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Lean Process Management with a 3PL Partner -
Order-to-Delivery Process of Global Service Center

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<p>This thesis was assigned by an aftersales unit of ABB Oy Drives, and its purpose was to analyze the order-to-delivery process of spare parts after the warehouse was outsourced. The objectives of the study were to discover challenges in the current process, evaluate the current performance measures, and to create procedures to assist in the collaboration management between Drives Service and their 3PL partner. The final target was to improve the current order-to-delivery process of spare parts.</p> <p>A case study was selected as the research method for this thesis. The research utilized a constructive approach aiming at problem solving through theoretical and empirical knowledge. The data gathered for the case study was qualitative, and it was collected by interviewing the stakeholders of the current order-to-delivery process and the warehouse relocation project. ABB's existing documentation, such as process maps and organization charts, were used to complement the analysis of the case.</p> <p>Current state analysis consists of three parts. The first part covers the warehouse relocation project with a description of the advantages and disadvantages. This gives insights for the next part of the current state, which describes the order-to-delivery process after warehouse relocation. As a result, a process workflow and summary of the current challenges were created. The third part of the current state analysis introduces and evaluates the current performance measures that are used to monitor the process. The benchmark study completes the current state analysis by introducing the practical collaboration model between Company X and their 3PL warehouse. The collaboration in the benchmark study has many contact points with the case, and is thus selected as a part of this thesis.</p> <p>The findings of the study can be divided into pointed challenges of the current state and solution proposals for them. Five different challenges were identified based on the current state analysis. For each challenge, there is a proposal for improvement based on the theoretical framework of this study. The workflow of the current process can be streamlined utilizing the development proposals of this study. Challenges, development proposals, and a new process workflow are described in the latter part of this thesis. Since the scope of this research was extensive, two additional challenges were recognized during the study process. These future research subjects are expressed in the conclusions of this thesis.</p>	
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<p>Tämä opinnäytetyö tehtiin ABB Oy Drivesin aftersales-yksikölle, ja sen tarkoituksena oli analysoida varaosien tilaus-toimitusprosessia ja sen johtamista tilanteessa, jossa varaosavaraa ja sen operaatioita hoitaa ulkoinen logistiikkapalvelujen tarjoaja. Tutkimuksen tavoitteena oli paljastaa haasteita nykyisestä prosessista, arvioida prosessissa käytettäviä suorituskyvyn mittareita, ja luoda toimintamalleja tukemaan yhteistyötä sekä sen johtamista Drives Servicen ja varastotoimintojen palveluntarjoajan välillä. Työn päätavoite oli parantaa nykyisen tilaus-toimitusprosessin suorituskykyä ja selkeyttää sen johtamista.</p> <p>Opinnäytetyön tutkimustapana käytettiin tapaustutkimusta, jossa hyödynnettiin konstruktivistista tutkimusotetta. Konstruktivistinen tutkimusote pyrkii ongelman ratkaisuun empiirisen ja teoreettisen tiedon pohjalta. Tutkimusta varten kerätty aineisto oli laadullista, ja se saatiin haastatteluiden kautta. Lisäksi tapausta varten hyödynnettiin ABB:n sisäistä dokumentaatiota, kuten prosessi- ja organisaatiokaavioita. Nämä mahdollistivat kokonaisvaltaisen ymmärryksen saamisen tapauksesta.</p> <p>Nykytila-analyysi muodostui kolmesta osasta. Niistä ensimmäinen käsittelee varaston muuttoprojektia, sisältäen siitä aiheutuvat hyödyt ja haitat. Tämä antaa esitietoja nykytila-analyysin seuraavaan osaan, joka käsittelee nykyistä varaosien tilaus-toimitusprosessia. Toisen osan tuloksena syntyi prosessikaavio nykyprosessista, sekä yhteenveto siinä olevista haasteista. Nykytila-analyysin kolmas osa esittelee ja arvioi prosessin johtamisessa ja seurannassa käytettävät suorituskykymittarit. Benchmark-tutkimus täydentää nykytila-analyysin esittelemällä yritys X:n yhteistyömallin ulkoistettujen varastotoimintojen johtamiseen. Benchmark-tapauksen yhteistyömallissa on monta yhdistävää tekijää Drives Servicen varaston ulkoistamisen kanssa, ja se on siksi osana tätä opinnäytetyötä.</p> <p>Tutkimuksen tulokset jakautuu haasteisiin ja niitä vastaaviin kehitysehdotuksiin. Nykytila-analyysin pohjalta tutkimuksessa tunnistettiin viisi tärkeää kehityskohdetta, joille luotiin kullekin kehitysehdotus. Viiden käytännöllisen parannusehdotuksen lisäksi syntyi paranneltu prosessikaavio tilaus-toimitusprosessille. Haasteet ja kehitysehdotukset on liitetty myös prosessikaavioihin raportin lopussa. Tutkimuksen rajaus oli laaja, ja sen aikana tunnistettiin kaksi suuremman mittaluokan haastetta, joihin tämä tutkimus ei tarkemmin syventynyt. Nämä haasteet on esitetty jatkotutkimusaiheina lopputyön päätösoasassa.</p>	
Avainsanat	tilaus-toimitusprosessi, ulkoistaminen, kolmannen osapuolen logistiikka, suorituskykymittarit, hukka, prosessin kehitys

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List of Abbreviations

DS	Drives Service, an aftersales organization in the business unit Drives in ABB group.
ERP	Enterprise resource planning. Integrated management of business processes mediated by software.
KPI	Key performance indicator. Performance measurement that helps to manage and tells the status of an operation.
OMS	Order management system. The online sales portal of the case company.
SAP	Systems, Applications and Products in Data Processing. An ERP system made by a German software company, used by Drives Service in the case.
TMS	Transportation management system. The transportation booking and management system of the case company.
3PL	Third party logistics. Outsourced, external logistics function.
3PL Partner	Third party logistics partner, an external service provider.

1 Introduction

This study was carried out as a part of logistics outsourcing project of the aftersales unit of ABB Oy, Drives. The warehouse operations and facility have been relocated to 3rd party logistics service provider in the end of 2017. Outsourcing brought changes to processes and operations management in Drives Service, since all the warehouse operations shifted under external organization and ERP system. Prior to outsourcing, the warehouse operations have been carried out in ABB's warehouse facility and ERP system. To achieve the potential benefits of the outsourcing project, Drives Service must ensure that the processes are reasonable and the procedures clear with the 3PL partner.

ABB as a group has a long-term objective to develop competitiveness of their operations by improving efficiency, quality, and collaboration. This has forced organizations within the group to redesign their operating models and to constantly develop their processes. Lean management philosophy has a strong foothold in this development. The warehouse outsourcing project stems from the same objective as well.

Major part of Drives Service's physical operations is performed at the warehouse, and thus the warehouse relocation project is strategically important. The company wants to ensure that their control over the warehouse operations will remain in a way, which ensures reliability, efficiency, and quality of operations. The objective of this study is to determine the benefits and risks that outsourcing warehouse logistics for 3rd party logistics provider contains. The study will also analyze the effects of the warehouse relocation on the order-to-delivery process and its management at Drives Service. Inefficiencies and other problems are supposed to be detected in the current state analysis. As a result, there will be a detailed flowchart of the current order-to-delivery process along with discovered problems. Finally, based on the empirical research and theoretical framework of this study, the objective is to improve the current process and the collaboration between Drives Service and its 3PL partner with development proposals.

1.1 Background

This study is carried out to support the implementation of new operating model with 3rd party logistics warehouse and Drives Service. The warehouse operations have been moved under other the responsibility of 3rd party logistics provider. Outsourcing logistics to another company leads to changes in operational processes and their management, especially in Drives Service which physical operations consist mainly of warehouse processes.

Before the warehouse relocation project, the warehouse operations had been carried out by an external organization operating in Drives Service's warehouse facility. Even though warehouse workers were not on the payrolls of ABB, they used the same ERP system as the rest of the organization. After the warehouse relocation, all facilities, ERP system, and organization of a warehouse are external. This means several challenges in operations management in Drives Service, as the old manners are not suitable for the new situation. When the processes and other details of a system change, also the process management model must be redesigned to match with the new operating model.

Performance of the order-to-delivery process has dropped significantly after the warehouse outsourcing. The process has changed remarkably, and it must be investigated whether the old procedures and performance measures are sufficient to manage it. As the process was redesigned in the warehouse relocation project, it is the first version of the order-to-delivery process in the new operating model. Hence, it is a fertile soil for finding opportunities for improvements.

1.2 Research objectives and demarcation

The basis of this thesis is to clarify the change in Drives Service's warehouse operations caused by outsourcing. The subject is examined through reviewing the order-to-delivery process of Drives Service. The main research questions are:

- How did the order-to-delivery process change during the outsourcing project, and what are the main challenges in the new process?

- How should the order-to-delivery process be measured and managed at Drives Service in collaboration with the 3PL partner?

The objective of this study is to discover the challenges concerning the order-to-delivery process, collaboration with the 3PL partner, and management of operations at Drives Service. Along with recognizing the problems, this study aims to find proposals for improvements in the current state. The objective is to find solutions that will enhance the efficiency and quality of the current process, but also improve collaborative operations management by clarifying the responsibilities between parties.

This study is limited to the standard spare part order-to-delivery process of Drives Service. Hence, the findings of this study are primarily applicable for the investigated process only. The framing is justified by the importance of this process for Drives Service. The spare part order-to-delivery process is the core business process in Drives Service, operating in the aftersales business. However, the theoretical basis of this study is applicable for all the operations in the company.

1.3 Structure of the study

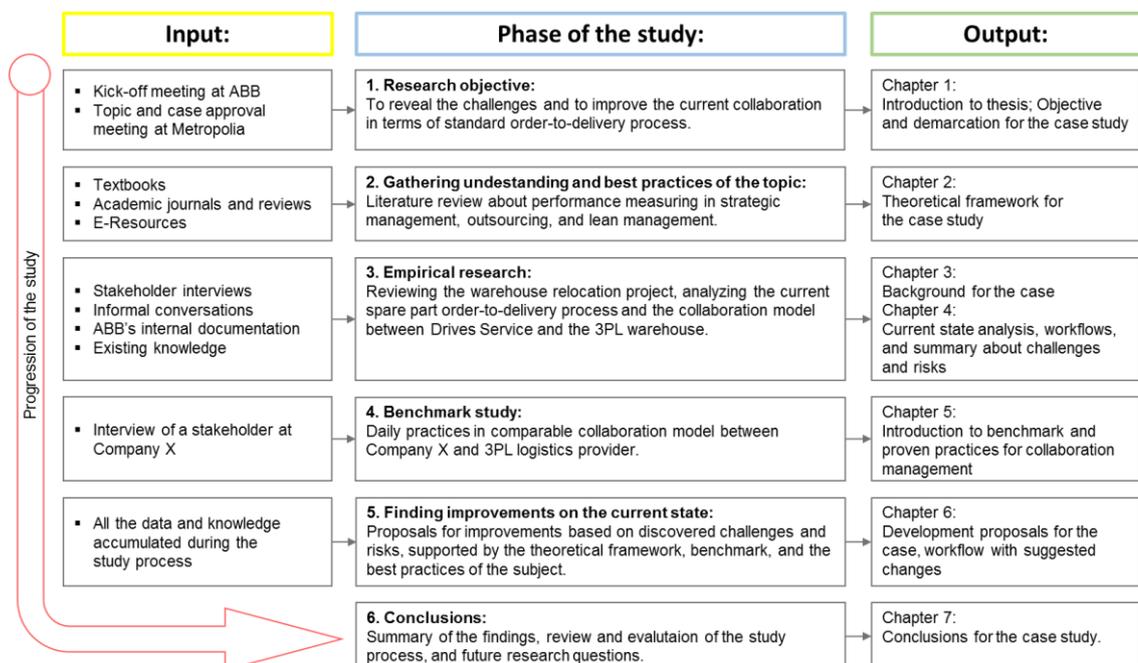


Figure 1. Phases of the case study and structure of the thesis.

As described in figure 1, this study can be divided into six main phases, that form seven chapters in this thesis, which are expressed in the table of contents. The first chapter is an introduction including the information about the study process. The second chapter focuses on the theoretical framework which is supporting the case study. Third chapter introduces the case company and is a background for the case study. The current state analysis with summary about the key challenges is included in chapter four. The fifth chapter introduces the benchmark case that is supporting the current state analysis. The sixth chapter presents the solution proposals for the discovered problems and evaluates them. The last chapter is for concluding the case study with evaluation about the study process. It summarizes the whole study and mentions the topics that are subjects for further research.

1.4 Research methodology and data collection

This thesis has been carried out as a case study with a constructive approach. A case study requires comprehensive observation of a specifically limited, individual unit of attention. Essential characteristic of a case study is that the investigated topics are all part of the case, and thus the case study provides a general and comprehensive view in certain topic. The findings of a case study are not generalizable, since the research focuses on a specific matter (Saaranen-Kauppinen and Puusniekka, 2006). The case study contains four major phases. First, the status of the investigated unit is recognized and determined. The second phase of the case study includes data collection about similar cases and applicable theory. Qualitative data is characteristically related to a case study. Further examination and history of the investigated unit are also part of the second phase in the study. The third phase is for diagnosis or analysis about the current state of the case. The analysis combines the collected data together and identifies the causal factors in the examined case. As a result from the third phase of a case study, there are findings about the best practices from theoretical framework and main challenges in the case that could be developed further. The fourth phase is to apply the findings of the study to the investigated case. This part is often called a case work, which is the final phase of a case study. (Kothari, 2004.)

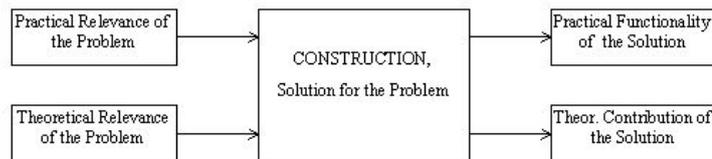


Figure 2. Constructive research approach (Kasanen, Lukka and Siitonen, 1991).

Constructive approach in research aims to solve an existing problem by applying theoretical and empirical knowledge to construct a solution. In constructive approach, there must be a practically relevant problem which has a research potential. After the topic is specified, the next step is to gather both theoretical and empirical understanding of the problem, and the topic which the problem is related to. Then the first solution can be innovated based on that understanding. After the solution is constructed, it must be demonstrated if the solution works. Besides proving practical functionality of the solution, it is also important to point out the theoretical connection of the solution. When all the steps described in figure 2 are performed, the last step in constructive approach is to investigate the scope of applicability of constructed solution. Constructive approach is useful for research that aims to solve problems, not just to investigate them. (Kasanen, Lukka and Siitonen, 1991.)

The data of the case is mainly qualitative, and it is collected by interviewing the stakeholders of the outsourcing project and the order-to-delivery process. There is also a benchmark chapter, which is a brief case about the collaboration model of Company X and their 3PL warehouse. The used interviewing method is theme-based, unstandardized interviews. In theme-based interviews the topics are pre-planned, but the interviewee answers freely and answers determine the next questions. The interviewer has to control that the conversation remains relevant and under the predefined topics (Eskola and Suolaranta, 2014). Theme-based method was selected since every interview focused on different subject, in which the interviewee was specialized in. ABB's internal documentation is also utilized to complement the information gathered through interviews. The schedule and topics of interviews held during this study is described in appendix 5.

Literature review, which contains the theoretical framework of this study, is focusing on three main concepts which are related to the case study. There are three main topics forming the theoretical framework;

1. Performance measurement in the context of strategic management

2. Outsourcing in the context of competitive advantage
3. Lean management as a part of improving performance through business process development

Academic journals and reviews, textbooks, and all kinds of e-resources are utilized to gather versatile information and understanding about the subject. Literature review is supposed to bring forth different aspects of mentioned topics.

2 Improving logistics processes and their management

This chapter contains the theoretical frameworks and topics that are utilized to achieve the objectives of the study. Introduced theories are supporting the case study by increasing understanding about the subject, but also by offering the best practices from academic researches in the field of process management and improvement. Topics are supposed to be relevant for the examined case, and to offer sufficient amount scientific information to support the conclusions.

2.1 Strategic Management

Global competition along with rapid changes in business environment caused by global development trends create challenges for the success of a single company. To succeed with these challenges, companies must be prepared for the future. Hence, focusing only on today's business is not enough. Consequently, companies need to decide the direction they want to navigate their business, how to differentiate from competitors, and how to make profit also in future. This plan for the business and competition is called strategy. (Jeyarathmm, 2007.)

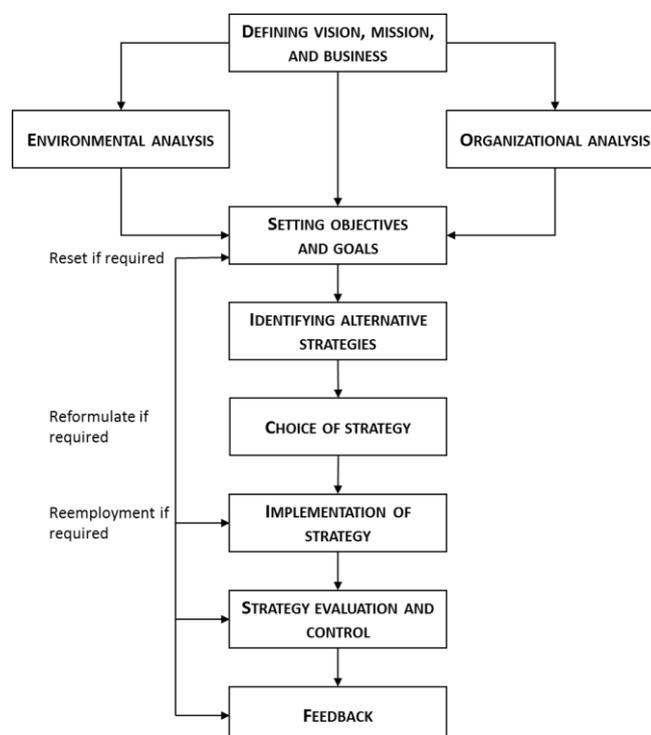


Figure 3. Basic model of strategic management (Glueck, 1980).

Prior to setting goals and objectives for future, strategic management begins from determination of company's mission, values, business, and vision, as pointed out in figure 3. A mission statement determines the purpose of company's existence, a business plan clarifies where the profit is gathered, and vision is the objective that a company is aiming to achieve in future. Organizational analysis includes recognizing company's internal strengths and weaknesses regarding to competencies, organizational structure, employees, and current business in general. Environmental analysis evaluates the external factors that somehow affect to the company and its business (Glueck, 1980). Environmental factors, such as competitors, suppliers, customers, politics, and industry development trends can be divided to opportunities and threats. After all these steps have been considered, the goals and objectives for the strategy can be set and the vision statement becomes more accurate.

Strategy

As the vision statement is a target state for the company's future, a strategy determines the path that leads to that target. According to William Glueck, strategy is "*a unified, comprehensive and integrated plan designed to ensure that the basic objectives of the enterprise are achieved* (Glueck, 1988)". Thus, all the objectives, both financial, such as revenue and profit, and non-financial, such as customer satisfaction and operational efficiency, should be defined in the strategy. These targets can then be divided into smaller waypoints and the responsibilities of different objectives of the strategy allocated to functions within the organization. On a grassroots level of a business, the strategic targets should be simple enough and addressed clearly in daily work. In operations these targets are usually related to efficiency and quality. (Jeyarathmm, 2007.)

The following subchapters will introduce the important topics concerning the strategy process and succeeding in competition in general. Chapters are concise, and indicating only the core of each topic to help understanding what are the factors that a strategy is targeting.

Efficiency

Efficiency, by definition, is the ratio comparing the amount of inputs needed to produce a certain output. In this context, inputs refer for example to capital, raw material, hours, know-how and land. Output in turn means the outcome of the process, usually a product

or a service. The more efficient business process is, the less inputs are consumed to produce one output (Jeyarathmm, 2007). The less inputs are consumed, the lower are the costs of the process. Being efficient is important for all companies, as it makes them more competitive and enables larger profits.

Quality

Quality measures how well a product or service fulfills customer's needs and expectations. From the viewpoint product manufacturer or service provider, quality measures how well a product or a service conforms the predefined specification. Both definitions are correct, and referring to the same issue; customer's observation on a product or service compared to customer's expectations. Companies plan their products and services to match with the expectation of customer's requirements. Past experience, personal needs and wants, word of mouth, and communications of the company are the main pillars that form the customer's expectations. The main characteristics of product quality can be observed objectively; usability, reliability, durability, maintainability, and other product-specific factors. Service quality is determined by the customer experience and is thus more of a subjective factor; how does the service perform compared to the promises and expectations, technically and functionally. (Kotler, 2005.)

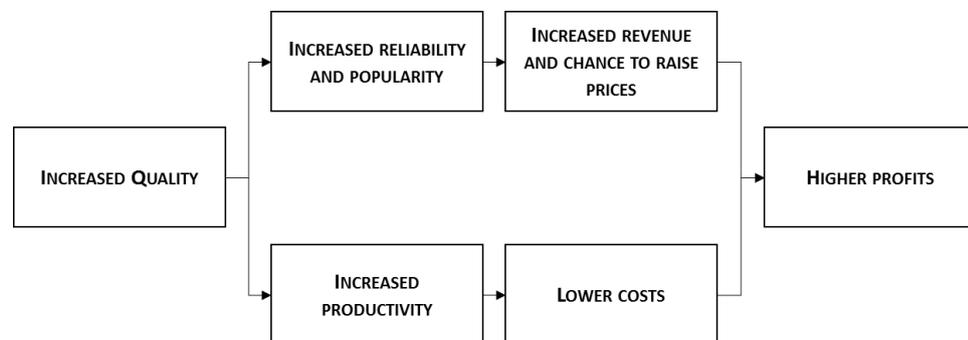


Figure 4. Positive impact of quality on an enterprise (Jeyarathmm, 2007).

