



ASSA ABLOY NEDERLAND B.V

MAPPING AND IMPROVING THE FLOW OF INBOUND PROCESS OF ASSA ABLOY WAREHOUSE

Internship Project

Supervisors:-
ASSA ABLOY

- Johan van Essen – Master Production Scheduler – johan.vanessen@assaabloy.nl
 - Joost Bressers – Project Manager – joost.bressers@assaabloy.nl
- Sipke Hoekstra – Program Coordinator - s.hoekstra@utwente.nl
 - Dorian Vandebelt – d.vandebelt@utwente.nl

UNIVERSITY OF TWENTE

Dipankar Shrigyan (s1598457)
d.shrigyan@student.utwente.nl

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1 INTRODUCTION

1.1 COMPANY Information

ASSA ABLOY was formed by the merger of ASSA in Sweden and ABLOY in Finland in the year 1994. Since then the company has had a continuous growth, hence becoming an international group from a regional company. The company is divided into three regional and two global divisions.

The global divisions are:

1. Global Technologies which is a leading supplier of electronic security solutions worldwide.
2. Entrance Systems is a global leader in entrance automation products, components and services.

The three regional divisions are namely:

1. Americas-This division manufactures and sells mechanical and electromechanical locks, cylinders, security doors and door frames. Some of America's industry leading brands include Corbin Russwin, Curries, Medeco, Sargent and Yale.
2. The Asia Pacific division manufactures and sells mechanical and electromechanical locks, digital door locks, high security doors and hardware. Some of APAC's industry leading brands include Guli, Pan Pan, King, Lockwood and Yale.
3. The EMEA division manufactures and sells mechanical, electro-mechanical and electronic locks, cylinders, security doors and fittings. The brands include some of the most respected in the industry such as Yale, Nemef, Lips and ABLOY, amongst others.

ASSA ABLOY Nederland BV, part of the ASSA ABLOY Group comes under EMEA division which stands for Europe, Middle East and Africa, is the specialist in locking and unlocking of doors for residential and non-residential construction.

With the vast range of mechanical and electromechanical quality products, Assa Abloy holds all ingredients to realize the ideal security solution. Within ASSA ABLOY Nederland many trusted players bundle their forces. This results in a convincing service, based on seven quality brands who have proven themselves many times: Nemef, LIPS, YALE, ASSA ABLOY, IKON, Eff Eff and ABLOY. Assa Abloy has two offices located in Apeldoorn and Ramsdonksveer. The Apeldoorn site is a manufacturing facility as well as warehouse in order to cater the need of clients in the region. Ramsdonksveer facility is mainly for the manufacture cylinder assemblies and keys.

1.2 ABSTRACT

The company intends to close out its warehouse and outsource to another company. In development of these events, certain actions were required for the foreclosure of the warehouse. This project deals with two certain objectives which needs to be achieved before the closing of warehouse. Thus, the whole project is divided into two assignments:-

Assignment 1:

Mapping and Improvement of inbound processes of the warehouse

The company at present does not have a descriptive flowchart for the flow of material at the inbound process in the warehouse. They require this process, in descriptive form as to explain the third party company about the handling of materials in warehouse. In this assignment, first a complete flow of inbound process of the warehouse is created. Secondly, actions or processes that delays the inbound processes or do not add value to them are identified. A viable solution is generated to fix those actions or processes or if non value adding to be removed accordingly, as not to be affecting the warehouse inbound processes in a negative manner.

For this assignment, the steps followed would be:-

- Mapping the inbound process for the warehouse
- Detailed description of the flow of all items that arrives at the inbound docks till it get stored at its designated location.
- Flow diagram includes all the departments that is required in order for the item to be stored into its location.
- Description of all the actions and procedures performed during the inbound processes.
- Identifying non value adding processes, or processes that delay or disrupts the flow of items in inbound process.
- Analyzing the aforementioned actions or processes, to generate the reasons for its failure.
- Generating solutions to fix the problems related to any processes.

Assignment 2:

Updating the ERP database for all items stored in the warehouse.

As, most of the items were to be shipped away to an outsourced warehouse. The third party requires a list of all items that ASSA Abloy produces or stores. This event requires data gathering with conditions to identifying the dimensions, type of packaging, type of respective pallets for storage, order of storage, weight and verifications of proper serial and barcodes for all the materials.

2 ASSIGNMENT 1: Improvement of the Inbound processes

2.1 Introduction

As mentioned above, the company is outsourcing its warehouse operations to a third party. Thus, before closing the warehouse, the company wants to make sure that there are no discrepancies in the present inbound process which might cause problems to the third party. These problems can include problems due to suppliers, material and packing problems and storage issues. If these issues can be identified and solved then the third party can smoothly run warehouse operations.

