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Inventory Management in Buyer-Supplier Relationships
Case: XX

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The objective of this thesis was to gain an understanding of the buyer-supplier relationships and how they can be developed in the case company, XX Finland with some of their suppliers. There are needs to increase communication between the businesses as well as to improve the material flow and inventory control in the client company in order to minimize lead time violation orders and large order quantities that could cause hindrance in the supply chain. The main focus in improving the relationship is in increasing the effectiveness of the day to day operations that the case company experiences with its suppliers. The author's personal interest for this topic came from working as a materials specialist first as a summer intern in 2014 and later as a full-time-employee from 2.1.2015 onwards. In my job I have seen the need to find ways to improve the production flow and avoid line stoppages.

The scope of this research is limited to the manuals purchased from different printing companies as individual products that are required in the case company's final product to the customer. Even though manuals are a rather cheap investment individually, they play a vital role in the product portfolio.

The theoretical framework of this thesis is based on various approaches of materials management and factors affecting supplier-customer relationship.

This thesis is based on case study and the main research methodologies were researcher´s own observation and interviews to the employees at the client factory (General Electric Healthcare Finland) and its suppliers. During the research some new inventory control methods were tested and implemented which added an action-based research element to the thesis.

The main results of the thesis were new materials planning parameters for the user documentation sets that belong to XX's monitors and a new visual monitoring method to act as a safeguard for manuals under the Min-Max planning method, and their positive effect on purchasing schedules which further improved buyer-supplier relationships.

Keywords	Supplier Relationship Management, Purchasing Process, inventory control

Contents

Key Terms and Abbreviations

ASCP – Advanced Supply Chain Planning, an ORACLE-based program that is used to generate and release planned orders in XX

Bill of Material - or BOM, is the material ingredient list of everything that is required to assemble the final product. The list includes information such as the part number of the item, description, where it is obtained (supplier), how much does each unit cost, lead times and quantity required for assembly.

BPA – Blanket Purchase Agreement, a purchasing contract with a supplier containing specific products with already agreed upon prices.

DEMANTRA – a planning program used to generate the forecast to be used in the ASCP.

ECR (Efficient Consumer Response) - Strategy aimed to increase service to consumers by having the supply chain work together in close co-operation.

Enterprise Resource Planning (ERP) system refers to a company-wide information system for managing the company's operational and support processes, its administrative processes, its human resources, its materials resources and financial resources (van Weele, 256).

FAI – First Article Inspection, performed every time a new product or a new revision of an existing product is received for the first time in XX Finland.

Inventory Status Records - are used to contain the status of all items in the inventory, including on hand inventory and scheduled receipts (Gallego.)

Kanban is a production demand card used by the production line to signal the need for material to the lower tier production. The main principle behind pull-oriented production.

Lead Times - The definition of the amount of time it takes from placing the order to receiving the goods.

LTV – A Lead Time Violation occurs when an order is placed with a shorter timeframe than originally agreed with a supplier.

Master Production Schedule - or MPS, as its name suggests, a system of scheduling the incoming materials in a way which allows the production to operate smoothly. In essence, it is used to calculate how much of each item is required and when through using forecasts of expected orders, established customer/internal orders and safety stock requirements.

MRP Planning - Material Requirements Planning (or Master Resource Planning) is a computer based system used to help companies control their production plans and inventory levels. Generally, MRP's primary function in many companies is keeping the inventory levels as low as possible while also ensuring that there are adequate resources available when needed, and plan manufacturing activities, purchasing requirements and logistic schedules. Using these three component functions the MRP determines the future needs of production requirements using the basic formula of available inventory – demand = purchase requirements. MRP systems are often enhanced by extensions called Enterprise Resource Planning (ERP) systems.

JIT – Just in Time, also referred to as LEAN production. JIT Production is based on planned elimination of all waste and on continuous improvement (Benton, 2010:112)

SCOT - Supplied Customer On Time is XX's internal ECR calculator that shows the % of daily orders shipped successfully.

Supplier – A person or an entity that is the source of goods or services

1 Introduction

Materials management and procurement has remained the same for the majority of the 21st century. When looking at ways to improve production or increase savings, companies mostly focused on labour and capital investments. Historically, the management of materials and component parts was the most neglected element in the production process. However, lately companies have begun to take an interest in the materials procurement and it is nowadays seen as one of the most vital aspects in the supply chain. It is very likely that in the future, supply management is likely to contribute to profits more than any other function in the company (Benton, 2010, 4).

Material procurement is one of the most vital aspects in production; after all, without proper materials it is impossible for the manufacturing unit to produce final goods for the company to sell. Ever since Toyota implemented their Toyota Production System, later known as LEAN production, companies around the world have taken an interest in finding ways to improve their material flow to increase value of their product while also reducing waste and unnecessary costs.

Just-in-time production and other forms of pull oriented production processes emphasize the importance of the manufacturing floor receiving just the right amount of materials at the right time to ensure a steady flow throughout the supply chain with minimum defects and costs. This in turn has generated new challenges in the material management field to find ways to ensure constant material flow with no shortages.

During my time working for XX as a Materials Specialist, I often found myself facing challenges with the material flow that found their root-causes on various areas; inventory errors, poor communication with the supplier and material management errors were the most common causes of shortages that often led to either late deliveries to the customer or stopping the entire production. The closer we aim for Just-in-Time production, the smaller the margin of error becomes.

One of the main challenges that are often overlooked is the fact that every material is vital for the production to continue. A hospital anaesthesia monitor includes

hundreds of parts, some are worth thousands of euros and some cost less than a cent. One would think that ensuring the availability of the high-costing goods is a priority, but the monitor cannot be finished if even a single screw is missing. This creates a challenge that each part requires a material plan specifically tailored for its availability.

1.1 Objectives and Scope

Supplier and customer collaboration is often taken for granted in modern business world; as business theories have moved from the conservative view of ”every other company is a competitor” to a more joined-venture type of approach where the focus of the business has shifted to an optimized end result, which in turn has led to many companies seeking co-operation within their supply chain network. The modern approach is for businesses to aim for invested co-operation in order to produce a high-end product or service with minimized costs. However in the business world achieving co-operation can be a surprisingly challenging feat, as there are many unseen complications on the way be it official such as legal ramifications or ideological conflicts such as the companies having different values or strategies.

My thesis will focus on two parts; firstly to establish an understanding of the current relationship with XX and its supplier in question, how effective the current product planning methods are in relation to their respective products and how to improve the situation in order to develop the relationship with YY Oy and ZZ Offsetdruck Gmbh through new inventory control methods and planning parameters. These two paper printing companies were chosen because although their products are similar, there are a number of key differences such as their geographical locations and order processes.

Although the thesis research was commissioned by XX, the aim was to be as objective as possible to create a transparent understanding of the situation from both sides.

Therefore the objective of my thesis is to provide XX Finland with research regarding their current supplier relationship status with feasible processes on how they may increase their collaboration with a number of their suppliers in a way

that will hopefully have a positive effect on the supplier on time delivery and inventory control in a positive manner. The research will focus on two paper printing suppliers that XX has suggested as case studies for various reasons varying from a long-time partnership that has potential for improvement to concerns regarding another suppliers lead times and its effects on production reliability.

During my time working in XX from January 2015 onwards, I noticed that manuals were often at risk of running out on production. This placed the suppliers in a difficult position of constant order reschedule pulls or new orders created with a lead time violation, sometimes for the very same day the order was placed.

The target of this thesis is to study how can the supplier-customer relationship be improved with each company? And how would the methods used to improve the relationship reflect on the supplier on time delivery, quality of the supplied parts and overall equity in XX?

The approach on how to improve collaboration will largely depend on the supplier company in question and their current relationship with XX. It is often agreed that the initial requirement for a steady customer-supplier relationship lies on two principles; for the supplier to provide the requested goods on time and for customer to have all the payments paid on time. From there, the methods of improving relationships can be made from a more independent case perspective. As the payment groundwork has been settled with each company, it is time to look at them as individual cases and attempt to find an approach that will benefit both parties and henceforth improve the supplier-customer relationship (Axelsson, 2006).

1.2 Methodology

The research was a case study trying to investigate the effectiveness of the case company's inventory control and planning parameters. This thesis research is qualitative, with main focus on my own observations regarding the manuals procurement throughout the year as a Material Specialist and semi-structured interviews with the XX materials management personnel and with the chosen suppliers' production planning representatives. The interviewed people will remain

anonymous for confidential reasons. Interview questions can be found on appendices 1 and 2.

Due to the number of factors involved with how the case company views and operates with its suppliers, such as communication, the nature of the materials and transportation, a quantitative research may fail to generate an understanding of how inventory control could be used to further improve the buyer-supplier relationships. Therefore it was concluded that it would be more efficient to focus on a specific type of material and suppliers related to it. Primary information sources related to this research are interviews with the people in the case company and suppliers side, with my own personal experience and observations coupled with secondary source literature on the topic of inventory control and buyer-supplier relationships.

I interviewed two Materials Specialists in XX, one who works with manuals alongside me and another who used to work with the manuals before I joined the team. I interviewed the production manager from both supplier companies who are responsible for the manuals that XX orders from them. The interviews were open ended to encourage the interviewed people to provide their professional opinion on the current situation and to draw ideas for development. The interviews were conducted in the spring of 2015, with YY providing additional points throughout the year as new inventory control methods were implemented. These controls will be further explained in chapters 6 and 7.

