POLITECNICO DI TORINO

Master course in Engineering and Management

Master course thesis

Inbound flow optimization of the Volvo France powertrain plant

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1. Thanks

First of all, I would like to thank the AB Volvo group for receiving me on its Venissieux plant and allowing me to live a wonderful experience. I convey my special thanks to my industrial supervisor, **Mme Tiphaine CHATARD**, for her availability in my integration process and also for her advices all along the project when it was necessary. I would like to thank also all the logistic managers: **Benoît POTIN** (Supply Chain director), **Thierry MOURIERAS** (program and planning manager), **Georges SANTINHO** (receiving inbound manager), **Jean-Robert MAURY** (internal parts flow manager), **Melanie PETIT** (material control manager), **Laurent ARBIBOU** (inventory and shipping outbound manager) and **Yann CROZET** (logistic engineering manager) for their time, the presentation of their department and their availability all along the thesis. Their help allowed me to better understand how the plant works and to figure out who I will be working with to complete my missions. This first discovery step was essential for the success of my project. Many thanks also to all logistics co-workers who helped me moving forward in this project: **Yann LAIGRON** for its warehouse knowledge, **Patrick BELZ**, **Frederic BERGERAT** and **Roselyne OBECNY** as packaging engineers, **Zoubir TOBBAL** and **Ali BOUGHENNA** for the warehouse storage, **Julien GROS** and **Abdhelac KHALDI** for the receiving inbound flows, **Pierre ALBANESE**, **Florian DACIER-FALQUE** and all the material control team. I would also like to thank **Emmanuel RIHM** and the Volvo Production System department (VPS) for the organization of the training sessions I followed. These training sessions were very relevant for me in order to quickly understand the required capabilities for the project's success. I would like to thank also all the co-workers that supported me in the project and brought me some precisions when it was necessary.

I would like to thank also **Mme. Valerie BOTTA-GENOULAZ** for following my internship and for visiting me in the engine plant to do a complete progress review of the project. Moreover, I thank also my Polytechnic of Turin supervisor, **M. Agostino VILLA**, for agreeing to supervise my thesis and for its availability for my thesis defense.

Finally, I would like to thank the INSA Lyon Industrial Engineering department and the Engineering and Management department of the Polytechnic university of Turin.

2. Vocabulary and definitions

5S: Sort, Set in order, Shine, Standardize, Sustain

Advanced Kaizen: Continuous improvement project requiring many resources and time and having a great return on investment (project longer than six months with savings higher than 100k€)

ASN: Advanced shipping notification, EDI message sent by a sender to a receiver

B/C: (Benefits to Costs) Indicator used to quantify the return on investment of a Kaizen; it is a profitability calculation

Blue boxes (V750, V780 and V500): handling unit used in Volvo Group and practical for its procurement and use on the production line

Bucket strategy: This strategy aims to optimize transports for class C parts with a price lower than one euro, by replenishing up to a maximum production duration days instead of taking into account the consumption on the production line and the safety stock (transport strategy)

Call off: Ordered quantity for a special date based on the net requirements calculation

Carton boxes (V100 and V156): handling unit used in Volvo group to handle small parts

C-Matrix: Matrix indexing all losses

EDI: Electronic data interchange; an interactive electronic system that enables a supplier and a customer to communicate easily

ELK: Estimated Logistic Cost; tool allowing the simulation of savings/losses following a packaging modification and/or a call off modification

"Fiche action": (Action sheet) each kaizen is formalized with an action sheet to record the savings done. Are also mentioned the co-workers working on the project, the deadlines, the department and the areas impacted by the project, as well as the B/C

GE: Static packaging or pallets without any sub packages, containing bulk parts

Gemba walk: work field's observations

GPT: Global Packaging tool; software used by the packaging engineers to handle the Packaging Instructions

Grid: Computational algorithm calculating automatically the safety parameters for a part, the safety stock for instance.

ICP: "*Idée concrète de progrès*"; continuous improvement ideas proposed by operators on the fieldwork. Like a Kaizen, the operator has to describe the problem and propose a solution that is then studied by a manager

K0: Typology of pallet used to transport blue boxes mainly. This pallet does not have any layer (appendix 8.5)

K1/K2: Typology of pallet used to transport carton boxes and other bulk products mainly. A K1 has one layer and can for instance handle thirty carton boxes V100, a K2 two layers with a maximum capacity of 60 carton boxes V100 (appendix 8.5)

Kaizen: Continuous improvement process

MACS: Inventory management tool; allows managing the locations of the parts in the warehouse, the storage, the inbound flows, the locations on the production (point of use)

Major Kaizen: Continuous improvement project requiring lots of resources and time and having a great return on investment (projects shorter than 6 months but with savings higher than 40 k€)

MMS: Inventory management tool

MOQ: minimum/multiple order quantity = smart call off; minimum and multiple order quantities of replenishment of the parts

Payweight: The weight that the plant pays which is the maximum between the booked weight and the volume of the pallet converted into a weight

PE: Small packaging, also called dynamic packages or sub packages when put on a pallet (main package)

PI (Packaging Instruction): contract between a supplier and Volvo on the specific packaging to use, the composition of the pallet and if need be, the composition of the sub packages. The supplier has to respect what is mentioned on the packaging instruction when sending its parts

Pick-up: act of picking parts from a supplier resulting in a transport arriving at the engine plant

PipeChain: module used to monitor stocks and the replenishment of parts

PL: Production Logistic = Transport provider

PSM1: Increase of the warehouse storage capacity project

Quick Kaizen: Very quick continuous improvement project (realized by one person in less than one month and with savings lower than 20 k€)

Repacking: Internal change of packaging due the production line requirements, before its entrance in the supermarket (SPMK) and the production line supply

Sequencing: warehouse area dedicated to picking parts and supply kits directly to the production line

SPLIT: Area to burst the pallets (separating empty blue boxes from the full ones for instance) containing small packaging (sub packages) before their entrances in the supermarket (SPMK)

SPMK: supermarket, small packaging storage warehouse

Standard Kaizen: Continuous improvement project requiring a small amount of resources and time with a quick resolution (shorter than three months with savings lower than 40k€)

STM6/STM1/SPM1: warehouses for big packaging storage (GE)

UC: Packing unit → packaging (carton boxes, blue boxes, providers' packaging and pallets) stored in the warehouse

UM: Handling unit → main package (pallet) handled on the inbound flows containing bulk parts or sub packages as carton boxes or blue boxes for instance

Unit load: Number of parts inside a UC

V100/V156: Volvo standard carton boxes

V500: Typology of packaging that is a Volvo standard. It is a blue box containing parts that are mainly stored in the supermarket and bring to the production line with small train carrying the boxes (appendix 8.5)

V750: Same as the V500 blue box but twice bigger (appendix 8.5)

V780: Same as the V750 blue box but twice bigger (appendix 8.5)

VPS: Volvo Production System

XTR/ Emergency transport: Urgent transport request

3. Presentation of the company

3.1 AB Volvo group

3.1.1 Group introduction

AB Volvo is a Swedish group founded in 1927 and specialized in the production and commercialization of vehicles and industrial engines. Nowadays, Volvo is one of the leaders worldwide on the heavy goods vehicles.

Volvo group counts **100,000 employees** in the world, is present on 190 markets with production facilities in 18 countries and delivers more than **200,000 trucks each year**. The success of the company is based on the group values that are:

- **The customer success**: Making its customers win
- **Trust**: Trusting in each other
- **Passion**: That everyone works with passion
- **Change**: Changing to stay ahead
- **Performance**: Being profitable to shape the future

The company produces several types of heavy goods vehicles. Trucks are the core market and contribute to a majority of Volvo sales revenues but the group produces also buses and construction machines. Finally, the firm produces also industrial and marine engines.

The turnover was, in 2017, of **35 billion dollars** divided as exposed on the figure below, with 64% of its sales revenues on the trucks markets.

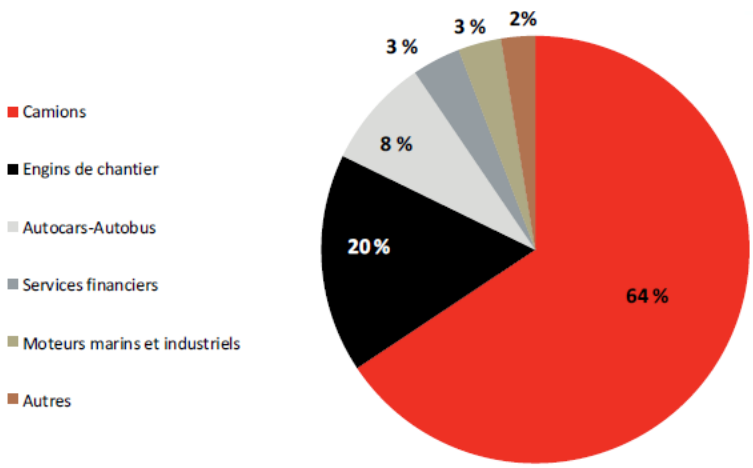


Figure 1: Volvo turnover distribution

The group owns twelve brands:

- **Trucks brands:** Volvo trucks (Sweden), Renault Trucks (France), UD trucks (Japan), Mack Trucks (United States), Eicher Motors (India), Dongfeng (China)
- **Coaches and buses:** Prevost (Canada), Nova Bus (Canada), Volvo buses (Sweden), UD Bus (Japan)
- **Construction equipment brands:** Terex, SDLG, Volvo Construction Equipment
- **Marine and industrial engines:** Volvo Penta
- **Arquus:** Military vehicles

Figure 2: Volvo brands logo

3.1.1.1 Volvo

The core brand of Volvo group is of course Volvo that is one of the world's best known brands and has four different lines of businesses with its own brand (Volvo Trucks, Volvo buses, Volvo Construction Equipment and Volvo Penta) but also brings together individual brands.

Volvo Penta is a world-leading supplier of engines and complete power systems for marine and industrial applications. This typology of engines is particularly innovative and performance-oriented. Volvo Penta has been registered trademark since 1935.

3.1.1.2 Renault trucks

Renault Trucks produces all types of commercial vehicles since 1894, from light trucks for urban distribution departments to heavy trucks for long-haul operations. Since 1894, Renault Trucks has offered all types of commercial vehicles, ranging from light trucks for urban distribution departments to specially designed and heavy trucks for long-haul operations. The company was bought by Volvo in 2001.

3.1.1.3 UD Trucks

The UD brand consists of two different lines of businesses: UD trucks and UD Buses. UD Trucks was established in Japan in 1935 and produces three types of trucks: light-duty trucks, medium-duty trucks and heavy-duty trucks mainly for the Asian markets.

UD buses are a new business of UD, introduced in 2014. The objective is to offer modern transport solutions developed for growth markets and will be including city buses but also coaches.

3.1.1.4 Mack trucks

Founded in 1900, Mack Trucks is one of the most well-known brands worldwide. It is originally an American company that was bought by *Renault Véhicules Industriels* in 1990 and was then acquired by Volvo after the redemption of Renault Trucks in 2001.

3.1.1.5 Terex trucks

Terex Trucks products are used around the world in mining, quarrying, and infrastructure applications and are submitted to various and extreme conditions.

3.1.1.6 Prevost and Nova bus

Founded in 1924, Prevost is one of the leading North American producers of coaches and conversion coaches for high-end motor homes.

Nova Bus is another leading North American provider constructing sustainable transits solutions, including buses, high-capacity vehicles and integrated intelligent transportation systems.

3.1.1.7 Arquus

Arquus manufactures vehicles adapted for operations in international projects to governments and organizations all around the world. Formerly Renault Trucks defense, it was renamed after the acquisition of Renault Trucks by Volvo.

3.1.1.8 SDLG, Eicher and Dongfend brands

Volvo created alliances and joint ventures with these three brands to strengthen its presence worldwide.

SDLG (Shandong Lingong Construction Machinery Co) develops, manufactures and markets a large range of products including wheel loaders, excavators and backhoe loaders for instance primarily in China but also in other emerging markets. Eicher is an Indian producer of trucks and is one of the most important actors on the Indian commercial vehicle market. Finally, Dongfeng Trucks is a Chinese company, employing more than 100,000 employees and producing trucks, buses and cars.

3.1.2 The future and challenges for the group

The most significant trends are driving Volvo's work towards sustainability. The main challenges in this industry concern the climate change, the demographic growth, the resource scarcity, the safety and security and the competition for skills in the industry.

Nowadays, many laws are restricting the trucks noise level and motor emissions (Euro 6). To face these laws, Volvo has to develop low emissions motors and reduce drastically the noise level. Moreover, to face the upcoming environmental challenges, Volvo is creating new vehicles using alternative energies as the 100% electricity vehicle, the compressed natural gas for vehicles, the hydro treated vegetables oils or the biodiesel. Finally, in the race for autonomous vehicle, Volvo is developing platooning trucks to save fuel and ensure a better safety on roads.

3.1.3 Volvo organization

The Volvo group organization is composed as on the figure below:

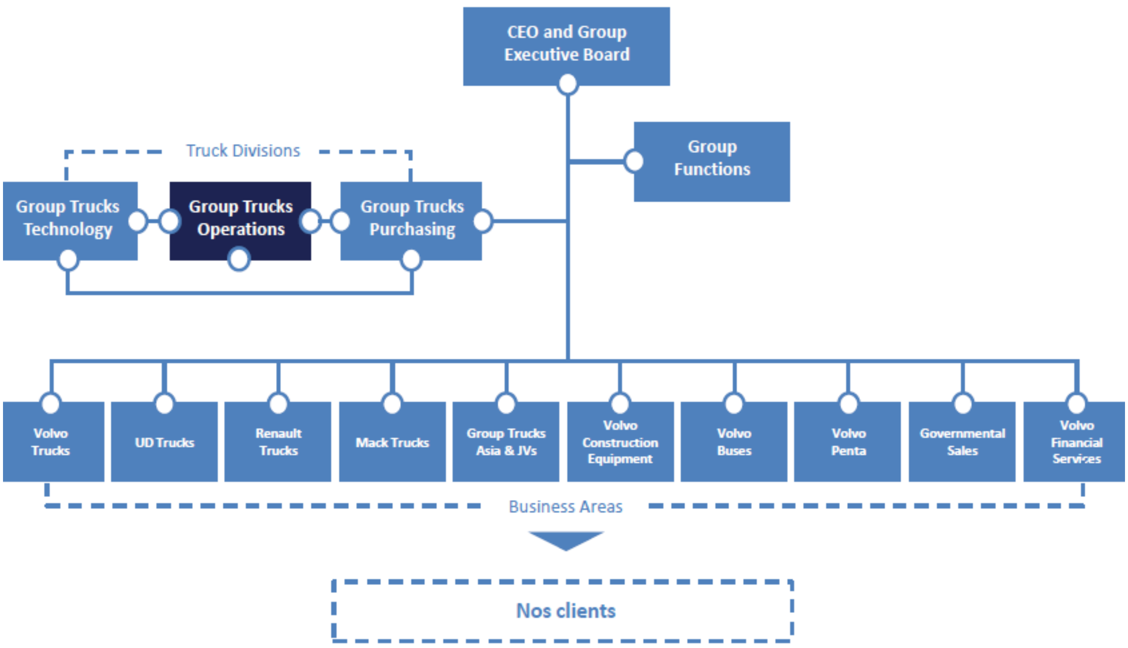


Figure 3: Volvo group organization

Volvo owns several brands and activities, including three Trucks divisions that are: **Group Trucks Technology**, **Group Trucks Purchasing** and **Group Trucks Operation**. The first one mainly aims to conceive and prototype the engines and the new trucks, buses and construction equipment. The second one is also a global entity in charge of all the purchasing of the group. Finally, during my thesis, I was part of Volvo Group Trucks Operations that is an operational entity in charge of the trucks' production, the cabins' and vehicles' assemblies, the spare parts distribution and the standard exchange. This entity gathers 31,000 employees and production plants in 32 countries.

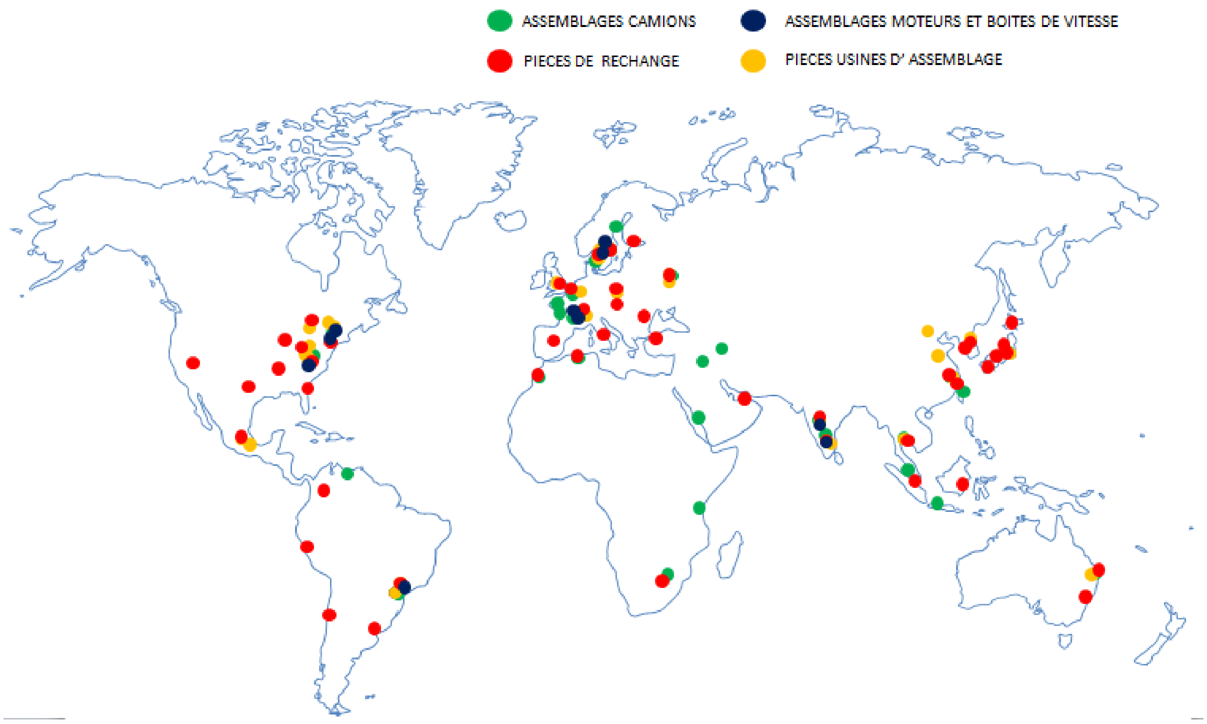


Figure 4: Volvo GTO facilities worldwide

3.2 Volvo France Powertrain (appendix 8.1)

The facility I worked in is one of Volvo's powertrain plants. There are seven powertrain facilities in Volvo Group: Ageo (Japan), Hagerstown (United States), Skövde (Sweden), Köping (Sweden), Curitiba (Brazil), Venissieux (France) and one in India. I was working in the one in Venissieux that produces powertrains for several brands and vehicles:

- Engines for Volvo Trucks, Renault Trucks and UD Trucks
- Marine and industrial engines for Volvo Penta

More than 700 hundred employees are working in the Venissieux powertrain plant and almost **50,000 engines are produced each year**.

The Venissieux powertrain facility executive committee is represented on the figure below:

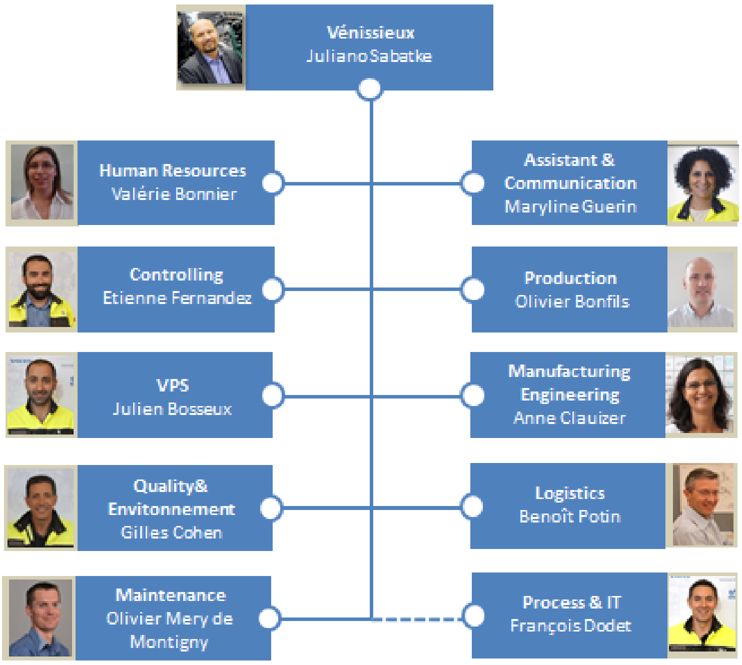


Figure 5: Venissieux powertrain plant organization

There is a facility director and ten departments being the human resources, communication, finance, production, VPS (Volvo Production System), Manufacturing Engineering, Quality and Environment, Logistics, Maintenance and the Process and IT department with a functional link.

3.3 The logistic department

I performed my internship in the logistic department that is composed of several departments. Its organization is the following:

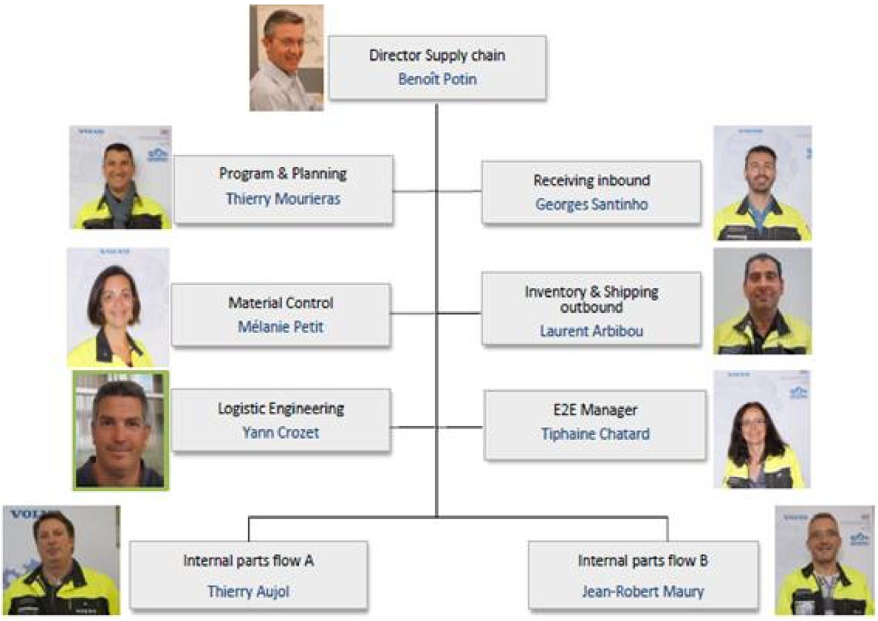


Figure 5: Logistic department organization chart

3.3.1 Material control

The material control department **manages and supply parts** while controlling the costs and the high level of service at the right time. The Venissieux powertrain plant receives parts from 475 suppliers from 32 countries. Almost 5,000 different parts are used to assemble the engines representing a stock value of ten million euros.

3.3.2 Program and Planning

The program and planning team is in charge of **receiving the customers' orders and plan the production on time according to the orders received**. Thus, its three main activities are to order, to plan and to program the engines production. It manages 250 to 300 orders a day and delivers powertrains to 25 delivery sites and seven customers.

3.3.3 Receiving Inbound logistics

This department **unloads, receives and stores the parts** used to produce the engines. The plant receives approximately 35 trucks each day and has to manage 1,300 pallets per day. The department is also in charge of kits and parts supply, meaning the preparation of kits, the quality and the vehicle of roads repairs.

3.3.4 Internal part flows

This team is the one with the highest number of collaborators. Thus, almost seventy forklifts trucks operators **prepare and deliver parts to the production line**. Six hundreds pallets and 1,700 small packaging (dynamic packaging) are delivered by little trains and fork lift trucks. This team is also in charge of sequencing 1,800 parts directly in the warehouse for the supply of sequenced parts on the production line. Finally, it also cleans, folds and sends back to suppliers almost 600 pallets per day.

3.3.5 Internal material control and shipping outbound

The IMC team **plans and manages inventories** on parts and engines. Thus, 4,860 cycles counting and three inventories for nine hundred engines are done.

This department is also in charge of the **internal flow** meaning moving the engines inside the plant and the **outbound or delivery flow** that is to store and ship the engines to the customer. Twelve trucks are shipped each day representing almost 300 engines.

3.3.6 Logistics engineering

This department has three main activities:

- **Packaging** : defining and optimizing the packaging according to the factory prerequisites, negotiating with the suppliers and deal with the defects
- Managing **projects of continuous improvements** on the logistic scope
- Manage **product project** and **industrial projects**

3.3.7 End-to-end supply chain

The main goal of the End-to-end supply chain is to **load and develop activities within the three components of the supply chain** based on the Volvo Operation Concepts, gathering all the best practices in Volvo Group.

Thus, the E2E department is managing continuous improvements projects on:

- **Inbound flows:** optimizing the transports and the packaging received from our suppliers
- **Internal flows:** reducing the engines' work in progress
- **Outbound flows:** optimizing the transports shipped to the customers

My thesis project was performed in that last department. The specificity of this department is that it was created in 2017, following Volvo's wishes to reduce the losses and give a new dynamic to cost deployment. Thus, I was part of this small department along with my supervisor and another trainee.

4. Project description

4.1 Project scope

As mentioned previously, the End-to-end department was recently created following the wish of Volvo to reduce supply chain costs. In fact, since the economic crisis of 2008, AB Volvo group have had the willingness to free cash flows, resulting in the increase of the group global logistic costs. The Venissieux powertrain plant was producing in just-in-time in order to minimize storage costs particularly. However, beyond stock shortages risks, important losses were noticed on logistics costs, particularly on transport costs. Working in just-in-time infers receiving the parts the plant needed on a daily basis and, thus, led to a non-optimization of transports and packaging.

Thus, in most of powertrain plants, an End-to-end department was created these past years. In fact, the regional organization work, headquartered in Sweden, permitted the **supply chain losses identification** of each powertrain plant. These losses are currently recorded in a C-matrix (cf. vocabulary and definitions). In response to these losses identification, the Venissieux End-to-end supply chain department was created to reduce it, on three main aspects:

- **Inbound flows losses**: optimization of transports and packaging sourced from the powertrain plant suppliers
- **Internal flows losses:** reduction of all internal losses identified (Work in progress, 3M…)
- **Outbound flows optimization:** Optimization of the transports' tours and filling of the trucks leaving the Venissieux powertrain plant towards the plant's customers

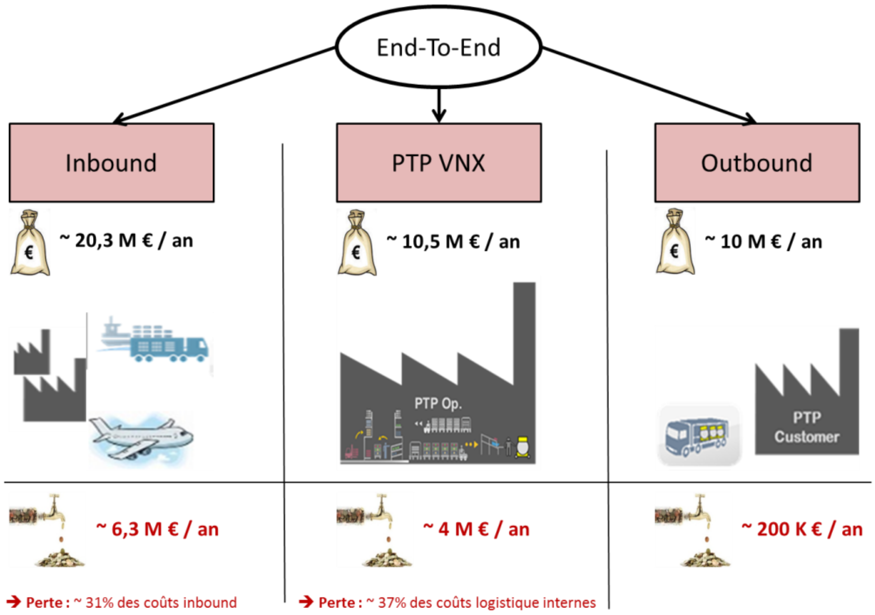


Figure 6: Costs and logistic losses identified

The figure above highlights the costs and losses identified on the three components of the supply chain. On the inbound flows, logistics costs amounting more than **20 million euros** were identified with huge losses of **6.3 million euros**, being 31% of the inbound logistic costs. The inbound logistic costs include 15 million euros for the normal transports and 5 million euros for emergency transports.