2.2 Mapping the flowchart for inbound process.

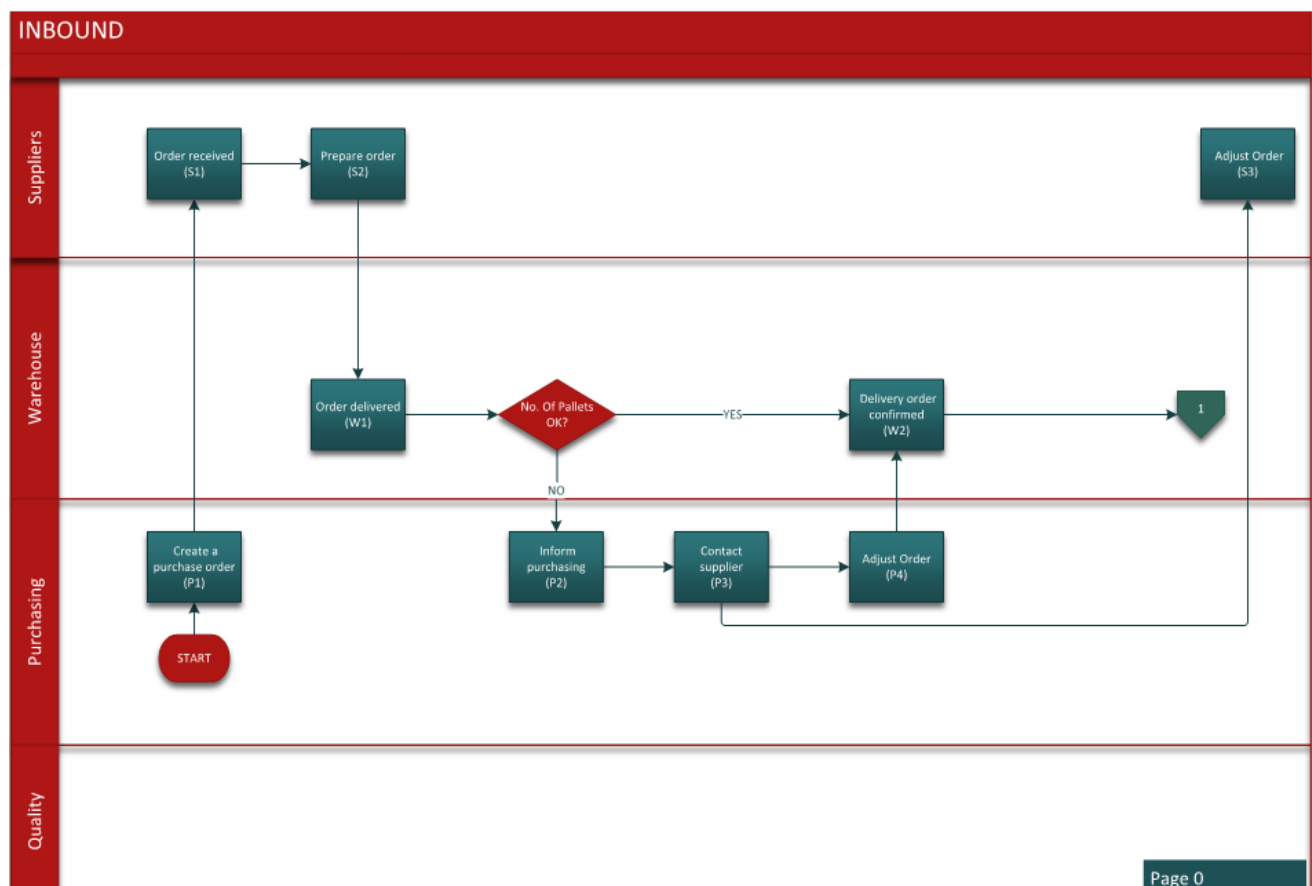


Fig1: Page 1 (Inbound process)

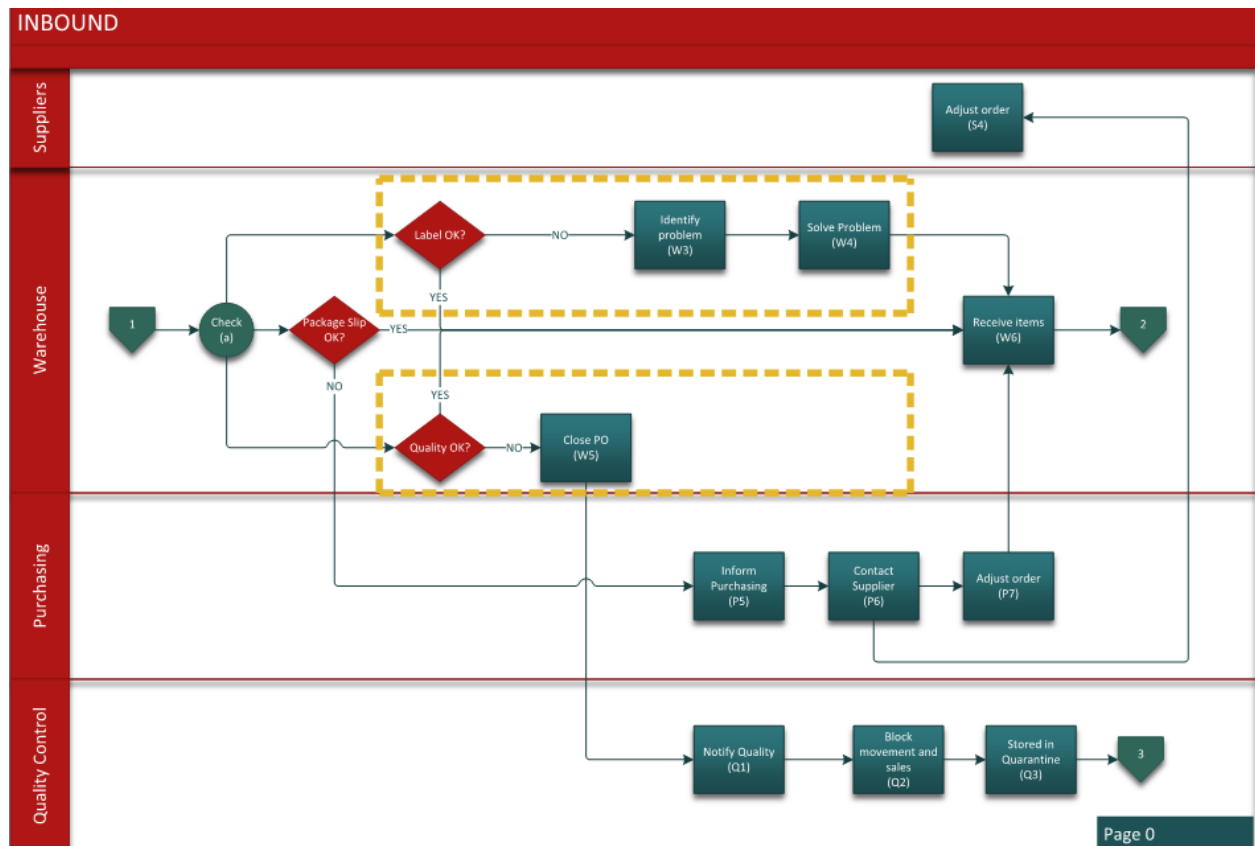


Fig2: Page 2 (Inbound process)

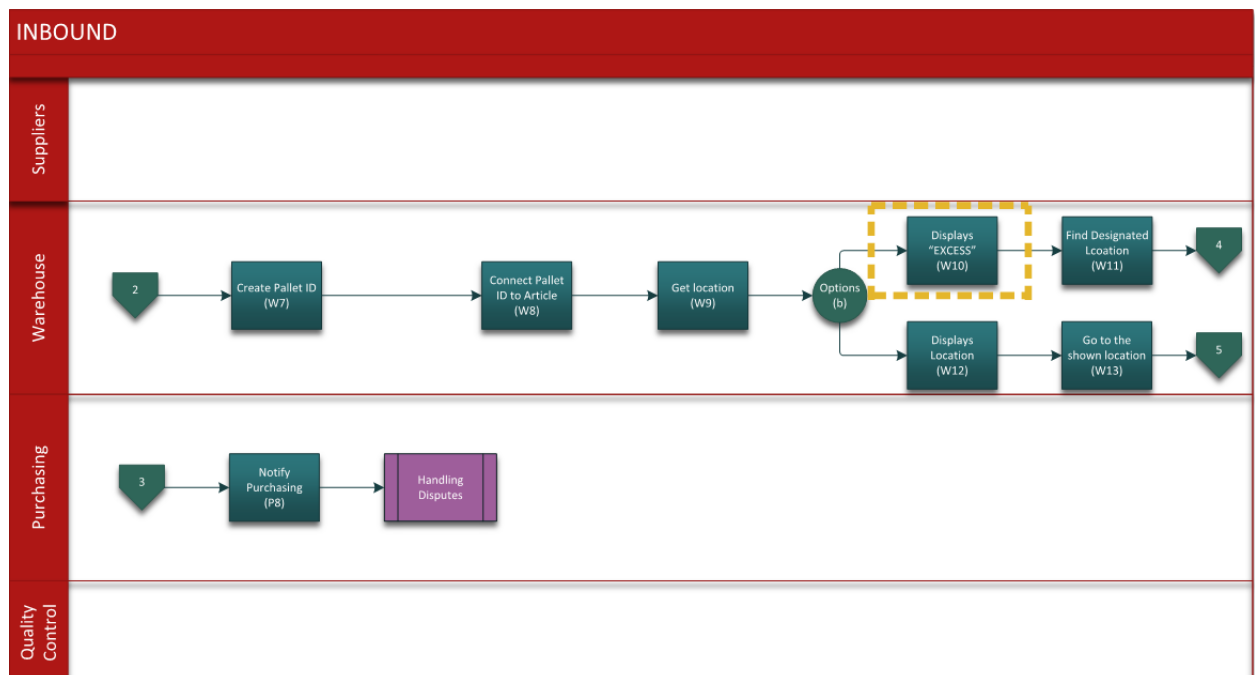


Fig3: Page 3 (Inbound process)