The quality in manufacturing and service processes can be assessed by the process performance and by the outputs of the process. In a process which is well designed, managed, and performed, the quality means productivity and minimal variation in outputs. If the process quality is high, there are no faults in outputs and thus no need for doing the process again neither fixing the outputs. Since a high-quality process produces the required output on the first try, it means that quality increases efficiency. The benefits

of quality are described in figure 4. Philip Crosby, an expert in quality management, referred to quality by stating: (Crosby, 1979) *“Quality is free. – Do things right in the first place, and you won’t have to pay for fix them or do them over.”* Cosby’s idea is clear, but it is important to recognize that it requires resources from a company to focus on the development, in order to make quality happen. Development requires resources, which on the other hand are not free.

Competitive advantage

Successful strategy aims to differentiate company from competitors in positive way from customer’s point of view. Differentiation requires a competitive advantage for company (Haverila et al., 2009). Competitive advantage can be unique way of doing business or unique products, but it always consists of the entirety; location, organizational structure, employees, strategy, management, processes, et cetera. Consequently, it is almost impossible to achieve competitive advantage by imitating a successful competitor. Competitive advantage consists of four dimensions; quality, efficiency, customer responsiveness, and innovation. Innovation is a new way of doing, and it influences customer responsiveness as it differentiates company from its competitors. Customer responsiveness means company’s ability to keep its customers satisfied by providing value for them. (Jeyarathmm, 2007.)

Benchmarking

Even though the competitive advantage cannot be achieved by copying ideas from competitor into own business as such, every industry has the best practices that are proven to work. If there is a problem in some function, company can try to solve it by benchmarking successful companies to see how they are doing the thing. Company needs to select a right kind of peer group to compare own business operations with. Peer group selection can be based on industry, business model, customer base, or assortment of products and services. Benchmarking helps avoiding the problems others have faced, and may give the insight about how company should execute certain functions or what products to offer. (Valdes-Perez, 2015.)

This study uses benchmarking to give insights about how to manage collaboration with external warehouse provider. The business of the benchmarked company on operational

level along with their outsourcing partner matches well to the current state in Drives Service. Benchmarking can be used utilized also in non-strategic projects.

Strategy analysis and evaluation

After setting the goals and objectives, a company should develop and identify alternative strategies to achieve the defined vision, as described in figure 3. Once there are couple of alternatives for the strategy to implement, them must be evaluated. A common tool for evaluating different alternatives is a SWOT-analysis, which combines the internal strengths and weaknesses with external opportunities and threats together. SWOT-analysis makes it easier to understand the key pros and cons of the strategy by simplifying it, but also helps identifying the future goals and challenges of it. Analysis consists of four areas; internal strengths and weaknesses of a company, and external opportunities and threats that are potentially affecting to a company in future. Internal strengths should be strengthened further, weaknesses reduced, opportunities enabled, and threats avoided. SWOT has some limitations too, since it is always somehow subjective, factors in it are seldom prioritized nor described accurately enough. (Jurevicius, 2013.)

Strategy implementation and control

Once a company has compared different options for achieving its objectives, and benchmarked the best practices, the progressive plan towards the vision can been created. Strategic targets must be transformed into practical plan in every function of the company. Well implemented strategy is visible in daily targets of every employee across the organization. Performance measurement is needed for effective management and implementing strategy in daily work. Results of performance measures act as a feedback on how well the current processes and targets are supporting the objectives of selected strategy. The ultimate feedback about the selected strategy can be seen for example in the income statement and market share of company. However, following only financial measures does not help steering operations proactively to the right direction. Financials does not provide enough data for analyzing challenges in a single process. Company can be proactively steered to the desirable direction by frequent monitoring of different, both financial and non-financial, aspects of performance. (Neely, 2004.)

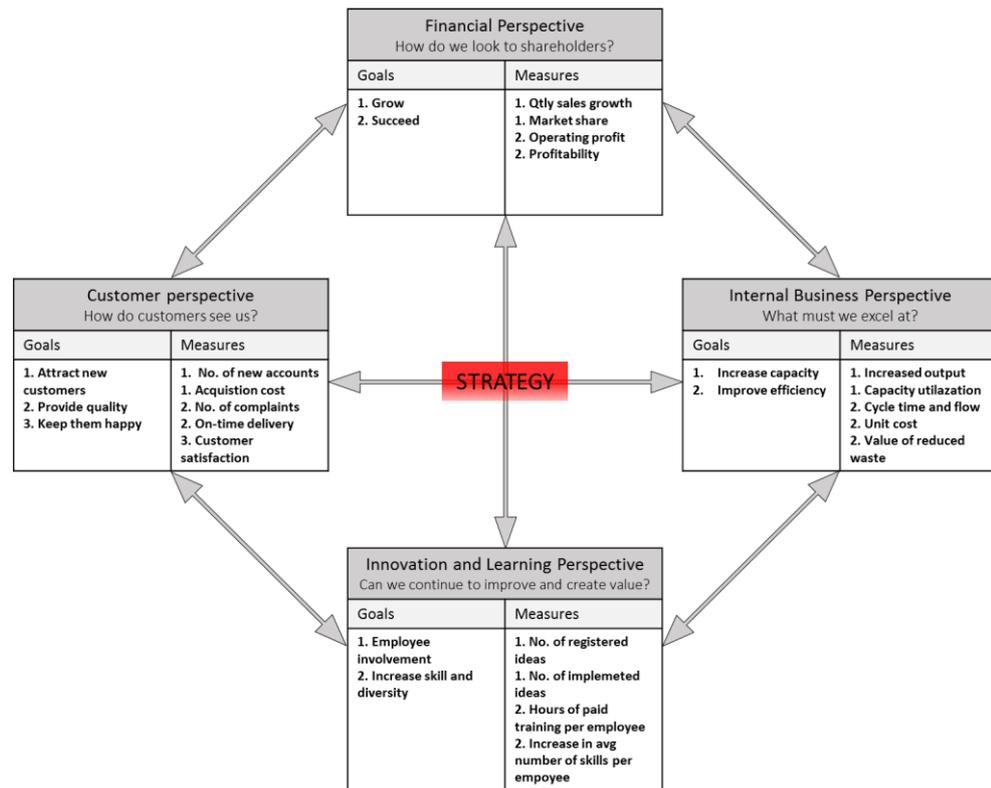


Figure 5. Balanced scorecard for strategy implementation and linking performance measures (Kaplan and Norton, 1992).

As performance contains several components and is always dependent on the perspective, there must be a diverse set of different objectives and measures to focus on. The balanced scorecard, introduced in figure 5, is a tool for giving a quick and many-sided view on overall performance of business in four main aspects; customer perspective, financial perspective, internal business perspective, and innovation and learning perspective. These categories contain goals derived from strategy. For every goal there are measures, and for every measure there is a target. It is important to limit the number of measures as much as possible to avoid information excessiveness, since balanced scorecard should be an effective tool for management. On the other hand, there must be enough goals and different measures to obtain sufficient and versatile information about the business. As balanced scorecard links different performance indicators with each other, it prevents company from sub-optimization and helps seeing the relations between different goals. Goals and measures in figure 5 are examples that could be used in a growth- and profit-oriented strategy. The strategic performance measures are called key performance indicators. (Kaplan and Norton, 1992.)

Performance measures

It is critical for company's success to define performance measures and targets correctly, in a way that indicators support company's strategy and they focus on the right performance drivers. There are two common proverbs about performance measures. First one, which is often associated to Peter Drucker, the founder of modern management, goes followingly: (Lavinsky, 2017) "*If you do not measure it, you cannot improve nor manage it*". Measuring different factors gives useful data about current performance. Current state must be known before improvements can be done. Information from performance measures helps finding the real problems. Without reliable information about the performance, management is based on a guesswork and focus is not on the valid challenges. However, every important factor cannot be measured. The other important expression about performance measures is from H. Thomas Johnson: (Stenzel and Johnson, 2007) "*What measure is all you get.*" Every measure and target have direct influence on organization works. They make employees focusing only on the measured factors and objectives, and this often leads to sub-optimization since the measures and targets cannot cover everything. Consequently, it is crucial to follow versatile set of financial, non-financial, internal, and external performance measures. Also, the followed measures must be carefully determined.

According to George T. Doran, targets for performance measures should follow a standard criterion which he calls by acronym S.M.A.R.T. (Specific, Measurable, Assignable, Realistic, Time-related). Specific means that a single target should focus on a specific area, for example a single function, process, or work stage. Targets must be measurable, preferably with quantitative method, to ensure the progress. Assignable means that the responsibility of achieving the target is determined to someone. Realistic means that every target should be achievable considering available resources. Time-related means the sequence of monitoring the progress, and deadlines for targets. (Doran, 1981.)

Pitfalls of performance measures

There are couple of common traps companies fall in with their performance measurement systems. Measuring the overall performance including all its aspects equally is difficult, since everything cannot be covered with simple quantitative measures (McLeod,

2015). Andrew Likierman mentions five common pitfalls companies face with the performance measurement systems in the HBR article “The Five Traps of Performance Measurement”;

- Measuring only against the own plan and targets while ignoring how the current performance compares in the competition. The measurement and performance targets should consider the benchmarks too.
- Focusing on the past by comparing the current performance with past results. Beating the past numbers is not relevant since performance measurement system should indicate whether the current operations and decisions will guide company in the desirable direction in the coming months.
- Relying on the numbers while ignoring the quality of the data. Metrics are often presented as numbers, and there is a risk that numbers are wanted no matter the quality of the data. Numbers never indicate the performance objectively and comprehensively. One reason for this is that people tend to emphasize the positive results and conceal the mistakes. Number-oriented companies tend to measure their performance with the most popular KPIs within the industry, in order to be able to compare their results against the benchmarks, even when those metrics would not serve own business in an optimal way.
- Using insufficiently determined performance measurement system leads to sub-optimization. Managing by metrics incites employees the optimize the results of monitored KPIs. To avoid sub-optimization, companies should measure performance with versatile and different performance indicators. To obtain a comprehensive view of the performance, the performance measurement system should utilize various data sources, such as customers, colleagues, bosses, and different time frames for the performance indicators. Also, the responsibilities of performance measures should be defined in a way which incites to co-operation when needed.
- Using old performance measures in fast evolving business environment creates data which does not help the management of operations. (Likierman, 2009.)

Companies tend to determine their performance indicators based on what is easy to measure, rather than measuring the most important factors. Also, measures are often determined falsely, because of a poor understanding about the causal connections of the performance. This means that the focus of a measurement is on the symptoms, not on the drivers of the performance. The selected performance indicators and their targets are also often considered as sources of objective information, while forgetting the initial purposes behind measuring those factors. As performance is always relative and many-sided concept, it is crucial to determine the measures correctly and diversely to achieve desirable results. Poorly selected set of measures results in misleading performance indicators, which lead to focusing on wrong things in daily work. Also, if the data provided by performance measures is insufficient, it leads to sub-optimization of operations. (Likierman, 2009.)

2.2 Outsourcing

Make or buy decisions are important strategic decisions concerning competitive advantage of company. Make or buy refers to a choice about what company should make by themselves, and what to buy outside. In a global competition, companies must put most of their resources to their core competencies, to what they are best at. Things that a company is best at should be made in the company. Because resources are scarce, it is often reasonable to buy components or services from other companies focusing on those areas. Companies achieve better overall quality and efficiency by utilizing the know-how and development contributions of companies specialized in other functions and industries (Haverila et al., 2009). Buying certain functions as a service or components from others also releases more resources to focus on the core competencies. Focusing on narrower scale of things increases the quality and efficiency, and thus helps maintaining the competitive advantage. Outsourcing means buying products, components, processes, or functions from an external partner for a remarkable period of time. Successful outsourcing partnership primarily requires a strategic decision from both parties, but also aligned incentives, information sharing, communication, and mutual development. (Jalanka, Salmenkari and Winqvist, 2003.)

Logistics outsourcing

Logistics is one of the most common function for companies to outsource. Supply chains are competing in global markets, and for companies the efficiency of supply chain has become an important factor of succeeding in competition. However, investments in supply chain often are often not as attractive than investments in other parts of the business. It requires significant investments to it-systems, facilities, equipment, and workforce to perform and develop logistics successfully. Therefore, companies aim to increase efficiency by outsourcing their logistics functions to a dedicated logistics company. According to researches, there are six main reasons for companies to outsource logistics: (Jalanka, Salmenkari and Winqvist, 2003).

- Company does not have suitable facilities, it-systems, equipment, or know-how for running logistics, and is not willing or able to invest and develop them
- Company is not willing to learn a new function
- Company wants to give away the function
- Fixed costs change to variable costs, making logistics costs to vary with the volume

- Better awareness about the costs originating from logistics
- Cost savings

These pros listed above are principally relevant in all kind of outsourcing decisions, not only in logistics outsourcing. Common misconception is that after a function is outsourced the buyer does not need to pay attention on it anymore. The higher the logistics outsourcing level is, the more collaboration, development, and information sharing is needed to ensure the efficiency and quality.

Logistics can be outsourced on four levels. The first level outsourcing contains buying a single procedure, such as transportation, as a service. As it is the outsourcing on a simple level, there is a normal supplier-buyer relationship between companies. The second level contains buying a few logistic procedures, such as transportation and in-house logistics from an external service provider, but the follow up remains at the buyer. On a third level of outsourcing, a company shifts the entire logistics function along with facilities, employees, and it-systems under responsibility of external service provider. This model is called 3rd party logistics, and it requires a partnership between the buyer and logistics service provider. The higher the level of outsourcing is, the more effort is needed to co-operation, development, performance measurement, control, and it-system integration. Outsourcing logistics extensively is a long-term business decision which is made on higher organizational levels. It also requires a lot of work to coordinate two companies to operate seamlessly together. Extensive outsourcing entails more risks as well, since the buyer is not able to control own logistics without the 3PL partner. (Jalanka, Salmenkari and Winqvist, 2003.)

Challenges of outsourcing

The potential benefits of outsourcing are not always achieved. Lack of communication, collaboration, and partnership development or fail in it-system integration decrease the quality and efficiency of the outsourced function. Increased organizational complexity makes management difficult via lower transparency and control on operations. Also, misaligned incentives between the parties of the outsourcing contract make it difficult for buyer to execute their own strategy. Outsourcing also unveils the hidden costs of the function, and them often ruin the pre-calculated profitability of the outsourcing decision. These factors have caused the cancellation of many outsourcing decisions. Taking the outsourced services back in-house is called back sourcing (McCray, 2016).

2.3 Lean Management

Lean as a concept is a fundamental management philosophy originating in Japan and Toyota Motor Company after the Second World War. It is an operating model that combines practical and analytical tools helping organizations to improve its operations in terms of quality, efficiency, and safety along with employee and customer satisfaction. Lean thinking makes an organization to produce more outputs with less inputs, ergo resources like time, tools, materials, facilities. Ultimately, lean aims to produce only what the customer needs and wants (Womack and Jones, 2003). Lean emphasizes the importance of employee involvement in continuous improvement, which aims to increase the flow efficiency and reduce costs by eliminating waste from processes. (Modig and Åhlström, 2013; Liker, 2004.)

History of Lean

The history of lean follows the general history of enterprise management. Taylorism ergo scientific management was invented at the beginning of 20th century by Frederick Taylor. The main innovations of Taylorism were dividing production in smaller phases by the type of tasks, standardization of working methods, close monitoring and timing of tasks, and further development of processes based on scientific measures (Taylor, 1911). Henry Ford implemented and developed Taylorism in car manufacturing, and concept called Fordism was born in the 1920s. Fordism focused on lowering the requirement for employee skills in processes by standardizing the product structure and inventing the assembly line, where simple parts were first assembled and then added to the main product in defined order. These innovations made products cheaper, production times shorter, and developed the visual monitorability of manufacturing processes which caused increase in quality. The scientific management and the mass production became popular especially in US after the Second World War. (Hounshell, 1997.)

The mass production enabled US car industry to utilize economies of scale with the help of big production lines and equipment which targeted to produce as many products as possible for the growing markets. At the same time in Japan, Toyota's markets were smaller, and they had to produce various products in the same assembly line which was not optimal for the mass production. Toyota developed their production system flexible as a solution for this challenge. Flexibility in this context means short setup times for machines in assembly line and multiskilled employees, both allowing Toyota to produce

smaller batches of different products profitably, but also to react promptly to the ever-changing demand. Toyota Production System (TPS) is used as a backbone of the modern concept called Lean Manufacturing. (Liker, 2004.)

The term Lean was invented in 1988 by John Krafcik, who wrote an article about the study of best practices in global automotive industry. Toyota had succeeded well with the help of their unique production system. They could produce better quality with less inventories, buffers, and repair areas. Working methods were standardized and work was done in teams. Teamwork was a remarkable difference compared to other car manufacturers, who believed in long assembly lines and high authority (Krafcik, 1988). Even though concept lean combines the best practices the study found from global automotive industry, most of its ideas are originating in Toyota Production System. As competitors started to utilize ideas from Toyota Production system in their own operations, concept lean became general. The concept has developed over the years, but the fundamentals of lean are still in TPS.

Principles of lean are nowadays widely implemented across industries. Lean has found its way from manufacturing to services, such as healthcare, and increasingly to all kinds of white-collar tasks (Modig and Åhlström, 2013). Even though many companies have achieved remarkable benefits by successfully implementing lean, many attempts have also failed because of lack of understanding the concept. There is a tendency for picking the simplest ideas of lean while ignoring the important fundamentals of it. This kind of a sub-optimization does not lead to expected, positive results. Lean as a concept is not only eliminating waste with its tools, it is a fundamental way of thinking; a long-term philosophy for enterprise management. (Liker, 2004.)

Toyota Production System

Toyota's principles for manufacturing and enterprise management are known as TPS, which is an integrated management system developed by Japanese industrial engineers at Toyota during 1940-1980.

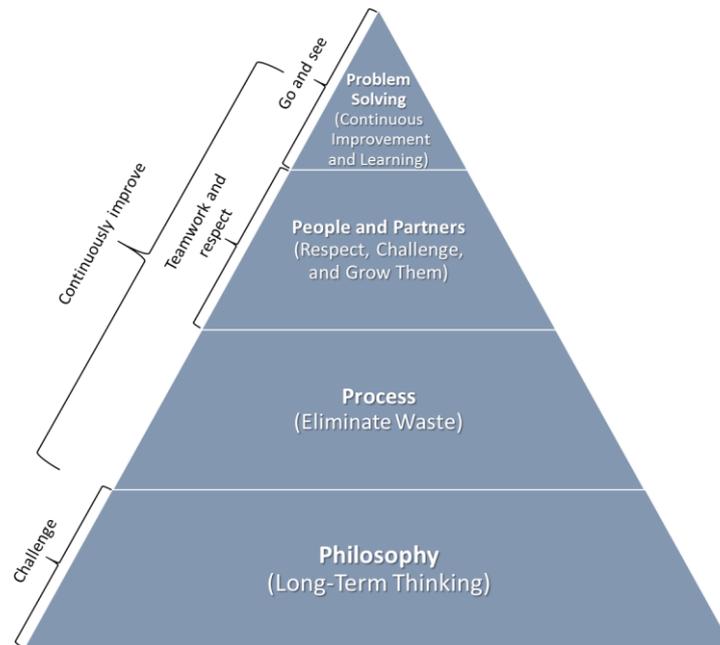


Image 1. The 4 P model of Toyota Production System (Liker, 2004).

Jeffrey K. Liker summarizes the foundation of the Toyota Production System into 14 principles in his book *The Toyota Way* (Liker, 2004). These 14 principles are divided into four categories in; philosophy, process, people and partners, and problem solving. The 4P model expressed in image 1 compresses the principles in a triangle. The basis of everything is a philosophy emphasizing the importance of long-term thinking. It means that management should base their decisions on a carefully considered long-term objectives regardless of potential negative financial effects in a short-term. The second part of the triangle concerns processes and making them flow by eliminating waste ergo unnecessary, non-value adding work. This includes utilizing pull production, standardizing tasks and leveling out the workload, and focusing on quality problems by using reliable technology and making visual control of processes possible. People and partners section concerns both own organization and all the stakeholders such as customers and suppliers. The 4P model instructs to respect people. Challenging and developing employees is important in growing self-imposed leaders. Problem solving is positioned on the top of the 4 P triangle. An organization must adopt a mindset of continuous improvement and learning to make this whole model work. As a part of this, employees should see the things they are working on to truly understand the situation. Organization is acting exemplarily in accordance with the 4 P model if it makes decisions meticulously together, but can rapidly implement them. (Liker, 2004.)

Flow efficiency

Lead time is the time that it takes for the object to pass through a process. It includes all the process stages from the moment the object comes in the process until the moment the object has finished the process. Often in service or manufacturing process, there are several units in different stages of the process at the same time and thus queues for the next stage. Little's law defines the formula of a lead time followingly:

$$\text{Lead time} = \text{Amount of unfinished units in the process} \times \text{Cycle time}$$

Cycle time is the time that it takes from the resource to process one flow unit. If there are several resources attending to one process, the cycle time of the slowest phase is used to calculate the overall lead time of the process. The phase that uses most time for processing one unit in the process is called a bottleneck. There is always a work queue before the bottleneck waiting to be processed, but also idle capacity after the bottleneck waiting for units to process.

Bottlenecks define the lead time of a process. Bottlenecks are cause of a sequential nature of process stages, that is work must be done in a specific order. Often in a many-sided process, one stage takes longer than other. Even if all the process stages were planned to consume equal time with each other, there are always some kind of variation in the process which means that a bottleneck always exists. Shorter lead time increases flow efficiency. Bottlenecks must be found to shorten the lead time. By improving the cycle time of a bottleneck, the lead time of a process becomes shorter and the bottleneck shifts to some other stage of a process. Consequently, the flow efficiency can be continuously improved. (Modig and Åhlström, 2013).

