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Supply Chain at Eniram Oy

Delivery and productization process phases and improvement

ideas from the supply chain`s point of view

LAHTI UNIVERSITY OF APPLIED
SCIENCES
Faculty of Technology
Mechanical and Production Engineering
Bachelor's Thesis in Production
Oriented Mechatronics
Spring 2015
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ABSTRACT

The aim of this thesis was to develop and describe the different phases of the
delivery process and new hardware`s productization process from the supply
chain`s point of view at Eniram Oy. Another target was to find out how to manage
future growth from the supply chain`s point of view. The plan was to find out
problems and deficiencies in the delivery process, and theories or solutions on
how to improve them. The theories and improvement ideas of this thesis are based
on the research and in the communication in the company. The subject for the
study was received from the company.

Supply chain`s actions in the product management – product release process were
defined and gathered in a process map. Then each of these phases in the process
was described and looked at separately to find out if there was something to
improve. Improvement ideas were taken as far into practice as possible during the
study and the actions will be continued in the future.

Listing the process phases and looking for improvements from the supply chain`s
point of view has been useful for the company. The improvements reduced lead
times and made daily work more fluent in the delivery and productization process.
Also, the supply chain`s actions in different process phases were documented and
are now available for the whole company.

Key words: Productization, hardware, supply chain, process development,
delivery process, product management

Lahden ammattikorkeakoulu
Kone- ja tuotantotekniikka

POHJANPALO, PYRY: Toimitusketju Eniram Oy:llä

Tuotantopainotteisen mekatroniikan opinnäytetyö, 30 sivua, 2 liitesivua

Kevät 2015

TIIVISTELMÄ

Tämän opinnäytetyön tarkoituksena oli kehittää ja kuvata toimitusprosessin sekä uuden laitteen tuotannollistamisprosessin eri vaiheita toimitusketjun näkökulmasta Eniram Oy:llä. Toinen tarkoitus oli selvittää, kuinka hallita tulevaisuuden kasvua toimitusketjun näkökulmasta. Suunnitelma oli löytää ongelmia ja puutteita toimitusprosessissa sekä teorioita tai ratkaisuja, kuinka parantaa niitä. Tämän opinnäytetyön teoriat ja parannusehdotukset perustuvat tutkimustyöhön ja kommunikointiin yrityksessä. Opinnäytetyön aihe saatiin yritykseltä.

Toimitusketjun toimet tuotehallinnassa, sekä tuotannollistamisprosessissa määriteltiin ja lisättiin prosessikarttaan. Tämän jälkeen jokainen näistä vaiheista kuvattiin ja käsiteltiin erikseen, ja katsottiin jos niistä löytyisi jotain parannettavaa. Parannusehdotukset vietiin niin pitkälle käytäntöön tämän opinnäytetyön aikana, kuin mahdollista, ja toimia jatketaan tulevaisuudessa.

Prosessin vaiheiden luettelointi, sekä kehitysehdotusten tekeminen toimitusketjun näkökulmasta on ollut hyödyllistä yritykselle. Parannukset lyhensivät läpimenoaikoja ja tekivät päivittäisestä työstä jouhevampaa toimitus ja tuotannollistamisprosesissa. Lisäksi toimitusketjun toimet prosessin eri vaiheissa dokumentoitiin ja on nyt koko yrityksen saatavilla.

Avainsanat: Tuotannollistaminen, laite, toimitusketju, prosessin kehittäminen, toimitusprosessi, tuotehallinta

CONTENTS

1 INTRODUCTION

This thesis is made for Eniram Oy in Lauttasaari, Helsinki. The subject for the study was received from the company and it was found a good way to define the current productization and delivery process`s different phases from the supply chain`s point of view. A preliminary end-to-end delivery process map in the company was already made but it had gaps, such as the supply chain`s steps and actions in the new hardware release and delivery process were not defined. These productization and delivery process phases in the supply chain were to be determined as well as to be documented and standardized. This would make the productization and delivery process faster, easier and better documented. In addition, well-controlled productization makes increased delivery volumes better controlled. Improvement ideas should make some working phases faster and reduce bottle necks.

Having previous experience in the company helped a lot in this study. Such as creating and updating documentation for new hardware for the company and contract manufacturer, for example assembly and preparation instructions for main hardware. Managing company`s inventory and being part of the delivery process had already given some thoughts before this study. Aim was to find out the bottlenecks of delivery and productization process and to look for possible solutions to reduce those.

The most difficult part was to define actions in fields that were not familiar for me. This required communication between the different teams and examining old documentation. End-to-end delivery process map was found very helpful to see the big picture and made it easier to start to find all the main supply chain steps under those main categories.

I would like to thank Supply Chain Manager Mr Jani Lehtinen for his support and encouragement I have got during this Thesis. This Thesis was also summarized for the company to help the current and future employees, and also to make the delivery process more efficient.

2 ENIRAM OY

Established in 2005, Eniram provides the maritime industry with energy management technology to reduce fuel consumption and emissions. Eniram's solutions range from single onboard applications to comprehensive fleet analysis. They are used by small and large shipping companies on ships ranging from cruise liners, tankers, container ships bulkers and ferries. Eniram delivers quality products and services that enable customers to save fuel, increase profitability and reduce harmful emissions. Eniram`s main office is located in Helsinki, Finland, and has subsidiaries in the UK, the USA, Germany and Singapore. It has 60 employees. (Eniram 2014a.)

On May 21, 2014 Eniram was named by Cleantech Group (CTG), developer of the i3 market intelligence platform, as one of CTG's five picks as a European Cleantech Company of the Decade. (Eniram 2014a.)

2.1 Products

Eniram has a variety of products that helps customers to operate their ships with the greatest possible fuel efficiency. Eniram collect data from onboard systems by Eniram Vessel Platform (EVP), which is complemented with data from the Eniram sensors. Data is then transmitted to the Eniram data center for further analysis and statistical modelling. (Eniram 2014a.)

DTA - Dynamic Trimming Assistant

DTA helps crew to maintain optimum trim and save money by using less fuel. DTA is designed to ensure maximum performance in actual variable conditions by collecting prevailing trim, propulsion power and vessel movement data. DTA gives actual fuel savings of 2-3 %. (Eniram 2014a.)

OSA – Optimum Speed Assistant

OSA gives the optimal RPM to reach port just-in-time at the lowest cost. OSA is the only speed optimization solution on the market that continuously takes into

account all the prevailing dynamic conditions, ensuring that the guidance is always up to date and accurate. OSA gives actual fuel savings of 1-3%. (Eniram 2014a.)

ELA – Engine Load Assistant

ELA helps vessel`s crew to use the engines in the most efficient way. Balancing the required engine load for multiple engines helps to enable fuel savings. ELA combines data from an onboard fuel flow meter with data on engine load and vessel speed. This ensures that your vessel burns no more fuel than is necessary to maintain the desired speed and service power requirements in prevailing conditions. ELA gives actual fuel savings of 3%. (Eniram 2014a.)

