:* During this step feedback needs to be collected from the workers as well as analysing the performance based on the measures. The project team decides what to refine and then goes back to the specification step in the technology development cycle. For each loop the system should be improved and this is done until the result of the RFID implementation is satisfying.
11. *Close project:* When the change is institutionalising a project closing meeting should be held where the project performance should be evaluated to capture all lessons learned.

The model is designed for RFID implementations as it is based on empirical studies for an RFID implementation. However, the model is very general and might be applicable to other technology change initiatives as well. The recommendation to Nowaste Logistics is therefore to apply the model at other change initiatives and evaluate the applicability. To make the change process model more general it could be used a guideline for the project manager where each step is considered as a reminder. Depending on the scope of the project, the work load within each step can vary significantly. During large implementations the project manager should consider following each step thoroughly, while in smaller projects the steps should be considered but not necessarily as detailed.

7.2.1 How Nowaste Logistics can use the model

This sub chapter describes how Nowaste Logistics can use the change management process model. Each step is thoroughly discussed with take-off from Nowaste Logistics' context.

1. Create a sense of urgency

The project leader needs to create a sense of urgency in the organisation and to him/her self. Nowaste Logistics has a lot of projects going on and the amount of time is always limited. If a sense of urgency is not created the project will not be prioritised and the change will probably be delayed. To create a sense of urgency Nowaste Logistics could;

- Work with setting project deadlines
- Allocate resources to the projects
- Spread the importance of making the change to people affected as well as the wider organisation
- Show arguments why the project is urgent
- Convince informal leaders

2. Form cross functional project team

The next step in the process is to form a cross functional project team. Before forming the team, it is important to list all stakeholders of the change. In a large project a stakeholder analysis might be useful to identify particularly important stakeholders.

There are two levels within the project team; *the project team* and *the core team* (Figure 16). In the project team, representatives from all internal stakeholder groups are included. The project team members do not necessarily need to work actively with the project. However, through their membership and attendance at regular meetings, important issues and risks concerning the project get raised. Because the selected team members will act as promoters towards the change initiative it is important that the team members also have a positive attitude. The team members also play a central role in communicating the course of the project with co-workers.

The core team consists of people that will actively be working with the project. The core team needs to be divided into different areas of responsibility that suits the particular project.

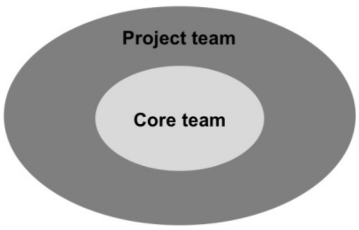

Figure 16. Project team and core team illustrated.

When both teams have been formed the team structure needs to be documented and communicated. The responsibilities of each subgroup should be documented. This process step ends with a kick-off meeting, which symbolises the beginning of the project.

3. Create a vision

The first task for the core team is to develop a vision and a strategy for the change. The vision needs to attract all stakeholders and be very easy to understand and communicate. The vision should guide the organisation through the change and make the organisation work together in the right direction. According to Kotter (1995), for the vision to be effective it should fulfil the following criteria;

- Provide a picture of the future
- Speak to people's long-term interests
- Contain realistic goals
- Clear enough to guide decision-making
- Flexible enough to allow room for individual initiative
- Easy to communicate

4. Planning

During the planning phase the following documents should be created and communicated to the project team;

- Time plan
- Team structure and responsibilities
- Objective statement
- Risk plan
- Communication plan
- Issue log

All documents can be compiled in a project plan. The documents should be easy to use and should not take extra time to learn. If the documents demands plenty of effort to understand and to update the usage of them will not be frequent. It is therefore important to develop and standardise documents which project team members feel easy, worthwhile and supportive. These documents should be the same for every change initiative performed at Nowaste Logistics and should constantly be developed. Furthermore, measures needs to be established during the planning phase that corresponds to the project objectives.

5. Technology development cycle

The technical development cycle is the process where technology is developed, for example software developments (Figure 17). It is preferably done after the planning phase but could in some cases be started before the planning phase is done.

Specifications

When the specifications have been developed the project team should have a look at the specifications. It could be a good idea to visualise the specification in order for easier understanding within the project team. During the specification, representatives from all stakeholders should attend to minimise the risk of missing essential parts. Not only the technical preferences should be considered, focus on business process should also be highly prioritised.

Developing
The actual development usually gets done by a third part developer. Therefore, the communication between the project manager and the developer is very critical. If the communication suffers, there will be serious issues which will cost money and take plenty of time at the end. Different documents could be used during this phase to keep track of the development and the transparency towards the project group. The flow on information is presented in Figure 17.

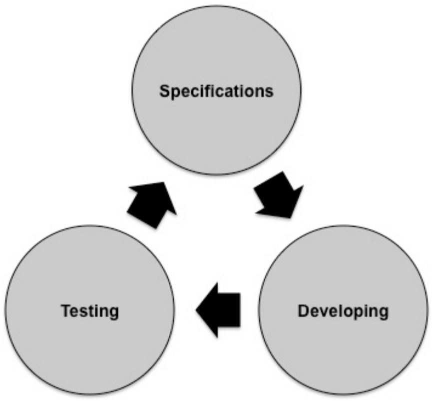

Figure 17. Technical development cycle.

Testing
The objective with the test phase is to find technical bugs and to get all possible feedback on the development phase. There are several ways for testing and the test environment should be realistic as possible to get correct and useful data. A virtual test environment is a common and very useful way of testing. Stakeholders from the project group should test the technology in order to capture how the developed technology complies with the different demands in the organisation. This way the risk of missing important aspects is minimised.

Refine
The potential process developments are reported back to the project manager who needs to decide whether or not they should be done. If the project manager decides to do the update, the specifications need to be modified and a new loop is taken place in the technical development cycle.

6. Communicate the vision
The vision should be communicated to the organisation in advance of the roll-out. It is important that the organisation is aware of the occurring change. If the vision is not communicated, the uncertainty could create a negative climate among stakeholders.

The time before the roll-out when the vision should be communicated varies. As a rule of thumb the vision should be communicated before the stakeholder get informed about the change initiative from another information source. The communication should preferably be verbal but other channels could work to.

