SAIMAA UNIVERSITY OF APPLIED SCIENCES
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DEVELOPING OUTBOUND LOGISTICS IN INTERNATIONAL POWER AND AUTOMATION TECHNOLOGY COMPANY

Master's Thesis 2010

ABSTRACT
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Developing Outbound Logistics in International Power and Automation Technology Company, 69 pages, 2 appendices
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The purpose of this Master's Thesis was to document and analyse what has been done in the outbound logistics development project that has not been finished yet and to define actions for completing the project. Another objective was to plan what could be done in the future to develop the outbound logistics further. The work was commissioned by ABB.

In the theoretical part of the study the main issues were related to developing outbound logistics processes. Also basic concepts of project management were covered. The data for this study was gathered by participating actively in the project meetings and brainstorming sessions and discussions with the project team and consultants. A quantitative analysis was made and the data for the analysis was gathered from ABB's ERP system.

As a result of this thesis the actions required to complete the development project were defined. The actions have been realized in practice and the first phase of the project has been completed. This thesis gives also suggestions for what could be done in the future to develop the outbound logistics processes in the company.

Keywords: Outbound Logistics, Project Management, Development Project, ERP System

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Tämän opinnäytetyön tarkoitus oli dokumentoida ja analysoida, mitä oli tehty keskeneräisessä lähtevän logistiikan kehitysprojektissa ja määritellä toimenpiteet projektin loppuun saattamiseksi. Toinen tavoite oli suunnitella, miten lähtevää logistiikkaa voidaan kehittää edelleen tulevaisuudessa. Tämän työn toimeksiantajana oli ABB.

Tutkimuksen teoriaosassa käsiteltiin lähtevän logistiikan prosesseja. Työssä käsiteltiin myös projektin hallinnan peruskäsitteet. Tutkimukseen tarvittava tieto kerättiin osallistumalla aktiivisesti projektikokouksiin ja keskustelemalla projektiryhmän ja konsulttien kanssa. Työ sisältää myös määrällisen analyysin, johon tarvittava tieto koottiin ABB:n ERP-järjestelmästä.

Tämän opinnäytetyön tuloksena määriteltiin toimenpiteet, joilla kehitysprojekti saataisiin valmiiksi. Toimenpiteet toteutettiin myös käytännössä ja projektin ensimmäinen vaihe tuli valmiiksi. Tämä opinnäytetyö antaa myös ehdotuksia, miten yrityksessä voidaan kehittää edelleen lähtevää logistiikkaa tulevaisuudessa.

Asiasanat: Lähtevä logistiikka, Projektin hallinta, Kehitysprojekti, ERP-Järjestelmä

CONTENTS

TABLE OF FIGURES

ABBREVIATIONS

ABB	Asea Brown Boveri
AS IS	Refers to a process's current state
DDU	Delivered duty unpaid (Incoterms 2000)
EDI	Electronic data interchange
ERP	Enterprise resource planning
FCA	Free carrier (Incoterms 2000)
ICT	Information and communications technology
JIT	Just in time
LAC	Low Power AC, a sub unit of ABB Drives
OTD	On time delivery
PGI	Post goods issue
RFID	Radio frequency identification
SAC	System AC, a sub unit of ABB Drives
TO BE	Refers to a process's future/wished state
WAC	Wind AC, a sub unit of ABB Drives
WIP	Work in Progress
XML	Extensible markup language

1   INTRODUCTION

In recent years, effective logistics management has been recognized as a key opportunity to improve both the profitability and competitive performance of firms. (Grant et al. 2006, p.8) Logistics may be the best source of competitive advantage for a firm because it is less easily duplicated than other elements of the marketing mix: product, price and promotion. For example, forming close, ongoing relationships with carriers or logistics service providers can help give the firm a distinct competitive advantage in terms of speed to the customer, reliability, availability or other customer service factors. The power of logistics in achieving an organization's customer service goals and supporting customer satisfaction has received an increased amount of attention in the press. Companies that understand and utilize the potential of logistics as a competitive weapon include logistics as a key component of their strategic planning process. (Grant et al. 2006, p.24)

1.1   Background

This Master's Thesis is a part of larger development project at ABB Drives. The development project was started in 2007 and the goal of the project was to release space from the factory for new production lines by reformulating the outbound logistics. Outbound logistics functions include packing, storing and transportation of the finished products and handling the export documents and booking the transportation from forwarding agents. The project has been concentrating on developing the processes and the ERP-system.

Also the procedures of the forwarding departments are somewhat outdated and different forwarding departments have different kinds of procedures. By improving and standardizing the procedures the products can be delivered more quickly and smoothly from the factory.

The development project has not been progressing as planned and there have been many problems and errors that need to be corrected before implementation. There is also a need to start planning the next stage of the development project. In this thesis the development project is divided into two phases. The first phase includes completing the unfinished tasks and errors and adding some new features that are necessary to have the processes and software functioning properly. These are actual actions that are being completed during spring and autumn 2009. The second phase refers to plans and suggestions how the outbound logistics at ABB Drives could be developed further in the future.

1.2   The objectives and limitations of the study

The purpose of this Master's Thesis is to document and analyze what has been done in the outbound logistics development project and to define actions for completing the first phase of the project. These actions involve mostly changes in the ERP-system and correcting errors that prevent implementing the new processes and software. Another objective is to plan what could be done in the future to develop the outbound logistics further. Also deliveries from different manufacturing facilities must be considered.

This thesis does not handle daily actions and procedures of packing and forwarding departments, how the products are being packed and working order, for example. Support actions in outbound logistics and user-related problems with the ERP-system are not handled in this thesis.

The theory part of this thesis is limited to theories about developing outbound logistics and project management. The theory of outbound logistics includes the theory about process development, outsourcing, and ICT technology for logistics. The project management part handles basic concepts of project management and introduces a project management model for development projects. These theories were chosen, because they are closely related to the research problem and they

support the empirical part of this thesis by providing guidelines how the processes can be developed and how a development project could be managed.

The main benefit for ABB is to have the project's first phase completed. The actions for further development are suggestions that could be investigated further after the first phase of the project is successfully completed.

This thesis is commissioned by ABB's System Modules unit, but the development project is common to all ABB Drives' units. This thesis will handle the development project as a whole and also the issues that are specific to System Modules unit.

Due to confidentiality issues the project budget is not handled in this thesis. In this thesis referring to ABB means ABB Drives unit in Helsinki, not the whole ABB group.

1.3   Research questions of the study

The main research question is:

"How to complete development project in outbound logistics in an international company manufacturing automation technology products?"

The research problem is complemented with sub questions: What actions are needed? How should the project be managed? How could the outbound logistics be developed further?

Solving the problems related to the ERP system is essential in completing the project. These actions have to be defined and the processes have to be reviewed. The development project was started in 2007 and it is still not complete due to poor planning and project management and unexpected problems with the ERP system. There is a need to find a model how to manage the project systematically and efficiently. The end users must be trained and written instructions must be made. In

addition to solving the practical problems the plans for developing the outbound logistics in future are considered in this thesis.

Main Research question

"How to complete development project in outbound logistics in an international company manufacturing automation technology products?"

Sub questions

What actions are needed?	→	Changes to ERP-system and processes

How should the project be managed?	→	Find a model how to manage the project

How could the outbound logistics be developed further?	→	Plans for future – Phase 2 of the project

Figure 1. Research question

1.4   Research methods

Because the research object is an ongoing project in an organization and the research is made in an actual situation in the organization, this thesis is a case study. The data is collected by using multiple methods and both qualitative and quantitative methods are used. The research is descriptive and it concentrates on processes. A case study is a flexible method, therefore it suits well for researching an ongoing project in its natural circumstances.

The information is gathered by participating actively in the project meetings and brainstorming sessions and discussions with the project team and consultants. Participation is the best method to gather information, because there is very little documentation available about the previous actions made in the project. Also understanding how the ERP-system works and what the processes are like require in-depth familiarizing.

This thesis includes also a quantitative analysis of shipments that is made to support the decision-making in the development project. The analysis gives background information of the volume of the shipments and shipment modes used. Based on this information it is easier to justify the actions suggested to complete the project. The data is gathered from ABB's ERP system and analyzed further in Excel.

1.4.1 Case study

A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context. Case study method is a comprehensive research strategy that covers the logic of design, data collection techniques and specific approaches to data analysis. Case study relies on multiple sources of evidence and they can be based on a mix of quantitative and qualitative evidence. (Yin 2003, pp. 13-15)

In case study the research object is usually practical actions, a process in certain circumstances, in an organization, for example. The goals and realization of case studies vary. A common feature for case studies is that the data is collected in versatile methods and by using several different methods. The case is usually a limited entity and the research takes place in an actual situation that cannot be organized artificially. (Ahonen et al 1994, pp.10-11)

Typical features for a case study are collecting the data in natural circumstances, the data collection methods are humane like interviews, observations and different written documents, the research is descriptive and it does not aim to quantify the data collected, the research concentrates on processes. A case study as a research method is flexible and it is renewing constantly. A case study concerns the present moment, but understanding it requires often examining the past. (Soininen 1995, p.82)

A qualitative case study does not aim to verify a specific, predefined hypothesis. The results of the research process are finding connections between different phenomena, or developing new concepts or deeper understanding of the research object. (Ahonen et al 1994, p.16)

1.4.2 Quantitative analysis

In quantitative research method the information is examined numerically. The research objects and their aspects are described in numerical form. (Vilkka 2007, p.14) The information for quantitative research can be acquired from different statistics, directories or databases, or the information can be collected by the researcher. By using quantitative research the current situation can be surveyed, but the quantitative analysis does not explain the causes sufficiently. (Heikkilä 2008, pp.16-18)

In this master's thesis the information for the quantitative analysis is collected from the company's ERP-system and analyzed in Excel and presented in charts. The quantitative analysis is made to obtain background information to support the decision-making in the development project.

1.5 Theoretical framework of the study

The theoretical framework of this study consists of theories about developing outbound logistics and project management. These theories are closely related to the research question and they support the empirical part of the study.

In the theory part of this thesis issues related to developing outbound logistics processes, like outsourcing and utilizing new technologies available, are handled. The theory part covers also basic concepts of project management and presents a model that can be used for managing a development project.

Theories about outbound logistics, outsourcing and new technologies provide ideas for the empirical part about how to reorganize functions of outbound logistics and how to utilize ICT to make the actions faster and more transparent through the outbound logistics chain. The theory about project management helps to define how the project should be organized and managed and how the project team should be chosen. The development project management model gives clear guidelines how to proceed with a development project.

1.6 ABB

ABB is a leader in power and automation technologies that enable utility and industry customers to improve performance while lowering environmental impact. The ABB Group of companies operates in around 100 countries and employs about 120,000 people. (ABB 2010a)

The ABB group was formed in 1988, when Swedish Asea and Swiss BBC Brown Boveri merged. Asea's history dates back to 1883 and BBC Brown Boveri was founded in 1891. ABB's headquarters is in Zurich, Switzerland. ABB is listed on Zurich, Stockholm and New York stock exchanges. (ABB 2010a)

In Finland ABB has strong expertise in electrical power and automation technologies. In Finland ABB has 6800 employees and the turnover is 2 billion Euro. Approximately 80% of the products are exported, especially to Europe and The Americas, but export to Asia is growing. (ABB 2010a)

ABB has five business divisions: Power Products, Power Systems, Discrete Automation and Motion, Low Voltage Products and Process Automation. (ABB 2010a)

ABB Finland organization

Discrete Automation and Motion Mikko Helinko	**Low Voltage Products** Heikki Uusitalo	**Process Automation** Lasse Mäkelin	**Power Systems** Jukka Soininen	**Power Products** Mikko Niinivaara
Drives Antti Suontausta **MV Drives** Timo Ristola **Machines** Kalle Huittinen **Motors** Mikko Helinko **Robotics** Timo Toissalo	**Low Voltage Switches** Heikki Uusitalo **Low Voltage Systems** Antti Heikkilä **Wiring Accessories** Paavo Tammisto	**Process Industry** Juha Moisio **Marine** Lasse Mäkelin **Turbocharging** Tommi Lassila	**Substations** Jukka Soininen **Power Generation** Mikael Strömbäck	**Distribution Automation** Heikki Mustonen **Medium Voltage Apparatus and Switchgear** Jukka Auranen **Transformers** Keimo Kalliosaari

Product Support Sari Huttunen
Service Kalle Mattila
Domestic Sales Kari Hakkarainen

Country Manager Mikko Niinivaara	**Finance, SCM, IS** Anders Nordström	**Human Resources** Marjut Brander	**Communications** Carita Jern	**Legal Affairs & Compliance** Tapio Metso	**Technology** Kimmo Forsman

Jan 1, 2010

Figure 2. ABB Oy organization (ABB 2010b)

1.6.1 Drives

Business unit Drives is a part of Discrete Automation and Motion business division. Drives consist of four units: management teams, Low Power AC (LAC), System AC (SAC) and Wind AC (WAC). (ABB 2010b)

Drives' products are drives with which the rotation speed of electric motors are being adjusted. Because the motor is used at the right speed that the process requires, a large amount of energy can be saved. (ABB 2010b)

The world largest Drives factory is located in Pitäjänmäki, Helsinki. Because of the growth in past years Drives has become more global and established manufacturing facilities around the world. (ABB 2010b)

1.6.2 System Modules

System Modules is a unit that belongs to System AC. System Modules manufactures and sells low voltage AC drives and supplementary parts for demanding industrial establishments. The biggest customers are in metal industry, marine industry, oil drilling, pumps, fans and cranes. (ABB 2010b)

System modules employs approximately 150 people globally in production, R&D and sales. System modules have manufacturing in three countries; Finland, Estonia and China. (ABB 2010b)

1.7 The structure of the study

This thesis consists of two main parts. The first section, chapters 2 and 3, provide the theoretical framework that supports the empirical part of the study. These theories are essential for this particular project and both issues are discussed in the empirical part.

