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DEVELOPMENT OF PROGRAMMABLE SPARE PART QUOTATION AND SALES ORDER PROCESS

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The goal of this thesis was to develop a process of a quotation and order handling of programmable spare parts. The aim was to create a current state of the today's process and find development areas within the supply chain. The current operating model has been experienced unclear and it has caused errors in deliveries to customers. The current state of the operating model was explored by interviews. The research was based on real life case, which was approached from process management point of view.

As a result of the research, operation model was visualized in process charts and the several problem areas were discovered. The biggest challenges in sales of programmable spare parts were weak recognizability in systems and unclear instructions on operation.

Based on findings, the recommendations were presented to decrease challenges in quotation and sales order process of programmable spare parts. The recognizability will be improved by utilizing the ERP-system better and giving proper instructions to sales persons how to act when the programmable spare part is faced.

TIIVISTELMÄ

Tekijä: Jonne Majuri

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Hakusanat: Prosessikehitys**,** Prosessijohtaminen, varaosat,

Diplomityön tavoitteena on kehittää ohjelmoitavina varaosina myytävien tuotteiden tarjous- ja toimitusprosessia. Tarkoituksena on luoda prosessista nykytila-analyysi ja sen pohjalta löytää prosessista kehitettäviä kohteita. Tämänhetkinen toimintamalli on koettu epäselvänä ja se on mahdollistanut lukuisia virheitä tavaran toimituksessa asiakkaalle. Prosessin nykytilaa ja ongelmakohtia selvitettiin pääasiassa haastatteluin. Tutkimus on luonteeltaan tapaustutkimus, jota lähestytään prosessijohtamisen ja prosessinhallinnan näkökulmasta.

Työn tuloksena nykyinen toimintamalli mallinnettiin prosessikaavioihin ja prosessia vaivaavat ongelmat saatiin seulottua. Suurimpina ongelmia ohjelmoitavien varaosien hallinnassa koettiin niiden heikko tunnistettavuus järjestelmässä ja epäselvät ohjeistukset kyseisten tuotteiden toimituksessa ja toimitusketjun hallinnassa.

Näihin ongelmiin perustuen työssä esiteltiin suosituksia, joilla prosessissa ilmeneviä ongelmia voidaan vähentää. Ohjelmoitavien varaosien tunnistettavuutta pyritään lisäämään hyödyntäen yrityksellä käytössä olevaa toiminnanohjausjärjestelmää ja luomaan selkeät toimintaohjeet jokaiselle ohjelmointia vaativalle varaosalle.

Abbreviations

BPM	Business Process Management
ERP	Enterprise Resource Planning
IP	Intellectual Property
KPI	Key Performance Indicator
MEW	Metals, Energy & Water
OC	Order Confirmation
OTD	On Time Delivery
PL	Product Line
PO	Purchase Order
QS	Quotation Support
QRT	Quotation Response Time
RFQ	Request for quotation
SaSu	Sales Support
SC	Service Center
SO	Sales Order

Contents

1 Introduction

This section gives introduction to research topic. First it presents background and goals bringing out the research questions that the research will answer to. The second section presents methodologies that are used for gathering information about the topic. The third section shows the structure of the thesis and the last part gives a brief presentation of the case company.

1.1 Background and goals

This Master's thesis is made for Finnish mining technology solutions company, Outotec. The focus is on a process of programmable spare parts in service sales. The issues in quotation and delivery process of programmable spare parts cause uncertainty in process chain. Unclear processes and lack of information lead to complications during the delivery.

The objectives of the study are describing the current processes, find the main bottlenecks and make recommendations to improve efficiency in the process. It will be reached by answering the following research questions:

1. How programmable spare parts are handled currently?
2. What are the main bottlenecks in current quotation and delivery processes?
3. What are the recommendations to solve the bottlenecks?

First the research is made to bring out every different method how programmable spare parts are handled. The current methods are visualized through process charts and explained in more detail. Visualization of the processes and the working habits gives good understanding of the current state. It also gives opportunity to raise issues where the problems exist.

The answer to the second research question brings out the problems and bottlenecks that people in organization feel slowing down the process. People inside the organization in the middle of process chain have opinions about the working methods and about the environment which gives good perspective on appearing problems. The goal is to

gather as many bottlenecks as possible which gives a good starting point to get answers to the research question.

The answer to the third question gives recommendations on how to solve bottlenecks. It tells how the company can make the quotation and delivery process of programmable spare parts more efficient. As a result, company can improve the performance of spare parts delivery. This helps company's spare part sales to keep up with the promised timeline and give more exact promises to end customer.

1.2 Methodology

Qualitative research method is used to acquire information in this thesis. "An interview, whose purpose is to gather descriptions of the life-world of the interviewee with respect to interpretation of the meaning of the described phenomena." This is how Kvale (1983, p.174) describes the definition of the qualitative research method. Tools for collecting the information is done with several ways from telephone interviews to most common face-to-face interviews. In addition, usage of internet and computers are becoming tools that are more common in these days. This includes electronic messages like e-mails and chat services like Skype and internet phone calls. Methods can be based on real time data transferring (internet call) or delayed data transfer (email). In this thesis, is used four main interview techniques: Face-to Face, telephone, Skype and e-mail. (Opdenakker R, 2006)

In first phase of the thesis the goal is to get familiar with the current process and get to known how things are done currently. The goal is to create current state analysis, which gives a general view to the current states of programmable spare parts in organization. Material to this analysis is gathered from company's system and by interviewing the persons who are working with the process. As a result of this phase will be visualized process charts of quotation and sales order process.

In the second phase, information of the bottlenecks is acquired. This phase is called problem analysis. Information is collected by several interviews from many points of process chain, which are conducted with specialists and product managers who are

working with the spare parts. With these persons the current state of quotation and sales order process is explored and the problems in process are popped up.

This follows a root cause analysis where the found problems are brought on the table and the root causes of the appearing problems will be found. In this analysis we try to find reasons why these problems are appearing. Going deeper in to root causes, the understanding of the problems will be clearer. At the end, recommendations to improve the process efficiency are presented. Support for getting recommendations are gathered from theory of process management.

1.3 Structure

The thesis consists two parts, theoretical part and practical part. Theoretical part presents key theories that are exploited to find guidelines for the solution. It consists material from scientific articles, books and public researches. The goal of the theoretical part is to give an understanding of the area where the solutions lean on. Theoretical part is divided in three chapters. The first chapter deals with process management and presents benefits of the process modelling. The second chapter gives an overall image of the nature of spare parts. The third chapter presents key elements of ERP system.

The second part is the practical where the goal is to find the problem areas with solutions in real life case company. In this part, real life and theory are united creating wholeness with the problem descriptions, finding solutions and offering recommendations to increase the efficiency in the process. The findings are gathered from interviews of the employees in the company and by discovering the company's web pages and the data base. This part consists of four chapters starting with problem description including case examples of failures in process. The chapter describes the problems from the employees point of views. This follows the chapter of process modelling, where the current processes are visualized. The process is pictured phase by phase from customer request for quotation to the delivery of the ordered spare part. The next chapter handles problems that exist in current process. These problems are gathered by interviews from experts from all over the company. Chapter 8 is root cause analysis,

which finds root causes to appearing problems. Chapter tries to find the roots that are causing the problems in spare part delivery. Final chapter presents recommendations how company can reduce the problems in their process and make it more efficient. The recommendations aim to tackle the root causes found in previous section. It gives ideas of actions that company can use to improve their efficiency of spare parts handling process.

1.4 Outotec Oy

The case company in thesis is a Finnish mining technology company called Outotec. Outotec provides technologies and services to the metal and mineral processing industries. The key word in operation is sustainability. For the company it means, they help customers take advantage of natural recourses in the most sustainable way. Together with customer, company tries to find the best solutions to water, energy, minerals and handling the full value chain from ore to metals. In addition to technology solutions company also provides operation and maintenance services. They support clients in every phase in their processes. (Outotec, 2016)

Total sales of Outotec in 2016 was 1,058 MEUR. It provides a job for over 4200 people and spends 55 million euros on research and development annually. Outotec has offices in 34 countries, head quarter located in Espoo. The company has customers in over 80 countries.

Sales (2016)	Personnel	Annual R&D expenditure	Offices	Deliveries
• MEUR 1,058	• over 4,200	• EUR 55 million	• in 34 countries	• to over 80 countries

Table 1: Key figures in year 2016

The company focuses on three business areas, Mineral Processing (MP) and Metals, Energy & Water (MEW) and services. They are leading organization in these core business areas. Business areas can be divided in following units described in figure 1.

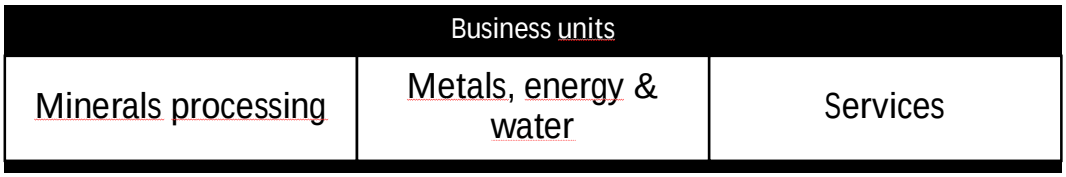


Figure 1. Business units at Outotec (Outotec, 2017)

Outotec offers sustainable mineral processing solutions, from pre-feasibility studies to complete plants and life-cycle services. They design and deliver state-of-the-art mineral processing equipment, optimized processes, including intelligent automation and control systems, as well as complete plants. In MEW Outotec provides sustainable solutions for metals processing, renewable energy production and industrial water treatment. Services business unit offers services from supplying spare parts to comprehensive solutions covering maintenance and operations. Sustainability can be considered as a core value of the company. “We build success together, we aspire for excellence and we create leading technologies for our customers.” (Outotec 2017)

Figure 2: Values in Outotec

Outotec’s strategy is to improve the customers’ productivity by using their leading technologies combined with life-cycle services that enhance the performance of their customers’ plants and processes. The company strives to be involved in every chain from ore to metals. Its goal is the strengthening operations in growing markets and improve the price competitiveness and the scalability.

The strategy focuses in 5 core areas, which are customers, service business, and competitiveness of the products, profitability and focus on their people. Customer-centric

way is to differentiate in increased competition which requires better understanding of customers' needs. (Outotec, 2017)

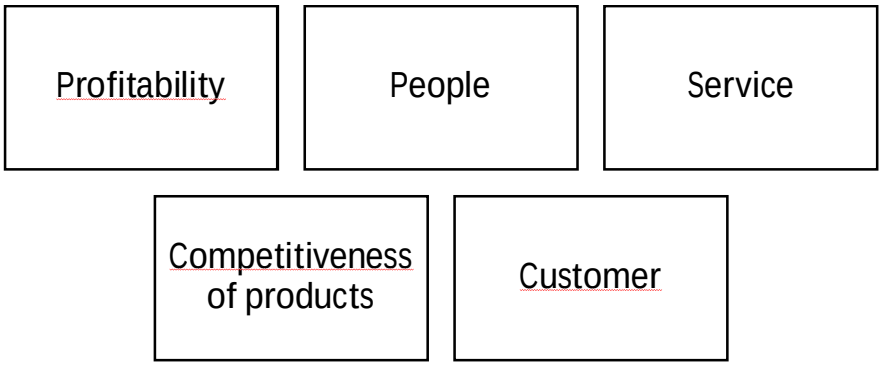


Figure 3: Five strategic core areas

The focus on service business is the way to achieve the profitability over the cycle. Fewer opportunities leads to situation where competitiveness needs to be improved. This has been done with further differentiation and reducing the product costs. Also, fixed costs are cut which improves the cost efficiency and therefore productivity. The last strategic focus on people by examining the leadership culture and the concentration on people's satisfaction in the company. (Outotec, 2017)

2 Business Process Management

In today's highly competitive environment, efficiency and performance have become essential competitive edge to companies. Companies are constantly finding better ways to improve their processes and making them perform faster. The solutions often come from process improvement point of view. Business Process Management (BPM) is key position to understanding processes and it helps to get birds-eye view to actions which are happening in company.

This chapter gives a cross-section to Business Process Management starting with the definition of process thinking and presenting benefits that process thinking brings with it. In the end, there are tools presented for business process management including Business process modelling and Lean management. In this research, process management theories are utilized in understanding the company's business model and give theoretical approach to develop company's processes.

2.1 Business process definitions

Business processes are the series of interrelated activities which crosses functional boundaries with inputs and outputs. Business process adds value by input meaning that the output from business unit has created value to the input which was inserted to business process. Originally business processes were created for manufacturing purposes, but thinking has widened to information work also. Companies working in service business, like in banks for example, are utilizing business process models in controlling their organization's operations. (van der Aalst et. all, 2016)

Picture 1 Business process (van der Aalst et. all, 2016)

Jeston J. and Nelis J. (2014) define business process management in their book by following words:

A management discipline focused on using business processes as a significant contributor to achieving an organization's objectives through the improvement, ongoing performance management and governance of essential business processes.

Business process management is continuous improvement of business processes. It is implemented along with daily management and there is no finish line for the BPM. Business process management requires end-to-end organizational view and common sense through the organization.