VPM – Vessel Performance Manager

VPM helps vessel`s crew to analyze the total energy efficiency of the vessel. (Eniram 2014a.)

FPM – Fleet Performance Manager

Helps users to gather, store and analyze vessel performance data to support their decision-making. FPM together with onboard optimization ensures continuous fuel savings of up to 10 %. (Eniram 2014a.)

Eniram Analytics Services

Using automatically collected data from an Eniram Vessel Platform (EVP) equipped vessel, Eniram can provide further insight into the vessel performance. The analyses can be done as a one-time project or made into a service of recurring reports. In addition to the analyses listed below, Eniram can also perform a custom analysis; for example engine configurations, engine aging, performance of hull coating, speed profile and optimal route are all aspects, which can be covered by Eniram Analytics. (Eniram 2014a.)

2.2   Production

Eniram`s production is outsourced to a contract manufacturer. Co-operation
started in 2009. Most components and hardware for the products are delivered to
the contract manufacturer from different suppliers. The usual approach is that the
manufacturer assembles, tests and packs Eniram`s products and ships them to
Eniram`s clients. In some cases the packages are left to the manufacturer`s interim
storage or delivered to Eniram Helsinki storage waiting for further shipping. The
main hardware in Eniram`s products are attitude sensors, system cabinets,
different size marine displays and a variety of servers for different installations.
These pieces of hardware are usually packed together so that they form a full
system (see FIGURE 1). Eniram also has some hardware in its warehouses in
Helsinki and Florida, which can be used for urgent installations and as
replacements. Sometimes Eniram delivers hardware for a contract manufacturer to
fill in orders in case they have a lack of materials. This can happen, for example,
if a lot of packages have been sold and the lead times for some hardware or
components are too long.

FIGURE 1. Eniram`s system package.

Eniram hardware deliveries are quite modest due to the nature of the business which is concentrated on optimizing operations and fuel savings using the data. Therefore, hardware deliveries do not give a full picture of all Eniram deliveries.

2.3   Supply Chain Management

> *Entire network of entities, directly or indirectly interlinked and interdependent in serving the same consumer or customer. It comprises of vendors that supply raw material, producers who convert the material into products, warehouses that store, distribution centers that deliver to the retailers, and retailers who bring the product to the ultimate user. Supply chains underlie value-chains because, without them, no producer has the ability to give customers what they want, when and where they want, at the price they want. Producers compete with each other only through their supply chains, and no degree of improvement at the producer's end can make up for the deficiencies in a supply chain which reduce the producer's ability to compete. (Businessdictionary.com, 2014a.)*

Eniram has one supply chain manager at the moment. Previously that role was given to project managers among their other duties that is not an ideal situation. In Eniram Oy, the supply chain especially takes care of contracts and communication with manufacturers and suppliers, shipping, inventory management, deliveries, forecasts and purchases.

3   HARDWARE RELEASE PROCESS

The following topic describes the productization phases from the supply chain`s point of view. See attachment 2, Supply Chain`s actions in Product management – Product release process map.

3.1   Defining the concept

This chapter contains two process phases from the supply chain`s point of view; "Building a prototype" and "Choosing the supplier/manufacturer". At the concept phase, supply chain does not have much to do but it is very important to be involved.

3.1.1   Building a prototype

The supply chain needs to communicate with the hardware developers and product managers when it comes to choosing the components for new hardware. All the components should be easy to purchase and for a good price and without too many suppliers. It is required to find out if the current suppliers or the contract manufacturer could be used to get the parts needed before looking for new sources.

FIGURE 2. Eniram`s new attitude sensor AS-005 prototype (Eniram 2014 a)

3.1.2   Choosing the supplier/manufacturer

When choosing individual components for a piece of hardware it is always better to use suppliers that already co-operate with Eniram, if possible. In this way the amount of suppliers does not grow too much. It can also be cheaper and safer to use the existing suppliers since there has already been previous co-operation.

During this study there was a certain component that was needed for a new product. When considering a new supplier or manufacturer, there are a lot of things that need to be taken into account before any purchases. It is required to check the supplier`s reliability, the quality and price of the component, lead times and delivery. Possible risks should be predicted and this is why a good background check for the supplier is required. Questions should be asked about the manufacturer`s factory, the products and their production in general, and possible changes.

3.2   Building the product

At this point of the hardware release process supply chain has actions in three phases; "Bill of materials", "Quotes from the manufacturers/suppliers" and "Assembly instructions".

3.2.1   Bill Of Materials

When all the components are defined, a BOM list needs to be created by the hardware development and supply chain. The supply chain can help with this by comparing it to old BOM lists and look if there are any old parts or components that can be used. It might be that some parts come from different suppliers and this needs to be documented. When the list is ready, the supply chain will deliver it to the manufacturer and negotiate if there are any questions or issues with parts required on the list. The list should include the name of the parts, their definitions, the manufacturer and the quantity.

A BOM "explosion" displays an assembly or sub-assembly broken down into its individual components and parts, while a BOM "implosion" displays the linkage of individual parts to an assembly. (Investopedia.com, 2014 a)

1.2 Part list

Item	Maker & Type	Qty	Contact
Box	-	-	-
Inclinometer	-	-	-
Serial converter	-	-	-
Back plate	-	-	-
Top plate	-	-	-
Thread bar M4x65	-	-	-
Lock nut M4	-	-	-
Washer M4	-	-	-
Allen M6x14	-	-	-
Lock washer M6	-	-	-
Allen M3x10	-	-	-
Allen M6x25 A4	-	-	-
Permanent thread locker	-	-	-
Medium strength thread locker	-	-	-
Silicone	-	-	-
D9M connector	-	-	-
M12-8F, 90deg	-	-	-
Mass connector	-	-	-

FIGURE 3. Example of Eniram`s attitude sensor`s BOM list (Eniram 2014 a.)

3.2.2 Quotes from the manufacturers/suppliers

Competitive bidding is needed when choosing a manufacturer or a supplier for new hardware or its components. The most efficient way is to use existing channels and try to get the best offer and deal. Familiar suppliers are better because there has already been some co-operation between the parties and mutual trust is built. It is also easier to handle if there are not too many suppliers. When finding a new supplier, it is also good to ask a contract manufacturer or any other party from own networks if they would already have some suppliers or channels which Eniram could use instead of contacting directly a new supplier. (Asianajotoimisto Jari Sotka Oy 2013a.)