Chapter 4 describes the development project and the results of an analysis of the deliveries. In chapter 5 the actions for finishing the projects are presented. Suggestions for continuing developing of outbound logistics are presented in chapter 6. Chapter 7 summarizes what has been researched in this thesis.

2 DEVELOPING OUTBOUND LOGISTICS

In this chapter methods and technologies for developing outbound logistics are presented. Also the role of ICT systems in logistics is discussed.

An effective and efficient logistics organization is a vital part of a firm's strategic management process. The problems and challenges that organizations face do not lie primarily with strategic decision-making, but how the systems, networks, formal procedures and processes, and people are integrated and coordinated; the way these interact to create a synergistic system is critical. (Grant et al. 2006, p.290) Logistics has become a part of a company's strategic planning, management and controlling. Every company must develop their strategy and logistics competitiveness factors from their own point of view. (Haapanen et al. 2005, p.15)

Logistics is the management of goods flows and related information flows. The goal is to guide the flow of materials and information throughout the delivery chain. Logistics is comprised of several different processes, such as procurement, shipping, warehousing, terminals, distribution and packaging. (Laamanen 2009, p.64) Logistic process includes a lot of communication between people. It could be said that half of logistics work is administrative work. (Sakki 2003, p.24)

In the past the goals of logistics were connected primarily to cost effectiveness. Nowadays, besides cost effectiveness, attention is paid also to fast lead times and developing customer service. Costs and as a result of costs, the price is still an important factor in competition, but in addition companies want to shorten delivery times, increase the speed of distribution and reaction, make sure that the delivery arrives on time etc. Logistics is not just "save money" action; it is an important part of customer oriented service strategy. (Sakki 2003, p.25)

In logistics the networking of businesses from raw material supplier to the end customer is often looked at in forms of order-delivery chain. The function of the chain is usually tried to improve by fastening the deliveries, reducing storage and allocating resources. Often also problems in communication and possibilities of IT are considered when aiming at more accurate planning and controlling in different stages of the order-delivery chain. The most recent applications are solving the problems of cooperation by forming partnerships and by creating contract and incentive systems that tie different parties. (Haapanen et al. 2005, p.123)

The greatest unused result- and savings potential of logistics application seems to lie behind networks of organizations conceptually in direct, but institutionally difficult structure changes. (Haapanen et al. 2005, p.125)

2.1 Developing logistics processes

A business process is a series of steps designed to produce a product or service. Most processes are cross-functional, spanning the "white space" between the boxes on the organization chart. A process can be seen as a value chain. By its contribution to the creation or delivery of a product or service, each step in a process should add value to the preceding step. (Hunt 1996, p.3) A business enterprise is only as effective as its processes. Business goals can be achieved only through development of logical business processes. (Hunt 1996, p.5) The only way to succeed is to understand, map, and change (where needed) your strategic processes so they can be improved from end to end to significantly improve your business. (Hunt 1996, p.30)

A key factor in function and organizational boarders crossing processes is to define those based on what is considered core business and what is considered support functions. Customers and owners are defined for the processes and their efficiency can be improved radically. (Haapanen et al. 2005, p.176)

In developing logistics, it is important to consider how many suppliers there are in the supply chain, how much overlapping work is done and how that could be reduced, which part of the work brings added value to the company and which part is just a cost. Developing logistics is above all developing of cooperation both inside the company and with the suppliers and customers. In logistics processes there is always a great potential to improve the productivity of capital and labour. (Sakki 2003, p.25)

The goals of developing logistics can be divided into two main parts:

1. External a.k.a. service efficiency: The continuous improvement of actions so that the customers are served more solutions than before instead of just products. The customers are being helped to add their own internal and external efficiency.
2. Internal a.k.a. cost efficiency: Avoiding unnecessary handling, decreasing storage level; and in a wider sense continuous improvement of capital productivity.

Internal and external processes should be developed simultaneously. If a company concentrates only on developing internal processes, it does not necessarily take into consideration the needs in external processes. Then internal processes may have to be changed later. (Lukka et al. 2006, p.12)

The goals of process management do not differ from the goals of common principles of management that are good financial result, customer satisfaction, high productivity and satisfaction of a company's own personnel (Sakki 2003, p.30)

The companies have sought after cost savings by standardizing processes through economies of scale. Form the information management point of view standardizing processes is essential. Standardized processes produce also standardized information, which is easier and cheaper to manage than not standardized

information. By utilizing ICT a company gains a better control over the processes, faster communication, smaller communications costs, continuous flow of information, standardized communications procedures, integrated processes and fewer errors. (Lukka et al. 2006, p. 12)

The ways that are related to process management to achieve the goals differ significantly from previously used ways. In the past the emphasis was concentrated on cost efficiency, now besides that, speed and flexibility are considered as important. Earlier it was important to achieve personal goals, now it is important that the organization networks and develops the networking. When earlier the suppliers and customers were not considered that important, now they are considered partners. (Sakki 2003, p.30)

Probably the most significant change in the ways of thinking is that when earlier the work division and development was based on organizational unit and its functions, now it is based on the processes cross-organizational borders. The goal is to describe the business logic of an organization as processes and develop these processes. As a result of this development work, the customers get better service, actions that are not adding value are eliminated from the chain and the company's own personnel understands and masters the entity of the company's own business. (Sakki 2003, p.30)

The changes have led to: (Sakki 2003, p.30)
- Shifting from function oriented to process oriented organizations
- Shifting from company oriented to developing cooperation between companies
- From measuring internal efficiency to measuring external efficiency
- From personal goals to team goals
- From looking at the past to forecasting the future

2.2   ICT systems in logistics

For every movement of goods, a large amount of information is needed. Improving handling and distributing information is as important as utilizing new technologies in materials handling and transporting. Rapid and accurate information exchange is a prerequisite for fast and correct materials delivery. (Sakki 2003, p.171) ICT is an essential part of a company's supply chain. Many companies still have much to improve in their internal supply chains and processes. (Lukka et al. 2006, p.15-16)

ICT applications add value to processes efficiency, integration of supply chains, data management. The processes will be faster and the IT system forces everyone to work in a similar way. There will be less errors and reporting will be more efficient. (Lukka et al 2006, pp.15-16)

ICT is most often seen as support function to the business and it is used to achieve cost cuttings. ICT has an essential role in process development and because of that process and IT system development should be developed side by side. No matter how good a new ICT application a company implements it does not add value unless the users are not able to utilize it in an optimal way. (Lukka et al. 2006, pp.60-63)

Every company has its own IT system and the actions are concentrating around the IT system. When developing actions, the inflexibility of the IT system is often a problem that slows down the development. Introducing new working methods is held back by the IT system, because it cannot be changed to respond the new needs. (Sakki 2003, p.180)

Controlling a chain of actions that goes through many companies is a big challenge for IT-systems. Even though communication and controlling works well inside the company, the IT-systems usually lack abilities for cooperation between two companies. The existing IT-systems are constructed based on the company's

internal needs and they lack ability to communicate between different systems. Adding that ability is at the moment an important goal when developing IT-systems. (Sakki 2003, p.180)

2.3   Outsourcing logistics

There is a trend that businesses concentrate on their core business and as a result of that functions, like logistics, are outsourced. Logistics has become an important competitive advantage. A growing number of supply chains compete with each other and the efficiency of the supply chains determines a company's success in business. By outsourcing logistics a company seeks to improve functionality and efficiency and that way increase the competitiveness. The benefits gained by outsourcing are greater flexibility, better service level, cost cutting and freeing capital that is tied to logistics. (Jalanka et al. 2003, p.10)

Outsourcing logistics means shifting actions like transportation, materials handling, storing and the IT that controls these functions, in logistics value chain to a company that is specialized in producing these services. (Sakki 2003, p.206) Nowadays the cooperation is not just buying certain services, it is developing more towards a partnership between the companies. (Jalanka et al. 2003, p.8) By outsourcing otherwise fixed personnel and space costs to variable by volume. A logistics service provider's essential success factor is the ability to control the resources in relation to the volume and use their personnel efficiently in action of different customers. (Sakki 2003, p.208)

Typical reasons for outsourcing are that a company does not have adequate space or equipment to handle logistics operations, a company cannot or does not want to invest in space, IT-systems or its own expertise, the company is not willing to learn new functions or is willing to give up a function, a company wants to change fixed costs into variable costs, for example. (Jalanka et al. 2003, p.11)

If a company's own competence in logistics can be insufficient from different reasons, it is useful to consider outsourcing logistic functions. (Sakki 2003, p.208) For a logistics service provider operating logistics functions is their core business. The service provider has equipment, processes and personnel that are specialized in logistics functions. The service provider is also able to utilize economies of scale in their business. (Jalanka et al. 2003, p.10)

Cost savings are achieved by streamlining activities and by using the workforce more efficiently. The service provider usually has more efficient working methods and better possibilities to manage high- and low peaks. But if the logistics is given to the service provider without any development work, the possibility for savings is not very good. A company should not give a function to a logistics service provider just because the function is seen complicated or unwanted in the organization. (Jalanka et al. 2003, p.11)

Factors that hinder outsourcing logistics are dependency, lack of trust and fear of losing control over the outsourced activities and if logistics is the core business of the company, it should not be outsourced. (Jalanka et al. 2003, p.11)

If the outsourcing is done the right way, both parties benefit from it. The partnership must be based on trust. Both parties have to give exact information to the other party and sometimes that information may be confidential. (Jalanka 2003, pp.11-12) Two-way information sharing, joint problem solving, the partner's ability to meet performance expectations, clearly defined and mutually agreed goals and mutual involvement in relationship development and planning are factors that makes outsourcing successful. Formal performance evaluation of the partner is also important. (Qureshi 2007, pp.693-694)

Outsourcing logistics may also cause disadvantages and extra costs. The disadvantages are usually caused when the outsourcing is poorly planned. Personnel problems, if the personnel is moving to work for the outsourcing

company and poor communication and lack of control are other typical problems. (Sakki 2003, p.209) One major challenge in outsourcing is the integration of the IT-systems. (Jalanka et al. 2003, p.13) Unclear goals and unrealistic expectations and flaws in the contractual agreement linking the parties involved are other typical problems with outsourcing. (Qureshi 2007, p.690)

If a partnership fails the reason is often the unbalance between the partners, the more powerful party may use the weaker party. The ideal is that both parties are equal partners and both benefit from the cooperation. (Jalanka et al. 2003, p.13)

Outsourcing is a big, strategic decision and the management and whole personnel must commit to that. Outsourcing cannot be left for the outsourcing company's responsibility; the outsourcer must be actively involved in the project. Developing the partnership requests significant input also for the outsourcing organization both in short and long-term. (Sakki 2003, p.209) Taking back the outsourced functions is extremely difficult. Also changing the partner is a very laborious and expensive procedure, so input in preparation the outsourcing and maintaining the cooperation are important. (Sakki 2003, p.212)

2.4   RFID Technology

RFID stands for Radio Frequency Identification, a term that describes any system of identification wherein an electronic device that uses radio frequency or magnetic field variations to communicate is attached to an item. (Glower & Bhatt 2006, p.1)

In a typical RFID system objects are tagged with tiny radio transponders that carry certain data about the objects. The transponders (tags) transmit this data, through radio waves, to nearby readers, which collect and process the data accordingly. These transactions between RFID tags and readers enable a multitude of applications that require efficient detection, identification, and tracking of objects. (Bhuptani & Moradpour 2005, p.4)

The two most essential components of an RFID system are the tag, which is the identification device attached to an item, and the reader, which is a device that can recognize the presence of RFID tags and read the information stored on them. The reader can then inform another system about the presence of the tagged items. The system with which the reader communicates usually runs software that stands between readers and applications. This software is called RFID middleware. (Glower & Bhatt 2006, p.1)
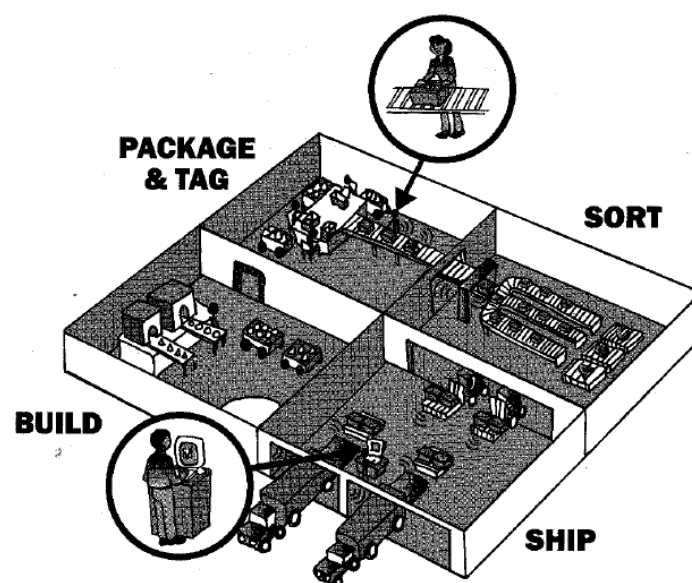