2.2 Benefits of business process management

There are reasons to take advantage of the process approach in management. Resources are listing several advantages how companies benefit from business process management. Managing business processes allows increasing flexibility to meet changing external demands. It also increases the speed to market of new products and services makes responsiveness to the demands of customers faster. In many industries, these are essential elements to stay competitive in highly changing markets. Visualized business process models give better understanding of the company's structure which makes it easier to manage. Process management facilitates the reduction of costs when the problem areas are clearly visible. That increases also the reliability of deliveries and helps

address the quality of products and services in terms of their consistency and capability. (Armistead C. & Machin S. 1997, p. 886-887)

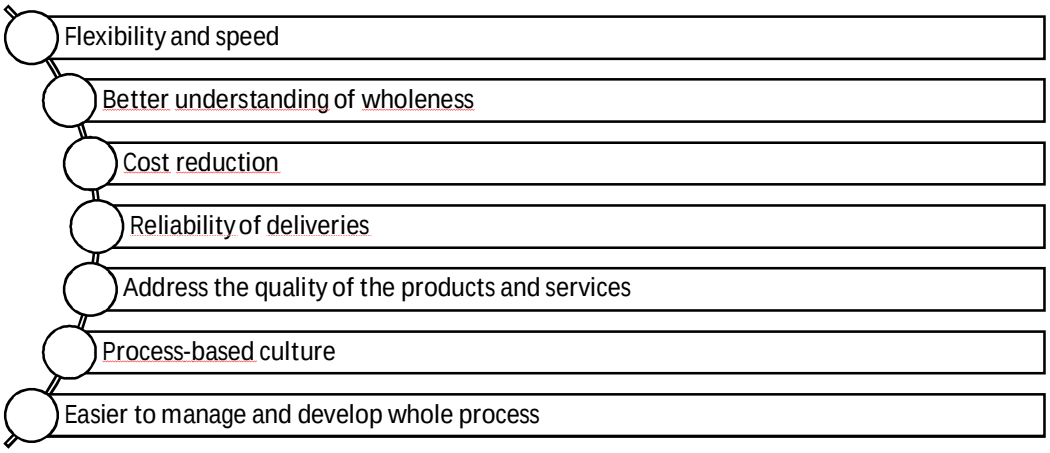


Table 2. Benefits of process management

Process management promotes process-based culture. Culture is the thing how organization operates. It describes the habits and ways to act, think and approach the work. It makes it automatic so employees don't even need to think about it. Process management also helps to manage end-to-end business processes. It gives better understanding from end to end of the whole process. This cross-functional view focuses on how to improve efficiency, lower costs and improve lead times. From customer point of view, it also helps provide quality products and services. Because the most important need is to understand customers' needs, managing process gives opportunity to custom and modify level of service to meet the specific criteria of the customer and fulfill their expectations. (Dowdle, P. et al. 2013, p 12-13)

2.3 Business Process Modelling

Business Process Modelling is the key concept of business process management. It helps to illustrate the process and gives better understanding of the supply chain by visualizing the material and data flows in organization. Knowing and recognizing own business processes are becoming more important in every organization. Better understanding of existing organizational structures and business processes gives more tools

to make changes to current processes and design new ones. It also makes possible to analyze, measure and manage performance of the whole supply chain. (Emmanuel D. 2006, p.557)

Creating a business process model can be instructive, revealing anomalies, inconsistencies, inefficiencies and opportunities for improvement. Once it has been created it will be valuable for whole enterprise. It shares information of the individual units and their links to each other's. It gives better understanding to business units how the supply chain works and what is their role in the whole process. (Koubarakis, M & Plexousakis, D. 1999, p 24)

There are several functions which are synchronized aiming one and only target to achieve the company's goals. Each function has its own objectives to achieve the organizational goal. The following benefits are achieved by having repeatable business processes (Mohapatra, S. 2013, p. 118):

- Consistently consisted results
- Easier to train people
- Smaller odds for errors
- Usage for refining and fine-tuning process to perform better.

Value and costs are often measured in supply chain management by the time used for the whole supply chain. By the following factors can reduce time in supply chain:

- Holistic view of supply chain
- Utilization of technology
- Removal of non-value adding functions / actions
- Speeding up of suppliers
- Product engineering
- Shorten the forecast period
- Re-designing of manufacturing process
- Re-evaluation of supply options

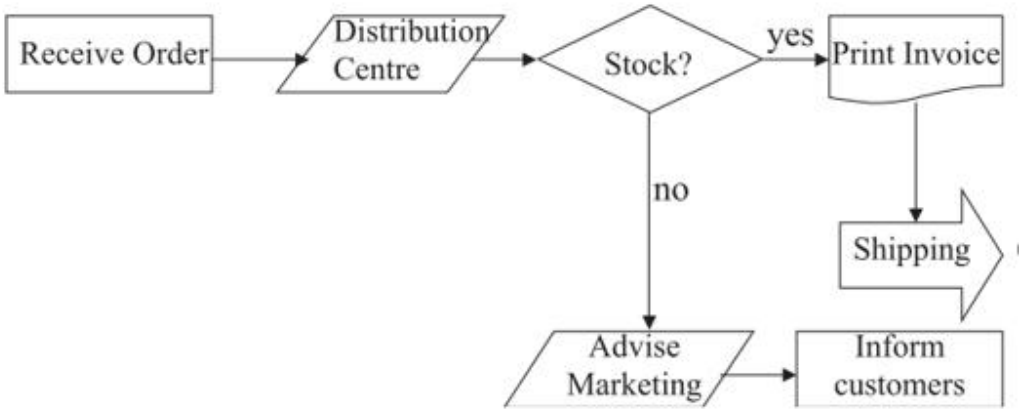
Process Modelling have the certain requirements to make sure that modelling is made correctly. One requirement is to get complete information of the firm's processes. Without complete information, process model will be too simplified. Having the right level of abstraction is important. The existing information can be gathered with questionnaires, interviews and checklists. Processes should also be kept realistic. Business process modelling should be practical enough to be implemented in real life. Usually problems arise when processes are theoretically planned before implementing. Then it becomes to think of practical feasibility when being implemented. When in organization there are too many processes, it is good to partition them some way. It could be made according to international standard or best practices basis depending on functionality or roles and responsibilities. (Mohapatra, S. 2012, p.119)

2.3.1 Process modeling methods

There are countless of methods for modelling processes. Every modelling technique has their own purposes and focus areas where they are suitable to use. It is not reasonable to present all of them here, but the most common ones are presented.

Flow Chart

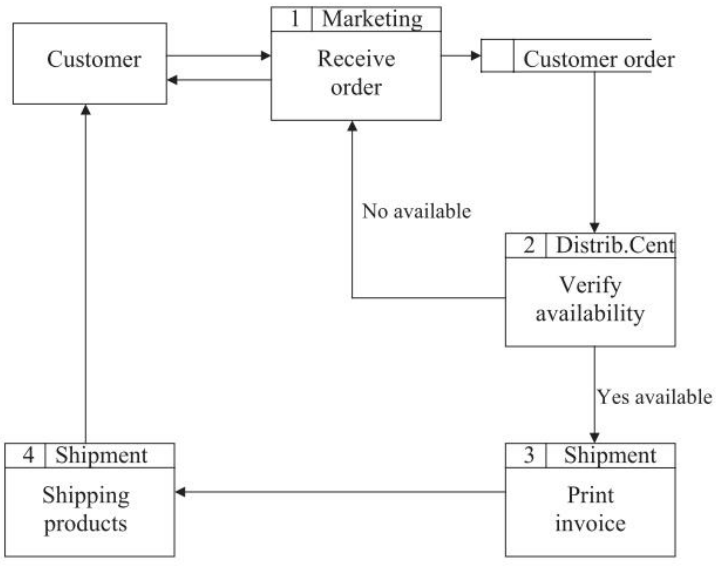
Graphical representation in which symbols are used to represent things like operations, data, flow direction and equipment. It can be used for definition, analysis or solution of a problem. Flow chart modelling method uses flow charts to represent business processes. Benefits of using Flow Chart modelling method is its flexibility. A process can be described in a wide variety of ways. It is easy to use and doesn't take much a time to draw a sketch of a process. (Aguilar-Saven, 2002)



Picture 3 Flow Chart (Aguilar-Saven, 2002)

Data flow diagram (DFD)

Data flow diagrams show the flow of data or information from one place to another. It describes how processes are linked together through data stores and how processes are related to the users and to the outside world. They show only flow of data, not any of materials. It tells what process will do, not how it does it. (Aguilar-Saven, 2002)



Picture 2 Data flow diagram (Aguilar-Saven, 2002)

Role Activity Diagram (RAD)

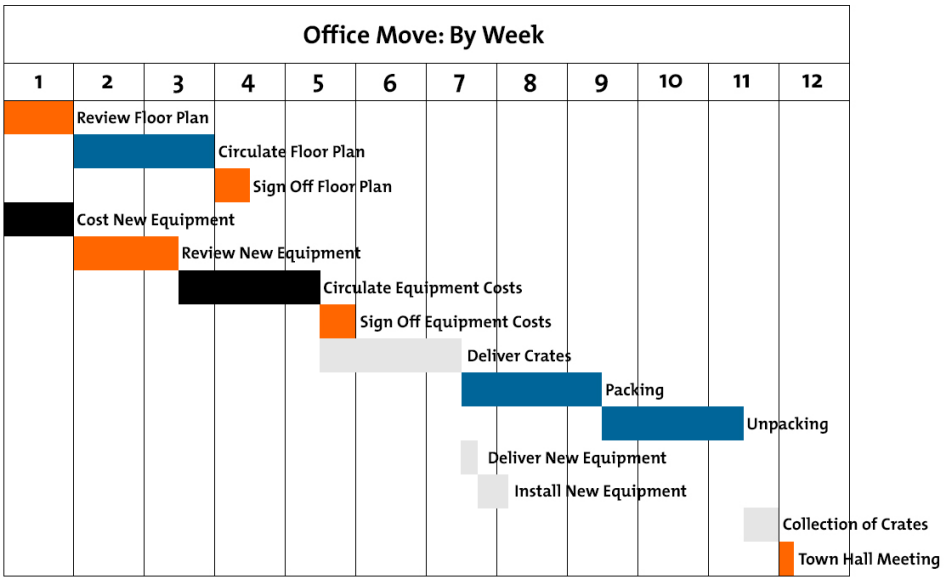
Role Activity Diagrams views the process from the perspective of individual roles and the interactions between them. RADs provides a different perspective of the process and it is useful in supporting communication. They are easy to read and understand presenting the detailed view of the process. RAD can be used for defining the degrees of empowerment within the business and it can also demonstrate how processes interact. It can even be used to describe how software systems interact. Disadvantages of RAD are that the technique explicitly excludes business objects, which is manipulated by the process as machines or products. The process is presented as a sequence of activities not letting a decomposition of the process, and thus it makes an overview difficult. (Aguilar-Saven, 2002)

Picture 3 Role Activity Diagram (Aguilar-Saven, 2002)

Gantt chart

Gantt chart is a matrix which lists tasks or activities on vertical axis and on row there are contained a single activity identification. That is usually a number and a name. The length of horizontal axis indicates the estimated duration of activity. It also indicates the needed skill level to perform activity and the name of the person assigned to activity. Each period may be expressed in hours, days, weeks, months or other time unit needed.

Gant Charts relate the list of activities to the time scale and they can be used to represent a process graphically and control its current situation of performance. Using Gant Chart for analyzing is limited. It gives very simple graphic presentation but it doesn't show the clear dependencies between activities. (Aguilar-Saven, 2002)



Picture 4 Gantt chart (Mindtools, 2018)

2.4 Lean Philosophy in Service Business

Lean is the most used philosophy in the name of process efficiency. The lean management philosophy was originally created by Toyota. The main principle in lean thinking is to reduce all the waste from work which is not adding any value to customer. This means reducing functions in chain that has no difference between input and output of the business process. (Chiarini, 2013, p. 141)

The lean was first created for manufacturing purposes but later the philosophy has been added to office environment also. In office work, customer service for example, there are many wastes that are slowing down the processes. This can cause long waiting times and frustration. The core in waste removing thinking comes from value added to customer. Recognizing which activities add value to customer and which are not is

important in recognizing the valuable activities in process. The definition of value adding activity is that it adds value to customer when it provides higher value output than input. (Chiarini, 2013, p. 141)

Toyota has listed seven related wastes in production system. These are the most common wastes that appear in literary. They are listed below (Chiarini, 2013, p. 144-145):

Overproduction or asynchrony – too much production and not meet the customer demand
Inventory – raw material, work in progress and finished goods stored
Motion – unnecessary movement of the body
Defectiveness – non-conforming products and services in general
Transportation – unnecessary movement between processes
Overprocessing – processing beyond the customer requires
Waiting – having to wait before next activity.

Andrea Bonaccorsi et. all (2011) presents in article Service Value Stream Management (SVSM): Developing Lean Thinking in the Service Industry, how these wastes in manufacturing can be applied to service business. The nature of presented wastes are mostly issues that companies face in the office environment. They are related to data, communication and reporting issues, but also customer service and paper work. At the end, all these wastes are affecting to customer experience and causing costs to the company. The examples of wastes in process transferred to service operations are presented in table 3.