In order to work on these losses, my external flow optimization mission focused on the inbound flows of the powertrain plant.

4.2 Thesis argument

The losses identification by the regional organization allowed the End-to-end department to visualize the occupancy rate of the trucks arriving in the powertrain plant.

On the figure below is shown the average product/air/packaging distribution on the inbound trucks. Thus, we can notice that the engine plant pays to transport a majority of products but also a lot of air (22%) and packaging (21%).

Figure 7: Average Product/air/emballage distribution on the inbound trucks

My missions focused only on normal transports. To compute the air loss, the transports booking information are used, being the weight, the volume and the number of pallets.

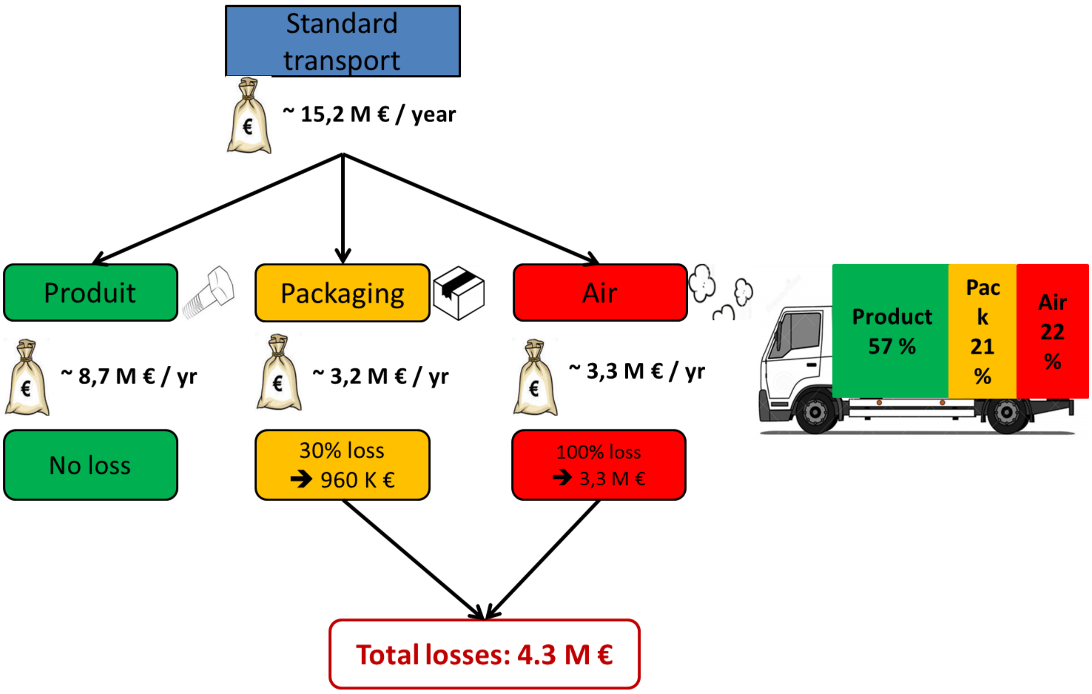


Figure 8: Costs distribution and losses identification

Thus, the payweight (cf. vocabulary and definitions) is the maximum between the booked weight (products and pallets) and the volume of the transported pallets. On the one hand, if the booked weight is higher than the volume of pallets converted into a weight, Volvo pays the booked weight. There is no air transported. On the other hand, if the volume of pallets is greater than the booked weight, the difference between the weight corresponding to the volume of the transported pallets and the booked weight is the air weight. The results can be seen on figure 8.

We considered the air as a deadweight loss which contributes to 3.3 million to the inbound logistics losses. Moreover, the End-to-End department also considered a packaging loss. The packaging are of course necessary to protect and transport the parts but there are not necessarily optimized. Thus, losses amounting 30% of the packaging costs were also recorded in the C-matrix, for **a total loss of 4.3 million euros on the inbound flows**.

Which are the levers to reduce the inbound logistics losses thus reducing the air and packaging shares on the inbound transportations of Volvo Venissieux engine plant?

4.3 Solutions identification

In response to this issue, the End-to-end department manages a continuous improvement project on the identified inbound losses. At Volvo, the continuous improvement projects are managed following a Kaizen methodology (cf. Vocabulary and definitions). A kaizen hierarchy exists depending on several criteria like the complexity of the analysis, the mobilized team, the estimated duration of the project or the potential savings identified (cf. figure 9).

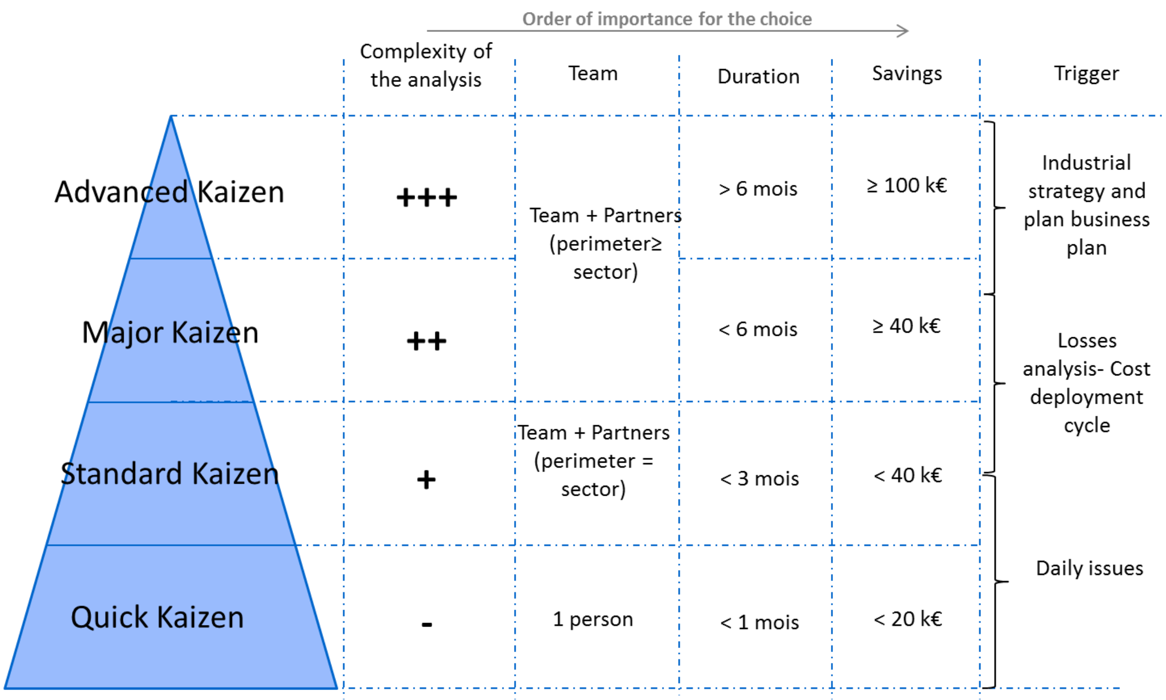


Figure 9: Kaizen hierarchy

In view of the losses' amount, of the project's duration and the resources needed to solve it, the End-to-end department opened an **Advanced Kaizen** (cf. Appendix 8.2) entitled "Reduction of the air and packaging loss on the inbound transports". The Kaizen methodology was used in order to structure the problem, to analyze the root causes and to propose a corresponding and consistent action plan to answer the identified problem. The methodology is used so that every Volvo collaborators follow the same process and a common way of structuring the projects.

A kaizen is composed of **eight steps** covering the Plan-Do-Check-Act continuous improvement method.

- **The problem**: this part consists of describing the problem using some project management tools like a “5W” and explaining why this subject was chosen
- **The cause analysis**: this step consists of listing the potential causes of the problem and finding the root causes, using tools like the “5 why” for instance
- **Objective**: This step aims to find a “SMART” (Specific, Measureable, Achievable, Realistic, and Time-sensitive) objective
- **Action plan**: The action plan responds to the problem and the cause analysis by defining a list of actions and tasks and by planning each activity, generally using a Gantt
- **Result monitoring**: This part is crucial in order to follow and monitor the result of the project. It consists of defining some key performance indicators in order to monitor the results of the project
- **Confirmation**: This step aims to compare and validate the result obtained with respect to the target
- **Standardization**: This part aims to capitalize the results of the project by doing instruction sheets and activity diagrams in order to ensure a traceability and a capitalization of the work done to easily form the following collaborators
- **Expansion**: This step aims to sustain the project by expanding it on other appropriated cases

Figure 10: Kaizen formalism

4.3.1 Advanced Kaizen problem and root cause analysis

This project deals with inbound transports optimization of the powertrain plant. As said previously, the identified losses are of 4.3 million euros.

The identified issue is **the excess of air and packaging transported in the inbound trucks**.

To understand correctly the issues, it is important to visualize the packaging types that are used to handle the pieces and supply the production line. Thus, we can distinguish two types of packaging, the large packaging (GE) and the small ones (PE). The GE packaging or static packaging are pallets containing bulk products (figure 11), thus not having sub packages inside. The GE pallets are generally supplied on pallets to the production line. Some pallets are also sequenced in the warehouse in order to provide kits directly to the production line and free some space on the line.

The sub packages (PE) or dynamic packages are carton boxes, Volvo blue boxes standards (figure 12 and 13) or all other types of providers' carton boxes that are put inside a pallet. These sub packages are mainly stored in the supermarket (cf. vocabulary and definitions), after being removed from the pallet. High runner parts conditioned in sub packages might also be stored directly in the warehouse on the pallet. These sub packages are supplied to the production line either on a pallet or with PE trains bringing only PE packaging to the line.

Figure 11: Bulky and light parts and heavy standard pallets

Figure 12: Incomplete blue boxes pallet

Figure 13: Non-optimized blue box

In order to ensure a complete understanding of the situation and to find the right solutions, the department found out the **excess of air and packaging causes**. Thus, as detailed on the figure 14 presenting a five why analysis, the air losses might come from bulky or light parts implying a volume of the pallet greater than the booked weight. It may also come from a non-optimization of packaging too. Therefore, numerous pallets have low filling rates with products that are not optimizing the pallet. Moreover, packaging losses also come from standards of pallets that might not be adapted to the parts, because these standards are too heavy. Incomplete pallets must also lead to packaging losses.

Therefore, the four main problems leading to an air loss or a packaging loss are **the bulky and light parts**, **the heavy pallet standards**, **the packaging not full** and **the incomplete pallets**.

The figure 12 underlines an incomplete pallet issue. The pallet contains four blue boxes, with one box containing the parts and three empty blue boxes. The figure 11 highlights a double issue; the part is bulky and light and this problem is combined with a heavy standard pallet that is not necessarily adapted to this typology of part. Finally, the last issue can be seen on the figure 13 that is stressing out one of the main issues in the plant, being the packaging not full.

Thus, the fact is that the packaging type, the product type and the net requirements (call off) are often not aligned. Multiple reasons explain this reality. First, Volvo internal rules impose a maximum weight of twelve kilograms that is possible to handle manually. Therefore, blue boxes or carton boxes weights must not exceed this threshold. Limitations on weight concern also the storage of the pallets in the warehouse. Finally, the group's will of freeing cash flow since the 2008 economic crisis drove the engine plant to minimize its stocks and work with just-in-time flows leading to plenty of non-optimized trucks.

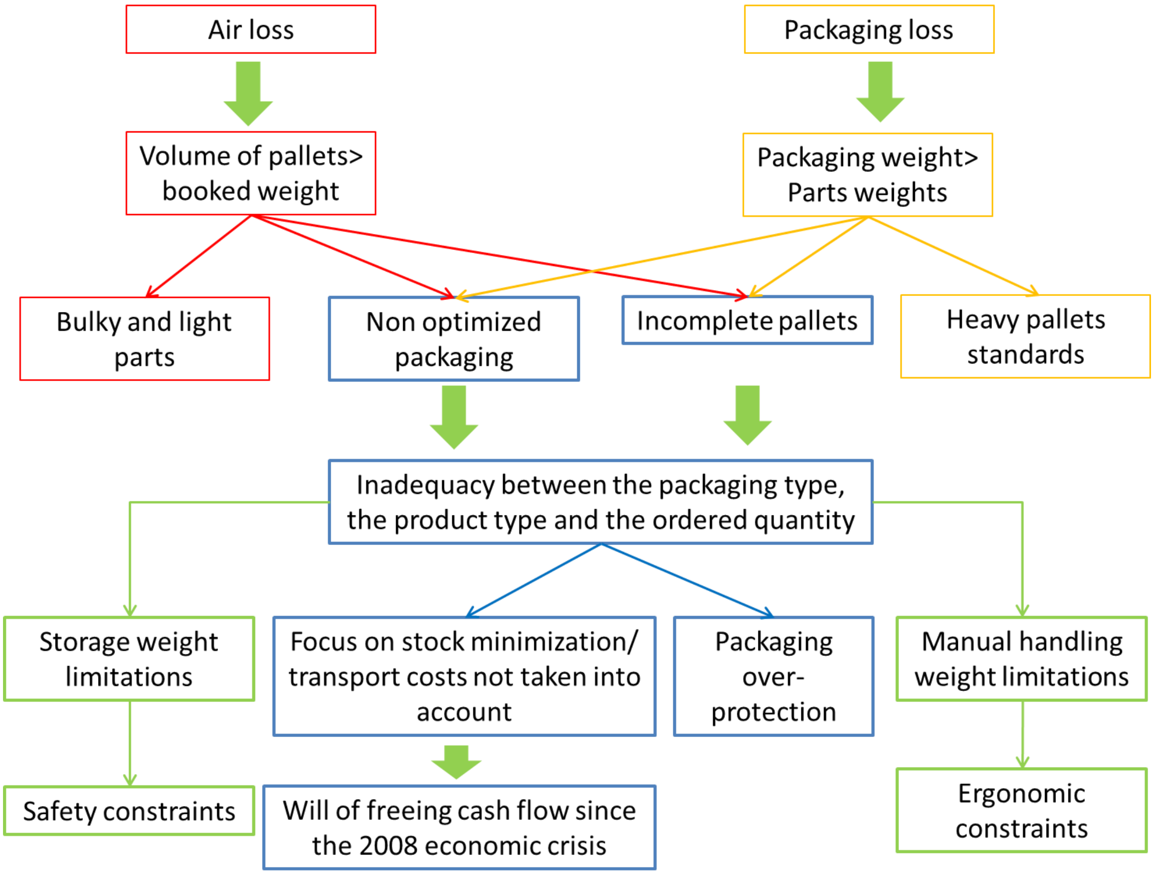


Figure 14: Root cause analysis

4.3.2 Objective

In order to reduce inbound losses, the regional organization fixed an objective of **reducing the standard transport costs by 15% on a three years period**, being 765,000 euros per year.

4.3.3 Solutions

Once the root cause analysis was completed, the End-to-end department found out the possible solutions to set up depending on the problem identified and responding to one of the problem's root causes being the minimization of stocks since 2008. In order to solve this problem and reduce the internal and inbound losses, different solutions were established. For instance, in the case of figure 13, an optimization of the packaging or a packaging better adapted to the part's typology is preconized. Moreover, the case of figure 12 underlines some free boxes on the pallet. Thus, it is possible to mix different part numbers on a pallet to fill the empty boxes. It is also possible to do small call off changing the minimum/multiple order quantity to complete the layers of boxes on the pallet. Finally, a work on the transport frequencies must also be an answer to non-optimized transportations. For now, solutions to bulky and light parts issues and to the heavy standard pallets are put aside because it requires a longer process to conceive new lighter pallets and new packaging.

To sum up, the five different solutions identified (figure 15) are:

- **Fill in more the packaging**: put more parts in the current packaging in order to optimize it
- **Change the packaging**: modify the packaging so you can put more parts in it or change to a smaller packaging

- **Reduce the transport frequencies**: Reduce the number of pick up per week of a provider in order to receive pallets that are better optimized
- **Set up mixed pallets**: Put different part numbers inside the same pallet
- **Smart call off/MOQ**: Order more boxes of the same part to fill more the pallet and avoid transporting empty boxes

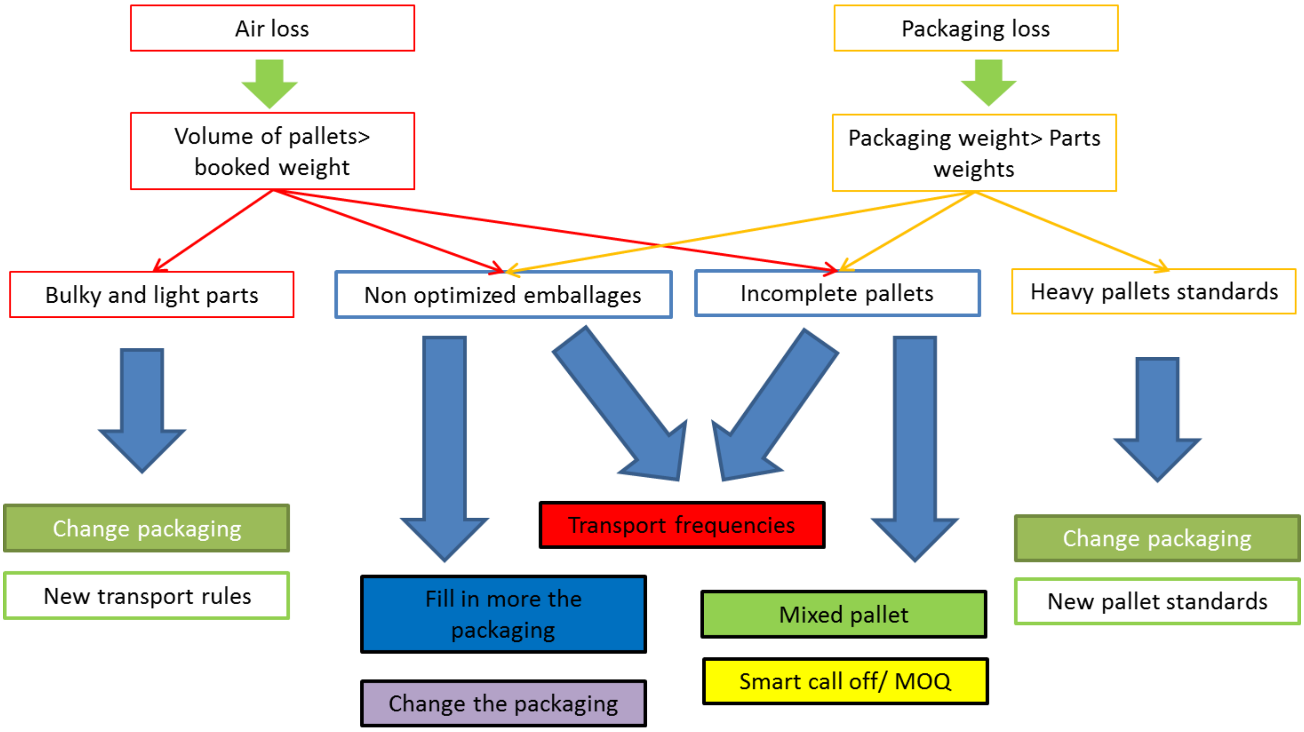


Figure 15: Solution tree

Once the department found out the solutions to set up, we established an action plan in order to treat these consequent losses. The solutions to set up depending on the packaging type, we decided to attack the problem per packaging typology.

My first action was to define, with Tiphaine Chatard (E2E manager) and Nicolas Avril (End-to-end apprentice), an effective E2E IN strategy. This strategy, formalized in the form of a process (figure 16), allows us to better understand how to treat the consequent transport, packaging and material handling losses and to act effectively to reduce it.

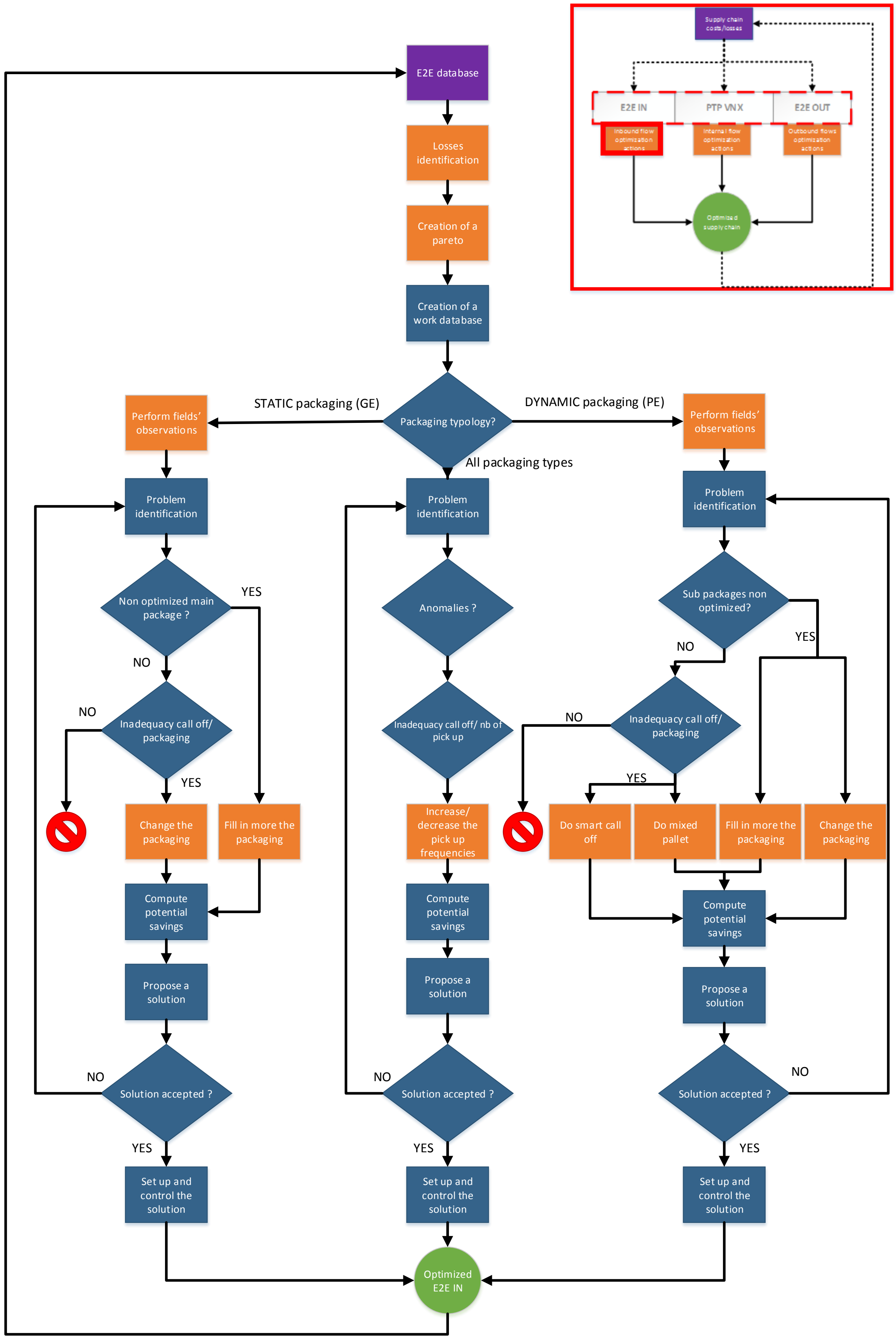


Figure 16: E2E IN process

The process is divided in three branches depending on the packaging typology and the solutions to set up. My thesis subject concerned the **reduction of the air and packaging losses on the dynamic packaging (PE), particularly the Volvo carton boxes and the Volvo blue boxes**.

Therefore, we identified four different kinds of solutions for the dynamic packaging coming from two main issues. First of all, if the problem comes from a non-optimization of the sub packages, two solutions might be applied that are to change the packaging to a more adapted one and fill in more the packaging, completing the sub packages with more parts. In the case of an inadequacy between the call off and the packaging, we identified two possible solutions: the smart call off and the mixed pallet solutions. These two solutions will be detailed further in this report.

5. Major Kaizen realized

5.1 Plan the project

As said previously, my main mission during this thesis concerned the optimization of small packaging pallets. Furthermore, during the majority of the thesis, I worked on the optimization of the incomplete pallets containing sub packages. In order to complete this project, I used the Kaizen methodology and I managed a major kaizen related to the advanced kaizen that I presented in the part 4.

5.1.1 Major kaizen issue

I entitled this major Kaizen “**Reduction of the number of blue boxes entering the Venissieux powertrain plant**” (appendix 8.3). Thus, this project aims to optimize pallets containing blue boxes by completing the layers of boxes on the pallets, such to transport and handle only full blue boxes.

Let’s take an example of a pallet carrying V750 blue boxes, being a typology of blue boxes used in the engine plant. It is necessary to dispose four blue boxes per layer on a K0 pallet and up to three layers per pallet.

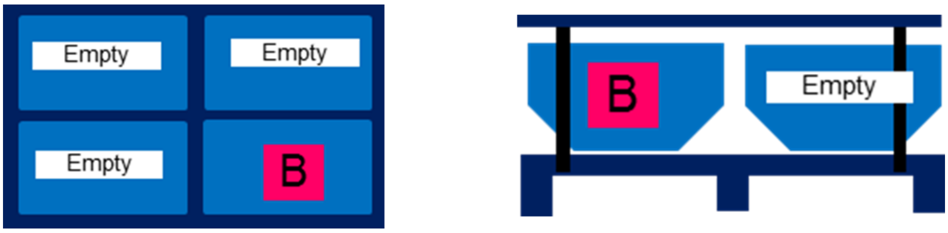


Figure 17: Above and side view of a pallet containing V750 blue boxes

Figure 18: Example of a received pallet with three empty blue boxes

At the receiving inbound department, it is very common to receive pallets containing, for instance, one full blue box and three empty blue boxes. This situation leads to transport and handle three empty blue boxes, with air and packaging losses as a consequence.

The identified solution being the same for Volvo standard carton boxes (V100 and V156), I extended this *major Kaizen* to the **optimization of pallets containing carton boxes**. Let’s take another example concerning a K1 pallet containing carton boxes. It is possible to put thirty carton boxes V100 in this type of pallet. On figure 19, you can see that the pallet arrived with only two carton boxes V100. Thus, there is an important air and packaging loss in this pallet too.

Figure 19: Non-optimized carton boxes pallet

Therefore, the project consists **in optimizing incomplete carton boxes and blue boxes pallets entering the plant.**

5.1.2 Requirements and constraints related to the project

The most important requirement of this project is to reduce the number of blue boxes and to optimize the carton boxes pallets arriving in the plant. Thus, the objective is to create a better link between the packaging that is used to protect the parts in the trucks and the net requirements.

Being a multidisciplinary project, several constraints have to be taken into account because the solution that I proposed has positive but also negative impacts on other departments. Thus, it is important to take into account these negative impacts and work with the collaborators in order to minimize it.