7. Training and knowledge spreading
The purpose of this phase is to spread the knowledge about the technology as well as the roll-out plan. Besides the training on how to use the new system the following knowledge need to be spread and communicated;

- Where and how to report errors
- Error handling (if applicable)
- The responsibilities in the project group
- Ways for communication

The advantage with a virtual testing environment is that it can be used during training sessions. By having a proper training environment, co-workers will have the chance to try the new features in a live-case environment. This is a very good substitute to hand-outs and power point presentations which will make co-workers feel more comfortable with new features and functions. It is important to give the people a good first impression to keep up a positive attitude towards the change initiative.

8. Roll-out
The roll-out phase is where the system is tested live for the first time. There are several major tasks that need to be ready before beginning the roll-out. These are;

- Make a detailed plan for the roll-out
- Do not execute the roll-out during “rush hours”
- Have a well prepared routine for handling errors
- Provide support functions to workers
- Document the roll-out

Right after the roll-out, the project team should gather to evaluate it. Questions concerning the roll-out should be asked and team members should contribute with their expertise. This meeting should be documented.

9. Communicate winnings
After the roll-out, early winnings should be communicated to the organisation. By doing so, co-workers will get more motivated and by showing winnings the project

team proves that the change was needed. The winnings could preferably be based on KPIs and/or other measurements that have been done along the change process.

10. Continues improvements

Kotter emphasises the importance of not communicating victory of the project until it is totally done. This step aims to highlight the importance of continuing to constantly improving the system. By doing so, the risk of slowing down in the change process lowers. There are always room for improvements but there is also a balance between how many things that could be done within the project and which tasks that might be included in other projects. There are several sources for gathering information about where improvements could be done. Two concrete and hands-on sources are;

- Feedback from the organisation
- Analysing results from measures and KPIs

11. Close project

When the change is implemented and the when the results are satisfying the project should be closed. During this phase, it is central for the project team to analyse the project performance and to identify possible improvements for up coming projects. A final meeting should be held where these topics are discussed and the results are presented. After this, the project should officially be closed.

8 Central components and their interaction in RFID implementations

This chapter handles the second part of the purpose; to identify central components of change and their interaction within an RFID technology implementation. In order to identify central components and their interaction, technology implementations in a wider perspective where first analysed with basis from the literature and observations from the new labelling process implementation. The new labelling process implementation did not involve RFID technology and the observation from this point of analysis is therefore more applicable for well known technology as supposed to innovative technology such as RFID. The central components and their interaction in technology implementations where then used to analyse RFID implementations in order the find what distinguishes RFID implementations from implementing well known technology. Finally, the findings resulted in a recommendation of how to deal with the uncertainty surrounding the RFID implementations.

8.1 Implementing technology

Implementing technology is a challenge to many companies in today's industry. The types of projects can differ widely from each other as well as the culture of the company that is implementing the change. The RFID implementation at Nowaste Logistics will differ from projects at other companies in multiple ways. However, we asked ourselves if there are any central components that need to be in place while implementing a technology. If there are, how do they interact with each other?

8.1.1 People, Process and Technology

During the case study, we were trying to understand the important components to successfully implement technology. What we discovered was that there were three main building blocks that needed to fall into place: people, process and technology. Within each of these components there are subareas that are important to succeed.

People

People are in the centre of the change. People can be divided into two groups: the users that are affected by the change and the project team that conducts the change. When talking about change management the focus is often on the people. Most change management frameworks can be used in order to describe what is necessary to get the people component in place. The following subareas were identified as important;

- *Capable project leader* – a capable project leader is one of the most important components in innovative change initiatives.

- *Cross functional project team* – the project team should consist of people from different functions within the organisation.
- *Communication* – communication within the project team and internally within the organisation is essential.
- *Training and support* – structured training and support for the users of the system.
- *Top management commitment* – a majority of the top managers need to support the change initiative and be committed to conduct the change.
- *Effort* – the project team and the users need to be able to put in enough effort on the change initiative.

Process

By process, we mean the design of the processes that is affected by the implementation. The process design needs to be aligned with the objectives to be fulfilled. For example, in the RFID implementation, the picking, labelling and hauling processes were changed. The design of these processes is essential to the success of the new RFID system. For the process to be successfully designed there are a couple of important areas;

- *Process understanding* – the project team that is developing the new processes needs to have sufficient knowledge about the process. Process mapping is a good way to achieve this information
- *Technology understanding* - the project team also needs to have knowledge about the technology and its limitations.
- *Feedback* – when the new process is rolled out the process improvements should not stop. The users must give feedback on the process and come up with possible improvements. By doing this, continues improvements can be achieved and the process design will become better.
- *Measures* – measures needs to be established to evaluate if the objectives have been met. If not the project design might need to be improved.

Technology

Technology is the enabler of the technical change but by it self, it is useless. Consider the RFID technology, without a proper system design and people that uses it, an RFID system is useless. The technology should support the process and the choice of technology is therefore essential. There are a number of areas that needs to be considered in order for the technology to fall into place;

- *Specification* – the process design needs to be translated into specifications for the technology system. The cross-functional project team should verify this work so that the system design complies with the different functions within the organisations.
- *Testing* – thoroughly testing needs to be done of the technology and based on the results the system design might need to be revised.

- *Pilot* – if a pilot is possible to conduct it is often valuable since it can reduce the risk, uncertainty and enable organisational learning (Turner, 2007).
- *Risk management* - implementing innovative technology often involves a great deal of risk which needs to be identified and properly managed. To proactively cope with the risk, the five step process by Smith and Merritt (2002) can be used.

8.1.2 The interaction between People, Process and Technology

The components people, process and technology are mutually dependent on each other and need to interact in order for the implementation to be successful. During the case study, we discovered that there was a need for continues improvements to achieve a successful system. No matter how much effort that is put into the design and test phase, the system will not be perfect when it is rolled out for the first time. Therefore, we tried to describe the interaction between the three dimensions in order to achieve these continues improvements (Figure 18). The illustration is of course a simplification of the reality.