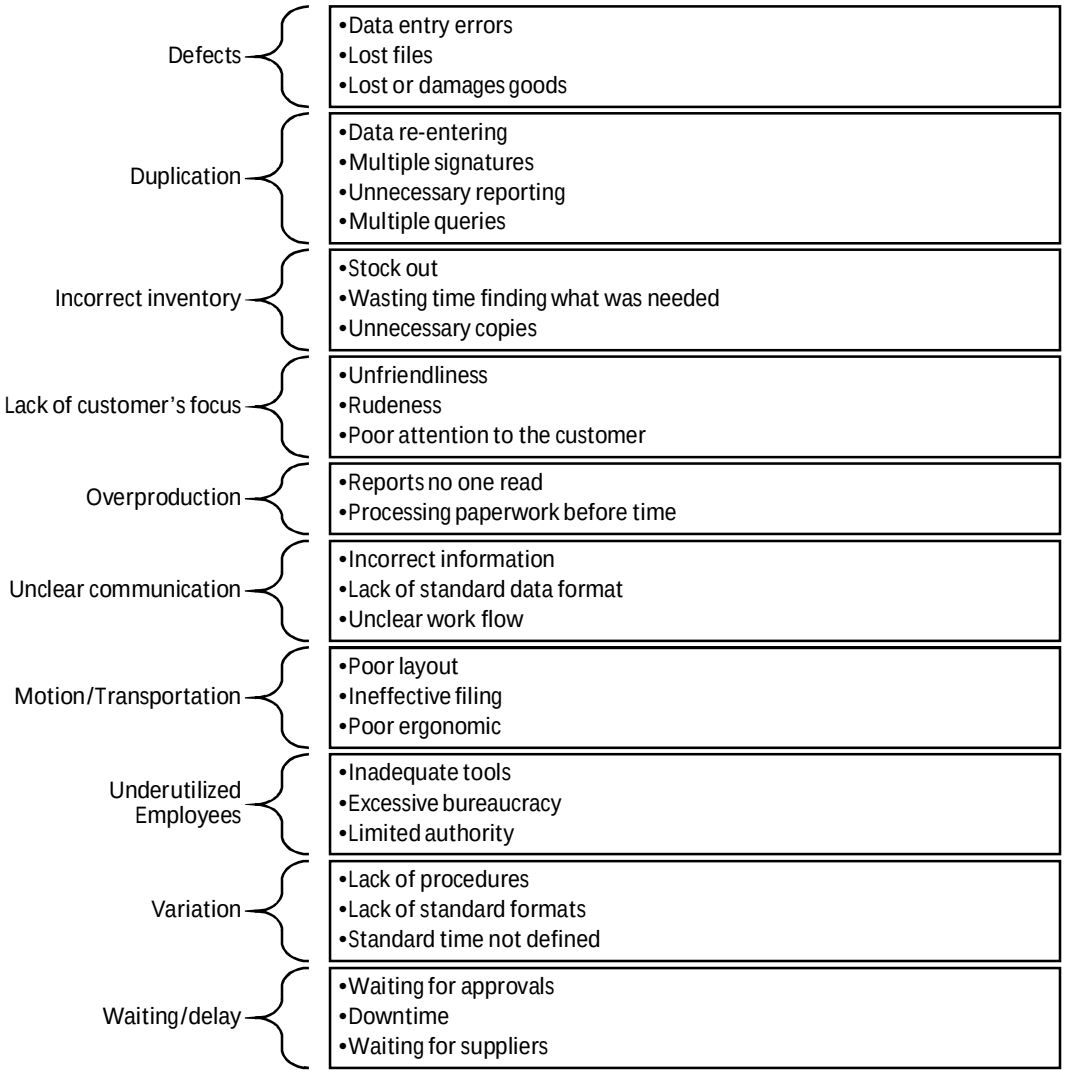


Table 3 Ten waste of service industry (Bonaccorsi A. et all, 2011)

3 Spare part management

This chapter focus is in presenting theories which are related to handling products that are considered as spare parts. The research focuses on development of spare parts and therefore it is reasonable to present some features related to spare part handling. Chapter gives definition of spare part and it lists characteristics that are related to product sold as spare parts. They are common principles which apply to spare parts universally regardless of industry.

Spare part is an interchangeable part in device that will be changed in some point of operation. After failure or wearing, original part is not usable anymore and it will be replaced by spare part. Spare part can be also called as a service part or service spare. Items sold as a spare part have certain characteristics that make the supply chain management different compared to non-spare items. Spare parts usually have high profitability which justifies the better focus on supply chain management of spare parts. (Dickersbach J. 2015, p. 2-3)

Service Spares	• High number of parts • Authorized stocking list • Sporadic demand • Availability and safety stock • Preventative maintenance • Repair and remanufacturing • Profitability

Table 4 Characteristics of service spares (Dickersbach J. 2015)

It is usual that there is high number of different service parts to deal with. Usually spare parts should be available many years after actual device has been sold, which ensures fast delivery to customer when needed. At the same time spare parts are moving slowly from stock to customer which gives reason to consider the need of stocking of the item. Demand of the spare parts is sporadic. You will never know when customer needs the

certain spare. The need for new spare varies due to wear, accident or other reason. (Dickersbach J. 2015, p.2-3)

Availability from customer point of view is important. If vital or essential part of the primary device fails it can cause huge losses in production. It leads to the need to keep downtimes low and ensure the availability of these items for the need. In most of the cases, companies have separated their spare parts production from the main product manufacturing. Organizational structure solutions focus on the distribution and the availability of the service part at the warehouses within supply chain. (Dickersbach J. 2015, p.2-3)

In management of spare parts, there are certain characteristics which can be considered universal to every company that are working with service spares business. S. Cavalieri et. all. (2016, p 383-391) present master data management and spare part classification key elements in managing spare parts business.

Master Data Management

Master data defines business-oriented properties used in different applications across the organization. This data has been cleansed, rationalized and integrated into an enterprise- wide system and used across multiple business processes. Core entities can be divided in parties, places and contents. (Silvola et al. 2011)

Each state in organizational supply chain need different kind of data. Purchasing needs data, which defines materials' purchasing information which helps supplier to recognize wanted items. In other hand customer master data must involve all the contact and invoicing data. Errors in data causes lot of losses for companies. (Silvola et al. 2011)

Material master data is the core data which includes the essential information to operate in business. It includes the basic information like what is the description and how much it weights. It can also include information about suppliers, lead times and manufacturer part numbers. The amount of information can be huge, but it is important to include the core data that is needed in daily operations. (Knolmayer & Röthlin, 2006, p. 368)

Errors and inconsistencies in master data enable mistakes and lost opportunities, which causes losses. Mistakes might relate to failed deliveries, invoicing blunders and problems with data synchronization for example. Solving quality problems in master data can be achieved from two perspectives; people and process. People have the most important role keeping material master updated. Each user is responsible for sufficient data quality. High quality of master data must be part of performance standards and incentives for providing good data quality should be defined. This should be monitored constantly and metrics for data quality should be applied. All employees need to understand that they share responsibility for the data they generate and will be accountable for its quality. (Knolmayer & Röthlin, 2006, p. 368)

Formal processes are needed to design for managing master data correctly. ERP systems give different ways of mapping real-world into information systems. For example, transportations to subcontractors might be booked in many ways. Same kind of ambiguities might appear in defective inventory, returned material and in-transit inventory. In respect of goal to improve aggregate inventory data, processes and requirements must be defined. Also, system transactions need to be implemented. Number of ERP system transactions allowed should be limited, business process guidelines refined down to transaction level and missing or dummy values in mandatory data elements should be banned. Also, automated checks should be installed to enforcement of guidelines. (Knolmayer & Röthlin, 2006, p. 368-369)

Value of information must be critically considered on organizational levels, especially between business units. Better data quality in one unit helps often usage of data in another unit. For visualization of data quality, data quality score cards and information quality report cards may also be applied. (Knolmayer & Röthlin, 2006, p. 368-369)

A coding system needs to be specific for spare part materials. The code must provide a prompt understanding of the technical features of the spare part. This includes also the specific tree it refers to and involved suppliers. For stocked items, it also includes their physical location in inventory. The point is to get all the information needed from

the code. All misunderstandings and confusions should be removed. (Cavalieri, S. et al. 2008, p.382)

Part classification

Spare parts should be classified differently by their purpose of use and by their features (criticality, specificity, value, type of supplier). Classification system gives fundamental information for establishing the correct stocking policy. Classification system helps to handle different spare parts different ways. There are several benefits of classifying spare parts with different categories. With classification the focus can be targeted to items that can be determined critical and more complex to handle while the less critical spare parts can be left for automation. From financial perspective, durable item is needed seldom than consumable items which are needed more in stock. (Cavalieri, S. et al. 2008, p.382)

Criticality of a spare part can be related to the consequences which follows if the replacement is not readily available. These consequences can be, for example, failure in process or total shutdown of the primary product. On the other hand, non-critical items do not have direct consequences to the primary functions of the device. (Schuh G. 2011, p.396)

For spare parts, there are different types of wear behavior. Wear can be continuous or spontaneous. If wear behavior is continuous, abrasion depends on the time of usage. Therefore, it can be managed predictable and the replacing of the spare part can be planned beforehand. If wear behavior is spontaneous, breakdown usually hits suddenly. Replacing this kind of spare cannot be planned beforehand. (Schuh G. 2011, p.396)

Strategies for the spare parts in supply chain can be roughly divided in two different types; responsive and efficient. Allocation is mostly based on criticality of the spare part. For non-critical spares it is important to make supply chain as efficient as possible keeping costs down. With critical items responsiveness raises to more important role when it is needed to secure the operation continuity of a primary device. (Schuh G. 2011, p.396)

Critical spare parts need to be replaced immediately to reduce down-time of the primary device. For those items the focus should be reducing the reaction time. For critical spare parts it is needed to offer higher service and shortest lead times to customer. Higher service levels and shortened lead times can be achieved by decentralizing network design. By this supply chain is going to be more responsive. Taking wear behavior into account, more distinctions can be made. Predictable wear behavior reduces the complexity in design of responsive supply chain. Non-predictable wear behavior is the biggest challenge in supply chain design. (Schuh G. 2011, p.396)

Non-critical items do not need as short reaction times as critical spares. Therefore, the supply chain can be designed efficient. Non-critical and non-predictable spare parts should be stocked with the certain safety stock levels. Safety stock can be reduced by centralized network design. If non-critical item is also easily predictable, there can be considered even lower inventory levels. Predictable and non-critical items should have the most efficient supply chain. (Schuh G. 2011, p.396)

4 Key Elements of ERP System (SAP)

This chapter focuses to describe the Enterprise Resource Planning system which is currently in use in case company. The spare part delivery process is organized by using SAP -system which includes all the needed tasks to deliver ordered items to customer. First section goes through the handling of quotation and sales order in SAP -system by describing the steps from request for quotation to delivery and invoicing of item. The second section focuses on subcontracting and how subcontracting is done using SAP. Subcontracting is widely used with certain spare parts in the case company and it is supporting function to organize them with subcontractors.

SAP (Systems, Applications & Products) is a global leader in business application and analytics software. It is also enterprise Cloud Company with the greatest number of users. It was founded in 1972 and has grown into a leader in providing software solutions. People around the world are using SAP enterprise resource planning software in their daily work to integrate and coordinate their different operations with each other's. SAP has over 100 000 business users worldwide. SAP has numerous amount of functions for every need in organizations practices. They have developed the software to make it easy and effortless to use. Few of the functions are presented here which are related to actual subject of this Thesis. (SAP, 2018)

4.1 Quotation and Sales order process handling

Quotation and Sales Order process handling in SAP consists of four main elements, Quotation, Sales Order, Delivery and Invoice. To ensure that there will be no problems in document creation at later stages, the business partner data and material master data must be maintained correctly.