Figure 3. Possibilities to utilize RFID-technology (Bhuptani & Moradpour 2005, p.17)

2.4.1 Utilization of RFID Technology

RFID technologies offer practical benefits to almost anyone who needs to keep track of physical assets. Manufacturers improve supply-chain planning and execution by incorporating RFID technologies. Retailers use RFID systems to control theft, increase efficiency in their supply chains and improve demand planning. Machine shops track their tools with RFID to avoid misplacing tools and to track which tools touched a piece of work. RFID-enabled smart cards help control perimeter access to buildings. Many retail chains and consumer goods

manufacturers have begun testing pallet- and case level merchandise tagging to improve management of shipments to customers. (Glower & Bhatt 2006, pp. 2-3)

In shipping and distribution industry RFID technology enables suppliers determine the location of a pallet accurately and track its way through the supply chain. In manufacturing sector RFID technology can be utilized in many ways. It can be used for example to tracking mechanisms to ensure accuracy. Parts can be individually tagged and tracked throughout the manufacturing process and parts received from the production plant can be tracked throughout the assembly process. This helps manufacturers that have just-in-time (JIT) assembly lines. (Attaran 2007, p. 253)

Tracking and tracing objects is one of the most common applications of RFID to help improve process efficiency and reduce overhead costs. Automated tracking devices for inventory control in factories and warehouses have the primary advantage of lowering costs by reducing the amount of manual work and operations. There are certainly other means of achieving automated tracking besides RFID. The most common is barcode technology. However, there are several major advantages that RFID technology offers beyond barcodes. RFID requires no line of sight. RFID tags can be read at much greater speed than barcodes, regardless of the orientation or placement with respect to the reader. Depending on the underlying RFID technology, much longer read ranges of up to several feet or more an be achieved, compared to a barcode's read range, which is typically measured in inches. Barcodes are a read-only medium. RFID tags that have write capability offer an added benefit of acting as small, mobile databases that can store data instantly. Barcodes can be destroyed easily or removed and cannot readily be applied to all substrates. (Bhuptani & Moradpour 2005, pp.16-17)

Supply chain integration is essentially the most extended application of tracking and tracing. It encompasses the tracking of literally anything in a supply chain, including raw materials from various suppliers, to manufacturing, and all the way to

final delivery of a product to the end user. In the supply chain, there are numerous, seemingly unrelated, business entities involved in processes that get the item to the next link in the supply chain, closer to the end user. Capturing and integrating data about the location and history of an item in the supply chain can help create more efficient workflow and error-free processes. RFID technology is an ideal enabler to help track the movement of products through the links in the supply chain, inspect and analyze the data collected from RFID tags, act upon the data, and potentially add or associate more useful data to the tags that can be used at the next link in the chain. (Bhuptani & Moradpour 2005, p.20)

Most of today's RFID-enabled supply chain solutions look at applying RFID between only two points (only one link) in the chain, fully integrating the links in the supply chain is recognized as the real value liberator. The more processes in the supply chain that can be integrated through RFID-collected data, the greater the potential for improvement in efficiency. This is the ultimate power of RFID. Sourcing and procurement, packaging, distribution, inventory control, forecasting, transportation, and logistics are all process common to many supply chain operations. Linking these up to all the business and integrating all the processes in the supply chain is the challenge for the next decade. (Bhuptani & Moradpour 2005, p.21)

2.4.2 Implementing RFID technology

When implementing RFID technology, the technology requirements must be aligned with the business requirements. It may mean that the business processes may have to be changed to adapt to the technology. Business processes have to be examined in the light of the technology and its capabilities. RFID application must be implemented to meet organizational business goals. (Reyes & Jaska 2007, p.572)

Before making the decision to implement RFID technology the company must understand what RFID can and cannot do. The present system and processes must be analysed. It is also useful to analyse the potential benefits that could be reached with RFID and also analyse the requirements and how RFID will be implemented. Before implementation the proposed RFID system must be tested. After the implementation the RFID system must be monitored and to make sure that it meets the expectations and also looks for improvements to processes and possible technology changes. (Reyes & Jaska 2007, p.573)

Although RFID is a natural enabler for supply chain integration, several intermediate issues must be addressed before RFID can realize its full potential in the supply chain: (Bhuptani & Moradpour 2005, pp.21-22)

- **Serialization** Most supply chain processes and applications are designed today to work with barcode technology. As such, they do not have a concept of a unique identifier for each instance of a product/item. As a result, business processes and their associated software applications will have to be redesigned to address the concept of unique identifiers before they can fully benefit from an RFID-enabled system.
- **Data synchronization** involves the complete, accurate, and timely updating and reporting of product/item data exchanged between trading partners in a supply chain. Historically, this has been an issue between trading partners such as consumer packaged goods manufacturers and their retail counterparts.
- **Standardization** Supply chain integration, by definition, requires cooperation and communication between a diverse set of hardware components and software applications and among many different trading partners. Standardization is the only effective means of satisfying this requirement in an efficient and cost effective fashion. Additionally, both serialization and data synchronization can largely be addressed through adherence to standards.

There are challenges in implementing RFID technology. It has to be understood that the business benefits RFID technology promises do not show immediately. There must also be incentive for suppliers and manufacturers to adopt the technology. The price of RFID tags is dropping, but the tag system is still more expensive than bar code system. RFID system also generates a huge amount of data that the IT system must manage and store. Integrating RFID with existing SCM and ERP applications is a challenge for IT specialists in companies. Also security and privacy policies must be considered. (Attaran 2007, pp.254-255)

2.4.3 Benefits of RFID

Using RFID offers many benefits that save time and effort. Alignment is not necessary because the scan does not require line of sight. This can save time in processing that would otherwise be spent lining up items. Multiple items can be scanned at the same time. As a result, the time taken to count items drops substantially. RFID tags range in size from blast-proof tags the size of lunch boxes to tiny passive tags smaller than a grain of rice. These different form factors allow RFID-technologies to be used in a wide variety of environments. Some types of tags can be written or rewritten many times. In the case of reusable container, this can be a big advantage. (Glower & Bhatt 2006, p.5)

Main benefits of RFID are: (Zare Mehrjerdi 2008, p.236)

- Improved speed and accuracy for tracing pallets, cartons and containers
- Reduced stock levels
- Reduced operating costs
- Improved inventory management
- Improved efficiency in WIP reporting
- Improved inventory visibility to feed JIT systems

Wal-Mart can be considered a pioneer in using RFID technology. The management of Wal-Mart believes that RFID system can help them reduce the labor costs, reduce inventory costs, reduce human errors, increase revenues by limiting shortages and increasing the overall efficiency and productivity of their supply chain. (Zare Mehrjerdi 2007, p. 235)

Utilizing RFID technology brings processes efficiency resulting from improving visibility in the supply chain, brings cost savings to more than one business because there are potentially dozens of businesses involved in the handling of goods through a supply chain. Ultimately, these cost savings can be translated into benefits that positively affect the end user/consumer and as a result an entire industry. (Bhuptani & Moradpour 2005, p.22)

3 PROJECT MANAGEMENT

In this chapter the basic concepts of project management are presented. This chapter presents also the Gate model for managing projects. The gate model is commonly used at ABB for managing development projects.

A project is an endeavour that has a definable objective, consumes resources, and operated under time, cost and quality constraints. (Kerzner 2004, pp. 1-2) Project is a group of people and other resources that are gathered together temporarily to perform a certain mission. A project must have a clear goal or a set of goals. In addition a project has fixed budget and schedule. (Ruuska 2008, pp.19-20)

Project is a logically limited entity. The responsibility is focused on one point, even though several interest groups are included. Achieving the goal of the project requires teamwork. The members of the project team can represent different organizational units. A project is unique. There should not be two similar projects. It is typical that during its lifecycle a project experiences several changes. The results from previous phases affect next phases. Every project contains risks and uncertainty. If a project is not well planned and limited the likelihood of risks grow. (Ruuska 2008, pp.19-20)

Project management can be defined as the planning, scheduling, and controlling of a series of integrated tasks such that the objectives of the project are achieved successfully and in the best interest of the project's stakeholders. Effective project management requires extensive planning and coordination. (Kerzner 2004, pp. 1-2)

Working in a project includes project meetings, continuous communication with the interest groups, milestones and checkpoints which help the project manager to keep the project within the scope, action plans that show what must be done in the

project and who and when is going to perform these actions, work- and responsibility division between the project team. Documentation must be made throughout the whole project. (Lööw 2002, p.17)

3.1 Project organization

The project organization is used one time only. The basic organization delegates a certain task to the project. The project is responsible for the basic organization of achieving the goal with the agreed resources. Managing by goals and exceptions, and flexibility and temporality is characteristic to a project organization. The size of the project organization can vary largely based on which phase the project is in. People may come to perform a certain task in the project and when the task is done they leave the project organization or move to another task in the project. A prerequisite for a well functioning project organization is that the responsibilities and authorizations are defined and that qualified experts are available for different tasks in the project. (Ruuska 2008, p.21)

A typical project organization consists of a sponsor, steering group, project manager, project team and support/reference group. (Lööw 2002, p. 29) The sponsor is a person who decides that the project is started. The sponsor nominates a steering committee for the project and chooses the project manager. (Ruuska 2008, p.21) The steering group decides about the goals of the project and defines the settings and resources. The steering group makes decisions about schedules, resource plans and budget. The steering group accept the project's moving to the next stage. (Lööw 2002, pp.29-30) The project group consists of experts that are responsible for their own areas in the project. (Ruuska 2008, p.21)

The project manager must be able to plan and manage the project and motivate the project team. The project manager aims for that the project team makes the needed procedures to achieve the goals of the project. The project manager must use the resources given in the best possible way to achieve a successful result.

The most common tasks of a project manager are: dividing and managing the work, inviting the project and reference group to meetings, making the project plan, responsibility for achieving the goals, reporting to steering group and following and checking procedures between the project meetings. (Lööw 2002, pp.30-31)

The project group is the "motor" of the project that makes sure that the project reaches its purpose and goals. The project group is responsible for the actual realization of the project tasks. The most important task is to hold on to the plans and report to the project manager if there are any problems. The project group is responsible for communicating the results for the organization. (Lööw 2002, p. 31)

3.2 Factors affecting success or failure of a project

A successful project has a clear structure, preferably a full-time project manager, clear assignment, enthusiastic workers, common goals for everyone, clearly stated expectations, roles and work division, taking into consideration the values of the participants, good planning, dividing the goals into legs, restructuring the goals if needed, continuous communication and familiarization, decision making based on good-quality information, follow up for results and milestones. (Lööw 2002, pp. 18-19)

Factors that may cause failing of a project are inadequate planning, the project is too confusing, the project is proceeding without steering group checking if it is proceeding according to the project plan, project manager is unable to motivate the project team, the scope of the project is not clear, the project team is too homogenous, the project is too big. (Lööw 2002, p.19)

If a project fails it is usually because of lack of control and inappropriate methods, most difficulties in a project come from poor organization and planning. Then the project team, a group of experts, is not functioning as an entity and the project fails to reach the wanted goal. (Ruuska 2008, p.41) Simply organized, small enough and goal oriented project team is better than a big project organization where the

project team is participating in the project and having other tasks outside the project at the same time. (Ruuska 2008, p.45)

Project work has quick tempo and it is tied to tight schedules. The project group must be able to work as a team efficiently to achieve the goals that are set for the team. It is not wise to choose the best person to a certain task in the project organization, the most appropriate person must be chosen. The most appropriate person is a person that is able to work in a team and whose motivation and abilities are in the right proportion compared to the demands of the task. If there are conflicts between the members of the project team it can reflect to the action of the whole group. (Ruuska 2008, p.47)

3.3 Project management systems

An organizations project management performance consists of elements that affect the company's project management performance and investments. The elements are: (Eve 2007, p.88)

- *Methodology and tools.* Structured methodology and documentation should be simple to use across all levels of the organization and it should be effectively applied in operational use.
- *Competence and career.* One of the biggest investments for a company is its employees. The project management competency required must be defined, measured, understood and developed to a visible career structure that has formal recognition, status and reward.
- *Mentoring, coaching, intervention and training.* The project manager and the members of project team need coaching and mentoring during the project.
- *Management development.* Development of management is also important, because the management must be able to support the project managers and project team and act as mentors for them.