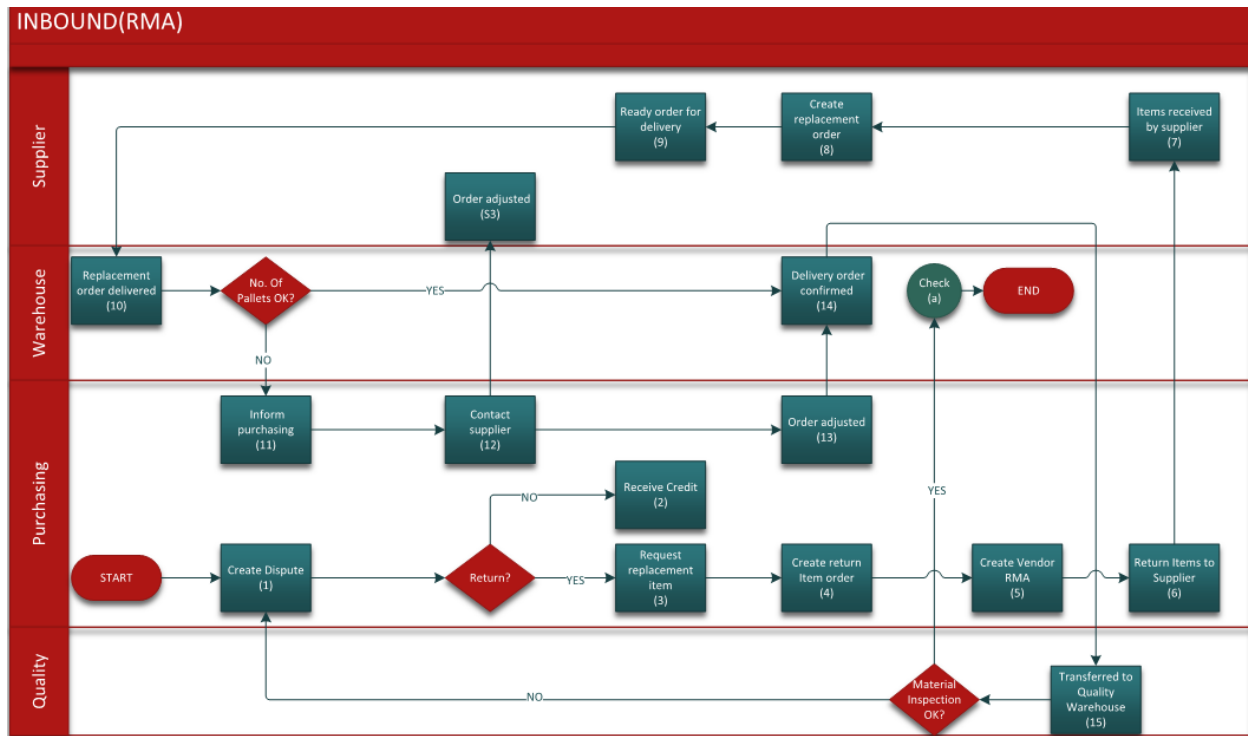


Fig4: RMA Subsection (Inbound process)

(RMA is a subsection process of inbound process which describes the Handling disputes section depicted in Page: 3)

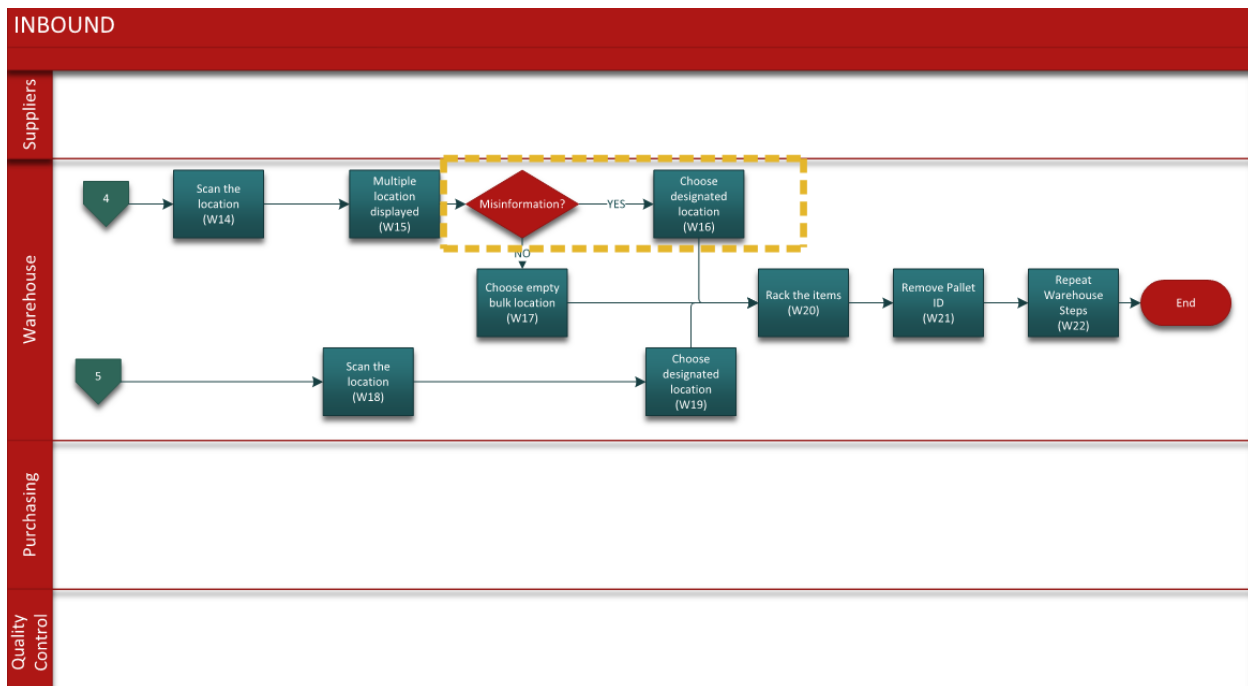


Fig5: Page 4 (Inbound process)