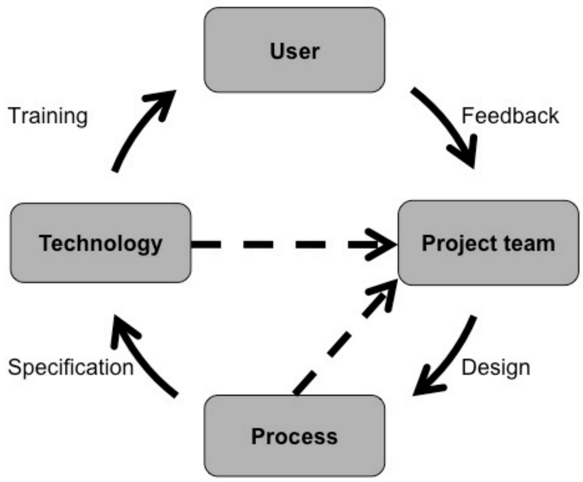

Figure 18. The interaction between people, process and technology.

The people component is divided into two components, users and project team. When a decision is made to start implementing technology a project team is formed. The project team designs the process. During the design phase the project team needs to gain understanding of current processes and the possible technology. When the process is designed, a specification needs to be done in order to describe how the technology should be developed. When the technology is developed according to the specifications the users are trained in the new system. After the users have begun to work with the new system they should give feedback on the new system to the project group. The project group then chooses to make changes to the system, redesign the process, make specification that are then rolled out and the loop is achieved. For each loop the system is improved.

The design and specifications are rather straightforward. However, common reasons why the loop is broken are the lack of training and/or feedback. If the training, information and support to the user are lacking, the result is insufficient knowledge about the system among the users. If the user does not have sufficient knowledge the system will not be used efficient and no proper feedback could be given on the system. Feedback is another component that is often missing for the loop to be fulfilled. Proper feedback channels need to be established and the users should be encouraged to give feedback on the system.

8.1.3 Building Technology Change

We have chosen to visualise the findings of the three components for successful implementation of technology with the model, "Building Technology Change" (Figure 19).

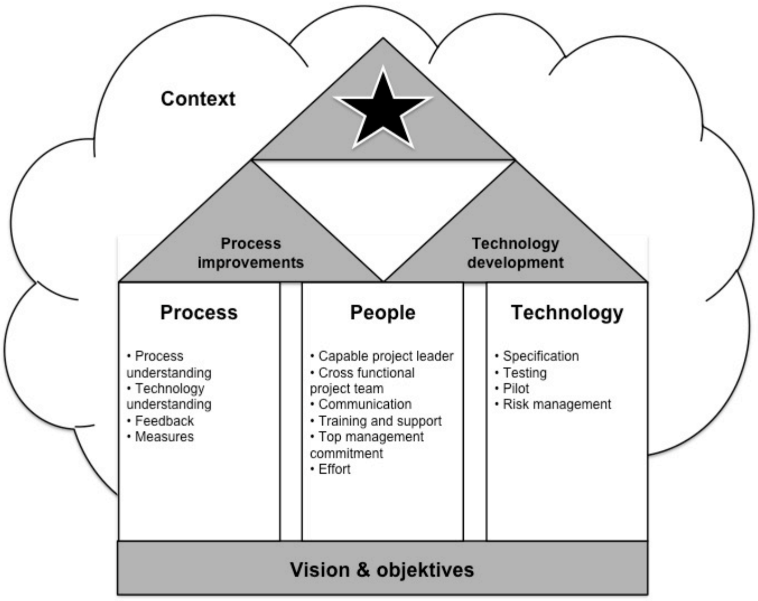

Figure 19. Building Technology Change.

The foundation: Vision and objectives

In the foundation of the building there are the vision and the objectives. These represents that the change initiative should be built on the vision and the objectives. All actions that are taken within the change initiative should be aligned with the vision and done in order to fulfil the objectives. Actions that are not aligned with the vision and objectives either have nothing to do with the change initiative or make the building unstable. If there is not a vision or objectives, the building is built on a very vague foundation which in reality could be expressed as a project without a defined purpose.

The building blocks: people, process and technology
People, process and technology are the building blocks that carry the roof. This represents that all three dimensions need to be in place to successfully implement technology. If a building block (component) is missing, the building falls apart. In each building block (component), there are subareas which need to be considered for the dimension to be stable.

The left roof: Process improvements
The process and people building blocks (components) carry the left part of the roof, process improvements. If there is no technology involved in the change, only the left part of the building exists. For example, if the pickers were told to manually write the load carriers ID number instead of a printer printing it, the pickers' process has changed but there has not been any technology involved.

The right roof: Technology development
The people and technology building blocks (components) carry the right part of the roof, technology development. If there is no process involved in the change, only the right part of the building exists. For example, if a database is replaced by a new more efficient database, the technology is changed but the process will not be affected.

The top of the roof: Successfully implementing innovative technology
If all parts of the building are in place, the top of the roof is carried. This represents that for a successful implementation of innovative technology, all building blocks need to be considered for a complete and successful implementation.

The context: Culture
The air around the building represents the culture within the organisation who conducts the implementation. Different companies will need to act differently depending on their unique culture. For example Nowaste Logistics has a “doer” culture which affects the way projects are conducted.

8.2 Implementing RFID technology

The components people, process and technology must be in place for all technology implementations regardless if it involves RFID technology or not. Therefore, we asked ourselves what is special when it comes to RFID technology. What we discovered was that the interaction between these components becomes more difficult due to the uncertainty the lack of knowledge about the technology. Companies tend to focus too much or too little on the technology. In addition, the process and people components seem to suffer from the uncertainty of the technology due to the interaction between the components. To deal with these issues, we have identified three success components for implementing RFID change.

8.2.1 Building RFID Change

According to Gilmore (2003), many firms are focusing too much on the technology and do not prioritise the business processes during RFID implementations. However, we discovered that Nowaste Logistics in fact did not pay enough attention to the technology. During the technical verification Nowaste Logistics discovered that the RFID technology was in fact harder to get in place then expected. With the knowledge that Nowaste Logistics now have about the technology there should have been a greater focus on the physical principles of the RFID technology.