A simple and effective thing that the management of a company can do to improve and support projects is to set put the company's policy for project management. This way there is a clear vision of how the company can utilize project management concepts. A company cannot get maximum value from project management unless it concentrates on the big picture. The vision for project management must be described. The tools and procedures for project management must be established. Project management competences must be identified and developed at all organizational levels. (Eve 2007, p.89)

3.4 Gate Model for process development projects

The Gate Model is a tool that helps decision makers to make objective, fact-based decisions on whether a project should be allowed to start or continue or if it should be terminated. The model also provides transparency regarding project status and progress. The gate model is used to ensure visibility for management and provide management assurance and support for project managers in process development at key milestones within the project. The model provides facts for decisions, aims to minimize time of completion and cost of poor quality, it also ensures organizational readiness and uses common terminology in project status follow up. The Gate Model does not describe how to execute the project; it describes what has to be done to enable business risk and investment decisions making. (ABB 2009)

A gate is a decision point in a project where the achieved results are evaluated from a business and strategic point of view and the business case is reassessed to determine whether to continue the project or not. Decisions are taken to go, go with action items, rework or no go – cancel the project. The objective of gate meetings is to ensure that a project is still feasible and that the management and project manager are aligned to the objectives for the next phase and overall project goals. (ABB 2009)
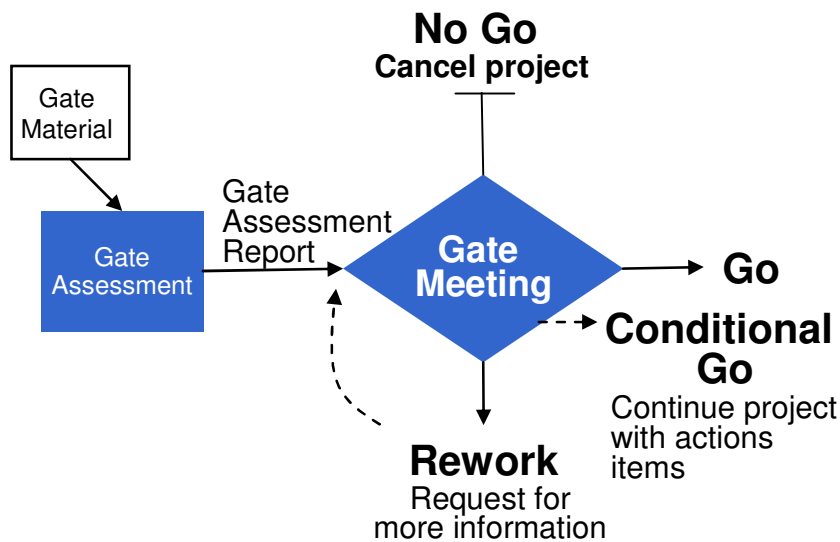
Figure 4. The Gate definition (ABB 2009)

A decision to continue may include changes to the project such as changes in scope or time plan. Any decision to proceed will include appropriate financial approval from management. (ABB 2009)

There are seven gates in the model. Gate 0 (G0) is the agreement to start a project. G0 identifies the existing challenge and estimate the opportunity and purpose of the proposed project idea. Gate 1 (G1) confirms the project scope, objectives, budget and timeline. G1 initiates project planning. Gate 2 (G2) starts project execution. Commitment on project execution plan is made and it is checked that the project execution plan is described in sufficient detail to proceed. At G2 a pilot solution can be implemented. Gate 3 (G3) confirms that target dates can be met and that the project progresses according to plans. Between G3 and G4, the focus is on going live with the pilot, running it, and making changes if needed. Gate 4 (G4) is the verification from the pilot that the solution design will deliver the desired project goals. At Gate 5 (G5) agreement on readiness to release project results and handover the project to the receiver should be obtained. G5 also

indicates that the project activities should be finished. Focus in the period to G6 is on resolving any remaining issues and finalize the project final report. Gate 6 (G6) confirms that the project results are stable, have been successfully transferred to the organization. G6 closes the project. Gate 7 (G7) evaluates the project results and verifies that they are sustainable. G7 also confirms that lessons learned have been captured and shared throughout the organization. Major investment decisions are typically made at G2 and G5. Infrastructure investments are typically made at G4. (ABB 2009)

Each gate consists of two parts; a gate assessment and a gate meeting. The gate assessment is prepared by the project manager and conducted by the gate assessor, who is nominated by the steering group, to ensure that all relevant information is available to enable decision-making at the gate meeting. The purpose of the gate meeting is to confirm actions, not to analyze those; any analysis and review should be done prior to the gate meeting. Checklists for each gate are provided to assist this process. (ABB 2009)
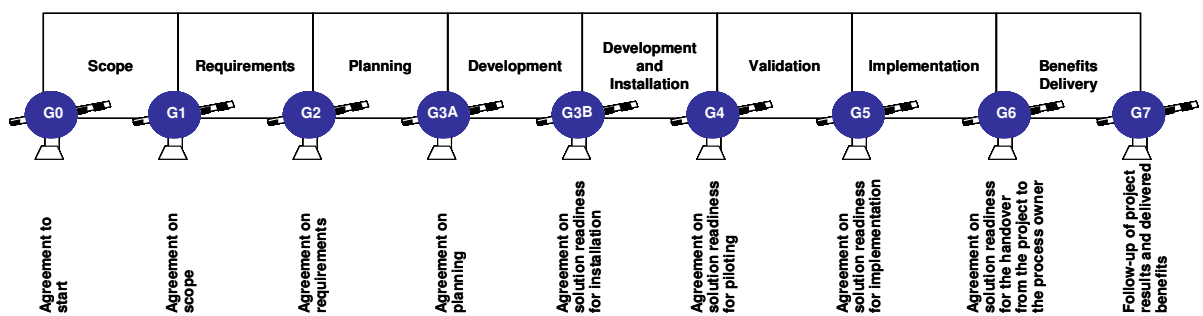

Figure 5. The Gates, the phase names, and the achievements for each Gate (ABB 2009)

4   THE DEVELOPMENT PROJECT

The development project for outbound logistics was officially started in January 2007. The project involves all units of ABB Drives (LAC, SAC and WAC). The main goal of the project is to release space from factory by reformulating outbound logistics. This means that the processes of different departments must be unified. This is challenging, because so far every unit has had its own procedures and also the products are different.

Outbound logistics functions include packing, storing and transportation of the finished products and handling the export documents and booking the transportation from forwarding agents.

Before the official launch of the project the current processes were described on process flowcharts. After that the project team started to plan the future processes by making a to be-process flowchart. In a very early stage it was clear that the ERP system needs to be modified to support the new processes. It was also decided that ABB will acquire RFID system for outbound deliveries.

After planning the processes the project has concentrated mainly on the software. IT consultants were used for making technical specification for the software. The consultants were also helping when the software was tested. Testing the software has taken several months, because a lot of errors and needs for improvements were found. When the software was tested in practice even more errors and problems were found. Fixing the errors has taken a lot of time and effort for both ABB personnel and the consultants.

The new system shifts part of the forwarding departments' work to the employees who are packing the finished products. The employees must be trained well for the new task and there must be good and clear instructions and a person or persons who can give them support with the software.

4.1 Starting point

At the beginning of this research the new processes and software are partially used in different units. There are still many problems with the software. Analyzing and fixing the errors is very time consuming. Another problem was that there is no project manager. Decision-making is difficult without anyone who is in charge of the project. Also the project meetings have been chaotic and no further development has been made for 6 months. The motivation of the project team is getting very low, because of the uncertain situation.

The actions of the project have not been documented. Only some process flowcharts from the beginning of the project are available.

4.2 Starting point in System Modules unit

In System Modules unit the software is used in the department that is packing the spare parts that are delivered with the modules. The transaction for packing is used and the RFID labels are printed on the packages, but the RFID readers cannot be used. There are RFID readers only for truck deliveries to Europe and a large part of system module's products are shipped by airfreight.

There are also problems with the RFID readers because the material data in ERP-system is not up to date. There are problems with storage locations of the materials and that is why the RFID reader cannot make the storage location movements as it should when the packages are taken through the readers.

In module packing the new software is not used at all. There are several reasons for that. The packing area for modules has been moving many times, so it has been impossible to assemble the equipment needed for using the new system. Training the employees is also a big challenge. Packing services are outsourced

and the employees are not very motivated. There are also language barriers because the employees come from several different countries.

There is also a problem with the module packages and with module-filter packages. There are certain modules that are sold as a package that contain 2-12 modules or packages that contain modules and filters. Neither the current nor the new system supports packing of these module packages. That issue must be solved before the modules can be packed using the new system. This is quite a complicate issue and it has been excluded from the development project.

4.3   The process AS IS

Figure 6 is the simplified description of the process' AS IS-state. AS IS refers to the process' current status. For more detailed process flowchart see appendix 1.
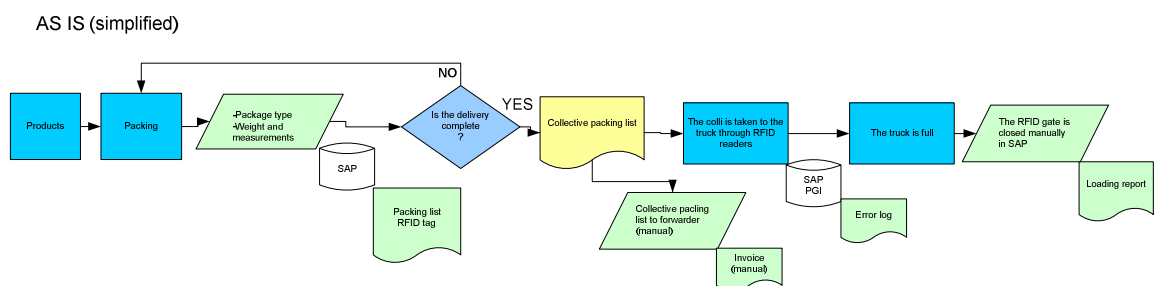

Figure 6. The Process AS IS

When the products are ready, they are packed and the packing information, package type, weight and measurements of the package are entered into the system and packing list and RFID label are printed and attached to the package. Then the package is taken to the truck through RFID reader. The reader reads the RFID label and adds the package to the truck's loading report and makes the post goods issue (PGI) if the delivery is complete. PGI removes the material from factory's stock. PGI is an important indicator to the factory, because it is used for

measuring on time deliveries (OTD). When the delivery is complete a collective packing list is printed to the forwarding department. The forwarding department makes then invoice and sends the collective packing list to the forwarding agent. When the forwarding agent gets the collective packing list or invoice in case the delivery goes outside the EU, they know that the delivery is complete and that they can send it to the customer.

When the truck is full at the factory, the RFID reader is closed manually in ERP system and a loading report is printed. The loading report contains information of the packages that are loaded on the truck. There is an error log in the system that must be checked if the RFID reader informs about an error when it tries to read the RFID label. The errors must be cleared before the RFID reader can be closed and the loading report printed.

At the moment this system is used only with truck deliveries to Europe.

At the moment System Modules is using only the part of the new process that is described in figure 7.
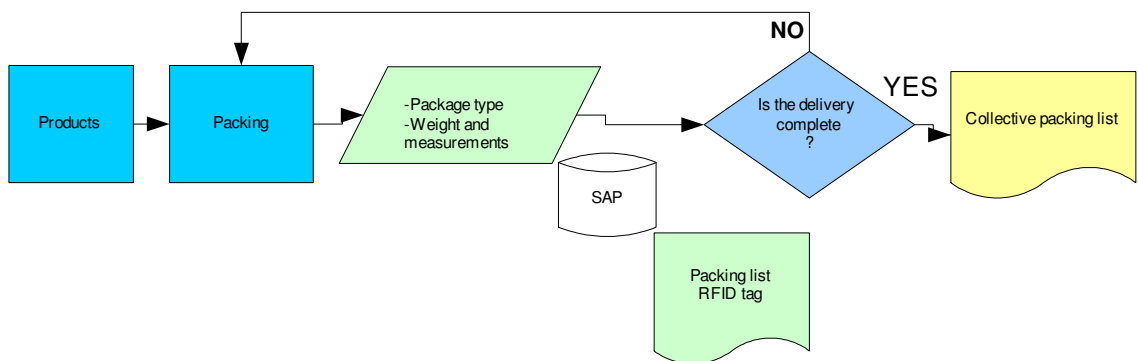
Figure 7. The process AS IS in System Modules

System Modules cannot utilize the RFID readers and the PGI has to be made manually. Manual PGI causes an error when the package is taken through RFID

readers, because the reader tries to read it and make the PGI even though it is already made. The RFID reader also tries to make the stock transfer and if there are materials that are sold from free stock, those are transferred even though those are already taken from the Factory's storage balance when the PGI is made. This causes faulty storage balance and confusion. The RFID reader also reads the package to the loading report, even though a manual shipment has been made already. This causes problems to the forwarding company because they have double reporting of the incoming packages. It has been confusing for them and clearing issues like this has taken much time from the forwarding company and ABB.

