UNIVERSIDADE CATÓLICA PORTUGUESA

Lean thinking applied to logistics: a case study

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October 2021

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Lean thinking applied to logistics: a case study

Master's Final Work in the modality of Dissertation
Presented to Catholic University of Portugal to fulfill
the requirements for the degree of MSc. in Management

by

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October 2021

ACKNOWLEDGEMENTS

To all those who contributed to this dissertation and helped me reach this important goal, my deepest and sincerely “Thank you”.

RESUMO

O presente trabalho demonstra a aplicação da metodologia lean numa média empresa (ME) de logística portuguesa.

Neste trabalho procurou-se responder à questão "Como é que o lean pode melhorar a gestão dos processos de uma empresa de logística?"

Para tal foi realizada uma revisão bibliográfica, análise documental, observação direta e entrevistas semi e não estruturadas. Posteriormente, diferentes recomendações lean foram sugeridas, para reduzir ou até eliminar os desperdícios na empresa em questão. Algumas ferramentas sugeridas foram poka-yoke, layout de células, kaizen e gestão visual.

Não foi possível verificar a eficiência das ferramentas sugeridas uma vez que a investigação em causa foi realizada durante o cenário de pandemia, o que impossibilitou ao autor permanecer mais tempo na empresa e também devido ao tempo relativamente curto do estágio.

Para investigação futura, sugere-se considerar todas as sugestões propostas, contratar pelo menos um especialista lean de forma de explicar aos colaboradores o que é o lean e porque é que é tão benéfico e, por último transitar para um ambiente de trabalho digital como por exemplo o Microsoft 365.

Palavras-chave: *Lean*, Desperdício, Ferramentas *lean*, Processos, Logística, Armazém

ABSTRACT

The following work demonstrates the application of lean in a logistics company, answering the following question: "How can lean improve the logistics company's processes?".

To answer the introduced question, a literature review was conducted, a documental analysis, direct observation and semi-structured and unstructured interviews were carried out. After that being completed, different lean recommendations were suggested to reduce or even eliminate wastes in the company. Some of the tools suggested were poka-yoke, cellular layout, kaizen and visual management.

It wasn't possible to verify the efficiency of the suggested tools since the investigation was done during the pandemic scenario, which enabled the author to spend more time in the company and due to the short time of the internship.

As a future investigation, it is proposed to consider all the suggestions proposed, hire at least one lean specialist to explain to the employees what is lean and why it is so beneficial, and to switch to a digital workplace environment like Microsoft 365.

Keywords: Lean, Waste, Lean tools, Processes, Logistics, Warehouse.

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CHAPTER 1
INTRODUCTION

The following report presents the author's internship program at a logistics company from March 2021 to August 2021. The presented company operates in the logistics and transport sector having as main activities transport organization and customs and similar transport support agents.

1.1 Challenge and purpose

The main challenge of this report is to improve the efficiency of different processes within the company, namely within Intermodal and Maghreb departments and warehouse management.

To achieve this challenge proposed, this investigation has as a purpose to demonstrate that lean applying helps to eliminate or at least reduce wastes that take place in the company.

1.2 Motivation

Nowadays the business environment is characterized by growing globalization, severe competition and customer sophistication so lots of companies continue to change their business operations to improve overall performance (Laosirihongthong et al., 2018). In the concrete context of the present company the departments' agile way of work execution and warehouse management are central aspects because if they are well managed, they could be adaptable, flexible, easy to access, and consequently play a significant and critical

role in achieving better company performance. These main aspects could be linked with the lean methodology which focuses on meeting demand for products and services immediately, with perfect quality, no waste, and at low cost. This concept is quite similar to terms such as “Just in Time”, “Toyota Production System”, “stockless production” and “lean synchronization”. It results in materials, information and customers flowing quickly and smoothly through the processes, operations, and supply networks (Slack & Brandon-Jones, 2019). There are many examples of the application of lean thinking to business processes ranging from project management to construction, design, and so on. Lean can be applied to all aspects of the supply chain and should be so if the maximum benefits within the organization are to be sustainably attained. Some of the benefits of being lean are decreased lead times for customers, reduced inventories for manufacturers, improved knowledge management and more powerful processes (Melton, 2005).