The conclusion is that it is hard to achieve a balance between the three factors during RFID implementations. Companies tend to have a mismatch between the amount of resources put on the technology component and the other two components. The result is often too much or too little focus on the technology. The reason is the uncertainty and lack of experience within the technology. Companies do not know what to expect from the technology and there are no prior experiences to gain knowledge from. Therefore, it is hard to know how much effort that should be put on the technology component. To adapt *Building Technology Change* to describe implementations of RFID technology we have visualised the uncertainty that is surrounding the technology component with a fog that is covering the component (Figure 20). As the company is implementing the RFID technology and gaining more knowledge about it, the fog starts to disappear. First now, the company realise if they have the right balance between the technology component and the other two.

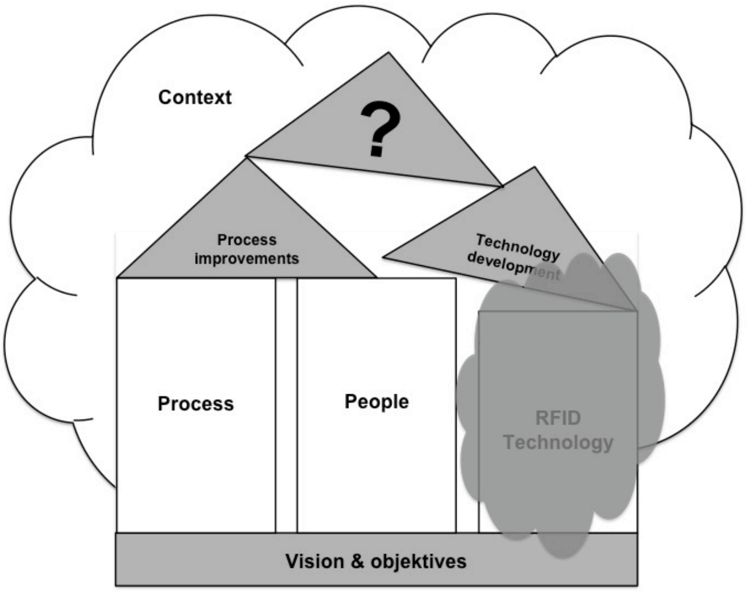

Figure 20. **Building RFID Change.**

8.2.2 Interaction between People, Process and RFID Technology

The interaction between the three components was described in "7.3.2 The interaction between People, Process and Technology". However, when implementing RFID technology the interaction between the three components becomes more important and more complex due to the uncertainty of the technology. In fact, we discovered that the other components suffer from the uncertainty of the technology and that it is harder to manage the other two components as well.

The process development becomes harder due to the lack of knowledge about the technology. This implication is described in Figure 21 where the information arrow from technology to the project team is cut off. Since the project team does have full knowledge about the technology when they develop the process, more loops are needed in order to get the process right. In the case study, the process was thoroughly developed prior to the technical verification. When the technology was tested and the issues were discovered it seamed as if the process was hard to revise since the project was already committed to that process.

According to Hellström (2007), organisational interaction is as important to success as ensuring technology integrity in RFID implementations. The set backs that the company often faces due to uncertainty of the technology also affects the people component negatively. We discovered that the commitment across the organisation, the effort put into the project and the communication suffered when the company was facing issues with the technology. Therefore, change management require more attention during implementations of RFID technology as supposed to well establish technology. Change management often gets neglected during RFID implementation since all resources are focused on getting the technology right. By putting effort into change management and the people component the company will most likely also experience gains within both the technology and process component, due to the interaction between the components.

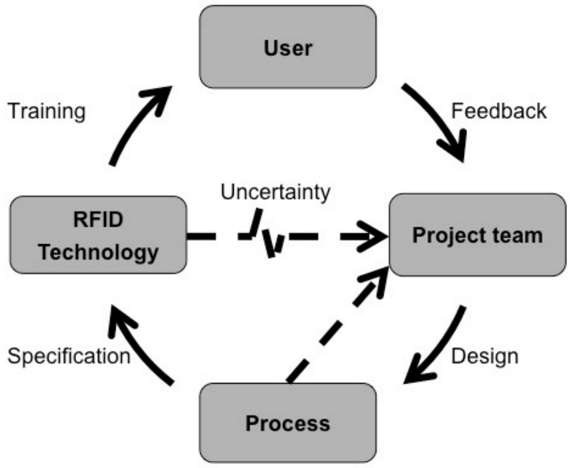

Figure 21. The interaction between People, Process and RFID Technology.

8.2.3 Dealing with RFID technology

We have identified three success components to deal with the issues surrounding implementations of RFID technology; *reduce technology uncertainty, flexible process development* and *focusing on change management*.

Reduce technology uncertainty

The uncertainty surrounding the technology needs to be reduced for the company to know how much effort that needs to be put on the technology. The most important part of reducing the uncertainty is to involve technical tests and pilot studies in the implementation. The technical tests should be conducted as early as possible in the implementation to gain knowledge about the technology and the effort it demands. Furthermore, proactive risk management focusing on the technology should be one of the first steps in the implementation process to identify risks and plan actions accordingly.

Flexible process development

To cope with the issues of process development we call for flexible process development. When designing the process, the company needs to be aware that the technology condition can change radical in the future. Therefore, it is important not to get locked in with a certain process that cannot be revised later in the implementation. Furthermore, action plans of how to handle the technology risks if they occur should be part of the process development. For example, if the readability of this tag turns out to be low one have to integrate barcode reading in the process design.

Pay attention to change management

Companies should pay attention to change management during implementing RFID technology. The following factors needs to be considered;

- *Vision* – The implementation process of RFID technology is uncertain and therefore a clear vision is necessary to guide the organisation in the right direction.
- *Capable project team* – The uncertainty of the technology puts greater demands on the project team. The company therefore needs to gather its best resources for the change initiative.
- *Regular project reviews* – Since the conditions can change fast during RFID change initiatives more regular project reviews are necessary.
- *Commitment* - The project will most likely face more set backs when it involves RFID technology and therefore a strong commitment from top management and users needs to be in place before the implementation starts.
- *Effort* - If the project experience set backs the natural response is to not prioritise the project since it feels hard to face the issues. Therefore, it is important to make sure that the project team puts enough effort into the RFID change initiatives at all times.
- *Communication* – Communication becomes harder since the company does not want to communicate an upcoming change that might not be implemented due to technology issues. Therefore, communication needs more careful planning since the time frame typically becomes shorter.