One of the major limitations of this research is the sample size of suppliers – there are only two that are focused upon, YY Oy and ZZ Offsetdruck Gmbh. The main reason for keeping the list of suppliers small is twofold; firstly, manuals are essential for every shipment so looking at their supply chain can reveal answers for the larger production. Secondly, manuals are relatively cheap compared to other components and have a short lead time, which gave an ample chance to test out some inventory control methods.

Another challenge came from the small size of interviewees – although there are many members in the Materials team in XX, only a small handful of them had any experience with purchasing manuals. However, due to working with them in the

materials team there were good opportunities to learn the process of manuals purchasing thoroughly.

Another limitation that I faced in this research was that some of the buyer-supplier relationship improvement methods were not usable due to budget restraints – I could only focus my improvement actions inside XX's systems and operation model, I could not directly influence the Supplier's systems and actions.

This research can further be used with other products that are not included in direct forecasts, in other words on products that are not used in the manufacturing of the frame model of the final product but on materials used on the customization part of manufacturing, such as language stickers or electricity cables. However, it should be noted that some of the inventory control methods used and implemented in this case study have been designed for the suppliers in question. For other materials, a new look at the supplier relationships and current purchasing controls is recommended.

1.3 Case Company and its Suppliers

1.3.1 XX Finland

XX is a global company operating on a world-wide scale in hospital ranging from surgical equipment to after care and heart stress systems to MRI-machines. The Helsinki site of XX specializes in producing anesthesia modules to be used in surgery and patient after care monitoring and heart-stress monitors used in conjunction with treadmills and stress bikes. The facility in Helsinki hosts roughly 800 employees. These products and monitors are manufactured on the Helsinki Site and delivered across the world. The main parameter by which all XX sites, including Helsinki, are measured is the SCOT parameter – Supplied Customer on Time. This parameter is used to track the amount of customer shipments that have been sent from the manufacturing site on time. XX also applies an identical tool for its suppliers to track their shipments to XX to ensure that all orders are fulfilled on time.

1.3.2 YY Oy

YY is a family-managed paper press company which operates on a wide variety of printing press related areas; ranging from architect designs to posters and advertisement papers and boards. YY has facilities in Helsinki, Lappeenranta, Tampere, Kotka and Tallinn, Estonia. YY is one of the key suppliers of manuals and addendums that are used in all of monitors and machines manufactured in the XX Helsinki site.

Although YY has a number of clients all around Helsinki Area, it is apparent that it values XX as its client a great deal – they even have a separate XX contact email address for XX purchase orders. YY is located in Pitäjänmäki and delivers to XX Helsinki on an almost daily basis. The relationship between YY and XX Helsinki can be best described as key customer based relationship; much of YY's daily production is dedicated to XX Helsinki's needs, and makes for an excellent target for this thesis's subject of research due to its high impact on production and its convenient location for logistical purposes.

However, even with such a close relationship and geographical location, there are challenges that YY has faced. As of beginning of 2015, YY's On Time Delivery % has been around very close to 100%. However, with the extremely demanding quarter end, YY faced a serious issue with keeping up the OTD% due to challenges with production limitations. This drove in some tension between the two companies with GE using its power as a key customer to drive in their own deliveries with possible repercussions to YYs' overall customer base. Another challenge that has affected the OTD% over time has been the new product / new revisions on existing product implementations that have caused some confusion on YY's side regarding what to print. This has been a renewing problem and is one of the issues YY wishes to find a solution to in order to guarantee that they are able to maintain their high OTD score.

1.3.3 ZZ Offsetruck Gmbh

ZZ Offsetdruck is another manual supplier for XX Helsinki. Located in Freiburg, Germany ZZ is considerably further away from the Helsinki site than its colleague company YY. ZZ was added as a supplier for XX Finland when one of the pro-

duction lines, the “DCAR” was transferred from XX Freiburg to Finland. However, ZZ is nevertheless able to provide manuals with the same lead times as its Finnish colleague. The relationship between ZZ Offsetdruck and XX Helsinki is currently in the initial stage due to ZZ’s recent introduction to XX’s supplier list. ZZ Offsetdruck makes for an interesting comparison to YY due to it being almost complete opposite; a rather new addition as a supplier with little pre-established relations and located in Central Europe.

While ZZ Offsetdruck has proven itself to be capable to answer quickly to urgent demands, sometimes even with a days’ notice, the new revision process causes quite a bit of additional work on the XX side. According to the materials specialist responsible for purchasing the ZZ manuals

> The process of ordering FAI pieces can be very confusing and hard to keep track of if there are a number of different FAI orders happening at the same time. One of the main challenges is that since I am not responsible for communicating the FAI data packets to the ZZ team but the Sourcing team in India is, which means that I do not have a clear understanding of have they received the data packets, and when they will be sending the new revision manuals to us. They just sort of appear out of nowhere and then I’m expected to create a purchase order for them afterwards. Since the invoice for the FAI’s arrives afterwards, if there is a price difference compared to the old revision price that is used as the basis there is a real dilemma. We cannot reverse the order because the previous manuals have most likely been scrapped (disposed of) and we cannot change the inventory value to zero. (Materials Specialist in XX)

The usual solution in the above mentioned scenario is to order more of the material in question and cancel the FAI order afterwards to change the price and re-accept it again. However this is a rather confusing process, and is easily forgotten until the invoice expires and the financial team begins to look into the billings for unpaid invoices.

This process is overall very complicated and troublesome, thus generating not only excessive work for the XX Materials team, but also causing a potential strain between the companies as any possible mistakes will generate payment issues, which in turn disrupts the cash flow of the supplier.

1.3.4 WW Oy

WW is a family-run steel hardware store and importer that focuses on supplying its customers with industrial screws, bolts, metal sheets and other raw components that can be used in production. The order management with WW's screws and bolts which are used in large quantities in various production lines can be defined as "two box" system, which is a modified version of kanban warehousing procedure. Both of these terms will be explained in more detail later. WW also acts as an intermediary with XX's Materials Department when facing trouble finding importers or suppliers for one time purchases. Although the business relation can be described as "arms-length" due to the fact that WW does not provide XX with any critical items, their status as an intermediary means that they provide XX with exceptional supplier value in terms of procurement reliability and time saving. Since this thesis will be focused on manuals and their logistics aspects, WW will act as a reference point for some of the inventory control methods that are used successfully with them that could be implemented with the printing companies as well.

1.4 Current Situation of the buyer-supplier relationships

Although the day to day communication between XX Finland and its manual suppliers runs rather smoothly, there are a number of recurring problems that have a potential to cause hindrance in the deliveries and thus generating damage to both businesses involved.

For example, YY has raised the issue that often with new revisions with the manuals, it is unclear whether the new data packets truly contain the newest edition required by the customer. Thus, YY has to seek confirmation from XX on a number of occasions or to just blindly trust that the data packets are genuine, which they always are not. From XX's perspective, such problems generate potential business risks as if the new revision for a given product is of such caliber that older revisions are no longer usable, incorrect deliveries can mean that the received manuals have to be turned back to the supplier immediately which generates a negative effect on the inventory when available stock is not enough to match the demand of the final customers.

YY also has sometimes experienced hardships with supplying XX with User Documentation Sets, large manual binders used with the monitors, on time with large orders due to lacking resources.

One generally agreed upon way to improve supplier relationships is to have them more deeply involved with the production and the final product. That way, the supplier understands their importance in the supply chain. To take this approach one step further, it is suggested that the supplier to be involved in the product development and work side by side with the engineering department in order to express their views on the coming production changes and how feasible they are. This would also aid in driving down production costs as if the supplier can already in the planning stage express if something is impossible, an alternative option can be researched immediately without wasting time (Buttle, 2010).

2 Material Management Principles

Supply chain theories can be categorized into two major groups: push – and pull principles. These two aspects determine the company's production strategy, which can then be divided into smaller areas and methods. Push method, more traditional of the two principles focuses around maximizing company's production output and is based around the forecasted sales for a long period of time (Sakki, 2003, 29).

This system is often used by commodities that can be expected to have a very large customer base with very few competitors and small demand fluctuation. For example, in the Finnish market the Valio Rye-bread can be assumed to operate on the push principle; it is the most famous and in-demand of its peer products, and the bakery can be expected to run at full production capacity to push as much of the product to the market as possible. Pull method uses the forecast as well but mainly for planning purposes only. The actual production is determined by the confirmed sale of the final product, which triggers the demand for all the components required for its manufacturing. (Sakki, 2003, 29-30). The Pull principle can be seen most commonly on specially made products that have very few models on the open market and are manufactured against a customer order, such as luxury sports cars.

2.1 Push

The different principles are not only tied to the type of product, but to the actual production plan. As mentioned above, the push system relies heavily on the forecast to estimate the overall demand for the product. This is also reflected on the production, as the push system focuses on the different production stages to operate based on their forecast and “push” their components forward from different manufacturing positions to the next with the assumption that the next stage will have use for them. With the pull principle, the material moves only when a production workstation signals for a need of parts (Benton, 2010, 116).