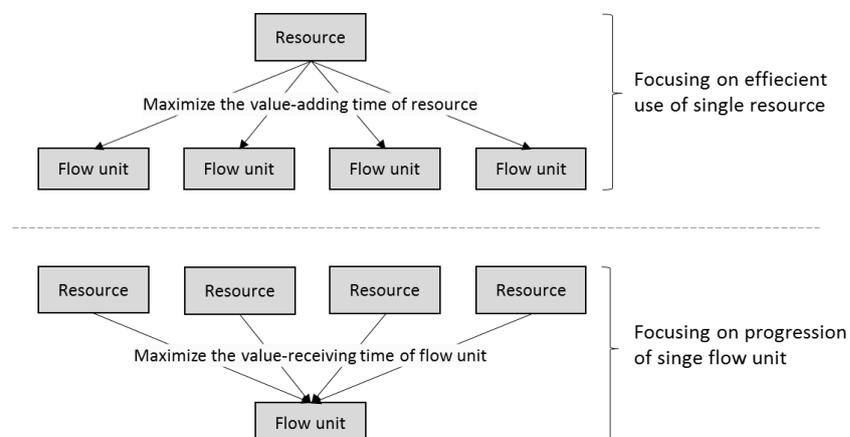


Image 2. The difference between resource efficiency and flow efficiency (Modig and Åhlström, 2013).

In a service or a manufacturing process, there are resources such as machines and people processing the object of the process. This object, such as product in a manufacturing process or customer in a service process, is called a flow unit. Companies naturally want to maximize the utilization of resources they are paying for. To maximize the utilization of for e.g. a machine in the assembly line, a company needs to ensure that there are always units to process for the machine. This often requires buffer stocks at the assembly line, where the unfinished products are waiting to be processed by the machine. Even though this method ensures the maximum resource utilization, it on the other hand increases inventory values through larger stock balances and work in process. Buffer stock also affects negatively to a lead time of a flow unit. Instead of increasing resource utilization through larger inventories, flow efficiency aims to minimize the lead time of the flow unit by maximizing the value-adding processing time and minimizing the waiting time of the flow unit (Modig and Åhlström, 2013). Maximum flow efficiency often results in low resource utilization, since there are idle resources waiting for the flow unit to process. This is a cause of poor process design, and lean aims to develop processes in a way that both flow efficiency and resource utilization are increased.

Root cause analysis with 5 Whys

Lean aims to improve processes by solving the root causes behind the problems. Rather than solving symptoms one by one, it is more efficient to focus on the original source of the problem. This is because one root cause may have several negative symptoms. Lean uses a method called five whys to uncover the root cause of a problem. The idea is to ask why five times, and thus get deeper to a cause of a problem. The following example about five whys from the book *Toyota Production System* (Ohno, 1988) explains the idea of five whys with the scenario of not working machine:

1. "Why did the machine stop? There was an overload and the fuse blew.
2. Why was there an overload? The bearing was not sufficiently lubricated.
3. Why was it not lubricated sufficiently? The lubrication pump was not pumping sufficiently.
4. Why was it not pumping sufficiently? The shaft of the pump was worn and rattling.
5. Why was the shaft worn out? There was no strainer attached and metal scrap got in."

As can be seen from the example, the five whys help seeing the long cause-effect chains and thus, enabling to shift the focus to the original problem instead of symptoms. Five

whys - method seems quite simple, but asking the right questions is essential for finding and solving the original causes. (Liker, 2004.)

Definition of waste

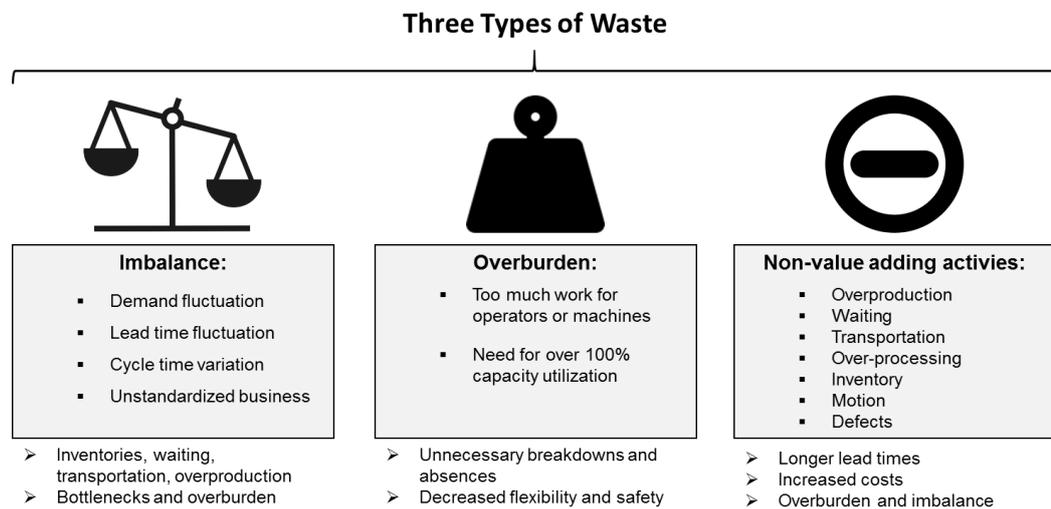


Image 3. Three types of waste in lean management (Liker, 2004).

Imbalance, overburden, and non-value adding activities are defined as three main types of waste in lean, as described in image 3. These three factors are interdependent of each other, and reducing one of these wastes usually reduces other wastes simultaneously. Everything that disturbs continuous flow, increases lead times and workload, or adds costs while not processing the product and adding value for customer, is waste. In simplified form, everything that increases costs without adding value is waste. (Liker, 2004.)

Non-value adding activities are divided in seven categories; overproduction, waiting, transportation, over-processing, inventory, motion, and defects. Overproduction means producing too much output compared to demand. Excessive waiting of machines, workers, or flow units lengthens lead times and do not raise customer value. Transportation of products or components increases the risk of damages while lengthening lead times. Over-processing means that product or service contains features that are not required by customer. Inventory means stocking components or products for future use, and it increases costs and decreases the flow efficiency. Waste of motion means needless movement of workers, machines, or flow units in a process. Defects refer to quality issues of products or services (Ohno, 1988). Jeffrey K. Liker have added an eighth waste for this widely known list of seven types of waste, and it is unused employee creativity.

Unused employee potential leads to loss of time, ideas, improvements, and skills. Unused employee creativity is a cause of not listening and knowing employees. (Liker, 2004.)

Obvious wastes are the non-value adding stages in a process, that are not compulsory under current work conditions. Obvious wastes are easy to remove and a starting point for the process development. The other kind of waste is the non-value adding work, that must be done under the present work conditions. To remove that kind of waste, the work conditions must be partially changed. For example, walking to another place to collect the needed parts is non-value adding work, but it must be done unless the layout of manufacturing is changed. Waste in operations generates a vicious cycle, which creates even more waste. For example, overproduction leads to excessive motion, transportation, and inventory. Transportation potentially leads to defects, and inventory means waiting for products. All the work for managing the inventory caused by overproduction is waste too. Therefore, waste can be divided into primary and secondary waste, and the root cause analysis, such as five whys, can be used to help discovering the primary source and the causal connections of waste. (Ohno, 1988.)

Process walkthrough and process mapping

Waste in a process is difficult to detect by just monitoring the outputs and current performance measures, ergo status quo. Every employee is supposed to participate in continuous improvement, and managers should be eager to listen to operators and their ideas. Before implementing an idea, decision-makers should go and see the situation by themselves. Process walkthrough helps understanding the whole process and its challenges. Company should go through their processes stage by stage, while keeping the aspect of customer value in mind with an important question; how does this stage increase customer value? After the walkthrough is performed, the process should be mapped. Process walkthroughs and process mapping are tools that help uncovering waste in operations. (Liker, 2004.)

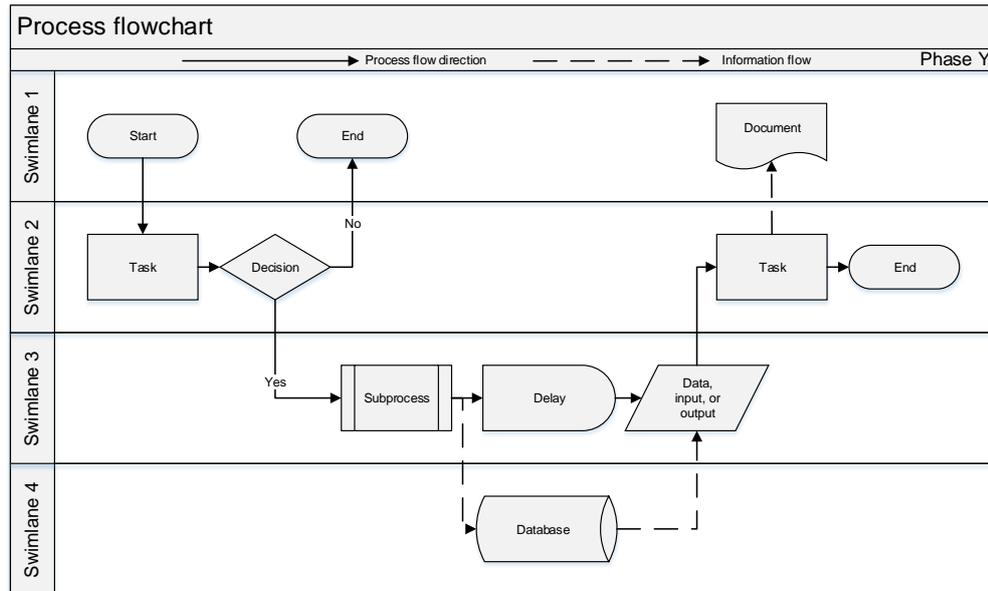


Figure 6. Cross-functional process flowchart and common symbols.

Cross-functional flowchart is widely used process mapping technique, which separates different types of tasks and stages in a process with different symbols. Operators and their responsibilities are expressed with swim lanes, and sequence of work stages is made visible by arrows, as described in figure 6 above. Lead time and cycle times can also be shown in this kind of flowchart, but it requires that tasks are expressed chronologically from left to right or from top to down, depending on the layout being horizontal or vertical. (ConceptDraw, 2017.)

Process re-engineering

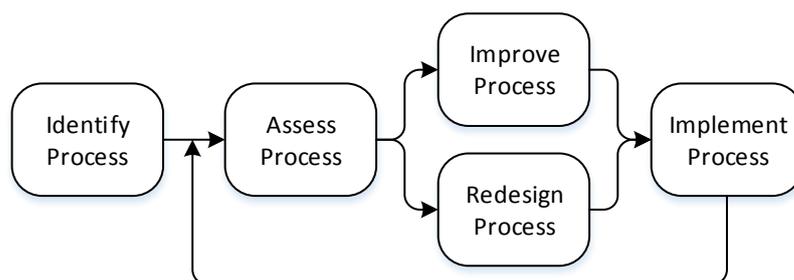


Figure 7. Flowchart of continuous process improvement (Sharp and McDermott, 2009).

Continuous process improvement is a cycle which starts from process identification and walkthrough. The current state of the process is known once process is assessed and mapped. Current state analysis evaluates the pros and cons of the current process, and determines how well it is reaching determined targets. After the assessment potential

problems can be solved, and this requires redesigning the process towards its target state (Liker, 2004). Once improvements are planned and process is redesigned, it can be implemented. The new process and its focus areas must be briefed to operators in the implementation stage. After implementation of the new version is done, the assessment of its results can start again. Continuous process improvement is an important part of Lean's continuous improvement philosophy. (Sharp and McDermott, 2009.)

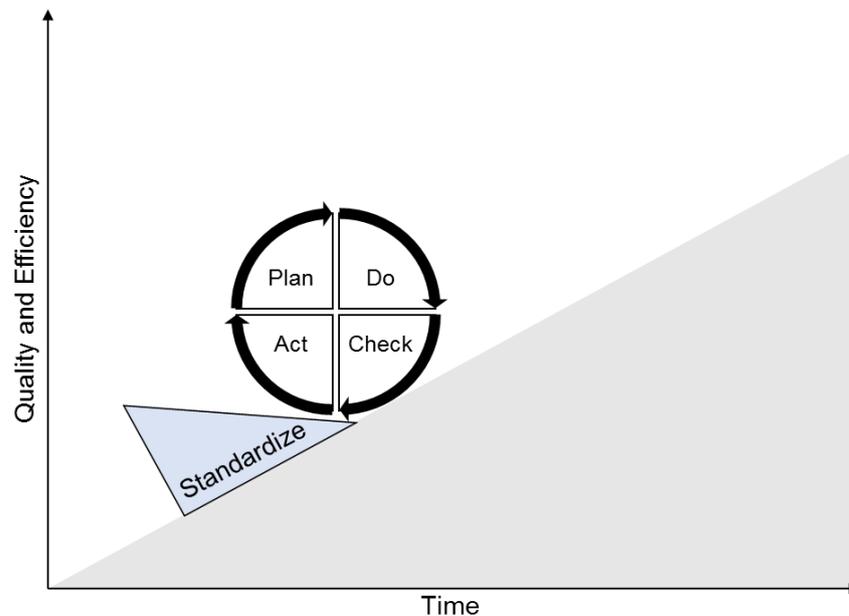


Figure 8. Continuous improvement with PDCA-cycle (Tague, 2004).

PDCA-cycle is a common tool for continuous improvement for quality and efficiency of business operations. In the first step called plan, the current state and problems are recognized, and corrective actions planned. After planning the change, the new model must be tested in real circumstances. Once the new model has been in use, the results can be seen from the performance indicators. Check means reviewing the results after test. Fourth step concerns actions, that are taken based on results in check part. If the change is positive and repeatable, it should be implemented and standardized. Standardizing prevents process from sliding back to the previous, worse level. In case the change was not for better, the information is still valuable and gives insight about the direction the development should be steered to. Once act-part is done, the cycle starts over from planning. This kind of iterative development cycle is effective for problem solving, and quality and efficiency improvement. Every phase must be correctly documented in order to have enough information for management and development. It is also crucial to standardize the proven model to ensure continuous progress. (Tague, 2004.)

Visual control

Visual control plays an important role in lean process management and continuous improvement. Visual control means that processes and standards are visible at the workplace so that employees know how they are performing and what must be done next. Visual control is a tool for uncovering problems and waste in processes. One tool of visual control is mistake proofing, which means that processes are designed in a way that they stop immediately whenever a problem occurs. As soon as the cause for the problem is investigated and fixed, the process can continue. This kind of process design builds high quality and continuous improvement in the process, since immediate actions are needed to minimize the waiting time at manufacturing line. Visual indicators, such as colored lights for monitoring quality or Kanban boards indicating workload, inform the current state of operations for employees. This makes one employee able to control more machines or processes simultaneously, since the visual controlling system helps noticing potential problems immediately and easily. According to determination from TPS, visual control means all kinds of just-in-time information provided in easily understandable form to ensure fast and proper execution of processes. Visual controls are supporting organization to do right things, but also to do things right. (Liker, 2004.)

The foundation of visual control is the 5S method, which is a process for organizing, standardizing, and visualizing workplace. The purpose of 5S is to improve efficiency, quality, flexibility, and safety in the workplace. The 5S method is explained in table 1 below. (Liker, 2004.)

Table 1. Description of 5S method with additional S for safety.

5S	Description
1. Sort	Organize necessary things and tools in the work area. Throw away everything that is not needed, also when there is a doubt about necessity. This ensures easy access to necessary tools, information, and material without unnecessary obstacles. Sorting also reduces inventory from the area while preventing usage of wrong tools or parts.
2. Set in order	Arrange the remaining objects and things in reasonable order according to workflow, and make them visual. Visualizing means marking places for tools with labels, for example. This makes it easier to find, pick, and return the items or information. Organized and visual workplace decreases unnecessary motion of employees because everything is rationally located and there is no need for retrieval nor searching. Also, it is easy to notice if something is missing when its dedicated place is empty.
3. Shine	Clean the work area regularly to ensure safety and comfort, but also operability of equipment and machinery. Cleanliness improves product quality as well.
4. Standardize	Set up procedures and schedule for maintaining the first three stages of 5S, and include them to daily routine. Standardize all the workstations to be equal with each other, so operators can perform the work regardless the workstation. Make standards visible with photos and visual controls, such as color codes. This ensures orderliness and cleanliness being part of daily work, and increases the clarity in the work area. Flexibility increases since operators can work in any standard workstation similarly.
5. Sustain	Sustaining refers to maintaining previous components of 5S with discipline. Once the 5S methodology is internalized and added into daily routines, organization should carry out the 5S method without having to be reminded. Regular 5S audits includes to this part of the methodology, and them are usually performed using standardized checklists to go through every aspect of 5S fulfillment.
+ Safety	Safety is often mentioned as sixth S, even though it was originally considered as one of the results of 5S. Anyhow, additional S for safety forces organization to focus on safety in daily work by continuously examining every workstation and work area from safety perspective.

5S is a tool supporting continuous organization, maintenance, and cleanliness at the workplace. It is not a spring cleaning, or being prepared for a customer visit. 5S reduces waste and thus improves efficiency, but it also enables to produce better quality in safe environment with increased flexibility. 5S is traditionally associated with manufacturing plants and blue-collar tasks, but it can also be utilized in the white-collar environment. In the office, the 5S method means general organization, safety, and logical positioning of tools and information. Principles of 5S can be further exploited in data handling, for example by rationalizing information appearance, and removing nonessential data information from files. Safety is also important in data handling. The biggest challenge for companies is the fifth S, that is maintaining the cleanliness and organization with discipline.

Problems first – culture

In lean thinking, continuous improvement covers everything action that is performed in a company. The most important factor for continuous improvement attitude in an organization is to always blame processes instead of employees for mistakes. Employees can be trained to reduce the human errors, but them can never be removed completely. Processes in turn should be designed in way that which guide the operator to perform them correctly. The possibility for human errors should be minimized in the process design. Consequently, every mistake is a symptom from non-error proof process. Finding these symptoms gives an opportunity to unveil the causes and thereby continuously develop the way of working. Once this attitude is part of the culture in an organization, employees are not afraid to bring the problems up. In terms of continuous improvement, the most significant problem for a company is that there are no problems. It indicates that either employees are not able to see the problems, or the culture is not encouraging to bring them up. If there are no problems, it often makes organization to be satisfied in the status quo. This satisfaction prevents company from continuously improving their operations. (Dolcemascolo, 2009.)

3 Background of the case company

In this chapter ABB group and its Finland based global service center ABB Oy, Drives, Drives Service will be introduced. After a brief introduction to ABB group, this chapter focuses on Finland based service center Drives Service, where this research has been conducted. The latter part of this chapter clarifies Drives Service's position in the organizational structure of the ABB Group. Moreover, the latter part of the chapter introduces business and operations of Drives Service, and clarifies how is the corporation strategy deployed in the business unit.

3.1 ABB Group

ABB is a multinational corporation operating in the field of automation and electrical power technology. ABB is an engineering company and it is divided into four divisions; electrification products, robotics and motion, industrial automation, and power grids. The company form is a publicly traded limited company and its headquarters are in Switzerland. ABB operates worldwide in more than 100 countries employing ca. 136 000 employees. The annual revenue of ABB was 33 828 million dollars with 12.4 % earnings before interest, taxes and amortization in 2016. (ABB, 2017.)

The abbreviation ABB is composed of ASEA Brown Boveri. The company is a merger of Swedish industrial company ASEA and electrical engineering companies Brown, Boveri & Cie (BBC) originating in Switzerland. In 1988, BBC merged with ASEA and ABB was established. ASEA had acquired the Finnish electromechanical company Strömberg Oy AB in 1987, a year before its merger with BBC. This explains ABB's strong foothold in Finland as well. (ABB, 2017.)

ABB as a company aims to improve performance, drive innovation, attract talent, and act responsibly. ABB's mission is summarized in the company's slogan "Power and productivity for a better world". As for the vision of the company, it is described via three factors; customers, environment, and shareholders. From customers' perspective, ABB wants to enable efficient usage of electrical power and to increase industrial productivity. On an environmental level the vision is to lower the environmental impact in a sustainable way. For shareholders, ABB's ambition is to accelerate sustainable value creation. (ABB, 2012.)

Next Level Strategy		
<p style="text-align: center;"><u>Growth</u></p> <ul style="list-style-type: none"> • Develop product portfolio • Strengthen competitiveness • Lower risk • Growth areas: <ul style="list-style-type: none"> • Microgrids • Oil & gas • Food & beverage • Africa 	<p style="text-align: center;"><u>Execution</u></p> <ul style="list-style-type: none"> • Develop leading operating model ➤ World-class operations • Focus areas: <ul style="list-style-type: none"> • Working capital • White-collar productivity • Quality 	<p style="text-align: center;"><u>Collaboration</u></p> <ul style="list-style-type: none"> • Simplify the way of working • Improve customer focus • Strengthen business orientation • Clear and efficient organization

Figure 9. Current strategy of ABB Group with three focus areas.

To reach the objectives mentioned in the company's mission and vision statement, and to succeed in the global competition, ABB has published its current strategy called "ABB Next Level Strategy" for the years 2014 - 2020. A summary of the main strategic objectives of ABB Group is described in figure 9. The strategy of ABB has a strong focus on competitiveness, growth, and quality. It emphasizes organizational and operational efficiency, innovation, and customer focus. The corporate strategy is adjusted to match business and location specific challenges in every business unit.