9 Concluding remarks

We have identified three main components that should be considered during technology implementations: *People*, *Process* and *Technology*. A model, *Building Technology Change,* has been developed to highlight the balance between the components and the importance of considering both soft and hard factors through the implementation process. We have also found that the interaction among these components is essential to successful technology implementations. However, during RFID technology implementations, the uncertainty and lack of knowledge surrounding the technology affects the balance between the components negatively. Companies tend to have a mismatch between the effort put on the technology component and the other two components due to its unpredictable nature. The uncertainty of the technology therefore needs to be reduced by conducting technical verification, pilot and risk management. The importance of change management also increases as the uncertainty of the technology can cause major set backs during the implementation. If the factors such as *vision, capable project team, regular project reviews, commitment, effort* and *communication* is not thoroughly considered, the RFID implementation is likely to fail due to such set backs. Furthermore, we have discovered that the process development suffer from the lack of knowledge in the technology. To deal with this issue, the process should be flexible to be able to adapt for changes in technology during the implementation.

By studying literature within *change management, pilot studies* and *risk management* and by conducting a case study at Nowaste Logistics, we have developed an RFID change management process model. The intention of the model is to guide the project mangers through RFID change initiatives. The model aims to be easy to use and absorb as well as applicable for both small and large RFID implementations. The model incorporates all thee components of RFID change; for example, factors such as *communication* and *vision* relates to the people component, *testing* and *development* relates to the technology component and *continues improvements* relates to the process component. Further, the model has also been described based from Nowaste Logistics perspective to concretise how they should work to achieve success within each step. Although the model is developed for RFID implementations it might be applicable for other technology implementations.

Through our case study we have also concluded that Nowaste Logistics handles changes successfully and that they have an obvious and honest drive to improve. The first conclusion is that Nowaste Logistics manages the hard factors of change management very good. However, the soft aspects could be improved. By focusing on the soft aspects we refer to defining a clear vision, communicating the vision through the entire organisation, improve communication and to standardise feedback to gain more input from co-workers. Further, we think the lack of documentation is an issue, which Nowaste Logistics should prioritise. Today, the project manager is the product champion. Through this, the projects get depending on the project manager and in case of his absence; few people have enough information to know what to do. Furthermore, the case study provides experiences of an RFID implementation within the fruit and vegetable industry. The special challenges connected to the RFID technology, due to the products with high water content, is a reality that should not be neglected during RFID implementations in this industry.

The next step for Nowaste Logistics is to apply the change process model in current and future change initiatives. When each project is closed and the change is institutionalised the process needs to be discussed and reviewed. The process should constantly be developed to improve the applicability of the processes for Nowaste Logistics. Furthermore, we believe that Nowaste Logistics can become even better at conducting change by regularly assessing their performance by using the DICE score. Most importantly however, they have to be aware of the soft components of change and constantly work to improve within these areas. Further studies need to be conducted to determine if the RFID change management process model could be applicable for other technology implementations.

The model, Building Technology Change, helped us understand the important components of change and how they interact with each other. Further empirical studies could be conducted to support or develop the model. It would also be interesting to find out how well the model relates to other change initiatives in different contexts. The focus within innovation often seams to be on the development phase, such as developing new products or strategies. The change management perspective during the implementation of the innovation is often forgotten. Therefore, we also encourage further studies on the role of change management within innovation, especially RFID implementations.

In conclusion, in order to run faster than your competitors, you do not have to be more creative then they are, you just have to be better at implementing the creativity that you possess.

> *"Creativity is thinking up new things. Innovation is doing new things" (Theodore Levitt, 1963)*

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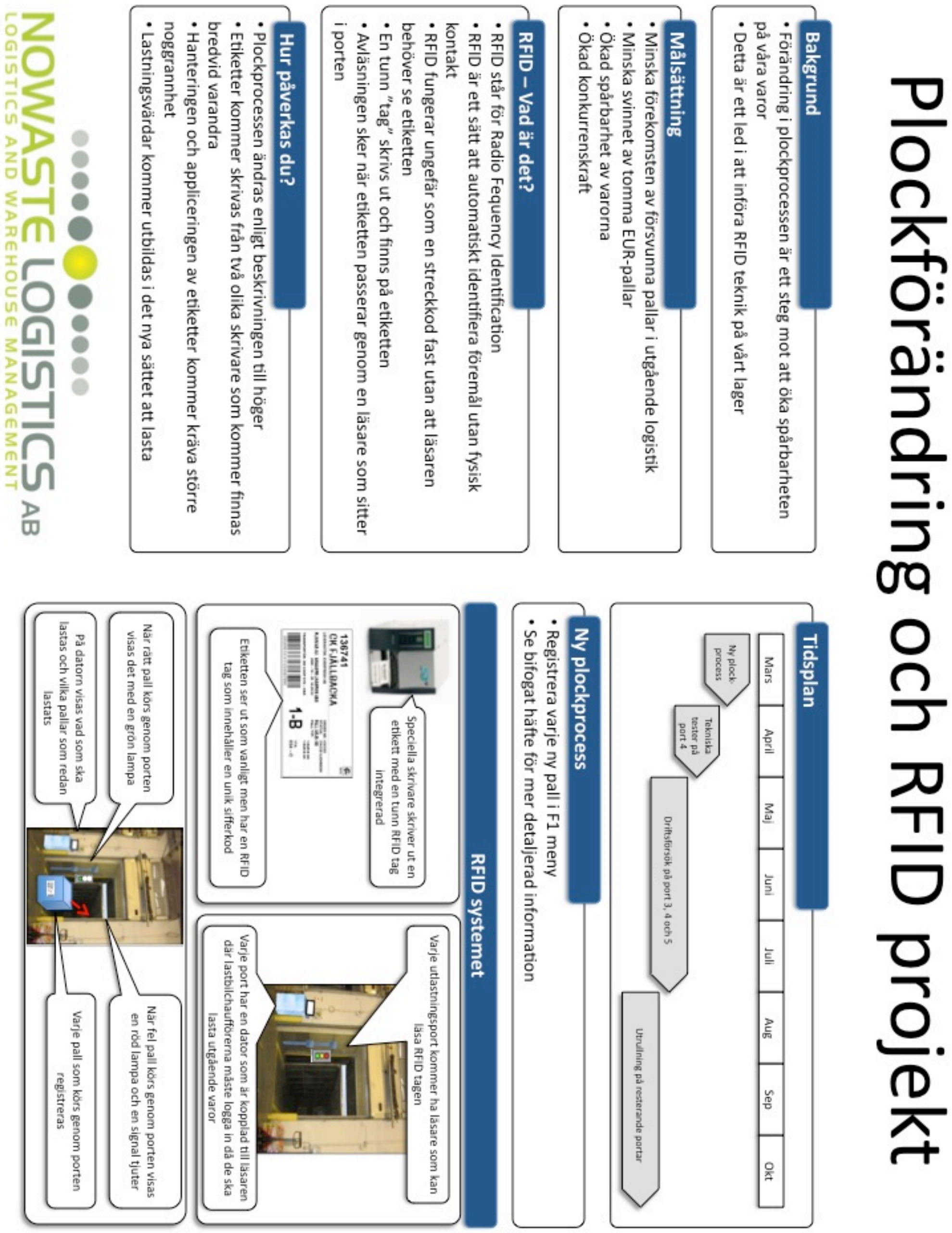
Appendix 1 – RFID information poster