3.2.3 Assembly instructions

Before taking new hardware to production, preliminary assembly instructions are needed to the contract manufacturer, where their actions are defined and documented. The current approach is that this is written at this point but it should be written earlier, if possible. At the latest when hardware is in production, someone from the supply chain need to go to the manufacturer`s facilities and create detailed instructions with pictures of how the hardware is properly assembled (see FIGURE 4). The point of it is to describe in detail how it is done in production. If something happens to a relationship between Eniram and the manufacturer, everything from technical drawings to assembly instructions and bill of materials are in the document database. Also these instructions can be used for internal training and hardware development.
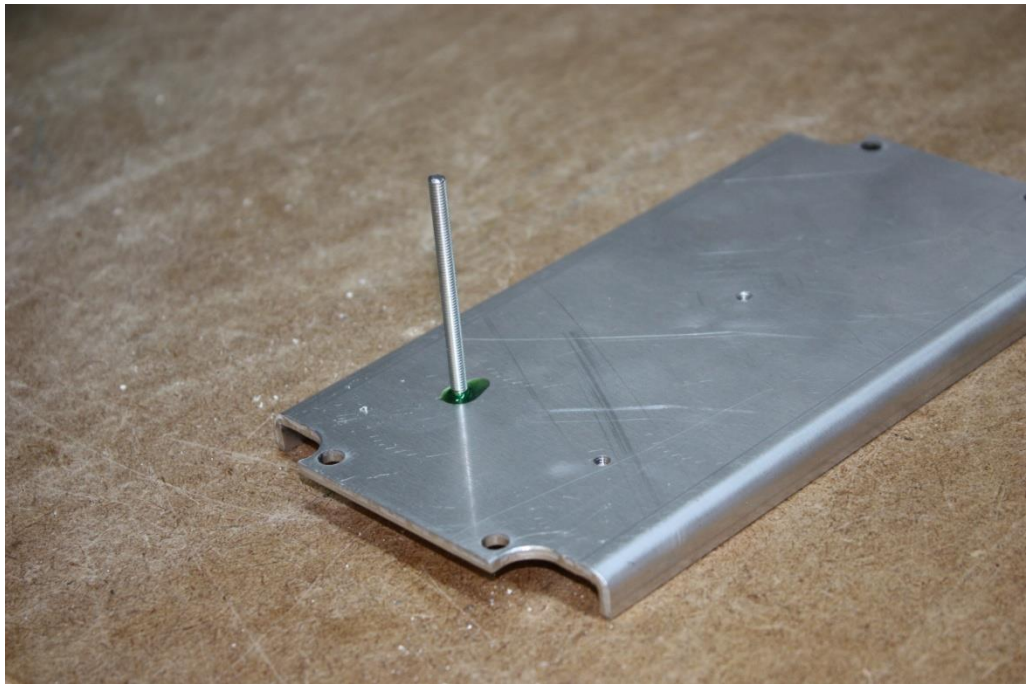

FIGURE 4. One phase of old attitude sensor`s assembly (Eniram 2014 a.)

3.3 Productization

At this point of the process supply chain has actions in five phases; "Contract and agreement with the manufacturer", "Guidelines and training", "Pricelist", "Material order template" and "Product codes".

3.3.1 Contract and agreement with the manufacturer

Contract negotiations are generally preceded by an agreement. Generally both parties negotiate the pre-conditions which are ideal for both. Parties have the freedom of negotiation, which means that they can discuss the conditions and give their opinions without agreement. Basically the contract is made when the offer is agreed on. The negotiating party can refuse to terminate the contract without further action, unless otherwise agreed. (Asianajotoimisto Jari Sotka Oy 2013a.)

There are a lot of things that need to be taken account in the contract, for example the delivery times, pricing, warranty/liability on defects etc. Before a new piece of hardware can be taken into the production it needs to be tested properly. These test units are to be ordered from manufacturer before any further orders. After the piece of hardware has been proven functional at the customer`s environment it can be taken into production. When taking new hardware into production there needs to be a ramp up plan and first order smaller amounts; for example forty units within three months and eighty units within six months. Frame contract is a good approach for critical components and for the supplier.

> *Frame contract is a non-legally binding agreement between two parties setting out their intention to agree on the precise delivery schedule and pricing terms in the future with respect to the supply and delivery of specified goods. (CSIMarket, Inc.2014b)*

3.3.2 Guidelines and training

Before new hardware can be launched in production, Eniram has to give proper training and instructions for the contact manufacturer. Before launch they also need all the relevant documentation, like the technical drawings, the BOM-list, the preparation instructions etc. These are provided together with the Supply Chain Management team, hardware and software developers.

Internal training and documentation is also required when launching hardware in the production. This is especially necessary for commissioning engineers who install all the systems onboard. Training is provided by specialists from different teams, for example software training is provided by the Software development

team and installation training and instructions are provided by the Technical manager.

3.3.3 Pricelist

Eniram has a pricelist which includes the cost for every solution, including hardware, working hours, software costs etc. The Sales team has it for the customers. A pricelist written only Eniram`s hardware costs was requested from the supply chain to add in the pricelist for internal use. This summary of hardware costs would give better visibility of Eniram`s hardware expenses.

The newest price list of the components was asked from the manufacturer where purchase price for each main piece of hardware would be shown.

By using original sales team`s price list everything else than hardware from the list was deleted and newest purchase prices were added from manufacturer`s given list. Then I calculated total amounts for each solution. Also every optional hardware and components that are used separately, for example replacements were listed at the end of the list.

This list is to be updated by supply chain every time when changes come up. For every other team this file is a read-only so that only editing access is in supply chain.

3.3.4 Material order template

When orders are placed to contract manufacturer, orders are filled in to order form called Material order template. It used to have about one page long list of main hardware of which you had to choose everything separately to form a package. This is also known as solution which includes x number of certain components. If some spare or optional hardware was needed, it needed to be typed manually which caused mistakes and misunderstandings in product codes or naming because everyone had different naming in mind.

This material order template was one thing that needed to improve to get order process easier, faster and to reflect with sales codes.

As solution I decided to put all the products like they are on the price list on the first page and include all the hardware that are included in products to "definition of products" field. In this way when ordering a product, all that is needed to do is to choose a solution which needs to be ordered by typing amount required in "order" field (see FIGURE 5). If other hardware is needed with the product or separately, there will be a full list of components below the products list with right codes and names (see FIGURE 6). This makes the order list longer but more easier and accurate since products are no longer needed to type manually, simply find what you need and choose how many.

When new version of material list was ready, it was showed to project managers and supply chain manager to hear their opinions. They had good improvement ideas and comments and those were updated to the list. After that a meeting was set up with the contract manufacturer and their opinions for the list were asked too. After everyone`s requests were heard, the final version was made and it was made sure that everyone is happy for it and knows how to use it properly. The old list was then replaced with a new one.