2.3 Instructions for flow of Inbound Goods

- An order is created by purchasing department according to the demand of the goods.(P1)
- The order is received by the supplier. (S1)
- The supplier then processes the order and manufactures it. (S3)
- The order is set to go and delivered back to the ASSA ABLOY warehouse the order is received at the inbound dock. (W1)
- At receiving, the number of pallets is checked before signing the delivery papers. [decision]
- If the number of pallets are correct then the delivery papers are signed. (W3)
- If not, then purchasing is informed.(P2)
- Purchasing contacts the suppliers and let them know the current situation (P3)
- In accordance to the stuff delivered order amount is adjusted by supplier and purchasing. This means that purchasing will keep the amount of order delivered and receiving bill will be adjusted by the purchasing department and the supplier. (P4)(S3)
- Item delivery is confirmed and papers are signed. (W2)
- Next step requires multiple checking for the complete assurance of the package delivered. (a)
- Three things need to be checked:-
- **Label OK?** - Over here, the concerns are about type of different labels and issues with them. Every supplier has their own kind of label and sometimes it causes issues with receiving those items. [decision] These issues will be discussed in a further section. Actions currently taken and how to make improvements will also be discussed later.
 - If label is not OK then, first we need to identify the issue with the label. (W3). The Issues with the label includes
 - I. Bar codes not present
 - II. Bar code not scan able
 - III. No EAN code present
 - IV. EAN Code not recognizable
 - After identifying the issue with the label, corrective measures can be taken to solve the problem. (W4)
 - Now the item is ready to be received and put in the system. (W6)
- **Package slip OK?** – To check pallet labels means to check if the items delivered matches with the packing order or not. If the items does not match there are certain steps that need to be taken:- [decision]
 - First purchasing is informed about the issue with packing list and order delivered. (P5)
 - Purchasing then contacts the supplier about the issue with packing list and order delivered. (P6)
 - Based on the discussion with supplier purchasing and supplier adjusts the order in their system. (P7) (S4)
 - After the adjustment of order, 'on hold' items is ready to be received by the warehouse. (W6)
- **Quality OK?** – When the items arrive the articles are randomly checked for specification of the item, the count and the condition of the item. After passing through this step it is determined if the item is OK or not. [decision] In case the item is not up to the mark, certain steps are taken:-

- Warehouse completes and closes the purchase order in the system. Although the physical goods are stored in a side space and tagged with quality defects. (W5)
- In the next step quality control is notified on the articles presence, location and issue. (Q1)
- Quality blocks the sale and movement of this particular article in the system. (Q2)
- The item is then scanned to be stored in a separate area in the quality section under quarantine until further action is taken. (Q3)
- Next purchasing is notified by the Quality control about the status of the articles. (P8)
- Now, Purchasing department handles dispute which can be understood in the RMA subsection.

RMA (Request Merchandize Authrization)

- Purchasing department creates a dispute. (1)
- This leaves us with two options either return the item or keep the items. [decision]
- If the items are kept then the mistake is informed to supplier and we receive credit from the supplier and the items are tried to made use of. (2)
- If the items are returned, purchasing to request for replacement items from the supplier. (3)
- A new Item return order is created. (4)
- Now, for returning purposes a Request Merchandize authorization needs to be created to the vendor. This form is compulsory for returning the items to the vendor in order to issue for replacement. (5)
- Now, RMA is tagged with the Packing list of return items and is ready to be shipped. (6)
- The items are then received by the supplier. (7)
- The supplier will create a replacement order for the requested items. (8)
- After the order is fabricated and packaged, it is ready to be delivered. (9)
- The Items are received at the inbound deck with the packing slip also tagged with notification, that the item is a replacement order. (10)(W1)
- Now, as the previous procedure, the items are checked for the number of pallets are then signed for delivery. If pallet count is not right, then purchasing is contacted and adjusted by contacting the supplier. (11)(12)13) and (S3). This is the same step as at inbound receiving section.(W2) (P2) (P3) (P4) (S3)
- Although after this process, it is not received at the warehouse location, but is transferred to Quality Control Warehouse. (15)
- At this place, a complete material inspection takes place for the whole batch of articles and check if the Quality is up to mark or not. [decision]
- If the quality is alright then it is sent to receiving section of the warehouse, where it is ready to be received and stored away in a location. Although in the checking list at the inbound station, Quality inspection is skipped and Quality control has already approved of it. [decision and check]
- If the quality is still not up to mark, Quality contacts the purchasing and the whole procedure of quality not up to mark is repeated further. (1.....)

Receiving

- If the Labelling, packing label and quality does not have an issue, then items are received in the system. This is done by scanning the item in receiving section of the scanner. (W6)

- Next step is creating pallet labels for each type of articles. For instance, if there are 10 boxes of article with article number. 9275xxxxxxx, then only one pallet ID is created. Thus, one pallet ID for one type of article in a purchasing order. (W7)
- Next step is to scan the pallet IDs and then scan the article. This way Pallet ID is connected to the article. Therefore, the article can be tracked and traced while in movement in inbound. (W8)

Put Away

- Next step is to acquire the designated location of the article. This can be done by scanning the article and every type of article has a fixed location in the warehousing where it can be stored. (W9)
- While checking the locations, the scanner shows two things either it displays “EXCESS” or it will show the location of the article. (W10) (W11)
- If it shows the location of the article, then the personnel in charge of put away process will carry the product to the listed location with the article. (W12)(W13)
- In the next consecutive steps, the location is scanned and the item is racked on the location. (W18) (W19) (W20)
- It is very important to remember after putting away of the article is done, the PO is closed and thus the pallet ID attached to the article needs to be removed and disposed. (W21)(W22)
- Now going back to step (W10) when the item location displays “EXCESS”, this corresponds to certain issues with the system. The excess location is found if no other location is available based on: (W10)
 - Available locations in zone (pallets with input area, not blocked)
 - Availability due to the pallet type allowed
 - Availability due to available pallet locations
 - Availability due to location
 - Availability by volume
 - Availability by weight
- This problem usually occurs because, the system might have a misinformation about the above dimensions. In this case, the put away person checks in the system the designated location of the article while manually going to the system. (W11)
- Next step is to go to the location physically and scan the location in the put away section of the scanner. (W14)
- This gives a list of location nearby the designated location. (W15)
- Check if the information from the scanner is correct or not? [decision]
- If the EXCESS information is a misinformation by the system, there must be space on the storage rack. Thus, the designated location is chosen. (W16) (W20)
- If the information provided by the scanner is correct and there is no space on the storage rack, then an empty bulk location is chosen and the item is stored to that location. (W17) (W20)
- Pallet ID needs to be removed after storing the item and should be disposed. (W21)
- Next Article is put away and PO is closed. (W22)

2.4 Improving the current Inbound Process

After mapping the flow of inbound process for all items in the warehouse and intensively noticing and depicting the steps for the flow of items in inbound process, there are certain actions which do create issue for the present working of the inbound flow. In this section we will discuss these problems, analyze the situation and come up with satisfying solutions.