Nonetheless it is important to note that all the processes are different and the way the lean is implemented in other companies could not be suitable in the company that has been studied.

1.3 Methodology

This report will have predominantly qualitative analysis since this is the most appropriate methodology for the type of problem. Main methods of data collection were data and documents analysis, direct and participatory observation, semi-structured and unstructured interviews realization.

To summarize the above mentioned, this case study investigation tries to answer the following question: “How lean methodology can improve the logistics’ company management?”.

1.4 Work structure

It is important to describe how the dissertation will be structured to ensure that the reader follows the created chain. At the beginning of the work literature review will be conducted, linking different academics and authors' opinions about the lean methodology, its application, frequent wastes, and tools to eliminate those wastes.

Third chapter will explain the methodology used, starting from the definition of the investigation, followed by the methodology and the strategy description. Later, the author will describe the data collection methods, the design of the methodology and, finally, the data analysis methodology.

Next chapter begins with the company presentation which includes the overall mission and activities, followed by the company structure presentation, focusing on Intermodal division because a bigger part of the work will be performed on that division. After that being described, Intermodal, Maghreb and warehouse management processes will be presented and analysed, highlighting the wastes identified and suggesting possible solutions to eliminate those wastes or at least reduce them.

The last chapter will present a case study conclusions and limitations and will end by giving future work recommendations.

CHAPTER 2
LITERATURE REVIEW

This chapter pretends to explain what is lean from different author's points of view, which are its' principles, most frequent wastes, and main tools.

2.1 Lean

Lean methodology emerged in Japan, through Taiichi Ohno who traveled to EUA to observe the car manufacturing process in EUA and then, after returning to Japan and analyzing all the processes created by Americans, he developed a system which increased the productivity at Toyota factory, named Toyota Production System (1945-1970). The idea was to optimize the consumption of vital resources and to add the maximum value to the final customer.

Lean concept was first shown (Womack et al., 1990) with the purpose to identify different working techniques of the Japanese car manufacturers, namely Toyota Production System (TPS). This concept presented an approach for continuous process improvement, which focuses at eliminating waste and unnecessary actions, also called non-value added (NVA) activities, with the help of different tools. These tools improve processes and increase the respect that employees have between them through correct leadership behaviors and business practices (Gupta et al., 2016).

Despite of lean is linking together different tools that can significantly help an organization it is not just a set of tools but a culture that could be understood as a strategic movement and a way of thinking. This culture is an important factor responsible for successful lean implementation because without the general

employees' concern and goals it is impossible to achieve desired results (Gupta et al., 2016).

In terms of employees, (Bowen & Youngdahl, 1998) it is defended that decision making process could be transferred from supervisors to individual workers and teams because this responsibility attribution will increase quality, flexibility and productivity. The focus should be on the product and its needs and not on the organization and equipment, as it should provide support for people's efforts to solve problems, learn more and standardize good practices (Liker & Morgan, 2006).

According to (Bowen & Youngdahl, 1998; Womack & Jones, 2003) the end customers can get more variety of products from suppliers since they don't lose efficiency and could allocate resources in order to develop new solutions and products or to correct any processes before the disruption.

2.2 Lean principles

The initial idea of lean was broadly defined and described by five key principles (Womack & Jones, 2003):

Specify value – define value from the end customer's perspective in terms of specific product and its capabilities offered at a specific time. Here, three types of activities could be included:

- Activities that add value for the client (VA);
- Activities that do not add value but are necessary and could not be immediately eliminated;
- Activities that do not add value for the client (NVA) and could be eliminated.

Identify value streams – identify all steps in the value stream beyond all parts of the organization involved with the aim of delivering the product or service to the customer. This value stream shows wastes in the form of unnecessary steps.

Make value flow – make the value creating steps flow in a sequence to allow smooth product flow until the customer.