[Official Name]		Material order for [Product]			
MARK	DEFINITION OF SOLUTIONS	ENIRAM COMP.NO:	ORDER	PACK NO	NOTES
EPV-040	Eniram Vessel Platform				
		EC [Vessel / Unit Number].01			
		EC [Vessel / Unit Number].22			
		EC [Vessel / Unit Number].31			
		EC [Vessel / Unit Number].32			
EPV-040	Eniram Vessel Platform With 20 A Power Supply				
		EC [Vessel / Unit Number].01			
		EC [Vessel / Unit Number].22			
		EC [Vessel / Unit Number].31			
		EC [Vessel / Unit Number].32			
ESG-010	Eniram Signal Gateway				
		EC [Vessel / Unit Number].51			
		EC [Vessel / Unit Number].12			
		TOTAL			

FIGURE 5. Part of solutions list (Eniram 2014 a.)

MARK	DEFINITION OF COMPONENTS	ENIRAM COMP.NO:	ORDER	PACK NO	NOTES
	Optional components:				
M-SC-001		EC [Vessel / Unit Number].01			
M-SC-001		EC [Vessel / Unit Number].01			
M-ESC-001		EC [Vessel / Unit Number].51			
C-UPS-001					
C-CS-003		EC [Vessel / Unit Number].11			
C-ACC-901					
	Sensors:				
M-AS-001		EC [Vessel / Unit Number].31			
C-ACC-XXX					

FIGURE 6. Part of components list (Eniram 2014 a.)

3.3.5 Product codes

Every Eniram`s products or so called "solutions" have their own sales codes. For example Eniram Vessel Platform`s code is EVP-040. Also every individual piece of hardware in the product has its own code. For example attitude sensor is AS-001, or AS-005, depending on the model. In addition every hardware have a component number which shows its position in vessel, for example number 31 after sensor`s customer and vessel code shows that its aft sensor and should be installed to vessel`s rear end. The letters come from items name; AS= Attitude sensor.

Creating codes has been very spread in the company. Probably because the company is still quite new and growing and there has not been dedicated person for this task. Usually solution codes are created in sales team and hardware codes and component numbers are made someone from technical, supply chain management, or project management team. Usually the numbers are next available numbers.

There should be only one person that creates hardware related codes and one person that creates codes for solutions. And these should of course to be communicated to each other. This would reduce misunderstandings and would be more systematic. Supply chain management has the responsibility to make sure that manufacturer and Eniram uses same codes and understand their meanings. Every code that is used between Eniram and manufacturer should always reflect to Eniram`s price list.

4 DELIVERY PROCESS

The following topic describes the delivery process phases at the supply chain point of view. See attachment 2, Supply chain`s actions in Product management – Product release process map.

4.1 Inventory

In this chapter there are three subjects; "Inventory value, "Inventory management in Helsinki and contract manufacturer", and "Inventory management in other Eniram offices".

4.1.1 Inventory management in Helsinki and contract manufacturer

Eniram have hardware and spare parts in Helsinki warehouse, contract manufacturer and Florida office. Helsinki warehouse inventory management is quite straightforward process and monthly inventory report can be created easily. But those hardware that are elsewhere needs someone else than Eniram supply chain management to do a monthly inventory check and report it.

One issue in Eniram`s inventory has been hardware that belongs to Eniram but are in contract manufacturer`s facilities. Those hardware are in Eniram`s inventory but are located in the manufacturer`s warehouse. There has not been a good visibility to these items because all the items were unmarked and in a same place. Also some of the hardware are packed to a big cardboard box (see FIGURE 1) and are shipped to customers. In these situations Eniram`s and manufacturer`s property gets easily mixed up and that causes problems in inventory, invoicing and hardware tracking. A good system to keep these items separate was needed to help both companies. Before monthly inventory, made by contract manufacturer, the only way to track those items was to compare serial numbers listed in Eniram`s inventory file to serial numbers listed in invoices. Those serial numbers were in pdf format so it required a lot of manual paperwork.

Also one problem is that all the documentation is located in database, a document management library where work orders can be placed by using workflow states and all the documents are saved. This works ok when orders are placed for contract manufacturer. The problem is that documents are hard to find from the database and it is hard to create a folder that includes all the relevant documents for both companies and would have a real-time view. Proper inventory management software was needed.

For the solution we have thought the following. Eniram`s property would be placed separately from other hardware in manufacturer`s warehouse. Also those items would have to be marked clearly so they can be easily recognized to be Eniram`s own so they won`t get mixed up (see FIGURE 7). These used to be all unmarked and all in a same place. Unsold Eniram`s property, i.e. unassigned systems, were to be marked in alphabetical order starting from the letter A. Also every time order is being prepared, contract manufacturer will list all the serial numbers of the hardware to a word document and copy it to the order folder in database. These used to be handwritten forms which were then scanned to a pdf format. This caused misunderstandings and made impossible to make searches in database by using serial numbers. Also you had to remember where each piece of hardware was located in database. We also asked contract manufacturer to do inventory at the end of each month to make sure that it matches to Eniram`s inventory list.

FIGURE 7. Marked Eniram`s hardware.

What comes to ERP system, supply chain management team and contact manufacturer`s managers and their ERP contacts from Sweden had a conversation of what would be a good solution or best way to manage the whole inventory situation. We went through current methods and issues and ERP experts presented options that could work. One possible option came up and that was a cloud service where all the important documents could be shared between both companies. There could be a shared inventory file that would be always updated and supply chain would have reading rights to it. Manufacturer would still continue doing monthly inventory though in their warehouse. There could also be meeting memos, forecasts and other important documents that need to be shared. One question would be that does Eniram need ERP system for inventory management only or could it be a handy tool to manage shipments or something else too.

For tracking hardware outside Helsinki office there should be an inventory tool that would make inventory managing faster and easier over all. Currently all the serial numbers are written down manually to inventory list which takes a lot of

time. It would be much efficient to have a barcode reader for serial numbers like in most of the warehouses and software that would have automatic functions. For example every time new hardware are purchased and delivered to warehouse, all the serial numbers could be scanned with a barcode reader and go straight to the system with inbound date. This would speed up the process and it would also reduce manual mistakes. That software should also be functional with the ERP system. At this point of my thesis this tool was introduced for consideration.

> *ERP collects, manages and distributes information across functional boundaries and helps break down information "silos"—those barriers that stand in the way of full cooperation between production, materials, planning, engineering, finance and sales/marketing. The resulting higher quality, reduced time-to-market, shortened lead times, higher productivity and lowered costs can help improve customer service and increase sales and market share as well as margins. (www.apteam.com, 2014 b)*

The most important advantages of using ERP system between Eniram and contract manufacturer would be inventory management, visibility and shortened lead times. At this point of my thesis ERP was still under concern of both parties but not decided yet. Eniram`s supply chain management team and contract manufacturer launched a cloud service where every mutual documentation would be placed in the future, for example monthly inventory files, meeting memos etc. This was already a huge improvement since it reduces exchanging emails and phone calls between both companies and every relevant document would be in one place.