5.1.3 Data mining and blue boxes analysis

The first step I did in order to clarify the subject and its scope was to realize a data mining. This first action helped me problematizing this subject while I was still in training.

This data mining phase was essential in order to understand how much part numbers and suppliers were concerned by my project and in order to define a consistent model area to attack the losses.

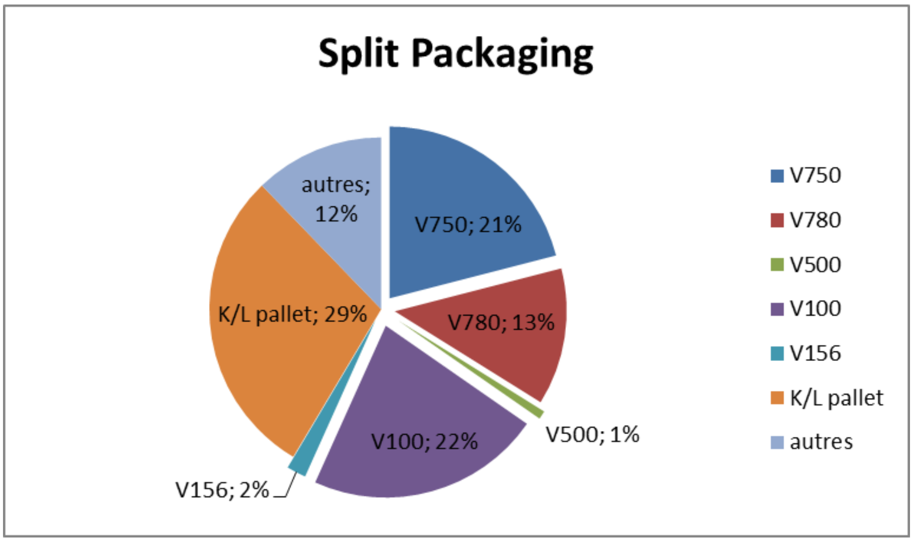


Figure 20: Packaging split

Therefore, my project's scope (blue boxes V750, V780 and V500 and carton boxes V100 and V156) represents 59% of all part numbers that the powertrain plant receives, being 2,189 parts for which an annual need is identified.

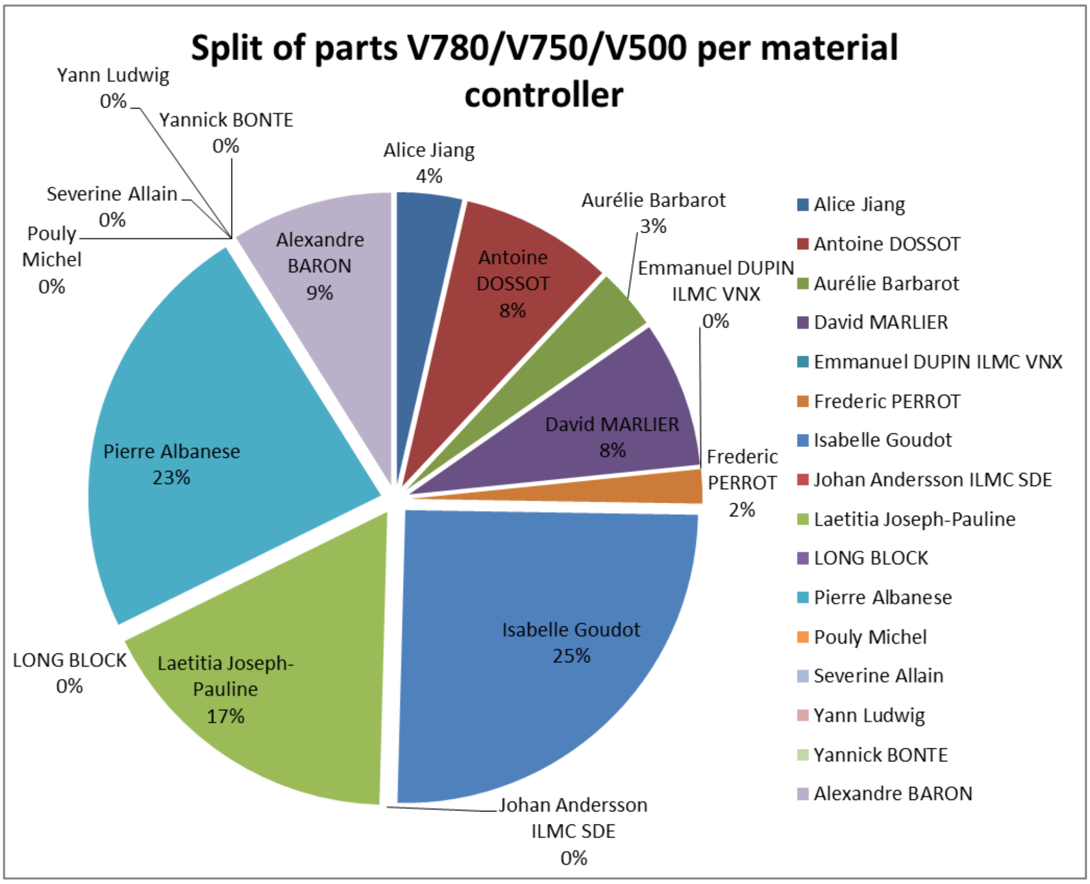


Figure 21: Split of the blue boxes parts per material controller

To have a better visualization of the losses on the blue boxes, I did an **estimation of the number of empty blue boxes entering the plant**. This analysis was done using the actual received packages with one month historic. Then, I quantified per typology of packaging the number of empty boxes arriving in a month and extrapolated this figure in order to obtain a yearly number of empty boxes out of the total blue boxes entering the plant. In fact, identifying the losses related to my project was essential to visualize the extent of the losses and to know if this major kaizen had important potential savings.

On the figure below, you can find the result of this analysis. Therefore, at the beginning of the project, the powertrain plant was receiving approximately **15% of empty blue boxes** out of the total number of boxes entering the plant, **being more than 68,000 empty blue boxes per year**.

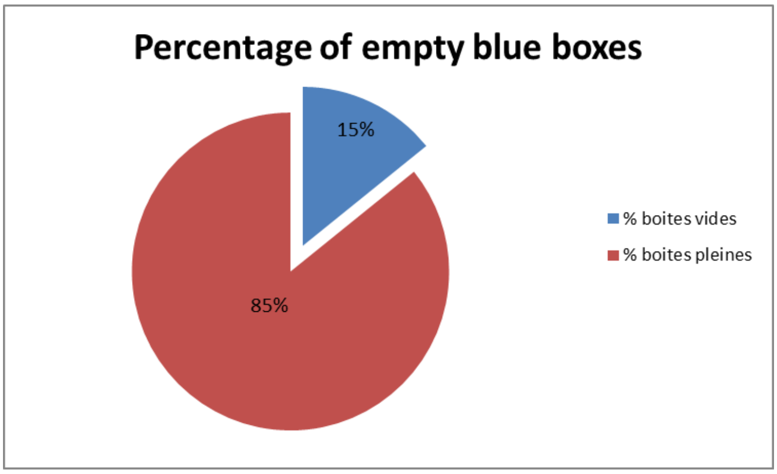


Figure 22: Initial percentage of empty blue boxes

5.1.4 Inbound flows presentation (Appendix 8.4)

My project impacting the engine plant inbound flows, I then needed to clarify the different inbound flows, from the pallet receiving to the production line supply.

First of all, from an operational point of view, two departments are involved: the receiving inbound department and the internal part flow department. The first one is in charge of receiving the pallets and storing it in the corresponding warehouse and the second one to bring the pallets to the production line, using a pull flow and a Kanban system.

There are approximately 1,300 pallets entering the plant each day. Several internal flows are possible. Mainly big parts, as long blocks (semi-finished engines) arriving from India, are stored in the warehouses SMM3, SMM9, SMHG and STHG, representing 110 pallets per day. These pallets are brought to the production line using forklifts. About 100 pallets are sent to the SQF department, for quality checks and then redirected towards the different warehouses. Furthermore, about half the daily pallets containing bulk products, the GE pallets, are sent to the STM1 or STM6 warehouses using forklifts. Some parts are sequenced (cf. Vocabulary and definitions) directly in the warehouse and brought as kits to the point of use, using GE trains (long trains transporting pallets). Other bulk products pallets are sent directly, without sequencing, to the point of use with the GE trains. The flows I just described concern the GE packaging, or static packaging that are out of my scope.

The flows I'm impacting with my project are the one of PE packaging, or dynamic packaging (bottom part of the appendix 8.4). About 600 pallets arriving per day contain sub packages (blue boxes or carton boxes for instance). Several flows are possible for PE packaging. The first one, representing the majority of the blue boxes pallets entering the plant, is the SPLIT flow. The pallets are brought from the tarmac to the SPLIT area and are then "burst", separating the empty blue boxes for a return flow from the full boxes for storage. The blue boxes or carton boxes are then stored in the supermarket (SPMK), that exclusively contains small packaging. Small packaging trains (PE) come and take the PE packaging when needed by the production line. A relabeling activity might be necessary for suppliers that send nonconforming ASN (cf. Vocabulary and definitions). After the relabeling activity, the dynamic packaging are also stored in the supermarket. Furthermore, a repacking activity is also used for specific point of use requirements, meaning that the received packaging is changed into a Volvo standard packaging (Volvo carton boxes, blue boxes…). The repacked parts are also stored in the supermarket. Finally, for some high runner parts, the storage of the main package (containing the sub packages) is possible in the STM1 warehouse for a supply with GE trains, or in the

SPM1 warehouse. The boxes stored on the pallet in the SPM1 are then picked for a direct supply to the point of use with PE trains.

5.1.5 5W analysis

The data mining and blue boxes analysis helped me problematizing the subject using the 5W tool. The phase described in the part 5.1.3 was useful in order to bring some figures concerning my project. Thus, the powertrain plant was, before the beginning of the project, transporting and handling 15% of empty blue boxes representing 68,000 boxes annually. It was urgent to work on these important losses causing useless logistic handlings, a non-optimization of the inbound transports and an inefficient use of the packaging.

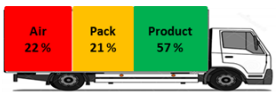
Initial problem (Advanced Kaizen issue): Air and packaging transportation in Vénissieux powertrain plant inbound transports		
What	**What is the problem?**	Transport and handling of empty blue boxes and uncompleted carton boxes pallets in the trucks coming from the suppliers
When	**Since when the problem was detected/appeared?**	Since 2017 and the creation of the End-to-end service
Where	**Where was it detected?**	At the inbound receiving service At the End-to-end service
Who	**Who detected the problem?** **Who else is concerned by this problem ?**	Inbound receiving service → at the split area (area to split up full blue boxes for their entrance in the warehouse from empty one for a return flow End-to-end service Concerned services: Inbound receiving, warehouse (logistic engineering), material control, packaging, transport
How much	**How many times does the problem appear? What is the trend?**	35 trucks/day with 22% of air and 21% of packaging → 55 000 empty blue boxes annually (15% of the entering blue boxes) 
How	**How the problem was detected?**	**Receiving inbound**: at the split area (area to split up full blue boxes for their entrance in the warehouse from empty one for a return flow **Au service E2E**: Regional organization file calculating the gap between the booked weight and volume of received pallets
Why	**Why is it a problem?**	• Non optimized transportation • Useless logistic handling • Non optimized packaging • Net requirements administrative costs

Figure 23: 5Ws analysis

5.1.6 Dynamic packaging payweight analysis

Then, in order to better define the scope of my project regarding the total losses identified by the End-to-end department (part 4.2), I made a complementary payweight analysis to the one that was done by the regional organization. The objective of this analysis was to identify the contribution of the small packaging on the inbound logistics costs and losses.

The result of this study is presented on the figure 24 below.

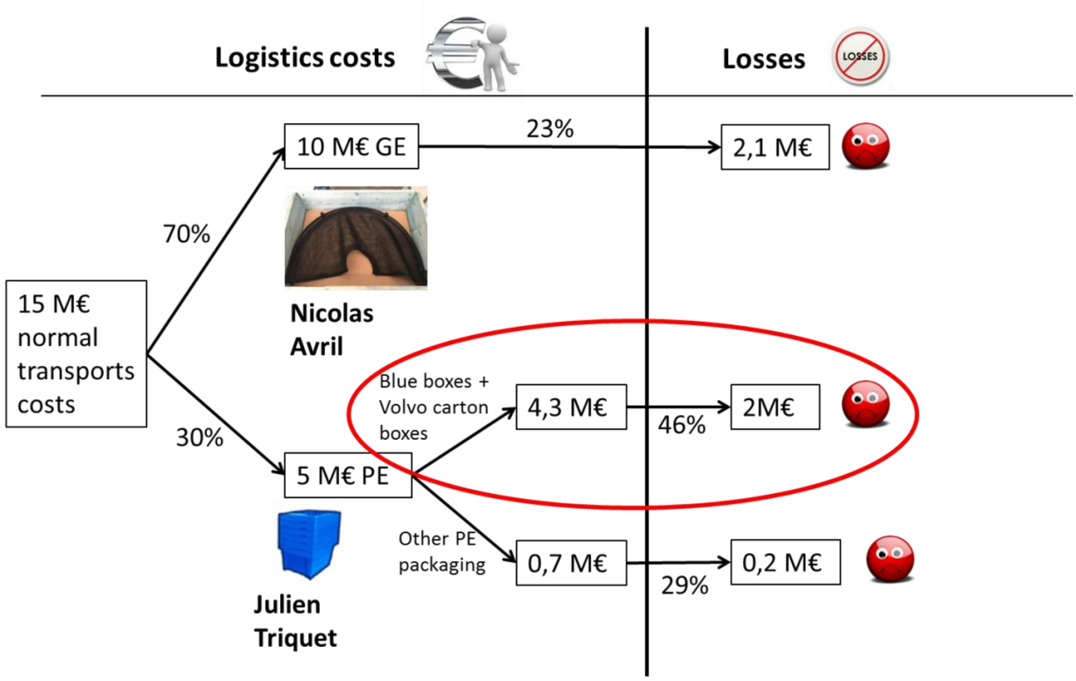


Figure 24: Cost and losses per packaging typology

Therefore, my project's scope represents 30% of the inbound logistics costs, being **approximately 5 million euros**. Furthermore, approximately 50% of the total inbound losses are dynamic packaging losses that are mainly due to blue boxes and Volvo carton boxes air and packaging wastes.

5.1.7 Root cause analysis

To define a consistent action plan, I first needed to analyze the causes of the empty blue boxes and incomplete carton boxes pallets transportations.

In this purpose, I realized a five why analysis. You can find the result of this analysis on the figure 25 below.

PROBLEM	WHY	WHY	WHY	WHY	WHY
Pay to transport and handle air and excess of packaging on the inbound transports	Empty blue boxes transortation in the inbound trucks	Pallets' wedging in the trucks	Balance and preservation of the parts inside the trucks		
			Inconsistency between the net requirements and the typology of packaging used	No communication between the packaging and the material control service	
				Focus on stock minimization and transport costs not taken into account	Since the 2008 economic crisis, will of freeing cash flows minimizing the stocks

Figure 25: 5 why analysis

Starting from the initial problem, Volvo pays 4.3 million euros to transport and handle air and excess of packaging in its inbound transports. In the specific case of PE packaging, the engine plant is carrying empty blue boxes in its inbound trucks, explaining the majority of the PE losses. This phenomenon is due to the fact, that for **a good balance and preservation of the pieces in the trucks** the pallets have to be stackable. Therefore, in the case of figure 12 for instance, whatever the quantity of parts and thus the quantity of full boxes needed by the plant, there has to be four boxes per layer and up to three layers on a pallet.

Why is there such an inconsistency between the net requirements, being the number of full boxes ordered to the supplier, and the typology of packaging used?

I found two explanations to this phenomenon. The first one is that there are two different departments involved that are not necessarily communicated to each other. The packaging department is in charge of defining the typology of packaging to use and the quantity of parts to put inside the box or the carton box and the material control is in charge of ordering the parts to the supplier according to the net requirements calculations. However, the material controllers have no idea of the typology of packaging used to protect and transport the parts, and thus, there are not ordering parts according to the typology of packaging but only according to the net requirements. Consequently, in the received pallets, there might be empty blue boxes or not fully optimized carton boxes pallets.

The second cause of this inconsistency is the focus on stock minimization. In fact, the transport costs were not taken into account and the plants were only focusing on liberating internal cash flow by reducing stocks and working in just-in-time. This will of freeing cash flows started with the economic crisis of 2008 and the engine plant, like all sites in the group, received orders to minimize the storage costs at the expense of the transports costs. This is the root cause of my problem and the fact that the pallets received are not optimized.

5.1.8 Objective of the project

Focusing on the optimization of the blue boxes pallets, the objective that the End-to-end department set was **to reduce by half the number of empty blue boxes entering the plant**, by the end of my mission.

Thus, as a result of the data mining analysis that I conducted, the powertrain plant is receiving approximately 68,000 empty blue boxes each year. The objective is to reduce this figure by half, obtaining approximately **34,000 annual empty blue boxes** with the to-be situation, meaning **7.5% of empty blue boxes**.

5.2 Do: the action plan

5.2.1 Choice of the solution

First of all, the issues identified being the transportation of empty blue boxes and incomplete Volvo carton boxes pallets, several levers were possible to treat the air and packaging losses (figure 16). The root cause analysis that I made highlights two areas of improvements. The first one is to fit the packaging type with the net requirements and the second one is to find a solution to the lack of communication between the packaging and the material control departments.

For the second area of improvement, I identified that the main issue was that the responsibility of each department concerning the adequacy between the call off and the packaging is not clear enough. This part will be discussed later in this thesis in the expansion part of this major kaizen.

For the first one, in order to fit the call off with the packaging used, several solutions were possible.

5.2.1.1 The mixed pallet solution

The first and preferable one is to ask the provider to send mixed pallets. As explained in the part 4.3.3, this solution consists of putting different part numbers on a single pallet. For instance, if the supplier has a sufficient density of part numbers, he can put four full boxes V750 containing the parts A, B, C and D on a pallet instead of sending only one full box containing part B on a single pallet, one full box containing part A on another pallet and so on.

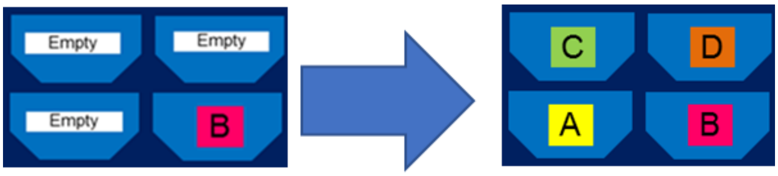


Figure 26: Mixed pallet example(above view)

This solution is ideal because it results in an optimization of transportation, reducing the transport costs and the packaging costs, reducing also the internal material handling without increasing the inventory level for the concerned parts. Therefore, as the plant is able to manage mixed pallets, this solution appears to be the best one.

However, the main disadvantage of this solution is the time needed to implement it. In fact, the feasibility of the mixed pallet solution depends on the supplier. Does he have a sufficient density of parts in order to optimize correctly the pallets? Is its information system allowing the mixed pallet? Is it an EDI supplier (cf. vocabulary and definitions)? Does he correctly label each box in the as-is situation? Therefore, despite this solution was the best one to set, it seemed complicated to spread it rapidly because there are many constraints to take into account and 250 suppliers to treat. I decided to push this solution on some suppliers that met all the necessary criteria and in parallel to establish another more efficient solution.

5.2.1.2 The smart call off/MOQ solution

The chosen solution is the smart call off, or MOQ (Minimum/Multiple order quantity). Increasing the MOQ allow the plant to optimize the call off and to fit the ordered quantity with the packaging used.

Let's take the example of a pallet containing V750 blue boxes. It is possible to put four boxes per layer and up to three layers on the pallet. A common as-is situation was to receive a single box on the pallet because the net requirements calculation identified this need. In that case, if the plant yearly need is sufficient, it is plausible to increase the multiple order quantity and ask the supplier to send a multiple of four boxes to complete the layers on the pallet.

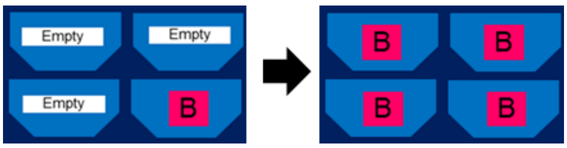


Figure 27: As-is and to-be situation using the MOQ solution

We can imagine a similar solution for carton boxes; increasing the minimum order quantities to increase the filling rates of the pallets, for instance ordering ten carton boxes at a time in the case of figure 19.

This solution allows, as for the mixed pallet solution, the reduction of transport costs, the reduction of packaging and material handling costs (reduction of the annual number of pallets to handle) but results in the increase of the inventory level for the treated parts. In fact, instead of receiving one box, setting a MOQ equal to four will imply a four boxes delivery, impacting negatively the inventory and possibly creating peak loads in the storage of parts in the supermarket. Furthermore, this solution is not adapted for low runner parts because ordering more boxes implies a very long production duration days (long storage duration before replenishment).

However, the smart call off solution presents the huge advantage to be easy to implement because it is a solution that can be applied internally, changing replenishment parameters on PipeChain (cf. Vocabulary and definitions). Therefore, the process is shorter than setting the mixed pallet solution with a supplier. Consequently, this solution was selected for most of the 250 suppliers of the scope.

5.2.1.3 Transport frequencies

Finally, working on transport frequencies is also possible reducing the number of pick up at the supplier's plant, thus optimizing the transports. This solution is possible but because of the impact of the smart call off solution on the number of necessary pick up, we decided to postpone this solution and do it afterwards.

5.2.2 Gantt of the project

I first realized a Gantt of the project to quantify its duration and the main activities to manage. The initial duration of the project was of four months with the will to end the project by the end of year 2018.

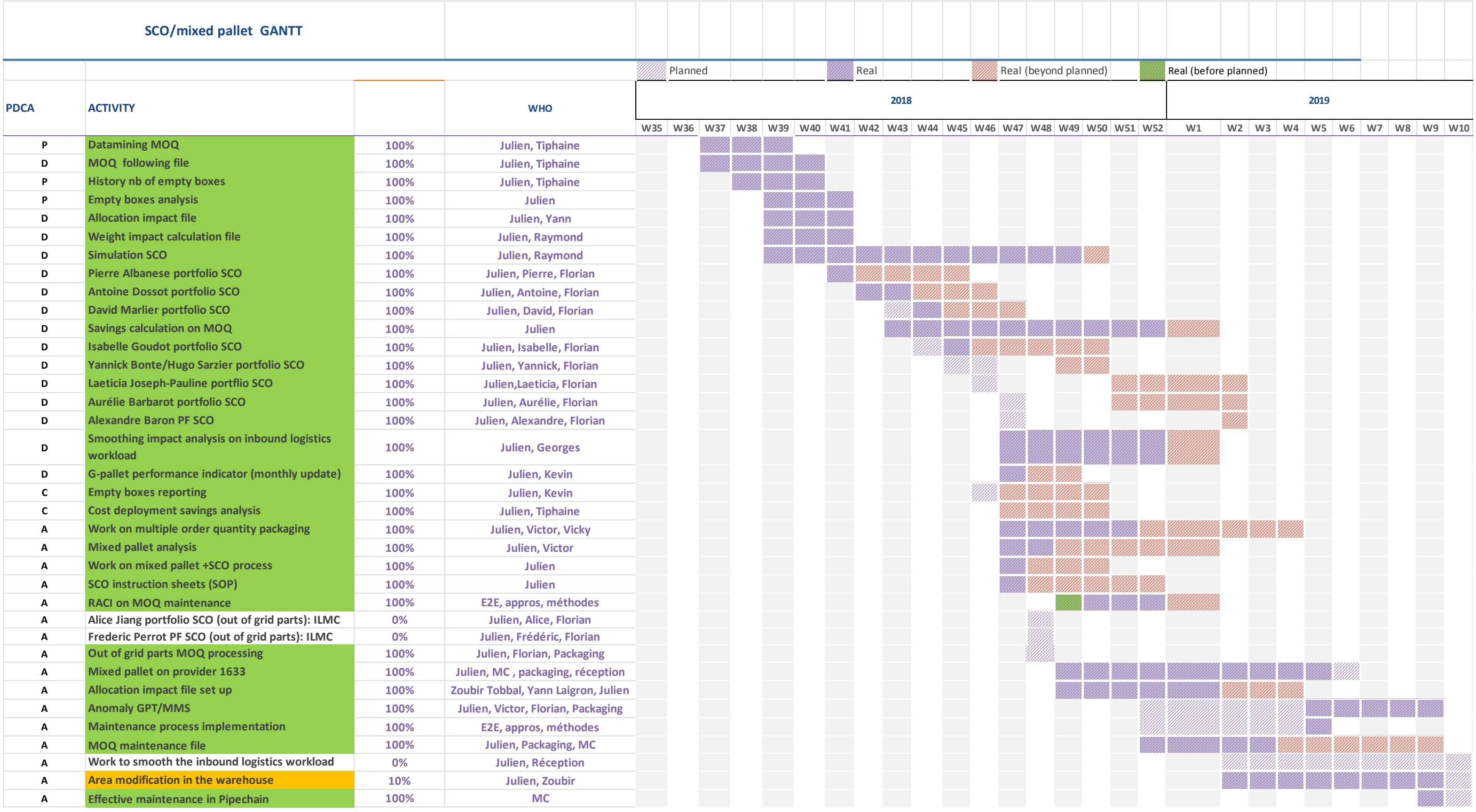


Figure 28: Smart call off and mixed pallet Gantt on the 27th February 2019

I identified two main phases to complete this project:

- The **"one shot" phase** consisting on implementing the smart call off solution on all the suppliers and all the material controllers. The planned end date was on week 52 of 2018 (Plan, Do, Check activities on the diagram)
- The **MOQ maintenance phase (expansion phase)** consisting of sustaining this major kaizen over time starting after the "one shot" phase and with a planned end date at the end of my thesis ("Act" activities on the Gantt diagram)

5.2.3 The model area

As the identified losses are consequent, it was necessary to define a model area. Based on the empty blue boxes analysis that I did, I figured out which supplier was sending the more empty blue boxes. In order to treat the losses efficiently, I decided to treat the problem per material controller because each one of them manages a consequent number of suppliers. In fact, there are 450 suppliers, of which 250 deliver PE packaging (blue boxes, carton boxes). Therefore, it would have been too long to treat the problem supplier by supplier and the easiest way to group them was by material controller.

Then, I chose the material controller's portfolio that has a significant number of blue boxes received and a high percentage of empty blue boxes with respect to the total number of boxes entering the plant. According to the figure 29, I consequently chose to start with Pierre Albanese portfolio as a model area.