Appendix 2 – Brown's RFID Implementation model

Phase	Activity description
Business justification	**Enumerate potential applications:** Identify specific areas within the company where an RFID implementation will make the most impact. **Build business cases:** Explore the benefits, costs and risks for each of the possible applications. **Determine priorities:** Evaluate all reviewed applications and rank them in order of attractiveness. **Create milestones:** Determine major goals for each activity during the implementation and estimate its duration.
Preliminary planning	**Preliminary planning:** Document objectives and scope, testing strategy and frequency choice. List touch-points and map their processes. Select sponsor, steering committee and RFID assessment team.
Pilot	**Plan the pilot:** Assemble core team, staff and project team. Prepare for testing, selection, procurement and installation. Compose pilot objectives and system requirements in a list. Request quotes from RFID suppliers and evaluate them. **Execute the pilot:** Test the tag - reader - host computer communication. Follow the project plan developed in the planning step. Review the results and document lessons learned.
Technical integration	**Plan technical integration:** Plan the integration of RFID technology into the company's systems. Take special care to plan the integration with the IT network and to establish what user training is needed. **Execute technical integration:** Connect readers to the enterprise network and tag data to application programs.
Roll-out	**Plan roll-out:** Carefully plan a monolithic expansion or an expansion in individual blocks of activity in logistical segments. **Execute roll-out:** Expand the implementation to include more readers, facilities and applications.

Appendix 3 – Hellström's RFID implementation model

Stage	Activity description
Initiation	**Problem identification:** Define the problem/opportunity and define an objective. **Concept development and system design:** Develop different concepts of how to solve the problem.
Adoption	**Cost-benefit analysis**: The result of the concept development and system design is assessed economically. **RFID trial:** The technology is tested and put though its working environment in order to verify that it works as anticipated.
Adaptation	**Choose system integrator:** Based upon software and hardware requirement, cost etc. system integrator(s) are chosen. **Installation:** Software is development and installed. Hardware is installed and adjusted. Business processes are changed and employees are trained in the new processes.
Acceptance	**Education and training:** Inform, train and discuss with employees and end-users about the use and usefulness of the system. **Communication:** Communicate with all involved organisations about the use and implication of the system.
Routinisation	**Improvements:** Perform installation changes to accommodate employee's needs and improve the level of automation and performance of the implemented system. **Process the collected data:** Analyse and interpret the data accumulated from the system.
Infusion	**Expand the implementation:** Use the implemented system infrastructure for other applications. **Transfer the technology:** Use the knowledge attained regarding the technology involved.

Appendix 4 – GS1 implementation guidelines

GS1 and EPCGlobal have together formed guidelines for RFID Implementations. The guideline provides an overview of the key actions that early RFID adopters have experiences as critical for success based on real implementation experiences. The company may choose to adopt all or just a selected list of actions, based on the nature of the specific implementation project. The actions are divided into different categories; knowledge, business, analysis and partner actions. The guidelines are briefly described in Table A.

Table A. GS1 implementation guidelines (EPCglobal).

	Purpose	Knowledge Actions	Business Actions	Analysis Actions	Partners Actions
Investigate	Develop RFID/EPC knowledge	•Learn about EPC/RFID technology.	•Understand business drivers. (compliance vs. transformation) •Secure Executive sponsorship & funding.	•Identify use cases.	•Learn about available resources in the EPC/RFID community. •Form a research based RFID project team.
Experiment	Gain hands-on experience in the lab	•Understand the technology and information flow.	•Identify baseline work process and key measurements/ KPI (time, frequency, cost, benefit, etc.)	•Conduct tag placement analysis. •Categorize product/packaging characteristics	•Identify technology partners. •Test various RFID products. (hardware, tags, software)
Trial	Test targeted applications in the field (1 - 3 locations)	•Define and map the current Supply Chain processes. •Examine process and environmental related issues in the field.	•Document EPC/RFID impacts to business processes. •Define testing success criteria before going into the pilot.	•Define EPC system/ data architecture, and the EPC numbering scheme. •Obtain EPC Manager numbers.	•Identify cost drivers. • Form a cross-functional RFID team. •Develop communication plan. (at least for internal purposes)
Pilot	Develop a scalable rollout solution	•Verify adoption strategy and cost items. (products, quantity, how and where to tag)	•Decide which EPC reading to be added to the baseline. •Develop a long term plan based on pilot result.	•Analyze the in-process data. (e.g. read rates & locations) •Validate performance in end-to-end systematic testing.	•Coordinate testing w/ trading partners. •Select technology partners for pilot and rollout.
Deploy	Engage in phased rollout	•Develop a scoreboard of metrics to adjust implementation parameters.	•Measure and track improvement of key measurements / KPI (key performance indicators).	•Refine business cases for targeted RFID initiatives.	•Ongoing collaboration with trading and technology partners on process/data flow improvement.