4.1.2   Inventory value

Inventory value has increased in 2014 compared to year 2013. One way to look at the inventory value and hardware sales is inventory turnover ratio.

> *The inventory turnover ratio is an efficiency ratio that shows how effectively inventory is managed by comparing cost of goods sold with average inventory for a period. This measures how many times average inventory is "turned" or sold during a period. In other words, it measures how many times a company*

sold its total average inventory dollar amount during the year. A company with $1,000 of average inventory and sales of $10,000 effectively sold its 10 times over. (Myaccountingcourse.com 2014 b)

This ratio is important because total turnover depends on two main components of performance. The first component is stock purchasing. If larger amounts of inventory are purchased during the year, the company will have to sell greater amounts of inventory to improve its turnover. If the company can't sell these greater amounts of inventory, it will incur storage costs and other holding costs. (Myaccountingcourse.com 2014 b)

The second component is sales. Sales have to match inventory purchases otherwise the inventory will not turn effectively. That's why the purchasing and sales departments must be in tune with each other. (Myaccountingcourse.com 2014 b)

I calculated inventory turnover ratio by dividing the cost of goods sold for a period by the average inventory for that period comparing year 2013 from January to August and year 2014 from January to August results.

Inventory Turnover Ratio

$$\text{Inventory Turnover Ratio} = \frac{\text{Cost of Goods Sold}}{\text{Average Inventory}}$$

The real numbers in calculations below has been replaced by letters.

In the beginning of January 2013, cost of goods was sold on income statement of X €. At the beginning inventory was Z € and at the end inventory was Y €. When calculated, the result is 0,99:

$$\frac{X}{\frac{Z + Y}{2}} = 0,99$$

In the beginning of January 2014, cost of goods was sold on income statement of A €. At the beginning inventory was B € and at the end inventory was C €. When calculated, the result is 0,55:

$$\frac{A}{\frac{B + C}{2}} = 0,55$$

The result shows that inventory turnover ratio has decreased in 2014 compared to 2013. In other words this means that inventory value has increased and hardware sales decreased in 2014.

One possible solution to decrease Eniram`s inventory value is to suggest to contract manufacturer if they could keep some buffer in their inventory for some time and then call off if deliveries does not happen. Also frame agreements with suppliers will decrease inventory value in projects and the goods would be in suppliers' stocks until there are actual orders. In this way there is always the chance that at some point inventory will suddenly grow a lot because of the call offs but most of the time the expenses could be directed straight to projects. In current situation, an ideal inventory turnover ratio would probably be around 1 which was the situation in 2013. This is very realistic goal if the suppliers or manufacturers agree to have materials in their inventory.

4.1.3   Inventory management in other Eniram offices

One problem has been the lack of supply chain management in Eniram Florida`s office. This is because currently that office is very small and there are only a few employees. It is not profitable to hire another supply chain manager or assistant yet. This is why Florida office`s inventory management is under supply chain management team`s responsibility in Helsinki.

There have always been some hardware in Florida`s office for US deliveries and replacements but there have not been similar monthly inventory check that in Finland. Those hardware are always been tracked based on serial numbers in material orders and invoices. Every time Florida`s office have run out of something they have ordered more from either Eniram Helsinki or US suppliers. In inventory file which is managed by the supply chain management team in Helsinki there is a separate sheet for Florida`s office goods. It has been almost impossible to track hardware by serial numbers because the lack of information. A better visibility was needed for US inventory.

First phase to solve this problem was to get someone from Florida office to check all the items there are at the moment. Commissioning engineer from their office agreed to make an inventory and send the list to supply chain manager in Helsinki. After the knowledge of what items are still in place, everything else was deleted from the inventory list.

The next question is how to keep track of items in the future and manage inventory list. Florida office`s commissioning engineer was assigned to manage inventory in US. Together with Helsinki supply chain team everything was taught and discussed. We agreed that inventory in Florida is managed same way that it is managed in Helsinki, at the end of each month inventory list is updated and all the hardware that have been delivered are marked to that list. It was also agreed that in Florida`s office there will be a list of usage so that every hardware that leaves the building will be marked to that list, which will help tracking a lot.

Items with small value which are not in inventory, for example wires, fuses, power supplies, it was agreed that those will be updated to a separate sheet in inventory file. That list is for their internal usage only. There should always be enough components so they do not ever run out. Small value items should also be found from local US suppliers so everything does not have to be shipped from Finland. That would save time and money. Also it was settled that US employees will choose local couriers, like UPS and Fedex for shipments inside the US. They could use DHL when shipping something to Europe like Eniram Helsinki is doing when shipping from Helsinki to Florida.

4.2   Forecasting and planning

This chapter includes three process phases from the supply chain`s point of view; "Pre sales", "Sales-to-delivery handover" and "Lead times".

4.2.1 Pre-sales

Supply chain management should be involved to pre sales meetings in special cases, for example when dealing volumes that are bigger than usual. Supply chain`s presence is required to avoid situations where products have been sold even though contract manufacturer is unable to fill that order. It may because of the lack of hardware and lead times being too long or lack of man power. This is why supply chain should always be some part of selling process. For example supply chain can check if it is possible to make bigger or different order than usual happen by asking that from the subcontractors, contract manufacturer and checking volumes from the inventory. Sales team should contact supply chain management directly or through a Project manager before any bigger or special deal is made.

4.2.2 Sales-to-delivery handover

Sales-to-delivery handover meetings include information about hardware needed for delivery and delivery schedules. This information is very important for the supply chain because it gives time to react and communicate with contract manufacturer and subcontractors. Supply chain can ensure that there are enough materials and time to prepare the shipments.

Sales-to-delivery handover meetings have been held, but supply chain was not participated, at least not in every meeting. Probably because it was thought that supply chain would get the information after meetings through project managers or someone else. It is good that supply chain joins those meetings to avoid delay in information and can ask questions if needed. When this was noticed, it was discussed between key persons and now supply chain participates to these meetings.

4.2.3 Lead times

When launching a new piece of hardware in the production, lead times must be taken into account. Lead times must be discussed with subcontractors and contract manufacturer and define how fast they can prepare and deliver goods when order

is received from Eniram. Also lead times needs to be defined in a contract with suppliers so that purchases and deliveries are as fast and easy as they could be. For example current lead time for displays is around six weeks. This needs to be cut to four weeks because it is very difficult to forecast future needs. Also long lead times causes increasing in inventory and deliveries cannot be late because the lack of hardware.

Sales team are interested in total lead times in delivery process, which means the total hardware delivery schedule starting from placing the order to package ending to the customer. All the phases should be able to estimate pretty easily and can be requested from contract manufacturer.