Let the customer pull value – provide the product only when the customer wants it, avoiding big batch production and reducing existing inventory.

Seek for perfection – aim for perfection by continually removing waste.

2.3 Lean wastes

The lean concept works on every possible feature of the value stream that removes waste with the purpose of decreasing the overall cost, increasing sales and revenues to occupy a solid market position. Lean focuses on removing waste and use processes that add value from the end customer point of view. Value is anything that could be paid for relevant service that is why the main idea of lean management is removing waste (or "muda", the Japanese word for waste) (Hines & Taylor, 2000).

According to Ohno (1988), there are seven types of waste:

- Overproduction – production continues after it should have stopped, causing an excess of goods produced that also causes an unnecessary inventory.
- Waiting – long setups, delays, unexpected machine downtime.
- Extra processing – rework operations, reprocessing, storage of products that happens because of defects or excess inventory.
- Unnecessary motion – extra steps taken by employees and equipment to solve possible defects, reprocessing and overproduction.
- Inventory – all inventory (raw materials, work-in-progress, and finished goods) that do not satisfy customer needs. Occurs from inconstant flow, idle material, and overproduction.
- Defects – finished goods that do not meet customer's requirements and cause cost of repair.

- Transportation – unnecessary movement of materials or information which adds time to process and does not add value to the product.

In addition to these seven wastes, (Womack & Jones, 2003) the eighth type of waste was added. This one is related to the underutilization of people and their creative input with the purpose of improving some processes or practices.

Regarding the nature of future investigation, it is crucial to list wastes that can occur not only in production but also in services.

Some of the production wastes listed above also fit in services. They are defects, errors and unnecessary movements (Piercy & Rich, 2009).

Bigger set of wastes occurring in the service industry, presented by (Chiarini, 2012) could be observed at the Table 1.

Table 1. Services wastes

Source: Adapted from Chiarini, 2012.

Type of waste	Description	Possible causes
Processes carried out ahead of or behind schedule	Data, documents or information are being processed either too quickly or too slowly and do not comply with the schedule. This can lead to an increase in process length because it means that activities are not balanced.	Badly managed schedules or priorities Unbalanced activities within the flow Staff not employed correctly No teamwork Insufficient awareness and inability to regard the process flow as a whole Inefficient software Strikes or excessive absenteeism
Staff having to wait	Staff having to wait before processing documents, data, and so on.	Unbalanced activities within the flow Staff not employed correctly Broken machines within the office
Slow activities/processes	Activities/processes that have an output that is inferior to the target.	Unbalanced activities within the flow Incompetent staff Broken hardware Inefficient software
Pile-up of information or data that requires processing	WIP which builds up when activities are not balanced or the flow has slowed down or stopped for whatever reason.	Unbalanced activities within the flow Incompetent staff Broken hardware Inefficient software Strikes or excessive absenteeism
Defects and mistakes	Mistakes during service implementation which mean that the operation/transaction needs to be repeated.	Inefficient inspections Missing standards Incompetent staff Defective hardware/software
Customer complaints	Mistakes that reach the customer, causing costs of poor quality and loss of image.	Incorrect information regarding customer demand Inefficient inspections Missing standards Incompetent staff Defective hardware/software
Service exceeds the customers' requirements	Service implementation that exceeds the customers' requirements. Often this is not considered a bonus and can be a real problem.	Incorrect information regarding customer demand
Duplications within the process	This type of waste is typical in the service industry, where many procedures are often carried out twice, or data is processed both on paper and on a computer.	Incorrect service flow design Missing standards No teamwork Insufficient awareness and inability to regard the process flow as a whole Inefficient software
Excessive staff movements	Members of staff that need to move around a lot to be able to carry out their job.	Incorrect layout and service flow design.
Unnecessary transport	This type of waste could be, for example, having to move documents from one office to another, or forcing a customer to move from one office to another one	

2.4 Lean tools

As soon as the companies identified sources of waste, they can start trying to eliminate them using lean tools. These tools will lead companies though to corrective actions to eliminate waste and become more competitive. In the following sections, a brief description of pertinent for this investigation tools are explained.