Here is described delivery sales order process with its main elements. Every element crates a document for printing as a proof of action. The simplest it can be seen to divert in four steps which are shown in picture 7. Usually the process starts when customer

sends the request for quotation. It starts the process in SAP when the quotation is provided to customer. The quotation gives binding promises about price and delivery times for certain time. It includes terms for payment and terms of delivery. (SAP help, 2017)

Picture 7: Quotation-to-Delivery process in SAP

The second document is made when customer places a purchase order on the items quoted. It is called sales order (SO). It is also a receipt of purchase for the customer. It is commitment of customer to buy product. In SAP, sales order starts possible purchases if items that are not in stock. It also gives a signal to warehouse to pack the items that are already in stock. It is important document for overall planning of production (SAP help, 2017)

When items are received in stock, system shows that they are available for packing and delivering. Delivery document is created which gives signal to warehouse to start packing. It is also a proof to customer that items are shipped. After the goods are packed, persons in charge of logistics, get the signal to book transportation and create an invoice for customer. Invoice is the last document created in SAP. With invoice, the payment from customer can be requested the revenue in profit and loss statement can be recorded. Case closes when customer pays the invoice. (SAP help, 2017)

4.2 Subcontracting

When the company doesn't have capability to make something by itself or it try to find ways to get savings in supply chain, the option might be in outsourcing some activities. These can be operative tasks like transport, storage, commissioning and packaging. This gives one challenge to ERP-systems and question how these situations could be handled. In SAP this outsourcing is handled with subcontracting-function. (Erproof, 2017)

In SAP items are managed as codes. Usually code changes when item face some changes. The unfinished product has a different code than finished product has. Finished product includes one or several sub items which all have individual codes. Also, for work, which is added to product can have individual code. These codes are like raw materials or modules of the final finished product. (Erproof, 2017)

In SAP, there are special features for producing work in external subcontractor. This is useful option in situations where one or more phases of the manufacturer process is handled in external vendor. Painting for example can be situation which can't be for reason or another be done internally. (Erproof, 2017)

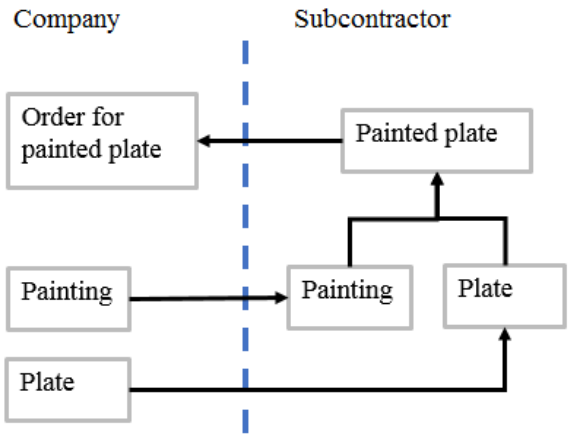


Figure 4: Illustration of outsourced process

For external work, there must be made some changes to the item structure. The made finished product includes the component which is performed externally. When purchasing the main component, SAP automatically creates the purchase requisition for sub item. Then purchaser knows this item needs component from the warehouse or from another supplier. Benefits of using this element of SAP is increased visibility of the process also to external vendors. It also automatizes purchasing process, letting less to worry for purchaser itself. (Erproof, 2017)

4.3 Bill of distribution

Service spares solution requires tree based supply chain network. It starts from entry level location, where supplier delivers to and one or more child locations before product is delivered to customer. One location can also act in two roles, as a child location and customer facing location. Then for another function virtual location is created to separate the parent role from customer selling role. In the example below, Stuttgart is the entry location, Lille and Frankfurt are child locations and London, Köln and Berlin are customer facing locations (Dickersbach J. 2015)

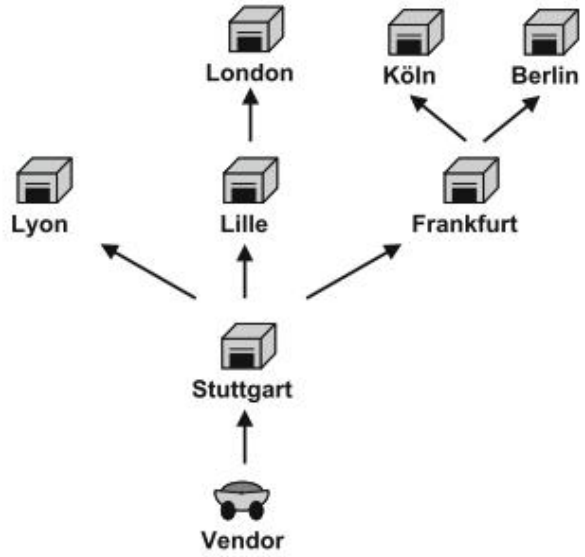


Figure 5 Example of supply chain (Dickersbach, 2015)

In service network the entry location acts the main location which represents the centralized location to suppliers to deliver goods. After receiving goods in entry location, the deliveries will be divided across the world to child locations. Child locations are local distribution centers which are used to store goods close to customers. This ensures faster reaction times compared to situation where all goods are stored in entry location. (Dickersbach, 2015)

5 Problem Description in Case Company

This chapter gives the background of the problems in the case company. First section goes through the programmable products that are in focus on the research. The second section presents how the products are divided by different technologies and what kind of problems there are in delivery phase. The third section presents two case examples of the unsuccessful deliveries giving a better understanding what kind of problems we are dealing with.

5.1 Products

The overall selection of spare parts covers every part which are installed in device. It consists small components but also bigger entities. Basically, any part from screws to pillars and from fuses to electric motors, customer has possibility to order replacing part from Outotec. The selection of spare parts includes commercial parts and parts engineered by Outotec. With commercial parts, Outotec acts as a reseller of products that are available also in other reseller companies, utilizing the economies of scale in volumes. Spare parts, that are engineered by Outotec are mostly managed with “made to order” –method. With these parts, local steel casting companies and other manufacturing companies are utilized as suppliers. In another word the manufacturing is outsourced to trusted partners.

Some of items are considered as a programmable or a configurable spare part. They consist items that requires either external or internal work added to product. This means that for these items the work is done in the Outotec office itself and for some items the configuration process is outsourced to external subcontractor. Some of the items need program installed to device and some of them need only testing and configuring parametric specified by customer. These products are classified as electronic components. The difference between regular spare parts components and the programmable spare parts is that regular spare parts just flow through the warehouse, but programmable

spares need special attention because the special value adding work included to components. In table 4, there is presented a list of titles of programmable spares currently in selection.

Programmable spare parts
POWER SUPPLY 50KV
ETHERNET NETWORK INTERFACE UNIT
OPERATOR PANEL
CPI COURIER PC USER INTERFACE
SENSOR DEVICE CELLSENSE
CELLSENSE GATEWAY BOX
COORDINATOR DEVICE CELLSENSE
PROGRAMMED PC PROGRAMMED PC FOR PSI 500I
PROGRAMMED PC PROGRAMMED PC FOR COURIER 5/6I
PROGRAMMED INTERFACE MODULE
HV-GENERATOR
TEMPERATURE CONTROLLER
PROGRAMMABLE CPU
PROGRAMMABLE SAFETY RELAY
PROGRAMMABLE TOUCH SCREEN

Table 5. List of programmable spare parts descriptions

5.2 Programmable spares by technologies

Outotec has divided the spare parts in categories based on technologies where they are used in. As Outotec manufactures devices to every point in mining and refining process, they are divided by the method there is used for refining. For example, Filters technology includes all the filters that are used for filtering solid material from slurry and grinding technology is in the beginning of refining process including Grinding Mills.

Because not all programmable spare parts are the same they should be handled differently. The current ways of working vary by the technology. The main idea in service organization has been the goal to make every sold spare part to fit in the same operating model. The nature of each product lines and devices make it not possible for all the items. In some product line it is enough just to change the programmable spare part to device but in another product line it is needed to make changes to another component

in device with the replacement. There are currently programmable spare parts in three product areas: Automation, Filters and Metals, Energy and Water (MEW).

Automation is the technology where most of the programmable items are delivered. It is obvious, because automation includes a lot of electronic component and different modules. Automation product line consists CPU's, power supplies, PC's, Generators and safety relays. In automation product line, all the orders are made from subcontractor, which is making the programming when hardware is provided to them. SAP is widely used and the item structures are developed in system so the process is basically automated. Only information that subcontractor needs is usually the customer's device serial number. Also, procurement unit needs to send empty hardware to subcontractor for programming. SubContractors have a good database of Outotec's customer projects and they are aware of their needs. They are more like business partners to Outotec.

Currently all the programmable items in automation technology are programmed in external subcontractor and the entire quotation and delivery process is flowing efficiently with the support of Quotation Support. The details where to focus in these items are in updating of Material Master and communication with customer. If Outotec has updated information about the customers' current programs the programming can be started earlier. Also, effective communication with customer and getting the needed information from customer side will improve the efficiency.

Programmable spare parts in filters product line are basically displays and safety switches. Displays must be programmed with the customer specific programs and safety switches are configured by customer specific parameters. The core expertise of filters is in Lappeenranta and the programming and configuring is done in Lappeenranta office. Programmable spare parts are delivered first to Lappeenranta office, where product line experts install the correct programs to the spare parts which are delivered to Vantaa warehouse. If the programming is involved in current process, the quotation support is the key link to product line, where the programming is happening. This needs co-work between QS, procurement and Sales Support. Sales Support gets all the needed information from customer via Service center, Procurement organizes

the hardware to correct address and QS communicates with product line of this delivery programming spare part.

Metal, Energy and Water -technologies are more complicated. Usually there are no simple individual spare part cases. The needed work is not limited only for changing one part but the entire entities. Therefore, the cases related to MEW are often bigger projects, where lot of big components are changed at once. It requires deeper communication with customer to analyze the real situation in the customer site. It is not recommended to handle these cases via spare part organization. The key is to recognize these opportunities to sell customer bigger upgrade projects. The focus areas should be in recognizing programmable items as early phase as possible and address the quotation and delivery process to persons, who are experts with these. The delivery of programmable items in MEW will not fit directly to the spare part delivering process.

5.3 Unsuccessful deliveries

Examples of unsuccessful deliveries present overall picture of the nature of the delivery process and the problems they include. The following examples are collected from persons who are working in the supply chain of spare parts delivery. The stories are written as they are told to give some examples with what kind of problems there are in delivery of programmable spares.

In the first example, customer places an order for programmable touch screen for their pressure filter. In history, these programmable touch screens are programmed by Filters-product line engineers in Lappeenranta office. In this case, procurement purchased the touch screen directly to Vantaa warehouse. This means that it was received in warehouse as a dummy, without any customer specific programs included. This was noticed in warehouse and Sales Person with forwarding & invoicing person organized programmable touch screen to Lappeenranta office. Product line engineer, who supposed to do the programming, wasn’t available at the time while being in business trip at a site. Sales Person received touch screen and communicated with filters product line engineer about the details of end customer device. When the programming was done,

touch screen was delivered back to Vantaa warehouse and on forwarded to customer. (Interview 3, 2016).

In the second example, **c**ustomer places an order of programmable CPU. This spare part is meant to be programmed in Espoo office. Item was received in Vantaa warehouse without programming. This time one of the employees drove from the Espoo office to Vantaa to get this item to Espoo for programming. Few days passed before there was recourses to program item. After programming CPU was sent to Vantaa warehouse and again to customer. (Interview 4, 2016)

Few points can be picked up from these examples. First, it was not clear for every person in chain that there are exceptions in delivery of programmable items. This can be basic human error, but generally the knowledge of these products and how these are handled are not clear to everybody. The second noticeable issue is that dependency on one person in some part of chain can cause delays to customer delivery. These are only a couple of examples what errors happens with the programmable spares while delivering them to customer and lead to delays and dissatisfaction of customer.

As we can see, in both cases item was ordered to wrong place. There was no knowledge of the process that these items should be programmed in Outotec. The system didn't indicate it and purchaser didn't know it. In ideal situation the nature of programmable spare parts has been in known of every person in chain and the process had been determined clearly to each one to understand what are the needs and actions how these spares should've been delivered to customer.

6 Process modelling

Getting known to how process works currently, the process must be modelled. The target is to keep chart as simple as possible to keep it easy to read and follow. The focus is kept in service organization which provides the sales of spare parts. First, the roles in supply chain are defined and then relations between the roles are described. Then current spare part quotation and delivery process is presented. In the end, the visualized process chart for programmable spare parts is presented.

6.1 Roles in supply chain

First the roles in supply chain are determined. This helps understand the actions that each function in supply chain is doing. Key roles are included here and their roles in supply chain are explained.

Customer is the end user of the device. It makes the order and demands service. Customer is the one who needs to be kept happy and the source where the money comes from. Customer is the most important starting point in every business areas. Customer gives an impulse to start manufacture or purchase demanded materials.

Service Center (SC) is the closest unit to the customer. Their job is to serve customer all the best way. They communicate with the customer and interact in many ways. They make visits to customer sites and make suggestions what they should repair to keep their devices run longer. Service Center is located close to customer. They are located all over the world to be near the customer locations. They are the visible local support to the customer.

Sales Support (SaSu) is the contact point to Finland for Service Center units in their businesses. Sales Support gives help with technical, pricing and availability related issues. Its purpose is to give support to Service Center in their daily operations. Sales Support can be defined as a centralized connection and communication point between market area and global support team. The location of Sales Support is in Finland.

Quotation Support (QS) is the unit which supports the Sales Support with technical related problems. They help to update Material Master Data, find correct items for customer and create new ones when needed. They also communicate closely with *product line* (PL) to solve issues they face during their daily operatives. They have experience in this business and have good expertise of the technologies.

Procurement is the business unit which is in contact with *suppliers*. They help Sales Support to find costs and lead times for products that are offered and sold to customers. They also keep up good relationships to suppliers and try to hurry them up if looks that they won't be in demanded schedule. They are in charge of organizing purchased items to Outotec warehouse.

Forwarding and invoicing (F&I) team is in charge of outbound and inbound logistics and warehouse activities. Their role is to deliver and invoice the goods. Even though the operational level of warehouse activity is outsourced, this team presents logistic part of the supply chain in charts. They organize the deliveries from Outotec warehouse to customer.