For cases when something breaks on a vessel or some hardware needs to be upgraded or replaced there should always be some spare parts in Eniram Florida`s office to make replacing process faster for USA. It takes too much time to deliver goods from Finland and it is complicated and expensive. This is a current approach but it is always depending on case and needs to be discussed between both offices. Eniram has offices in England, Singapore and Germany too but at the moment there are no spare parts held anywhere else than Finland and USA. This might change when the company grows.

4.3   Deliveries

This chapter includes three process phases from the supply chain`s point of view; "Shipping", "The Combined Nomenclature for customs" and "Invoicing".

4.3.1   Shipping

Most of the materials are shipped by the contract manufacturer from their warehouse. Some of the materials are shipped from Eniram offices, for example user manuals and other documents, USB sticks, spare parts and system packages in some special cases. Eniram usually uses standard freight forwarding

companies. Sometimes customer arranges a pick up too. Most of the shipments in Eniram Helsinki office are usually done by supply chain.

There are a lot of bottle necks that slows down the shipping process and makes it laborious. First of all there is too much paperwork that needs to be done by hand. Three to four different shipping documents needs to be filled manually, then print multiple copies and sign and stamp and scan them. Also the lack of customer details slows down shipping and requires a lot of questioning between customers, supply chain and project managers. All the customer addresses and contact persons could be in one place and paperwork pre-filled as much as possible to save time. ERP system could be a useful tool for this.

Most of the shipping requests come with a very tight schedule even though there might not even be any hardware available for that order or any customer information. When shipping something in a hurry there is always that change that something have gone wrong with the papers or item`s preparation etc. Supply chain management taking part to sales to delivery handover is a good way to get heads up for upcoming shipments and have more time to react especially in bigger cases.

Packing shipments in Eniram Helsinki warehouse is pretty hard and takes a lot of time. This is mostly because the size of facilities and the lack of packing materials and packers. To make it faster and tolerable, everything in there needs to be arranged so that there is as much empty space as possible and every material in marked places (see FIGURE 8). 5S planning could make working in Eniram warehouse easier and faster.

FIGURE 8. Marked inventory shelf.

> *Motion is a significant factor within the seven wastes and every effort should be made to remove it from your processes to both increase efficiencies as well as make work easier for all those involved. Movement is not work, but it costs you time and money; so look to lean tools such as 5S to help you reduce and eliminate excessive motion from your processes. (http://leanmanufacturingtools.org, 2014 b)*

During this study problems appeared with the US customs. Couple of shipments got stuck to a different state`s customs and at least one returned back to contract manufacturer from where it was re-sent to customer but to another country. When contacting a courier`s customer service they replied that they have no idea why this happened and that US customs do what they do. This kind of forth and back sending costs a lot of money and time to the company. One theory is that US customs did not reach the customer and because of that they were not able to send the package forward. The question is how to prevent this in the future? One option is to make sure that there are correct customer contact details on the shipping papers and if the shipment gets stuck again, then immediately contact to customer if customs cannot reach them. Good communication with shipping companies is important to prevent problems and react right away when there is an issue.

4.3.2   The Combined Nomenclature for customs

Every time when hardware are shipped to a client from Eniram office or from manufacturer`s facilities, Pro forma invoice requires The Combined Nomenclature. If this number is missing from the invoice, the shipment may get stuck in customs. Some countries are more stringent than others.

> *The Combined Nomenclature is the common nomenclature of the European Community. The 8-digit sub-headings in the nomenclature are used in export declarations and in statistical declarations on internal trade. There are changes to the nomenclature every year and the nomenclature that will come into force in the beginning of the following year is published yearly in the Official Journal of the European Union, by the end of October at the latest. (Customs 2014b.)*

All the codes are listed in the Finnish customs website. Each piece of hardware or combination of hardware requires a different code. Eniram has a document which has all the most common nomenclature for most shipped items (see FIGURE 9). Eniram`s nomenclature usually begin with 8000. For example, LCD Display is 8582597000. If the piece of hardware that is being shipped is not on the Eniram`s list and is hard to find from customs website, then a phone call to a Finnish customs customer service is required by the supply chain. After the new code is received it needs to be added to a Eniram`s CN-code list.

- Server & System Cabinet 8471 50 00 separately
- LCD Display 8528597000 separately
- Inclination sensor 8473 30 20 separately
- Draft monitor (radar) 9026 10 29 separately
- Multiplexer 8473 30 80 00
- Power Supply 8501 10 93

FIGURE 9. Part of Eniram`s CN-list (Eniram 2014 a.)

4.3.3 Invoicing

The current process is that every time someone from the supply chain makes an order, it needs approval from the supervisor. This is requested by workflow in M-files. After approval, order can be placed to a supplier. When order and its invoice are received, it needs verification, approval or both in Procountor which is finance management software. Usually orders that are placed to the manufacturer needs verification from project managers if they have made that specific order and final approval goes to supply chain. If someone from the supply chain places the order to manufacturer, he can approve that alone when invoice is received. Any other purchases from suppliers are usually made by the supply chain which usually takes care of purchasing. In these cases it is not determined whether supply chain should approve invoices straight away or should they be verified first and then final approval would go to supervisor, who has approved that order already in M-files workflow. The lack of instructions in invoice verification process have caused confusions and waste of time when each invoice`s actions needs to be discussed between parties.

This needs instructions so that it does not slow the delivery process down. That is why it was proposed that every time supply chain orders some installation materials to inventory, since it already gets approval from supervisor in workflow, it does not necessarily need another approval in Procountor. This would save time. In this case someone from the supply chain who made the purchase is responsible that numbers match in invoice. All the project and customer related orders should be verified by some project manager and to be approved by someone from the supply chain. This proposal needs to get approval from all parties and after it is ok to everyone, instructions can be written. After this there should not be any more questions or misunderstandings.

4.4   Product lifecycle management

This chapter includes two process phases from the supply chain`s point of view; "Replacing process" and "Claim hardware".

4.4.1   Replacing process

Every time when something brakes on the vessel, that broken piece of hardware or component needs to be replaced pretty fast. This is why there are some spare parts in manufacturer`s facilities and Eniram`s warehouses in Helsinki and Florida. It makes replacing process faster to deliver replacement part from where it is easiest, fastest and cheapest. For example many times when some spare parts are shipped from Finland to USA the materials have got stuck to US Customs for several days. This is one reason why it is much easier and faster to have some inventory in Florida.

Eniram usually takes care of replacement parts shipping. Usually Eniram`s commissioning engineers do the replacing but sometimes vessels crew is advised to do the replacing by themselves. In these cases spare parts are sent to vessel with instructions and replacing can be taking care of by for example vessels electrician. Smaller parts like power supplies and system cabinet`s components can be easily replaced and usually the broken component is left to onboard. Commissioning engineers also have always some spare components in there toolbox just in case. Bigger hardware like servers and displays are required to ship back to manufacturer if there is still warranty left. If not, then it needs to be shipped to Eniram office or manufacturer for testing and repairing or to be recycled. When sensors brake, they are always delivered back to Eniram and then back to contract manufacturer where they can be examined and repaired.