3.2 Drives Service

Drives Service is a product group of ABB's business unit Drives. Drives Service focuses on the aftersales and service in the business unit. The business unit Drives offers devices and software that enable efficient use and control of electrical power, such as variable speed drives. Along with the drive hardware, the business unit offers software and service solutions for their customers. Drives Service is a global service center in Helsinki with 150 employees and annual revenue of slightly over 100 million euros.

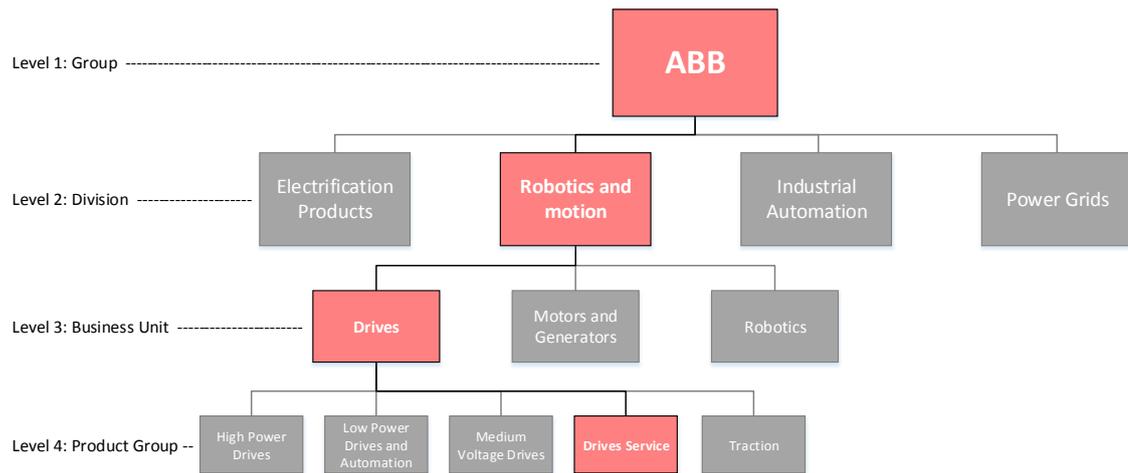


Figure 10. Drives Service within the organizational structure of ABB Group.

As can be seen from figure 10, business unit Drives includes five product groups. Three of these including High Power Drives, Low Power Drives and Automation, and Drives Service (DS), are based in Finland. HPD and LPDA, called Drives manufacturing afterwards, are responsible for global manufacturing and sales of new drives. Drives Service is responsible for the aftersales for customers of Drives manufacturing. Drives manufacturing and DS are separate organizations, but they are contiguous both business- and location-wise. There is a close co-operation between Drives manufacturing and Drives Service, and they have some shared resources as well.

AC drive, technically known as variable speed drive or variable frequency drive, is a device controlling an electric motor. Input power and rotational speed of a motor can be controlled with the drive. A drive adjusts a motor to operate with a precisely required power, thus reducing the environmental load of the motor through efficient energy usage. Without a drive electric motor works with on/off – principle, binarily. In this situation the only way to control the motor is to brake it mechanically while the motor itself rotates with a maximum power. This is neither optimal or sustainable to steer the electric motor because both too fast rotating motor and the braking system waste energy and wear out materials. (ABB Offerings, 2017.)

Users of ABB's drives are industrial factories, power plants, paper mills, ships, and other large and critical actors. Investments within these industries are significant, and plants often part of local infrastructure. Drive owners have an incentive to maximize the utilization of capacity by avoiding breakdowns. To keep the processes running constantly without disruptions, a drive needs constant service and care. Often this care is scheduled to a maintenance break which is strictly limited to avoid unnecessary, expensive idle time

at a plant. Moreover, if there is an unpredictable breakdown at the customer's site, the requirement for fast service is urgent. This underlines the importance of Drives Service as a supplier for its customers. The organization is supposed to deliver the correct spare parts and repairs exactly in time to fulfill the customer requirements. At the same time the product and service offering must be wide since DS is supposed to support all the AC drives in different life cycles. These factors create a demand for reliable, flexible, and efficient operations.



Figure 11. Drives Service's position in a simplified global sales process.

The portfolio of Drives Service consists mainly of spare parts and maintenance service solutions for drive owners. In addition to these, also maintenance kits, repairs, refurbishment solutions, training, and other solutions, such as preventive maintenance belong to DS's assortment. Direct customers of the global service center Drives Service are local ABB sales units all over the world. Local sales units are directly in touch with the end customers, as described in figure 11.

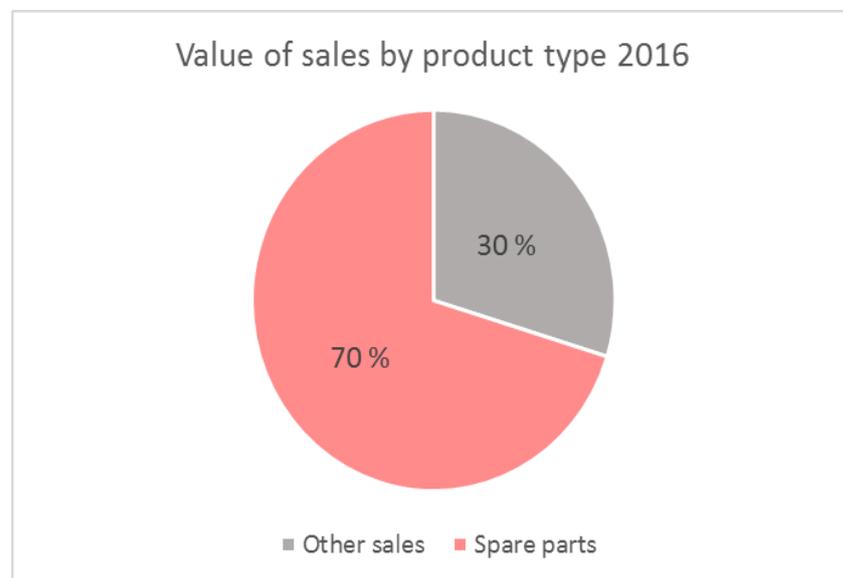


Figure 12. Relative distribution of Drives Service's sales orders in 2016.

Even though DS as a service organization is constantly trying to increase the relative share of tailored services in their sales, spare parts are still having a dominant share in their sales proceeds. As can be seen from the figure 12 above, 70 % of sales comes

from the standard spare part orders. Standard spare parts are products that DS orders to shelf directly from supplier. They are stored mainly in a sales condition, except some items that require single packing at the warehouse. Compared to more complicated service products and post-manufacturing units, spare parts are a straightforward business with a smaller gross profit for Drives Service. Considering this, spare parts have a dominance in delivered order rows as well. The value DS spare part selection offers for customer, is the guidance along with a wide selection of parts available in one place with a short lead time. This explains the study demarcation to the standard spare part order-to-delivery process. The most benefits are achieved by improving the most frequent processes.

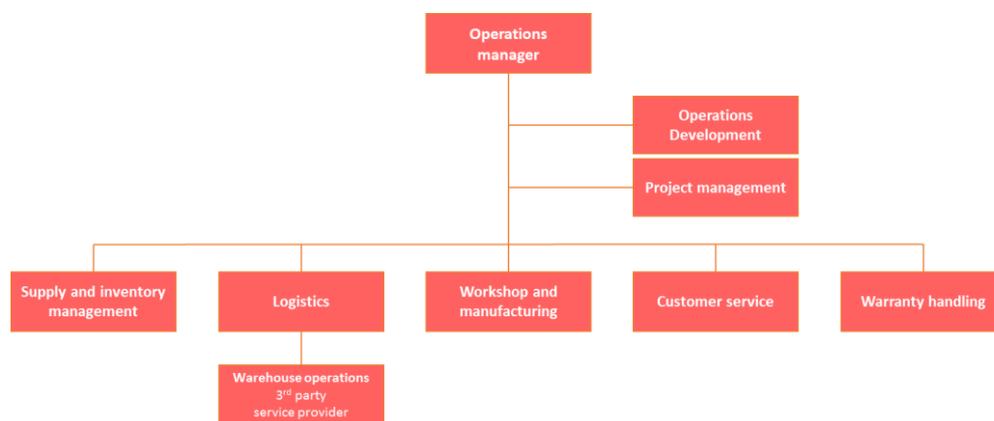


Figure 13. Organization chart of Drives Service Operations before the warehouse relocation.

Drives Service is organized functionally with basic functions such as finance, product management, sales, and operations. As described in figure 13, Drives Service Operations function is divided into seven sub-functions called supply and inventory management, customer service, warranty handling, logistics, workshop and manufacturing, project management, and operation development. The logistics team and the 3rd party warehouse operations will change in the warehouse relocation project introduced in the current state analysis.

Strategic focus areas of Drives Service

The corporate strategy of ABB Group is adopted by every business unit. The group level strategy does not consider every business unit particularly, but it is steering the whole group by giving the framework for the business unit - specific strategy. Drives Service implements the group strategy by determining its strategic focus areas for the upcoming

year. Strategic focus areas determine the development trend in the business unit specifying the needed actions.

Drives Service is focusing on the following factors in their strategy for years 2017 and 2018:

- Operations transformation, which includes moving out from the previous warehouse and setting up a co-operation with new logistics partner.
- Reducing waste in all departments by ensuring that processes are streamlined, and data correct. This affects to the customer experience by providing shorter waiting times, but also increases profitability.
- Inventory optimization concerning the inventory value and availability of materials.
- Profitable growth by better pricing along with the productivity and quality program in sales department.
- Improving quality by process mapping, process development, and relevant performance measurements. Quality section in the strategy includes also better information exchange within Drives Service and KPI automatization program to streamline the decision-making.

4 Current state of the order-to-delivery process after the warehouse relocation

This chapter introduces the warehouse relocation project conducted in Drives Service. Furthermore, the current state introduces how does this warehouse outsourcing affect to the spare part order-to-delivery process and the management of it. Biggest challenges, wastes, and inefficiencies are evaluated in this chapter, and them consist the basis for development proposals in chapter 6. The current state analysis has been executed by interviewing the process owner and the stakeholders of the process.

4.1 Background about the warehouse relocation project and evaluation of impacts

Drives Service supports existing Drives customers with constantly growing drive-base, and thus their business is growing steadily. The scarcity of storage space had been increasing in recent years at the warehouse. Heretofore, Drives Service had managed to operate with the existing warehouse space, but lately the need for warehouse expansion had become essential in order to allow DS to maintain their service level. Drives manufacturing in Helsinki had utilized 3rd party warehouse and logistics provider for couple of years while DS had their own warehouse separate from it. Since DS uses partially same components as Drives manufacturing, Drives had to transfer items between two warehouses. There were overlap in Drives inventory as both warehouses stored same items, and the stock transfers created waste in Drives operations too.

Drives Service's warehouse building was rented by ABB, but most of the employees working there were employed by an external service provider. Warehouse management and the forwarding team were ABB's own employees, which made the management of warehouse operations straightforward. Besides working in DS's warehouse facility, the external employees executed tasks in ABB's SAP ERP system. The external service provider was only responsible of the execution of warehouse processes, but the ownership of processes was at completely at ABB's side.

Referring to the strategy of DS, outsourcing all the warehouse operations and facilities provided the opportunities to eliminate of the scarcity of warehouse space, to improve the cost efficiency by pooling inventories within the business unit, and to simplify the organization and material flows overall. Drives Service's warehouse relocation project

started in October 2016. The warehouse transfer project started with determining the requirements for the service provider and evaluating the potential service providers. The most suitable service provider was selected based on the selective tendering. For earlier mentioned reasons, Drives decided to locate DS's warehouse operations under the same 3PL warehouse where Drives manufacturing stores their components. The transfer project involved about 20 employees from ABB, and about 10 employees from the 3PL partner all year round on 2017. The physical relocation of the warehouse was carried out on November 2017, and since then DS's warehouse operations have been running under operations of the 3PL partner.

According to the relocation project manager, the biggest challenges in the warehouse relocation project were related to it-systems. Selected 3PL partner is not operating in the ABB's SAP ERP system, which caused a lot of coordination and planning to the processes. The interconnection between it-systems had to be planned, built, and tested before the actual relocation, so that the processes could be executed at the new location. Besides synchronizing and coordinating the processes in it-systems, the project included general process development, inventory optimization together with Drives manufacturing, physical warehouse relocation, and teaching new processes and systems to employees of DS and the 3PL partner. Even though the cornerstones of the collaboration were listed in the outsourcing contract, the collaboration model needed to be created in practice.

The outsourcing contract primarily determines the responsibilities, terms and conditions, and fees of the outsourced warehouse operations. The 3PL partner is responsible for development of their in-house processes, and DS is responsible for the development of their own processes but also for the synchronization of the processes and systems with the 3PL warehouse. DS has an incentive to improve the operations overall to cut down the costs and to make the customer experience better. The 3PL partner has an incentive to perform the warehouse tasks as efficiently as possible, because the price list in the outsourcing contract is based on the volume of transactions. Moreover, the outsourcing contract includes bonus-malus clauses concerning the performance of operations. It means that the 3PL partner can earn bonus or penalty fees if their performance differs, positively or negatively, from the agreed levels. To utilize these incentives determined in the contract, parties must build a reliable and clear KPI framework to evaluate the performance together.

SWOT-analysis about the warehouse relocation project

	Positive	Negative
Internal factors	<p>Strengths:</p> <ul style="list-style-type: none"> • No need for warehouse expansion and investments • Inventory pooling with manufacturing • Reduces internal material transfers • Increased flexibility as 3PL partner has several customers • Fixed costs from warehouse operations become variable costs 	<p>Weaknesses:</p> <ul style="list-style-type: none"> • Two collateral ERP-systems create challenges and risks to fluency of operations • Lower process visibility and transparency • Increased complexity in operations management
External factors	<p>Opportunities:</p> <ul style="list-style-type: none"> • Simpler to get more storage space • Better quality and efficiency, focus on core competencies • 3PL economies of scale • Lower inventory levels • Better availability through automated stock transfers ➤ Cost effective warehouse logistics with better customer responsiveness 	<p>Threats:</p> <ul style="list-style-type: none"> • Errors in interaction between it-systems • Quality of operations falls behind without sufficient attention • Know-how gets lost • Lack of communication and collaboration • Incompletely defined outsourcing contract incite parties towards different objectives and suboptimization

Figure 14. SWOT - analysis about the warehouse relocation of Drives Service.

SWOT-analysis in figure 14 sums up the impacts of the warehouse relocation project. The evaluation is based on the interviews and the theoretical framework of this study. It can be used as a framework for further development of the collaboration. DS must consider how to take advantage of the strengths, utilize the opportunities, reduce weaknesses, and avoid the threats with the outsourced warehouse.

Strengths

Primary strength of the outsourcing project is that DS can obtain more warehouse space without investments for warehouse expansion; hence, they can eliminate the increasing fixed costs and risks that pertain to running a warehouse. The other advantage is inventory pooling with Drives manufacturing. After DS moves its warehouse to the same building with Drives manufacturing, there is no need to transfer materials between two locations. This reduces waste from the supply chain by simplifying material flows. As the 3PL partner has several customers in their warehouse, they can allocate the capacity easier to match with a fluctuating demand of a single customer. This increases the flexibility of DS warehouse operations too. Outsourcing the warehouse operations also makes DS's cost structure lighter, as it decreases the share of fixed costs. Previous fixed costs from the warehouse and equipment become variable costs. As DS is buying the warehouse

operations as a service, it makes the costs to adapt with the volume, and that is decreasing the business risks.

Opportunities

Besides the realized strengths, the outsourcing project contains a lot of potential advantages ergo opportunities. Opportunities are related to financial and operational factors. Operationally the outsourcing enables DS to grow its business without having to worry about the warehouse space. As the 3PL partner operates the warehouse logistics, it releases resources of DS from daily warehouse matters to more productive tasks such as developing the processes better for the customer. The arrangement also allows the 3PL partner to focus on its core competencies. As a logistics professional the 3PL partner has more resources and knowledge for improving the logistic warehouse processes. This potentially improves the overall quality and efficiency of DS operations. The 3PL partner can also utilize economies of scale in their warehouse since they have several customers there. This keeps the operational unit costs moderate and lowers the pressure of raising prices. Possibility to pool inventories with Drives manufacturing is potentially helping Drives to lower its overall inventory levels while it reduces internal stock transfers within the business unit. Because there is no need to physically transfer the common-use items between two warehouse locations, they are immediately available from one storage location. This improves the availability of materials. The overall opportunities for cost effective and high-quality warehouse operations are remarkable due to the outsourcing project.

Weaknesses

After outsourcing all the processes, where the warehouse is involved in, get more complex since there is an organizational gap between the operators. That is the biggest disadvantage of the warehouse outsourcing. The gap decreases the visibility in processes since ABB has no access to the 3PL ERP where the data about warehouse transactions is stored. As the operations transparency decreases, it creates challenges to process management and development. ABB has noticed this weakness upfront and therefore the warehouse relocation team worked most on building a reliable interface between two ERP systems. The ERP interface is filling the gap between organizations for its part, but there is still an existing risk of system messages getting stuck in the middle which has a

negative effect to operations reliability. The gap is there between the employees of two organizations as well, so this challenge is not only pertaining to the it-systems.

Threats

The biggest threat affecting directly to operations reliability is the malfunction of ERP-interface. If necessary system messages are not transferred promptly between two collateral ERP systems, it will cause many problems to operations of DS. Most importantly, these it-problems have a direct effect on DS's delivery performance. This is a big risk for the business, since lower quality decreases profitability and customer satisfaction. Urgent customer projects often include penalty fees regarding delivery delays which causes extra costs for DS, while the overall reliability of DS as a supplier suffers. Like in every outsourcing project, there is a possibility that the objectives and potential benefits are not achieved. In this scenario, the quality of DS operations may become worse than it was before the warehouse outsourcing. This is likely if DS does not pay enough attention on building a successful collaboration model with the 3PL partner. It is also a challenge to maintain the accumulated know-how about the DS-specific warehouse operations over the outsourcing project. DS's business differs from Drives manufacturing's one in a way that their operations must be more flexible. DS must be capable to handle the special cases also at the new warehouse. The last threat is about unclear responsibilities and objectives in the collaboration with the 3PL partner. DS has no authority over the 3PL partner, even though ABB is responsible for the deliveries to their customers. The ultimate authority for both parties in the collaboration is the agreed outsourcing contract. Incompletely defined contract can cause fundamental problems for the collaboration. The outsourcing contract should tackle interest conflicts and incite both parties towards same objectives.

Impact of the warehouse relocation on the spare part order-to-delivery process

Before the warehouse relocation, the order-to-delivery process was executed completely in ABB's own ERP system and warehouse building. Moreover, the warehouse operations management were on ABB's responsibility. The previous order-to-delivery process is described in the appendix 1. As can be seen from the workflow in appendix 1, it was easy to monitor the process from ABB's ERP system before the relocation. Even after the warehouse outsourcing, DS can only monitor the order-to-delivery process based on

the data in SAP. DS does not have access to the 3PL ERP, which decreases the monitorability and transparency of the process. All the physical warehouse operations, such as picking and packing, are executed in the 3PL ERP. Anyhow, SAP and 3PL ERP are interconnected via ERP interface, but it provides only a limited visibility to the whole process for DS. The overall risk for process stagnation increases as there are more it-systems and parties involved in it. Current state of the spare part order-to-delivery process is described in the following chapter.

4.2 Spare part order-to-delivery process after the warehouse relocation

Standard order-to-delivery process for spare parts starts from a customer order and ends when the customer receives the ordered item. Drives Service's operations, the 3PL partner, and a carrier company are all involved in performing this process with the help of couple interconnected it-systems. The process is described from the viewpoint of Drives Service and its customers. The accurate process workflow of the current spare part order-to-delivery process is illustrated in the appendix 2.

Customer order

The process begins when a customer places a purchase order for a spare part in the order management system of Drives Service. The OMS is an interface between customers and Drives Service. Customers can order parts and services, and follow the delivery process there. Customer selects needed spare part, sets a requested delivery date, and places the order in the OMS. A basic contact information, terms of delivery, and a standard carrier are determined by the customer account. The order form contains input fields that are divided into mandatory and additional information. Customer cannot to place the order if mandatory fields are not filled. Sometimes the additional information is also critical for on time delivery. In case customer's delivery address is unclear, the order can be placed but it cannot be delivered, for example. Therefore, the customer service of DS educates the local sales units to use the sales portal correctly and add necessary information to the order.

The service promise of DS is that all the customer orders for stocked spare parts will be shipped out on the same day, if the order is placed in the system before 18.00. Since

aftersales business has an unpredictable nature, majority of the incoming spare part orders have the requested delivery date on the same day. In addition, there is a feature in the OMS that causes reactive order behavior; the requested delivery date field is filled to the current date by default. As the field of requested delivery date is prefilled, a customer does not bother to modify it even though the need would not be that urgent. The service promise and reactive order behavior of local sales units together make it challenging for DS to forecast demand for coming days, and that causes waste in DS operations.

After customer have submitted the order in the OMS, it transfers automatically to ABB's SAP ERP system. In some conditions orders won't transfer automatically to SAP, whereupon order handling activities are needed by DS customer service. There is a modifiable criterion working behind the user interface of the OMS, and it determines how orders are confirmed and which orders transfer automatically to SAP. DS can set a stop feature for specific item codes if they want to disable orders for them transferring automatically to SAP. This is needed for items that require use specific information. If necessary information is missing on the order form, the order does not transfer automatically to SAP either. In order handling, customer service solves the problems regarding the order and then releases the order to SAP. In case the order is placed totally wrong, it will be returned to the customer.