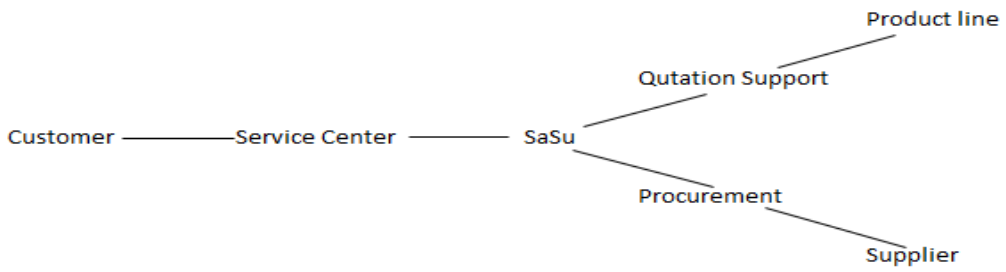
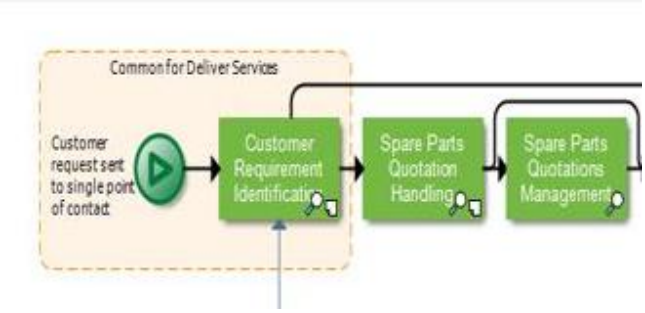


Figure 5: Simplified illustration of spare part organization

Additionally, there are other support functions, which give help in many issues. There are invoicing and accounting related functions, packing and delivery related functions and pricing and sourcing related functions.

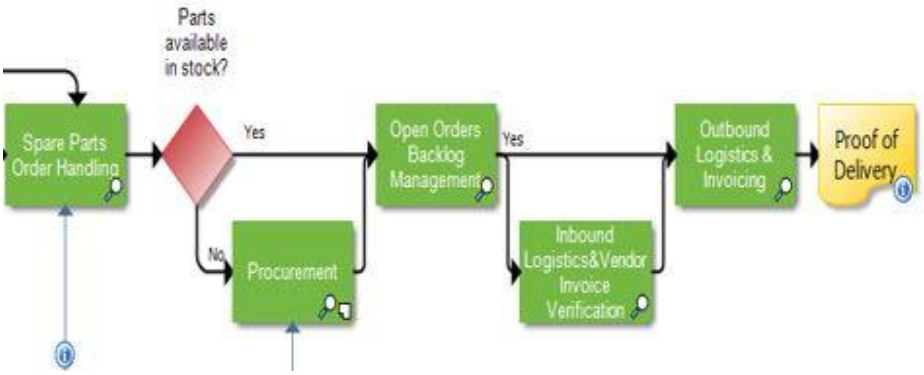
6.2 Spare part delivery process

The quotation and order handling process is managed as it is shown in pictures 9 and 10. The process starts from quotation phase, where customer approaches the company in need for a spare part for their Outotec device. The requests vary a lot and sometimes it needs a lot of effort to recognize which is the needed spare part that customer is requesting. In quotation phase, the price, lead time and terms of delivery are determined. To determine these attributes, services sales person utilizes price lists, purchasing and selling history and all the support functions who are helping with the getting needed information like services pricing and technical support.



Picture 9 Quotation process (Outotec process, 2016)

When the quotation phase leads to customer order, it opens the Order Handling phase, where the terms of quotation will be realized. If the needed parts are not in stock, the purchases will start, and later spares will be delivered to customer and invoiced after the delivery. Items from warehouse are delivered directly after warehouse operations, packing and freight bookings. Meanwhile when open orders are not delivered, sales persons look actively after their open orders backlog. That’s how they keep on track if there will be any late lines or other troubles in orders



Picture 10 Spare part order handling process (Outotec process, 2016)

6.3 Delivery process of programmable spares

Now we focus on the process of programmable spare parts. In interviews it appeared that there are several modes of operations to handle programmable spare parts. In one product line it is common to use internal workforce to make the programing and in some other product line the programming is outsourced to third party subcontractor. The process is going through by each product line and it was sketched on paper for visualizing. The goal of this phase is to create visualized process map of the current status of how the process is flowing.

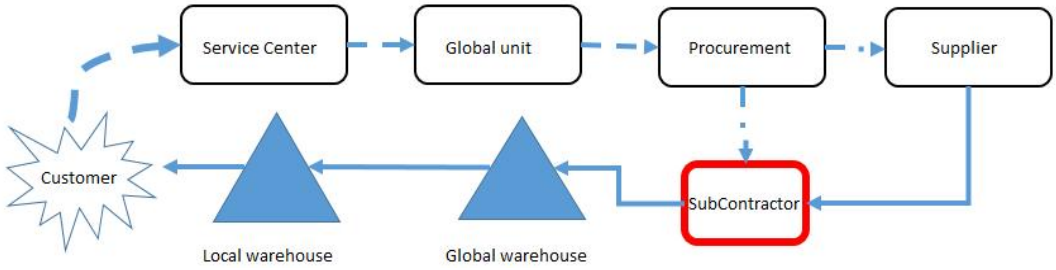
The quotation and sales order process is mostly like all the other regular spare parts. With regular spare parts we mean items that basically flows through Outotec warehouse. The only difference is that it is not fully automatized as most of the sold spare parts. The input of organizing the hardware to certain place for programming or configuring must be done manually without a help of systems. The delivery of them cannot be set in the normal mold because it needs separate concentration to finish the delivery to customer. Programmable spares are configured for certain customer and for certain device. Configuration is implemented in house and in external subcontractor depending on product line. The methods vary mostly depending on how things were done in the installation phase of the main project. These spare parts are not taken in consideration when creating business process models for spare part quotation and order management.

When it comes to configuration or programming of the spare part, there are mainly two different methods, internal and external work. Internally configurations and programming are done in Lappeenranta office for filter product line items and in Espoo office for all the other technology parts. The reasons why the programming related work is divided by Espoo and Lappeenranta offices is that the original knowledge of the filter product line is in Lappeenranta. The core knowledge for another Finnish based technologies is in Espoo.

Because the programmable items are programmed to certain customer device, it is necessary to have good communication with customer to know exactly where the demanded spare part is needed. The customer can have several similar products but the programs are not fit each other's. This ensures that correct software versions are installed to spare part according to customer processes and the customer specific parametric are set.

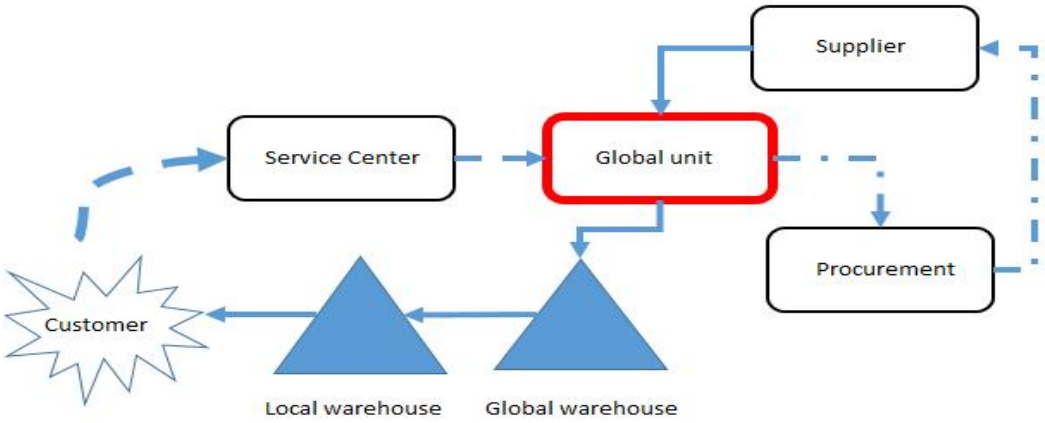
In theory, programmable item can be quoted to customer without knowing the exact parameters because it won't effect on price and lead time, although getting the information in quotation phase will ensure smoother actions in delivery process.

Currently it can roughly be divided in two different ways of handling the programming of the programmable spare parts, internal and external work. In the first scenario, hardware is purchased from one supplier and the program is purchased from another. The hardware is delivered from hardware supplier to software supplier who then programs the hardware as it is ordered by Outotec. Finished product goes then through the supply chain to the customer.



Picture 11: Programming by Subcontractor

In the second situation, Outotec orders the hardware from one supplier and makes the programming or configuration in house. The locations to do this are mainly in Espoo office and in Lappeenranta office. In these situations, product is ordered to office address instead of warehouse. After the programming, items are delivered to warehouse located in Vantaa.



Picture 12: Programming in-house

In pictures above there are visualized how the process flows. Full process charts are available in appendices. The dotted line presents information flow between units, like purchase orders. Arrows present how the actual material flows through the supply chain. Triangles presents warehouses. The unit which is circulated with red color, represents the unit which handles the programming. In the case where global unit is the responsible programmer of the item the product line is the supporting part to do the actual programming.

7 Problem analysis

The essential point in developing supply chain is to recognize its problem areas. People who work closely with spare parts are the most suitable persons to describe the issues they feel to be the most problematic in their daily work in spare part sales. Opinions were gathered from the each working unit which are involved the spares delivery process. The method for getting opinions was using interviews with each department. Six persons were included in different interviews where was asked about the programmable spare part process. The chapter clarifies the issues each functions experience in their daily operations which is divided by each unit related to delivery process.

7.1 Sales Support (SaSu)

The first issue sales support persons feel difficult with programmable spare parts is identification them in the system. To succeed in delivery, sales person must know what actions or requirements are needed. They can be inspections, programming or configuring which are made to item before delivering them to customer. Sasu mostly works around item numbers and they do not have deep expertise about the certain products themselves.

Therefore, it is essential to have this information in system to provide information to sales organization. In system there are many items where in description filed is mentioned word “programmable.” But there are no instructions about who and where the programming should be done. Incomplete information in material master data leads to situations, where the item might end up to customer without programs in the item. Below is the current instruction created by product lines, how items should be recognized in SAP environment.

Sales Support persons are asked to contact Quotation Support in cases, when programmable item is sold. In these items there is some of the following words mentioned in item description: CPU, Computer Rack, CM Control, CPU Control System Rack, Rack PC or it includes words "Programmable" or "Programmable Device." Quotation support persons have better knowledge about the products and they can give instructions

to sales support how the item should be delivered. But here the key is also in recognizing the item in the system.

Intercompany Automation model (ICA) creates new challenges when responsibility of the selling item is more in Service Centers' hands. ICA is created to decrease internal work between service center and global unit. It removes internal quotations, sales orders and purchase orders which causes less work internally. When Service Center creates end customer Sales Order in SAP and it creates purchase order requests to procurement to buy certain products in Finland. Basically, service center creates sales order to customer and system processes the internal goods movements automatically.

In addition to weak recognition of programmable spare parts, the most noticeable problems in quotation and delivery process are in unclear instructions and in unclear processes. Even if programmable spare part is noticed, it is not always in known how the certain spare part needs to be delivered to customer. New employees have no any clue about special treatments of the delivery of these items.

7.2 Product Line

Product line persons are the experts of Outotec technologies. They have strong vision to understand what is wrong in process of programmable spare part sales. They are responsible of product management and they have fought with the same problems for years. Product line lists four key problem areas:

1. System
2. Dependence on few people
3. Documentation
4. Practices

First detected problem is system support. There is a feeling that the company is not fully utilizing the capability of systems they have in use. There are possibilities to exploit the systems, but not all the functions that system provides to ease the work are in use. SAP provides huge amount of functions in their service selection, which many companies are using daily in their operations that Outotec have not took in use. For

programmable spares delivery, there are useful tools for manufacturing and external subcontractor work, which is partly but not fully, used already. There are various opinions depending on product line, how automatized the process should be. In automation product line, the programmable items are by nature easy to automatize but in Metals, Energy & Water, spare parts are more complicated and need more expertise to understand what the full need of customer is. Often it is not enough to change that one part and it requires bigger project to make replacements. For projects, there is own organization unit in Outotec.

The second issue is the dependence of few persons. In many cases programming of the spares is managed by one person who is the only one in the house capable to do that. People do have their vacations and they do go their business trips which leads to situations where the key link in delivery chain is not available. If the needed person is not available the delivery can delay weeks from original schedule.

The third issue is documentation. Many projects are delivered long time ago. In history, after sales markets were not as clearly part of company's portfolio as it is now. When old projects were made, the documentation was not as specific we could hope it to be nowadays. Also, all the changes which are made to customer devises are not always documented in one place to know the latest versions of programs. Lack of information in master data causes extra work to solve what are the spares and programs customer needs. This problem is viable with every spare they are selling for old devices.

The fourth issue in the list is different practices in delivery. There aren't common instructions how to deliver programmable spares to customer. Sometimes part is delivered to customer with manual for assembling and sometimes services engineer goes to customer and assembles it for them. Therefore, customers get different service compared to each other's. These practices vary between market areas and Service Centers. In some market areas there is capability to help customer with assembly while in other market area there is not. There are also differences between customers. Some customers are skilled with the assembly and they can manage it by themselves while elsewhere customers need turnkey installation.

7.3 Procurement

Procurement team is responsible for getting items from supplier to warehouse. They also organize items to correct place for programming. If the item is programmed in subcontractor, they organize the device to subcontractor for programming. If the programming is made in-house, they end up ordering the device straight to the person who is capable making the programming. According to some instructions, Sales Support is in responsible of contacting product line via Quotation Support to get customer information communicated to product line. Therefore, there are uncertainties in responsibilities of organizing the delivery.