4.4.2 Claim hardware

Some customers want to know cause of the failure of a broken sensor. This is why I created a reclamation template which is filled by manufacturer and where they write the cause of failure and what tests have they run to sensor (see FIGURE 10). It also have the testing date and tester`s signature. Reclamation list can then be showed to customer if needed.

Attitude Sensor reclamation

- **Check the following parts of Attitude Sensor when looking for the cause of failure.**

  Attitude Sensor serial number: _____

1. Test sensor if there is a signal   ☐ OK

2. Try functionality with new Moxa   ☐ OK

3. Try functionality with new inclinometer   ☐ OK

4. Check wiring and connections   ☐ OK

Passed   ☐

Failed   ☐

Reason of failure: _____

In Vantaa _____ Date _____ Name

FIGURE 10. Sensor`s reclamation list (Eniram 2014 b.)

It is undefined what to do to repaired sensors. Currently they just pile up in manufacturer`s warehouse and every time when replacement sensor is needed, manufacturer assembles a brand new one even though old repaired sensors are

equally as good. The problem is that some of the old repaired sensors do not fit to installation plate that is installed on a vessel. It is usually glued or welded so the easiest way is to choose a sensor that is similar to what was installed there before. This is why it should always be checked from installation photos which sensor is suitable and then use old repaired sensor as replacement instead of manufacturing new one. This needs to be discussed between Eniram`s supply chain management, hardware developers and specialists and manufacturer.

When servers and displays break on the vessel, they are usually shipped to Eniram Helsinki where they can be repaired and used as test units. Those can be useful for software development or training purposes. New servers and displays are pretty expensive so it is better to use used or repaired claim hardware for those purposes.

It has also been undefined how to documentate returned hardware. I created a list which shows where and how to mark all returned hardware. For those hardware that are meant to send back to manufacturer there are "claim components" list. Usually every returned sensor is marked to that list. It shows all the necessary details of sensor. For example serial number, where it was, when it got returned and when it was shipped back to manufacture for repairing. Returned servers can usually been repaired at the Eniram office. These need to be marked to inventory template`s "test units" sheet. It shows almost the same details that claim components list but it also shows the re-usage purpose for example "repaired training unit". These are great for internal usage, for example for the software development and trainings. Every used but functional piece of hardware should be gathered to a test items cabinet which is located in Eniram warehouse and can be taken from there.

5   SUMMARY AND RESULTS

As a summary of this final thesis it can be pointed out that a lot has been improved significantly in the supply chain during this study. Most of the improvement proposals have been taken into practice at some level and will be improved further in the future. The supply chain`s daily work has become more fluent and lead times in the delivery process have shortened. Also the bottlenecks and the number of mistakes caused by insufficient information have been reduced.

This thesis lists the main phases in the delivery and productization process from the supply chain`s point of view and will remain as a guide and help for the supply chain management.

Inventory management has become much smoother. Eniram`s warehouse is well arranged according to the 5S method. Every item in the inventory has their place and is marked clearly. Monthly inventory is now done by the Eniram Helsinki office, the contract manufacturer and the Eniram Florida office. The contract manufacturer adds inventory update at the end of each month to a shared cloud service. Inventory in the Eniram Florida office is updated by the commissioning engineer and he sends update also at the end of each month via email. The supply chain will then update everything in the official inventory file. The contract manufacturer marks Eniram`s property clearly and writes every serial number into computer. This will make the tracking of hardware easier and does not require manual paperwork. The inventory management tool and barcode reader are still under process and will probably take actions in the near future.

Returned hardware has now two cabinets in the Eniram warehouse from where they can be used as test/training or replacement units. These pieces of hardware are for the supply chain to handle only so they do not get mixed up with anything. It was also agreed that the contract manufacturer can use the repaired sensors as replacement units so they can get rid of those since there are already a couple of new sensors coming to production.

The new material order template is now in use and seems to be faster and easier than the old one. There are still some codes and components that are not yet in production but are under process and will be updated soon.

The invoicing process is now clearer since better instructions were made, all gathered in one file with approval limits and instructions for the invoicing process.

During this study new hardware was not released. Negotiations with the manufacturer are still going on and a new attitude sensor will probably be launched in the production during this year.

Listing the process phases and looking for improvements from the supply chain`s point of view has been very useful for the company. Improvements have reduced lead times and made the daily work more fluent in the delivery and productization process.