The two principles also heavily influence how the business manufacturing the final product views its component and raw material suppliers. Companies following the push principle are more heavily inclined to have a large supplier base with which the customer business often engages in bidding and tethering discussions to drive the price of the components down by having the suppliers compete amongst themselves. (Benton, 2010, 116)

Although the push principle may seem a bit outdated and is primarily applied for products with very low demand fluctuation, many “pull” oriented manufacturing sites still use Materials Resource Planning to set a rough estimate of their future material needs. This enables them to ensure that even the goods with considerably longer lead times are flowing in continuously. (Benton, 2010, 116)

2.2 Pull

There are two basic principles when it comes to order management and scheduling, the push system and the pull system. Whereas the “push scheduling” system is based on the idea that the material planners schedule the incoming shipments according to a given time frame whether the production needs the shipments or not. This approach is based around the idea of growing stock and ensuring that there is always material available. The Just-In-Time scheduling is based on the process of “pull scheduling” dynamics, meaning that incoming shipments are scheduled based on the customer demands and expedited when the demand rises to a level where the currently scheduled incoming materials are not enough

to meet the demand. JIT is a set of principles, tools and techniques that allow a company to produce and deliver products in small quantities, with short lead times to meet specific customer needs (Liker, 2004, 23). Figure 1 shows the main elements of JIT production.

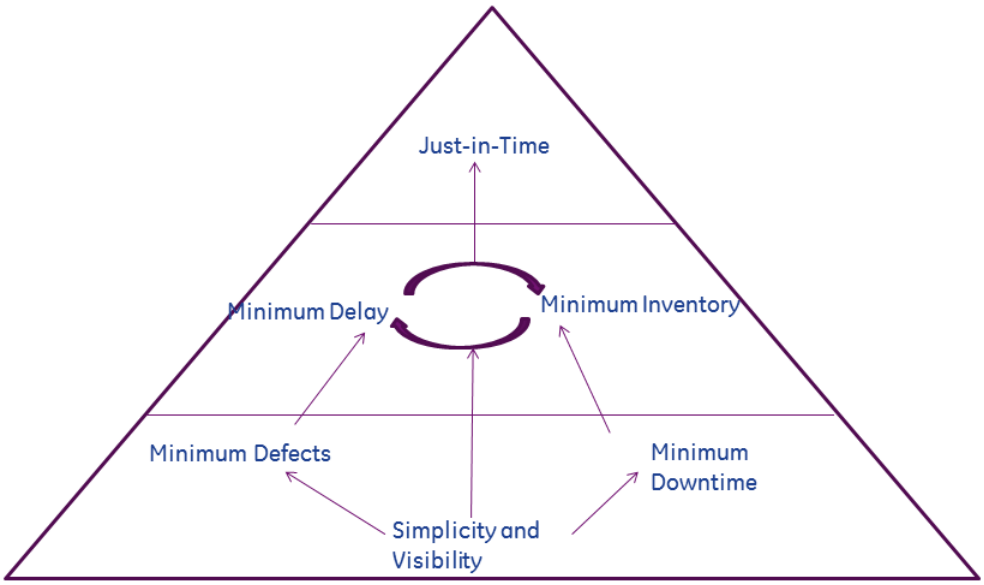

Figure 1. Key concepts of JIT production (Harrison, 2014, 226)

There are many attributes linked to JIT production, with simplicity and visibility being the base-line. One of the key challenges with JIT production and delivery aspect is synchronizing the lead times with the ordering process to ensure that the products are not received too soon, which causes a rise in inventory levels, or too late which creates a shortage and thus affects the company's ability to prepare the shipments on time. If there is a conflict of processes with delivery, it is always safer to schedule the delivery too soon, as high inventory can be evened out over time but a production hold up creates stress and increased goods demand on the long run.

In unison with the Efficient Customer Response parameters, XX places heavy focus on inventory level control on the site; due to warehouse limits and generated inventory costs, the on-site inventory is aimed to be kept at sufficiently low, with physical stock of roughly 3 days estimated demand. The Just in Time delivery performance principles are used to help keep the inventory levels under control and to ensure constant flow of materials in and out of site. With most of the materials required for production are planned with forecasted demands; the planning

experts estimate the expected sales of given products and input the estimates into the Advanced Supply Chain System (ASCP) in order to communicate to the Material Specialists the required purchases for the coming months. This planning method works well for materials that are used on the product regardless of customization, such as framework and hardware. For customized-dependent products such as manuals that are location dependent, a Minimum-Maximum planning is used, which will be explained in chapter 3.3.

However, many companies today have opted for some hybrid between the push- and pull principles in an attempt to maximize their production output but also reducing waste and non-value added actions in the production. This has led to a larger emphasis on buyer-supplier relations in order to satisfy the needs of the company in question.

2.3 Inventory Planning: Min-Max System

Inventory-level control systems are applications that support coordination between ordering and the level of inventory (Axelsson, 2006,180). There are a number of different inventory-level control systems from various forecasting systems to evenly spaced out standard orders and systems which generate a need for an order when the inventory parameters meet preset criteria. One of these inventory parameter related systems is the Min-Max planning system in use at XX. A Min-Max planning affects products which are dependent on some form of product customization and therefore significantly harder to estimate on forecasting. The Min-Max planning essentially revolves around the premise that the inventory control system keeps track of the number of pieces in stock and alerts the buyer when the inventory levels reach a certain point. This is shown in figure 2.

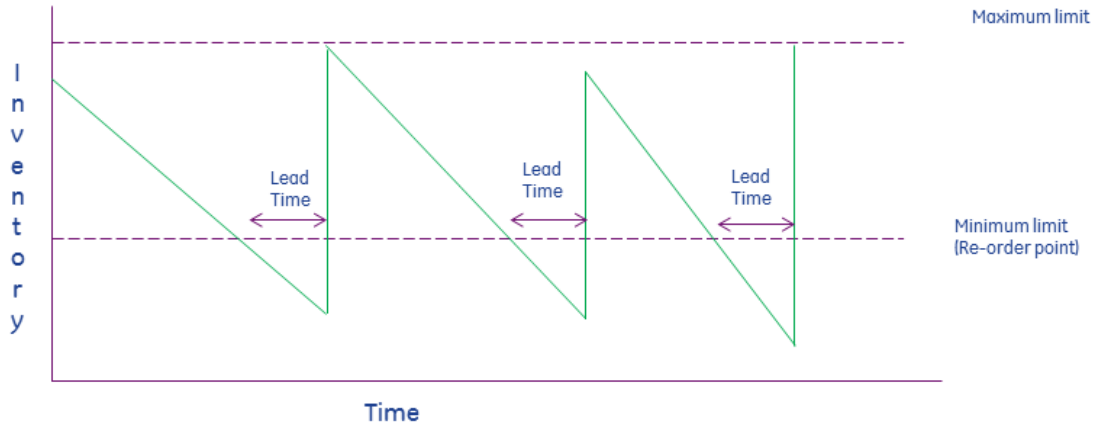

Figure 2.Visual representation of min-max control (Harrison, 2014, 215)

Let's take a Spanish Manual for an Anesthesia machine B450 as an example. Even though the sales estimates for B450 can be calculated, it is much harder to estimate how many of those sales will be sold to Spanish speaking countries. Therefore the manual for the B450 is set on min-max planning to ensure that there is minimum risk of ordering too many manuals with the sales estimates that would then negatively affect inventory values. The current stock of the manuals is 29 pieces, and the minimum limit for stock is 25. A sales order for 7 B450 machines to Barcelona is generated, so the need for seven Spanish manuals arises, dropping the available stock to 22. Since the available stock has fallen below the minimum limit, the system alerts the Materials Specialist that more manuals are needed at the site.

However the Min-Max planning comes with its own challenges; depending on the sales demand, it is important to ensure that the minimum limit for the manuals are kept at a level that enable the remaining stock to cover the demand while new manuals are being prepared. For bigger manual sets, the supplier has set the Lead Time (time for preparation + delivery to the site) to five days. If the Minimum-level for the manual is set to too low, the available inventory cannot supply the demand that is generated over the five days that cover the arrival of the new manual sets, thus leaving orders unfulfilled which in turn means that the entire order is incomplete and cannot be sent to the customer.

Another challenge the Min-Max planning presents is its unresponsiveness until the actual minimum level is reached. If the set minimum limit is at 30, and there are 31 pieces in stock, the system will not generate a new purchase order request until a new customer order comes in that will bring the inventory level to 30 or below. If the customer orders 50 units, the current stock will not be enough to fulfill the order until the supplier receives and fulfills a new order.

2.4 Kanban

Kanban is a scheduling method used to achieve JIT production by controlling the logistics chain from the production point of view, instead of the more traditional inventory control systems used. (Dictionary.com. 2011) Much like JIT, the Kanban system finds its roots from Toyota factories developed by Taiichi Ono. Kanban's roots originate from 1940's when Toyota was looking at transforming the supply methods used in supermarkets into their car manufacturing plants. This was achieved by using Kanban cards to signal the need from one point of production to another to ensure that every production point was well supplied. The most notable aspects that were transferred from the market management to production were the billboards which signaled when stock was running low for certain products and the "bin rotation" practice (Liker, 2004,23). See figure 3 for the basic principle of two-bin rotation system.