4.4 Analysis of deliveries

An analysis of deliveries was made to support the decision making in the development project. The purpose of the analysis was to provide background information about the deliveries. The deliveries were analyzed by transportation mode and then each transportation mode was analyzed further by different forwarding companies used. The data for the analysis is retrieved from ABB's ERP-system for period from 1.7.2008 to 31.12.2008. During that period over 46 000 line items were delivered.
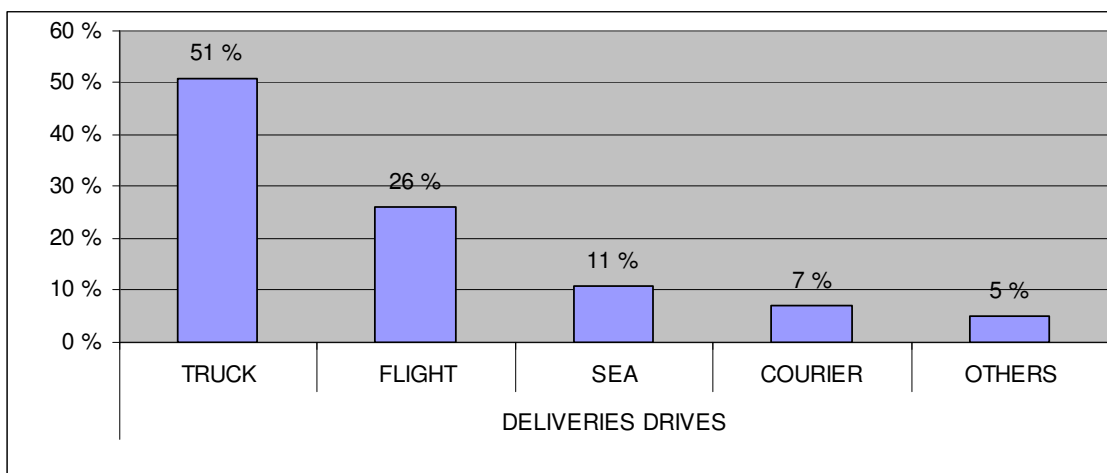

Figure 8. Deliveries in ABB Drives

Figure 8 shows how the deliveries are divided by different transportation modes in ABB Drives. More than half of the line items are delivered by truck. Flight and sea deliveries together are almost 40%. For the rest different courier services are used. Category others refers to shipments that customers are picking up from the factory themselves. Most of these are deliveries between ABB's different units.
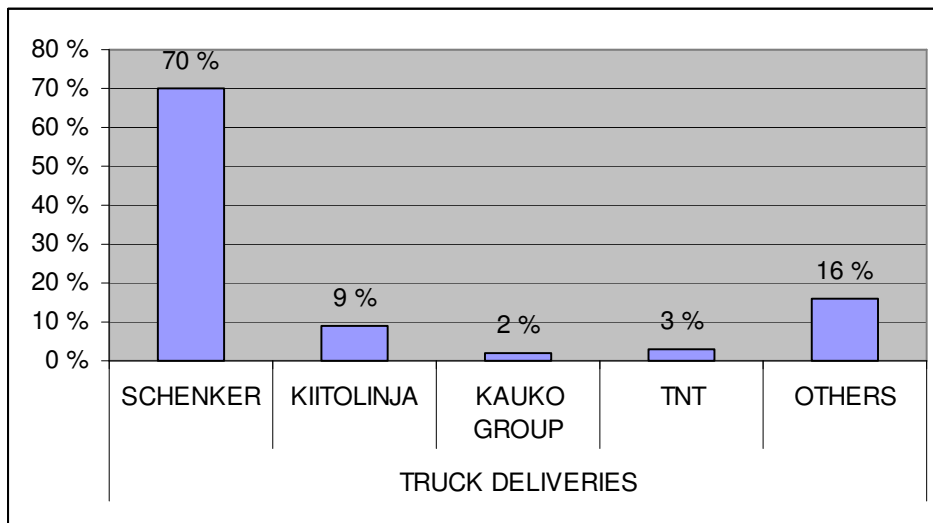

Figure 9. Truck deliveries in ABB Drives

As figure 9 shows Schenker is used for most truck deliveries. These are DDU-deliveries to Europe. For most customers in Europe the delivery term is DDU. When the delivery term is DDU, ABB chooses the forwarding company.

The co-operation with Schenker is well operated. There is a trailer at ABB's loading dock that Schenker comes to pick up four times a day. RFID-readers are used for these deliveries.

Kiitolinja is used for deliveries to Finland. At the moment Kauko Group is used for deliveries to Turkey. TNT offers a service that is something between normal truck delivery and courier delivery. It is used for urgent deliveries that are too big (in weight and volume) to be delivered by courier.
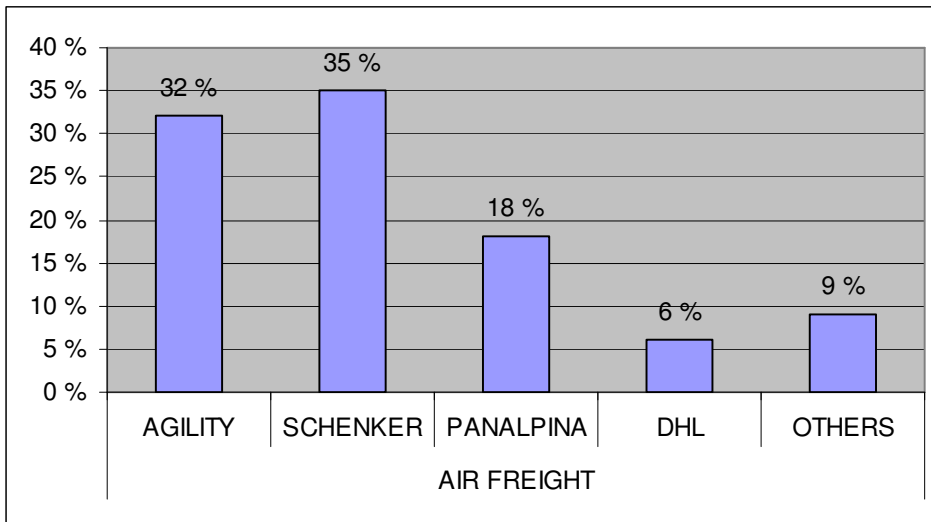
Figure 10. Air deliveries in ABB Drives

There is a large variety of forwarding companies for air deliveries. The reason for that is that when the delivery term is FCA, the customer chooses the forwarding company. Most of air deliveries go outside Europe.
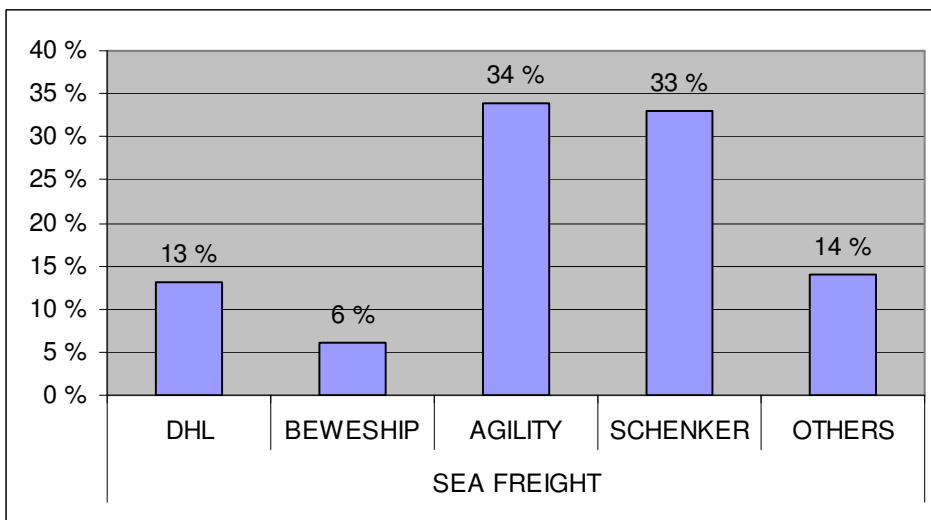
Figure 11. Sea deliveries in ABB Drives

Also sea deliveries are FCA-deliveries and because the customer chooses the forwarding company there are many different companies. Often the customers are

not using the same company, because they are asking for offers from forwarding companies separately for each delivery

Figure 12. Courier deliveries in ABB Drives

DHL is used for most courier deliveries. It is easy to use because ABB's ERP-system is integrated with DHL's IT-system. The Air waybill labels can be printed directly from ABB's ERP-system. DHL has also daily pick-up from the factory.

Figure 13. Deliveries in SAC and WAC

Figure 13 shows how the deliveries are divided by different transportation modes in SAC and WAC. Compared to deliveries in the whole ABB Drives SAC and WAC use more air- and sea freight. Otherwise the same forwarding companies are used and their division is mostly the same.
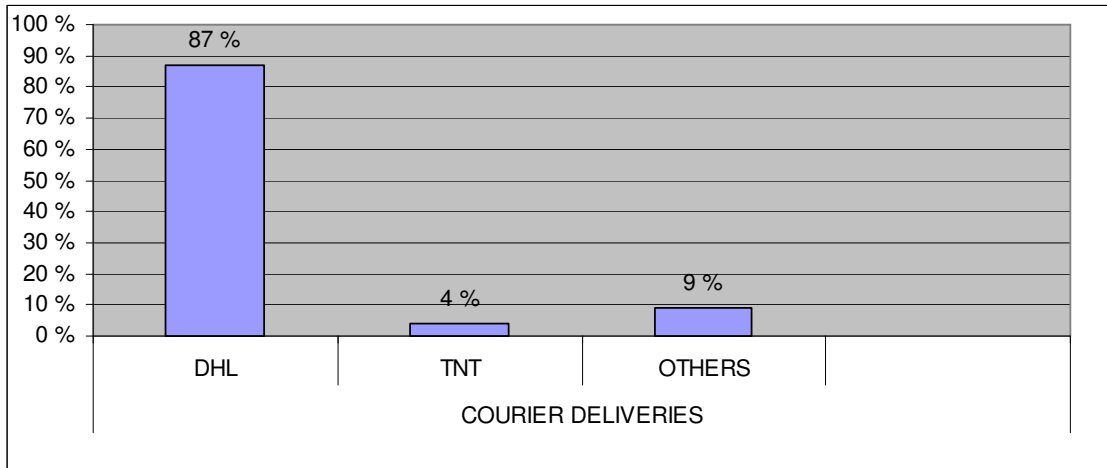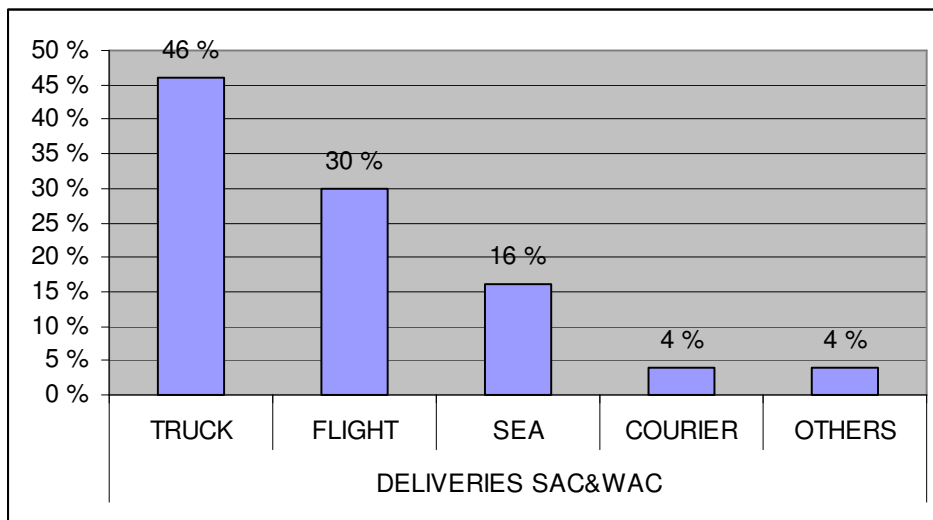
Because airfreight is the second largest group, the next step should be to create a similar process for air deliveries that truck deliveries have. There should be RFID-readers also for air deliveries, possibly also a trailer where the packages could be taken directly when those are packed.

It can be seen from the charts that there are two companies that are used most for both air and sea freight. It should be considered if ABB could have closer co-operation with these two companies. The problem with this is that the customers may change their forwarder quite often based on who gives the best offer.