2.4.1 Fixing the Label Issues:-

The company has 36 internal suppliers. The internal suppliers provides takes about 90% of the items in the warehouse. Internal suppliers are suppliers which comes under the ASSA Abloy conglomerate. The company would like to remove the process of Label check from the inbound process, as it is non value adding. The label check process is shown in Fig2 of the flowchart. The question is, "IS it possible to remove the process and still function properly?" In order to come with an answer, there is a need for analysis of the label check process.

a) Problem Description:-

According to the current process, a warehouse personnel tries to scan the label for a delivered item. If the scan does not work, the personnel has to manually go the system and find the item using the item code. They have to manually register the amount of item with the correct packaging form in the system and print a fresh label for the item, which is stuck on the packaging of the item. For instance, assume a package of item code 925xxxxxxx arrived at the inbound dock station. Let us assume the package contains a stock of 50 for that item. At the receiving station, a personnel tries to scan the item in the system, but the label does not scan. These items are to be sold as each from outbound. Now, the personnel has to go to system and manually enter the delivery details of the item. After this, they will print out 51 labels of the same type, one for the outer packaging and 50 for the inner packaging of each piece of the item. They have to personally stick each label on every designated space. The example carefully explains, how can this non value adding function can delay and disrupt the flow of material flow in the warehouse.

b) Analysis of Labels:-

For this analysis, certain steps were performed

- Make a list of all the internal suppliers linked with ASSA Abloy.
- Select randomly three to four items from each supplier that are available to on stock.
- For Example, below is the table containing on stock items for suppliers:-

Supplier code	Supplier name	Item number	Location1	Label Issues
000852	ASSA OEM unit Fix	10027438	C4300	NOT OK. No bar code present
		10027439	C4000	NOT OK. No bar code present
		10035838	C2200	NOT OK. No bar code present
		10035837	A7100	OK
001399	FF ASSA ABLOY Sicherheitst	10014188	KARDEX1	NOT OK. Invalid Item code
		10014189	KARDEX1	NOT OK. Invalid Item code
		10001579	KARDEX1	NOT OK. Cannot Scan
		10014897	KARDEX1	NOT OK. Invalid Item code
001398	FF ASSA ABLOY Sicherheitst NOT CIP	10001010	KARDEX1	NOT OK. Cannot Scan

		10020812	KARDEX1	NOT OK. Cannot Scan
		10026585	KARDEX1	NOT OK. Cannot Scan
		10035564	KARDEX1	NOT OK. Cannot Scan

Table 1: Label Issue specific for On-stock Item

The above example is only an example to explain the process of selection. The list was made for all the suppliers.

- At the same time keep track of labels for all the items arriving at inbound station.
For example, below is the table containing a packing list for 3 different suppliers with the mentioned label issues:-

Supplier	Supplier Number	Article number	External Item number	Issue	Purchase order
ASSA ABLOY Sicherheitstechnik	001313	10003305	10003305	NO BAR CODE	20000015498
	001313	10005293	10005293		
	001313	10011311	10011311		
	001313	10049282	10049282		
	001313	10003302	10003302		2000009950
	001313	10003310	10003310		
	001313	10003310	10003310		
FF ASSA ABLOY Sicherheitst	001399	10001006	13105--11602E34	BAR CODE NOT READABLE	20000016485
	001399	10003716	37----10602F91	BAR CODE NOT READABLE	20000016485
FF ASSA ABLOY Sicherheitst	001399	10002675	609-602PZ----1		
	001399	10001278	14----12002R11		20000016484
	001399	10000339	1048.10RR---Q11		
	001399	10001595	1705---82301F41		20000016486
	001399	10019782	844U4SBL1----01		
	001399	10034686	118E-----A71		
	001399	10001585	1705-24=		
	001399	10001765	17E-----R11		20000016487
	001399	10004254	42130-10-----00		
	001399	10035551	-----68935-01		
	001399	10004643	496D0801011-B87		20000014524
	001399	10004664	496D0803211-B87		20000012703
	001399	10011188	90331RR10L24=		20000016949
	001399	10003722	37RR---01001F91		20000016637
	001399	10002736	27E----10602R11		
	001399	10034050	MAGDN3000ALS--D		20000016639
	001399	10010777	331U81-02802F95		
	001399	10034053	MAGAC-Z300D---1		
	001399	10015410	901-IC-4-----00		20000016752
	001399	10034058	MAGAC-Z500-----		20000014923
	001399	10048546	5011-B99K10212-		
	001399	10003395	331UR--02802F94		20000016753

	001399	10003374	331U---11602E95		
	001399	10003375	331U---11602F95		
	001399	10014247	-----26402-01		
	001399	10019782	844U4SBL1----01		20000017463
	001399	10049037	118WR-----A71		20000016949
	001399	10003359	331U---02802E94		20000017736
	001399	10004540	49510-3-7293-00		20000017737
	001399	10011188	90331U6-----F94		
	001399	10002678	65-----60A35E91		20000017051
	001399	10003409	331UR--11602F94		
	001399	10003375	331U---11602F95		
	001399	10049019	5011-B99M11212-		20000017052
	001399	10049019	5011-B99M11212-		20000017052
ASSA OEM unit Fix	00852	10027438	8812 8RE1 0043	NO BAR CODE	20000009065
	00852	10027439	8812 8LE1 0044		20000011926
	00852	10027439	8812 8LE1 0044		
	00852	10035837	8830 8RK1 0185		20000012690
	00852	10035839	8832 8RK1 0189		
	00852	10035840	8832 8LK1 0190		

Table 2: Label Issue on a packing list

The above example only explains the method in which the analysis is performed. The same analysis was performed on multiple packing list.

- Stop after collecting a sufficient data set to perform the analysis.
- Scan the original bar codes provided by suppliers to check the error message or the issue with the items. This action is performed on both the randomly selected items and all the items arriving at the inbound station.
- Considering this random analysis for article label codes, collectively gather all label issues.

c) Label issues:-

- **Cannot be Scanned-** The primary reason barcode is not scan able is because it uses a different kind of scanning code. The barcode is not recognizable by the system. The company system only recognizes standard EAN 13 code. This is probably because the supplier uses a different kind of scanning code than ASSA Abloy. EAN code stands for European Article Number code. Every item sold throughout Europe contains an EAN code. It is a unique digitized code number different for every item type. Today, EAN code has been generated in various type of digit code. For instance ASSA Abloy uses an EAN 13 code for its articles. It means the articles contains 13 digit codes. The scanners made and issues in Europe is not built to scan only specific type of EAN codes. Although EAN 13 codes are most commonly used for Items sold in Europe. It is not to be confused with article number.
- **No EAN code present-** some labels on the item are without any barcode or EAN code. This way ASSA ABLOY cannot scan the article number and thus cannot identify the article.
- **Invalid Articles-** Although, the label seems to be arising straight from the miscommunication between suppliers and the company, there are certain cases in which the company solely is responsible for creating label issues. Lots of items were discovered for which the either the item number or the EAN code is not registered in the system by the warehouse personnel. The

proper protocol dictates that every article which arrives in the warehouse needs to have an article number and an EAN code. Both of them needs to be linked to each other in the system with the description of article. Upon investigation, the reason for this confusion when an EAN code has been updated but was never changed in the system.

d) Actions required:-

Suppliers

- Must provide all items with the EAN code described on their brochures.
- Must have scan able EAN codes on all items.
- Change their EAN scanning code type to Standard EAN 13 type.