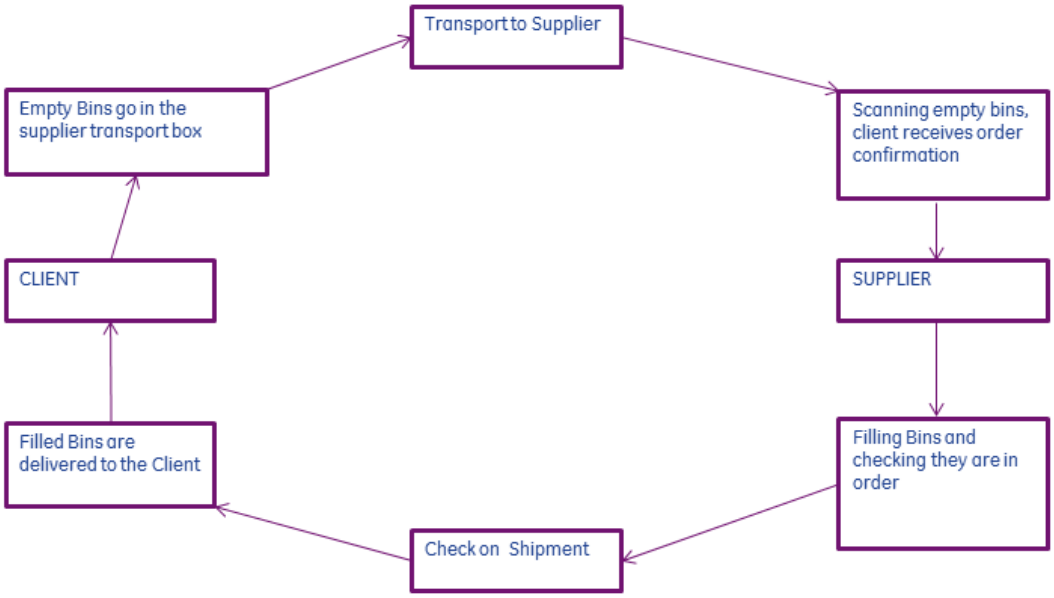

Figure 3. Basic principle of two-bin rotation system (www.kobout.com)

The bin rotation is a method that can be explained as follows; imagine you have three bins for lightbulbs that are used in the production of table lamps. One of these bins is located in production, one is located in the warehouse, and one bin is located at the supplier. Once the bin in the warehouse runs empty, the production picks a full bin from the warehouse and signals the supplier to send their bin into the warehouse, whilst the empty bin is sent to the supplier for refilling. This system ensures that there will always be one bin to keep the production running and one bin as a back-up. It is also possible to further strip down this process to two bins (one in production, one in warehouse) which places heavier emphasis on the supplier being able to provide a new full box on time and that the box capacity has been calculated to match with the production speed and delivery process of the new box to ensure there are no halts due to lacking resources. As with JIT, Kanban is used in a pull-based production plan where the production is driven by demand rather than forecast (push).

3 SCOR Model

The Supply Chain Organization Reference model (SCOR) is a framework developed by the Supply Chain Council. This particular framework is designed to help the company to understand its functions and overall logistics benchmarks by looking at five management processes. (Axelsson, 2006, 122). These processes are Plan, Source, Make, Deliver and Return and there are three different levels that the SCOR model utilizes:

Level 1: A broad definition of the plan, source, make, deliver and return management processes, which is used to set competitive objectives
Level 2: Defines core process categories that are possible scenarios of a supply chain (e.g. make to stock, make to order, engineer to order).
Level 3: Provides the process breakdown needed to describe each element that comprises the level 2 categories. Detailed performance metrics are set at this level (Harrison, 2014, 123).
SCOR Model is not only limited at looking at the functions within the company, but can be expanded to look at the supply chain on a wider perspective. Figure 4 below shows the basic framework of the SCOR model in a simplistic Supply Chain.

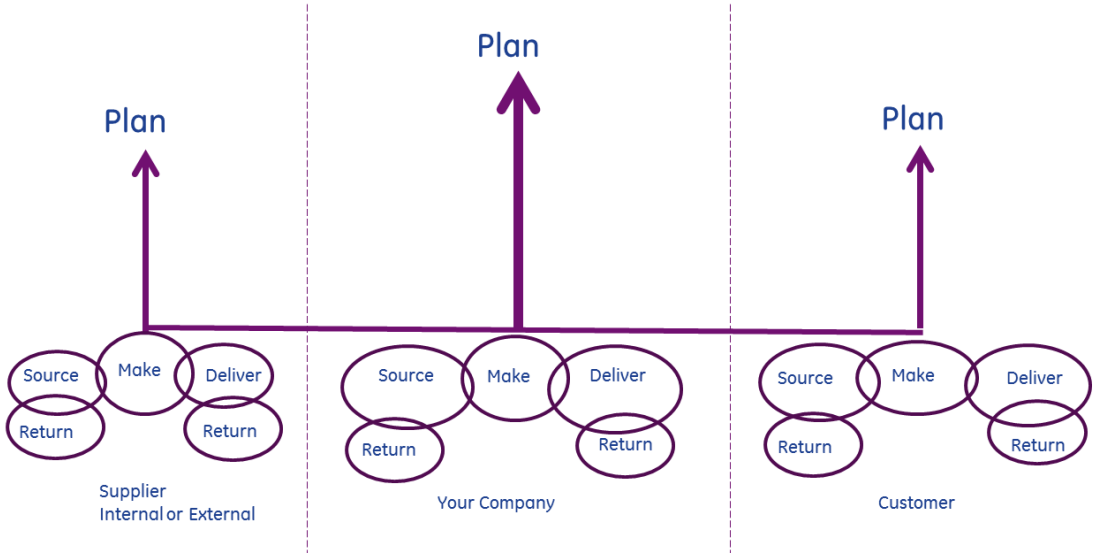

Figure 4. SCOR model in a simplistic Supply Chain framework (www.supply-chain.org)

Next I will explain how the SCOR model applies to the processes in XX´s supply chain:

The tasks of planning demand and supply set within an overall planning system that covers activities such as long-term capacity and resource planning. (Harrison, 2014,123) In context to XX, this refers to the activity of Material Planners calculating and scheduling the minimum requirements of when the materials have to arrive at the site in order to meet the production demand.

The task of material acquisition, set within an overall sourcing system that includes activities such as vendor, certification and vendor contracting. (Harrison, 2014,123) This activity is left to the Sourcing department at XX, who are responsible for finding suppliers for the required products, ensuring that they meet the required standards such as certain ISO certificates or FDA approvals and are responsible for setting up the contracts, prices and transportation methods.

The task of production execution, set within an overall production system that includes activities such as shop scheduling. Any added value activity (e.g. material repackaging at a distribution center; quality control at a production line) falls under this process type as well. (Harrison, 2014,123) This process and its responsibilities are divided upon a number of different departments within the company, depending on the type of activity at hand; quality related issues are left to the

Quality Assurance department, repackaging is done at the Distribution Center, shop scheduling is the responsibility of the production managers to ensure that their production can meet the demand.

The day-to-day tasks of managing demand, orders, warehouse and transportation, and installation and commissioning. These tasks are set within an overall delivery management system that includes order rules and management of delivery quantities. (Harrison, 2014, 123) This process is bound to the inbound logistics and is left mainly to the responsibility of the materials team, who are responsible for ensuring that incoming orders arrive within the expected timeframe so that the production does not go into a halt due to lacking supplies, and the incoming shipment department to receive the inbound materials and check that they conform to the set standards.

The return of non-conforming goods for replacement or rectification, and the recycling of materials no longer needed by the customer. (Harrison, 2014,123) This process is mainly the responsibility of the Receiving Department who, as described above, are responsible for checking that the incoming goods adhere to the set standards. In case the products are deemed non-conforming, they are set to a quarantined area where they cannot be picked and delivered to the production lines unless they have been cleared by the Quality Assurance team. If the products cannot be cleared, they will be claimed back to the supplier with the assistance of the Materials team.

The aim of the SCOR model is not to guide the company how to become the best in all its respective aspects, but rather understand its capabilities and limitations and where it’s differentiating opportunities lie. In essence, the SCOR model is a more detail driven SWOT analysis (Strengths, Weaknesses, Opportunities, and Threats). In XX’s terms, since a high emphasis is driven on Efficient Customer Response and low inventory values, it would be beneficial for XX to take a look at aspects such as lean thinking, waste reduction and efficient supplier management for on-time deliveries.

4 Buyer-Supplier Relationships

Empirical research in the area of buyer-supplier relationships has primarily sought to explain the nature of relationship processes rather than their effect on manufacturing or business performance. As a result, there is a considerable body of work focusing on the interaction between the various dimensions of buyer-supplier relationships such as trust, commitment, adaptation, communication and collaboration but far less on the impact of buyer-supplier relationship dimensions on manufacturing performance (De Koster et al, 2007, 109).

What de Koster and Delmann are implying is that the existing theory on buyer-supplier relationships are primarily focused on the communication between the two businesses and their improvement, and its effects on production planning has been overlooked. Michael Baudin (2004) reached the same conclusion, stating that the relationship perspective has received more attention in press and literature than the more technical aspects of lean logistics.

Lean supplier network can be categorized into the following six characteristics; a small number of direct suppliers with a tier structure, single sourcing for a single item, collaboration on product design and collaboration in cost reduction during production, collaboration in problem-solving and emergency response, and a community. The first point means that a small number of direct suppliers finds its roots with Toyota and Chrysler who both cut down their suppliers in the automotive business from multiple thousands down to a few hundred key suppliers who also took in more responsibility with assembling parts to be used at the clients manufacturing site. This first step underlines the importance that developing relationships with a large number of suppliers is close to impossible – the more suppliers you have, the more time and effort goes to developing the relationship with each. It is wiser to focus on a small number of key suppliers, which can then become the sole supplier of their respective parts, as marked by the second characteristic (Baudin, 2004, 45).