The customer order from OMS generates a sales order in SAP

Once the customer order comes from OMS to SAP, the ERP system performs an availability check. At this stage SAP automatically checks whether the ordered items are available at the time the order comes in to the system. Straight after the availability check, SAP generates a sales order for the customer order. Delivery date of the sales order row is determined by the customer request. In case the items on a sales order are not available as requested, SAP sets the delivery date on the sales order row to the date of next inventory replenishment. After the sales order with delivery dates have been generated in SAP, the order confirmation is delivered to customer. For customer, the most important part of the confirmation is the provided delivery date. The service promise regarding same day deliveries are programmed in the logic of the system, so the same day orders placed before 18.00 are confirmed to be sent on the same day. The same service promise concerns every stocked spare part, but deliveries with certain carriers will not reach the same day transportation if the order comes in after 15.00 o'clock, and that creates a

conflict between the confirmed delivery date and the actual date of delivery. Earlier mentioned exceptions are minority among all the customer orders, and most of the orders are confirmed realistically. These exceptions may still weaken the customer perceived service quality without reason.

The sales order generates a delivery

The sales order reserves the material from the stock until the confirmed delivery date. As soon as there is sufficient availability for the sales order row, SAP generates a delivery for it. If there still is not enough available items on the confirmed delivery date, the delivery cannot be generated in SAP and the sales order must continue waiting for the inventory replenishment. After the delivery is generated, SAP sends a system message about the delivery to the 3PL's ERP system via ERP interface, which is interconnecting these two ERP systems. If the ERP interface manages to transmit the system message to the 3PL ERP, the incoming system message generates an equal delivery in 3PL ERP. Once the delivery exists in the external ERP system, it goes to the work queue of the system to wait for the processing by 3PL employees.

Two collateral ERP systems increase the risk of unnecessary delays in order-to-delivery process. If the ERP interface is not working properly, the system messages about deliveries and inventory level changes do not transfer between Drives Service and the 3PL partner. Malfunction of ERP interface causes non-value adding waiting and delayed deliveries. As the delivery is critical for picking, packing and shipping the customer order, it must be properly transferred from SAP to 3PL ERP. Both ERP systems have inventory management for materials, but changes in inventory levels occur first in the 3PL ERP, since warehouse operations are performed by the 3PL partner. After a transaction in the 3PL ERP, a system message about the inventory level change is transferred to SAP. If the ERP interface is working well, there should not be any differences between the stock balances of these two ERP systems. In case there are errors or delays regarding the system messages in the ERP interface, there are differences in inventory levels. This may disallow the delivery creation in SAP even though there is enough availability at the warehouse, and vice versa. Reliable and prompt ERP interface is highly important for the order-to-delivery process, since it affects to process flow directly and via inventory accuracy.

Waiving, picking and packing of the delivery

The work queue of deliveries in the 3PL ERP was initially processed manually at the external warehouse. The first step of the delivery process is called waiving. Waiving consists of releasing deliveries for picking based on the delivery date and material availability. Deliveries are prioritized according to the confirmed delivery date. Manual availability check is needed because the stock balance of the 3PL ERP might differ from stock balance of SAP. After availability for the delivery is checked, the picking list will be printed out and job assigned to the picking team by a 3PL warehouse worker.

Picking list assists the warehouse worker to collect the needed items from the shelf. The 3PL partner uses bar code scanners for picking and packing at their warehouse. Once the material code has been scanned and picked from the shelf, the 3PL ERP assigns the collected materials to the delivery. After picking, the delivery will be packed according to customer requirements mentioned on the order. Once the package is ready, the packing list and the handling unit labels are printed out from the 3PL ERP system. These printouts contain information about the delivery and they will be attached on the package. Finally, the package containing the content of the delivery is left to the outbound area to wait for the upcoming transportation.

Checking the availability twice during the order-to-delivery process lengthens the lead time while deliveries are waiting for waiving in the work queue. It can be considered as over processing, and it would not be necessary under optimum conditions. As the waiving in the beginning of the delivery process required manual work for 3PL employees, it was identified as a bottleneck for the order-to-delivery process of spare parts. Since the waiving contained manual stages for 3PL employees, it was vulnerable for human errors too. The purpose of this wasteful process stage was to avoid problems caused by inventory imbalance between two ERP systems. It was also performed because Drives manufacturing uses it to consolidate deliveries at this point. DS cannot utilize consolidation of deliveries similarly than Drives manufacturing, since almost every delivery is a unique customer order with a different delivery address. Therefore, waiving stage was automated soon after the warehouse relocation. Inventory imbalance, which is the initial reason for waiving, is caused by inbound and picking errors, or malfunction in the system message traffic of the ERP interface.

Export forwarding and transportation of the order

Meanwhile the packing list and handling unit labels are printed out at the 3PL warehouse, their ERP system generates a system message indicating that the delivery has been picked, packed, and thus processed in the 3PL ERP. This system message reduces stock level for material by the delivery quantity in the ERP system. This message is automatically transferred also to SAP through the ERP interface. The incoming system message called PGI (Post Goods Issue) reduces the delivery quantity also from the stock balance of SAP, and completes the open delivery under the sales order. The status of the processed sales order row changes to acknowledged. At this point the customer receives an order acknowledgement along with the notification that their order has been shipped. Anyhow, the customer order may be still waiting for transportation at the warehouse regardless the order shipped – message.

The export forwarding begins once the packing is done. The delivery should be waiting for transportation in the outbound at this point. The export forwarding is carried out by the 3PL employees at the warehouse, but instead of their own ERP system they use ABB's SAP for the forwarding tasks. Forwarding team processes the sales orders considering the delivery date, delivery destination, and the customer specific carrier company. Different carrier companies have different pick-up schedule, and delivery destination affects to the lead time of forwarding procedures. Last pick-up from the warehouse is at 20.00 o'clock, so the PGI-message enabling forwarding to begin must be created at the latest at 19.30 in SAP for the same day orders. Transportation booking will not be done, if the delivery won't reach the pick-up on the same day.

After the PGI – message has been created for the sales order in SAP, the system prints out the collective packing list to the forwarding team. The collective packing list informs forwarding about the ready-to-ship package, and it contains instructions for the shipment. Once the collective packing list is printed out, the 3PL employee in forwarding arranges the needed export documents for the delivery, and creates an invoice for the shipped sales order rows in SAP. The shipment is created for the sales order once the export documents and invoice are ready. The invoice is delivered to customer straight after it has been generated. Lastly, the forwarding person prints out the waybill for the shipment and this action sends a transport order to the transportation management system. The print of the waybill is attached to the right package in the outbound by a 3PL warehouse

worker so that the transportation company would be able to pick-up the right customer orders.

The TMS is an external system for transportation booking, tracking, and management. The TMS is linked with the shipment part on the sales order in SAP, so the transport information about the outbound orders would be visible in both systems. Once the TMS receives a transport order from SAP, it books the transportation according to the requirements mentioned on the order. The transportation company receives the transport requisition and information about the awaiting delivery via TMS. After the transportation is booked and confirmed, the delivery receives an AWB-number (Air Waybill) which is transferred to SAP's sales order. The AWB-number is an evidence for the contract of carriage, and it can be used for delivery tracking as well. From SAP this tracking number is sent to customer with the shipment information message. The tracking information indicates when the delivery has been taken into transit, and where the package is moving at each time. It also tells when the order is delivered to the customer.

Transportation to the customer

After forwarding procedures the carrier collects the delivery from the specified area at the warehouse, and transports it to the customer according to the information on the transport order. For about half of DS deliveries, the shipment in SAP receives a delivered-status via delivery tracking of the TMS once the customer has received the order. The spare part order-to-delivery process is completed once all the rows from the customer order are delivered and invoiced.

DS interprets that the delivery is shipped at the moment when the PGI-message is transferred to SAP from the 3PL ERP, even though it is only packed at that time. This makes ABB to overlook the forwarding stage, and they cannot effectively control the real outbound date of the customer order. This is a problem in term of efficiency and quality in the order-to-delivery process, since it incites to sub-optimization instead of improving the entire process. DS should pay attention to forwarding stage especially after the warehouse relocation, since it is now executed by the 3PL partner instead of ABB's own employees. In case the forwarding takes too long, the customer order does not reach to the same day pick-up. Currently the lead time of the forwarding stage is not measured. The other problem is that order shipped – message is sent to customer straight after the PGI

occurs on sales order row in SAP. This information is misleading the customer, and it can gratuitously weaken the perceived service quality.

Summary for the challenges in the spare part order-to-delivery process

Managers and process owners from both DS and the 3PL partner have been interviewed for this process walkthrough. Concerning the new order-to-delivery process, the biggest challenge that came up from DS side was the decreased transparency of the process after the delivery is created. DS cannot monitor the delivery after it has been transferred to the 3PL ERP, and it causes uncertainty and unnecessary status checks via email. It also prevents DS to detect the stages of the process the 3PL partner seems to have challenges with, since cycle times of the process stages performed at the 3PL warehouse cannot be specified with the data in SAP. DS cannot develop the process in collaboration with the 3PL partner optimally with limited visibility to the process. The 3PL partner also needs more visibility from DS. The operations manager from the 3PL partner mentions unpredictable daily volume as the biggest challenge for them in the collaboration concerning the order-to-delivery process. As DS is currently unable to share a reliable forecast for the upcoming volume, the 3PL partner must perform a lot of tasks ad hoc, which disturbs their capacity plan. They need a lot of input for the common development from ABB's side, because their resources are limited as they serve other organizations at the same warehouse too. DS as an aftersales service organization have better expertise for their own business requirements, and the 3PL partner see themselves as an executor.

The bottleneck of the order-to-delivery process was the waiving stage which was performed manually in the 3PL warehouse in the beginning. Previously waiving included manual availability check, printing out the picking list, and allocating work to the picking team. Waiving stage increased the lead time of the process and decreases the flow efficiency, since none of those tasks add value for customer. Waiving is waste by definition, but what causes it? The following five whys – analysis explains the cause-effect chain.

Table 2. Root cause analysis about the waiving stage in the current order-to-delivery process using the Five Whys – method.

5-Whys	Problem: Waiving is a bottleneck and adds no value in the order-to-delivery process.
1. Why	Why the waiving stage exists in the current process?
Reason 1	Material availability must be checked again once the delivery has been transferred to the 3PL ERP.
2. Why?	Why the availability must be checked again in the 3PL ERP?
Reason 2	Stock balance in SAP is not necessarily equivalent with the stock balance in the 3PL ERP. There is a waste of inventory imbalance behind the non-value adding waiving tasks.
3. Why?	Why the stock balances are not equivalent between SAP and the 3PL ERP?
Reason 3	One or more system messages have stopped in ERP interface. As system messages are not transferred from one ERP to another, important stock balance updates do not happen in both ERP systems. There is also a systematic delay of system messages, since they are transferred in batches.
4. Why?	Why system messages stop in ERP interface?
Reason 4	The quality of a system message is poor. Other scenario is that the message traffic exceeds the capacity of ERP interface, and that increases the latency.
5. Why?	Why is the quality of a system message poor?
Reason 5	System message contains characters that are not recognized and that generates an error in ERP interface.

The waiving stage is primarily caused by the imbalance between inventories. Besides causing non-value adding waiving stage, inventory imbalance has other negative impacts to the collaboration and the order-to-delivery process too. It distorts material availability, and thus causes unnecessary waiting for customer orders, or creates deliveries even when there is no availability in fact. Investigating this kind of problems requires a lot of manual work for employees in the 3PL warehouse, DS customer service, and inventory management team. That has a negative effect on capacity and customer satisfaction.

Inventory imbalance is a cause of an error or latency in system message traffic in ERP interface. As mentioned in the previous chapter, malfunction of ERP interface is one of the biggest threats for the collaboration and process fluency. If the system messages are not transferred between ERP systems, the whole order-to-delivery process cannot be performed. Besides causing waste in all its forms to the order-to-delivery process, momentarily lags in system message interface corrupt the KPIs of DS, since measures are based on the data in SAP. Malfunction of ERP interface is the biggest single challenge for the order-to-delivery process. Capacity of the interface and system message quality are the most important factors behind this problem. DS can manage both factors by adjusting the amount and content of system messages.

In some cases, DS is sharing misleading information to their customers concerning the process status and their service promise. Customer orders using certain carriers, or requiring extra time in forwarding, are falsely confirmed with the same day delivery day even though it is known that they are placed too late to reach the same day pick-up. Problematic carriers and destinations are known, but the confirmation policy is still the same for all the customer orders. Other misleading information is the “order shipped”-notification, which is sent after the delivery is just packed. These system features likely to decrease the reliability of DS as a supplier and lower customer perceived service quality unreasonably.

4.3 Performance measures of the spare part order-to-delivery process

Drives Service measures the order-to-delivery process and its stages with couple of key performance indicators. These KPIs are the basis of monitoring, management, and development of the process. Current performance indicators are selected before the warehouse relocation. Key performance indicators for the spare part order-to-delivery process are introduced and evaluated in this chapter. Evaluation considers the reliability, relevancy, and impact of current performance indicators.

Outbound OTD

Table 3. Evaluation of current outbound OTD – measure.

Dependency	Purpose	Impact
<ul style="list-style-type: none"> • order confirmations • reliability of ERP interface • performance of the 3PL partner • inventory accuracy • inbound OTD of delivery time items 	<ul style="list-style-type: none"> • to indicate the on time performance of the order-to-delivery process • to measure the lead time and cycle times in the delivery process • to indicate DS's ability to reach its service promise • to discover challenges in the order-to-delivery process 	<ul style="list-style-type: none"> • customer satisfaction • customer perceived service quality

Primary performance measurement for the spare part order-to-delivery process is an outbound on time delivery indicator. It is meant to indicate DS's overall capability to ship the customer orders on time, as they are confirmed. Optimally this indicator shows how well the order-to-delivery process is matching with the service promise, which eventually is the order confirmation that is sent to customer. Currently outbound OTD indicator is

primarily dependent on the order confirmations, reliability of ERP interface, and the performance of the 3PL partner.

$$\text{Outbound OTD} = \frac{\text{packed sales order rows in time period}}{\text{confirmed sales order rows for time period}}$$

Technically, the measurement compares the packing date of the customer order to the earlier confirmed delivery date. For delayed rows, SAP automatically detects the process stage where the delay has happened, and in this way DS can investigate the root causes for failures and develop the whole process. Outbound on time delivery is a relevant indicator about DS's performance, but the measurement points are currently not optimally positioned in the order-to-delivery process.

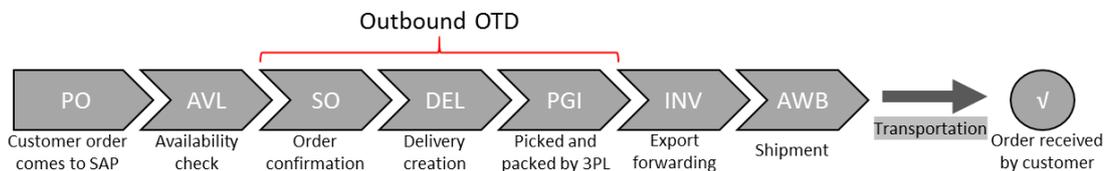


Figure 15. Spare part order-to-delivery process in SAP and the measuring points of outbound OTD.

Figure 15 expresses the measuring points of the current outbound OTD indicator. As can be seen, outbound OTD measures the percentage customer order rows that have been picked and packed on the same day when they are confirmed to be shipped. By ignoring the forwarding procedures and the moment of actual pick-up of deliveries, the indicator does not perfectly illustrate the real on time delivery of spare parts. This feature decreases the visibility to the whole process, and is likely to embellish the delivery performance. It also leads to sub-optimization in process development, since outbound OTD, which is the most utilized performance indicator of the order-to-delivery process, can be improved by just packing the orders earlier. As described in the process walkthrough, packing is not equal to shipping.

As the KPI is based on the sales order confirmations and their PGI's in SAP ERP, it does not completely correspond with the delivery performance of the 3PL warehouse either. This is because there may be sales order rows waiting for availability in SAP still on their confirmed delivery date, in case the replenishment for delivery time item is late. Because delivery cannot be created without sufficient availability, these order rows are not visible in 3PL ERP. Also, the 3PL warehouse is unable to process deliveries that have stopped

in the ERP interface. This means that the currently the outbound OTD does not indicate the performance of the 3PL partner reliably, and thus it cannot be used for evaluating the 3PL partner.

The outbound OTD is reported daily in DS, and it is a binary measure which tells if the sales order row were shipped on time or not. The outbound OTD report can also be used for monitoring the lead time and the cycle times of the process from sales order confirmation to PGI-message. All delayed rows must be investigated and commented within the same day by the employees of DS operations. Before the warehouse relocation, DS had better visibility to the process from SAP as all the stages were documented in there. In the new order-to-delivery process, DS cannot measure which process stage has delayed the delivery after it has been transferred to the 3PL ERP.

OTD at destination

Table 4. Evaluation of outbound OTD at destination – measure.

Dependency	Purpose	Impact
<ul style="list-style-type: none"> • outbound OTD • reliability of transportation company • customs procedures • accurate information on customer order • master data accuracy 	<ul style="list-style-type: none"> • to indicate DS's ability to deliver customer orders to destination in expected time • to discover the problems in the whole supply chain 	<ul style="list-style-type: none"> • customer satisfaction • customer perceived service quality

Optimally DS could confirm the customer order with a date when the order will be at the requested delivery address. OTD at destination is a performance indicator which indicates how many percent of the customer orders were transported to customer in expected time. DS is currently measuring the on time delivery at destination for certain orders, but there are some challenges which prevent measuring it for all the customer orders.

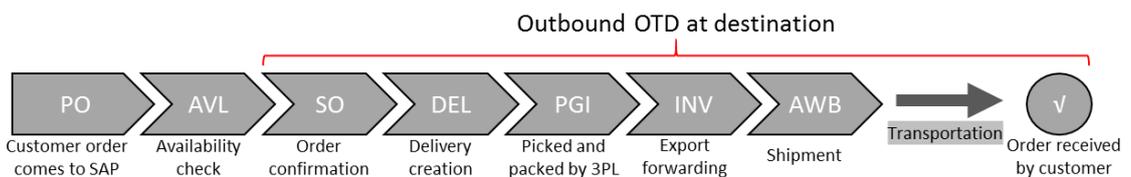


Figure 16. Spare part order-to-delivery process in SAP and the measuring points of outbound OTD at destination.

The challenge with this KPI is that currently only certain transportation companies provide information of the final delivery time to the TMS. For the customer this KPI is relevant, since it measures if the order is delivered to destination on time. In terms of DS operations management, the problem with this measurement is that external factors have remarkable effect on the result. KPI cannot be used as a tool for managing the warehouse operations effectively, because a delay in transportation or customs weakens the OTD at destination. A delay in customs may occur because of incomplete information on products, but the reason can also be insufficient communication or actions of the receiver.

Outbound OTD at destination is potentially the best way to measure the whole order-to-delivery process. This measure incites DS to optimize the whole process from order to transportation, and improving the result requires solving both external and internal causes for delays. On the other hand, it measures too many factors. Too broad measurement prevents DS managing the in-house process effectively in collaboration with the 3PL partner.

Automatically confirmed orders

Table 5. Evaluation of automatically confirmed orders – indicator.

Dependency	Purpose	Impact
<ul style="list-style-type: none"> • customer's ability to fill the order form correctly • customer order behavior • user interface and logic of the OMS • amount of STOP codes 	<ul style="list-style-type: none"> • to measure the relative share of manual work with customer orders • to detect the problems in the user interface of the OMS or customer order behavior and develop them 	<ul style="list-style-type: none"> • workload of order handling • lead time and efficiency of the order-to-delivery process

Automatically confirmed orders measures the relative share of customer order rows that are transferred to SAP's sales orders without manual order handling. Under optimal conditions every customer order from the OMS should transfer automatically to SAP, and in this way, receive the order confirmation automatically. Exception to this are items for which DS has determined a stop feature for manual checking. Under optimal conditions the amount of stop codes is minimum. If the indicator falls below the target continuously, the corrective actions from DS are briefing the local sales units to fill their order forms correctly, checking whether the OMS user interface and logic is supporting the purchasing process optimally, and possibly investigating and solving the reason behind too many stop codes

Since demand for different items varies, it is possible that most of the customer orders during a day comes for items with the stop feature. In this scenario, the result of this indicator decreases, and the order handling may become a bottleneck for the order-to-delivery process, depending on the cycle time of manual order handling. Therefore, order handling time is an important indicator for customer service concerning the order-to-delivery process. Order handling process takes around four hours on average, but 85% of the orders are handled in 15 minutes. Order handling time is also measured by the customer service manager, but the share of automatically confirmed orders is the main indicator for the order-to-delivery process.

This KPI is dependent on customers' order behavior and their ability to fill the order form correctly, intuitiveness user interface of the OMS, and the amount of STOP codes. Automatically confirmed orders have an impact on the relative manual workload of customer service in order handling and thus, lead time of the order-to-delivery process. The current objective for this indicator is that 50% of customer orders would be confirmed automatically. This is because the measurement includes all kind of items, not only spare parts, and many of them are meant to go through the manual order handling stage. Automatically confirmed orders is relevant indicator for the first stages of the order-to-delivery process, that are not monitored otherwise. Anyhow, for customer this indicator is not valid.

Availability of materials in SAP

Table 6. Evaluation of availability indicator.

Dependency	Purpose	Impact
<ul style="list-style-type: none"> • forecast accuracy • inbound OTD • purchasing parameters • inventory accuracy • reliability of ERP interface 	<ul style="list-style-type: none"> • to measure DS's ability to maintain availability for needed materials with forecasts • to measure if DS is stocking the correct items • to detect issues with suppliers and purchasing parameters, and develop them 	<ul style="list-style-type: none"> • inventory costs • service level • customer satisfaction

Availability of materials is measured in the first availability check of the process. As described, SAP checks automatically if the whole order quantity could be covered within the same day by the unrestricted stock balance in SAP. This indicator concerns only stocked items, which are promised to be available for customers from shelf without a

delivery time. Availability is vital factor for the order-to-delivery process, and this measurement is useful tool for the inventory management and purchasing of DS. Since DS decides what items to stock and what to offer with a delivery time, the availability check is also included to orders for delivery time items. The result is not officially reported, but it gives insights about which delivery time items should be stocked instead.