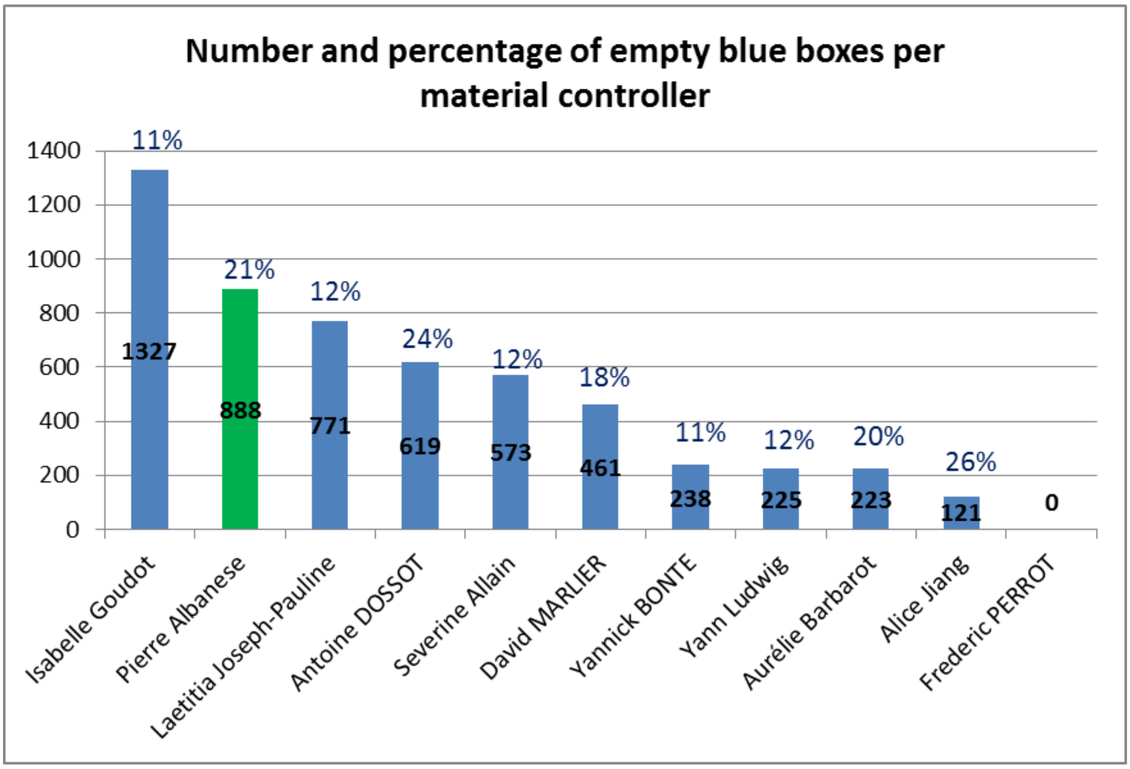


Figure 29: Number and percentage of empty blue boxes per material controller

In fact, as you can see on the above figure, Isabelle Goudot providers carry the greatest number of empty blue boxes but only 11% of the blue boxes received are empty. Pierre Albanese's suppliers transport less empty blue boxes (888 empty blue boxes in September) but a greater percentage of empty blue boxes with respect to the total number of blue boxes received from Pierre's suppliers.

Therefore, I considered that the potential for improvement was greater on Pierre Albanese portfolio and I decided to consider his portfolio as model area to implement the solution.

5.2.4 Smart call off on the model area

5.2.4.1 Smart call off simulation

The model area and the solution chosen, I first decided to simulate the potential savings on Pierre Albanese suppliers' delivering blue boxes V750, V780 and V500 and carton boxes V100 and V156, that are the only typologies of blue boxes and Volvo carton boxes that the Venissieux powertrain plant uses. In order to simulate the savings, I used a tool provided by the regional organization to all the powertrain plant that allows the calculation of the savings following the simulation of a MOQ increase.

Let's take an example for the provider number 172 that is in Pierre Albanese portfolio. On the tool, I entered the supplier and the part number. Then, the excel tool retrieved the data concerning this part. It is a part delivered on a V750 blue box. In the as-is situation on the left, we can notice that the "Inner emb Qty1" is equal to one, meaning that the minimum and multiple delivery quantities on this part are equal to one box. Below, we have some information on the number of sub packages that the plant receives yearly, the number of call off and the number of boxes received per call off. In this particular example, the plant receives 1.6 boxes on average at each call off, implying that, on average, 2.4 blue boxes per call off are empty. On the right, I simulated the to-be situation entering in the "Inner Emb Qty1" cell, the MOQ that I would recommend. For this particular part, I recommended a MOQ of four, implying a to-be situation with eighteen calls off per year and a production duration days of thirteen days meaning thirteen days of production after replenishment. Then, a savings' calculation is done, taking into account the packaging cost, the material handling cost, the inventory cost and the administrative cost of the call off. Comparing the to-be costs with the as-is ones, the simulation gives the potential pallets and financial savings. I realized the simulation for all Pierre Albanese providers' portfolio and all the part numbers.

The parts with very low annual volumes were not taken into account in order not to have too long durations between the replenishments.

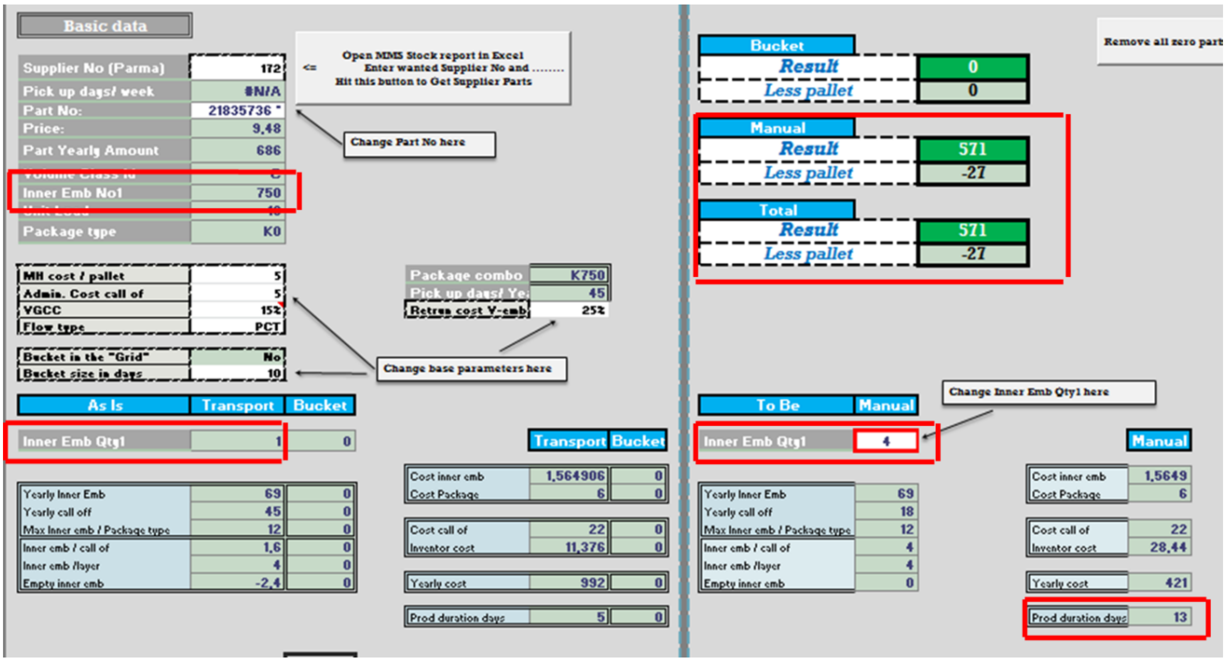


Figure 30: Smart call off tool screen

5.2.4.2 Smart call off modifications on PipeChain

I sent the list of simulated parts to the concerned material controller. He modified on PipeChain the minimum delivery quantity and the multiple order quantity parameters according to what was simulated. The material controller also made the decision not to increase the MOQ parameters on risky suppliers, to avoid worsening a situation that is already complicated, with non-conforming deliveries.

The figure 31 shows the screen on PipeChain to modify the MOQ parameters. The concerned part has a unit load of ten pieces, meaning that a full box contains ten pieces. The minimum delivery quantity was set to two, meaning we want to receive at least two boxes at each call off. Finally, the "Delivery Unit" parameter mentions that the minimum delivery quantity is also used as a multiple order quantity. As a consequence, the plant orders by multiple of two boxes or 20 pieces.

Figure 31: PipeChain MOQ modification screen

These modifications were done on all the simulated parts.

5.2.4.3 MOQ follow up file

In order to compute global savings and to follow up the MOQ modifications, I created an excel file to monitor this project. I reprocessed the data extracted from the smart call off tool and did the calculations necessary to present the project to the material controller. The important figures that I calculated are the financial savings, the number of pallets and blue boxes saved, the inventory losses and the location losses in the supermarket. Therefore, on Pierre Albanese portfolio, I identified potential savings of **85,000 euros** (internal and packaging savings) representing a **reduction of 4,512 pallets annually** and about **10,000 empty blue boxes less**.

Savings			
Savings PF Pierre	POTENTIAL	REAL	% real/pot
boxes	9794	1 016	10%
Finance (without transport) k€	85	10	12%
Transport (k€)	152,3	85,7	56%
pallets	4512	598	13%
suppliers	22	14	64%
number of parts	222	38	17%

Figure 32: Potential versus real savings on Pierre Albanese portfolio

5.2.4.4 Weight impact calculation file

However, the tool is not able to compute the transport savings. In order to do that, I calculated the payweight savings that each MOQ change would imply comparing the to-be situation with the as-is one and then sent these savings to our transport provider to get the corresponding financial savings.

The detailed calculations that I did are the following:

$$Payweight\ per\ call\ off = MAX(booked\ weight; pallet's\ volume\ converted\ into\ weight\ )$$

With, in the case of blue boxes pallets (V750, V780 or V500) transported on a K0 pallet:

$$Booked\ weight = Pallet\ weight + Product\ weight\ + boxes\ weight$$
$$= K0\ pallet\ weight + Unit\ load * Average\ number\ of\ boxes\ per\ call\ off * part\ weight\ +\ Box\ weight *\ number\ of\ boxes\ per\ call\ off$$

And

$$Pallet's\ volume\ converted\ into\ weight = (Volume\ of\ K0\ pallet + Volume\ of\ boxes) * Conversion\ factor$$

With the volume to weight conversion factor:

$$Conversion\ factor = 333$$

Finally

$$Savings = As\ is\ payweight * As\ is\ nb\ of\ call\ off - To\ be\ payweight * To\ be\ nb\ of\ call\ off$$

I computed the weight savings for each simulated part and obtained the weight savings per supplier. For Pierre Albanese portfolio, the potential transport savings represented approximately 150 k€, for **total potential savings of 237 k€.**

5.2.4.5 Allocation impact file

I quantified also the negative aspects of the MOQ changes on the supermarket storage in order to be fully transparent with the impacted departments. You can see on the appendix 8.6 the supermarket map.

The logistic engineering, in charge of defining the supermarket's organization, and the receiving inbound department, in charge of the supermarket daily management, were also reluctant regarding this project. First of all, it is important to quantify the End-to-end impact on the supermarket and see if it matches the warehouse's capacity constraints.

In this purpose, I managed to create an excel file quantifying the additional number of spans necessary to store the parts. The calculations are based on the comparison between the as-is number of boxes after replenishment and the to-be situation.

I first calculated the safety stock, being:

$Safety\ stock\ (parts) = \frac{Safety\ time\ (days)*CMJ}{Unit\ load}$ (CMJ= average consumption per day)

I then calculated the number of boxes after replenishment in the as-is and the to-be situation.

$$Nb\ of\ boxes\ after\ replenishment = Safety\ stock + Average\ nb\ of\ boxes\ per\ pick\ up$$

These calculated figures helped me quantifying the number of allocations necessary to store the parts in the worst case that depends on the area in the SPMK where the part is stored.

For instance, if we consider the third line on the figure 33, in the as-is situation, it is stored in the area 1, which has a capacity of two boxes per span for blue boxes V780. Therefore, we are able to quantify the number of spans necessary in the as-is and the to-be situation and obtained the allocation loss in the supermarket. This means that, in order to store the part in the to-be situation, it will be needed, on average, one allocation more than on the as-is situation.

Part number	Supplier nb	Location type 2	Zone SPMK 2	Nb of boxes/ allocatio ns	Warehou se	Safety time (days)	CMj para	Safety buffer (nb bac)	As is nb of boxes after replenish ment	To-be nb of boxes after replenish ment	Real Inner emb /call off	As-is nb of allocation s needed	To-be nb of allocation s needed	Allocatio n impact
21456552	20209	Q	72	5	SPMK	3	10,74	3,2	6,5	7,2	4	2	2	0
21544809	20209	Q	19	5	SPMK	2	11,78	2,4	6,0	6,4	4	2	2	0
21892602	20209	Q	1	2	SPMK	3	2,68	0,2	1,2	2,2	2	1	2	1

Figure 33: Allocation impact file results

I quantified also the negative impacts in terms of location losses in the supermarket for instance. This represents, on average, the increasing number of boxes stored in the supermarket. It amounts an increase of 90 boxes stored.

As a result, this study allowed me to quantify the negative impact of the smart call off solution on the portfolio realized. Therefore, the calculated data showed that is most cases, applying the smart call off solution does not mean increasing the number of allocations needed in the supermarket. In fact, in many cases, the allocation depth is sufficient to hold the boxes in the to-be situation. In these cases, only the storage costs will increase but the transport, packaging and material handling savings will be much higher. Consequently, the group will do global benefits. These calculated data helped me convincing the material control and the business analyst in charge of the stock controlling that were reluctant at first.

5.2.4.6 Smoothing impact on the inbound logistics workload

A mid-term review of this major Kaizen presented to the plant's logistic committee, highlighted the possible negative impact of the MOQ solution on the inbound logistics workload smoothing. In fact, by completing our layers on the pallet or ordering more carton boxes, it is possible to create, at the storage replenishment level, a temporary workload peak.

Let's take an example. In the case of figure 17, the to-be situation implies a storage replenishment of four boxes instead of one. As a consequence, several replenishment missions to the SPMK might be needed instead of one increasing the workload temporarily.

Therefore, at the replenishment level, I managed to quantify an annual reduction of the workload of 30% on the treated parts, due to numerous pallets that will not enter the plant anymore. This positive impact might be compensated, in the worst case, by an equal workload peak, if all the treated suppliers deliver the to-be situation at the same time.

However, over time, a smoothing of the workload was noticed with the amount of treated suppliers and the different pick-up days.

5.2.4.7 G-pallet performance indicator

Moreover, a difficulty that I noticed at this point of the project was that some providers were already delivering mixed pallets. The smart call off tool that I was using to simulate the MOQ savings did not show the suppliers delivering mixed pallets. Therefore, I identified a complementary need in order to fulfill my project correctly and use the smart call off solution only on PE packaging providers that are not delivering mixed pallets. I developed an indicator quantifying **the performance of a supplier in delivering mixed pallets**, that I called G-performance indicator, meaning the ability of a supplier to deliver G-pallets (mixed pallets).

This indicator is based on the same file that I used to quantify the number of empty blue boxes entering the plant. The file calculates, for each supplier and typology of PE packaging (V750, V780, V500, V100 and V156), the ratio of G-pallets delivered with respect to the total of pallets received from this supplier. Moreover, I also analyzed for each supplier that delivers mixed pallets, the G-pallets' filling rate and the total supplier filling rate. Finally, I set **some thresholds** for each typology of packaging that indicate which suppliers have a good delivery level in mixed pallet and which suppliers have not. In the latter case, if the mixed pallet is not done correctly or on a too little percentage of pallets, I considered the possibility of setting the smart call off solution in order to treat the consequent losses.

Let's take some examples for blue boxes V750. As shown on the figure 34, the supplier number 172 has a very good filling rate for both G-pallets and M/S pallets (mono-part pallets). Therefore, it is useless to set the MOQ solution for this supplier because it already has a high pallets' filling rate.

In the case of provider 321, we can notice that its deliveries are below the threshold. Thus, this provider was considered in the MOQ solution and **I cumulated the mixed pallet solution with the smart call off one** in order to complete the layers on the V750 pallets.

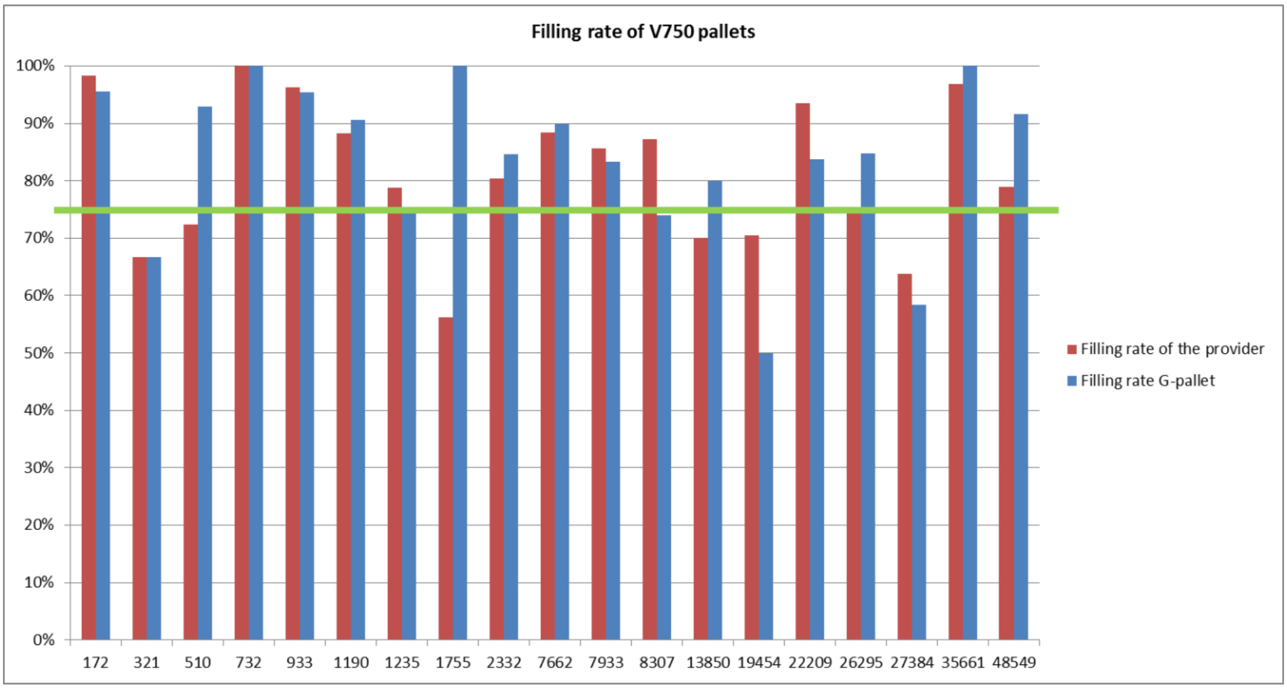


Figure 34: V750 pallets filling rate for mixed pallet providers

5.2.4.8 Conclusion on Pierre Albanese portfolio

As you can notice on the figure 32, the real savings on Pierre Albanese portfolio are far from the potential savings identified. This is due to risky suppliers that do not deliver correctly the parts. Consequently, the material control and I agreed on not treating risky providers in order not to put more constraints on them by increasing the delivery quantities. Moreover, as explained in the previous part, some mixed pallet providers were not treated because already optimized. Finally, we also agreed on not treating low runner parts not to increase drastically their stock coverage.

Therefore, the huge gap between the real savings and the potential one is mainly due to the fact that bigger providers were the risky ones. Finally, the real savings done on Pierre Albanese are of **500 pallets** and **1,000 boxes** representing financial savings of **96 k€.**

This first phase also permitted to identify some inconsistencies in the data transfer between the different software involved. Furthermore, I also noticed some limitations in the way of ordering the parts because the responsibility of each department (packaging and material control) was not clear. These sections will be discussed later in this thesis, in the expansion phase of this major kaizen.

5.2.5 Expansion of the smart call off solution to all material controllers portfolio

5.2.5.1 Implemented processes

In order to be efficient in processing all the material controllers' portfolios, I presented the smart call off results on the model area to the whole material control department. The objective was to introduce the project and present the savings already done in order to convince all material controllers to do the same with their providers. I also introduced to them a cross functional diagram describing the process used on the model area. We validated this way of functioning.

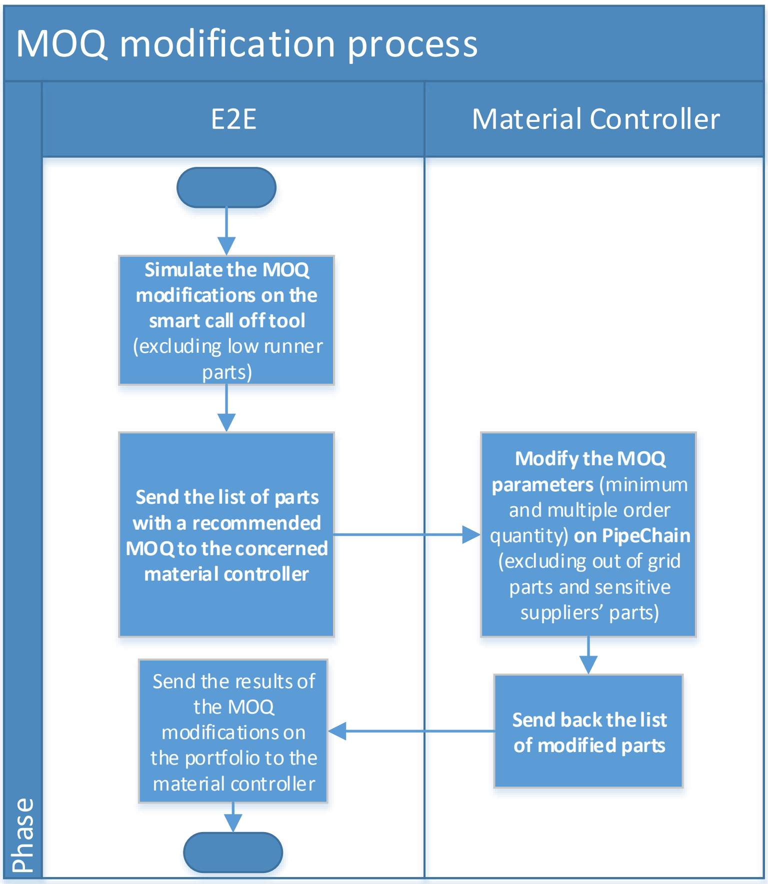


Figure 35: MOQ modification process

Furthermore, thanks to the model area results and the material controller's feedbacks, I was able to create a support process in order to exclude from the smart call off solution the suppliers and the parts that must not be treated (cf. figure 36). Therefore, suppliers delivering mixed pallets correctly must not be treated as for risky providers. Moreover, low runner parts must not be treated either in order to limit the stock coverage. A threshold of twelve yearly calls off, being one call off per month was defined. According to this rule, the MOQ can be increased until having a maximum coverage of one month for a part. Finally, parts that are not in the "grid" must not be treated either. The "grid" is a computational algorithm calculating automatically the safety parameters for a part, the safety stock for instance. Manual safety parameters are entered for out of grid parts. These parts can be new parts, end of life parts or risky parts for which manual safety parameters need to be entered. These parts were first excluded from the smart call off solution because of their specificities and the unavailability of the MOQ parameters on the PipeChain screen. This part will be discussed further in the expansion phase of this major Kaizen.

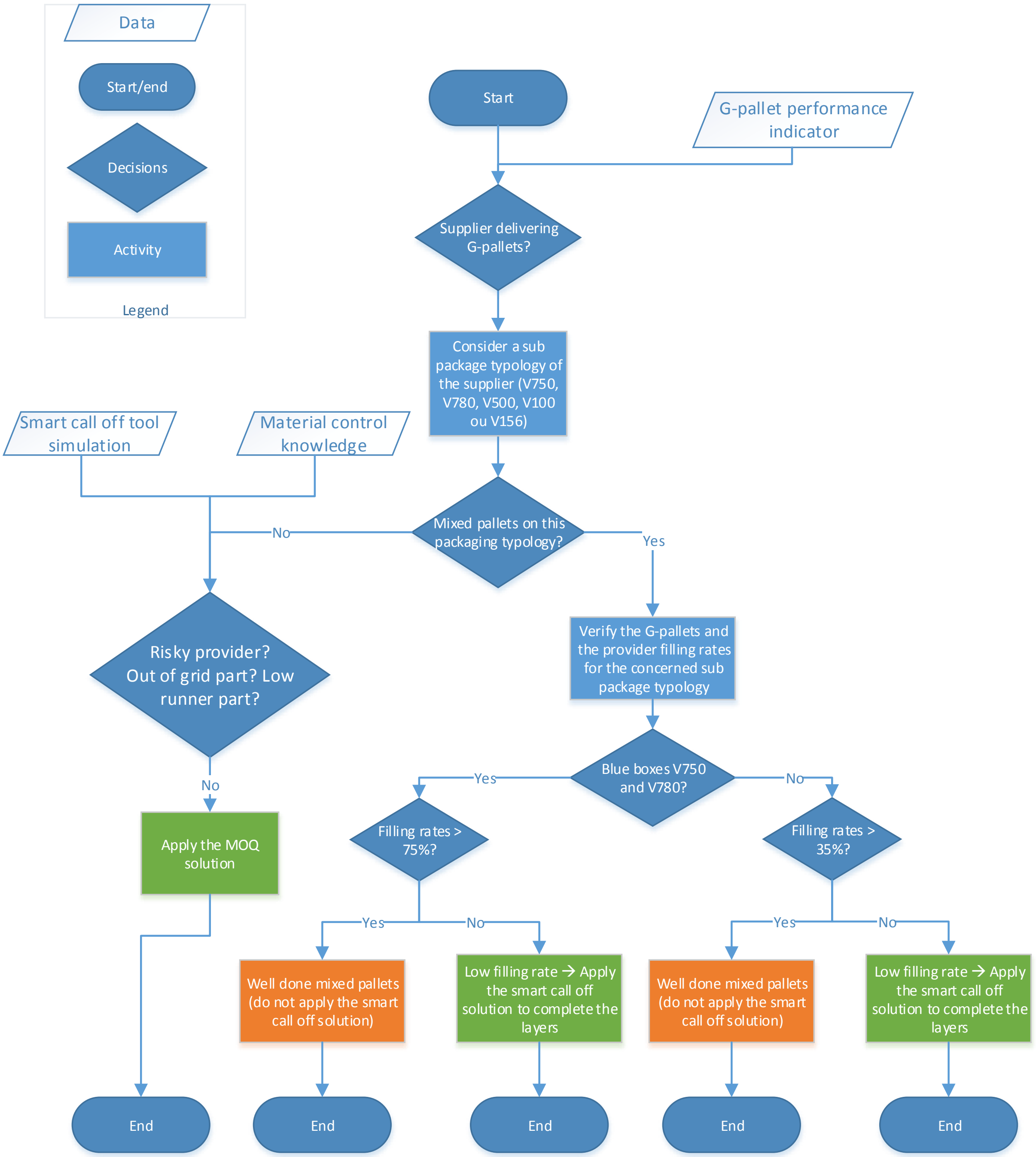


Figure 36: Smart call off application criteria

5.2.5.2 Expansion to the other material controllers' portfolio and results

Following the above processes, all the material controllers' portfolios were treated by mid-January, so with a delay of two weeks with respect to the initial objective.

This delay was due to the effort done on structuring the procedure, mainly analyzing the parts that must be treated and the one that must not, implementing the mixed pallet indicator for instance. Moreover, following the feedbacks from the receiving inbound department and the logistics engineering on the potential negative impacts of the project, I did some complementary analysis to quantify the number of allocations needed in addition in the supermarket and an analysis on the supermarket workload smoothing.

You can find on the figure 37, the global results on all portfolio.

Savings			
Savings all portfolios	**POTENTIAL**	**REAL**	**% real/pot**
boxes	61 954	32 945	53%
results k€	437	225	51%
Transport k€	552	393	71%
pallets	22 113	11 364	51%
suppliers	158	125	79%
nb of parts	924	473	51%

Figure 37: Results on all portfolio

First of all, 125 suppliers were attacked for a total amount of parts of 473. Therefore, approximately half of the identified parts with potential savings were treated. About 33,000 empty blue boxes were saved, representing more than 11,000 PE pallets that will not enter the plant anymore.

I also realized a productivity analysis (cf. figure 38) with the ideal situation on the left and the real productivity on the right. **The productivity indicator is the savings regarding the inbound logistics costs**. For the 158 suppliers with potential savings identified, the logistics costs represent almost 3 million euros, with losses amounting 1.7 million euros (air and packaging loss). If the adequate MOQ had been set on all the parts, the savings would have been of almost 1 million euros, meaning a 34% productivity regarding the logistics costs. However, only 125 suppliers were attacked, amounting logistics costs of 2 million euros, losses of 1.2 million euros and savings of 618 k€. Consequently, **the productivity is of 22% with respect to the total logistics costs identified**.