This will also enhance their importance in the supply-chain and transfer value down-stream to them (Benton, 2010, 112). This second stage, single source for a single item is also where most of the literature for buyer-supplier theory is aimed at; developing the relationship between the client and supplier in order to advance to the latter stages of Baudin's characteristics.

4.1 The Four Stages of Buyer-Supplier Relationships

The complexity of buyer-seller relations and the importance of communication, trust, mutual adaptation and co-operation cannot be implemented in a single step, but the whole progress must be divided into different phases. While the terms of these stages differ from writer to writer, the main emphasis of each stage can be labeled as Pre-Relationship Stage, The Early Stage, The Development Stage and the Long-Term stage (De Koster et al, 2007,109).

The Pre-Relationship stage is the very first step in supplier sourcing – choosing the supplier company with whom to do business with. This phase places heavy emphasis on proper information communication – both formal and informal in order to gain understanding of both parties' business strategies and values, and finding how they interconnect. Toyota, the pioneer of LEAN production had a very high level of entry for new suppliers who had to prove their commitment to Toyota's high performance standards for quality, cost and delivery before they were considered moving forward into the Early and Development stages (Liker, 2004, 202).

The Early Stage of Buyer-Supplier relationships can be viewed as the beginning of the two companies doing business with one another; first orders are placed in and the quality of the delivered goods is tested in order to ensure that the supplier is capable of the agreed quality. The agreed delivery times are monitored as well from this point onwards to see that the supplier is prepared to commit to the customer business's needs, and that the customer gives a reasonable time-fence for fulfilling the orders (Liker, 2004, 202).

Once the key suppliers for each part have been identified, the two businesses can embark on collaboration with the product design. With a single supplier whose source of business has been guaranteed, it is much easier for the two companies to begin co-operative design work on the components and their effect on the final product (Baudin, 2004, 46).

If for example, an automotive company wants to ensure that their cars exhaustion systems CO2 emissions are cut down by 10%, it is much easier to create and implement the design changes to the components when the companies have

done business together for a prolonged time and have an understanding of each other's values and business cultures, rather than beginning from scratch and collecting bids and design ideas from a large number of possible suppliers. Another advantage of a single source supplier comes with the collaboration and cost reduction during production – once the day to day business operations have become smooth and efficient, the two companies can begin to work on improving these operations to find ways to improve quality and lower the total costs, thus bringing about a better final product with better value to the supplier (Baudin, 2004, 45).

Collaboration in problem-solving and emergency response is something you can expect when the two businesses have established a relationship of mutual respect and recognize each other's impact on their respective businesses. If the supplier has a problem, they are more likely to be open about it to their key customer and less likely to try and hide it until it is too late and shipments are at risk. If the client hears about the issue with ample warning time, this will give them time to readjust their production planning around the possible shortage. Similarly, if the client business has insight on a potential large demand, they are more likely to communicate this to their key suppliers well ahead of time, or when it is not even confirmed yet, just to give their supplier ample amount of time to prepare. (Materials Specialist, XX)

4.2 Other approaches to buyer-supplier relationship development

There are a number of possible buyer-supplier relationship approaches that the experts agree have proven to work. For example changing the payment system to an incentive based payment, where the supplier would be paid an agreed sum depending on the quality of their product. Should the supply batch contain units that were discarded from manufacturing, the supplier would lose a certain amount from their payments due. If the whole batch cleared through, the supplier would be paid the agreed sum and an incentive bonus to keep up their quality base. (Axelsson,2006,122). However, this method does have potential to damage the day to day business activities between the two companies if disagreements about payments should arise, which in turn would greatly hinder the progress of the relationship.

Another agreed upon approach is to provide the supplier with a quarterly forecast to ensure that even with the lack of communication, the supplier has an overall understanding of how much will be demanded from them over the coming months. (Buttle, 2010). This comes with a challenge in itself however – the quarterly forecast should be as accurate as it possibly can in regards to how much the supplier is expected to provide. If the forecast is too low, the supplier's output will not be enough to match the demand. In a quarterly review based operation system, companies often attempt to cut down their inventory levels in order to appear more successful to their investors. This can lead to complications with the suppliers if the incoming supply is greater than the expected sales; the customer company can attempt to either cancel or delay the incoming shipments from the supplier in order to control its inventory value, which can be very troublesome for the supplier.

5 Production Process in XX

The production process in XX is a multi-functional process that involves a number of phases handled by different operating units. The production process can be divided into the following categories; planning, purchasing, manufacturing, customization, packaging and shipping. The production process is measured by the SCOT parameter, which measures XX's ability to meet the customers demand date with a fully equipped order.

The ERP system used in XX is the ORACLE system. The Oracle system allows for the control of MRP, Master Resource Planning, ASCP Advanced Supply Chain planning, direct and indirect purchases of materials used for the production of the goods as well as non-stockable materials used in indirect production (for example, drills for the production lines and gases for calibration purposes.) Other functions in Oracle include Inventory supervision and engineering Bills of Material. Through Oracle, the Materials Specialist (the buyer) can generate and launch purchase orders to their supplier.

5.1 Planning

The first stage of the production process, planning, is the only non-responsive function that is not initially affected by a customer order pull; planning involves predicting the possible customer orders and calculating the material required for the production to be able to meet the customer demand on a given timeframe. This is usually done one a quarterly basis on the grand scale with weekly requirements as the more definitive variable. Planning is done by investigating the trends of the previous years to find the possible peaks a particular product may experience and by analyzing customer order history. Also, if the marketing team has information to share on a possible large scale deal they inform the planning department to prepare for a possible increase in demand. Planners input the calculations on the DEMANTRA program which communicates the information to the ASCP program used by the purchasing team. Planners are also responsible for keeping the BOM files updated to ensure that each product communicates the proper material needs to the purchasers.

5.2 Purchasing

Once the Planners have updated the production demand to the DEMANTRA database, the purchasing team can see the new requirements on the ASCP program as either new orders or recommendations to reschedule existing purchases in (to avoid material shortage) or out (to avoid inventory overload). It is the Purchasing team's responsibility to ensure that there are sufficient materials to maintain production without production lines experiencing downtime due to material shortage. The Purchasing team will generate orders for their suppliers in either Blanket Purchase Agreement form or Standard Purchase Agreement form, as described below. The overall Purchasing Process can be seen in figure 5.

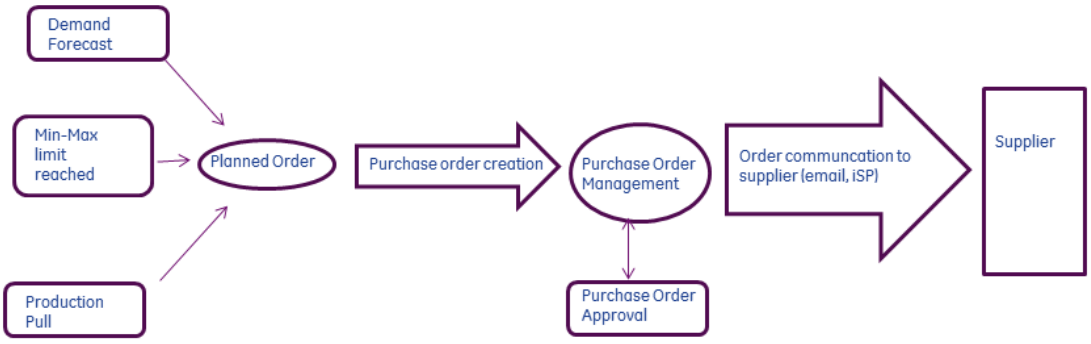

Figure 5. Purchasing Process in XX (from the XX database, details omitted)

If there is demand that planners were unable to predict, it will still show in the ASCP (Planned order in figure 5). Once the order has been registered in the system, although this does not necessarily mean that the purchasing department will be able to acquire all the required materials as some materials can have a larger lead time than the customer order.

The Purchasing team is also responsible for the materials that cannot be planned, such as the manuals which this thesis is focusing on. The forecast calculations can predict the incoming demand for products, but it is not efficient enough to forecast the customization requirements such, as language options that the products will require. The materials that are tied into the customization part of the process are most often kept on the Min-Max planning system that requires more material to be kept in the physical inventory due to its more limited demand forecast.

5.3 Purchase Orders

There are two ways to generate a purchase order for direct purchases (purchase products that have their own item code and are virtually tracked in the inventory.) The Standard Purchase Order (SPO) is the more common of the two. The SPO is used for items and suppliers that have no long term agreement set between the supplier and buyer companies, and thus are priced depending on current market value of the products. The SPO is therefore ideally used when the parts in question are not ordered constantly or if the supplier has not entered into a long term agreement with XX.

Blanket Purchase Agreement is used with suppliers who have entered into a long term supplying agreement with XX. The BPA's resemble Standard Purchase Orders with the major exception that the BPA's have all the item codes embedded onto their logs; if the item requested cannot be found from BPA's item list, it cannot be ordered through the BPA. Another difference is that unlike with a Standard PO, since BPA is based on a long-term agreement with the supplier the price for the item has been embedded into the BPA and generally cannot be changed.