For filters technology programmable spare parts consist programmable monitors and CPU's for PF filters. Now process should go as following: purchaser gets information from Sales Support that this kind of product has been sold and gives him or her the information about the device this monitor goes. Purchaser orders the monitor to Lappeenranta office, where all the filters product line engineers are located. When item arrives in Lappeenranta, purchaser takes it to PL engineer who programs the item. After this, delivery planner sends item to Vantaa warehouse to wait for re-sending to customer.

Like in almost every unit, the problem is in recognition of the certain items that needs to be ordered somewhere else than in warehouse. Often seller doesn't recognize the programmable part and then the part flows through the system without programming. Also, visibility in system is nonexistent and causes problems recognizing what is the current situation in the delivery process. The main issues in procurement can be named unclear instructions and lack of determined processes.

7.4 Customer

It is usual that customer is not happy with long lead times in spare parts. Often when spare parts are needed in plant, there is urgent situation and the replacements are needed quickly or the spare part is needed in certain date to ensure fluent shutdown maintenance. They are not satisfied for the situations where some of the spare part in their

catalogue offered by Outotec is not available anymore. This happen a lot with programmable spare parts and with other electronic items. They assume, for a reason that all spare parts that Outotec is promised to be available. Of course, it does not apply to devices which are old. History has changed the coding and availability of the original parts. Customers have their expectations to get support from Outotec in their processes and accuracy in information is essential. The key point with customer is to keep promised timelines and keep customer informed if there will be changes in them. Customer appreciates honesty and openness. Therefore, good communications and co-operation with customer improves the overall customer experience.

7.5 Service Center

Service Center faces customer in their daily operations. They have good knowledge about customer needs and they aim to satisfy customer needs as well as possible. The overall knowledge of the products varies a lot between service centers. In some market areas, they can manage their spare parts business quite well with using their local technical experts whereas in other market areas, they utilize more the global support (SaSu) in their daily operations. Overall, they have even less knowledge about the items that are not delivered according to standard delivery process. The main problems in service centers are the lack of knowledge of the programmable spare parts. They have no awareness if some spare part needs to be programmed customer specific way. They also don't know what and when they need to communicate with the customer about the programmable devices. Again, the problem is overall in awareness and in lack of instructions.

7.6 Summary

Summarizing together the problems that are in programmable spare parts are in their recognizability and in the instructions how they should be managed. People are not trained to understand the function of every spare part they are selling and therefore some categorizing is needed. The main knowledge how they are managed is in quotation support and product line but the issue is that no-one know that they should be

contacted in the situations where programmable item is sold. Meanwhile most of the spare parts are sold in automatic guidelines, the items, which need special attention are drowned in the mass. The system and master data does not give help in giving special attention to programmable spare parts. Another issue which was recognized is in dependency of capable persons to make the actual programming or configuring to the spare part. This, with the issue of organizing the spare part configuration with the related person are the problems to take note.

PROBLEM	DESCRIPTION
MASTER DATA	Master Data is missing information which is needed to purchase and deliver products. Also, there are duplicate codes in system.
RECOGNITION IN SYSTEM	Programmable items are poorly marked in system to raise them up from the mass
GUIDELINES / INSTRUCTIONS	The instructions for programmable spare parts delivery are poor or nonexistent
AWARENESS	Employees are not aware of programmable spare parts
DEPENDENCY ON FEW PEOPLE	Some links in supply chain are in the hands of one person which causes risk of delay
SYSTEM USAGE	Systems are not utilized with their full potential

Table 6 Summary of problems

8. Root Cause Analysis

The analysis aims to identify the root causes which leads to issues that emerged from interviews. The root causes were found by exploring the quotation and sales order process, following the work of specialists doing their job and asking questions about the work. Based on the findings, it is easier to provide recommendations to prevent failures in everyday businesses. Support for finding root causes is achieved from the chapter 2.3, where the main wastes in office environment are listed.

8.1 Narrow knowledge of the technologies and processes

Last past years, Outotec has faced many organizational changes. Operational model has changed and new roles have been presented. Process of programmable spare parts has always been unclear and they have caused troubles in deliveries. The issue in big companies is in how the work is structured. When the work flow raises high, it is seen good to modify the process chain to a functional or to a modular, dividing each task for each unit to handle. In modular working system each person is specialized in one narrow expertise and handles this small area very well. This is often recognized to have highest productivity in process. The other side in modular system is that it can lead to individuals lose the overall picture of the whole chain. In constantly changing environment tasks can easily drop between stakeholders while responsibility areas of certain tasks can be unclear. Also, wider understanding of the customer's specific needs disappears while going further in chain from the end user. The control of the whole process is missing and the tasks over business lines will be tougher.

Sales Support in Outotec, for example, is mainly trained to be experts at making quotations and sales orders. They don't have large technical expertise about the products they are dealing with. They know pieces of every technology but are not experts at any specific technology. For technical expertise purposes, they have Quotation Support who are experts at the technical side of products. They know how the customer devices work and what components are needed by customers. It would be beneficial to every unit to have wider perspective of the overall wholeness in points of understanding and

helping each other's. The work is mostly meant to learn while working and therefore it is quite impossible to know everything about everything. You learn certain things through the experience every time you face a new situation.

The narrow understanding of the technologies affects also to quality of communication. Currently there can be even 6 persons between supplier and customer. If supplier needs some detailed information from the end customer, the whole communication chain will take time while emails are forwarded from one to another and then back. Getting more information through the chain is slow and the information through the chain can be changed if everyone is not knowing the technical details. Different time zones also slow down the overall communication flow.

The level of expertise of employees varies a lot. It is sure that every link in information chain do not understand the true need of customer. In most of the cases it is not necessary, when the customer knows exactly what they need and the master data of the item is clear. When the information goes through lot of people, it is difficult to ensure all the links in chain understand all the needed information about the spare parts. In long chains it is common to face so called broken telephone effect. In company it is good to think how the communication can be kept efficient and simple.

The issue with the spare part selling is the fact that the whole spare part selling and quoting is working mostly around the item numbers. There are pros and cons with that. It is easy to train new employees using codes in system when there is no need to understand the actual principles of device and spare parts customer is using. The negative side is that the "code-world" can sometimes be too far from reality and the understanding the needs of customers can be difficult without code references. Also, project deliveries are mostly interested in actual products in devices and therefore the integration with the systems is not the main interest. Therefore, link between project sales and after sales might be unclear.

Like in chapter 5 was presented, there are many ways how programmable spare parts are delivered to customers. There are no special groups of items, that are handled certain way but the delivery is individual for each item. For programming, Outotec uses several subcontractors and hardware is usually provided by Outotec.

The problem in programmable spare parts process is showing also in that the chain has links that are depending on only one person. The knowledge of programming is left for only one person in product line which increases the dependency on these persons. In addition, these persons are in position, where lot of business travelling is required. This leads to situations where delivery process stops for the time the person is absent. This can be weeks or even months in worst case and at the same time customer is waiting to receive their missing spare part to continue their process.

Co-operation between product line and services spare part organization is not so tight and these cases appears seldom so there is not a routine to make every person to learn how the programming is done. To decrease dependency of one person, the capability to help the service sales organization should be increased.

Currently programmable spare part cases are handled case by case and the problem-solving process starts every time from the beginning. The root cause is that workflow is not defined for programmable spare parts. It can be considered as a waste when time is consumed in unnecessary movements. The root cause for unclear workflow can be found in abnormal process which is not defined in organization. Secondly, for every programmable spare part has their own individual modes of operation, how they are delivered to customers which are impossible to remember in daily operations. Originally, when these items were delivered to customer in project phase, it wasn't thought through how the delivery will be done in after sales phase.

8.2 System usage is not fully exploited

Majority of employees feels that programs used in the service organization are not fully exploited. They have larger potential to serve the company in the service spare parts

sales and quotation processes. Outotec has in use many different programs and applications. Also new systems are implemented while old ones are slowly staying in history.

Employees feel that programs are slow and frustrating to use and there are issues in authorizations. They are not able to reach needed data from the systems and sometimes data is somewhere beyond the authorizations. Company's policy is not to spare confidential information for every person in company. The higher the availability to confidential information, like manufacturing drawings, the higher is the risk that the information will flow to customers or to other third party.

Programmable spare parts go partly out of the ERP systems. The process is not visible in systems and only few people know in which phase of delivery the spare part is going. This affects lack of visibility and decreases the predictability of final delivery date to customer. For example, when the item is programmed in Lappeenranta, it is not received in system and is not visible before it is received in Vantaa warehouse. Handling these items in Lappeenranta happens only when several persons know what to do and can coordinate the delivery of programmable device. In some cases, when key person is away, for example on vacation, process might get stopped.

SAP for example, which is currently in use in Outotec has offered solutions for hundreds of companies and it is sure that some other company has faced the same problems in their process. Therefore, these same solutions can be applied to Outotec's spare part processing also. In this case there isn't any usage of system when spare part needs internal or external work. When item is purchased, there isn't visibility to the progress of spare part delivery. Using system correctly, item is visible through the whole delivery process.

In some point of view service organization in Outotec does not have transparency through the data available in systems. There is limited accessibility to technical drawings and information. Lot of information must be asked from Global Unit although the information could be available for everyone who needs them. Asking information from

people who has access to information slows down the process while waiting someone's response to provide the needed information.

Also, transparency through the quotation and sales order process is quite low. Market Area has no visibility to see stock levels in global stock. In other words, they cannot promise customer about availability of certain spare part before checking it from global person from Finland. Transparency from customer to global unit is also not so visible. It is not always clear what is the customer situation on site and what for the certain spare parts are needed. Openness on the both sides of chain with better visibility would decrease the unnecessary asking from side to another.

Employees face the problem often that they don't have the authority to access certain documents they need for their work or the visibility to some views in systems are limited for certain persons. This forces them to ask the information from a person who has access to documents. If they would have the access from the beginning, they won't need to disturb another person to get them the data. Limited authorities can be found in ERP system, when Service Centers cannot see the global stock inventories and in PDM, where the access to data sheets and DWG's are limited.

8.3 Lacks in master data and documentation

The work with spare parts requires skills to find correct information to identify customer's needs. Sometimes it is like solving a puzzle when customer sends their request to get a quotation. It can be a photo of their broken part or some description with their own system codes. Engineers in Outotec then tries with their all effort to solve these requests collecting information from several places. Not always knowing where to find the information the time and energy gets wasted while looking from places that does not have the correct information. Usually answers can be found in original project files. If the project has been made locally, the project information is usually stored in Market Areas. If the project is made by Outotec Finland, the project files should be found in Finland. Sometimes customers send requests for the devices that are not supplied by Outotec, which causes extra work use energy just to find out that the component is sold

by competitor. The most experienced employees know where the information can be found, but missing standards where to store the information makes different product lines store the information and data to different locations.

The size of the master data is growing with huge speed and new codes are created continually. With programmable spares poor master data quality appears in the level of data the company has about the customer. The company do have the data available about the programs which are installed in to the device at the startup-phase. If there has been made any updates after the installation the master data is not up the date. The latest information about the software versions is in the customer side.

Also, the Material master data is partially messy. It includes duplicate item codes, mostly because same components are inserted to system several times. Usually it is because of different product lines are not communicating with each other's and they use same components with different codes. Master data includes items that don't have enough information to purchase from any supplier. There are also items which are not available anymore. They are not blocked proper way in the system to prevent sales persons to sell them. Usually time has made electrical components old and replacing components are difficult to find. Inserting obsolete items to sales orders causes complications later when the lack of availability is noticed.

Poor quality of material master data causes misunderstandings in item information, possibility to create duplicate codes for the same items and time is wasted when guessing where the item in system can be purchased from. Therefore, good quality of the data need to be at satisfying level to ensure that the items can be used more than one time and across the whole organization.

Another issue in data storing is that there are several systems where the data is stored. Once person need to find information about the customer devices or about the spare parts, there are big amount of different systems where to find the information. The reason for many data storages is behind company acquisitions and centralizing. Target should be in focusing in few systems where to store all the information.

Incorrect information can easily mislead Outotec engineers and in worst case customer will receive the wrong part which is not suitable for their device. Outotec devices are divided in to different technologies based on which part of mining process they are used. Every technology has their own experts. If the technology is informed wrongly, wrong person might take the case to handle with. Eventually he realizes he cannot solve the problem and handles the case for another person to handle. Some examples can be found in purchasing master data, where incorrect information leads to delivery of incorrect items.

ISSUE	ROOT CAUSES
NARROW KNOWLEDGE OF THE TECHNOLOGIES AND PROCESSES	• Modular work structure • No training protocols • Poor transparency through the process • Working with codes and descriptions • Unclear instructions of operating model
LIMITED SYSTEM USAGE AND AUTHORIZATIONS	• Missing knowledge of system potentials • Fear of data leakage
LACKS IN MASTER DATA AND DOCUMENTATION	• Several systems and databases • No clear guidelines for data creation • History of many technologies through acquisitions

Table 7 Summary of root causes

9 Recommendations

In the research there were found several problem areas which are causing inefficiency in spare part quotation and delivery process. This chapter focuses on the recommendations which can be used to decrease the effects of current problems and remove the biggest bottlenecks from the process. Chapter also provides ideas for further research to make deeper analysis of the actions which are needed to improve efficiency of spare part process.