One way to control the deliveries better and restrict the number of the forwarding companies is to change the sales terms. If the sales term were DDU for all the customers, ABB could choose the forwarding company. With ABB's delivery volume it would be easy to get good contracts with the forwarding companies. But changing the sales terms is a major change and the sales department and the customers most probably would not accept it.
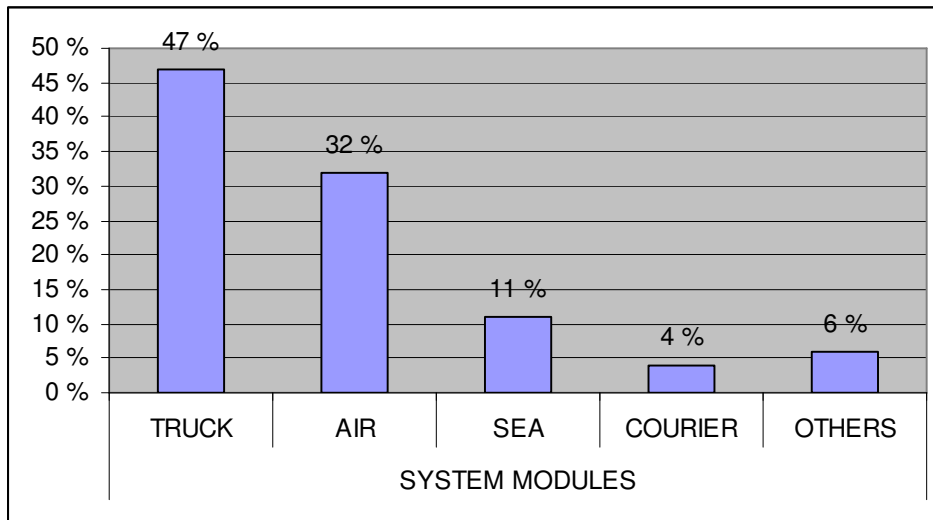
Figure 14. Deliveries in System Modules

Figure 14 shows how the deliveries are divided by different transportation modes in System Modules. This data supports the suggestion that the process for air deliveries should be developed further.
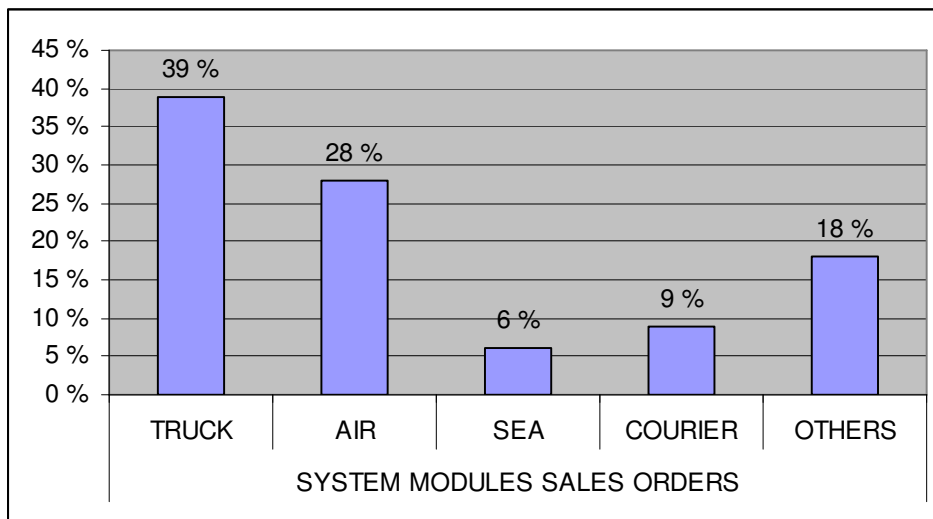
Figure 15. Deliveries in System Modules per sales order

Figure 15 shows how the deliveries are divided by different transportation modes in System Modules. This analysis was made based on the number of sales documents when all the previous analyses were based on the number of line items delivered. This chart was made to illustrate the difference between the units.

System modules' orders have often more line items, because in addition to the modules, system modules sells also assembly parts to their customers.

This data justifies the suggestion that the process for air deliveries should be developed further.

This analysis gives objective information about the volume of the deliveries by transportation mode and shows the different needs for different units. As stated earlier, the process for truck deliveries is working well, but it covers only half of all deliveries. The air and sea deliveries can be handled in similar manner, therefore the emphasis in development should be put on developing those. Both ABB and the customers will benefit from more fluent process.

5 SHORT TERM ACTIVITIES – PHASE 1

In this chapter the short-term activities for completing the development project are presented. The most acute problems are related to the software; especially the packing transaction still contains some errors that prevent utilizing it fully. There are also problems with storage locations and the financial result analysis process must be adjusted to be in line with the new processes. In addition the airfreight process should be defined and the specification for the software concerning the air shipment should be made.

5.1 Project organization

In order to proceed with the project, the most urgent action is to appoint a project manager or a project coordinator who will take charge of the project. When the project manager has been chosen, the project team should be chosen. It has been quite unclear who is in the project team and what their responsibilities are. It is easier to manage a project with a smaller group of people. The project team should also be committed to the project and they should not have too many other responsibilities that take time form the project work. The project team should be selected carefully; there should be one representative from every business unit and an ERP-specialist. The roles of the team members should be clear to everyone. A reference team could be used when needed. The representatives of different business units should present the issues discussed in project meetings to their own unit and plan with them the actions that are critical to that specific unit. These plans could then be presented in the project meetings. These procedures would make the project team's work more organized and efficient.

Also the ERP experts should be actively involved in the project. At the early stage of the project ABB's own ERP experts were not involved in the project and that has caused some problems later. The use of external ERP consultants must be considered carefully. So far there have been many consultants form many

companies. At the moment it is unclear who should be contacted when external consultancy is needed. The consultant that is chosen for the project should also be committed to the project and fully familiarized with the project.

In this project software changes and testing them have an important role. Testing should be coordinated more carefully in cooperation with the consultant and ERP-specialists. It would be good to arrange common testing sessions for the super users, so that everyone understands what has to be tested and how. At the same time the super users can share their experience and all possible errors would be noticed. The testing must also be documented, so it is easy to check that all tests needed are completed.

The Gate-model should be applied to this development project. Gate model is a model that is used at ABB Drives for process development projects. The Gate-model gives clear instructions for the project manager how the project should be planned and executed. The Gate model also ensures visibility and accountability for management and provides management assurance and support for project managers at key milestones within the project. By following the steps in Gate model it is easy to keep the project on right track and it is easy for the steering group to supervise the project.

Communication is also important. Informing about the status of the project, meetings and changes etc. should be efficient that everyone who needs the information receives it. The information like schedule, meeting memos and testing documentation should be also available at a common network drive.

When the project manager, project team and the consultant is chosen, they should solve the most acute problems with the software. After that it is important to have proper training for every employee who is using the software and also explain the other processes involved with the new system. Also written instructions must be reviewed and updated.

5.2 Sub-project

The management has decided that it is important to complete the first phase of the project. Because the previous project organization's ways of working were not systematic and effective and gate model was not used and there were no documentation and follow up for the project, a new sub-project was started. The objective of the sub-project is to coordinate fixing the unfinished matters that are presented in chapter 5.3. The sub-project will also cover issues that were considered necessary to achieve a functioning process for all units. These issues are presented in chapters 5.3 and 5.4. The sub-project utilizes Gate-model principles. The project team consists of 6 people. The sub-project was started in April 2009 and the preliminary project timetable was quite tight and it was planned that the project would be completed by the end of June. But because of external factors, like availability of consultants and development freezes in the ERP system, it is not possible to complete the project in such a short time. According to the updated timetable the project should be finished in September 2009. The costs of the project will be followed regularly and thoroughly with the project sponsor. All the consultancy work must be approved by the sponsor before ordering the work.

5.3 Most acute problems

The most acute problems are related to the software. Still it is important to be able to differentiate problems that are directly related to the software and problems that are user related or problems that appear when using the software, but are caused by some other factor. It seems that there is no clear overall picture of the project and the causes and effects of software change. There have been some overlaps with change requests because the users do not have clear overall picture of the processes. This causes unnecessary extra work and consumes time.

Good instructions and adequate training are important both for the end users and super users. There should be separate instructions for end users and instructions

for super users. There should also be instructions what to do in the most common error situations and how to correct typical errors. There should be separate instructions for order handling, because errors in order handling affect the deliveries.

It seems that the forwarding departments are trying to use the new system without changing their procedures. New software does not alone change anything; also the processes and procedures must be changed and unified which was the original idea of the development project.

5.3.1 Changes to packing transaction

There are changes that must be done to the packing transaction to have it functioning properly. The most important changes are that the system must be changed so that it allows creation of complete delivery for the sales order even though all the materials are not yet finished from manufacturing. Also material availability checking when creating a handling unit must be reviewed, because at the moment it is not working properly. These changes require help from an external consultant and the project team must test the changes.

There are also smaller changes that will make the packing transaction easier and more convenient to use. A calculator, that calculates the packed materials, has been added to the packing transaction. A control for the weights has been added, now the system will not accept greater net weight than the gross weight. There is also a new feature that does not allow using the packing transaction if someone else is handling the same sales document at the same time.

Also some improvements have been made to the loading reports. The loading reports are now more informative and easy to read; both for ABB and the forwarding company and those can be easily converted to PDF format.

These changes have been coordinated with an external consultant and the project team has carried out the testing and these changes were implemented in May 2009.

5.3.2 Result analysis

One more important issue that has to be handled is the financial result analysis. The system has to be fixed so that it supports the month end result analysis, also called Work in Progress analysis (WIP) and that all financial data will be transferred correctly in the system.
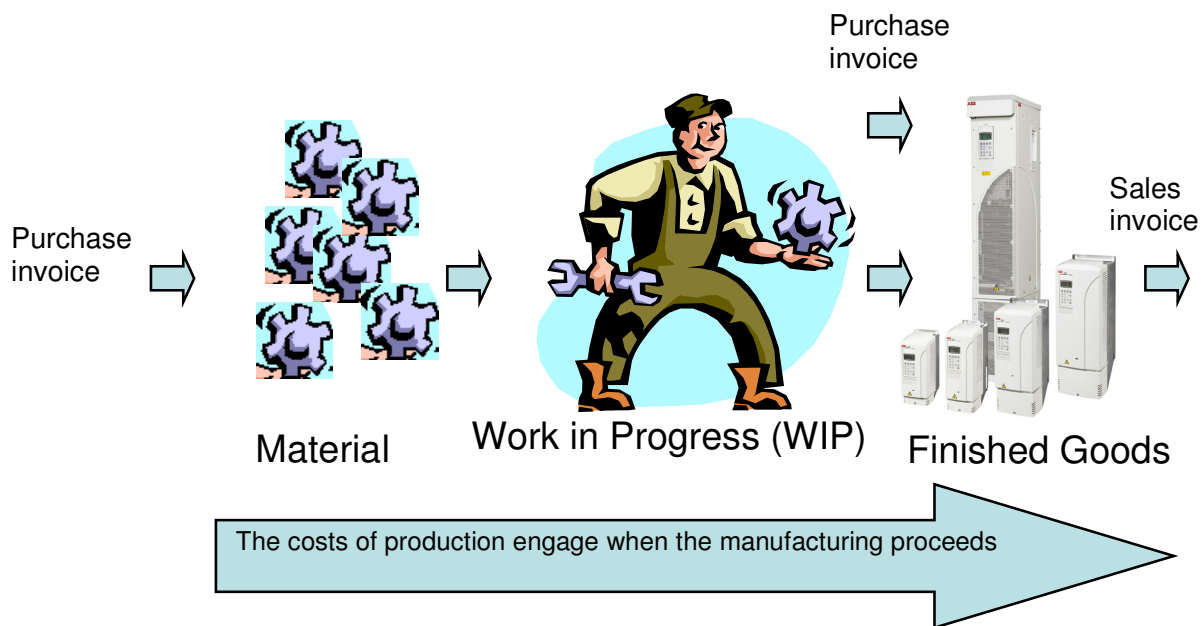

Figure 16. Result analysis

Figure 16 describes the manufacturing process and how the costs are transferred in the ERP system. Previously the ERP system's result analysis was triggered by PGI. The finished goods should have been invoiced within same month with PGI,

but the system had to be changed so that the result analysis is triggered by the invoice. This change was made because when the goods are taken to the trailer and the PGI is automatic, at month end there would have been situations that the night shift would have been taking packages to the trailer and the RFID gate would have issued the PGI, but no one would have made the invoice within same month. That would have caused faulty financial data to the ERP system and this is why it was important to make this change before the volume of the finished goods handled with RFID readers increases.

Fixing the result analysis requires a consultant who is specialized in ERP system's financial matters. The consultant has made the technical specification and after that the result analysis process was tested by the project team and ABB's business controllers. The specification was clear, but in testing phase everything was not working as assumed and more testing and consultancy was needed than originally planned. It consumed more time and money than was budgeted, but because the result analysis is a critical matter, it had to be made properly before proceeding with other changes. This change was implemented in May 2009.

5.3.3 Storage location movements and error handling

Some errors have occurred with the storage location movement when the packages are taken through RFID reader to the trailer. The RFID reader should move the material automatically to a storage location called tube. There are different tubes for different transport modes, but at the moment only one tube storage location for truck shipments is used. When the last package of a delivery is taken through RFID reader, the system makes PGI, which removes the material from factory's storage balance (tube).

There have been cases when the materials are not transferred to correct storage location. It must be found out what causes the error and how it can be fixed. It may be impossible to prevent all incorrect material movements and that is why it must

be considered how incorrect material movements can be corrected in the system. It is important to fix this before starting the airfreight process, because then there will be more automatic movements and the amount of errors will also grow. These errors cause faulty storage balance.

This has been discussed with a consultant and there is a proposition how this problem could be solved. The implementation will be in August 2009 because of development freeze in the ERP-system during summer 2009. After implementation this has still to be tested in practice and made sure that there are no more other problems that might cause incorrect material movements.