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- Should follow the same EAN code as the suppliers for the articles.
- Should link all the article numbers with external article numbers. If possible use the same article number as the suppliers.
- Make sure the customers also follow the same change of EAN code as the company. This can be obtained by making new brochures for products to be sold to customers.

A questionnaire was prepared to better facilitate the communications between the representative of suppliers and ASSA Abloy Company.

- What kind scanning EAN code is used in your company?
- Is it possible to switch to standard EAN 13 code?
- If not, what kind of scanners are used to scan your item codes?
- Are your scanners capable of scanning all type of EAN codes?

Certain cases were created:-

- Suppliers used the same EAN code, but made the label too small and not suitable for our scanners to scan. They agreed to fix it.
- Suppliers were proactive in agreeing to the change their EAN codes to standard EAN codes.
- Suppliers used a different kind of EAN code and they did not have problems with any of the customers.

An intensive discussion is required to fix the remaining problems with labels on a higher hierarchy level. As, we are the major customers for most of the mentioned Internal suppliers.

2.4.2 Fixing the “EXCESS” issue

AS mentioned above in Fig 5 of the flowchart, Excess is displayed when there is not enough space to store an item in the warehouse or there is a misinterpretation about the information of the designated storage space for that article. This is a huge issue, as it creates a huge toll of time to figure out where to

keep the received article which displays EXCESS. Below, a descriptive analysis with reasoning will be provided concerning the EXCESS issue.

a) Reasons for “EXCESS” display

- Available locations in zone (pallets with input area, not blocked)
- Availability due to the pallet type allowed
- Availability due to available pallet locations Availability due to location
- Availability by volume
- Availability by weight

In general it can be concluded if an article exceeds the maximum area limit defined in the system for the storage location, excess is displayed.

b) Present situation:-

- While putting away the system displays “EXCESS”, it means it does not have available space. Although this might be a misinformation as, there have been cases where the slot still has enough space for the purchase order to be stored.
- This situation presently demands the personnel to check the location every time physically as it can a misinformation. This requires lot of extra time.
- In another situation where the designated storage location is actually full, the personnel has to first to move with the purchase order to the designated location, then scan the location. This gives a list of bulk location which is empty.
- The personnel moves with the item to the empty bulk location and racks the order of article.

c) Actions required

The most optimized way would be reducing the excess situation as much as possible. Certain action can help improve the situation.

- Starting an Inventory Control Policy
- Defining the dimensions of the storage locations properly. This will depend on defining the physical dimensions of items, their inner and outer box packings and their Gross weight. Also, the maximum volume they will take when stacked.

i. Inventory Control Policies

Inventory is the most important asset in an industry. It is the goods that is sold which brings in profit. The idea for building any industry is based on two major factors.

- Customer service levels
- Profits

Now, Inventory control policies applies to control in a way that the industry can maximize both service levels and profit at the same time. Although various other factors contribute to the factors above, inventory management is one of them. Others are asset management, production efficiency and various others.

Inventory contributes towards holding costs. So having too much inventory unnecessarily increases your holding costs, thus reducing your profits. Whereas, having low inventory, does not meet the demands criteria by the customer, thus reduces your customer service level and reduces your profits, as selling the extra commodities would have sold out and profit would have been generated from them. Most commonly used control policy is Min/Max control policy.

Min/Max Control Policy

It is the most basic inventory control policy where the minimum order becomes your reorder point. Max level denotes the new targeted stock level. The difference between Min-Max is frequently termed as EOQ (Economical Order Quantity). The graph below shows a basic representation of Min/Max Control Policy. Although Min/Max policy can be modified, when you include different safety stocks and separate reorder point according to the conditions the company wants to fulfill.

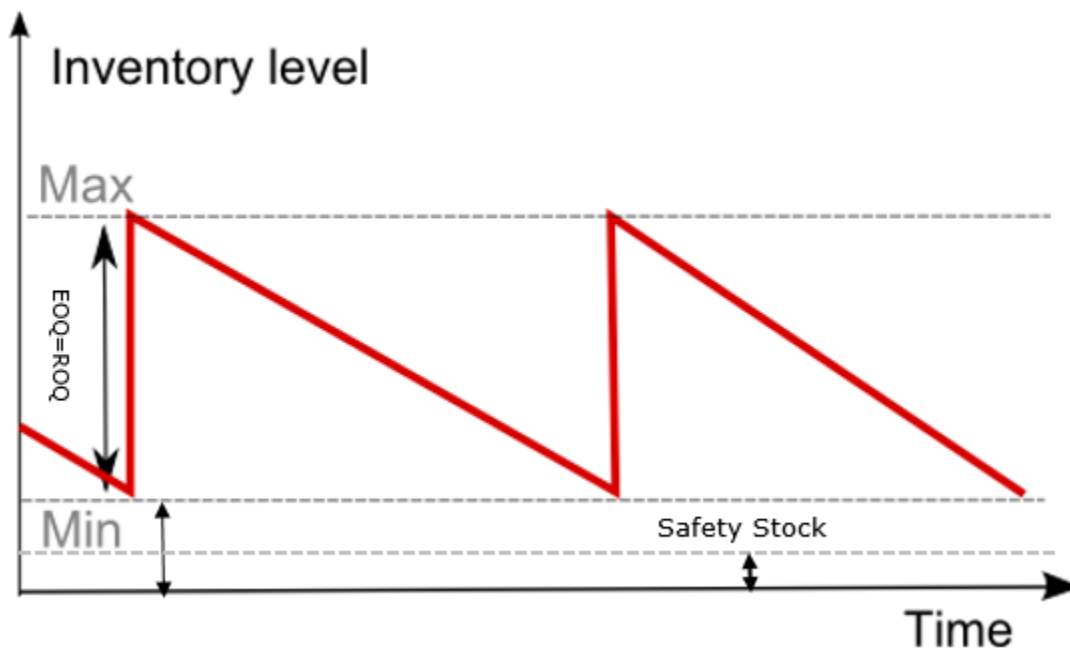


Fig 6: Min/Max Inventory policy

Important Terms:-

1. Safety Stock – It is the amount kept in stock to prevent stock out in conditions of error in forecasting causing high demand variability and lead time variability.