9.1 Train people

The company should always find ways to improve their employee's expertise and profession in the position they are working. With training and education company can invest in workers' professionalism making also the organization more efficient. Intellectual property is the true value of the company which needs to be raised. It should be thought that every person in organization represents the whole company. The higher is their expertise the more professional image they give about themselves and the company. Better trained employees are more engaged to their job and are more interested of the results they are making for the company. Highly engaged people will more likely achieve higher level of productivity and find constantly solutions to make their work better. Training increases the productivity of work and offers higher variation to use skills.

Different training methods exist from seminars to workshops and self-studies. In Outotec's intranet, there is training material available to employees to make self-studies. Everyone has access to basic material and courses which can be conducted by the time what is best suited for the personal schedule of the person. That is very useful but not every employee will check the courses. With scheduled trainings to employees there will be more results on people's learnings and there will be no feel of guilty spending time out from direct work. For example, 1-hour training in a week about variety of topics will increase the potential of each employee. Trainings also gives change to every day routine work. They don't always need to be about hard technology related

topics but some lighter topics about working habits etc. increase the motivation and comfort in workplace.

Job rotation is an effective learning method to widen employees' understanding the stakeholders around them. The idea of job rotation is to change positions with another colleague for a short period of time. It can be done in under supervision of one's person. The objective doing this is to widen the sight of the employees with the links they are working with. Getting them in other people's position, they can better understand the methods of work and therefore get ideas how to work in their own position to serve better stakeholders. This gives new perspectives and ideas to improve the existing working methods when new eyes watch the work instead from the eyes of person who has done same work for years. Job rotation gives also wider chance to allocate the work force to the units where it is mostly needed. Sometimes the overall target to serve customer might disappear in positions which are too far away from end customer.

Making excursions to mining sites would open many employees' eyes. Not many of them have seen the devices in real life where all the spare parts are sold. Going out from the office environment to the field, would be beneficial for the workers, who are dealing with mining equipment. Seeing the mining process in real life gives better understand of the devices and customer processes.

Handling the fear of leaking information should be done in changing corporate culture instead of concealing information from people who need it. Openness in company gives feeling that employees are trusted. And if there is a feeling that the information would be used wrong, the situation should be changed with training, informing and practicing. This act would decrease the need of parent organization and make it faster to reply customer. This is related also to decision making at lower level of organization. If the employees close to customer are more able to make small decisions by themselves it decreases the need of use Support organizations and they can focus on problems that really are challenging for Market Areas.

9.2 Focus on master data

Employees continuously face situations where the item in system cannot be recognized. Material master data is not in sufficient level in the company. There are lacks manufacturing codes, missing drawings and other information. This leads to mistakes and delays in delivery chain.

Starting from recognition in system to forward getting all the needed information will be high impact on processes and the probability of human errors decreases significantly. Little indicators in system which gives indication to operating person that this is spare part which needs to be handled differently erases most of the errors that are caused by employee not to memorize every programmable item in system.

Updating master data must be planted in every person's head in the company. Material Master oriented culture keeps Material Master healthy and continually updated. Every time person notices something in Master Data which needs to be changed, they should contact the person who is in responsible of updating data in systems. This prevents errors in future when someone else faces the same problem with the data. This requires that everyone can use and view Master data without any barriers. Also, the standards of data quality level must be planted in every person's head in company. From the beginning of the creation items in system, there should be in mind to create sufficient data. All the needed information must be defined in database to give wide usability of data base. It should be widely kept in mind that there will be users to this data in other organizational units. Good example is new projects, where project organization purchase parts. Documentation should be in good condition to ensure that in future, when it is time to sell spare parts for the device, it is efficient to solve, what parts were used and where they have been purchased. This ensures faster reaction time to serve customer when they contact the company for getting spares for their device. The data needs to be recognizable to ensure it can be used again in future.

Code includes description of the item, manufacturer and a manufacturer part number. Data also includes weight and all the necessary information for exporting and importing them from country to another. All other documentation should be also available for anyone who needs the information.

The codes itself do not include the information that are usually missing when customer makes the order. Usually in code, there isn't data included of the programs or the versions of the software systems there should be programmed. Basically, same items, touch screens for example, which are programmed for different machines, are having the same code.

Behind every item which needs additional information from customer will be added behind the code. Already in quotation phase when sales person inserts code to system, system gives notification to check data with customer. These are site, project and device where the wanted spare part is needed. When the needed info is available sooner, it makes the process faster. In table below, there are listed data what excellent material master should include:

Master data requirements
1.Code
2.Full item description
3.Perfect technical description
4.Manufacturer part number (commercial)
5.DWG number (proprietary) and DWG attached
6.Preferred manufacturer
7.Size and weight
8.Commodity code
9.Country of origin
10.Any other special functions like programming or configuration etc.

9.3 Take full potential out of programs

SAP has integrated platforms for companies who manufacture items by themselves. Making programming and testing in house can be related to small own manufacturing process. It adds value to the product and forwarded to the customer. It also helps allocate costs to correct place and it can be utilized in pricing of the process also.

Programmable spare parts processing can be split in two processes, external and internal. External is the process, where item is programmed in external subcontractor. Item is purchased from place one and programmed in place two. It is already implemented with some products, where programmed finished product has one code and it has structure which includes hardware as own code itself.

Creating BOM's to the all materials in SAP makes it automatic for purchaser to order correct hardware and send it to subcontractor for programming, testing or configuring. This is already in use for part of the items, but it need to be implemented to all other programmable spares also. Sales person inserts item, "programmed spare part" to the sales order. It creates purchasing requisition for hardware and for programming. Purchaser now knows from material master data to purchase hardware from one place and send it to subcontractor for programing. Purchaser orders programming from subcontractor. Subcontractor sends programmed item to warehouse and it will be forwarded to customer.

Customer specific programmed spare parts are always sold to certain customer and are not interchangeable with each other's. Therefore, it is good to use YTAB in sales orders, when item purchase is locked for certain sales order. YTAB makes the purchase of the item for certain sales order and therefore it cannot be delivered in another sales order to another customer. This decreases the risk that customer will receive the spare part which is pointed to another customer.

There are several ways to categorize items and set up different blocks to get notifications when entering items in to sales orders and quotations. Using sales text in item level to ask customer to provide correct information for programming the spare

part can be used. Y- blocks can be used to notify the creator of quotation or sales order that you need to ask more information from customer about the end-use device. Usually the only needed informations the device serial number. With this information the spare parts can be programmed as they were in project phase.

9.4 Create clear instructions

Service organization has been changed few times in past years. New products have been introduced and many new employees has been hired. The process for majority of service spare parts sales is similar but there are lot of new variations in products. New employees do not know about the processes and habits of the exceptions until they face the situation for the first time. Not even all the old employees know the processes for all exceptional spare part deliveries. The processes need to be clear and pointed out to employees to know what to do when face exceptional spare part. Who, what and when are important questions there. With simple and clear processes, the work can be presented to employees with easily understandable form. Programmable items should be included there to avoid confusions in the delivery process.

Dependency can be decreased by giving instructions to other persons in product line how programming's can be done. Even two capable people to manage these programming works decreases the risk of delay to customer. Someone could use time to create specific instructions how everyone could do programming only using the guide. Also, job rotation would work here. If there are more than one capable person to make the programming, this will get rid of the situation where only person needed is missing and causing delays to delivery. The knowledge of the processes varies a lot between customers and in some customers, there is expertise to do the programing by themselves without a support from Outotec.

The key for effective process is in information and in sharing. When every unit in process flow has all the needed information available, the communication and problem solving will be realized faster. The role of units working closely to customer have the

highest responsibility to gather all the information from the customer to give best possible tools to supportive units to solve customer issues. Customers' requests vary a lot between different cultures and customers. Therefore, units which are close to customer must communicate and discuss effectively with client to ensure highest possible starting point to help with customer request. Also, the information which service center units can access is needed to be high. With training and information, they can understand client's situation better.

Service centers which are closest unit in spare part organization should explain the customer's situation to support units. Sales support should be aware of the customer's situation to know what for the spare part is requested. This helps in prioritizing the cases and give higher focus to correct cases. For example, break down cases should be prioritized higher than budgetary offer cases.

In ideal world KPI's should support these requests accordingly. Currently for all spare part cases have determined same KPI's, in RFQ < 5days. The cases could be measured by their priority for example:

Priority 1 = 24hours

Priority 2 = 5 days

Priority 3 = 30 days

This gives a focus to urgent cases and lower priority cases can be handled later.

9.5 Evaluate the chances to make the programming locally

Customer specific programming needs always certain information from customer. Therefore, it is beneficial to make the programming as close to customer as possible. The level of expertise varies a lot between customers. Some customers can program their devices by themselves and some customer don't have this skill. Therefore, they need the help from Outotec to provide set ups to customer.

Level of skills in local offices varies also. This leads to situation where standard working model won't fit in every corner of the world. But the aim should be to push programming phase closer to customer. By providing guides, manuals and trainings, it is possible to train persons in site to program items by themselves. Then only the empty hardware can be delivered from Finland and the programming and installation can be done with customer on site. Overall "one Outotec" should offer similar services in all over the world. If there are lack of expertise or capability in some points of service centers, the capability and expertise should be created there. This would fit in filters technology devices, where the programming is relatively easy and possible to train with small training lessons.

10 Conclusions

Programmable spare parts are small part of total sales of Outotec's spare part sales but they are one of the most trickiest particles to handle. Missing process, unawareness in ways to work and lacks in data base cause numerous risks for failed delivery. Even thought these are not in high role in big picture it is still reasonable to fix issues to ensure smooth operation.

Thesis focused on visualizing current situation of quotation and delivery process of programmable spare parts and finding problem areas which causes troubles in fluent delivery. The used methods to explore the supply chain were interviews with persons working with issue. Hearing opinions from people who are working closely with programmable spare parts gives understanding how things are done currently. The purpose was to find grievances in the current process of programmable spares quotaton and delivery process.

Exploring the current process, it appeared that there are different kind of programmable spares, which needs to be handled different ways. Mainly they can be categorized by processes in two sections, internal and external processing. Sometimes programming and configuring are done inside of Outotec house and in some cases the programing has been done in external subconracting companies. There was two different process charts created for both of the processes, one for internal and one for external.

After current processes had been vizualised, it was time to focus on reasons that are causing unefficient supply chain. Information was gathered by interviews. By interviewing one for every part of the supply chain gives a picture of reasons that causes problems in quotation and delivery process. The same themes repeated in every part of the process chain but some were more related to specifically to work they were working with. The arised problems are not relative only for programmable spare parts but every spares that Outotec is selling to customer. Therefore the findings can be applied in to wider scale in Outotec's spare part portfolio.

In research of problem analytics, several bottlenecks were found. The first was difficulty to recognize items that need to be handled differently. All of the programmable and configurable items belong to this category. They are not clearly enough marked in the system to alarm awareness. The second issue is the lacking knowledge about how the process should go if the programmable item was sold. Many of employees do not know who to contact and what there should be done. Also, the communication through the chain was not at the sufficient level. There are uncertainties about what information is needed and when it it was needed. Creating clear instructions how to act when item requires customer specific programming will reduce the uncertainty in order handling. Transparency through the organization felt also be not at as good level as it could be. Siloing in own units makes the whole customer focus disappear in daily work. The further the chain goes from the customer, the less information about the need of customer is coming through.

At the outcome of the thesis process charts were created for the programmable spare parts quotation and sales order process and the most problematic areas in the process were found. After focusing on tackle the bottlenecks of the programmable spare parts, process ends up to be clearer. There would be no inner hassling anymore and also claims from customers will be reduced. Lead times will also be more excact keeping the promises to customer most of the time. Improving small areas from there to there, the overall process will get improved.

Because changes in technology is so fast, programmable touch screens should not be included in cotracts with customer. It is quite likely that when it comes the time and customer needs replacement for their touch screen, it is not available anymore as it was in original device. This applies for many electronic components. The lifecycle of them is not too long and therefore it is not clever to keep them in catalogues.

To change direction in future, the planning in project phases needs to be thinking about spare part business. The most service sales friendly model is currently in automation product line, where the programmed products are ordered from external subcontractor.

Because programmable spare parts are bringing significally small slice in spare part profit, it is not reasonable to sacrifice too much energy and investments in improving such a small area of overall spare part sales. Focusing on small things, like improved master data and increased knowledge about the products will create the efficiency to satisfying level. Improved recognibility helps sales persons quickly notice the special needs about the programmable items and can make fast actions communicating with customer that certain information is needed and also communicate to global support function that there is order for programmable product. This helps to give special focus on the order and follow it more carefully when it is raised up from the delivery mass. Also recognizing and understanding what are the main root problems in processes and daily work the focus can be pointed to actions that are creating value to customer. Removing all the non-adding actions and finding more efficient ways to solve problems the overall efficiency will become higher.