5.4 Short term activities for System Modules unit

There are a few issues that system modules unit should consider in order to proceed with the project. The storage location problem must be solved. The problem is caused by incorrect material type in the ERP system and the difference how the new transactions function compared to the old transactions. Some materials like softwares and manuals do not have a storage location in the system and when taken through RFID reader the system tries to make the storage location movement, but it is impossible if the material does not have a storage location. Furthermore this prevents the system to make PGI. These materials need to be handled in the system in a way that the storage location check is not made or the material type must be changed. This was solved together with a consultant in October-November 2009.

Handling of module- and module-filter packages must be solved in order to start packing also the modules with the new system. The new way to handle these packages has been created and tested. This has required also pilot deliveries to customers, because the layout and the information on packing list and invoices have changed and it had to be tested that the new documents will pass the customs control. It seemed that otherwise this would be ready to implement, but it

must be checked that the financial data is transferred correctly in the system. When the final testing was made, some issues still came up and the whole process was reconsidered and needs for some changes were still found. These changes are still in progress and the target is to finish those during December 2009.

System modules unit has manufacturing units in three places: Helsinki, Vantaa and Tallinn. At the moment the new system is used only in Helsinki factory. At the moment all the modules form Vantaa and Tallinn are sent to Helsinki factory for consolidation. This is considered unnecessary work and transportation. System modules unit should start considering how to implement the new system also to these two other manufacturing plants. Implementing the new system to other manufacturing units requires that the system is tested and working well in Helsinki factory.

5.5   Handling of air shipments

Based on the analysis of deliveries in chapter 4.4 the next step of the project should be creating process for air deliveries. When air- and sea deliveries are handled with the new process, 80% of the deliveries would be handled by utilizing RFID system. It is possible to use the process for air shipment also for sea shipments, at least to some extent with the forwarding companies that are used both for air and sea shipments.

It could be considered if there could be a trailer for air deliveries, like there is one for truck deliveries. The problem with the trailer is that there would be packages for many different forwarding companies and the packages should be loaded in the trailer in the order the driver is planning to take the packages to different forwarding companies. Loading and unloading would be complicated if the packages are taken to the trailer directly after packing. It is impossible to have many trailers for different forwarding companies, because the space at the loading dock is very

limited. For this reason it would be good to develop co-operation with the forwarders that are most used for air deliveries.

The first step would be to start using the RFID reader for air deliveries too. There is one free RFID reader on the loading dock that could be used for air (and sea) deliveries. There is also one RFID reader that is used manually that can be used when the other reader is occupied or if the truck is not able to drive to the dock.

When the truck comes to pick up the air shipments, the RFID reader can be opened and the packages loaded to the truck in the order the driver is planning to take the packages to different forwarding companies. When the loading is complete the RFID reader is closed and the loading report can be printed for the driver. This operating model requires that there is a specific place in the loading dock where the air delivery packages can be brought when those have been packed.

This way the air deliveries could be handled faster and also the RFID reader could be used and it is not necessary to wait that the whole sales order is ready to be shipped. This requires co-operation with the forwarding companies that they are willing to store the packages at their premises for a few days before the delivery is complete and ABB gives permission to send the packages to customer. Basically the forwarding companies are ready to take packages for short term storing and this possibility is utilized to some extent, but it would be good to have a meeting with the forwarding companies and make sure that they are prepared for increasing number of packages that are stored at their premises.
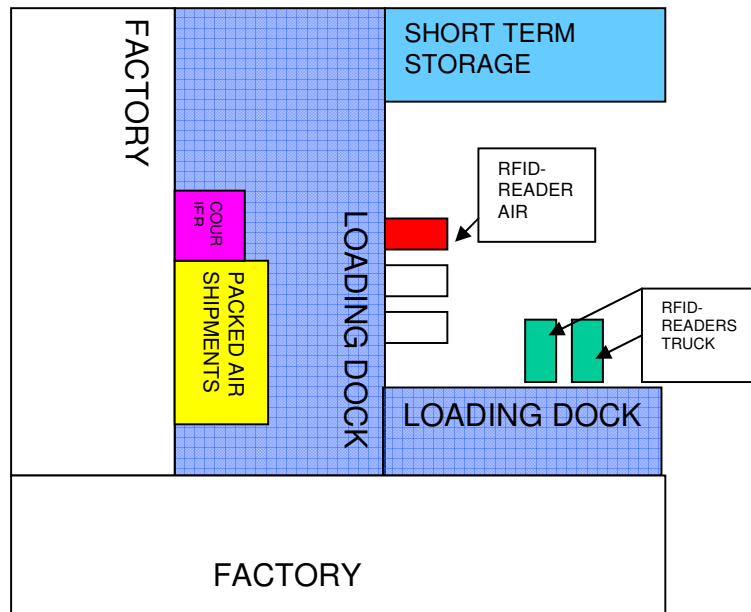
Figure 17. Layout of the loading dock

Figure 17 illustrates the loading dock and the location of the RFID readers and storage areas. The storage area at the loading dock is extremely limited and that is why the deliveries should be taken to the forwarder promptly.

5.5.1 Air freight process

Figure 18 describes the process for air shipments. For more detailed process flowchart see appendix 2.The start of the process is similar with the process of truck shipments. The process differs when the packing is finished and RFID tags and packing lists are printed.
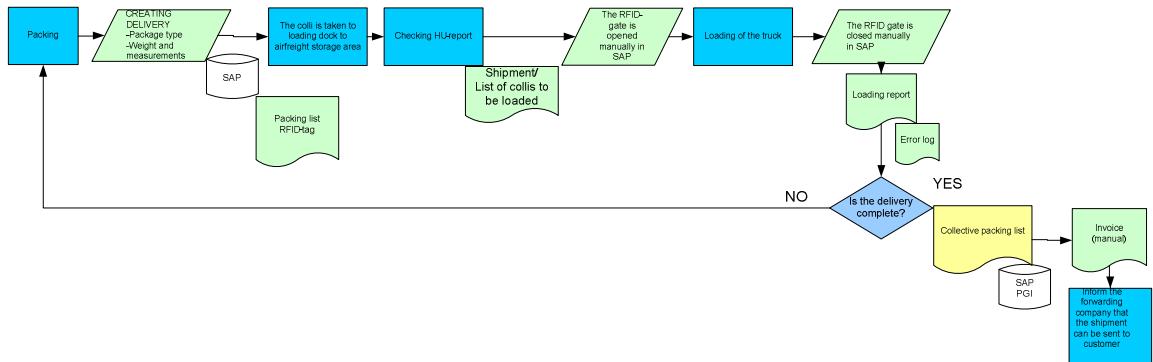
Figure 18. Air freight process TO BE

The packages are not taken directly to a trailer, they are taken to a specific place reserved for air deliveries and a shipment document has to be created manually in ERP system. The shipment document has to be created, because it indicates which packages have to be loaded and where they must be taken. When the truck arrives, the RFID reader is opened and the packages loaded to the truck according to the shipment document. When the truck is full, the RFID reader is closed and a loading report is printed. The packages are taken to the forwarding company's terminal to wait that the sales order is complete and ABB makes the export documents and gives permission to send the delivery to customer.

This process does not differ very much from the process that is currently used. With this process the RFID readers can be used and the packages will be moved to the forwarding company's terminal faster. This process requires more work from the forwarding department compared to the process where the packages can be taken to the trailer without creating a shipment and storing the packages for short time at the loading dock.

5.5.2 Restrictions and limitations for implementation

There are some issues that have to be solved before starting to use the new process. Creating shipment document in ERP system locks the storage location and storage location movement, which means that PGI at the RFID reader is not possible. The system has to be changed so that it is possible to make the shipment document so that it does not lock the storage location and prevent the storage location movement and PGI. When this was tested and investigated more closely, a solution that does not require any changes to the ERP system was found.

Another practical issue is that when complete delivery is made, the forwarder will not receive any information about what has been packed, because the collective packing list is printed when the whole delivery is complete. There must be a transaction in ERP system with which the forwarder can follow the packed materials to be able to send the packed materials to the forwarding company's terminal. There is an existing report in the ERP system that could be modified to suit also this purpose.   But after consideration it was decided that a new transaction has to be created. The specifications for the new transaction have been made and the consult is working on it. The target is to have the transaction tested and implemented during December 2009.

There have also been problems with storage location movements. The system has made movements to incorrect storage location and the material has remained in the wrong storage location causing faulty storage balance. Also this problem should be solved before starting to use the system with air deliveries, because when more deliveries will be using the RFID system, there will be more errors and the storage balance will be even more faulty. This has been also been investigated and tested and the main reason for faulty movements has been found. It is a user-related problem that can be solved by better instructions and changing the ways of working.

It has to be ensured that the beginning of the sales process is handled correctly. The sales administrators that are booking the orders in the ERP system must keep the customers' information and shipping instructions up to date in the system. It is possible to use delivery or billing block in the sales orders. Having the block on prevents making the delivery or invoice and forces the packing or forwarding department employees to check either from the system or from the sales administrator why the order is blocked and if there are some special requirements that must be considered before proceeding.

It is important that the employees understand and accept that when the processes are changed, also the procedures must be reviewed. There is no point trying to fit the new process into old procedures. The employees must be trained properly and there must be someone who can give them support if anything is unclear or if there are problems.

The target was to finish the remaining changes in September 2009, but again, the schedule has not realized. At the beginning of December 2009 there were still two unfinished issues: the new transaction for packed materials to be utilized for airfreight and handling the module and module-filter packages. The target is to finish these during December 2009. Writing instructions and training the personnel will probably remain to be done in January 2010. It is more critical to have the actions related to ERP system finished before the end of the year, because in January there will be again development freeze in ERP system.

5.6 Realization of planned actions

Table 1 summarizes the main actions made in the project and how and when those were implemented.

Table 1. Summary of main actions

PROBLEM	SOLUTION	REALIZATION
Project organization	Project manager, small project team, Gate model	Project managers and team was appointed in April 2009
Improvements to the packing transaction	Planned with project team and consultant	Implemented in May 2009
Month-end financial result analysis	Planned with controllers and consultant	Implemented in May 2009
Storage location movements and error handling	User related, does not need changes to the software	
Storage location movements for system modules	Special handling for some materials in ERP-system	Implemented in August 2009
Airfreight process	Planned with project team and consultant	Implemented in December 2009/ Partly still in progress
System module's module- and module filter-packages	Required actions have been planned with project team	Not implemented yet, waits for other changes that have to be done first
Instructions and training	Every unit is responsible for training their employees and special instructions	Continuous during the project and still if needed

Almost all the actions were implemented during 2009. Only the handling of module packages has not been done. There is already a solution for that, but system modules wanted to change the whole process of handling the packages starting from production planning and those changes must be implemented first. There is a long development freeze in ERP system at the beginning of 2010, but the changes are implemented during spring 2010. The airfreight process is not yet fully utilized, because of problems with RFID readers, but as soon as those are fixed, the process can be tested in practice. Every unit is responsible for writing their instructions and training their employees. The instructions have been written and updated during the project, also training has been continuous and more training will be provided if needed.

6 LONG TERM ACTIVITIES – PHASE 2

In this chapter suggestions for the project's second phase are presented. It has not been decided whether the project will be continued after the first phase is finished. The issues presented in this chapter are only suggestions that could be utilized when planning possible continuation for the project. Phase 1 of the project must be completed and fully implemented before taking any of actions described in this chapter.

6.1 Consolidation of shipments outside the factory

In order to make the goods flow from the factory faster and more fluent an external warehouse or terminal could be used for consolidating the shipments. Having a place for consolidation can become quite necessary as the number of manufacturing facilities grow. Currently most of the products that are manufactured outside the main factory are coming there for consolidation and some products also for packing. It is taking space and resources, which is quite the opposite of the management's wishes to reduce packing and storage space. This also increases traffic in the factory area that is already very crowded.

It has been planned that different packing departments would be combined as one unit. If that project will be realized the need for external consolidation space probably increases.

In the early stage of the project it was planned that the consolidation of the shipments would be done in an external terminal. This option was not fully examined, because developing the software has taken most of the project team's time.

There is already one terminal where the products can be stored for a short time and consolidated. This possibility is not fully utilized. The forwarding agents are also taking finished products to their terminals for temporary storing before the shipment is complete. This potential is not fully utilized either.

Having several forwarding agents and terminals and different trucks coming to pick up the packages from factory can be confusing and challenging to manage. This is probably the reason why the existing possibilities are not fully utilized.

Having just one terminal would be easy to manage and the cooperation with the chosen partner can be developed according to ABB's wishes. All the finished products from the factory could be taken to the terminal with one delivery truck. This would be fast, simple to manage and reduce the traffic in the factory area. Also the packing and spare part collecting and kitting could be moved to this terminal later, which would free even more space from the factory.

The location of the terminal should be considered carefully. The terminal should be located near airport, preferably somewhere between ABB's factory and the airport. That way transporting the products would be effective and economic and deliveries to airport would be fast and easy to handle.