The accuracy of demand forecasts, purchasing parameters, and inbound OTD affect directly to the availability indicator, because stocked items are bought to stock from suppliers according to the pre-calculated forecasts, and with defined delivery times and lot sizes. Target for the availability of stocked items is 95%, which is a compromise between maximum service level and minimal inventory value. If the availability indicator falls below the target, the inventory management team must check the items that are causing the problem. It includes reviewing purchasing parameters, such as demand forecasts and order quantities. Possible delivery issues must be checked with the supplier. From the customer point of view, the availability KPI is necessary as it helps DS to improve the service level.

Inbound OTD

Table 7. Evaluation of inbound OTD indicator.

Dependency	Purpose	Impact
<ul style="list-style-type: none"> • supplier reliability • inbound efficiency • reliability of ERP interface 	<ul style="list-style-type: none"> • to measure suppliers' delivery accuracy • to measure warehouse inbound accuracy • to detect problems of suppliers and WHS inbound, and develop them 	<ul style="list-style-type: none"> • availability of materials • outbound OTD for delivery-time items

Inbound OTD measures how many percent of the stock replenishments are received in time. Technically, the expected receiving time is calculated by adding transport and inbound processing time to the confirmed delivery date. Supplier accuracy and warehouse inbound efficiency both affect to the inbound on time delivery indicator. Inbound OTD has an impact to the availability but also to the on time delivery of delivery time items. In case supplier is incapable to deliver orders to DS as agreed, the number of stock-out situations increases. It also affects directly to DS's capability to ship the customer orders for delivery-time items on time. The inbound OTD indicator is a useful measurement especially for purchasing team by allowing them to focus their development resources on suppliers that are performing poorly. The other reason why the outbound-OTD could

fall below the target is the lead time of warehouse inbound process. Problems in the warehouse inbound lengthen the lead time of receiving process which causes delays to inbound OTD.

Order backlog

Table 8. Evaluation of order backlog indicator.

Dependency	Purpose	Impact
<ul style="list-style-type: none"> customer order behavior upcoming customer demand 	<ul style="list-style-type: none"> to show the upcoming volume in advance to enable operations to allocate capacity proactively for coming demand 	<ul style="list-style-type: none"> capacity planning

DS follows the order backlog so that they would be able to plan capacity for upcoming demand. Order backlog measure counts the number of confirmed items per day for coming two weeks. As most of the customer orders for spare parts arrive on the same day they are requested to be delivered, this measurement is unreliable indicator about the upcoming demand. In addition to that, this KPI is not indicating the upcoming workload because it only shows confirmed quantities. Workload cannot be derived from order quantities, because DS has various kind of different products and spare parts in offering. For example, a customer order for simple screws usually contains hundreds of items, but the delivery is straightforward and easy to pick and pack at the warehouse. Concerning the spare part order-to-delivery process, this KPI as such is irrelevant and useless, since it is not correlating with real future volume. However, optimally this indicator could be utilized in the volume forecast shared with the 3PL partner.

Quality KPIs

Table 9. Evaluation of picking and packing quality indicator.

Dependency	Purpose	Impact
<ul style="list-style-type: none"> in-house process quality inbound mistakes picking and packing mistakes 	<ul style="list-style-type: none"> to discover picking and packing mistakes to help allocating development resources for needed stages of the process 	<ul style="list-style-type: none"> efficiency inventory accuracy final on time delivery of customer order customer perceived service quality customer satisfaction

As customer needs a right product in a right time with correct quality, the outbound OTD is not the only factor to measure succeeding in the order-to-delivery process for DS.

Benefits of a quick delivery fade away if it contains false part, or the quality is not acceptable. Thus, quality indicators concerning picking, packing, and the items are truly relevant measures for the customer. Picking and packing quality is directly dependent of the order-to-delivery process, but product quality of spare parts depends on suppliers. Picking mistakes have impact on inventory accuracy, efficiency, and to customer satisfaction. Packing mistakes usually have negative impact on product quality.

To control and develop the quality of warehouse processes, DS measures number of picking and packing mistakes per delivered order rows. The target is maximum of 0,45 mistakes per 1000 picked order rows in the picking quality, and for the packing the target is maximum of 0,25 mistakes per 1000 packages. After the warehouse relocation, the responsibility for the picking and packing quality have shifted to the 3PL partner, but DS monitors quality too as they receive the complaints from customers.

Most relevant KPIs in the order-to-delivery process

As described, DS has a versatile combination of KPIs measuring quality, punctuality, and operability of the spare part order-to-delivery process. Customer wants right product to be delivered according to order confirmation, and often as soon as possible. Order should also be delivered to a right place with a correct quality. Process and the performance indicators should be determined in a way which allows DS to manage its performance of fulfilling customer requirements effectively.

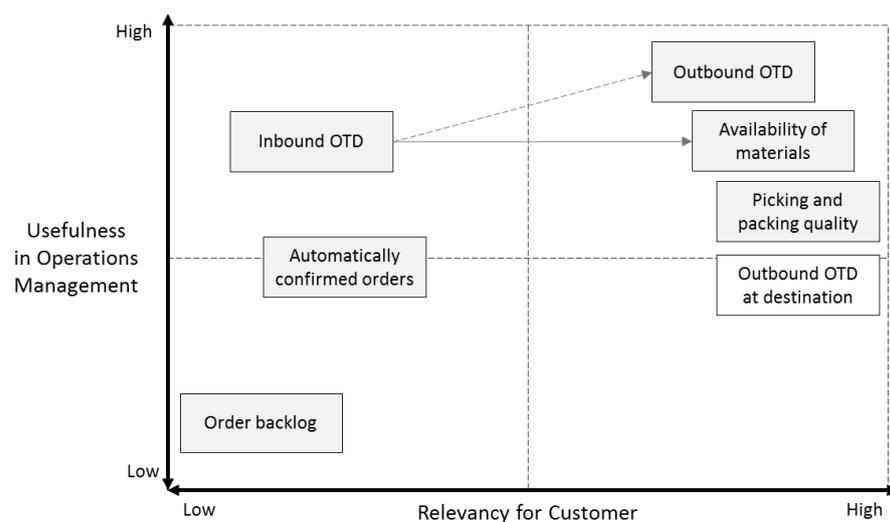


Figure 17. Evaluation of current performance indicators for spare part order-to-delivery process.

Current performance indicators of the order-to-delivery process are described and evaluated in figure 17. Y-axis illustrates the relevancy of the information that the performance indicator currently provides for Drives Service. Also, it illustrates the size of the effect the indicator has considering the whole process and its successful execution. The most informative and useful measurement for DS is the outbound OTD regardless the problems it contains. This is because it measures how well the delivery performance match with the order confirmations, but also contains the lead times of the delivery process and its stages. Availability of materials is equally useful measure for DS, as it indicates how well they can serve customers, and are they storing enough correct items. Inbound OTD is important for the order-to-delivery process, since it has a direct influence on availability and outbound OTD of delivery time items. Picking mistakes decrease the inventory accuracy, which disturbs availability and cause waste in operations. Automatic confirmations for orders are not important for customer since they are likely to receive the confirmation promptly anyway, but manual order handling requires resources from DS and at worst it can become a bottleneck for the whole process. Automatically confirmed orders also indicates how well the user interface and logic of the OMS guide customers to fill orders correctly. High amount of STOP-codes also influences on this indicator, and them are symptoms of other problems that should be investigated.

X-axis illustrates how relevant the KPIs are from the customer point of view. Factors having a direct impact on customer satisfaction, such as on time delivery, quality, and availability, are the most relevant for customers. The other KPIs that do not have direct effect on customer satisfaction are not very relevant for customer. However, they are used to develop the process, and eventually all the introduced performance indicators are somehow connected with each other.

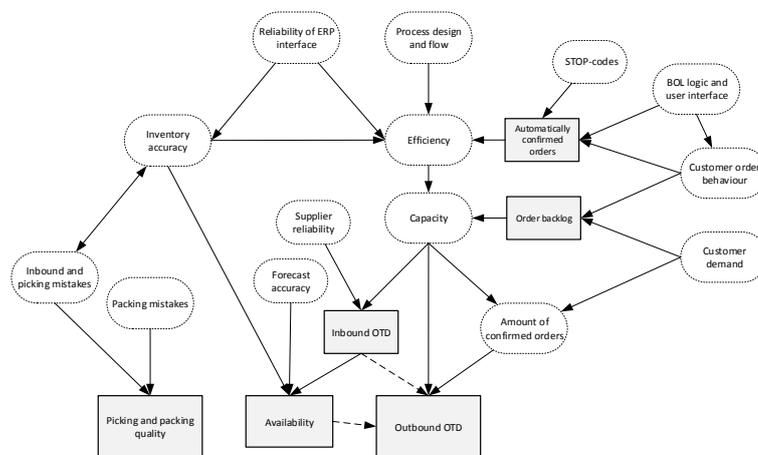


Figure 18. Causation network and interdependence of current KPIs and other performance factors of spare part order-to-delivery process.

Figure 18 combines evaluations of each performance indicator from tables 3-9 in one network, which expresses the interdependences of different performance factors in spare part order-to-delivery process. The lowest performance factors have direct effect on customer perceived quality and satisfaction. Thus, the primary performance indicators of the order-to-delivery process are picking and packing quality, availability, and the outbound OTD. As can be seen, many of the current measures are having partly same fundamentals behind them. Some of them, like inbound OTD, order backlog, and automatically confirmed orders are measured and controlled, but the other important factors affecting to the whole process, such as inventory accuracy and reliability of ERP interface, are not formally monitored. The network is versatile, and it is challenging to describe all causes and effects for indicators in one figure. However, figure 18 expresses the main relations between different performance factors and indicators described in the evaluation tables 3-9.

Daily management of operations at Drives Service

DS operations function follows outbound OTD for the order-to-delivery process by reporting it daily within the organization. Report contains all the sales order rows shipped during the previous day. For every delivered sales order row there is a field indicating whether the row was delivered on the confirmed day and another field for potential delivery delay reason. Delayed sales order rows from the previous day must be commented on the same day the OTD is reported. Delivery delay reason determines the function who is responsible for investigating and commenting the delay. In this way DS can follow their delivery reliability on daily basis, but also monitor performance and lead times of all the process stages. However, currently this procedure is unable to monitor the whole process due to incompleteness of current outbound OTD and lack of transparency.

Other key performance indicators regarding the order-to-delivery process are reported monthly, but followed daily. Operations development team used to share a file expressing performance indicator results from the previous day every morning. This file was called daily management, and it was shared for the process owners and managers in DS operations. Every team followed the indicators that were related to their daily work, but the daily management file was mainly used for information only. As this procedure only required working hours but did not lead to any actions, the operations development team discontinued sharing the daily management file every morning. Except commenting

the delivery delays on the outbound OTD, there is no standard method within teams for going the indicator results through or taking the corrective actions daily.

Reporting the performance indicators require a lot of manual work. Several different reports must be manually queried from the SAP ERP system. Then they are combined in a one file either manually or with the help of automated macros in Excel. After the preliminary results are ready, the data must be corrected manually. Producing different reports takes relatively big share of working time in DS operations. As manual modifying and corrections take time, the data is always a bit old. Old data is not optimal for process management and controlling. This makes DS operations being reactive rather than proactive, and thus the management and control are not effective.

Major weaknesses of the current daily management system are old data which requires a lot of manual work to be formed, lack of standard routine for utilizing the reported numbers, and a poor visibility of current performance in workplace. Currently the performance indicators are only expressed in email messages, so anyone in the office cannot see how the organization is performing. All these factors decrease benefits and profitability of current daily management system, which causes a lot of work to maintain anyway.

4.4 Summary of the current state analysis

This chapter composes the key findings of the current state analysis. The analysis investigated how the warehouse relocation project affect to the spare part order-to-delivery process, and how the current daily management model and its performance indicators help DS to manage and develop the current order-to-delivery process in collaboration with the 3PL partner. As all the subchapters in the current state analysis already contain a summary, this chapter combines and describes the most relevant problems and challenges that came up in the study.

Table 10. Summary of discovered challenges and problems in the current state analysis.

Problem	Description and impacts
1: Errors and latency of system messages in ERP interface.	The biggest challenge for the order-to-delivery process is that there are two collateral ERP systems working simultaneously in the same process due to the warehouse relocation. Malfunction in the ERP interface causes latency or errors for system message traffic between SAP and the 3PL ERP, which can stop or slow down the order-to-delivery process. Besides lengthening the lead times and decreasing the delivery reliability, malfunction in ERP interface corrupts the data in SAP. This prevents DS from effective process management and development.
2: Imbalance of inventories between two ERP systems.	Problems with system messages create imbalance of inventories between SAP and the 3PL ERP. Inequivalent stock balances and inaccurate inventory are the primary cause for the manual delivery waiving stage in the 3PL warehouse. Waiving is currently the bottleneck in the order-to-delivery process, besides it is not adding any value. Inventory imbalance distorts material availability check in SAP, which causes unduly deliveries, excessive waiting, and waste in all kinds.
3: Lack of transparency of the 3PL warehouse operations.	The process transparency is weak because the delivery process is only documented in the 3PL ERP. There are not enough system messages to update the status of the delivery, which creates uncertainty and unnecessary status inquiries in DS. The other symptom of this problem is that DS is unable to measure performance of the 3PL warehouse operations with the data in SAP.
4: Insufficient KPI data about the punctuality of the order-to-delivery process.	Current outbound OTD is misleading, as it is not measuring exactly the factor what it is supposed to. Since current outbound OTD indicator overlooks forwarding stage and the moment of actual pick up from the warehouse, DS cannot monitor and optimize the order-to-delivery process as whole. Interpretation, according to which packed delivery is equal to shipped order row, leads to sub-optimization, lower process visibility, and lower service quality in DS.
5: Inaccurate order confirmations and communication to customer.	Too optimistic order confirmations are a problem for the service quality in the order-to-delivery process. Orders with certain carriers and destinations cannot be delivered according to the general same day promise, but they are still confirmed to the same day in the OMS. This problem cannot be seen from the outbound OTD, since the measure does not currently count the actual delivery time. Other misleading information shared to customer is the "order shipped" - notification, which is sent after the delivery is just packed.

Problems 1-5 in table 10 are marked in the workflow of the spare part order-to-delivery process in appendix 3. Problems in table 10 are put in order by their significance, ergo how much they are disturbing the daily performance of DS operations. Problems 1-3 are directly related to the warehouse relocation project, and the changes it caused on the processes of Drives Service. Problems 4 and 5 existed even in the previous process and operating model, but especially the problem with the outbound OTD (4) became more significant once responsibility for export forwarding shifted to the 3PL partner after warehouse outsourcing. Also, inaccurate measurement method of outbound OTD has prevented DS from noticing the problem with too optimistic order confirmations, since those

delays have not affected negatively on outbound OTD. All these problems together decrease the efficiency of DS significantly by creating waste in operations, but also deteriorate the service quality directly or indirectly.

Other challenges that were discovered during this study discovered mentioned below:

- The current manual method for daily performance tracking is arduous and slow. It takes time to create the reports and clean the data manually every day. Consequently, the indicator data is always a bit old and impractical for real-time management. This performance data, which is daily achieved by a large amount of work, is not optimally utilized either. Creating KPI reports is waste unless the achieved data is utilized in process management and it has affect to daily work. Currently most of the daily reported performance indicators are hiding in emails, which are not much viewed. In terms of daily operations management, there is a lack of suitable tools for acquiring the data on sight effortlessly and just-in-time, a lack of routine for going the indicators through in teams and assigning the daily tasks based on that, and a lack of data visualization for instance about work queues, which would make every team aware of the current performance, work in progress, and focus areas all the time. All these problems concerning the daily process management result in reactive attitude instead of proactivity in DS operations.
- Forecasting the upcoming volume is difficult in the business environment DS operates in. The demand is fluctuating and unpredictable, and most of the customer orders for spare parts arrive on the same day them are supposed to be delivered. It is not only the nature of aftersales business, but customer order behavior affects to the predictability of demand as well. DS should consider what are the factors in their system that cause a great amount of same day orders. For example, the “requested delivery date” - field in the OMS is currently prefilled to same day for stocked items. Local sales units should be instructed to send their orders in advance always when possible. This would make a larger share of upcoming volume visible in the order backlog of DS. 3PL partner would benefit much from the volume forecasts shared by DS. As DS is currently unable to predict the upcoming volume, the 3PL partner is unable to effectively plan their capacity, and the same goes for DS itself. Low visibility to demand creates a lot of waste in the whole supply chain.

These challenges are demarcated outside the scope of this study, and thus development proposals in chapter 6 are addressed to problems 1-5 mentioned in table 10. Above mentioned two additional challenges are large-scale topics, that are subjects to further investigation.

5 Benchmark about the best practices in a comparable partnership

This benchmark concerns the KPIs and time-tested procedures of the co-operation management between an aftersales organization and its external 3PL warehouse. The co-operation with the 3PL partner in this benchmark company has many common factors with Drives Service and their 3PL warehouse. The benchmark has been performed by interviewing the warehouse manager of Company X, who is responsible for monitoring the external warehouse operations. The benchmarked company didn't want to be recognizable in this report due to the confidential content, so it is called Company X.

5.1 Introduction to Company X and their warehouse operations model

Company X is an international vehicle manufacturer that has a manufacturing plant in Finland. Annual revenue generated by the Finnish branch is roughly 300 million euros. Growing demand forced company to expand their manufacturing plant to the near-located warehouse building which previously had been in use of their aftersales organization. Expansion of manufacturing plant made Company X to outsource their aftersales warehouse operations to the 3rd party logistics provider located in another city in Finland. The reason for relocating the aftersales warehouse to another city was its more optimal location from the logistical aspect.

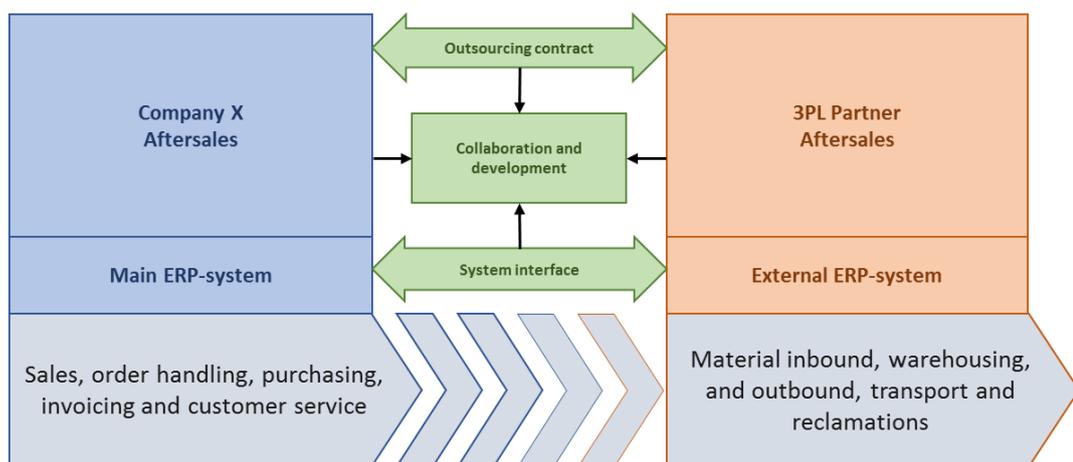


Figure 19. The collaboration model and the key responsibilities between Company X aftersales and their 3PL partner.

The outsourcing arrangement concerns all the logistical operations of the aftersales business including warehouse inbound, inventory management, outbound, and reclamation handling. In terms of integration of the ERP systems, the co-operation in the benchmark

case is similar with DS and their 3PL partner. Company X and their logistics service provider both have their own ERP systems operating collaterally, and there is an interface connecting them. The management and ownership of all the customer processes is under Company X's responsibility, but the outsourcing contract obligates and encourages their 3PL partner to participate in the co-operation development too. The previous aftersales warehouse manager of Company X manages the daily co-operation with their 3PL warehouse.

The biggest challenge in this outsourcing model was to build a reliable and working system interface between two ERP systems. It is crucial that all the required data transfer seamlessly between ERP systems. The confirmed customer order in the main ERP system must be converted into picking list in the external ERP system. Furthermore, customer's delivery address, packing requirements and other information must also be visible to the 3PL partner to enable successful delivery. The stock balances must be equal and correct in both ERP systems, because differences create unnecessary delivery delays and lost sales. That's because a sales order will not be confirmed and converted to the external ERP system if the stock balance is insufficient in main ERP system. The information about the picking, packing, and delivery process must return to the main ERP system from the external system, so that Company X can manage the process and inform the customer. The 3PL partner also wants a forecast about the demand for the coming days so they can plan their capacity accordingly. All these issues are similar than in the current state analysis of the study conducted in Drives Service.

5.2 Collaboration in practice

To coordinate and develop the collaboration, Company X and their 3PL partner have regular meetings where they discuss about the specified topics related to the co-operation. Meetings are divided by frequency to daily and weekly meetings and participants from both organizations are defined according to the subject. Daily and weekly topics, procedures, and the KPIs related to collaboration are introduced in the following chapters. Daily and weekly meetings are held mainly through remote connection, but Company X also visits at the warehouse at least once a month.

Table 11. Meeting types and descriptions in the collaboration of Company X and its 3PL partner.