5.4 Communication channel between XX and its Suppliers

Collaborative Platforms are applications that support post- and pre-purchase communication between the supplier and customer (Axelsson, 2006, 178). There are various collaborative platform systems, and the system in question with XX and its suppliers is ISP. ISP is an internet-based collaborative platform that enables the information flow of new purchase orders from XX's Materials department to appear directly at the supplier's systems without a need for separate notifications such as an email. Through ISP, the Supplier receives direct information regarding what is ordered, the quantity, and when it is expected to arrive at XX site. Through the ISP the supplier can also acknowledge the purchase order and send a confirmation to XX's Oracle system which will then show the buyer when the supplier has promised to deliver the said order. It should be noted that not all suppliers are equipped with the ISP system; some suppliers still require to be

contacted separately every time a new order is issued for them. (Materials Specialist, XX)

5.5 Collaborative Product Development Platform

The Collaborative Product Development Platform is a system which supports spatially distributed communication in product development projects (Axelsson, 2006, 178). The AGILE program is another internet based program that is used to communicate both within the XX personnel and between XX and its suppliers. Whereas the ISP is used to communicate purchase orders, the AGILE program is designated to communicate possible changes in the product such as a new component in hardware or a new manual revision, or an entirely new product. Through this program the supplier can be notified of these changes and once the supplier has confirmed their approval of these changes, the production of the new product/revision may begin. This process will be described in more detail in FAI/Revisions subsection.

5.6 FAI orders / New Revisions

When engineering department releases a new product, the components in its Bill of Material (BOM) are communicated to their respective suppliers in Supplier Change Notification (SCN) where the specifications for the product part are listed which the supplier is expected to provide to XX. It is often the responsibility of the Materials Specialist or Planner to communicate the change and the specifications of the new product or new revision to the supplier through the Agile application. From the application, the Materials Specialist or Planner extracts the data packets describing the new specifications and communicates them to the supplier through chosen means, be it email or any cloud-based program.

Once the supplier has prepared their first batch of the new product and it has been delivered to the XX site, a First Article Inspection (FAI) is performed to the part to ensure that the specifications required by engineering are met. If for some reason the product does not pass the FAI inspection, it is sent back to the supplier and the engineering team revises the product plan. As shown on the figure 6,

this is something everyone wishes to avoid since not only does it require additional resources to drive the alterations through, the costs increase significantly.

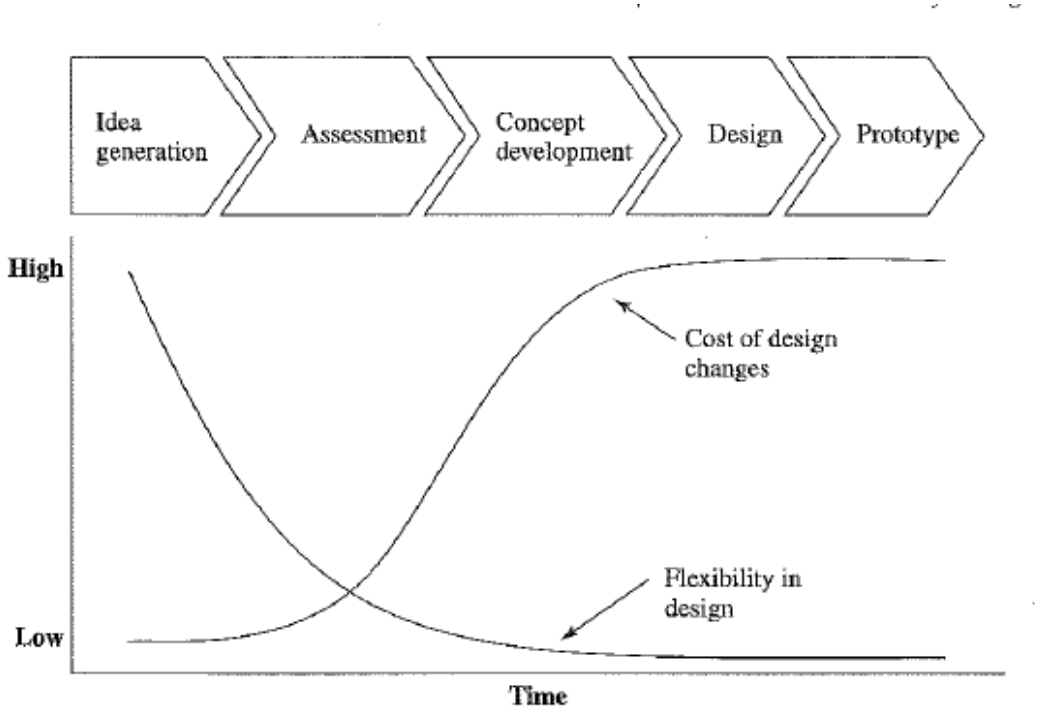

Figure 6. Displaying the FAI variable change (Bowersox et al, 2007, 87)

Once the product has been cleared from inspection, the supplier is informed that the new product has been approved and further deliveries can be resumed. The same principle applies with new revisions for a pre-existing product, except after the FAI inspection has been completed, the older versions are either scrapped or kept in production depending on the degree of change from old revision to the new one.

6 Case Studies

In this chapter, I will explain the main areas of improvement that I found while working as a Materials Specialist. This chapter is mainly based on my own observations, but the people interviewed, especially in the YY also agreed on these issues. The division of manuals into different sections (addendums, manuals and user documentation sets) came from the interviews with the YY representative who stated that each type faced its own unique challenges.

6.1 Importance of lead time

The term Lead Time from logistics point of view refers to the time it takes to produce the item in question and delivering it to the end customer. Lead times greatly vary from supplier to supplier depending on a number of variables, most notably regarding the size/complexity of the product in question, the distance between supplier and customer and the established methods of transportation used. For example the lead time for copper wiring from China from two different suppliers can vary greatly depending on the agreed method of transportation; for one supplier, the lead time could be 20 days (10 days for production, 10 days for transportation) whereas the other suppliers lead time may be only 15 days (10 days production, 5 days transportation) if they use a faster (and albeit more expensive) method of transportation. One major challenge for the Materials Specialist responsible for production purchasing is to synchronize the scheduling of incoming materials from around the world to ensure that none of the products appear too late as the entire production faces a halt if even a single part product is late from delivery.

6.2 YY Addendums and Small Manuals

Since YY is conveniently located less than 10km away from the XX Helsinki site, it would make for an excellent candidate to test out Kanban approach with in regards to specific produced items. Naturally, the larger manuals such as User Documentation Sets which are physically full A4 binders cannot realistically be used in a bin-rotation system, but various language addendums which are only 1 page printouts could very well be implemented into a Kanban system. For exam-

ple, at the current moment the ordering of addendums is done by the way of min-max planning.

Table 1. “High runners” of the Addendums in XX

CODE	DESCRIPTION	LEAD TIME	ALERT LEVEL
20683XXXX	ADDENDUM, XXXXXXXXXXXXXXXXXXXXXXXXXX	6	709
M122XXXX	Addendum, XXXXXXXXXXXXXXXXXXXXXXXXXX	5	407
20XXXXX1	XXXADDENDUM, MULTILINGUAL	7	232
M1XXX123	MANUAL,XXXXXXXXXXXXXXXXXXXXXXXXXX	5	131
206XXXXX	ADDENDUM, XXXXXXXXXXXXXXXXXXXXXXXXXX	5	91
206XXASX	ADDENDUM, XXXXXXXXXXXXXXXXXXXXXXXXXX	5	90
206AAAAA	ADDENDUM XXXXXXXXXXXXXXXXXXXXXXXXXX	5	89
M1AAA123	MANUAL, XXXXXXXXXXXXXXXXXXXXXXXXXX	5	87

Table 1 shows some of the “high runners” of the Addendums in XX and their currently set alert levels when the materials specialist is alerted to make a new purchase. (Due to the sensitive nature of the information presented, the codes and language specifications have been censored). Although this system works fine for the majority of the time, it is open to a number of potential risks; naturally, since the system only alerts the materials specialist at a certain level, there is always a possibility that the alert level is set to such a state that the current available addendums will be used up before a new order arrives, which has a standard lead time of three working days, plus one day for delivery and one for receiving actions. Also, there is always the possibility of human error, in other words the materials specialist may overlook the order and react too slowly on it, again risking production halt.

The biggest challenge (and risk) this system faces however is potential inventory mishap in physical world vs. electronic world. It is not unknown for production parts to be discarded without proper documentation (or they simply get lost) which will lead to a difference between electronic inventory levels and physical inventory levels. This has a potential risk of the physical stock running to the alert

level without the system actually notifying the materials specialist of the need for new purchase order, which could potentially lead to a three day halt in the production line.

However, with the Kanban system these risks could be mitigated. Let's assume for example that the standard demand for German addendums is 100 pieces a week, and that the bins in question hold between 80 and 100 addendums. With a three bin system, once the first bin runs low the already available bin would allow for a weeks´ worth of production, with the another bin supplied by YY another week. If XX and the suppliers expand this solution to all the different language addendums this will allow for more reliability on both parties with reduced stress on the supplier.

Not only does this allow for the production to run smoothly, it allows more than the current three day limit for YY to replenish the emptied bin, which in turn would allow for YY to focus more on the more pressing orders they have that require immediate attention. Also, since the monetary value of the addendums is on the very low end, this approach would not have a noticeable impact on inventory levels. However, there is still a challenge when it comes to new revisions; in roughly half of the revisions set on addendums or manuals, the change is of such caliber that once implemented, the old ones are no longer usable and must therefore be thrown away.