6.1.1 Consolidation model

Figure 19 illustrates the model for consolidation if one external terminal is used.
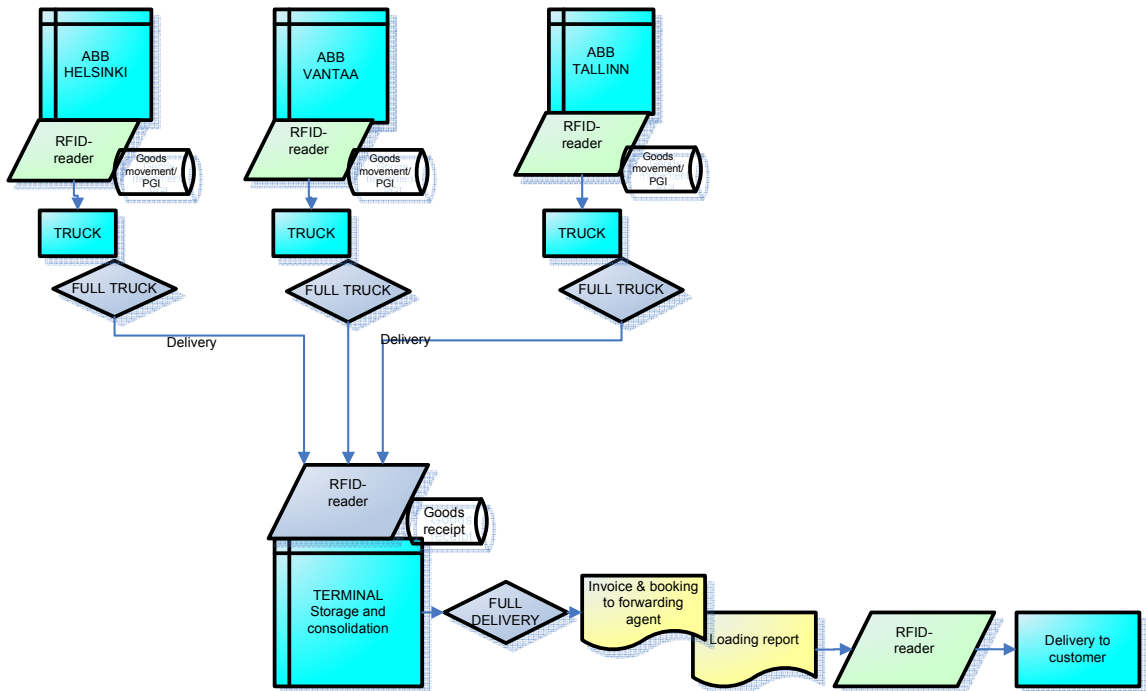
Figure 19. Consolidation model

The finished products are taken through RFID-readers to the truck at the factory. When the RFID-reader has read the package the system will make a goods movement to the external storage location. When the truck is full, the packages will be delivered to the terminal. At the terminal there is also a RFID-reader that makes the goods receipt to the terminal. The goods are stored in the terminal as long as the delivery is complete. When the delivery is complete the forwarding department will make invoice and booking to the forwarding agent. After that a loading report is issued to the terminal for collecting the goods. The loading report contains the package information and also information to the terminal about which forwarder is going to pick up the shipment and when.

6.1.2 Advantages and disadvantages of consolidation model

Table 2. Advantages and disadvantages of consolidation model

Advantages	Disadvantages
Easy to control the shipments	Tracking of packages and shipments
No storage outside	IT problems
Saves space	Controlling
Easy to consolidate shipments from different manufacturing facilities	Cost
	Service

Consolidation of the shipments would facilitate the work of forwarding department because controlling the outgoing shipments would become much easier and the packages of finished products would not be stored outside. Also space is saved which is important.

Consolidating outside the factory can also make controlling of the shipments more difficult, handling of the packages could not be controlled anymore. The cost of consolidation may become too high.

6.1.3 Costs and operation of the consolidation terminal

The easiest way to operate the terminal would be to choose a partner who will take charge of operating the activities in the terminal. In terms of costs it would also be convenient to make such contract with the operating partner that would cover all or most of the operating costs. Below are calculations that are made based on costs of a similar kind of terminal to show an estimation of the costs for a consolidation terminal.
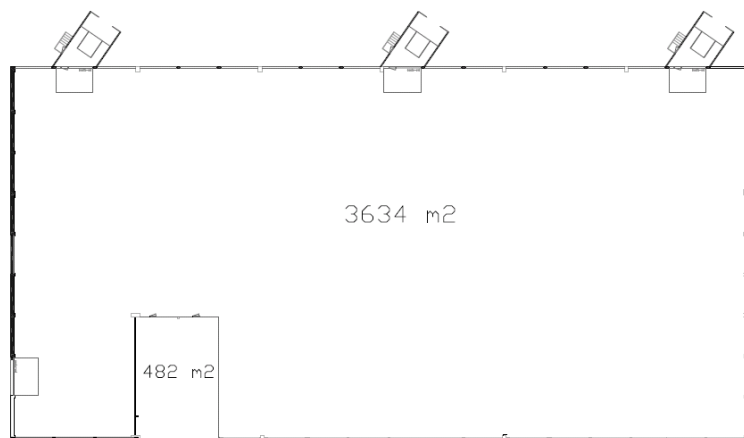
Figure 20. Layout of the consolidation terminal

Figure 20 is a proposition for the simplified layout of the consolidation terminal. There are loading docks for loading and unloading the packages. RFID readers could be installed to the loading docks. There is also an area where the office and employees' dressing rooms are located.

Table 3. Monthly rent of the consolidation terminal

Definition	m²	Price/m²	Total
Warehouse	3766	8,25	31070
Office	350	10	3500
			€ 34570

In Table 3 an estimation of the rent of a consolidation terminal excluding VAT is calculated. The calculation is based on costs of a similar kind of terminal that ABB uses. At yearly level the rent of a warehouse space and a small office area of approximately 3800m² would be approximately € 415 000 excluding VAT.

In addition to rent, there will be other costs for operating the terminal. The operation costs depend on what kind of contract ABB makes with the operating

partner. There are costs like electricity, heating, maintenance, and waste management. There are also costs of the personnel needed operating the terminal. The terminal should be operated in two shifts, because ABB's packing departments work in two shifts. In the terminal should be forklift drivers who will take care of the warehouse management, receipt of incoming packages and loading the outgoing packages and one coordinator who coordinates mainly the outgoing shipments and is in contact with ABB. There should also be a person at ABB's factory who coordinates the traffic between the factory and the terminal and takes care of other practical issues concerning the deliveries. The people working in the terminal must be trained by ABB.

In the terminal different kind of equipment is needed. There must be forklifts, RFID readers and printers and normal IT equipment like computers and printers. It should be decided if this equipment would be owned by ABB or the operating partner. Concerning IT systems it should also be considered, if an operating partner is chosen to operate the terminal, is the partner given access to ABB's ERP system or what kind of system would be used and how the information would be transferred to ABB's system.

It could also be considered if the terminal is used just for short time storage for finished products or could there also be other activities like packing, manufacturing and storing, collecting and packing of spare parts.

6.1.4 Benefits of consolidation

It is difficult to calculate the benefits of consolidation in money, but having a consolidation terminal is not just to save costs. By using a consolidation terminal, space would be released from the factory. The finished products would not be stored outside anymore, which would decrease the risk of damages. Risk of damages would also be diminished, because in the terminal there would be more room to operate than at the factory's premises and a system could be created that

facilitates keeping the warehouse in order and finding the packages when those are wanted to move.

The operating partner is specialized in this kind of functions and probably has more modern and efficient ways of working than ABB. That way the operating would be more efficient. Also the personnel costs for ABB would be smaller and the operating partner is probably able to use their personnel more flexibly and react to high and low peaks.

6.2 Reporting and traceability

The current reports available in the ERP system are not sufficient, especially when the goods flow and the number of manufacturing facilities is growing and if it is decided to use an external terminal for consolidation.

A reporting system should be created to the ERP system where the status of the deliveries can be followed and tracked. The system should be easy to use, so that everybody could utilize it. For example, the sales department could check with the sales order number where the order is, is it still in the factory, is it packed, is it moved to the external warehouse or is it completed and sent to the customer. The system should also function with delivery number and with package number (RFID tag number). This way the deliveries and their status could be tracked easily at every level.

There should be a report that shows which orders are due to be delivered on a specific date. By following this report daily, it can be ensured that all deliveries are made on time. This makes the packing and forwarding department's work easier, improves customer satisfaction and on time delivery rate.

The reporting system should also show when the delivery is complete and that it can be invoiced (billing due list). This would facilitate the forwarding department's

work. Also the sales department could check from the system whether a specific order is already invoiced.

6.3   Utilizing RFID-technology

Now when ABB Drives has acquired RFID technology for both inbound and outbound deliveries, the potential of the technology should be utilized to its full potential.

RFID technology could be utilized in shipments from ABB's different manufacturing facilities. It would make tracking the shipments faster and easier.

To utilize the potential of RFID fully, would require that the partners, like forwarding agencies would also have RFID readers and that the systems would communicate with each other. So far at least Finnair has been interested in utilizing RFID technology.

6.4   XML messages between ABB and forwarding agencies

One way to facilitate and speed up communication between ABB and forwarding agencies is to utilize XML (extensible markup language) technique for booking the deliveries. At the moment the information about deliveries and bookings are handled via E-mail and fax. XML is equivalent to EDI (Electronic data interchange), but it is more versatile, in real time and cheaper.

7 CONCLUSIONS

The goal of this thesis was to document and analyze what has been done in the development project and to define the actions to complete the project. The project has not been proceeding as originally planned and the project management has not been systematic. The commissioner wished also for ideas for future development in outbound logistics.

In the theory part of this thesis theories about developing outbound logistics and project management were presented. The empirical part of this thesis consisted about an analysis of the deliveries, plan of the actions to complete the project and suggestions for further development of outbound logistics. In the empirical part both qualitative and quantitative methods were used. The analysis of deliveries is a quantitative analysis. The rest of the information for the empirical part was collected and analyzed by using qualitative methods.

The research question of this thesis was "How to complete development project in outbound logistics in an international company manufacturing automation technology products?" In this thesis the project has been analyzed and based on the analysis actions required for completing the project were presented. A model for managing the project was selected and presented and the composition of project organization was discussed. The problems related to the software were discussed and a solution was provided. These actions have been implemented in practice and the project has been closed. This thesis includes also ideas and suggestions of further development of outbound logistics.

Profound understanding of the project's status and background research, like the analysis of the deliveries that was made, facilitated planning the measures to complete the project. The actions described in this thesis for phase 1 have been implemented and the project has been closed successfully. There are still a few

practical issues to be fixed, but the software and processes are working and the employees are quite content with them.

Managing a project is a challenging task. In addition to the expertise of the theme, project work is a combination of managing people, schedules and budget. In this particular project the main focus has been on processes and the software. The schedule has been mainly dependent on the software. There have been periods when the software cannot be changed and that has set challenges to the development work and testing. The project team has been working on the project besides their normal tasks, which has required flexibility both from the project team and the managers of the project team members. Having a clear model for managing the project as presented in the theory part is useful, because it helps to follow the project plan and evaluate whether the project can proceed from one phase to another. The principles of the gate model that was presented in the theory were utilized in managing the development project.

Eventually the first phase of the project was finished successfully. It turned out that systematic planning and implementation are essential in managing a project that is also stated in theories about project management. It would be important to plan the implementation and have some follow up plan for it. That is something that could be improved in future projects. The company could also appoint a process owner, who would be responsible if some problems appear and coordinate the follow up and fix the problems.

This thesis includes also suggestions for future development, phase 2, for the project. A model for consolidating the shipments outside the factory was presented. Also ideas for cooperation with the partners and utilizing new technologies were included. No decisions have been made if the project will be continued. If the volume of deliveries will grow in future, these suggestions can be useful.

There are still many development needs in outbound logistics. It would be important to continue the development work. One aspect is the manufacturing plants in Vantaa and Tallinn. Basically the software can be applied there, but the consolidation of products from different manufacturing facilities should be considered.

One big challenge for outbound logistics is that the circumstances and cooperation partners are changing constantly. That should be considered when designing the processes and software. The software should adjust to changes without major modifications. In theory part it was stated that it is typical that the companies develop their software inside the company, but it is not considered how it could be integrated with the software of the cooperation partners. This is a future challenge at ABB as probably in many other companies.

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APPENDIX 1

AS IS (simplified)

Products → Packing → -Package type -Weight and measurements → SAP → Packing list RFID tag

Is the delivery complete? — NO → Packing

YES → Collective packing list → The colli is taken to the truck through RFID readers → The truck is full → The RFID gate is closed manually in SAP → Loading report

Collective packing list → SAP PGI → Error log

Collective packing list to forwarder (manual) → Invoice (manual)

AIR FREIGHT TO BE

```
Packing → CREATING DELIVERY
              -Package type
              -Weight and
               measurements
                    ↓
                  SAP
                    ↓
              Packing list
              RFID-tag
```

```
The colli is taken to loading dock to airfreight storage area
                    ↓
              Checking HU-report
                    ↓
              Shipment/
              List of collis to
              be loaded
                    ↓
              The RFID-gate is opened manually in SAP
                    ↓
              Loading of the truck
                    ↓
              The RFID gate is closed manually in SAP
                    ↓
              Loading report
                    ↓
              Error log
                    ↓
              Is the delivery complete?
```

YES

NO

```
Collective packing list
         ↓
       SAP
       PGI
         ↓
Invoice (manual)
         ↓
Inform the forwarding company that the shipment can be sent to customer
```