Appendix 5 – Brown's recommended pilot documents

- Brown (2007) recommends the following documents to be created during the pilot planning phase;
- *Business Infrastructure Document* – describes the business infrastructure such as methods of identification, network impact, reader and enterprise network integration, data quality and supply chain performance
- *Pilot Objective Document* – document objectives that will work as a score-card when the pilot is performed
- *Pilot System Requirement List* – document a list of what will be required to deliver all objectives
- *Pilot Work flows Description Document* – description of how each work flow is impacted by the pilot
- *Pilot Facilities Description Document* – describes the facilities that will be affected by the pilot
- *Pilot Data Description Document* – description of the data structure and source that will be necessary to fulfil the objectives
- *Pilot Software Description Document* – describes the RFID software necessary to format and decode the data received form the tags
- *Pilot Systems and Storage Description Document* – describes the requirements for the computer and database hardware; such as, CPU speed, memory, etc.
- *Pilot Product Description Document* – describes the products that should be tagged in the pilot
- *Pilot SKU Description Document* – lists the SKUs (Stock Keeping Units) that will be used in the pilot
- *Pilot Network Impact Description Document* – documents the impact on the network
- *Pilot Human Resource Description Document* – describes the human resources that will be necessary in the pilot
- *Pilot Tag Selection Document* - document for selecting the proper tag
- *Pilot Reader Selection and Deployment Document* – document for selecting the proper reader
- *Pilot Procurement Document* – lists all the items that one needs to purchase for the pilot and the vendors that are providing them.
- *Pilot Training Document* – documents the training outline for the workers
- *On-site Document* – a document available at the site with all relevant information
- *Project Plan* – project plan for the pilot
- *Budget* – budget for the pilot

Appendix 6 – Gilmore's Phases of an RFID Pilot

Table A. Gilmore's (2003) phases of an RFID pilot and their objectives, duration, required resources and common mistakes.

Phase	Objective(s)	Typical Duration	Resource Requirements	Common Mistakes
I. Application Definition/Business Case	■ Define New RFID Process Flows (Compliance or Internal Benefit) ■ Estimated Return on Investment	1-3 Months	■ Two full or near full time internal resources ■ Often, use of an outside consultant	■ Doing an abstract business case that does not really reflect operational reality ■ Not closely tying pilot definition to business case assumptions ■ Underestimating costs of integration, modifying existing application software ■ Over estimation of actual reader deployment given costs ■ Underestimating change management issues and roll-out times
II. RFID Technology Immersion (often in parallel with Phase I)	Gain baseline familiarity with RIFD technology and options	2-4 Weeks	■ 1-2 internal technology champions ■ Vendor RFID starter kits ■ Dedicated "lab "environment" (optional)	Spending too much time in this phase "playing around"
III. Product/Platform Testing	Understand the specific interaction of tag types, tag placement, and reader configuration on individual SKU and containers to be tagged	2-8 Weeks	■ 1 operations resource ■ 1 IT resource ■ 100-10,000 tags, often several types ■ Readers and antennae – often, several types must be tested ■ Actual products/ containers – 1-2 pallets per SKU generally ■ Tag "printer" (optional) ■ Software that automatically measures and reports read results (optional)	■ Not testing in similar environmental conditions to production environment ■ Not meticulously recording test data ■ Over or under testing product/packaging configurations ■ Not testing "read time" dynamics ("dwell time" in reader range required to get a good read)
IV. Production Pilot	■ Validate technology performance in real world operating environment ■ Validate/fine tune process flow assumptions ■ Validate business case assumptions and likely true ROI ■ "Go or No Go" Decision	2-6 Months	■ Hundreds to perhaps tens of thousands of tags ■ Readers/encoders on 1-2 dock doors, sometimes on conveyors, wireless hand-helds or fork truck mounts ■ RFID "middleware" to manage RFID reader set up and operation ■ RFID tag printer (optional) ■ "Bolt-on" application to maintain RFID data and serve as point of integration ■ Limited integration to live production systems (optional)	■ Focusing too much on the technology and not on business process ■ Not tracking quality of incoming tags ■ Underestimating the time to tweak readers, antennae and tags to achieve acceptable results in live environment

Appendix 7 – Off-site test protocol

Test	Test Case	Description	Notes	Times	Read	%
1) Pallet reading						
	1.1 Test with 2 Antennas per side	Test reading with four tags, placed to varying height with 2 antennas	General testing showed that reading with powers between 22 and 30 had no problems at reading all tags from pallet	N/A	N/A	N/A
	1.1.1 Test with 50cm distance	Test reading while the pallet stack is horizontally 50 cm away from antennas	These were tested at the same time with direction detecting tests	300	300	100
	1.1.2. Test with 130cm distance	Test reading while the pallet stack is horizontally 130 cm away from antennas	These were tested at the same time with direction detecting tests	200	200	100
	1.2 Test with 4 Antennas per side	Test reading with four tags, placed to varying height with 4 antennas		Tested at NWL if needed		
2) Impinj reader direction detecting						
	2.1 General	General reading test (does it work generally)	General testing showed that reading is better if power is not full and enough for all tags being read properly	N/A	N/A	N/A
	2.2 Pallet with heigth differences	Pallet reading test with warying tag height				
	2.2.1 Test with power 27, 50cm	Tested with reader power 27 and run horisontal distance 50 cm		80	77	96,25
	2.2.2 Test with power 25, 50 cm			80	78	97,5
	2.2.3 Test with power 25, 130 cm	horisontal distance 130 cm		100	100	100
	2.2.4 Test with power 25, 50 cm		(Antennas reconfigured)	100	100	100
	2.2.5 Test with power 25, 130 cm		(Antennas reconfigured)	40	40	100
	2.2.6 Test with power 25, 50 cm	Metal plates added for reflection testing	(Antennas reconfigured)	100	99	99
	2.2.7 Test with power 25, 130 cm	Metal plates added for reflection testing	(Antennas reconfigured)	100	100	100
	2.2.8 Test with power 23, 50 cm			50	43	86
3) Direction detecting with Vilant Device Manager						
	3.1 Antennas close	Antennas close together	Not tested because case is similar to Impinj reader detecting and antennas separate case seems to be workin.			
	3.2 Antennas separated	Antennas separated (3m away from each others)				
	3.2.1 Test with 50cm distance	Metal plates added for reflection testing		100	100	100
	3.2.2 Test with 100cm distance	Metal plates added for reflection testing		100	100	100
4) Tag tests						
	4.1 Short dipole	Test pallet reading with short dipole tags	All tests were done with Short Dipole, it works so good that there is no need for Dogbone	850	850	100
	4.2 Dogbone	Test pallet reading with dogbone tags	Not tested	N/A	N/A	N/A

Appendix 8 – On-site technical tests

The on-site technical testing took place at the warehouse in Helsingborg the 13th and 14th of April by the on-site test team in cooperation with Vilant. All tests were conducted at gate 4.