However, this situation would challenge mostly communication between the supplier and client; in the dawning of a new revision which would result in discarding of the older ones, the customer would have to notify the supplier of the new revision well ahead on time. Then, once the next empty bin arrives it will be fulfilled with the newer revision and sent to the customer. The customer still has one or two weeks of stock to get rid of before finally implementing the new revision. If successful, this approach would give XX plenty of time to make use of the older revision before implementing the new one and discarding whatever was left over after the two weeks.

6.3 Manuals in Min-Max Planning

Since most of the manuals cannot be implemented in to the Master Resource Planning due to their fluctuating demand and language restrictions, XX is forced to keep them in Min-Max planning. However, as described earlier, Min-Max has a number of limitations that can potentially have negative effect on the production process and the SCOT percentage. These limitations include the unresponsiveness until the inventory reaches its minimal level and vulnerability to cause shortages in production if a large customer order is placed. Due to their irregular demand, it is also possible that there will be inventory errors if these manuals are not checked on a regular pace; if a box of 20 manuals goes missing, it will not be recognized until there are no more manuals physically left. This again has potential to cause significant production shortage if the unaccounted missing amount prevents the Min-Max planning from releasing a new purchase order.

6.4 User Documentation Sets

As established earlier in the description, YY provides XX Finland with almost all of its paper instruction / manual needs for their products. One of the most important business segments for YY is providing XX with User Documentation sets for monitors which are very extensive instruction manuals for the end-users on how to operate each function of the medical system in use. These manuals are of exceptional importance to the Supplier due to their monetary value in relationship to the other products. However, these manuals also require the most of physical work on the supplier side (Printing process + book binding + packing) and thus have a longer lead time than other manuals.

Recently, the demand for these larger documentation sets has grown which has caused quite a bit of a stress on the supplier to be able to respond to the demand (YY Representative). In a number of cases the workload has been of such caliber that the Supplier has been having trouble staying with the agreed five day lead times, thus creating an On Time Delivery risk both on their own accord, as well as XX's in respect to the end user. In order to prevent any such issues from continuously arising, something must be changed. Unfortunately due to the production time limits and physical restrictions, Kanban approach cannot be used in this instance; the documentation sets are of such size that 36 pieces take up the

space of one full Euro Pallet (120x100x180 cm). This, combined with language multiplier creates a warehouse area demand that is practically impossible to implement both on the supplier and client sites.

Also, a simple increase in inventory levels at XX site is not a wise solution; not only does a single extra pallet of 36 pieces cost roughly around 2,100€ extra for each language, not to mention the physical limitations of storing additional pallets in a warehouse that has been designed for quick inventory turnover.

6.5 New Products / New Revisions

With both suppliers there are a number of issues regarding the communication and process when it comes to the implementation of new products or updating the revision of an existing product. In the case of YY, there is the issue of communicating the data packets with proper information, and for larger data packets a sustainable channel needs to be found when the data packet is too large to fit in an email attachment.

With ZZ Offsetdruck, the issue is much more convoluted: First off, there is no issue with the data packets. As ZZ produces the manuals to the production line that was transferred from Germany to Finland, the communication principles that were in effect with the XX Germany site are still in effect; the sourcing team manages the data packet transfer to the supplier, so the materials team does not have to focus on that. Although there is a different team that communicates the data packets to ZZ, there is another issue with their process; ZZ prefers to send the new versions of the manuals before-hand and have the purchasing representative create the purchase order afterwards, the issue is more complicated. This method is very time consuming, as the manual cannot be processed by the language department until there is a purchase order, so if the materials buyer is busy or misses the email about the new manual, the process can be delayed by days. Also, as ZZ keeps one of the manuals as their own reference for future printing jobs but writes the invoice for two, the buyer needs to create an order for two pieces and then manually delete the other from the system to ensure that the inventory levels are kept in order (ZZ representative).

7 Conclusion

There are a number of solutions that were implemented during the autumn of 2015 as the result of observing the most common challenges in the manuals purchasing process and from the supplier feedback. These changes within XX factory site that not only helped with inventory control, but additionally helped with improving the relations with the suppliers due to more efficient and less troublesome day to day operations and order amounts or sizes. With the improved inventory control, I saw a major decrease in having to place last minute orders or requesting drastic order rescheduling with the suppliers. The new development solutions which were implemented as a result of this research are presented in the following chapters.

7.1 Manuals in Min-Max Planning

The easiest solution for this would be to change the planning parameters so that the minimum level is set to a much higher level. From example, a Korean manual has its minimum level changed from 30 to 100. This alone does not create much of a monetary addition to inventory value, so its effects are negligible. However, when considering that there are close to a hundred active manual codes in Min-Max planning, the increase would definitely show in inventory value and also create an issue on the physical inventory side, so this solution is not feasible.

Another solution which we decided to implement was to increase the visual observation of the manuals in physical form, rather than rely on the system's information. Since the smaller manuals are located at the production lines where they are packed with the modules and monitors, unlike the larger user documentation sets that are stored in their individual packages, we installed an alert flag which the production workers could lift up when the physical level of the manuals fell below 20 units. This would then alert the Material Specialist responsible for the manuals when they would walk past the production line, which they do every day. The production workers would mark the manuals in question with two stickers; red and yellow. When the Material Specialist checks the alerted manuals, he/she removes the red sticker to indicate that the manual quantity has been inspected and that the manuals have been marked down for a new purchase order. See an example in figure 7.

Figure 7. A visual monitoring practice for manuals

Once this has been done, the Materials Specialist takes down the flag and the production team lifts it again in the event of next possible shortage. Although there is no numerical data, it is estimated that this method has reduced the risk of production stoppage by around 80%. The risk of large customer orders still exists, but they are a much rarer risk than inventory error. (Materials Specialist)

7.2 User Documentation Sets

Upon closer look at the current user documentation set setups in the Oracle system it is clear to see a distinct problem; the min-max alert level has been set too low on a large number of documentation sets, especially on the English, French and German languages which are the high-runner products. For example, originally the English set was set on the alert level of 35, equaling one full platform. However, calculations over the usage of six months proved the daily usage to be around 10 pieces, meaning that after the new purchase proposal was formed, the remaining stock would last roughly three days before running out. As the supplier production time for the documentation set is five days plus one day for delivery and incoming inspection, this meant that there was a major risk of having no stock for almost five days, creating a major delivery shortage risk. On high sales weeks, the remaining stock was depleted on the same day as the new purchase proposal was created, creating even more of a drop.

Table 2. Current Purchasing setups for User Documentation Sets

Item	Description	Min_Min	Fixed_Lot	Total Lead Time	Current Minimum	Cal. Min +5
206XXX	USER DOCUMENTATION SET X	35	72	7	140	240
206XXX	USER DOCUMENTATION SET X	10	20	7	41	70
206XXX	USER DOCUMENTATION SET X	4	8	7	38	64
206XXX	USER DOCUMENTATION SET X	6	16	7	35	60
206XXX	USER DOCUMENTATION SET X	10	24	7	22	39

Table 2 lists the current settings used for the high running user documentation sets and the calculated new limits that would ensure the availability of the products even on high peak periods. However, as mentioned above 36pieces of one language equals one full platform with a height of 180cm. Thus, the calculated values cannot be implemented due to physical inventory restrictions because even with one language set XX would have to find space for two platforms, more so for the high runner English language set which would require seven platforms of manuals available at all times.

Due to the physical limitations, it is safe to say that the parameters for Min-Max planning method are unobtainable. In fact, the entire planning method may be wrong for these items due to their high usage, which was emitted from the table above for legal reasons. After discussing the matter with the Materials Leader of XX and the Production Representative of YY, we came to the conclusion that a new planning method would be implemented for the high runner user doc sets. We chose to set the high runners on MRP-planning system which calculated the average usage of the user documentation sets from the past and developed a sales forecast, allowing for the materials specialist to see the expected demand on the ASCP system and to respond accordingly. Also, as a fail-safe, we decided to set safety stock records for the manuals which would trigger a purchase order requisition even if the forecast showed low sales estimates. After the initial rise of purchase orders for YY (due to the new higher safety stock / Min-Max levels) the ordering process has smoothed down thanks to the inventory levels allowing for more flexible production processes from YY. If the Kanban approach can be implemented as well, this should leave YY even more flexibility and resources to answer to the more demanding orders which include book binding and manual labour.

7.3 New Revision / New Item issue

From the interview with the YY representative, it became apparent that one of the major issues that YY faces are the new revision orders it receives from XX. There have been cases where the revision data packets that they have been supplied with have not been correct, causing them to print wrong revisions which in turn have been rejected by the client. This has often led to a new data packet being communicated and a new shipment that has to be completed quickly, otherwise facing the risk of having an unhappy client due to them being unable to ship to the end user on time. This also creates tension on their end because they have to re-prioritize the work orders. According to the YY representative:

> "The root cause of these troubles is the fact that there is no proof that the data inside the data pack is actually the newest revision. All that we have is the data pack name (which the materials specialist types in) that tells us what it is. If that is incorrect, we have no way of knowing until it's too late."