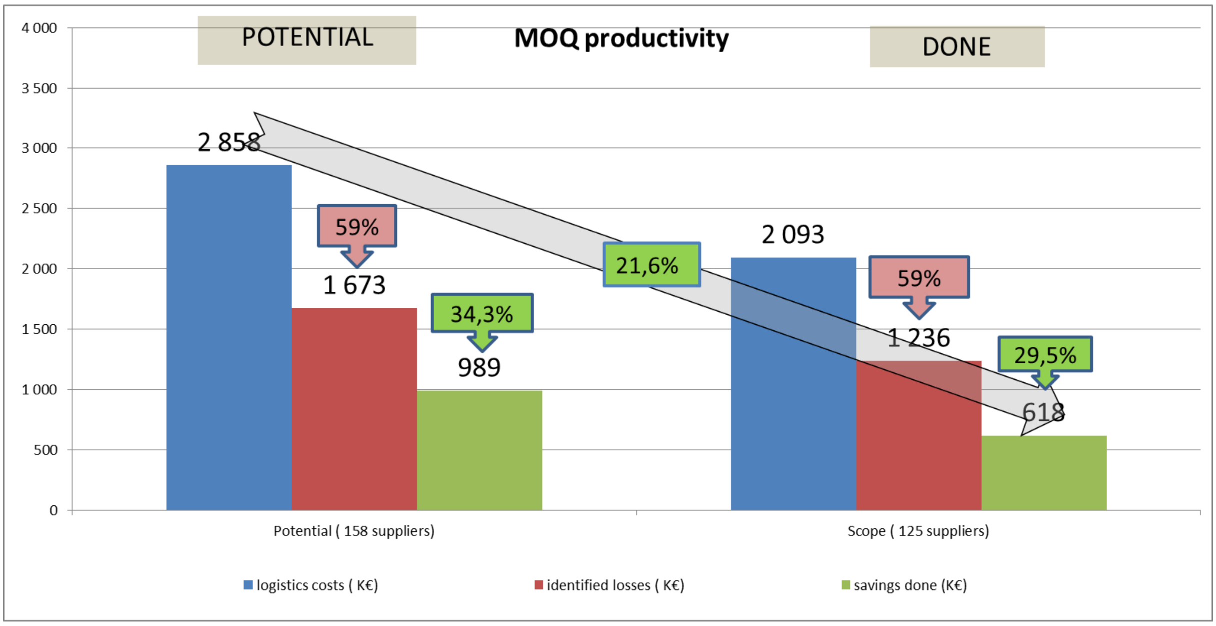


Figure 38: MOQ productivity

Finally, the financial results of the project, composed of the transport savings, the material handling savings, the packaging savings and the inventory losses, **amounts 618 k€ saved**.

The split can be seen on the figure 39:

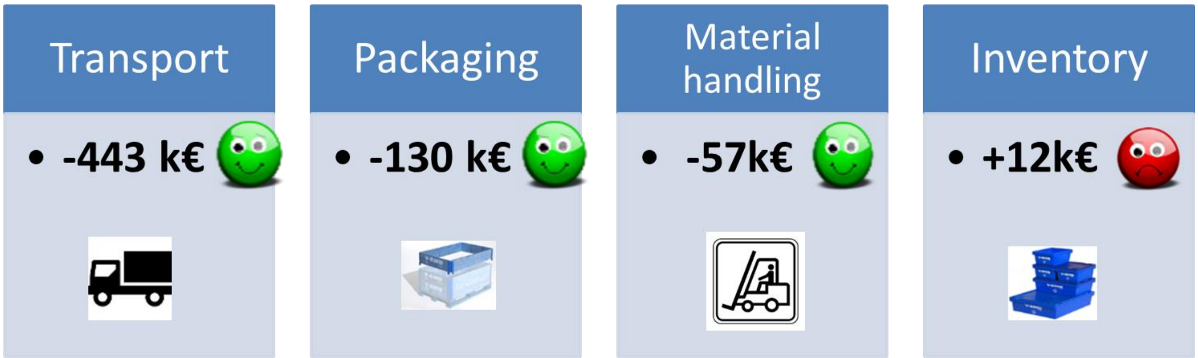


Figure 39: Split of the savings per sector

The negative impact on the inventory was also quantified in terms of additional allocations necessary to store the treated parts. **230 additional allocations due to the MOQ increases are needed in the to-be situation**. These additional allocations are taken into account in the PSM1, being a project aiming to increase the warehouse storage capacity. A work to minimize this impact has been launched and will be detailed in the expansion phase of the major Kaizen.

Furthermore, it has been quantified that the reduction of the workload to store the parts in the supermarket might be equally compensated by workload peaks for the first deliveries. These workload peaks will tend to smooth automatically in time with the numerous deliveries and different pick up days of suppliers.

5.3 Check: result monitoring and introduced KPIs

5.3.1 Compliance with the objective

The objective was to reduce by half the number of empty blue boxes entering the plant, thus arriving to 7.5% of empty blue boxes being **34,200 empty blue boxes annually**.

As shown on the figure 39, 68,400 empty blue boxes entered the plant annually in the as-is situation. By applying the smart call off solution, the to-be projection is of **35,445 empty blue boxes annually**, being **7.8% of empty blue boxes**. Therefore, the objective of 34,200 annual empty blue boxes was almost reached.

Furthermore, some complementary actions were realized in order to better optimize the pallets, increasing the filling rates and reducing the number of empty blue boxes. These actions will be discussed further in the expansion phase of this major kaizen.

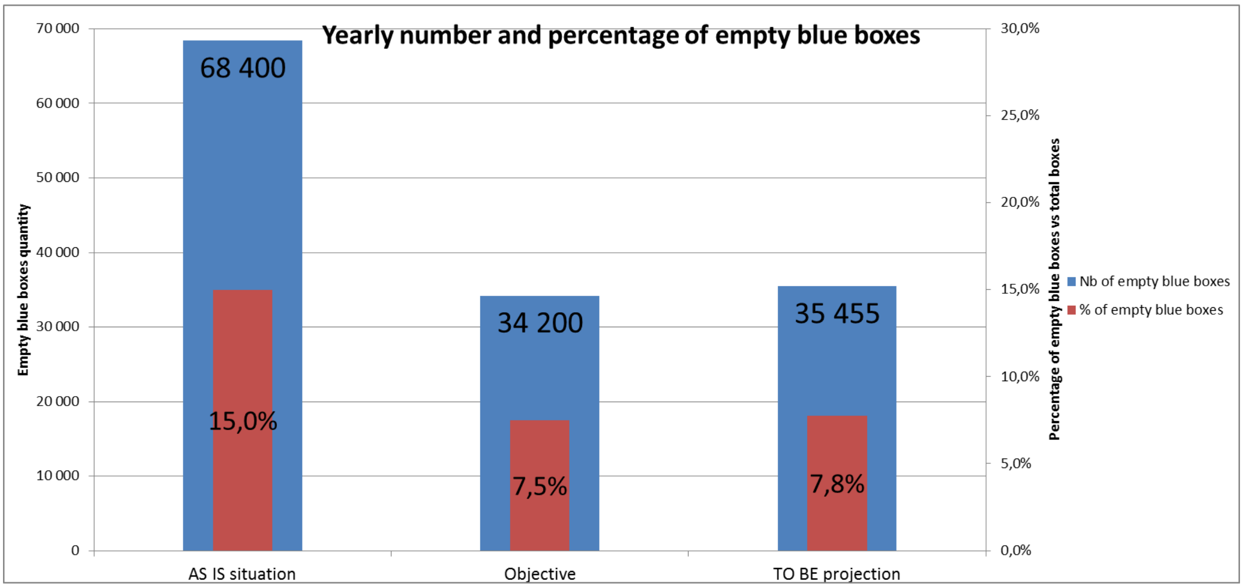


Figure 40: Yearly number and percentage of empty blue boxes

The End-to-end objective is to realize an annual productivity of 5% each year, meaning savings amounting 5% of the total inbound logistics costs. Moreover, losses representing 30% of the logistics costs have to be identified. Comparing this objective to the realized productivity on the major Kaizen, we can see on the figure below that the target is largely satisfied.

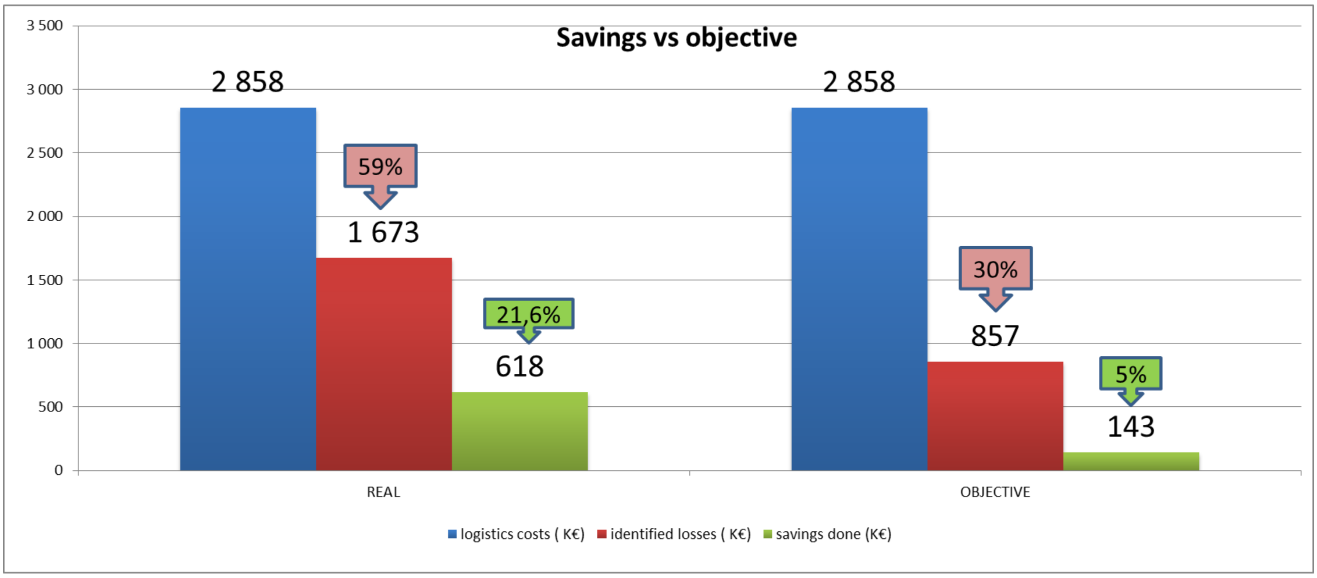


Figure 41: Cost deployment savings

Furthermore, in order to monitor concretely the savings done, I decided to implement an indicator to measure the project's achievements. Therefore, based on the pallets received month by month, I developed an indicator quantifying the number and percentage of empty blue boxes entering the plant each month.

You can see the monthly evolution of the percentage of empty blue boxes entering the plant on the figure below. From the 15% of empty blue boxes originally identified, the **percentage was in February of 7.9%**, quasi as expected by the projection realized (figure 40).

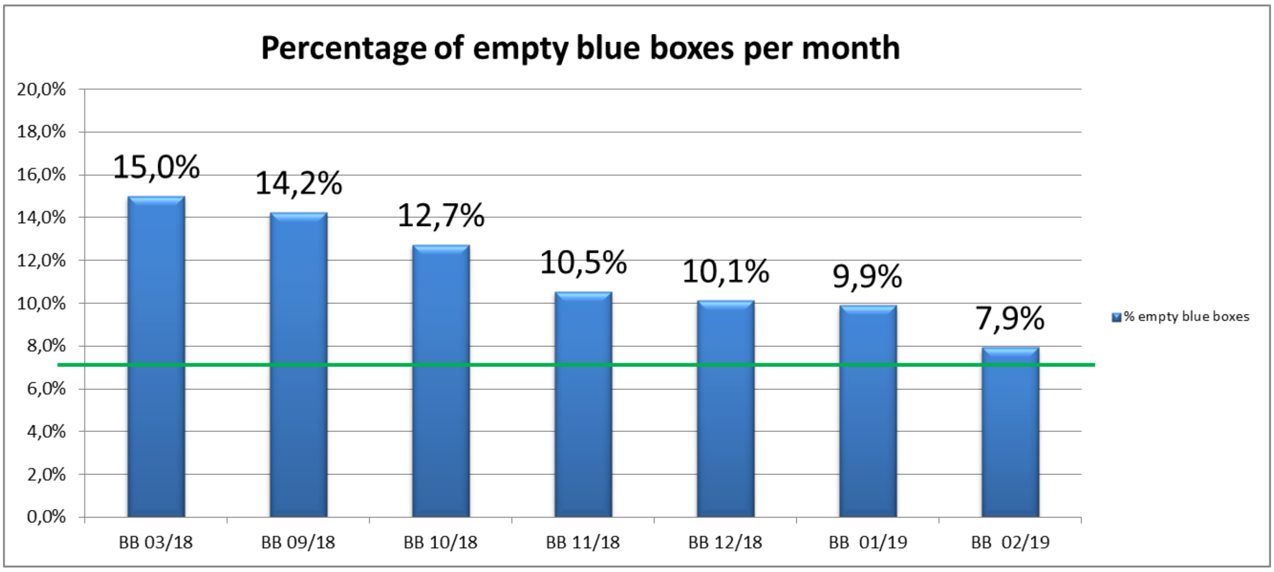


Figure 42: Empty blue boxes reporting

5.4 Act: standardization and expansion of the major kaizen

5.4.1 Measured B/C ratio

To measure the profitability of the project, I used the commonly used B/C ratio, for Benefits to Costs. By summing the project's costs, being the labor costs of all the people that were involved in this major Kaizen, the total costs were of approximately 25 k€, for benefits of 618 k€.

Therefore, **the B/C ratio is equal to 24**. The savings can also be split uniformly on a year basis meaning that the project allows the plant to save 1.7 k€ per day. Therefore, the project is profitable in approximately 15 days.

5.4.2 Standardization of the project

In order to ensure a good traceability of this project, I also managed to standardize it by creating **processes** and **instruction sheets**. These processes and instruction sheets were connected to the general E2E process described in part 4.3.3. The major Kaizen realized aimed to solve the inadequacy between the packaging and the call off. Therefore, the sub processes and the instruction sheets created concern the two activities "Do smart call off" and "Do mixed pallet" of the general E2E in process.

First of all, on the activity "Do smart call off", I created a sub process describing the three main phases of my project: the "one shot" MOQ modification process phase that I presented in the part 5.2 and the maintenance phase that I will present in the part 5.5. The activity "Create a MOQ maintenance file" was essential in order to define the maintenance criteria and a consistent tool for the MOQ updates.

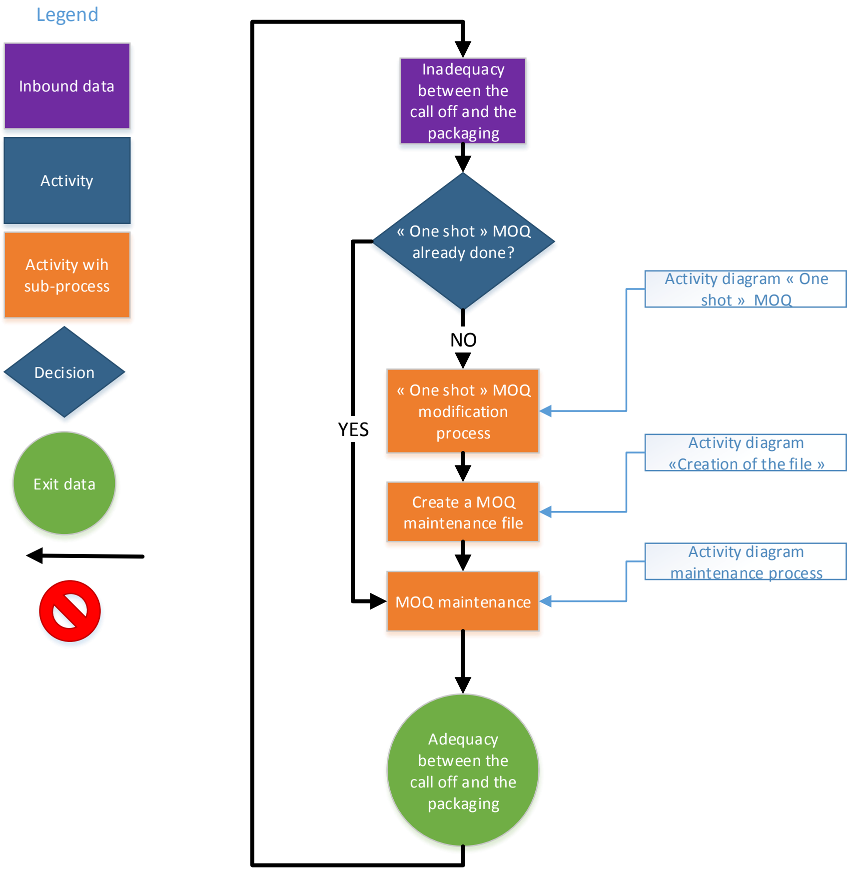


Figure 43: Global MOQ process

These three main activities of the project were detailed further into activity diagrams, describing my way of doing all along the project.

The "one shot" MOQ modification process on the figure below describes the main steps that I used to realize the major kaizen (described from 5.1 to 5.3). I used a cross-functional diagram to highlight the role of each department involved in the major Kaizen, that are, for the "One shot" phase, mainly the material control and the transport department. The series of steps in the process describe my way of functioning during the project in order to treat all the material controllers' portfolios. The different activities of the process were already explained in the action plan and the result monitoring.

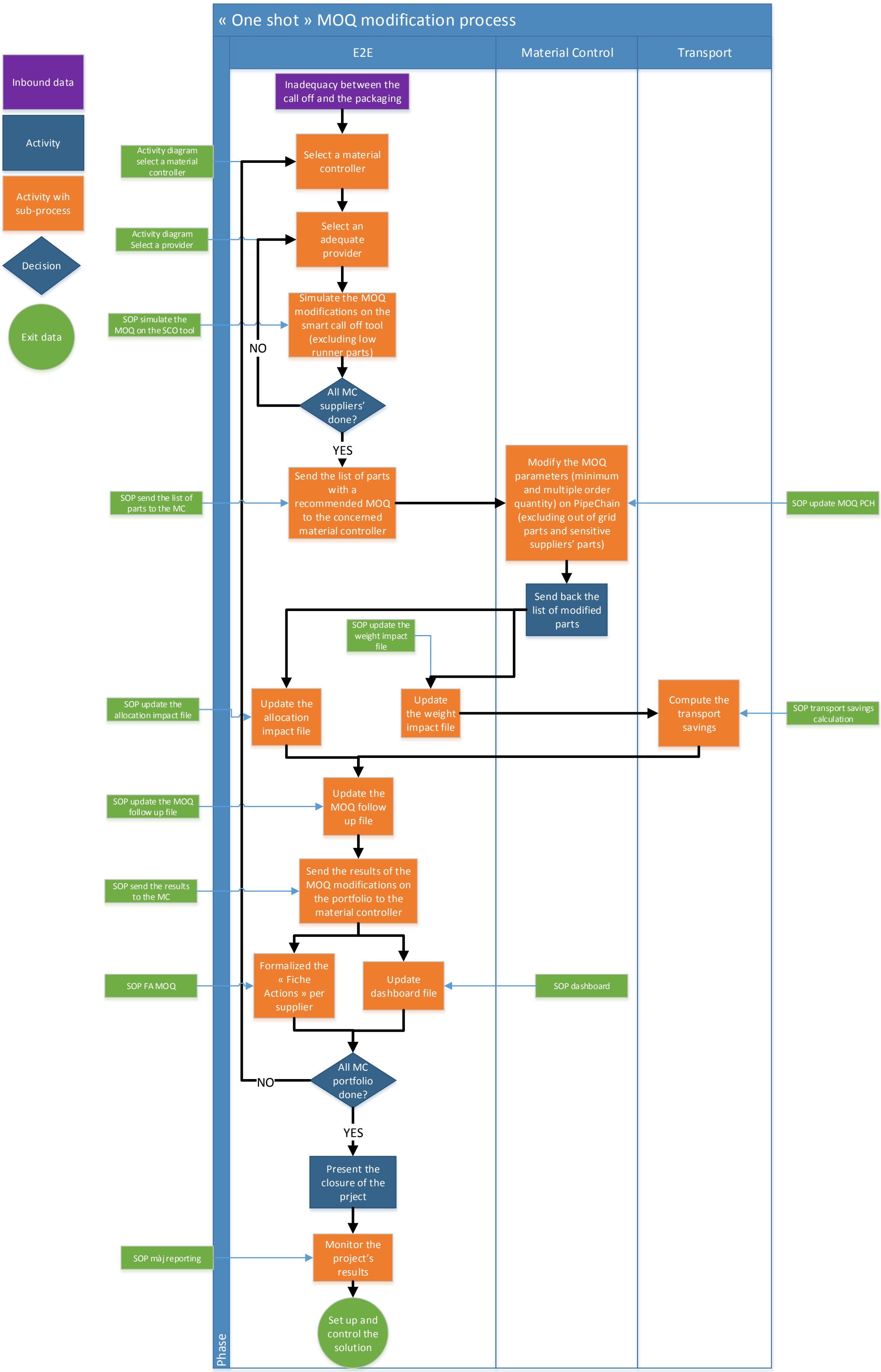


Figure 44: "One shot" MOQ modification process

Each step that needs to be further described has a more detailed activity diagram or an instruction sheet (SOP). You can find such an example on the appendix 8.7.

The closure of this major Kaizen was presented to the logistics committee and the executive committee. The committees validated the results of this project regarding the objective that was set initially. The following parts of the report concerns the expansion phase of the major kaizen.

5.4.3 Expansion of the major kaizen

5.4.3.1 Area changes in the supermarket

The « one shot » MOQ modifications highlighted the necessity to perform some area changes in the supermarket. In fact, as explained in the part 5.2.4.4, the MOQ increases have in some cases a negative impact on the number of allocations needed to store the part. Moreover, the supermarket has different areas with different allocations depth. For instance, in the area 1, it is possible to store only two blue boxes V750 per allocation. This storage is used for low runner parts. On the contrary, high runner parts are stored in allocations with a maximum capacity of 15 blue boxes V750.

Therefore, working with the logistics engineering and the receiving inbound department, I managed to create an area changes tool. We established some criteria in order to change the area of a part in the supermarket. The idea is to adapt the area to the real number of boxes received and to the average stock. With the MOQ increases, the trend will be to change the parts to allocations where it is possible to store more boxes.

The appendix 8.6 shows the current supermarket map framed in red. Therefore, there are several allocation depths. If we consider a blue box V750, it is possible to store two boxes of such a type in the area 1 and 10 in the area 15. On the examples below, the MOQ that the material controller set in PipeChain increased the average stock. Therefore, according to the area change criteria that I established with the logistics engineering, it is recommended to change these parts from area 1 to area 15. Consequently, for the first part for instance, the to-be area will allow to store, on average, all the boxes of this part on one allocation instead of five in the as-is situation.

Volvo Part No	Real subpackage type	Real subpackage qty	Total current stock	Average nb of boxes	As is Zone	POC	To be Zone
21451304	750	20	19,7	9,827143	1	Hdep	15
21912898	750	5	12,2	9,199524	1	Hdep	15
22442798	750	25	9,6	18	1	Hdep	15

Figure 45 : Example of results of the area change file

The storage cost is the same but the area is better adapted to the average number of boxes that the plant stores and allows to free some allocations reducing the additional number of allocations needed due to the smart call off solution.

5.4.3.2 Transfer of the MOQ management responsibility: the new RACI

Moreover, the main challenge of the major kaizen expansion phase was the MOQ maintenance. The MOQ maintenance aims to always have the adequate minimum and multiple order quantities for each part. For instance, due to variations on the parts consumptions, the MOQ that was set might no longer be adequate in the future. Therefore, the maintenance is supposed to bring a greater flexibility. The challenge was to maximize the automation of the MOQ updates. In fact, the "one shot" MOQ phase that I managed was very manual because I had to simulate, for each part of each supplier, the MOQ that was adapted. To ensure an effective maintenance in the future, this way of doing is not sustainable because it is too time-consuming.

Therefore, I had to think of a solution to ensure an effective maintenance, allowing the department in charge of the MOQ maintenance to be autonomous.

First of all, the first step of this expansion phase was to clarify the responsibility of each department involved. For this purpose, I created a RACI that was validated by the material controller manager and the logistics engineering manager managing the packaging department (cf. figure 46).

	Packaging	Material control	E2E	Warehouse	Receiving inbound	Transport
9 a. Creation of a MOQ maintenance process	C	C	A,R	C		
9 b. Creation of an automated MOQ maintenance file	I	I	A,R	I		
9.c MOQ maintenance file update			A,R			
9 d. MOQ maintenance on PIpeChain		A,R	I	I		
10. MOQ on new parts and on parts with packaging change	R	R		I		

R : Responsible
A : Accountable
C : Consulted
I : Informed

Figure 46: Expansion phase RACI

As department managing the project, it was decided that the end-to-end department would be in charge of creating a MOQ maintenance process consulting the packaging, the material control and the warehouse in order to define the different criteria. Furthermore, I was also in charge of building the file to automatize the MOQ updates. Finally, the main proposal that I made to the managers was to transfer the responsibility of the minimum and multiple order quantities management from the packaging department to the material control one.

The packaging managed a tool called GPT standing for Global Packaging Tool (cf. Vocabulary and Definitions), particularly used to exchange Packaging Instructions with the suppliers. The material control, in charge of ordering the parts, manages the software PipeChain (cf. Vocabulary and Definitions). In both software, multiple and minimum order quantities can be entered.

As shown on figure 47, in the as-is situation, there was a duality in the MOQ management responsibility. In fact, the major kaizen that I managed aimed to modify the MOQ directly on PipeChain. But, it was also very frequent that the packaging, following providers' requests for instance, inserted MOQ on GPT, the Global Packaging Tool. GPT having a master relationship towards the module PipeChain, the information contained on GPT is sent to PipeChain. Therefore, if the packaging enters a MOQ for a part on GPT, the information of the multiple order quantity entered is retrieved on PipeChain, losing the information of the single box unit load. The figure below sums up the as-is situation with the duality of responsibility, the packaging entering MOQ on GPT and the material control entering MOQ directly on PipeChain.