Frequency	Duration	Attendees	Agenda	Purpose
Daily	15-30 minutes	Company X: WHS operations manager 3PL partner: WHS manager and supervisor	<ul style="list-style-type: none"> • inventory snapshot • yesterday's performance • other important matters 	To ensure the process fluency via daily collaboration and communication.
Weekly	1-2 hours	Company X: WHS operations manager and process owners 3PL partner: WHS manager, supervisor, and process owners	<ul style="list-style-type: none"> • inbound and outbound OTD • current volume and forecast for the coming week • delivery quality • reclamation handling OTD • status of continuous stock-taking • number of empty shelves in the WHS 	To follow and develop the collaboration in the long term, and to ensure that the warehouse operations are on the agreed level in terms of efficiency, service level, and quality.

Weekly meeting takes 1-2 hours depending on the agenda. The purpose of them is to take a closer look to the current problems and matters, and thus ensure continuous improvement of collaboration and warehouse operations in long term. Once a week the warehouse managers, supervisors, and process owners from both organizations attend to meeting concerning the topics described in table 12.

Table 12. Agenda of weekly meetings between Company X and their 3PL partner.

On time delivery of outbound and inbound function:
Every customer order that comes to the main ERP system before 13:00 should be shipped to the customer within the same day. Outbound OTD is the main KPI of warehouse operations and it gets checked together in detail every week. Detailed inspection of inbound and outbound OTD includes investigating the root causes behind every delayed order row, but also planning how to avoid them in the future. Delayed rows in the order backlog are reviewed together as well.
Quantity of orders on the current week and estimated demand for the coming week:
The general business situation is checked together weekly. Company X provides a volume forecast for the next week to their 3PL partner, so they can reserve needed capacity. Company X is responsible for the accuracy of the forecast, and the 3PL partner is obliged to be prepared with a sufficient capacity. In case the forecast was clearly incorrect, Company X compensates the costs of excessively reserved capacity to their 3PL partner.
Delivery quality:
Delivery quality issues are checked and discussed together weekly. Company X measures the delivery accuracy and error frequency of the 3PL warehouse in four categories: picking errors, packing errors, delivery errors, and other errors.
Reclamation handling:
The 3PL partner should handle customer reclamations on the same day them arrive. The punctuality is measured and checked weekly in common meetings.
Status of continuous stock-taking:
An inventory check is a constantly running process which target is to count the physical stock balances at the whole warehouse once a year along with correcting the verified balances to the ERP system. The purpose of this procedure is to improve inventory accuracy. The progress of continuous stock-taking is reviewed weekly.
Number of empty shelves in the warehouse:
Company X follows the empty space in their area at the warehouse. This is checked weekly to maximize the utilization of costly storage space.

Daily meeting takes 15 - 30 minutes and it is held every morning. Meeting focuses on current performance and routine matters. The warehouse managers from both parties and a supervisor from the 3PL warehouse participate in this meeting. Daily meetings are short briefings including topics described in table 13 below.

Table 13. Agenda of daily meetings and procedures between Company X and their 3PL partner.

Inventory snapshot check:
To reduce the differences in the stock balances between two ERP systems, inventories between the main and the external ERP system are compared every night. The automatically produced report of the comparison brings up every item which inventory levels differ between two ERP systems. A daily meeting begins with a review of this report. Every mismatch must be checked and corrected before 12.00 o'clock on the same day by the 3PL warehouse. This procedure includes checking the shelf balance and is thus expediting the progress of continuous stock-taking. Initial purpose of this procedure is to avoid imbalance of inventory and problems caused by it. Accurate and equivalent inventory levels are crucial for operations of Company X, and this procedure is performed daily to ensure it.
Yesterday's performance and today's important matters:
Employees from both parties review the daily KPI results from yesterday's performance and discuss about the current challenges. The daily KPIs are outbound OTD, inbound OTD, and count of picking, packing, and delivery mistakes. This part of the meeting focuses also on a day-specific important matters, such as inbound and outbound deliveries that will occur on the same day.

Company X have had the partnership with the 3PL provider since 2013. Remote location of the physical warehouse, external warehouse workers, and separate ERP system have increased complexity of warehouse operations management for Company X. Currently Company X is satisfied with the decision of outsourcing the warehouse. The current collaboration model and its KPIs are result of years-long iterative development, which has required a lot of work from both parties. Company X is applying the principles of lean with a special focus on a continuous improvement. When it comes to process development, they emphasize the importance of physical presence on the spot. According to their experience on collaboration and process development with the 3PL warehouse, seeing things by own eyes is the key for understanding how the ERP systems and processes work together.

5.3 Summary and findings of the benchmark study

This benchmark provided useful information on how Company X manages its 3PL warehouse successfully. The benchmark case has many similarities with the current state of DS, and findings include useful input for the development proposals of this case study. Both cases have similar challenges with two collateral ERP systems. The collaboration model of Company X and their 3PL warehouse indicates that it is essential to determine clear responsibilities between parties. Once both parties are aware of their duties, it is easy to manage the operations together. The other lesson is that frequent meetings, and other effort put on the collaboration are worthwhile. Daily standardized and unstandardized interaction with the 3PL warehouse increases trust in the collaboration, and helps

developing processes together via information sharing. Regular and frequent interaction through standardized meetings, clearness of responsibilities, and common objectives both increase the trust, quality, and efficiency of the collaboration and operations. Followed performance indicators and daily procedures must be clear for both parties to ensure continuous improvement. Daily inventory balancing procedure keeps the inventory accurate and balanced with the external ERP system, and this helps avoiding waste and other problems caused it.

6 Development proposals

This chapter introduces development proposals that are aimed to improve the current spare part order-to-delivery process, and other major challenges discovered in the current state analysis. Development areas are described in table 10, chapter 4. Development proposals are based on the theoretical framework and empirical research of this study. The objective for this chapter is not only to propose improvements, but also evaluate them by effects, pros, and cons. The latter part of this chapter clarifies the key performance indicators, most important procedures, and responsibilities of the collaboration.

6.1 Five practical proposals for improvements

Development proposals are addressed to the problems summarized in table 10. The number before each development proposal indicates the problem which it is addressed to. As there are five major problems mentioned in table 10, this chapter includes five development proposals, suggested solution for each problem. After every development proposal is introduced, there is an evaluative table summarizing the ideas with the method of SWOT-analysis.

1. Focus on the root challenge of the collaboration by measuring the reliability of ERP interface

Two collateral ERP systems and interruptions in the ERP interface create a major threat for the operations of DS. In addition, momentarily lags and errors create a lot of uncertainty and waste in all forms. To control this cause, the focus must be shifted to operability of ERP-interface with a performance measure indicating the number of critical system messages, that have stopped in the ERP-interface due to error. The error messages in the ERP-interface are divided into two categories by type: informative errors that do not require any actions, and errors that require actions to enable continuation of the process. The latter type of errors are the critical error messages that must be monitored. Proposed formula for measuring the reliability of ERP interface:

Number of critical error messages generated in ERP interface during last 24 hours

Even though the indicator tells only the amount of new error messages in ERP interface, there is a more detailed report behind this indicator. In this report, each row represents a single error message. All the rows containing critical error message should be processed daily by investigating and commenting the cause for each. After there is data about the causes, they can be sorted and categorized. This data is useful for continuous improvement, as it allows DS to reduce the causes for error messages starting from the most frequent ones. By implementing a daily followed KPI, a target for it, and a procedure for improving the reliability of the ERP interface, DS can decrease the errors in ERP interface and thereby, reduce all kinds of waste in operations. The purpose of this measure is to make the primary challenge of the outsourced warehouse operations visible in the operations management, and to improve the efficiency of operations while ensuring delivery reliability of Drives Service. This is also a way to manage the risk with external warehouse logistics.

2. Balance the inventory levels and increase inventory accuracy with a standardized procedure of inventory matching

Imbalance is one of the three types of waste in lean. In context of the current state analysis, imbalance primarily refers to imbalance of inventory levels between SAP and the 3PL ERP. For the spare part order-to-delivery process, this imbalance creates two main problems. Firstly, it disturbs the availability check in SAP, which decreases the accuracy of order confirmations. Inaccurate availability either prevents the delivery creation in SAP even though there would be availability in the 3PL ERP, or generates a delivery in SAP without availability in the 3PL ERP. As inventory levels and availability are unreliable in SAP, it creates further challenges for purchasing who base the schedule of replenishments on that data. Most importantly, unreliable availability and inventory levels worsen the customer experience. The second main problem is that the risk of inventory imbalance is the primary reason for the bottleneck of the spare part order-to-delivery process; waiving stage at the 3PL warehouse. In waiving stage, the availability is checked again from the 3PL ERP, and then the delivery is printed and assigned manually to picking team. Both steps in the waiving stage are non-value adding activities that lengthen the lead time of the delivery process unnecessarily.

Rather than trying to avoid the symptoms of inventory imbalance by performing wasteful steps in the order-to-delivery process, it would be more effective for both parties to focus on

ensuring that the inventory levels between SAP and the 3PL ERP are equal and accurate. Thus, DS should implement a procedure in collaboration with the 3PL partner, which ensures the inventory balance every day. Currently there is an automatically performed inventory level comparison, which creates a report about differences in inventory levels between SAP and the 3PL ERP. However, there is not a standardized procedure to utilize this report. As inventory level comparison is automatically performed every night, the report about mismatches should be reviewed every morning. The reviewing process includes investigating the mismatches, checking the shelf balance at the warehouse, and correcting inventory levels in both systems to be accurate and equal. Once this has been implemented as a daily routine in the 3PL warehouse, a lot of waste will be tackled. If necessary, the employees from DS operations support the 3PL warehouse in this procedure. The time frame for correcting the stock balances should be set in the beginning of the day, similarly as the inventory snapshot procedure is performed in the benchmark study.

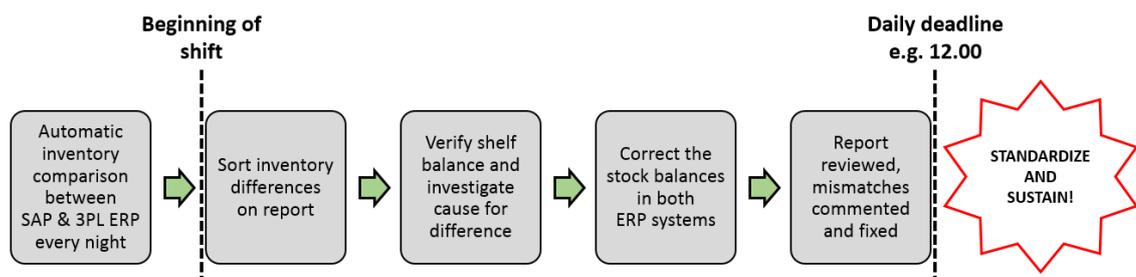


Figure 20. Suggested procedure for daily inventory checking and balancing.

Inventory balancing procedure together with focusing on the reliability of the ERP interface will reduce the number of differences in stock balances gradually. For the spare part order-to-delivery process this means that there won't be any reason to perform the waiving stage at the 3PL warehouse. Once the focus is on improving the root causes, there is no need for ensuring availability twice in the order-to-delivery process. Consequently, after the delivery transfers from SAP to the 3PL ERP, it goes to the work queue to wait for its delivery date. Instead of checking the availability and assigning the delivery to picking manually, the delivery prints out automatically to the designated area in picking on the date of confirmed delivery. Automatically printed picking list a visual indicator for picking team that the delivery can be picked and packed. Automatically printed picking list was part of the order-to-delivery process before the warehouse relocation, as described in appendix 1. This releases resources to more productive tasks from the 3PL partner, such as ensuring the inventory accuracy and equivalence.

3. Increase transparency and measurability of the 3PL warehouse operations with additions to system message traffic in ERP interface

Lack of transparency in warehouse operations causes uncertainty, unnecessary status checks, and complicates the management of collaboration with the 3PL partner, as described in the third development area in table 10. Since DS operations has no direct access to the 3PL ERP and there are no status notifications from the 3PL ERP to SAP indicating progress of delivery, the control over the process is limited for DS. Without control, DS relies completely on trust in the 3PL partner. Trust is a requisite for the collaboration in outsourcing, but relying only on it is risky. In case there is no way to control the process, there should be commonly agreed performance targets with the bonus/malus-clauses mentioned in the outsourcing contract to reduce the risk. Besides using bonus/malus-clauses in the first place may not be constructive for the collaboration, DS is also unable to reliably measure the on time delivery of the 3PL partner with the current data in SAP.

For above mentioned reasons, Drives Service should improve their visibility to the processes operated by the 3PL partner. In terms of the spare part delivery process, increasing visibility means more system messages about the progress of the process from the 3PL ERP to SAP. DS needs to add one more system message during the order-to-delivery process, and to add more information to the PGI-message.

Once the delivery is created in SAP, it transfers automatically to the 3PL ERP to wait for the picking to begin. After the delivery exists in the work queue of the 3PL partner, their system should update DS's SAP with a system message indicating that the delivery exists in the 3PL ERP. This would reduce uncertainty and unnecessary checkups. Additional system message about successfully transferred delivery would also provide an opportunity for DS to follow the on time delivery performance of the 3PL warehouse separately from the general outbound OTD, as it would be possible to exclude all the customer orders that do not exist in the 3PL ERP. The 3PL partner is only capable to process customer orders that exist in their system. Separate outbound OTD for 3PL partner would clarify the responsibilities in the order-to-delivery process; DS is responsible for ensuring availability of materials and providing deliveries to the 3PL ERP, and the 3PL partner is responsible for shipping every delivery in their system on time and with high quality. This provides an opportunity to utilize the bonus/malus-clauses based on the performance of the 3PL partner, if wanted.

The other addition relating to system message traffic in the spare part order-to-delivery process concerns cycle times of picking and packing. Optimally DS could monitor the progress of deliveries in real time from SAP. However, the lead time of picking and packing of single spare part order is relatively short, and it adds minimal value for DS to transfer every status update separately from the 3PL ERP to SAP. Furthermore, increasing the number of system messages transferring through the ERP interface requires more capacity of the system. More capacity means more costs, and in addition, sending more systems messages per delivery increases the risk of malfunctions and latency in the ERP interface since total message traffic increases. Consequently, DS should include the cycle time information about the picking and packing stages of delivery to the PGI-message, which is transferred to SAP after the delivery is processed in the 3PL ERP. This enables DS to monitor the process more closely, and is helping to discover the tasks that cause problems for the 3PL partner. This information is useful for continuous improvement in the common development sessions.

4. Modify the outbound OTD to indicate the actual on time delivery performance

The performance measure called outbound OTD is supposed to measure the punctuality of the spare part order-to-delivery process, and thus to indicate how accurately DS can deliver customer orders from the warehouse according to confirmed delivery date. As proved in the current state analysis, the current measurement method of outbound OTD is insufficient for indicating the delivery accuracy truthfully. The current outbound OTD compares the packing date to the confirmed delivery date, and thereby overlooks the forwarding procedures and the actual moment of ship out. That decreases the controllability and transparency, and incites to sub-optimization of the order-to-delivery process in DS operations. Furthermore, after the warehouse relocation the export forwarding is performed by the 3PL partner, and this makes it even more important for DS to include the forwarding stage to the outbound OTD measurement.

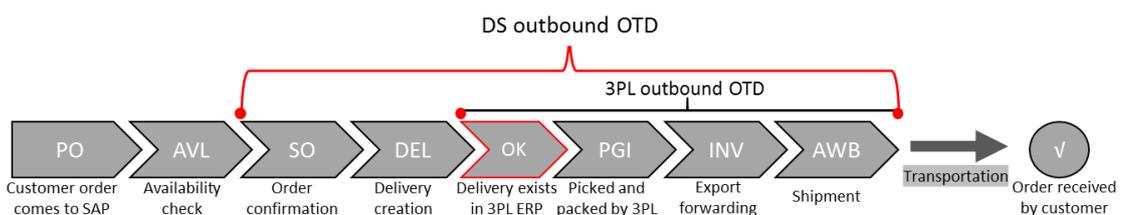


Figure 21. Suggested spare part order-to-delivery process in SAP, revised measuring points for outbound OTD included with separate measure for outbound OTD of the 3PL partner.

Data about the actual moment when the customer order is shipped out from the warehouse can be acquired from tracking information in the transportation management system. The tracking details in the TMS indicate the moment when the order row has been taken into transit. This data should be transferred to the shipment partition of the sales order in SAP. If the tracking information is not available, the moment when the transportation order is placed can be used in calculating the outbound OTD. This is because the outbound OTD measures delivery accuracy on daily level, and forwarding shouldn't make transportation orders for the next day. This enables DS to measure the on time delivery of operations truthfully, and thus optimize the order-to-delivery process comprehensively, including the forwarding procedures under control. Also, once the new system message about successfully transferred delivery is set according to suggestion in development proposal 3, it enables DS to measure the on time performance separately for the 3PL partner, as described in figure 21.

Modifying the outbound OTD to indicate the real on time delivery from the warehouse may decrease the result of the performance indicator in a short term, since taking the whole delivery process under measurement will unveil problems that are not included in the current measure. These hidden problems are valuable inputs for continuous improvement, and will help DS to serve its customer better in terms of quality and punctuality in the long term. Accurate data about the current performance is the basis of effective process management, and thereby it is wasteful to measure the irrelevant factors.

5. Align the customer communication with the current process and performance

There are two mistakes concerning messages sent to customer during the spare part order-to-delivery process. The more obvious one is the order shipped notification, which is sent too early to a customer. After the PGI-message transfers to SAP from the 3PL ERP, the order shipped message is sent automatically to customer even though actually the order is just packed and waiting for the forwarding to book the transportation in the outbound area. This feature is quite harmless, but it misinforms customers anyway. Inaccurate communication weakens the perceived service quality, because customers expect that the order is already on its way even though it is not. This feature also causes waste in customer service, as customers may inquire the tracking information when they receive the order shipped – message without an AWB number or further information. The order shipped message should be connected to the current shipment information and

tracking number message, which is sent after the transportation is booked by the forwarding team. Additionally, DS should change the text of the current order shipped – notification into a form, which indicates that the order has been packed and will be shipped out soon. As customer perceived quality in a service process is partly dependent on communications, it is important to avoid sharing misleading information to customer.

The second challenge concerning communication is related to the current service promise and accuracy of order confirmations. It is known that there are some customer orders with certain carriers and destinations which DS is unable to deliver according to their service promise. Reason for this is either the pick-up schedule of certain carrier companies or extra forwarding procedures for some destinations. Despite this, every customer order for from-stock spare parts that are placed before 18.00 and with same day delivery request, are confirmed to be sent on the same day. This creates a systematic conflict between the confirmed delivery date and the actual delivery date. Due to insufficient measuring method of outbound OTD, these conflicts have not been visible in on time delivery indicator of DS. Outbound OTD has not suffered from this challenge if these customer orders have been packed during the confirmed day. If DS decided to change the measuring method, this kind of problems would be noticed from the on time performance indicator.

There are two ways to solve the challenge with inaccurate order confirmations for customers using certain carriers or with certain delivery destinations. The first one is to lower the service promise for these orders. This would require adding criterion about the expectations in the logic on how the OMS confirms customer orders. For instance, customers with special carrier or destination would receive the order confirmation with the delivery date not earlier than the next day, if the order for from-stock item is placed after 15.00. The second way to solve this challenge is to negotiate improvements on the pick-up schedule with problematic carriers. If that is not possible, DS should use another carrier for the same day orders, that arrive too late to reach the last pick up of the intended carrier company. Since continuous improvement is not about lowering targets to reach them, DS should go with the latter option first. If there is no way to solve this conflict by negotiating improvements on the pick-up schedule, or another carrier with suitable pick-up schedule cannot be used, the service promise concerning same day orders must be lowered for mentioned special orders. Removing the conflict between same day service promise and the problematic customer orders, one way or another, will increase the

accuracy of order confirmations. Accuracy of order confirmations increases the actual outbound OTD, which increases the customer perceived service quality.

Evaluation of development proposals

The development proposals introduced earlier are practices to reduce the problems discovered in the collaboration between DS and the 3PL warehouse, and in the current order-to-delivery process. Revised flowchart for the spare part order-to-delivery process and the development proposals 1-5 are described in appendix 4. The following tables 14 and 15 summarize and evaluate each proposed solution.

Table 14. Summary and evaluation of development proposals 1-3.

Development proposal	1. Performance measure for critical errors in system message traffic and daily monitoring of errors in DS	2. Daily procedure for inventory checking and balancing at the 3PL warehouse	3. New system message to SAP updating status of transferred delivery, and additional information about cycle times to the PGI-message
Strengths	<ul style="list-style-type: none"> - Turns the focus on the most critical factor of the collaboration model - Improves reliability of ERP interface, and thus delivery reliability of DS - Reduces waste of imbalance in operations and collaboration - Decreases differences between inventory levels of two ERP systems - Increases KPI accuracy in SAP 	<ul style="list-style-type: none"> - Concrete way to ensure continuous inventory equivalence and accuracy - Reliable availability check in SAP makes delivery waiving unnecessary at the 3PL warehouse - Reduces non-value adding activities in operations and collaboration 	<ul style="list-style-type: none"> - Increases visibility to the delivery process in DS - Allows DS to monitor the order-to-delivery performance of the 3PL partner separately - Reduces inquiries - Transparency increases trust in collaboration - Transparency helps collaboration and common development
Weaknesses	<ul style="list-style-type: none"> - Requires manual work for employees of DS 	<ul style="list-style-type: none"> - Requires manual work for the 3PL partner 	<ul style="list-style-type: none"> - Increases the number of system messages in the ERP interface: <ul style="list-style-type: none"> ➤ Increased costs
Opportunities	<ul style="list-style-type: none"> - Increased on time delivery - Better availability - Reduces manual work from other processes 	<ul style="list-style-type: none"> - Better availability - Increased on time delivery - Decreases differences between inventory levels of two ERP systems 	<ul style="list-style-type: none"> - Possible to avoid delays through immediate problem solving if delivery does not transfer to 3PL ERP - Clarifies responsibilities in the order-to-delivery process between DS and the 3PL partner - Enables to utilize the bonus/malus – clauses based on the performance of the 3PL partner
Threats	<ul style="list-style-type: none"> - Focus on other important factors in collaboration may weaken 	<ul style="list-style-type: none"> - Lack of standardization of the procedure and discipline to maintain it at the 3PL WHS 	<ul style="list-style-type: none"> - More error messages in the ERP interface increases the workload of monitoring them
Difficulty of implementation	Easy	Moderate	Moderate
Benefit of implementation	High	High	High

Development proposals 1-3, described in table 14 above, are new additions to the current state. They are about to reduce the root causes for problems 1-3 listed in table 10, that originate from the warehouse relocation. New situation requires new procedures.