2. Minimum Inventory level – It is the minimum required inventory level for which the inventory policy works smoothly without stock out.
3. Reorder Point – It is a point on the minimum inventory level where at some moment of time an order is issued. This means when the inventory level drops to minimum level, then an order for the quantity is issued to reach the maximum level.
4. Reorder Quantity - It is the quantity which is placed or ordered at a certain point of time under a given condition. In Min-Max inventory the reorder quantity is issued when inventory level reaches minimum value. The reorder Quantity is equal to Economic Order Quantity (EOQ).
5. Economic Order Quantity (EOQ) – EOQ is the number of units added to inventory to minimize costs of inventory like holding costs, ordering costs and shortage costs.
6. Holding costs- It is the cost for an item in an inventory for the review period. Although, it says holding cost, which should include holding an item on storage. But it also includes damages in warehouse, loss of items in movement, Insurance for an item, finance for the goods sold and cost of movement of the item in inventory and out of inventory.
7. Ordering Costs- Ordering costs focuses only on the extra cost it takes to make an order of an item. It does not concern with the cost price and movement of item.
8. Maximum Inventory level – It is maximum limit to which the inventory should be filled up to. In Min-Max inventory policy the maximum inventory level is equal to the sum of reorder quantity and minimum inventory level. (Vermorel, 2014)

Below is a descriptive example for how to perform a Min/Max Inventory control policy:

This policy is based on having a minimum inventory and a maximum level of inventory for any item. The reorder quantity is Economic order quantity (EOQ).

Steps for creating a min-max inventory (based on demand variability):-

- First calculate Average demand over a certain period of time. (Ex- monthly average demand over 1 year)
- Assuming the demand is distributed normally over the time period, calculate standard deviation for the demand sample.
- Next step is calculating safety stock.

$$SS = Z * \sqrt{LT} * \sigma_D$$

Where,

- Z= factor for confidence level for no stock out probability.
 - LT = Lead time for the order to arrive.
 - σ_D = variance for demand (King, 2011)
- After calculating safety stock for the article, calculate the reorder point or the minimum inventory level for the item.

$$ROP = (Avg. Demand * LT) + SS$$

- Next calculate the Reorder quantity (ROQ), which is equal to Economic Order Quantity in this case.

$$EOQ = \sqrt{\frac{2 * A * D}{h}}$$

Where,

- A= Cost of an order
- D= Average demand
- H= Holding cost for an item for considered period of time. It is assumed to be 3% of the total price of the unit.

* Reorder quantity will also depend on the fact that EOQ is our reorder quantity only if it is bigger than the minimum order quantity assigned. Otherwise, MOQ will be the reorder quantity.

$$IF [EOQ > MOQ; EOQ; MOQ]$$

- Finally, we need to calculate Maximum inventory level for items.

$$MAX = MIN + ROQ$$

Example:

This is an actual item with real time data taken to perform the Min/Max inventory control policy

Item Number – 3543981010

Demand table:-

MONTH	SALES OF UNITS
MRT'17	123
FEB'17	10
JAN'17	221
DEC'16	23
NOV'16	5
OKT'16	355
SEP'16	189
AUG'16	41
JUL'16	80
JUN'16	100
MEI'16	193
APR'16	275

Table 3: Sales Data

$$1. \text{ Average Demand } (D_{avg}) = \frac{D_1 + D_2 + \dots + D_n}{n} = \frac{123 + 10 + \dots + 193 + 275}{12} = \mathbf{135 \text{ units}}$$

$$2. \text{ Standard deviation} = \sqrt{\frac{\sum_{x=1}^n (D_x - D_{avg})^2}{n}} = \sqrt{\frac{(123-135)^2 + (10-135)^2 + \dots + (193-135)^2 + (275-135)^2}{12}} = \mathbf{113 \text{ units}}$$

3. The confidence level of no stock out probability is **95%**
4. From the Normal Inverse table, it is equal to **Z=1.65**
5. Given Lead time is 60 days. Convert it to months. So, Lead time = $\frac{60 \text{ days}}{30 \text{ days}} = \mathbf{2 \text{ months}}$
6. Now. To calculate safety stock from the formula:-

$$\text{Safety stock (SS)} = Z * \sqrt{LT} * \sigma_D = 1.65 * \sqrt{2} * 113 = \mathbf{263 \text{ units}}$$

7. Holding cost = Holding cost is assumed to be 3% of the price of the item. In this case, Cost price = €0.14. Thus Holding cost (h) = 3% of €0.14 = **€0.004212**.
8. Next we need to calculate, the economic order quantity (EOQ). EOQ in Min-Max inventory policy is the reorder quantity when the inventory level reaches minimum.

$$EOQ = \sqrt{\frac{2 * A * D}{h}} = \sqrt{\frac{2 * €10 * 135 \text{ units}}{€0.004212}} = \mathbf{800 \text{ units}}$$

Where,

A = cost of ordering for 1 order of the article is fixed = €10

D= Average demand(D_{avg}) = 135 units

H = holding cost per item per year = €0.004212

9. Next is to calculate minimum inventory level for the item inventory level. Please note, that minimum inventory level is always higher than the safety stock and should not confused with each other. Also, Minimum Inventory level can also be called the point where an order is issued. So, its reordering point (ROP =MIN).

$$MIN = ROP = D_{Avg} * LT + SS = 135 \text{ units} * 2 \text{ months} + 263 \text{ units} = \mathbf{532 \text{ Units}}$$

10. Now, it is important to decide, whether reorder quantity is EOQ value or the minimum Order Quantity value (MOQ). Now, MOQ value is a where it is mandatory to make an order more than this quantity. For this purpose, we apply a condition

IF EOQ > MOQ, then EOQ is my reorder quantity
If EOQ < MOQ, then MOQ is my reorder quantity

EOQ =800 units

MOQ = 1500 units

Thus, Reorder Quantity (ROQ) =EOQ < MOQ =800units < 1500units = **1500 units**

11. Finally maximum inventory level for the item needs to be calculated.

$$MAX = MIN + ROQ = 532 \text{ units} + 1500 \text{ units} = \mathbf{2032 \text{ units.}}$$

ii. Defining the Physical Dimensions of Items

The physical dimensions can help solve the issue of Excess. If all the items are correctly measured for their attributes, then based on that maximum volume for storage can be defined. From Inventory policy we already know, the maximum inventory level for items are already calculated. This way if the dimension for each article is known, maximum volume for each article can be defined in the system. Thus, the system should never have a misinformation of EXCESS. If both protocols are followed, then the system should not require the options of EXCESS and there will always be space to store the item without costing any extra money towards inventory.

Dimensions to be measured:-

1. Maximum Length, breadth and height of the object
2. The length, breadth and height of the inner box.
3. Number of articles in Inner box.
4. Length, Breadth and Height of outer box.
5. Number of articles in Outer box.
6. Type of Pallet used.
7. Number of Outer boxes that can fit on one layer of a pallet
8. Maximum number of layers for the outer boxes on that pallet.
9. An example for the following calculation steps is provided below in the table:-

Material		A000127134
Item description		SLUITPLAAT /P1255/12 OXLOC 1217777
#in a box	<i>Each</i>	1
	<i>Inner Box</i>	1
	<i>Outer Box</i>	250
Each(cm)	<i>Length</i>	7
	<i>Width</i>	4.2
	<i>Height</i>	0.2
	<i>Length</i>	Plastic packaging

Inner Box(cm)	Width	
	Height	
Outer Box(cm)	Length	18
	Width	16
	Height	12
Weight(gms)	Each	not required
	Inner Box	20
	Outer Box	5081
Outer box per layer		24
Layers Per pallet		2
Pallet Type		Euro Pallet

Table 3: Data Measurement Table

IN the above table dimensions and weights are measured and packing is defined.