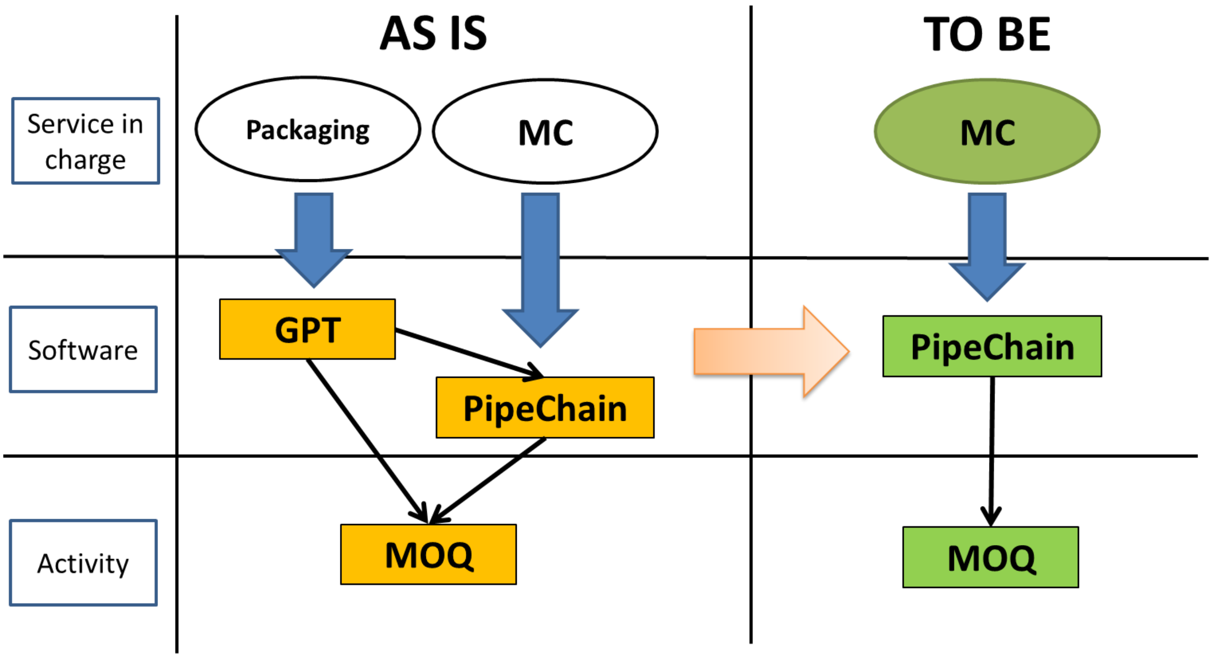


Figure 47: Transfer of the responsibility of the MOQ management

This situation raises several issues. The first one is that the unit load of the box, meaning the quantity of parts contained in a single box, is lost during the data transfer from GPT to PipeChain. Therefore, the material control has no idea if the multiple order quantity is of one box or several boxes.

Let's take an example. As you can see on the packaging instruction below, the part number 21103701 of the supplier 23429 is packaged on a K0 (pallet without any layer) in blue boxes V780. It is possible to put maximum six blue boxes V780 on a K0 pallet, two per layer. As you can see on the figure below, there is one part per V780 and 6 blue boxes 780 on the pallet. Therefore, the packaging instruction was signed between Volvo and the supplier for a full pallet at each delivery (6 blue boxes of one part). Consequently, the packaging engineers were already optimizing some of the parts when requested by the suppliers, mainly for batch sizes constraints.

PACKAGING INSTRUCTION
21103701-005

Valid from date
2017-10-24
Valid for
31972 Volvo Powertrain Lyon - Vénissieux, FRANCE

Part no	Renault part no
21103701	7421103701

Part name
STARTER MOTOR 24V5.5KW11/3.175 F.GASKET

Supplier no	Supplier name
23429	

Outer packaging

Package type	Unit load	EMB no	EMB name	Quantity
K0	6	2	PALLET OF WOOD, TYPE K	1

Inner packaging

EMB No	EMB Name	Quantity	Inner pack unit load
780	BOX OF PLASTIC	6	1
92	LID OF PLASTIC	1	6
781	LID OF PLASTIC	6	1

Figure 48: Information from a Packaging Instruction on GPT

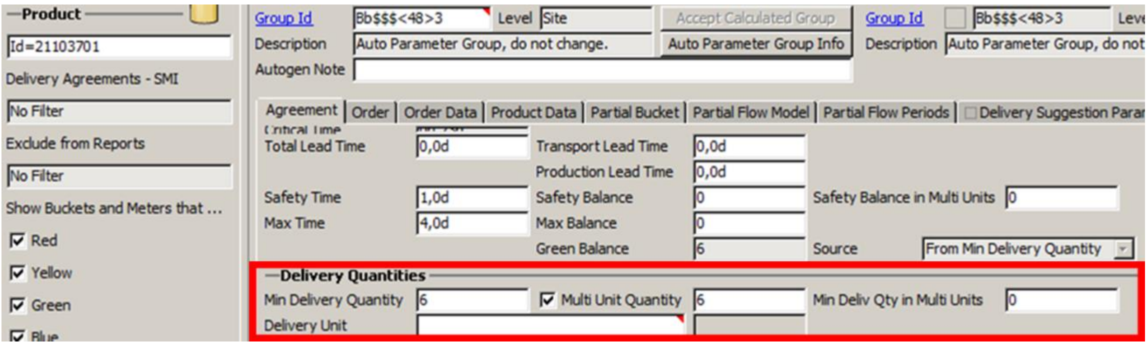


Figure 49: Inbound delivery agreement screen on PipeChain

However, this situation results in some inconsistencies and lack of clarity. As we can notice on the PipeChain screen above, in the "*Min Delivery Quantity*" parameter, we retrieve the same unit load that was signed between the packaging and the supplier, being at least six parts per delivery, and with a multiple order quantity of six parts. But we have no information on PipeChain if the minimum and the multiple order quantities correspond to one box or several boxes.

This lack of clarity on the sub package's unit load (quantity in the box) is source of mistakes for the material controller that does not have a packaging expertise and does not know how the parts are packaged. Moreover, it reduces the flexibility on stocks because the safety stock is necessarily of 6 boxes minimum although it could be of one if the unit load of one sub package was present in PipeChain.

As the parts' ordering is managed by the material control department, my proposal was **to transfer all the responsibility of the smart call off management to this department**. Consequently, as shown on figure 47, the packaging department will no longer have the responsibility to set multiple order quantities in GPT. This proposal was validated by both managers. Consequently, the packaging department will be in charge of defining with the supplier all the sub packaging specificities and the material controller, that has a better view on the needs per part, will have the responsibility of managing the minimum number of boxes that the plant wants and the multiple order quantities.

As you can notice on the PipeChain screen, the material control has no idea of the packaging used to transport the parts. Therefore, the challenge of this expansion phase was to permit to the material control to know, for all the blue boxes and carton boxes parts, the MOQ parameters to set into PipeChain, without any packaging expertise.

5.4.3.3 MOQ in GPT

Consequently, the second step was to clean up the GPT databases in order to have the correct unit load, corresponding to a single box, in PipeChain.

Three hundred parts were in this case. Thus, in order to maintain the optimization actions done by the packaging (MOQ set in GPT), I organized a work group with one material control's and packaging's collaborator in order to put back the MOQ parameters to one sub package on GPT and set the same parameters on PipeChain.

This phase of cleaning was essential to ensure an effective maintenance and avoid errors in the future MOQ updates on PipeChain. This phase allowed to **have the correct sub packages quantities on PipeChain** and to have consistent data.

5.4.3.4 To-be MOQ management process and automated file

The second step was to think of a solution to ensure the material control autonomy in the MOQ management. The only immediate solution was to create a tool to ensure the material controllers' autonomy without the need to ask the packaging or the End-to-end department the right MOQ parameters to set for a particular part.

First of all, in order to have a functional tool covering all the needs and the necessary criteria, I consulted each impacted department to elaborate a global process (appendix 8.8). In fact, it is necessary to consider some criteria in order to decide if, for the considered part, the MOQ parameters can be changed on PipeChain. This process is like a design brief that I followed conceiving the tool.

First of all, on this global process, there are two different paths, one for blue boxes and one for carton boxes. In both cases, the constraints established with the packaging, the material control and the logistics engineering are:

1. Keep the MOQ parameters on GPT in the case of a specific providers' request or for quality reasons in order to avoid MOQ updates in PipeChain
2. In case of packaging change and for new parts, the packaging department has to communicate the right MOQ parameters to the material controller in order to have directly an optimized pallet (without waiting for the future maintenance)
3. Do not change the MOQ parameters for unfaithful packaged type, meaning for parts for which there are uncertainties on the received packaging
4. Do not apply the smart call off solution for suppliers that correctly deliver mixed pallets
5. For former bucket strategy parts (cf. vocabulary and definitions) from mixed pallets providers, consider anyway the smart call off solution because these parts are class C parts with low prices and low storage costs
6. Be careful on the typology of main package (pallet) used because the number of boxes that can be put on a layer might be different

The constraints of application of the MOQ maintenance being defined, I propose some criteria in order to set the right MOQ parameters, depending on the annual consumption, the transport frequencies, the typology of packaging used and the internal flow type. Let's take the example of blue boxes V750 (Appendix 8.9). As defined previously in this thesis, it is possible to put four blue boxes V750 on a layer and up to three layers per pallet.

For parts transported on a K0 pallet (99% of blue boxes parts), I classified the parts in three categories: the **high runners**, the **medium runners** and the **low runner parts**. High runners are parts for which the quantity received at each delivery is greater than a pallet, on average. For blue boxes V750, as it is possible to put twelve boxes maximum on a pallet, I defined as high runner the parts for which the plant receives more than twelve boxes per pick up. Furthermore, I considered a part as a low runner when the plant receives less than a full layer per pick up, being less than four boxes at each pick up for blue boxes V750. Finally, by exclusion, the medium runners are the parts for which the plant receives between four and twelve blue boxes V750 per pick up.

For high runner parts, the MOQ parameters to set into PipeChain depend of the internal flow. For instance, if the part is stored directly on the pallet in the warehouse (STM1 or SPM1 flow), we decided to put a minimum order quantity of twelve blue boxes V750, meaning a full pallet, and a multiple order quantity of twelve blue boxes as well, in order to receive only full pallets and delete potential empty blue boxes. To ensure a better flexibility on the SPMK and SPLIT flows, the minimum and multiple order quantities need to be put at four blue boxes, in order not to have any blue boxes and ensure pallets receiving as close as possible to the net requirements.

For medium runner parts, the net requirements being between four and twelve blue boxes per pick up, to avoid transporting and handling empty blue boxes, it is needed a minimum and multiple order quantities of four blue boxes.

Finally, for low runners, in order to avoid too long stock coverage, we agreed not to increase the minimum order quantity higher than one month coverage. For very low volume parts, for which one blue box V750 correspond to more than one month stock coverage, it was decided not to increase the MOQ parameters, to minimize the stock impact and avoid the risk of having lots of remaining pieces at the end of life of the product.

The idea is the same for the other blue boxes typologies. For carton boxes, there is a small difference. Reasoning with multiple order quantities, aside from high runner parts, is not adequate because the aim of increasing the MOQ parameters is just to increase the filling rate of the pallets, not removing some empty boxes. Therefore, in order to increase the filling rate of carton boxes pallets, I recommended minimum order quantity increases.

These MOQ criteria were validated by both the packaging and the material control and are the basis of the tool that I created. It is an excel file using VBA code that treat all the cases that I explained above.

A smart call off maintenance on a three-monthly basis was decided with the logistics engineering and the material control. The MOQ maintenance activity was also detailed in a cross-functional diagram. As you can see on the process below, the packaging does not intervene in the MOQ maintenance process anymore. All the responsibility was transferred to the material control.

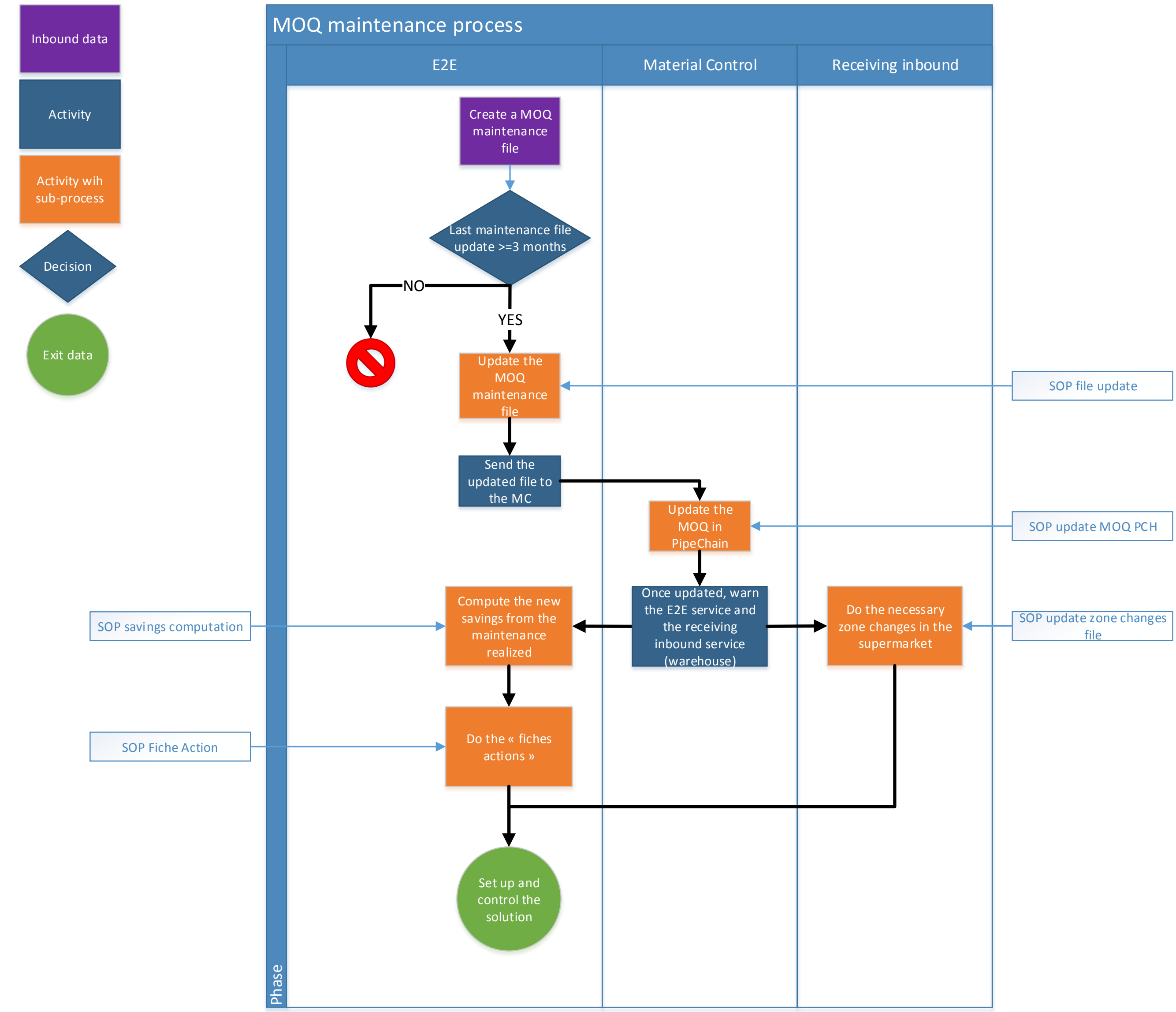


Figure 50: MOQ maintenance

The only parts that will need the packaging expertise are the new parts and when a change of packaging is decided, for instance from blue boxes V750 to V780 or to carton boxes. In these two cases, it is impossible to wait for the next maintenance and the packaging engineer has to warn the material controller of the change to put into PipeChain. You can find below the detailed process splitting the few parts that needs the packaging intervention from the rest that will be automatically included in the maintenance process.

Finally, as you can notice on the following figure, even the out of grid parts that were not treated in the "one shot" phase will be treated in the maintenance because it is possible to use a specific procedure to set the MOQ parameters in PipeChain.

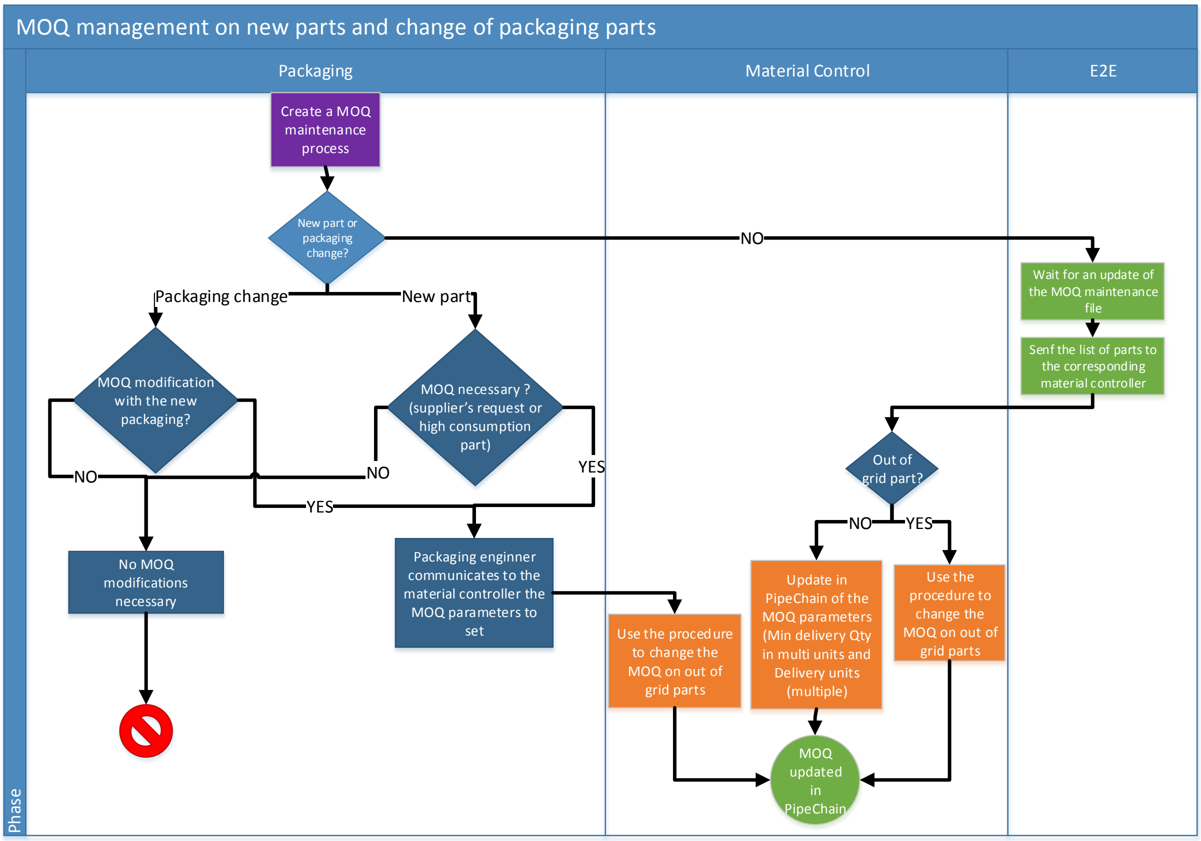


Figure 51: MOQ management on new parts and change of packaging parts

The MOQ maintenance file was validated by both the packaging and the material control departments and user tests were organized in order to validate the relevance of the tool created.

5.4.3.5 Mixed pallet

Finally, as shown on the figure 16, there are two levers of action to solve the inadequacy between the call off and the packaging issue. The first one is the smart call off solution that I deployed on most of the suppliers. The second one is the mixed pallet solution that I introduced in part 5.2.1.

To set this solution on a supplier, I first needed to investigate which supplier could be a good candidate. I analyzed the pareto of the product, air and packaging weight and extracted the possible candidates that are the blue boxes and carton boxes providers. I extracted also the total annual losses for these suppliers to make a choice.

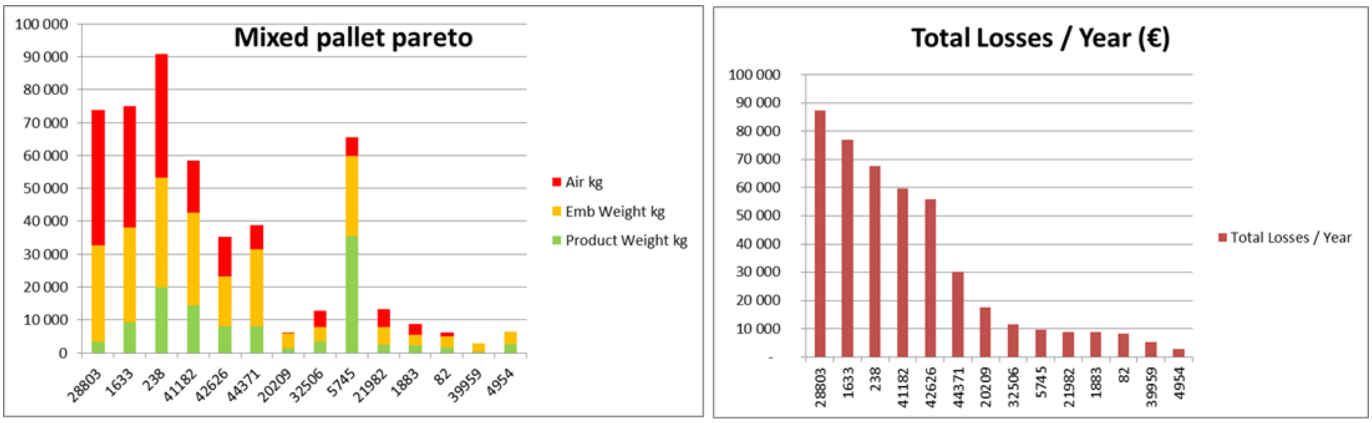


Figure 52: Mixed pallet pareto and total losses/ year

The provider with the highest losses is the 28803. A procedure was already initiated with this supplier before I arrived that still has not succeeded because of numerous setups to do in the provider's information system. The supplier 1633 also has important losses. In fact, we did not apply the smart call off solution on this provider because the material controller considered it as risky for capacity reasons. Thus, I studied the possibility to push the mixed pallet solution on this provider.

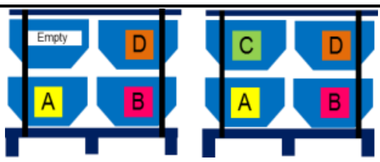
Option	Blue boxes/ Carton boxes	Supplier maturity	Packaging instruction	MOQ in pipechain	Internal flow maturity to split pallet	Kind of label	pack diversity for the supplier
Mixed pallet		Sends M pallets correctly	mixed pallet autorized	qty of a box	avoid pallet breakdown in receiving area	Odette label	High
Mixed pallet		Sends M pallets correctly	mixed pallet autorized	qty of a box	avoid pallet breakdown in receiving area	specific label developped with the supplier if no specific label, mixed pallet could be set but secure way of relabelling	High

Figure 53: Prerequisites to set the mixed pallet solution

Some prerequisites are necessary to set the mixed pallet mode:

- The supplier's **diversity of parts** needs to be consequent in order to optimize the pallets
- The supplier needs to be in **full EDI** (Electronic Data Interchange) with Volvo
- A verification of the current pallets received from the supplier is needed in order to confirm that the supplier **sends correctly M-pallets**, meaning pallets with a label on each sub package
- An **authorization to mix the pallet** has to be set in the packaging instruction that the packaging engineer and the supplier signed.
- The **MOQ should be of one box** in order not to apply the two solutions at the same time

The supplier 1633 respected all the necessary criteria. The packaging engineer and the material controller validated the feasibility of this solution as well as the receiving inbound department. We decided to push the mixed pallet solution only on blue boxes in the first instance for simplicity reasons. The supplier agreed to send mixed pallets and parameterize in its information system the authorization to mix the parts sent to the Venissieux engine plant.

Figure 54: Example of an as-is received blue boxes pallet from supplier 1633

AS-IS			TO-BE		Savings
Internal flow cost (material handling)	21 193,50 €		Internal flow cost	7 660,88 €	13 532,62 €
Packaging cost	7 357,35 €		Packaging cost	4 062,45 €	3 294,90 €
Transport cost	41 614,26 €		Transport cost	12 665,21 €	28 949,05 €
Total cost	70 165,11 €		Total cost	24 388,54 €	45 776,57 €
Total savings					45 776,57 €

Figure 55: Savings conclusion on supplier 1633

This solution will allow saving 1,680 pallets per year on this unique supplier and save almost 3,000 empty blue boxes. Savings amounting 46 k€ were realized by setting the mixed pallet solution on this provider, split between transports costs savings, material handling and packaging costs savings.

This standard kaizen is a good example of the cooperation between the packaging, providing its packaging expertise, and the End-to-end department, in charge of managing logistics continuous improvement projects, and will be presented to the logistics committee on the 12th of March.

6. Conclusion of the thesis

6.1 Conclusions regarding the Volvo and the End-to-End expectations

6.1.1 Conclusion of the project and future perspectives

The figure 56 sums up the share of this project in the total End-to-end inbound flow losses. I managed to split the logistics costs of the GE packaging (static packaging) and the PE packaging (dynamic packaging). As presented previously in this report, the normal transport costs represent 15 M€ annually. Nicolas Avril, my end-to-end collaborator, is working on a majority of the logistics costs and almost half of the inbound flow losses. My scope was covering all the PE packaging, representing logistics costs amounting 5 million euros. The losses identified on the PE packaging were of 2.2 million euros. The scope that I attacked concerned 159 suppliers with potential savings due to the inadequacy between the packaging and the net requirements. These suppliers are amounting 3 million euros of logistics costs and 1.7 million euros of losses. The major Kaizen that I realized allowed to save approximately 0.7 million euros.

Approximately half of the losses due to the transport of empty blue boxes and incomplete carton boxes pallets were saved, meaning there are still 0.7 million euros to save. The reasons is that out of the 159 suppliers identified, real savings on “only” 125 suppliers were done, mainly due to sensitive suppliers for which the material controllers decided to postpone the MOQ increases. Furthermore, I estimated that, mainly due to low runner parts on small suppliers for which the mixed pallet solution is impossible to set, some losses will never be attacked and about 7.000 blue boxes will always be transported.

As shown on the figure 16, we identified two other possible solutions on dynamic packages that are the sub packages optimization and the packaging change in order to reduce the air and packaging losses. I identified potential savings of 400k€ by applying these solutions to all PE suppliers.

Finally, other PE packaging are used by the plant with logistics costs amounting 0.7 million euros and losses of 0.2 million euros. The potential savings on this scope were not identified yet.

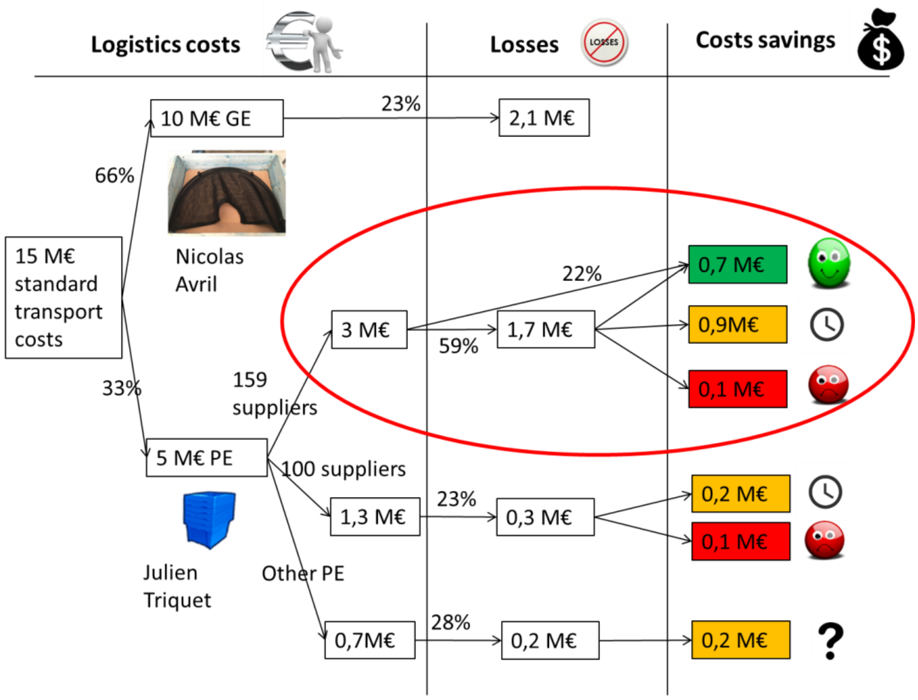


Figure 56: Results and other perspectives on PE packaging

The maintenance process implemented will help obtaining new savings from former risky suppliers, from out of grid parts and also from former anomalies in the databases. Therefore, a kaizen was opened and it will be necessary to record these new savings.

Furthermore, the kaizen realized on the provider 1633 also shows the possibility and the relevance of setting the mixed pallet solution on some providers with an important diversity of parts and many low runners. It will always be possible to remove the MOQ parameters on PipeChain on a future maintenance if there is a new opportunity to set the mixed pallet solution with a supplier.