Table 15. Summary and evaluation of development proposals 4 and 5.

Development proposal	4. Modifying the current outbound OTD – measure to compare confirmed delivery date with the date of factual delivery, not the packing date	5. Conforming the delivery performance of the problematic orders to match with the current service promise and confirmation policy;	OR Conforming the service promise and the confirmation policy for the problematic orders to match with the current delivery performance
		AND rescheduling the “order shipped”-message to match with reality	
Strengths	<ul style="list-style-type: none"> - More accurate indicator about on time delivery performance of DS - Prevents from overlooking the forwarding and shipment stages, and thereby sub-optimizing the order-to-delivery process - Better view to the whole process helps continuous improvement and collaboration 	<ul style="list-style-type: none"> - Truthful communication increases perceived service quality of customers - Less inquiries about order status since customer is informed properly, and can trust in confirmations and status messages - Increased accuracy of order confirmations will have a positive effect on outbound OTD once the new way to measure it is deployed 	
Weaknesses	<ul style="list-style-type: none"> - Not comparable with the current outbound OTD 		<ul style="list-style-type: none"> - Customer satisfaction suffers from lowering the service promise
Opportunities	<ul style="list-style-type: none"> - Allows DS to send more accurate order confirmations - New measuring method may unveil hidden, unknown problems in the process 	<ul style="list-style-type: none"> - Helps DS to reach its target in terms of outbound OTD 	
Threats	<ul style="list-style-type: none"> - Result of outbound OTD is likely to decrease after implementation, and this may lead to wrong conclusions in the top management of ABB Oy Drives 		<ul style="list-style-type: none"> - Lowering the service promise for problematic orders may only hide the problem, not solve it
Difficulty of implementation	Moderate	Moderate	
Benefit of implementation	High	Moderate	

Development proposals 4 and 5, in table 15 above, are modifying the current operation model, not adding new procedures in it. These suggested solutions are aimed to tackle

problems 4 and 5 from table 10. These problems have occurred in DS operations even before the warehouse relocation, but were discovered during this study.

Development proposals introduced in this chapter are supporting effective management of outsourced warehouse operations in Drives Service. Collaboration with the 3PL partner requires trust, which can be strengthened by increasing transparency between partners as described in development proposal 3. ERP systems must communicate promptly to ensure efficiency, delivery reliability, and equivalent inventory levels. Development proposals 1 and 2 are set to reduce the risk concerning ERP systems and inventory imbalance. Operational systems and functioning integration between them make the data reliable, which is the basis of the collaboration management and efficient process execution. By ensuring that data in both systems is correct, DS and the 3PL partner can reduce many kinds of waste from their operations. Modifying the outbound OTD to be more truthful indicator about on time delivery performance allows parties to control, and thus develop, the whole order-to-delivery process better. It is crucial to include the forwarding into the outbound OTD – measure, as suggested in development proposal 4, since forwarding tasks determine if customer orders manage to reach the transport in confirmed time. Development proposal 5 is about improving the accuracy of customer communication, including order confirmations and status updates about orders. This improves customer perceived service quality, but also the actual outbound OTD of customer orders.

6.2 Clarification of responsibilities

Development proposals described earlier helps clarifying the responsibilities between DS and the 3PL partner. Increased transparency, standardized procedures, and new ways to measure the order-to-delivery process enables parties to view the performance of the collaboration through quantitative measures. The following KPIs and procedures form a framework for mutual meetings and collaboration development concerning the spare part order-to-delivery process.

Table 16. Most important performance measures and procedures for the collaboration in terms of spare part order-to-delivery process.

Performance factor	Drives Service in charge	3PL Partner in charge
Reliability of it-systems	Number of critical errors in ERP interface*	Daily inventory checking and balancing procedure*
Punctuality of operations	Outbound OTD*	3PL outbound OTD*
Availability of materials	Supplier OTD	WHS inbound OTD
Quality	Supplier quality	Picking and packing quality
Capacity	Forecast for upcoming demand**	Capacity issues
Communication	Number of enquiries	Response time

* new or fixed method ** subject for further investigation

As described in table 16, DS is responsible for providing proper deliveries to the 3PL ERP, and the 3PL partner is responsible for delivering them on time. Instead of waiving each delivery manually, 3PL uses resources to ensure the inventory accuracy and balance between SAP and the 3PL ERP. This makes availability check reliable, and thus material for every order is available in the 3PL ERP, if SAP creates a delivery for it. Increased visibility to the whole process in SAP enables DS to measure outbound OTD detailedly and accurately. This allows to locate the problems within the process correctly.

According to benchmark, frequent meetings and close collaboration are the key for successful partnership. Transparency and communication add trust. Everything cannot be covered with performance measures, but them support the management by providing a standardized agenda in common meetings. The selected set of measures covers the most important factors in the order-to-delivery process. Hence, ensuring that the defined measures are on an adequate level, the performance of the process is protected.

7 Conclusions

The objective of this study was to investigate how the warehouse outsourcing at Drives Service affected their standard order-to-delivery process, and what were the key challenges of the new process executed in collaboration with an external organization. Since the responsibility of warehouse operations shifted to the 3PL partner, this study focused also on important factors in managing the collaboration at Drives Service. The scope of this study was quite wide, and the purpose was to obtain a comprehensive view of the new operating model of Drives Service. However, the study was demarcated to standard spare part order-to-delivery process, which narrowed the focus to moderate for one study.

The research was divided into logical phases, which aided in conducting the study. The study process started with specifying the objective with instructors from both ABB and Metropolia UAS. Then the empirical research of the case was started along with gathering understanding and theoretical knowledge of the subjects related to the research objectives. The empirical research contained also a separate benchmark study, which supported the current state analysis but also enriched the development proposals. Every phase of the study completed each other, and together they formed a logical case with a many-sided view of warehouse process management and outsourcing.

Scientific knowledge in theoretical framework was utilized to support the case study and development proposals. The main subjects in theoretical framework were strategic management and performance measures, outsourcing, and lean management. The data was gathered from multiple sources, such as academic journals, textbooks, and e-resources. Information was versatile and supported the study well. Empirical research of the case study was conducted by using unstandardized interviews, reviewing ABB's internal documentation, and discussing with the stakeholders regularly. A constructive approach in the research worked well, since the challenges in the case were relevant both practically and theoretically. Also, the problem-solving mindset of the constructive approach was suitable for this case study.

Findings of the study correspond well with the research objectives. This case study managed to reveal several different challenges concerning the topics related to the spare part order-to-delivery process, performance measures, and collaboration model. The biggest challenges in the current state are related to problems caused by two collateral

ERP systems in the same process. Separate ERP systems as a part of the same process decrease the transparency of operations, and the system integration between two ERPs is vulnerable for errors. Errors in the ERP interface cause multiple further problems, such as inventory imbalance and delayed customer orders. The study clarifies the challenges in the current state, but along with that, provides proposals for improvements of each listed challenge. The development proposals are based on the theories about Lean management, performance measuring, and outsourcing. Along with the theory, the benchmark study inspired the creation of the development proposals. Since the system interaction is similar in the benchmark, the inventory balancing procedure can be utilized also in the collaboration model of DS and their 3PL partner. The other proposals are based on theoretical knowledge, such as determinations of quality and waste.

Transparency would also help the 3PL partner. This means that 3PL warehouse should be able to see Drives Service's upcoming volume in order to plan their capacity effectively. The first subject for further research concerns this dilemma:

- What are the critical factors of forecasting upcoming demand reliably?
- How could Drives Service make a bigger share of customer orders visible in the order backlog in advance?
- Could existing information, such as historical consumption statistic, and installed device base, be utilized in consumption forecast?

Since tasks at Drives Service Helsinki are constantly shifting towards controlling and managing the processes instead of performing them, the current method to obtain information about the performance and progress of processes through manual enquiries from SAP is not optimal. It requires a great amount of manual processing and combining data, which takes time and makes the management reactive. The second subject for further research concerns this challenge:

- What kind of software add-on would enable monitoring and controlling processes in real-time?
- What kind of changes would this require to current processes?
- Profitability calculation of deploying the tool, considering the waste that is currently caused by manual reporting and monitoring.

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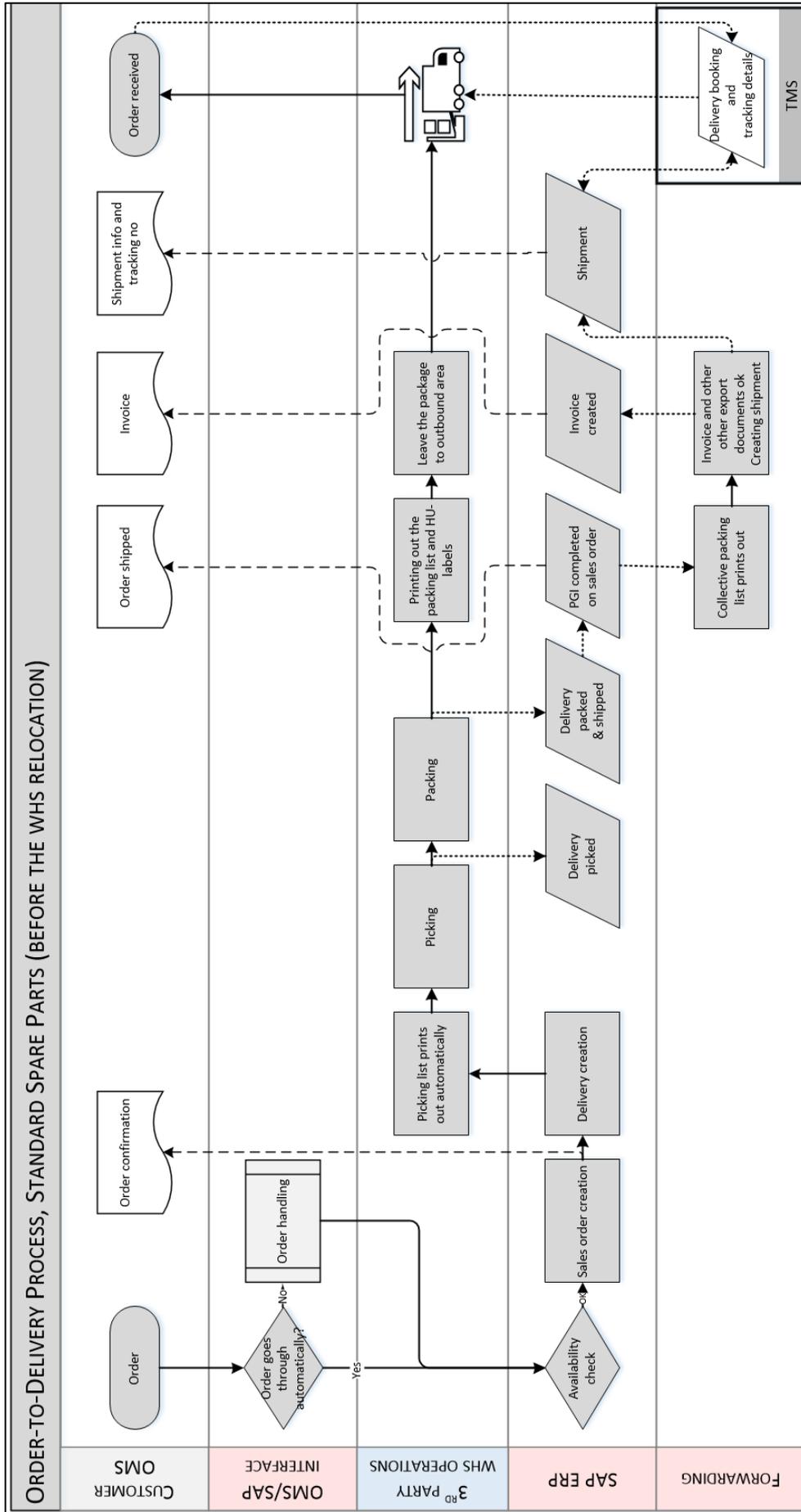
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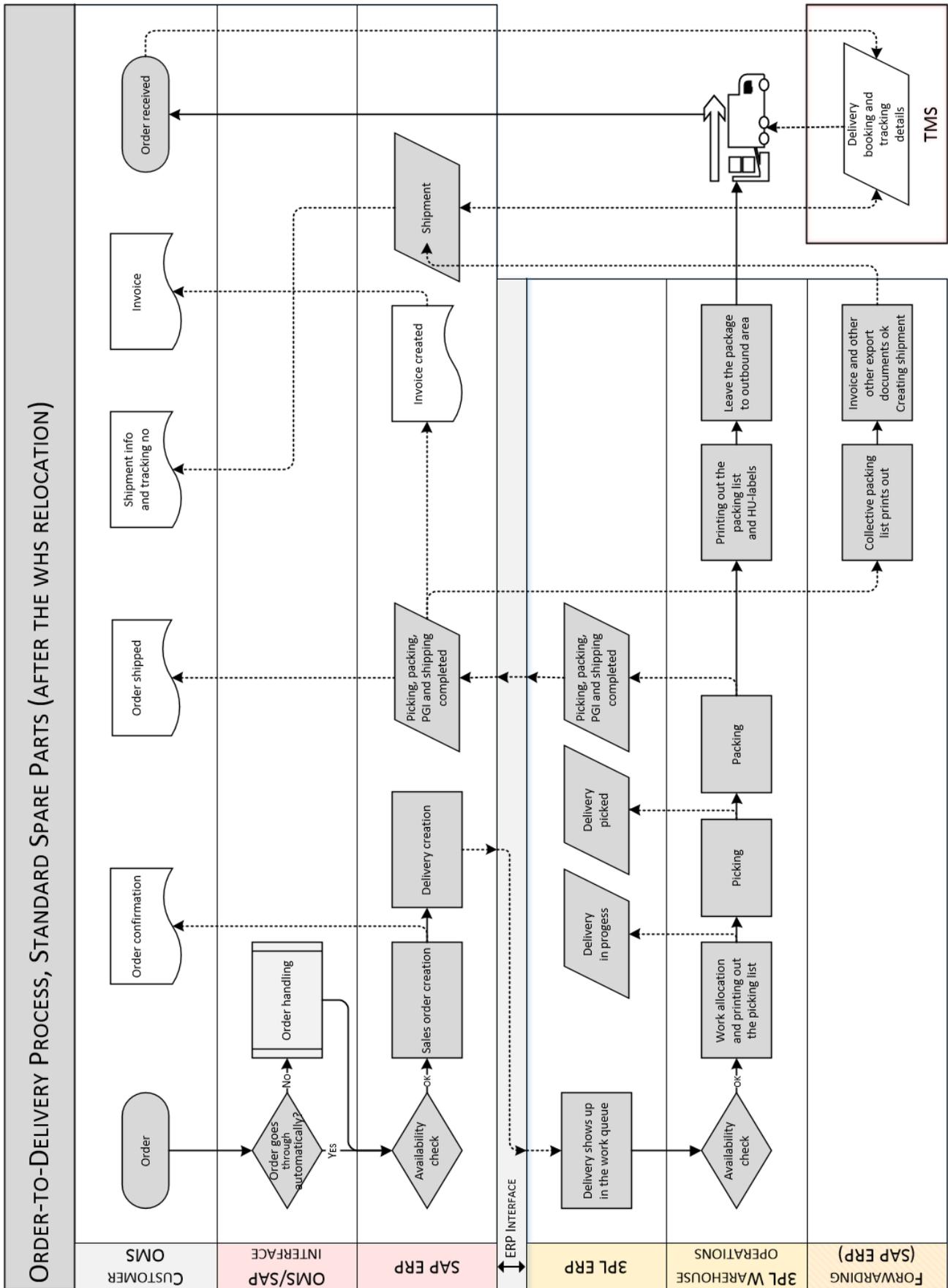
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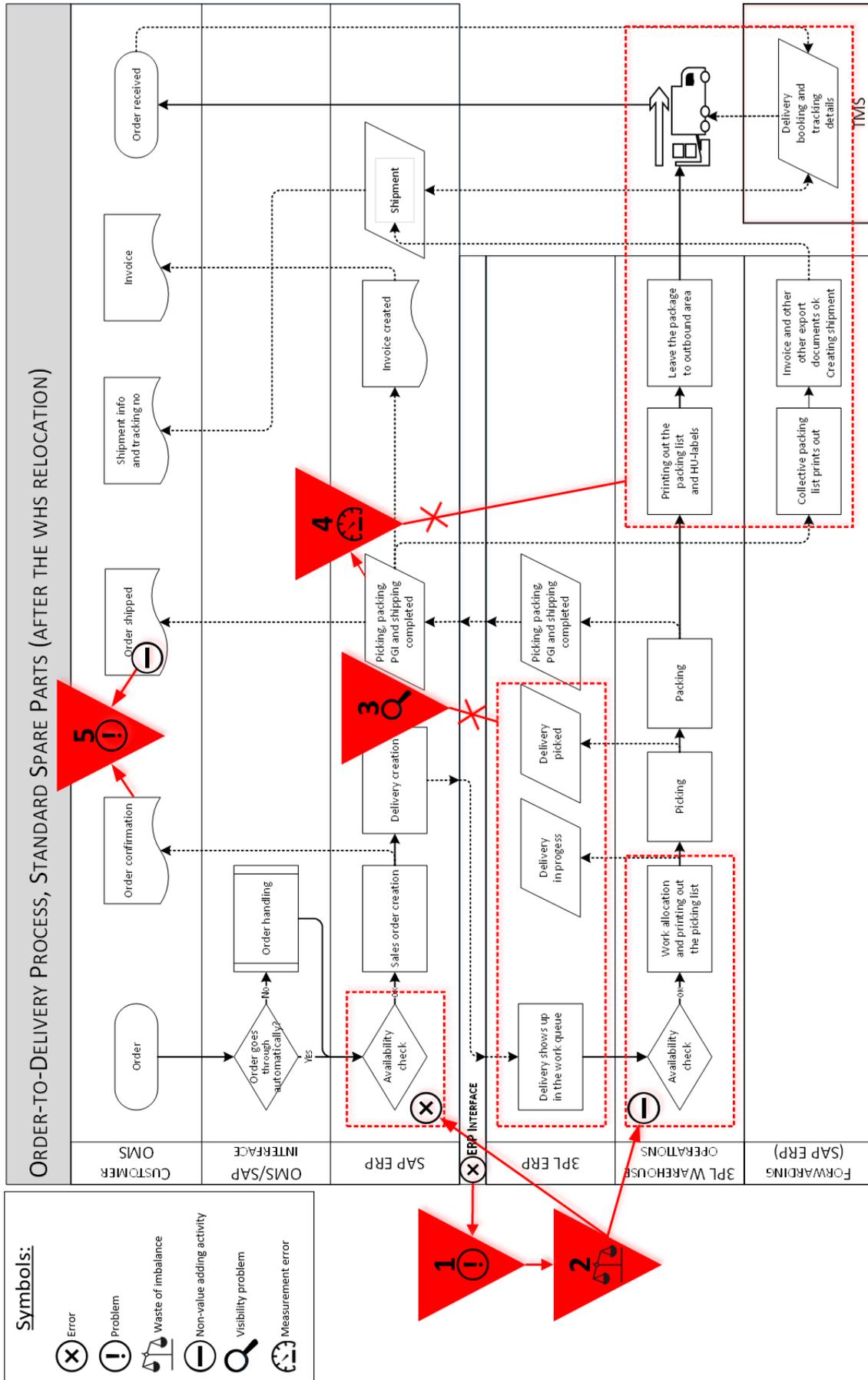
Appendix 1. Workflow of the previous spare part order-to-delivery process



Appendix 2. Workflow of the current spare part order-to-delivery process



Appendix 3. The current spare part order-to-delivery process with problems 1-5 mentioned in table 10



Appendix 5. Interviewing schedule with agendas during the case study

Schedule and Agendas of Interviews during the Case Study				
Interviewee(s)	Agenda	Date	Type	Place
Manager and Team Leader of DS Customer Service	Customer orders, order handling, and challenges in the current order-to-delivery process	6.10.2017	Meeting	Helsinki
Warehouse Operations Manager of Company X	Benchmark about collaboration model, agenda of meetings, and proven practices in managing outsourced warehouse	26.10.2017 - 9.12.2017	Phone call & E-mail interview	Helsinki
Owner of the Order-to-Delivery Process of DS	Workflow of the current order-to-delivery process, outbound OTD measuring method, and general challenges	22.11.2017	Meeting	Helsinki
OpEx- and Quality manager of DS	Specification of material availability performance indicator	24.11.2017	Meeting	Helsinki
Manager of the Logistics Transfer Project of DS	Warehouse relocation project and agreed collaboration model between DS and the 3PL partner	28.11.2017	Meeting	Helsinki
Operations Manager of the 3PL warehouse	Performance measures, procedures, objectives, and requirements in terms of Drives Service's order-to-delivery process	12.12.2017	Phone call	Helsinki
Forwarding Specialist of DS	Clarification about forwarding stage in the order-to-delivery process	24.1.2018	Skype interview	Helsinki
Operations Development Manager of DS	Steering the scope of the study and evaluating of the findings.	18.10.2017 - 16.2.2018	Regular meetings	Helsinki