In this case, it is clear that the root cause is lack of information on the data packets which causes the unnecessary additional work and wrong shipments. This issue should be taken up with the engineering team in XX to implement an additional line or description into the information inside the data pack to verify which revision data is included.

With ZZ Offsetdruck, the solution is not as simple. As explained before, ZZ prefers to send the new manuals beforehand to XX and the materials buyer creates a PO afterwards. The major issue is with the pricing, which is often done based on the previous revision, and altered afterwards if changed. This could be handled by having ZZ communicate the invoice beforehand to the materials buyer to ensure that they are aware of the correct price, rather than sending it afterwards as is the normal procedure. Also, it would be wise that instead of creating a purchase order for two manuals and later deleting one, the procedure could be changed so that the purchase order will be made for one manual, and the one staying with ZZ would be written off as an additional expense. One last possible approach would be to send the new manuals only when ordered; this would lessen the logistics cost as sometimes the single manual is the only shipment for the day. This however would require that there would be almost zero possibility that the data packets would provide false information, as then the entire shipment would be faulty.

If we are to consider the basic theory of JIT-production, all of XX's manual needs should be supported by a single supplier. Due to the already established relationship with XX and their more convenient location, it would make sense to transfer all of the manual manufacturing to YY. Not only would this solution cut down on the transportation costs, but it would serve as an establishment to further involve YY with design collaboration and further solidify their position as a key supplier.

7.4 Summary

It is stated in a number of supplier management sources that one of the key aspects that are required for supplier – client relationship to develop is to make the day to day operations run as smooth as possible. This includes purchase orders, deliveries, and payment (www.supplymanagement.com). Until these are fulfilled to the best of their abilities, it is very challenging for the two companies to consider moving forward in the business relationship sense; after all, why would companies want to form more strategic relations between each other if they cannot trust each other on the basic level? Michael Koploy (2011) argues on The Strongest Link website that also in order to improve supplier relations, companies ought to look away from Key Performance Indicators and more to create a closer personal relationship first; after the companies have understanding of each other's goals and strategies, can the KPI and the "carrot and stick" approach be implemented .

Although the communication between XX Finland and its suppliers is rather frequent and possible mishaps are taken care of in a fast manner, unless the root causes of the problems are tended to there will not be viable chances of improvement in the future. This includes actions from both parties; with YY, there is a need for setting up new implementations with the XX engineering department to allow more information on the data packets. Regarding the manual purchases, the larger user documentation sets have been set on a new MRP program that created a momentary increase in demand while building more sustainable safety stock, but now the purchasing frequency has calmed down and more flexibility has been obtained.

Looking at the supply chain function from the manuals perspective, it seems that the operation falls to level 1 on the SCOR model. Although there are performance measurement indicators that are implemented at level 3, it could be a good idea to take a step back and look at the core process elements as defined in level 2. Currently, all the manuals are manufactured against the purchase order, and the lead times are defined by this process. Considering that the majority of the purchases orders are for the high running language options such as English, German, Chinese and French, some different approaches could be considered for the user documentation sets and manuals for these languages. For example, if XX would negotiate a new proposal with the suppliers to have them prepare a set amount of the manuals as make to stock on the supplier's end, lead times could be diminished by 1 day which is the printing process. With the User Documentation Sets that take up physical space, the make to order would not have to be complete; there could be an agreed amount of papers printed ready for the languages that are then prepared to binders when an order comes in. With this, the Kanban system that is in use with WW could be easy to implement with the manuals and addendums.

The Kanban approach would assist further with the two/three bin system for one page addendums which could be billed on a monthly basis like the screws and bolts with the supplier WW. This would allow for a more flexible purchase and delivery process with the high runner addendums that technically be produced within a day. It is unfortunate that we were not able to implement the two bin rotation system to test out its effectiveness in action. Main argument against this process was that the two bin system is profitable with WW due to the sheer volume of different screws and bolts that are included in the bin process. With the addendums and manuals, there would be less than 100 codes in the bin rotation, and due to their uneven usage rate there would only be a handful of manuals actively used in the bin rotation. The difficulty of organizing new revision implementations also further complicated the feasibility of this approach.

With ZZ Offsetdruck, there are a few actions that could be implemented to help with the FAI process. As of right now, whenever a new revision or a new product is released, ZZ prints out two copies and ships one copy to XX and bills for the both. While this is not an issue, it can be a challenge when revision prices change; since the invoice is sent afterwards, sometimes the prices cannot be

changed in the purchase order if the shipment has been accepted and the order closed. In order to fix this, sometimes a new purchase must be made because the inventory levels cannot be altered. This causes unnecessary work for both the finance, materials and receiving departments.

If ZZ could either send updated prices or the invoice together with the shipment, the changes could be implemented before closing the order. However, taking into account the fact that the product in question is manuals and ZZ Offsetdruck does not meet the qualifications of being considered a “strategic” supplier, there is very little incentive to keep ordering manuals all the way from Germany. By moving the products to a local supplier XX would see major savings, especially in the logistics cost as the price of transportation can be considered bigger than the product itself.

If these changes can also be implemented, the day to day operations between XX and its suppliers should be taken to a level that further improvements on the relationship between the companies can be improved. Future possibilities include strategic partnerships, supplier involved design planning and altogether closer relations once both companies have mutual trust that basic operations run smoothly. XX and the suppliers could also begin to look at the SCOR theory to map out their respective core strengths and begin to investigate how they could support each other in further developing the supply chain.

A possible future topic to expand on this research could be to look at Vendor Managed Inventory based solutions to further reduce delivery times and overall costs, or looking into the milk-run principle within the Just-In-Time production.

References

Axelsson, Björn, Frank Rozemeijer and Finn Wynstra *Developing Sourcing Capabilities – Creating strategic change in purchasing and supply management* 2006

Baudin, Michael *LEAN Logistics – The Nuts and Bolts of Delivering Materials and Goods* 2004

Benton, W.C. Jr *Purchasing and Supply Chain management 2nd edition* 2010

Bowersox, Donald J. et al. *Supply Chain Logistics Management* 2nd Edition, 2007

Buttle, Francis *Customer Relationship Management – Concepts and Technologies* 2nd Edition, 2010

De Koster, Rene and Werner Delfmann *Managing Supply Chains – Challenges and Opportunities* 2007

Foster, Thomas S. *Managing Quality – Integrating the Supply Chain* 4th Edition, 2010

Harrison, Alan et al. *Logistics Management and Strategy – Competing Through the Supply Chain* 5th Edition, 2014

Liker, Jeffrey K. *The Toyota Way – 14 Management Principles from the world's greatest manufacturer* 2004

Plenert, Gerhard *Reinventing LEAN – Introducing Lean management into the supply chain* 2007

Rushton, Alan and Steve Walker *International Logistics and Supply Chain Outsourcing* 2007

Sakki, Jouni *Tilaus-toimitusketjun hallinta - Logistinen B-to-B prosessi 6th rev* 2003

Koploy, Michael. "Relationships 101: Back to Basics for Supplier Management." The Strongest Link. The Strongest Link, 8 July 2011. Web. 15 Nov. 2015. <http://strongest-link.softwareadvice.com/back-to-basics-for-supplier-management-0711/>.

North, Mickey. "Supply Management | The Procurement and Supply Website." The Five Secrets of Supplier Relationship Management. Supply Management, 17 Feb. 2015. Web. 15 Nov. 2015. <http://www.supplymanagement.com/blog/2015/02/the-five-secrets-of-supplier-relationship-management>.

Lean-Manufacturing-Japan “Efficient Consumer Response”. Web. 31 March 2016. http://www.lean-manufacturing-japan.com/scm-terminology/ecr-efficient-consumer-response.html

Appendix 1: Interview Questions with XX members

Interviews with representatives of both supplier companies and members of the purchasing / materials department of the client company were conducted between February and March 2015.

QUESTIONS to XX Helsinki Materials Team, two Materials Specialists were interviewed who had prior experience with manuals purchasing.

1. How long have you worked on materials / inbound logistics

2. How do you primarily communicate with your suppliers?

3. How would you define the relationship between your suppliers?

4. Do you have to expedite shipments often?

5. Are customer shipments late if your orders do not arrive on time?'

6. Are there any major issues you have with the purchasing process with them?

7. What would you change in order to make supplier deliveries easier?

8. How far ahead do you plan on MRP?

9. Why such a time period on question 8, what are the decisive factors for this timeframe?

Appendix 2: Interview questions to the Manual Supplier representatives; YY's production leader and ZZ Offsetdruck's customer service representative

1. How do you communicate with your clients

2. What are some of the major challenges you face in regards to day-to-day orders?

3. On average, do you have an ample time to respond to the customer's needs?

4. From what are the agreed lead times for the manuals based for?

5. What do you wish could be improved?

QUESTIONS to the YY purchaser and his answers:

1. What are the major challenge areas with this supplier

   The biggest challenges are in my opinion the financial quarter ends when we often receive numerous orders from across the globe and need manuals for all the different languages; even if the demand was such that we set the orders as per agreed Lead Times, due to production restrictions YY cannot always meet the demand and we are forced to prioritize the manual needs as to take as little SCOT % damage as possible

2. How would you change these issues?

   The only feasible idea that comes to mind is to increase our own stock – as unwanted as it is, on the smaller manuals and addendums that are only a couple of pages long and do not create such a big increase in inventory value. This would hopefully help with YY in focusing in on the bigger user documentation sets.