- Firstly we locate the material described in the table in stock list.
- After the item is found, scan the item to confirm through item description if it in fact is the same item.
- Next we describe the type of packing of the material. IN the above case, we describe how many parts combines to be item. It is called as “Each”. Then we go towards the packing. In above example 1 unit of the item is another type of packing. This is called “Inner packing”. Next we describe how many of item units are in the big carton box. This is called “Outer Packing”. In the above example 250 units of the items are in one carton of the outer box.
- Next is to calculate dimensions. The dimensions of the item and the packing is measured. In the above example, the inner packing is mentioned as Plastic packing. Now plastic packs cannot be measured in dimensions as it is wrapped around the item.
- Similarly, weight of 1 unit of the item is calculated, then 1 unit of the material inside Plastic packing is calculated and finally weight of 250 units of the item wrapped in the outer carton box is calculated.
- Next section mentioned is Outer Box per layer. It means the count of outer boxes kept on pallet when it is not stacked.
- Layers per pallet means the stacking of outer boxes over each other.
- Type of Pallet is important because it defines the dimensions of the pallet.

The important thing how this information helps the third party. Let us focus on that:-

- With the dimensions of the pallet we know the surface area required to store any certain type of item.
- Layers per pallet defines the maximum height required while storing it.
- Weight, Outer box per layer and layers per pallet will give the maximum weight that will be stored on the racks. This will help in designing the beams for the racks.

- Dimensions of each, Inner and outer box actually leads up to finding outer boxes per layer and layers per pallet.

Please not, the same calculation as defined in the example were performed on approximately 4800 articles. The table will be too huge to put up. So an explanation was provided to help understand the process and reasoning behind it.

2.4.3 Fixing the Quality Check Issue

Initial quality check is performed by warehouse personnel. This is initial check to see if the dimensions of all the items are absolute and the quality is up to the mark. Now, as it is shown in Fig 2 of the flowchart, that if the quality is not ok, then the warehouse personnel closes the PO order and informs Quality Control to take over. As mentioned above in description of flowchart, Quality takes over from this point.

a) Problem Definition

When the warehouse personnel checks all the item at the inbound dock, the items that do not pass initial quality check are stored on the side and their PO is closed. The addition of quality “Not ok” item lies on the inbound dock till a quality control personnel comes and take and moves it to Quarantine area. They inform Purchasing and then Dispute is created regarding the material, which has been discussed above in RMA section. The overall coagulation of failed quality test items blocks the inbound dock which is always running as deliveries keep coming.

b) Analysis

Upon Investigation it was observed that there are not many items per day that do not pass quality test. At any point of time there is a maximum of 1 pallet which contains defective items, which can be easily stored on the side. Considering the minimal occurrences of such events, no action is necessarily taken.

c) Probable Solutions

In future, if the occurrences of defective materials increase. A solution should be devised. Upon discussion with senior staff and my supervisor, a viable solution was generated. In this case, instead of a warehouse personnel doing initial quality checks, the company can assign a quality control personnel to perform this test. If the material is substandard or defective, the PO can be closed at the exact moment and the quarantined item can be moved away to Quality control. There will be no need to involve Warehouse personnel in this process. This reduces a sublevel and removes the yellow section mentioned in Fig 2.

At this moment, no actions are taken because of two reasons. The first reason is mentioned above, as there are very few cases per day of such occurrences. Another reason is there needs to be restructuring in between the communication of divisions, which is too much of a hassle at this moment.

3. ASSIGNMENT 2: ERP Data Update

ERP data update is required because, ASSA Abloy is outsourcing its warehouse to a third party. This third party requires data requirements about all the items presently stored in the warehouse. This data is required because the outsourcing company can define the amount of space required to store all the items. The information required are dimensions of each article and the packaging, type of packaging, weight of packaging, type of pallets required for separate articles and the order of storage. This assignment corresponds to **section 2.4.2 (c) (ii)**. In that section, we were trying to solve the EXCESS issue which also required the same conditions to be met. So, all the information was covered during **section 2.4.2 (c) (ii)**.

4. CONCLUSION

There were various tasks that needed to be completed in order to achieve the goal of the assignment. The list of the achieved tasks are:-

- Successfully mapped the flowchart diagram and explanation of flow of materials at inbound process.
- Identified the various discrepancies and non-value adding processes with the flow at inbound process.
- Successfully proposed a solution to solve the label issues
- Successfully proposed a method for solving the EXCESS problem in the storage area of the warehouse.
- A viable method was proposed to improve the Quality Check process. Although, It was not necessary to implement at this moment.
- ERP data base for all the articles was successfully updated. Data relating to approximately 4800 articles were gathered. In this project 600 articles were completed before I took over the project and 600 articles were left to be measured at the end of my internship. I was informed by the company that the data base has been completely finished and updated. There were around 6000 types of articles in stored in the warehouse.

5. RECOMMENDATIONS

At the end of the project, certain actions would have made the project details more concrete. There are two recommendations to be exact:-

5.1 Performing ABC Analysis: Make to Stock OR Make to Order

When the Inventory Policy is applied, a prior ABC analysis is required to trim out the items which does not have a high demand. ABC analysis refers to a method of classifying materials into mainly 3 categories. These categories are defined either on the basis of usage or value. In our case it is based on demand value. A class covers the 70% to 80% of the total revenue of the company and occupies around 10% to 20% of the total inventory space. B class items are items which account for 15% to 25% of total revenue and occupy about 30% of the total revenue. Finally C class items are items which accounts for 5% of the total revenue but occupies about 70% to 80%. Based on these, A class items are usually selected for Make to Stock items are used for inventory space. C class items are usually make to Order items and it is too money consuming to have safety stock for such item. (Collignen & Vermorel, 2012)

Thus, if ABC analysis was provided beforehand, Inventory Control policy would be more accurate. Unfortunately, no data was ready beforehand and there was not enough time to complete ABC analysis with my assignment during Internship period.

5.2 Insufficient Data about stock of articles

While working on Inventory Control policy, the demand data was not organized with each supplier at hand. It would a lot of time to organize demand data based on articles of the same suppliers, which was not possible within the scope of my internship. The Inventory Control Policy was applied to only one Internal supplier from China. It has approximately 300 articles.. The table would be too big to include int eh report. Keeping that in mind, the process of Inventory Control Policy was explained using an example from the table.

6. REFERENCES

1. Collignen, J., & Vermorel, J. (2012, February). *ABC Analysis (Inventory)*. Retrieved from [www.lokad.com: https://www.lokad.com/abc-analysis-\(inventory\)-definition](https://www.lokad.com/abc-analysis-(inventory)-definition)
2. King, P. L. (2011, July/August). Understanding safety stock and Mastering its equation. *CRACK THE CODE*. APICS Magazine.
3. Vermorel, J. (2014, October). *MIN/MAX INVENTORY PLANNING*. Retrieved from [www.lokad.com: https://www.lokad.com/min-max-inventory-planning-definition](https://www.lokad.com/min-max-inventory-planning-definition)