The Impilj direction detection method was tested first since this was the most simple and economically better solution. Antennas were mounted at 3.10 m height according. Two tags where placed on a 2 m high pallet with mixed fruit. The Impinj tests result was that 100 % readability was achieved but the direction was not satisfying with this set up. Different antenna direction where tested but none received satisfying direction results so it was decided to change the direction sensing method.

The set up was changed so that Vilant device manager could be used for direction detection instead. Antennas where mounted outside of the gate and in the end of the gate (Figure A). However, the Vilant device manager direction detection requires software that should be installed at the server. Because of some technical difficulties the direction testing was delayed and could not be started until the next day.

Figure A. Vilant devise manager direction detection set up.

The rest of the day was spent conducting readability tests for different products. The first product that was tested was containers with juice. This is not a product that Nowaste Logistics is selling today, but it is possible in the future since they are delivering other products such as milk and eggs for producers that have juice in their assortment. The reason why juice was tested is that it is considered to be one of the most difficult products to achieve proper readings with according to RFID experts (Hydbom, 2010). As expected, the readings where readability was really poor for all types of tag placed directly on the cartons. When the tag was placed around 1 cm away from the carton by using a fly tag or carton board the reading became better. It was now obvious that the products that the tag was placed on were going to be the major problem for the readability. Therefore, different products that Nowaste Logistics have in their warehouse were tested. Tests showed that the hardest product to get good readability from was potatoes and onions. The reason is that these products are delivered in a net and the label is therefore attached directly at the product without any carton board or plastic box in between. Pallets with milk and egg also resulted in poor readability. The readability was also unsatisfying when the tags were placed directly at the wooden pallet.

With the antennas mounted above the pallet and pointing downwards, it was also discovered that the tag could not be place in vertical position. The reason is that the relationship between the tag and the direction of the antenna affects the readings. In addition, the tag cannot be read when it is put directly on top of another tag. Therefore, it is importation that two labels are not put directly on top of each other.
Most tests were conducted with the cheapest tag, Monza3 (Figure B). Some tests were also performed with a Dogbone tag but this tag did not result in better readability (Figure B). The sensitivity of the Monza3 tags was also tested by intentionally trying to destroy the tag in different ways. The test showed that the tag was much more robust then expected and that uncareful treatment will not cause any problems.

The read range was also tested by moving away from the readers until the readers did not detect the tag anymore. When holding the label carefully without blocking the tags readability with the hand. However, when the tag was put on a pallet with fruit in cardboards the read range was decreased drastically. This showed that even the pallets that were not initially considered to create any interference are affecting the signal strength quite much.

During the second test day Vilant device manager direction detection started to work. Different antenna positions and tag placements was tested. The result showed that this direction detection method had similar problems as Impinj direction detection. Especially tags that were placed low on the pallets received poor direction detection. Vilant device manager direction detection also had the problem that the false direction was shown as supposed to Impinj that did not show any direction at all when the reading was incorrect.

Figure B. SRS pallets, Monza3 tag and Dogbone tag.

Finally, the test set up was changed back to the Impinj direction detection that was tested the first day. Tests were conducted on a 2.80 meters high pallet with mixed fruit. The direction detection had 98 % accuracy. The lower tags were again the problem. The reason why the lower tags are the problem is probably because they are at a bigger distance from the antennas. They also have a different angle that can affect the reading.

SPS pallets with integrated tags where also tested with both direction testing methods. The readability for the SRS pallets was 100 %. The Impinj's direction detection had a 99.3 % accuracy when five SRS pallets where loaded at the same time. However, when 10 SRS pallets were loaded at the same time the accuracy was only 91 %. The reason why it differed was probably because the Impinj direction detection has a read limit of 15-20 tags at the same time.

The findings can be summarised as follows:

- Impinj direction detection was preferred due to a more simple and economically solution and comparable readability
- Readability varies a lot with the type of products. Flag tags or distance between tag and product will be necessary to receive satisfying readability.
- Read range is affected a lot when the tag is put on a pallet.
- More antennas with different position might be necessary to get closer to the tag.
- SRS pallet readability is satisfying
- The tag is robust enough to cope with insensitive treatment
- The tag needs to be put in a horizontal position (assuming the antenna position is not changed)

- Tag selection does not affect the readability enough to be economically defensible. The cheapest tag will therefore be used
- Tags cannot be read when they are put on top of each other.
- Impinj direction detection has a limit of 15-20 tags loaded at the same time.

Appendix 9 – Nowaste Logistics' DICE score

DURATION [D]	1
Do formal project reviews occur regularly? If the project will take more than two months to complete, what is the average time between reviews?	1 (appr. 2 weeks)
INTEGRITY OF PERFORMANCE [I]	2,0
Is the team leader capable?	1
How strong are team members' skills and motivations?	3
Do they have sufficient time to spend on the change initiative?	2
SENIOR MANAGEMENT COMMITMENT [C1]	2,0
Do senior executives regularly communicate the reason for the change and the importance of its success?	3
Is the message convincing?	1
Is the message consistent, both across the top management team and overtime?	2
Has top management devoted enough resources to the change program?	2
LOCAL-LEVEL COMMITMENT [C2]	1,5
Do the employees most affected by the change understand the reason for it and believe ifs worthwhile?	2
Are they enthusiastic and supportive or worried and obstructive?	1
EFFORT [E]	1,3
What is the percentage of increased effort that employees must make to implement the change effort?	1 (5-10%)
Does the incremental effort come on top of a heavy workload?	2
Have people strongly resisted the increased demands on them?	1
Nowaste Logistics' DICE Score = **D + (2 X I) + (2 X Ct) + C2 + E**	11,8