Problems	Root Causes	Recommendations
How to identify?	Unclear processes	Create clear instructions and processes
Uncertainty in delivery process	Poor expertise of products	Enrich Master data to sufficient level
Lack of documentation	Continuously changing personnel	Train people basics of products
Availability	Poor Master Data	Achieve full potential of systems usage
Inaccurate lead times	Inadequate system usage	
	Dependence on few people	
	Variable practices	

Table 8: Conclusion of the Thesis

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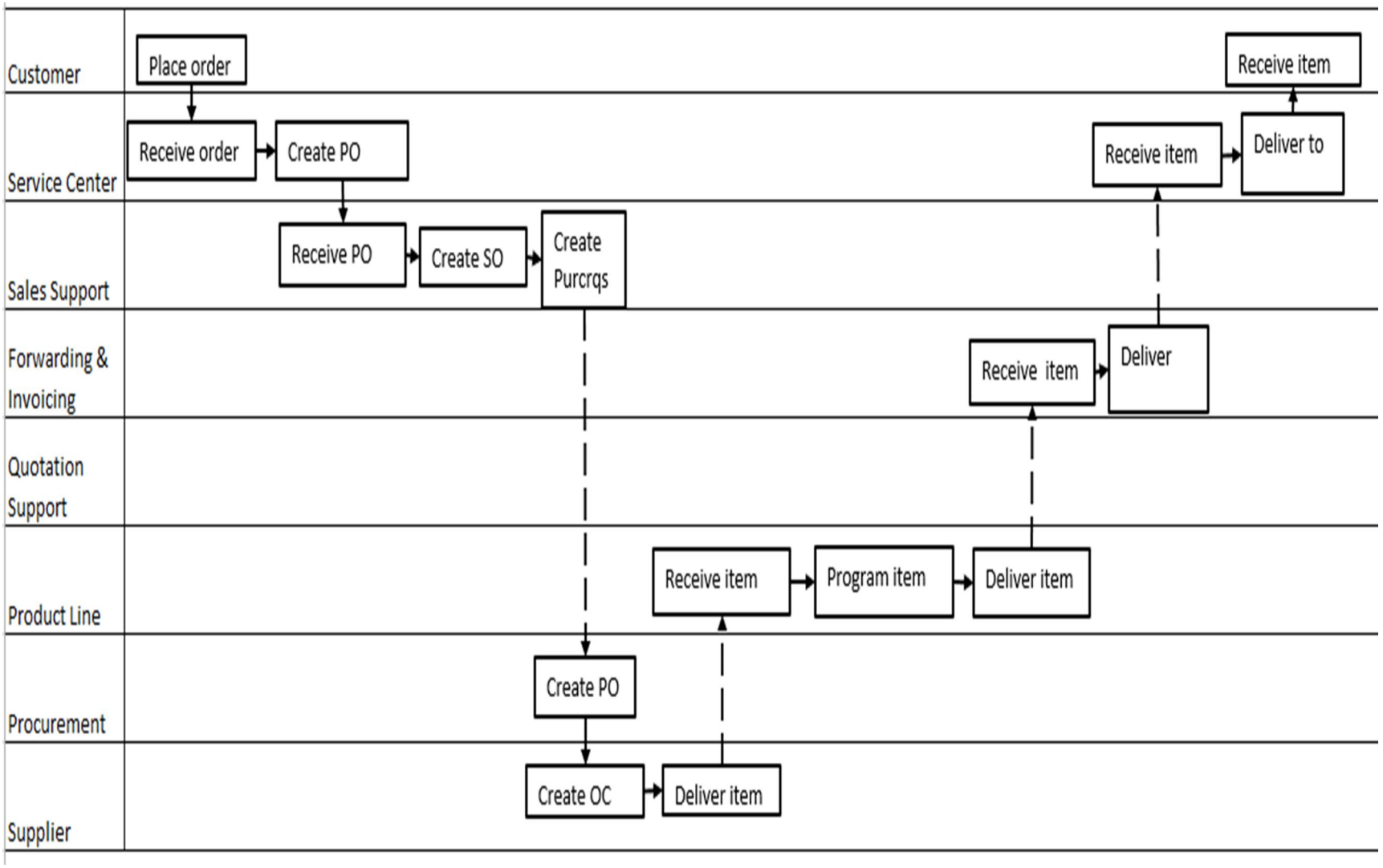
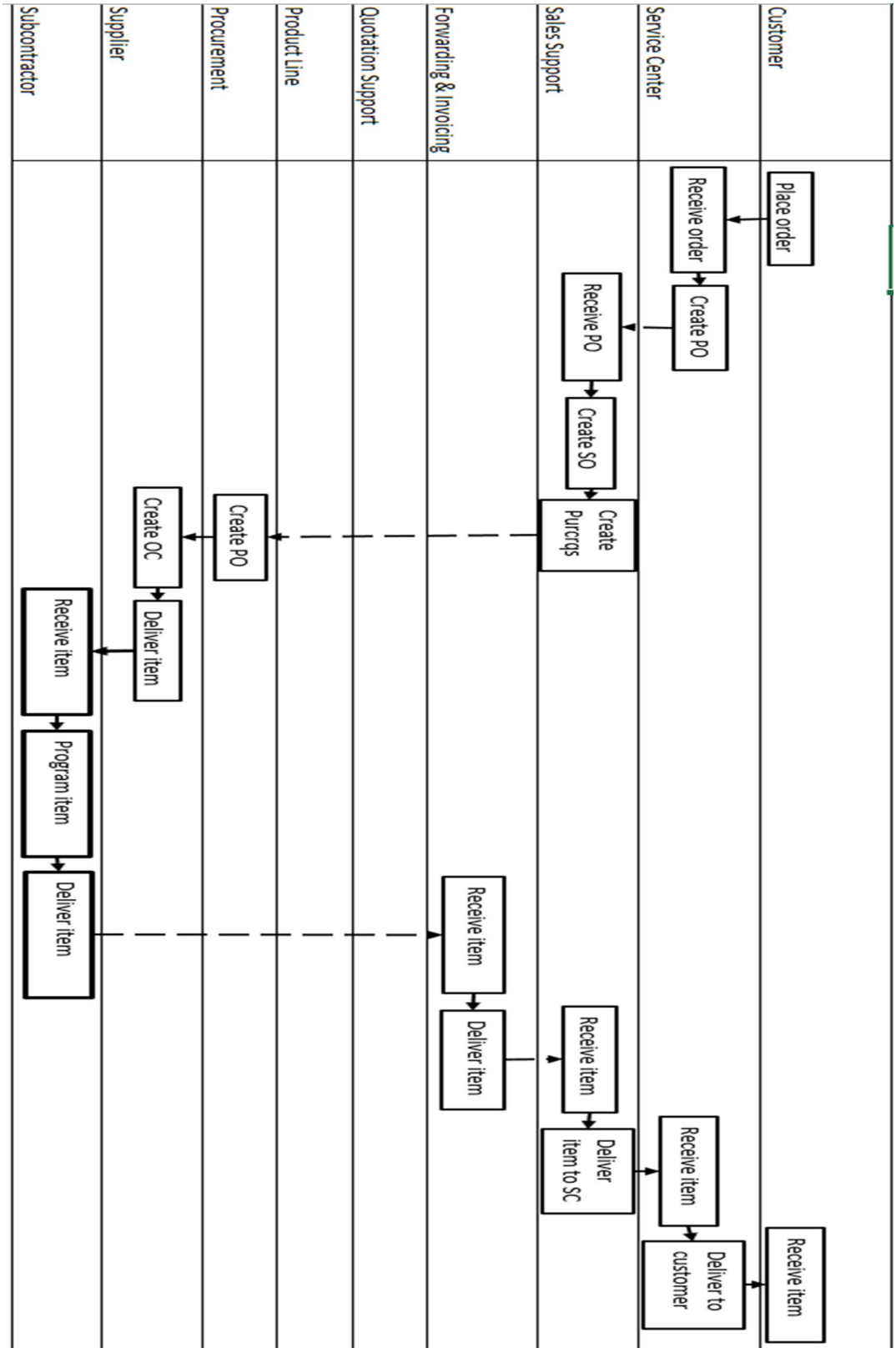
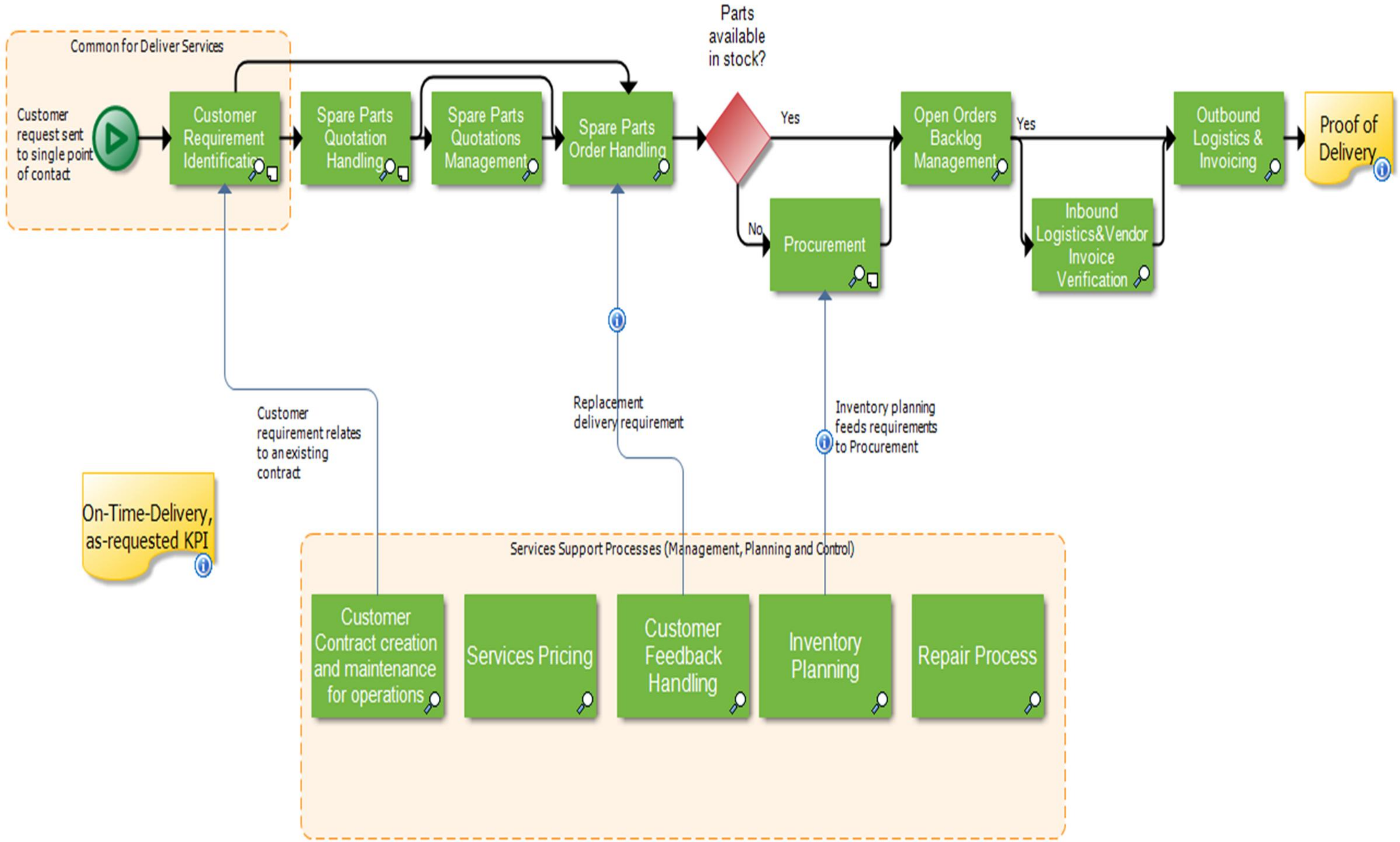

Customer
Service Center
Sales Support
Forwarding & Invoicing
Quotation Support
Product Line
Procurement
Supplier
Place order
Receive order
Create PO
Receive PO
Create SO
Create Purcrqs
Create PO
Create OC
Deliver item
Receive item
Program item
Deliver item
Receive item
Deliver
Receive item
Deliver to
Receive item


Customer
Service Center
Sales Support
Forwarding & Invoicing
Quotation Support
Product Line
Procurement
Supplier
Subcontractor
Place order
Receive order
Create PO
Receive PO
Create SO
Create Purcrqs
Create PO
Create OC
Deliver item
Receive item
Program item
Deliver item
Receive item
Deliver item
Receive item
Deliver item to SC
Receive item
Deliver to customer
Receive item



Common for Deliver Services
Customer request sent to single point of contact
Customer Requirement Identification
Spare Parts Quotation Handling
Spare Parts Quotations Management
Spare Parts Order Handling
Parts available in stock?
Yes
No
Procurement
Open Orders Backlog Management
Yes
Inbound Logistics&Vendor Invoice Verification
Outbound Logistics & Invoicing
Proof of Delivery
Customer requirement relates to an existing contract
Replacement delivery requirement
Inventory planning feeds requirements to Procurement
On-Time-Delivery, as-requested KPI
Services Support Processes (Management, Planning and Control)
Customer Contract creation and maintenance for operations
Services Pricing
Customer Feedback Handling
Inventory Planning
Repair Process