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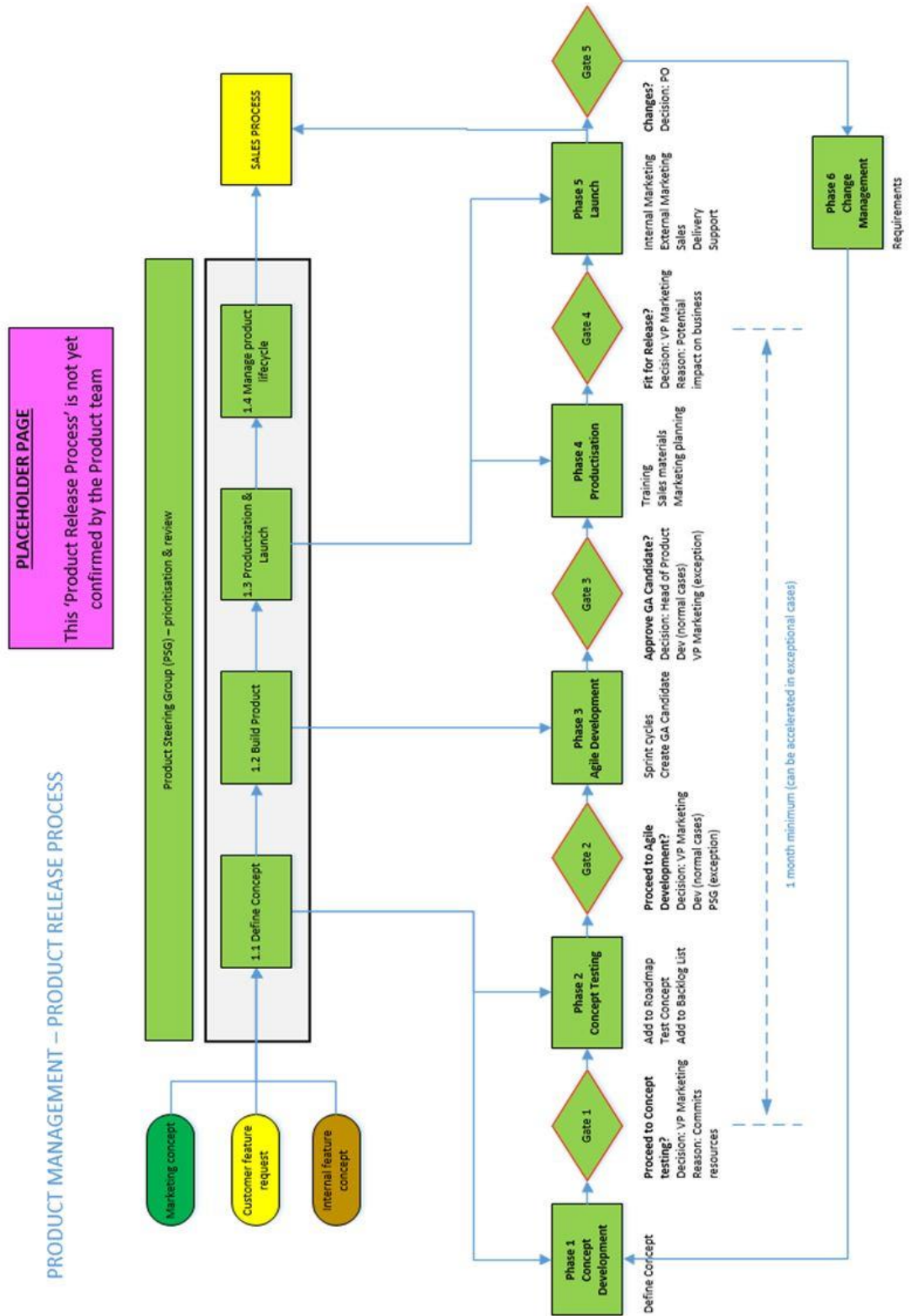CSIMarket, Inc.2014b. Term frame contract [lainattu 29.9.2014]. Saatavissa:
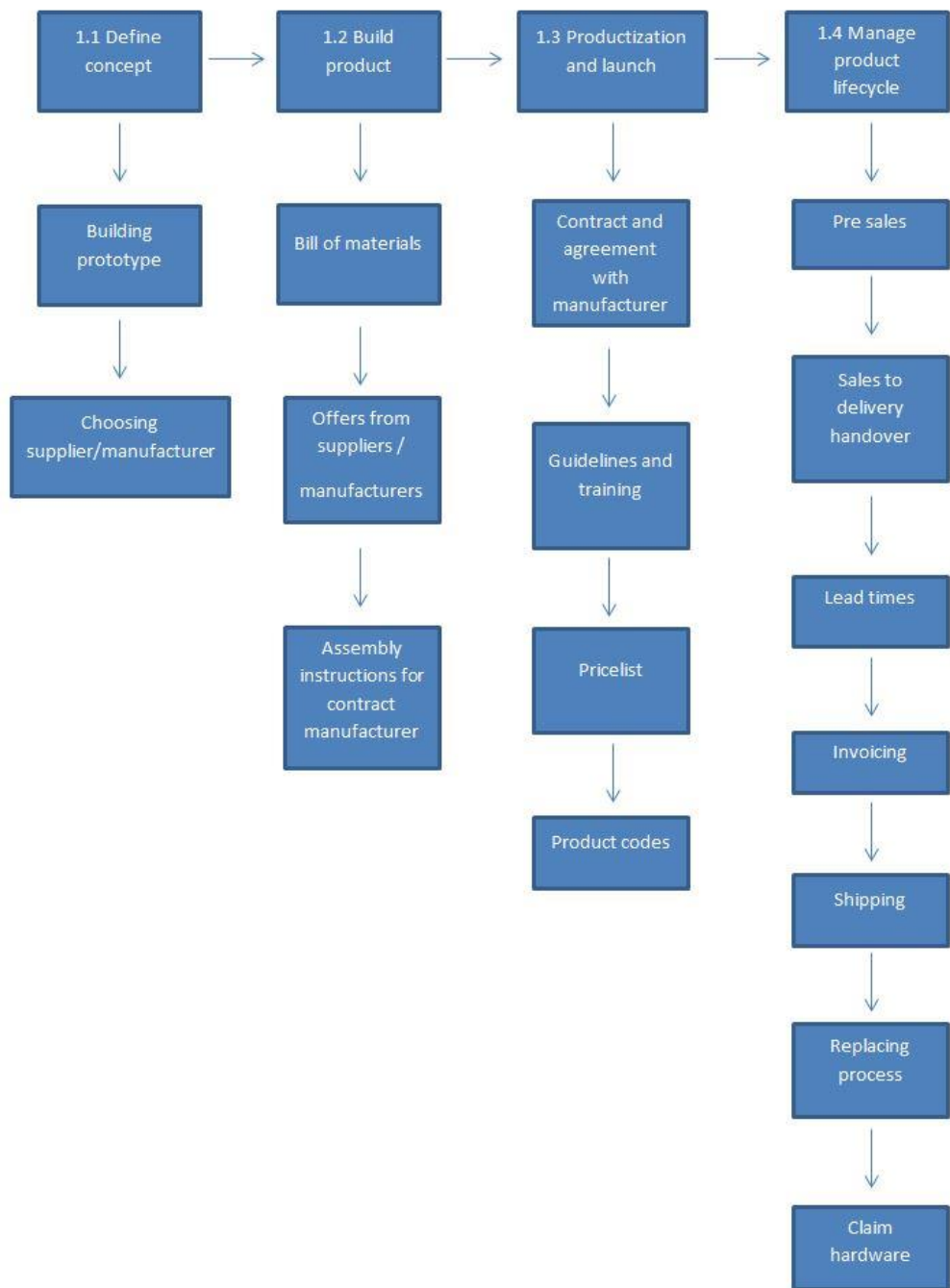http://csimarket.com/glossary/term_Frame_Contract.html

APPENDICES

Attachment 1: Product release process from end-to-end delivery process map (Eniram 2014.a)

Attacment 2: Supply Chain`s actions in Product management – Product release process map

Product release process from end-to-end delivery process map (Eniram 2014.a)

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┌──────────────┐      ┌──────────────┐      ┌──────────────┐      ┌──────────────┐
│  1.1 Define  │ ───> │  1.2 Build   │ ───> │ 1.3 Producti-│ ───> │ 1.4 Manage   │
│   concept    │      │   product    │      │ zation and   │      │   product    │
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│              │      │              │      │ with         │      │              │
│              │      │              │      │ manufacturer │      │              │
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│  Choosing    │      │ Offers from  │      │ Guidelines   │      │ Sales to     │
│ supplier/    │      │ suppliers /  │      │ and training │      │ delivery     │
│ manufacturer │      │ manufacturers│      │              │      │ handover     │
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                      │  Assembly    │      │  Pricelist   │      │  Lead times  │
                      │ instructions │      │              │      │              │
                      │ for contract │      │              │      │              │
                      │ manufacturer │      │              │      │              │
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Supply chain`s actions in Product management – Product release process map