As illustrated on the figure 56, there are still more than **400 k€ of savings** to do even if the maintenance process eliminates all the identified losses due to the inadequacy between the call off the packaging. Therefore, I formed a new collaborator in order to follow the work that I did on the PE packaging. We initiated a new major Kaizen mid-February, dealing with the optimization of the sub packages, meaning filling more the blue boxes and carton boxes. This major kaizen will aim to solve the issue described on figure 13 by adding some more pieces inside the boxes respecting the twelve kilograms ergonomic constraints. This new improvement project also highlights the necessity of a flexible maintenance of the MOQ parameters because increasing the number of pieces in a box might change the adequate MOQ parameters. This solution represents a potential of more than 400 k€. The last solution consists on changing the typology of packaging used to transport and handle the parts. In fact, due to ergonomic constraints, it is in many cases, impossible to add more parts in the box. Therefore, a change of packaging to a smaller one might also be a solution. The boundary between these two solutions is not clear and the trainee that will work on this subject will have to consider both options in order to match the transported parts with the packaging used.

Therefore, it will be important to think of mixing the solutions in order to optimize the blue boxes and carton boxes transported. Considering alternative solutions starting from fields work observations will be determinant in order to raise some new cases and continuous improvements projects. Finally, the cooperation between the packaging using its packaging expertize to propose solutions and the End-to-end department managing the continuous improvement projects is essential in order to have a packaging fitting perfectly the transported part.

6.1.2 Conclusion regarding the expectations of the firm

The End-to-end logistics is a new department that was created following the will of Volvo Group to reduce the Supply Chain consequent losses. Therefore, the department offers a pool of new opportunities in terms of costs deployment and new continuous improvement projects. As a consequence, the expectations of the supply chain director and the executive committee are huge. An ambitious objective of reducing the inbound logistics costs of 15% in three years has been set by the regional organization. Thus, it was important to act fast identifying the causes of these losses and working to eliminate it.

Consequently, the results of the major kaizen that I managed were eagerly expected by the logistics and executive committees that put resources in this new department. The huge savings that I introduced in this report convince the supply chain director of the importance to keep some resources in the End-to-end department.

The results exceeded what was initially expected on this project. In fact, as shown on the figure 41, the expected losses identification is of 30% with a 5% annual productivity while almost 22% of productivity was realized on this major kaizen.

Moreover, one of the main issue resulting in the losses that I treated was the lack of communication between the packaging department and the material control department. In order to reduce losses, the cooperation between these two departments is essential and the project that I managed helped connecting these two departments on a daily basis. For instance, a dialogue was established to fit direclty the packaging used with the net requirements on new parts. This part was not expected initially but the project's change management was essential to sustain the adequacy between the net requirements and the packaging used.

Finally, besides the savings done, I also realized an important work of standardization and capitalization of the major Kaizen that I managed. In terms of methodology, this work was well received when I presented it to the executive committee. This work follows our will, inside the End-to-end department, to standardize what we do. A kaizen, managed by Nicolas Avril, has been iniated in order to formalize what the department does and the capitalization done on the PE packaging is included in this kaizen.

6.2 Personal conclusion and recommendations

6.2.1 Personal conclusion

This final thesis is a wonderful and very formative experience that brought me a lot on a personal and professional point of view. The project that I managed mobilized many resources from different departments. Moreover, the new point of view brought by the End-to-end department was sometimes not well received by other departments with opposite objectives. In fact, it was difficult for some collaborators to identify the benefits of increasing the storage costs. Therefore, facing reluctant collaborators, I had to convince them by showing the numerous advantages of the End-to-end solutions while being transparent on the negative impacts.

This thesis was also a good opportunity for me to discover the logistics in an industrial environment. In fact, it was very complementary to my fourth year internship at Gerflor that was less operational. This thesis was closer to the fieldwork. I learnt that it is essential to identify the problems directly on the fieldwork that is the best place to observe new improvements' axes.

Moreover, being in a department with many areas of improvements and many things to build was also very useful because I had to be creative in order to identify the solutions and manage brand-new projects for the plant.

This experience also brought me many useful tools and methodologies. For instance, all the tools that I used in order to formalize the Kaizen were relevant for the project's success. It also reminds me the importance of the problem and the causes' analysis in order not to go on the wrong path and misunderstand the issues. These first two steps are essential in order to achieve a project. The best practices and the Volvo standards that I used were very useful to manage my project correctly. Furthermore, the deadlines fixed by the presentation to the committees challenged me in order to present the project's progress at each deadline. The only disadvantage that I noticed managing a project in a big group is that it is sometimes difficult to progress because many constraints are set by other collaborators and many validations are needed in order to go on; hence the importance of presenting the benefits of a project in order to increase its visibility and push the collaborators to work in the same direction.

Another project management tool that I used is the "4 cadrans" (four quadrants) that helped me setting some priorities for the next tasks and capitalized on what was already done and the difficulties encountered (Appendix 8.10). This tool allows also following the main indicators set. Therefore, the difficulties that I encountered during this project were multiple. The principal ones were the quantification of the negative impacts of this major Kaizen, mainly on the workload smoothing of the receiving inbound department. At first, I had the same problem to face in order to quantify the number of allocations needed in addition in the warehouse. Consequently, I noticed that, it is easier to convince a collaborator when you can be supported by figures. Moreover, while I was able to quantify the number of allocations needed, we were able to take this impact into account in the project PSM1 aiming to increase the capacity of the warehouse. Finally, it was also difficult to mobilize some collaborators who have little time to dedicate to projects.

Finally, in the last part of this thesis, I spent time forming the following trainee that takes back the PE packaging subjects. This training phase was also interesting for me in order to have an external point of view on the work done and to get some remarks on the standardization and capitalization done.

6.2.2 Future recommendations

First of all, I would recommend to continue to **communicate the End-to-end projects** by presenting regularly the subjects we are working on to the other departments and to the committees. The objective is to increase the motivation of the collaborators to work on End-to-end projects.

I would recommend to **maintain regularly the MOQ parameters** into PipeChain. Maintening it quaterly or at each speed modification might be a good compromise to ensure the adequate MOQ parameters without constraining too much the material controllers in charge of updating the MOQ parameters. According to me, the End-to-end department needs to support the material control and the packaging in this transition phase, but progressively needs to let the two departments in autonomy, except for the maintenance file update.

It is undeniable that, progressively, the losses will be more and more difficult to attack. The major kaizen that I managed attacked losses amounting 1.7 million euros out of the 2.3 millions euros identified on the PE packaging. Even if there are still important savings to do on this scope, it might take more time to do savings on it. In fact, although the project that I managed was pluri-disciplinary, all the stakeholders were internal to the plant. The major Kaizen opened on the sub packages optimization will necessitate the validation of packaging instructions by the supplier. Therefore, it might take more time to concretize the savings. I would recommend to **alternate phases of Gemba walks to identify the issues and phases of analyses in order to find adequate solutions**. In fact, because the sub packages optimizations necessitates the supplier's validation for each packaging modification, the solution is longer to implement. Spacing out the gemba walks and the period of analyses allows having progressive earnings and feedbacks from suppliers. Furthermore, it would be interesting to consult what was done on the static packaging scope because the solutions identified are the same. Therefore, asking for advices to be more efficient during Gemba walks and maybe identify some common constraints on both projects might be a good option to consider.

According to me, a fundamental work needs to be done on the different ERP modules used that are sometimes miscommunicating between each other. Many errors in the data transfer between the software were identified. This issue might be problematical and might increase the air and packaging losses. For instance, a fundamental work on weights needs to be done in order to pay exactly what the plant orders. Therefore, I would recommend weighing the part each time a box is opened in order to confirm that the weight written on the label is faithful and raising the information in order to correct the databases.

Furthermore, it might be necessary to **redefine the End-to-end boundaries**. Until now, the End-to-end scope on the supplier side, started with the transportation. It must be possible to expand the scope contacting the purchasers from GTP (Volvo Group Trucks Purchasing) in order to renegotiate the contracts. For instance, by increasing the minimum and multiple order quantities, the material handling is reduced on the Venissieux plant but also for the supplier that does not need to handle the same amount of pallets each year. Moreover, increasing the MOQ must also coincide with an increase of the supplier's lot sizes at the production level reducing the changeover times. Consequently, Volvo purchasers might be able to renegotiate the price per part.

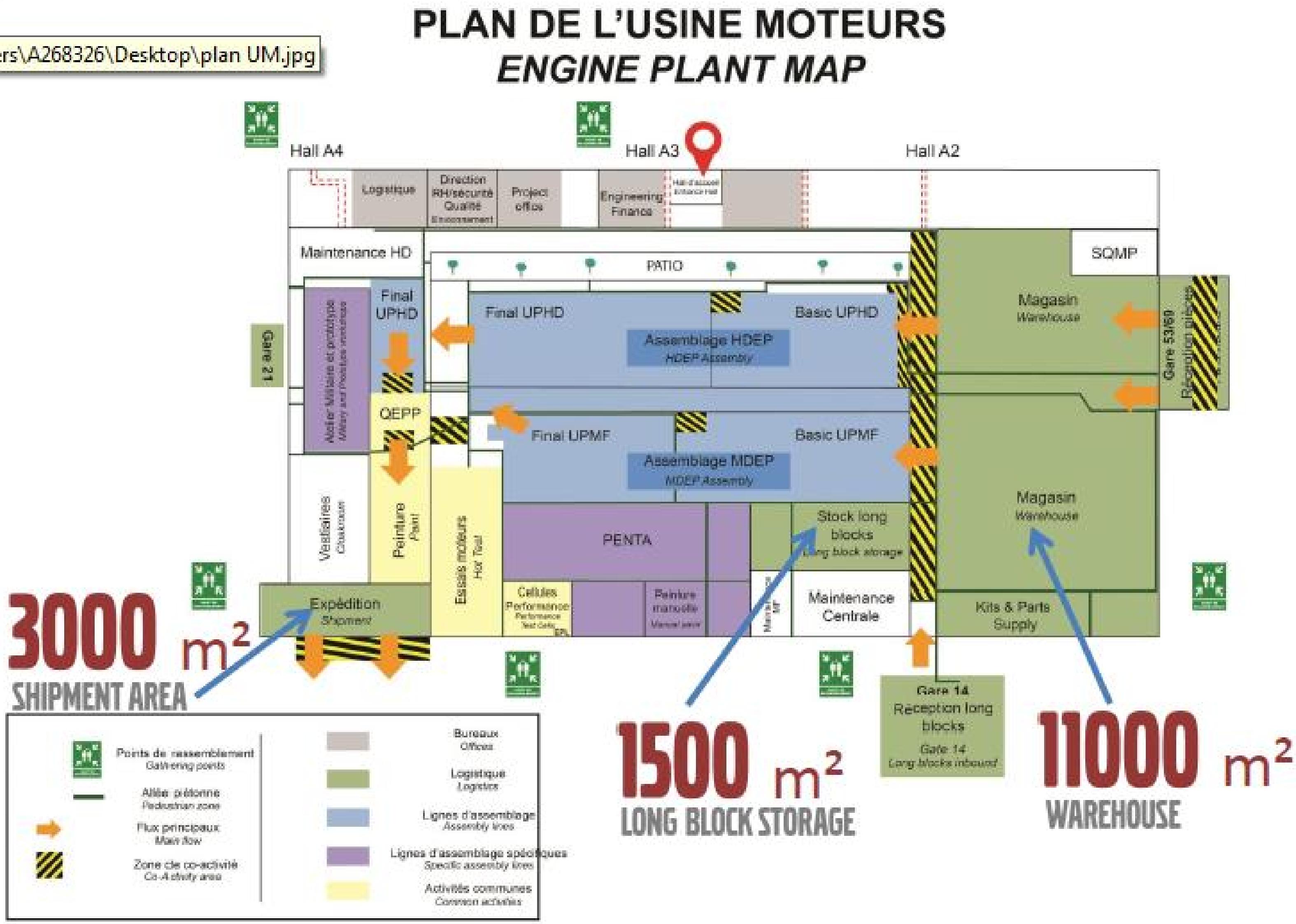
Finally, I received a good remark during my presentation to the executive committee concerning **the environmental impact**. It would be interesting to quantify it for each End-to-end project done because reducing the excess of air and packaging results in a reduction of the number of transports needed and a positive environmental impact.

7. Table of figures

8. Appendix

8.1 Engine plant map

C:\Users\A268326\Desktop\plan UM.jpg



8.2 Advanced kaizen : reduction of losses on inbound flows between suppliers and the powertrain plant of Vénissieux

VOLVO KAIZEN

☐ Safety | ☐ Continuous Improvement | ☐ Autonomous Maintenance | ☐ Professional Maintenance | ☐ Workplace Organisation | ☐ Logistics | ☐ Quality | ☐ People Development | ☐ EEM | ☐ Environment | ☐ Others

PROJECT : Reduction of losses (Packaging and Air) for inbound flow between suppliers and PTP VNX

PROCESS / DEPT. :

DEPT. : Logistics

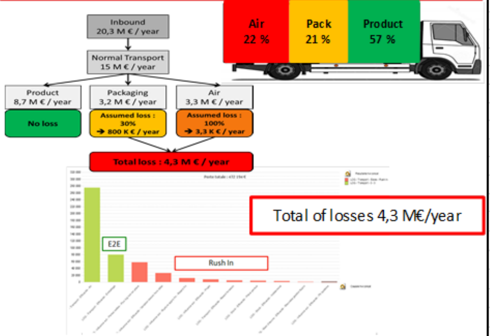
LEADER : Tiphaine Chatard

TEAM MEMBERS : Tiphaine Chatard/Alice Pontette/ Julien Triquet/Nicolas Avril/Patrick Belz, Kévin Joud

DATE : 22/02/2018

1. PROBLEM / OPPORTUNITY :

Transport of a large amount of Packaging and Air from the suppliers



Total of losses 4,3 M€/year

2. CAUSE ANALYSIS / CURRENT STATE :

- Empty boxes
- Packaging not Full

→ dynamic packagings (V750/V780/V100/V156

- Packaging Weight > Products Weight
- Packaging not Full
- Volume > Weight

→ static packagings (L/K pallets)

- Truck not full

→ all types

-Until now focus on the turnover rate , the inventory value ,...
- Volvo standards Packaging not always adapted to pieces
- Packaging not reviewed on a regular basis to take into account comsuption's changes of P/N
- Transport constraints
Packaging constraints (stackable blue boxes)

3. TARGET / FUTURE STATE :

Objective:
Reduction of 5 % of the normal transport costs by the end of 2018

→ Reduction of 760 K €

Projected B/C Ratio :

B/C Ratio = 1
B/C Ratio calculated on each related Kaizen

4. ACTION PLAN :

ITEM	ACTION	WHO	W12	W14	W16	W18	W20	W22	W24	W26	W36
1	To understand the different files available to analyze the losses	AP/TC	■	■	■	■					
2	Build the pareto of suppliers to attack	AP	■								
3	To integrate losses inside the Cmatrix	TC	■								
4	Potential root causes anlaysis	TC	■	■	■						
5	Network to build with packaging	TC				■					
6	E2E scope com to packagers	TC				■					
7	Connection with other PSM 1/2	TC							■		
8	To open the different kaizens	AP	■	■	■	■	■	■	■	■	■
9	To build the dashboard	TC					■				
10	Connection with PL	TC		■							
11	Gemba walk per supplier	AP			■						
12	Analysis per packaging and gemba w	JT/NA									■
13	To launch MK on MOQ	JT									■
14	Gemba walk for Penta parts	NA									
15	Gemba walk for sequencing P/N	NA									
16											
17											

5. RESULT MONITORING :

KPI:
- Decrease of the % of Packaging and Air
- Decrease of the Loss for Packaging and Air (C matrix)
- Results Dashboard (nb kaizens, savings)

	Internal saving at plant (EUR)			Transport related cost saving (EUR)			Total cost saving (EUR)		
Plant	identified	Ongoing	Finished	identified	Ongoing	Finished	identified	Ongoing	Finished
PTP Venissieux	0	-34 527	-140 308		-66 368	-328 986		-100 895	-469 294
Total	0	-34 527	-140 308	0	-66 368	-328 986	0	-100 895	-469 294
		34%	30%		66%	70%			

6. CONFIRMATION / CONCLUSION :

Measured B/C Ratio :

7. STANDARDIZATION :

(SOP, FI, Calendrier AM, Formation, etc.)

- Instructions Sheets
- Logigrams

Process EEM : OUI / NON

8. APPROVAL / HORIZONTAL EXPANSION :

UTILIZED TOOLS :

3G/5G	5 Pourquoi	5S	AMDEC	MIFA/VSM	Analyse ergo
QQOQCCP	4M	Pareto	SMED	7QC	Analyse NVAA
DOE	SPC	Spaghetti	PPA	TWTTP	Analyse de temps

9. CONTINUOUS IMPROVEMENT MONITORING :

Action Sheet Number : LG-180219-1720

8.3 Major Kaizen: reduction of the number of empty blue boxes entering the Vénissieux powertrain plant

VOLVO — **KAIZEN**

☐ Safety | ☐ Continuous Improvement | ☐ Autonomous Maintenance | ☐ Professional Maintenance | ☐ Workplace Organisation | ☐ Logistics | ☐ Quality | ☐ People Development | ☐ EEM | ☐ Environment | ☐ Others

PROJECT : Reduction of the number of empty blue boxes entering the plant

PROCESS / DEPT. :

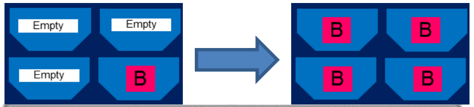
DEPT. : Logistics

LEADER : Julien TRIQUET

TEAM MEMBERS : Tiphaine Chatard, Florian Dacier Falque,Kévin Joud, Pierre Albanese, Raymond Touma, Yann Laigron

DATE : 29/10/2018

1. PROBLEM / OPPORTUNITY :



Problème initial (facultatif) : Transport d'air et d'emballage dans nos transports venant des fournisseurs

Quoi	Quel est le problème, l'anomalie, le dysfonctionnement?	Transport de boîtes bleues vides dans les transports venant des fournisseurs
Quand	Depuis quand le problème est-il apparu/détecté?	Depuis 2017 et création du service E2E (End to End)
Où	Où a-t-il été détecté?	En réception Au service E2E
Qui	Qui a détecté le problème? Qui d'autre est concerné ?	Réception → Zone de SPLIT (séparation des boîtes bleues pleines et vides) Service E2E
Combien	Combien de fois le problème est-il apparu ? Quelle est la tendance ?	35 camions/jour avec 22% d'air et 21% d'emballage → 65 000 boîtes vides annuelles (15% des boîtes entrants dans l'usine sont vides)
Comment	Comment le problème a-t-il été détecté?	**En réception**: en zone de SPLIT → Séparation des boîtes pleines pour mise à stock et des boîtes vides pour flux retour **Au service E2E**: fichier de l'organisation régionale avec étude de l'écart entre le poids réservé et le volume de la palette convertit en poids
Pourquoi	Pourquoi est-ce un problème ?	• Transport non optimisé • Manutention logistique inutile • Packaging non optimisés • Coûts administratifs non optimisés (expression des besoins)

2. CAUSE ANALYSIS / CURRENT STATE :

Problème: On paie pour transporter et manutentionner du vide dans nos transports venant des fournisseurs

Pourquoi? Transport de boîtes bleues vides dans nos camions entrants dans l'usine

Pourquoi? Calage des palettes dans les camions

Pourquoi? Equilibre et préservation des pièces dans les transports

Pourquoi? Pas d'adéquation entre notre expression des besoins et le packaging

Pourquoi? Pas de communication entre les appros et le packaging

Pourquoi? Focus stock (et non transport)

Pourquoi? Depuis crise de 2008, volonté de libérer du cashflow --> diminution des stock

3. TARGET / FUTURE STATE :

Objective:
Reduction of 50 % of the empty boxes by the end of 2018

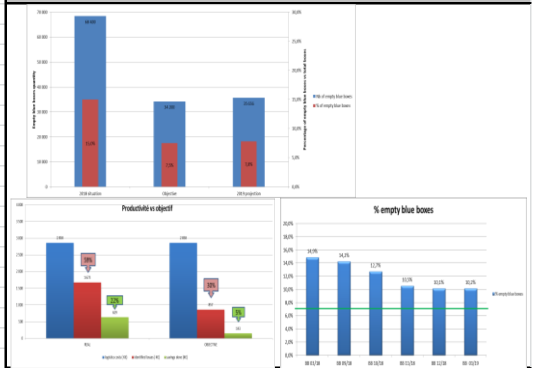
Projected B/C Ratio :

B/C Ratio = 1
B/C Ratio calculated on each related Kaizen

4. ACTION PLAN :

ITEM	ACTION	WHO	W37	W39	W41	W43	W45	W47	W49	W51	W4
1	Identify the part number concerned/providers/MC	Julien, Tiphaine									
3	Create a MOQ follow up file	Julien, Tiphaine									
4	Empty boxes analysis	Julien, Kevin									
5	SCO Gantt file	Julien									
6	Allocation impact file	Julien, Yann									
7	Weight impact calculation file	Julien									
8	Simulation SCO +Savings callulation and FA	Julien, MC									
9	MOQ changes on MC portfolio	Julien, MC, Florian									
10	Smoothing impact on inbound logistics workload file	Julien, Georges									
11	Area modification in the warehouse file	Julien, Yann									
12	Empty boxes reporting	Julien									
13	Multiple order quantity packaging	Julien, Florian,									
14	G-pallet performance indicator	Julien, Kevin									
15	Mixed pallet analysis	Julien, Victor,									
16	Mixed pallet +SCO process	Julien, Victor									
17	Mixed pallet on provider 1633	Julien, Victor									
18	SCO instruction sheet	Julien									
19	RACI on MOQ maintenance	Julien, MC,									
20	Maintenance file	Julien,									

5. RESULT MONITORING :



6. CONFIRMATION / CONCLUSION :

Measured B/C Ratio : B/C=24,4

7. STANDARDIZATION :

(SOP, FI, Calendrier AM, Formation, etc.)

- Instructions Sheets
- Logigrams

Process EEM : OUI / NON

8. APPROVAL / HORIZONTAL EXPANSION :

- All Material Controller portfolio
- MOQ maintenance

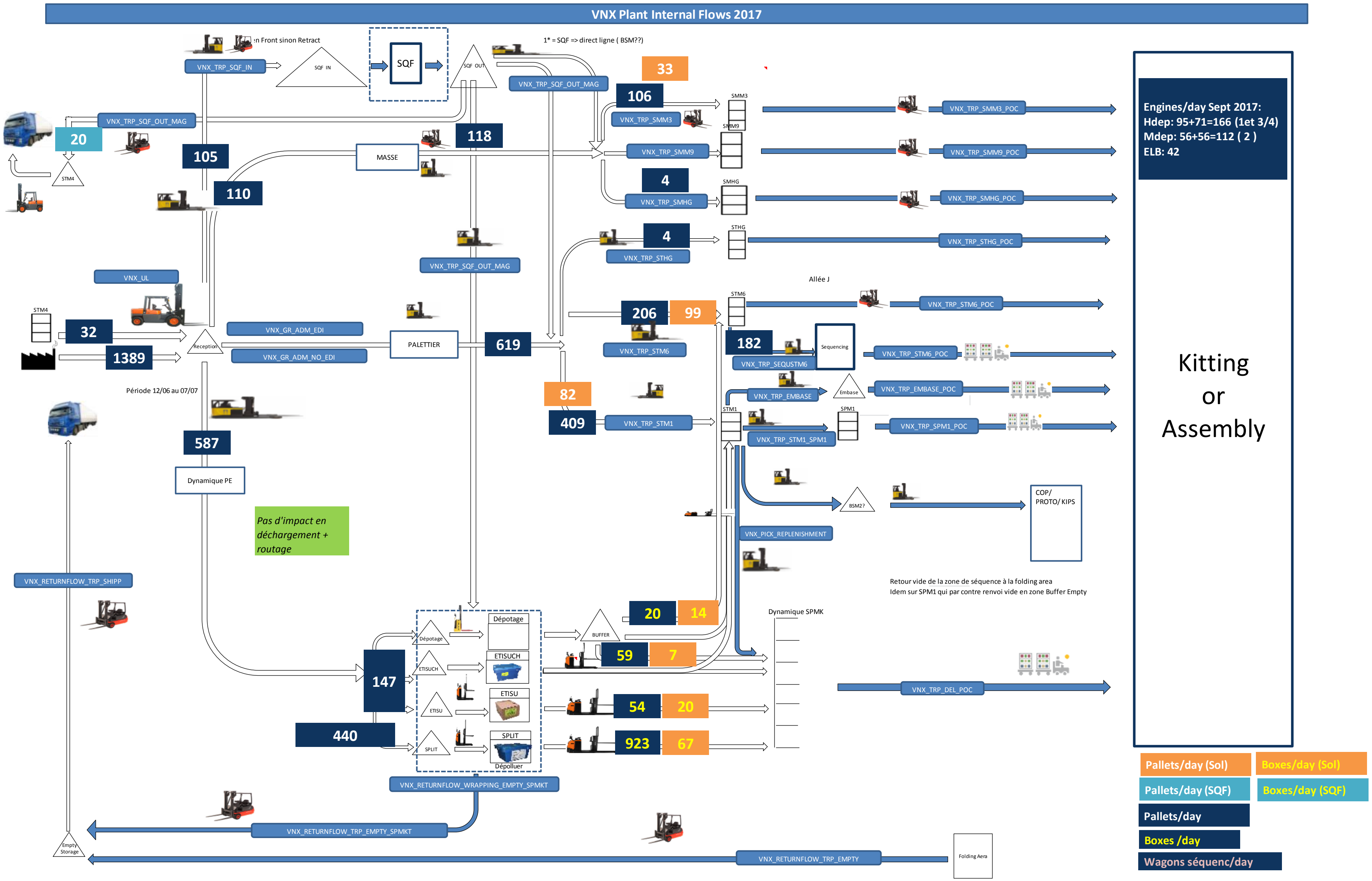
ED TOOLS :

3G/5G	5 Pourquoi	5S	MDEC		MIFA/VSM	Analyse ergo
QQOQCP	4M	Pareto	MED		7QC	Analyse NVAA
DOE	SPC	Spaghetti	PPA		TWTTP	Analyse de temps

9. CONTINUOUS IMPROVEMENT MONITORING :

Action Sheet Number : LG-181003-1402

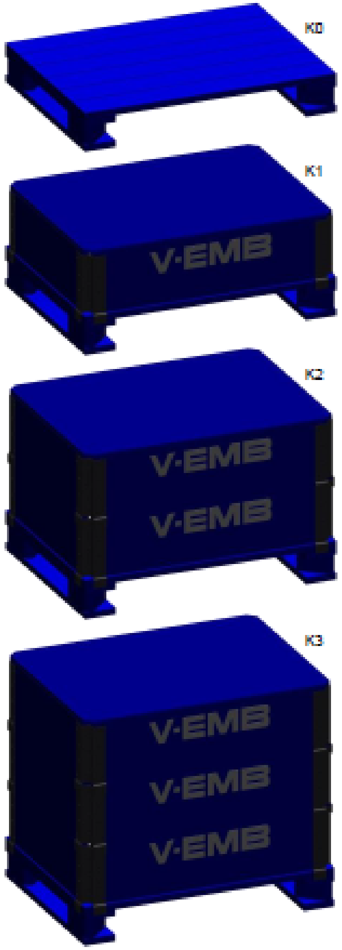
8.4 VSM of the inbound flows



8.5 Volvo standard packaging

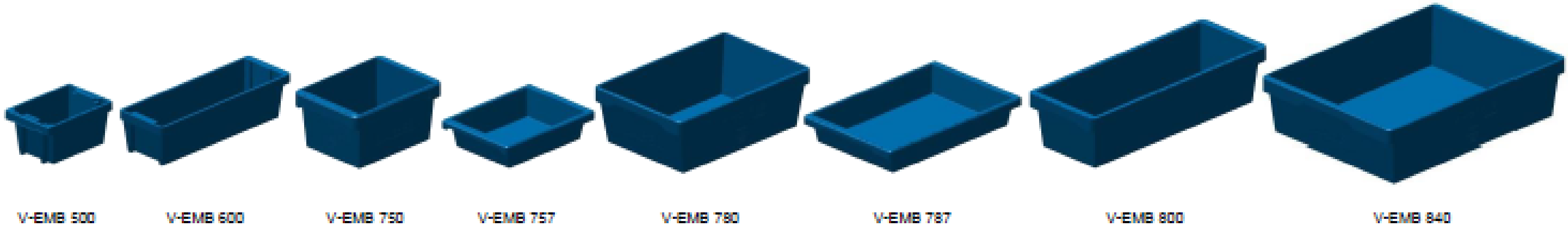
Volvo standard and returnable wooden Pallets and Combitainers: outer dimensions and weights.
These are the combinations of the most common Volvo standard packaging:

	MILLIMETERS			KG	M^3	INCHES			LBS	CUBIC IN
V-EMB	LENGTH	WIDTH	HEIGHT	WEIGHT	VOLUME	LENGTH	WIDTH	HEIGHT	WEIGHT	VOLUME
K0	820	615	126	11.00	0.06	32.28	24.21	4.96	24.25	3878
K1	820	615	330	21.50	0.17	32.28	24.21	12.99	47.40	10156
K2	820	615	525	28.50	0.26	32.28	24.21	20.67	62.83	16156
K3	820	615	720	36.00	0.36	32.28	24.21	28.35	79.37	22157
K4	820	615	915	43.50	0.46	32.28	24.21	36.02	95.90	28158
L0	1225	820	151	25.00	0.15	48.23	32.28	5.94	55.12	9256
L1	1225	820	355	41.00	0.36	48.23	32.28	13.98	90.39	21761
L2	1225	820	550	51.00	0.55	48.23	32.28	21.65	112.43	33714
L3	1225	820	745	61.00	0.75	48.23	32.28	29.33	134.48	45667
L4	1225	820	940	71.00	0.94	48.23	32.28	37.01	156.53	57620
F0	1630	1220	167	50.00	0.33	64.17	48.03	6.57	110.23	20266
F1	1630	1220	371	76.00	0.74	64.17	48.03	14.61	167.55	45022
F2	1630	1220	566	90.50	1.13	64.17	48.03	22.28	199.52	68685
F3	1630	1220	761	105.00	1.51	64.17	48.03	29.96	231.48	92349
F4	1630	1220	956	119.50	1.90	64.17	48.03	37.64	263.45	116012
G0	1445	820	151	32.00	0.18	56.89	32.28	5.94	70.55	10918
G1	1445	820	355	50.50	0.42	56.89	32.28	13.98	111.33	25669
G2	1445	820	550	61.50	0.65	56.89	32.28	21.65	135.58	39769
G3	1445	820	745	72.50	0.88	56.89	32.28	29.33	159.83	53869
G4	1445	820	940	83.50	1.11	56.89	32.28	37.01	184.08	67969
H0	1805	820	151	35.00	0.22	71.06	32.28	5.94	77.16	13639
H1	1805	820	355	57.00	0.53	71.06	32.28	13.98	125.66	32064
H2	1805	820	550	69.50	0.81	71.06	32.28	21.65	153.22	49677
H3	1805	820	745	82.00	1.10	71.06	32.28	29.33	180.78	67289
H4	1805	820	940	94.50	1.39	71.06	32.28	37.01	208.33	84902
701	2400	820	151	47.00	0.30	94.49	32.28	5.94	103.62	18134
701-1	2400	820	358	78.00	0.70	94.49	32.28	14.09	171.96	42994
701-2	2400	820	553	92.00	1.09	94.49	32.28	21.77	202.82	66412
701-3	2400	820	748	106.00	1.47	94.49	32.28	29.45	233.69	89831
701-4	2400	820	943	120.00	1.86	94.49	32.28	37.13	264.55	113249
C400	1630	1220	1382	-	-	64.17	48.03	54.41	-	-
C419	1630	1220	1382	116.50	2.75	64.17	48.03	54.41	256.84	167708
C422	1630	1220	1582	121.50	3.15	64.17	48.03	62.28	267.86	191979
C814	2270	1450	1176	198.00	3.87	89.37	57.09	46.30	436.51	236211



Hinges add another 15 mm or 0.6 inches to length and width.

Volvo standard and returnable blue boxes. (material = polypropylene)
Lids are not displayed.



Outer dimensions and weights

	MILLIMETERS			KG	M^3	INCHES			LBS	CUBIC IN	ON K0 PALLET (DEFAULT)		ON L0 PALLET	
V-EMB	LENGTH	WIDTH	HEIGHT	WEIGHT	VOLUME	LENGTH	WIDTH	HEIGHT	WEIGHT	VOLUME	PER LAYER	MAX LAYERS	PER LAYER	MAX LAYERS
500	300	200	150	0.45	0.01	11.81	7.87	5.91	0.99	549	8	-	16	-
600	600	200	150	0.77	0.02	23.62	7.87	5.91	1.70	1098	4	-	8	-
750	400	300	200	1.06	0.02	15.75	11.81	7.87	2.35	1465	4	-	8	-
757	400	300	100	0.74	0.01	15.75	11.81	3.94	1.63	732	4	-	8	-
780	600	400	200	2.05	0.05	23.62	15.75	7.87	4.52	2929	2	-	4	-
787	600	400	100	1.30	0.02	23.62	15.75	3.94	2.87	1465	2	-	4	-
800	800	300	200	2.05	0.05	31.50	11.81	7.87	4.52	2929	2	-	4	-
840	800	600	200	2.98	0.10	31.50	23.62	7.87	6.57	5858	1	-	2	-

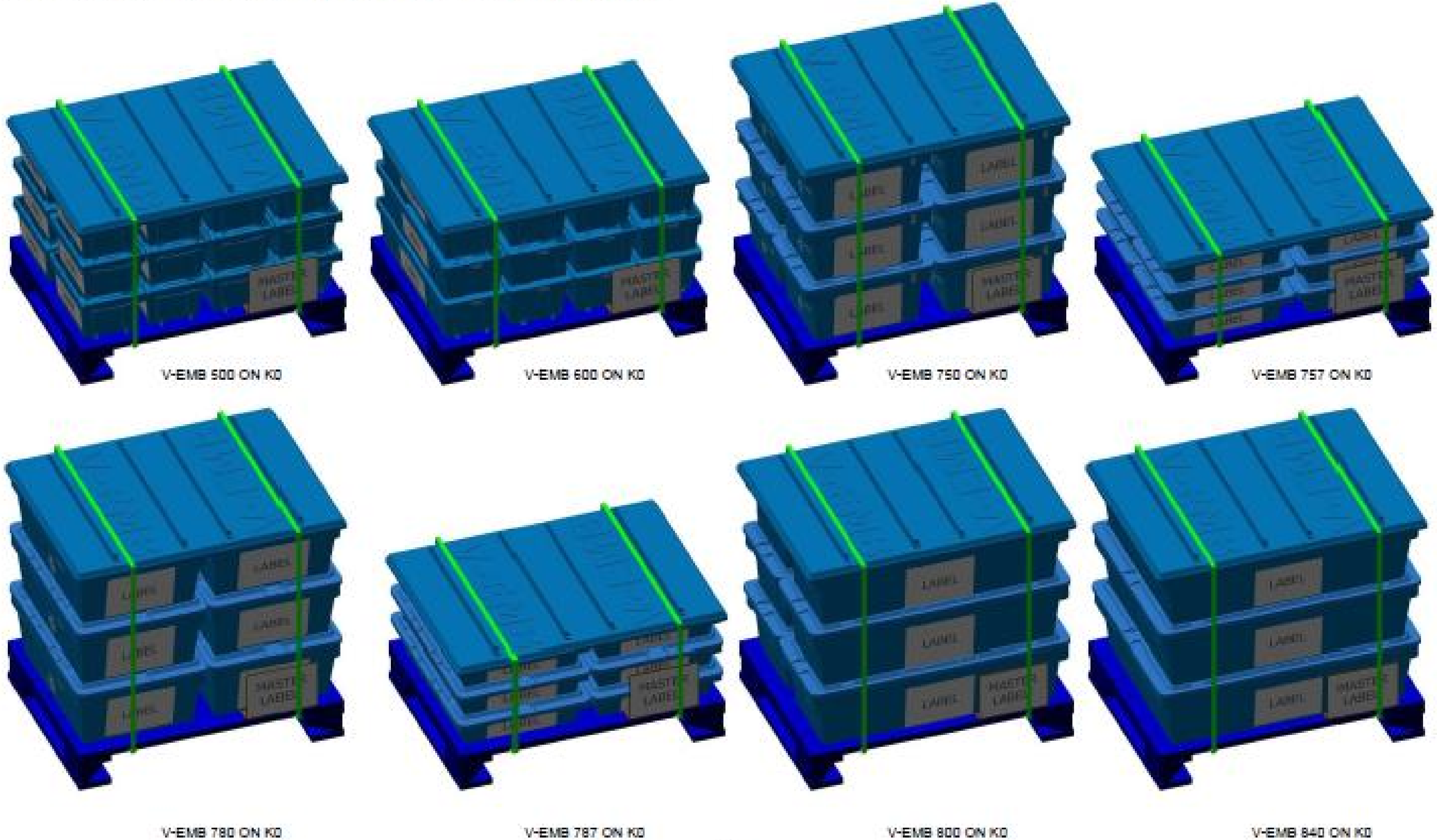
Inner dimensions and weights

	MILLIMETERS			KG	M^3	INCHES			LBS	CUBIC IN	ON K0 PALLET (DEFAULT)		ON L0 PALLET	
V-EMB	LENGTH	WIDTH	HEIGHT	WEIGHT	VOLUME	LENGTH	WIDTH	HEIGHT	WEIGHT	VOLUME	PER LAYER	MAX LAYERS	PER LAYER	MAX LAYERS
500	203	178	148	0.45	0.01	7.99	7.01	5.83	0.99	326	8	-	16	-
600	406	178	148	0.77	0.01	15.98	7.01	5.83	1.70	653	4	-	8	-
750	345	265	185	1.06	0.02	13.58	10.43	7.28	2.35	1032	4	-	8	-
757	345	265	85	0.74	0.01	13.58	10.43	3.35	1.63	474	4	-	8	-
780	537	362	185	2.05	0.04	21.14	14.25	7.28	4.52	2195	2	-	4	-
787	537	362	85	1.30	0.02	21.14	14.25	3.35	2.87	1008	2	-	4	-
800	745	265	185	2.05	0.04	29.33	10.43	7.28	4.52	2229	2	-	4	-
840	745	565	185	2.98	0.08	29.33	22.24	7.28	6.57	4752	1	-	2	-

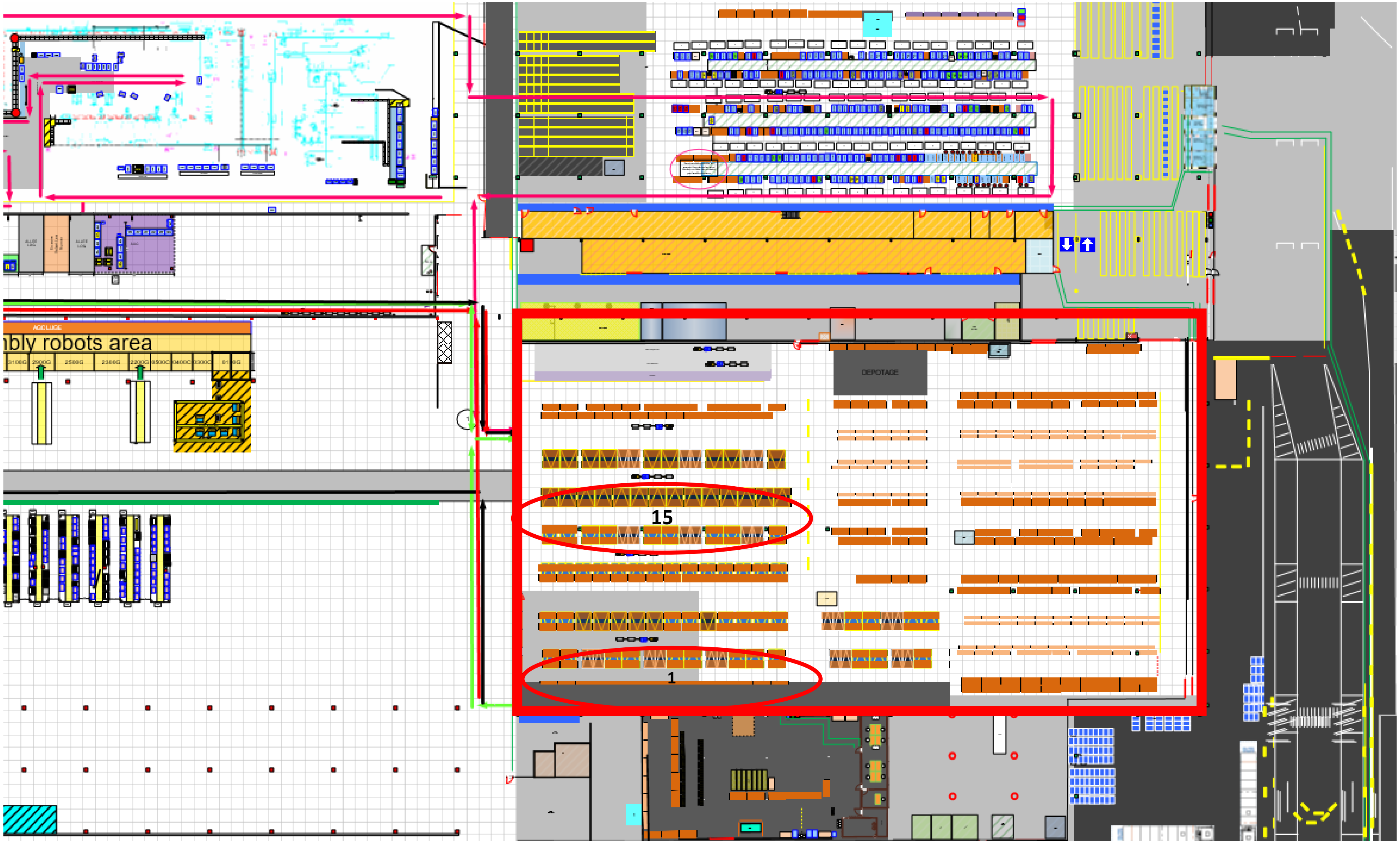
The maximum layers authorized can vary per plant.

Delivery Unit with blue boxes
Examples with three layers on a K0 pallet.

<u>Plastic bands must never cover the bar codes on the master label.</u>



8.6 Warehouse and supermarket map

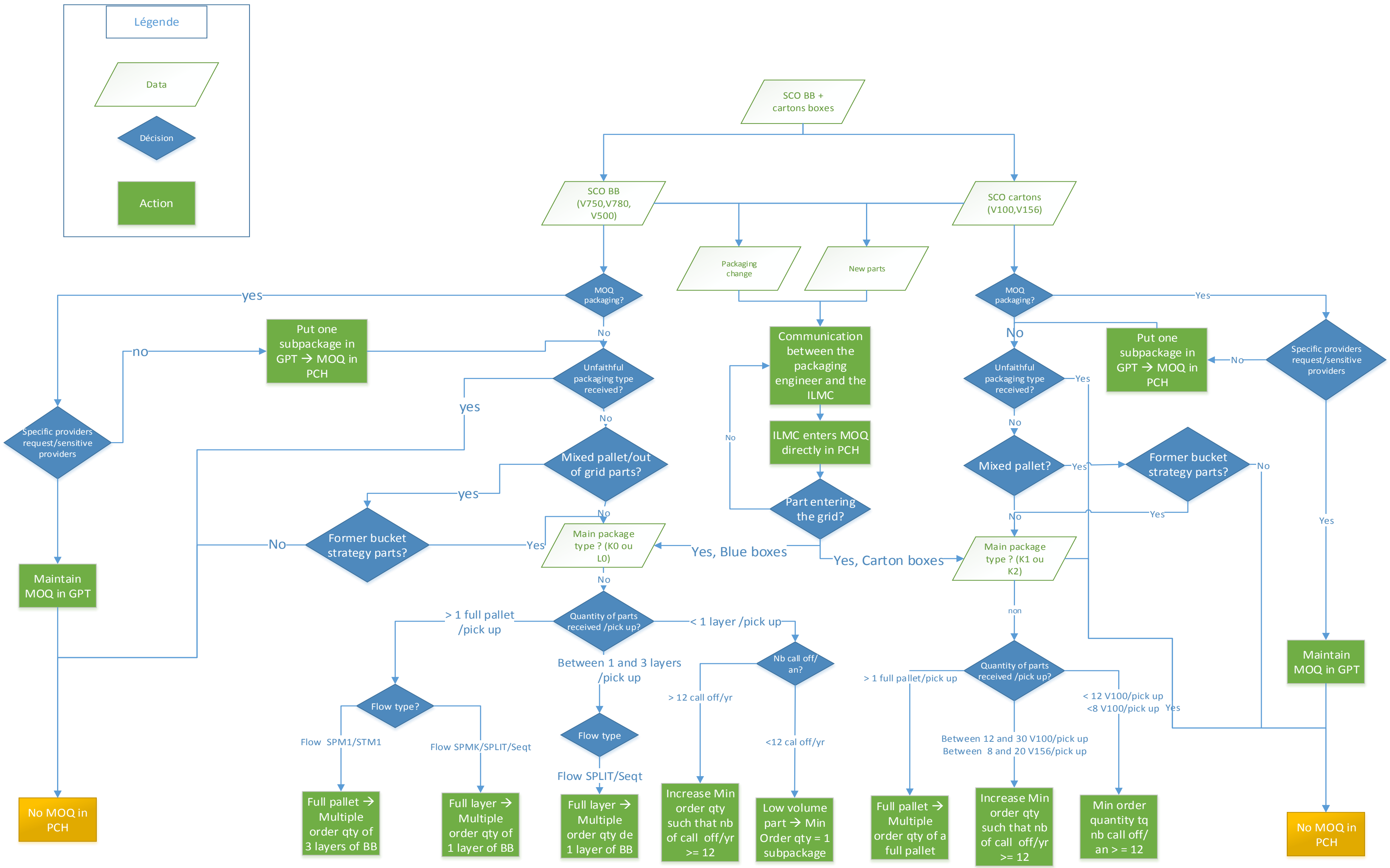


8.7 Example of an instruction sheet realized

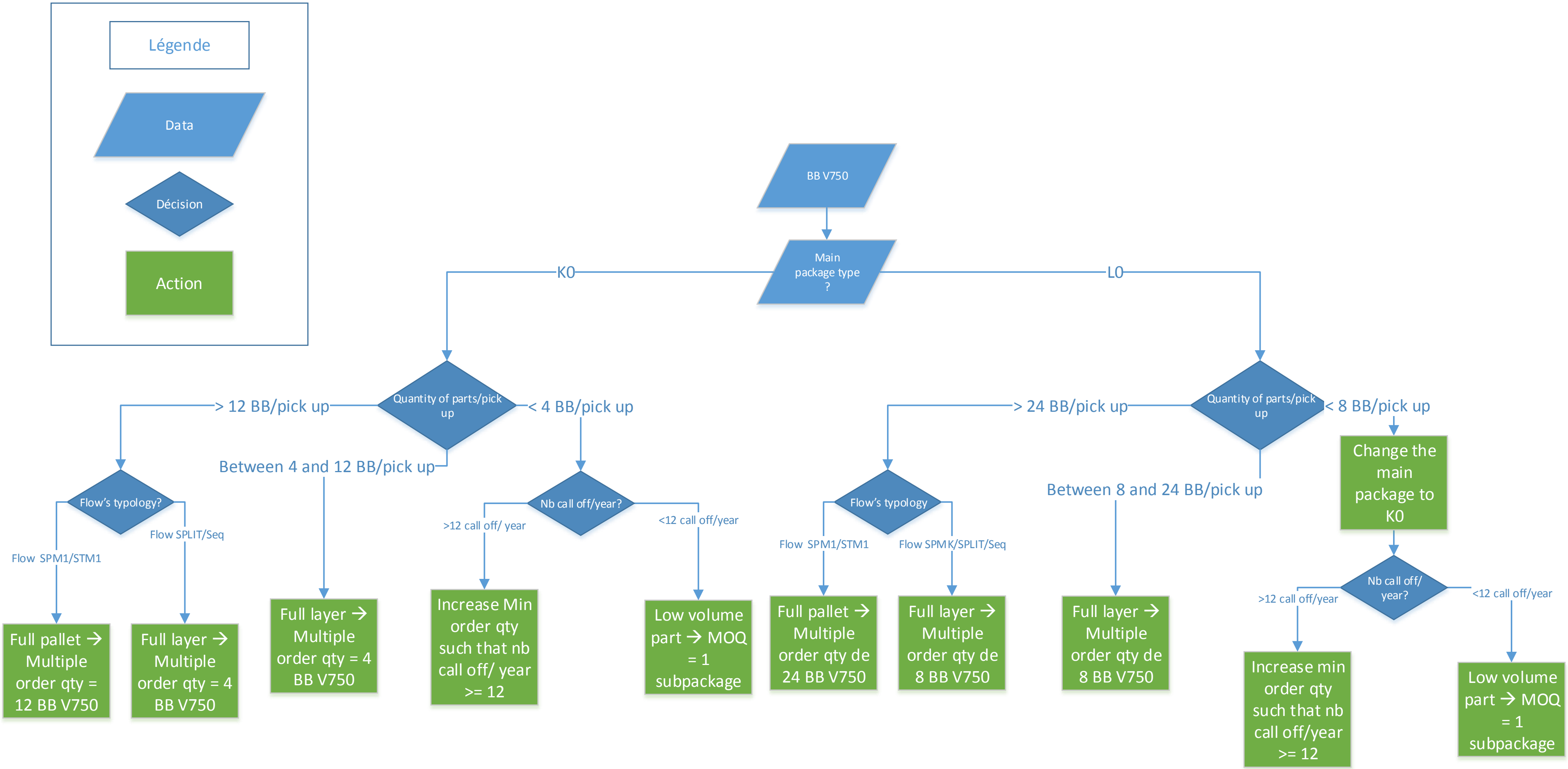
Volvo Powertrain France		FICHE D'INSTRUCTION	Section :
Log	N°:000	FI – E2E – Create a « Fiche d'action »	Page 2 sur 3

Process description	1. Click here 2. Click on *"nouvelle fiche"* **"Entête"** 3. Insert the objective of the project in the *"Intitulé du projet"* box 4. Select the origin of the project in the *"Origine du projet"* box Remark: Usually *"Chantier issu de la matrice"* 5. Select the method used on the project in the *"Méthodologie utilisée"* box Remark: Usually *"Kaizen standard"* 6. Select the status of the project 7. Select the major area of the project in the *"Pilier"* box Remark: *"LOG – Logistique"* 8. If the method used is a kaizen standard, insert the number of the kaizen reference (Major/advanced kaizen) in the *"Kaizen réf."* box 9. Insert a description of the project in the *"Descriptif du problème/opportunité"* box **"Ressources"** 10. Select the responsible of the project in the *"Pilote"* box 11. In the other boxes *"Equipier x"* select the others members of the project • For example, if it is a kaizen standard for the references of a specific supplier, add the material controller responsible for this supplier **"Planning"** 12. Select the date foreseen to start the project and the real date of start 13. Do the same for the closing date Remark: The closing date will appear just if the status of the project is "closed", otherwise there is just the starting date **"Bilan gains coûts"** 14. Select the impacted sector in the *"Secteur impacté"* box Remark: 9998 EXT IN or 9999 EXT OUT 15. Select the type of losses the project is about in the *"Type perte attaquée"* box **"Les coûts"** 16. Fulfill the boxes with the costs of the project Remark: As default 5h foreseen and real of work hours **"Les gains"** 17. Insert all the gains of the project, classified by nature of the gain, and their values, foreseen and real (when the project is closed) Remark: Usually are the following gains: "Manutention logistique", "location packaging" and "transport" (efficacité transport) 18. Click on the button *"Sauvegarder et quitter"* to save the *"fiche d'action"*

8.8 Global MOQ maintenance process



8.9 MOQ maintenance applied to blue boxes V750



8.10 « 4 cadrans »

End to End

Month 2019/01

Activités réalisées

1. **Major Kaizen: réduction du nombre de boîtes vides entrants dans l'usine**

- Présentation du fichier final de changement de zone à Zoubir Tobbal et début du travail de changement de zone
- Màj mensuelle des fichiers étude sur les boîtes vides et du reporting blue boxes
- Finalisation du SCO sur l'ensemble des PF Appros et calcul des gains SCO sur l'ensemble des portefeuilles de fournisseurs
- Formalisation des fiches actions pour comptabiliser les gains et création d'un fichier de synthèse des références traités (MOQ)
- Finalisation du travail de remise du MOQ à 1 sub package dans GPT → objectif de transférer la responsabilité de la gestion des MOQ du packaging vers le material control
- Réunion packaging/appro/E2E sur la stratégie de maintenance MOQ → RACI MOQ validé
- Finalisation du process de maintenance MOQ → ensemble des critères d'update des MOQ
- Expansion du MOQ aux refs hors grid → création d'un process de fonctionnement et mise en place d'une communication inter-service entre le packaging et l'ILMC pour les nouvelles références et les changements de conditionnement
- Validation de la liste de références à livrer en mixed pallet pour le parma 1633 → attente paramétrage fournisseur + première livraison en mixed pallet
- Quantification de l'impact final des modifications de MOQ sur le lissage de la charge en réception et sur la diminution de charge
- Début du traitement des anomalies sur les cartons + BB avec Victor Pietrocola + erreurs dans GPT/MMS, envoi au packaging d'un fichier d'écart entre données de GPT et PCH
- Travail sur les coûts transports des fournisseurs non identifiés par Renaud Aubert (prestataire logistique)
- Analyse couts/pertes/costs savings sur le E2E IN
- **Présentation au comité logistique de la clôture du major Kaizen de réduction du nombre de boîtes vides**

2. Autres

- Retour d'AMI et début de la démarche de test du nouveau conditionnement chez le fournisseur
- FA sur refs 1633 optimisées

Difficultés rencontrées

- Incohérence entre GPT/MMS et MACS sur les unit load
- Fichier de maintenance MOQ → nombreux cas à exclure
- Non utilisation du fichier de changement de zone?
- Code VBA sur fichier de maintenance MOQ

Activités en cours/à venir

- **Travail sur un fichier de maintenance MOQ « user friendly » pour le material control S7-S8**
- **Formation de Bianca (fichiers analyse, reporting et database): S7- S8**
- **Process E2E PE: S7-S8**
- Travail sur le remplissage des BB/cartons au SPMK (feuille d'analyse à construire par tranche de poids 0 à 4 ; 4 à 8 et entre 8 et 12) → ouverture du major kaizen: **S8**
- Gemba walk dépotage (optimisation flux repacking) + SPMK (optimisation flux in): **S8**
- **Présentation du major kaizen au comité de direction 14/02**
- Attente retour fournisseur ref AMI: **S10**
- Finaliser le travail sur les anomalies GPT/MMS: **S10**
- Vérification réception conforme mixed pallet 1633: **S10**
- Fichier de changement de zone à adapter suite à futur réorganisation du SPMK en aout 2019
- Travail sur les fréquences:
- Travail de lissage réel de la charge en réception (Julien Gros)

KPI (mis en place)