2.4.1 Visual management

Visual management is one of the lean tools which aims to place in clear view all production activities, tools, parts, and indicators of production system performance. All the processes must be transparent in order to increase operations efficiency. Visual management shows how certain processes must be done and if there is any deviation from the standard work method. Using visual management it is possible to find where all materials are located, which is the standard work method for any type of procedure, what is the current state of the work. Some of visual management tools are kanbans, 5S, andons, information boards, work graphs, trend charts and schedules which must be always simple, only containing value-added information (Liker & Morgan, 2006; Parry & Turner, 2006; Tezel et al., 2009).

2.4.2 Cellular layout

Cellular layouts allocate opposite machines into cells to work on products with similar shapes and processing demands (Jacobs & Richard, 2018). The main benefits of cellular layout are improved human relations since cells consist of few workers who form a small work team; improved productivity because workers perform limited work volume which increases learning process, perfection in its execution and decreases in-process inventory; enhanced flexibility, communication, and visibility.

2.4.3 Kaizen

Kaizen, firstly mentioned by Masaaki Imai in his book "Kaizen – The Key to Japan's Competitive Success (1986)", is a philosophy of constant improvement between all the people of an organization. Its main purpose, like any other lean tool is to eliminate waste (Sayer & Williams, 2007) which could be achieved through leveling production, implementing standardized work, reducing inventory, work-in-process, performing just-in-time delivery, and more. All this is done to improve safety, quality and to reduce cost.

According to Wittenberg (1994) this philosophy is people oriented, which means that improvements in people's actions and efforts are more intended to produce better results in a long time period.

Kaizen englobes everyone, from top management to workers at the shop floor (Berger, 1997). Senior management should define directions of kaizen within the company, set goals for everyday improvement actions, even if it is something small, encourage people's suggestions for improvements and never judge for mistakes done, set new standards and maintain existing ones, by setting rules that help to maintain the performance levels previously defined (Sayer & Williams, 2007; Wittenberg, 1994). Also, all necessary materials and tools should be supplied by middle management to be possible to perform kaizen activity and lastly, supervisors should make sure that improvements occur on both an individual and workgroup level.

Kaizen philosophy considers that the way of life, being it working, social or home life, has a right to be constantly improved (Masaaki, 1986).

2.4.4 Pareto Chart

This bar graph, also called pareto chart or pareto analysis, forms a set of quality tools and aims to help to break down a problem into the relative contributions of its components (Jacobs & Richard, 2018). These components are

based on the principle which says that 80% of an effect comes from 20%of the causes.

The objective of this tool is to find the defects to prioritize with the aim of improvement. Pareto chart should be used when analyzing data about frequency of problems, when there are a lot of problems, and it is important to focus on the most relevant and when communicating the data with others (Tague, 1995).

2.2.5 Poka-Yoke

This tool, which means mistake proofing in Japanese, was created by Shingeo Shingo in 1961 in Toyota Motor Corporation. It is achieved through simple, inexpensive devices created to catch errors so they do not become defects.

According to Shingo (1986) it is important to understand the difference between error and defect. Humans will inevitably make mistakes. That's why complete error elimination is impossible since employees are humans and could not be all the time completely focused on the work and remember everything that must be done at each step. Regarding defects, they occur when someone allows the error to reach the customer and at this point defects are fully preventable.

The main goal is to stop defects at the source, detect the cause of the defect and avoid moving the defective part to the next workstation (Feld, 2000; Robinson, 1997).

2.2.6 Value Stream Mapping

A value stream is a set of value added and non-value added activities that are required to deliver a product or group of products that use the same resources through the flows, starting from the raw materials and going until the arms of customers (Rother & Shook, 1999). This tool helps to visualize a big picture, representing both material and information flow with the aim of identifying all

types of waste in the value stream to try, later to eliminate them (Rother & Shook, 1999). This is a pencil and paper tool, which is created with the help of predefined set of icons (shown in Figure X below).

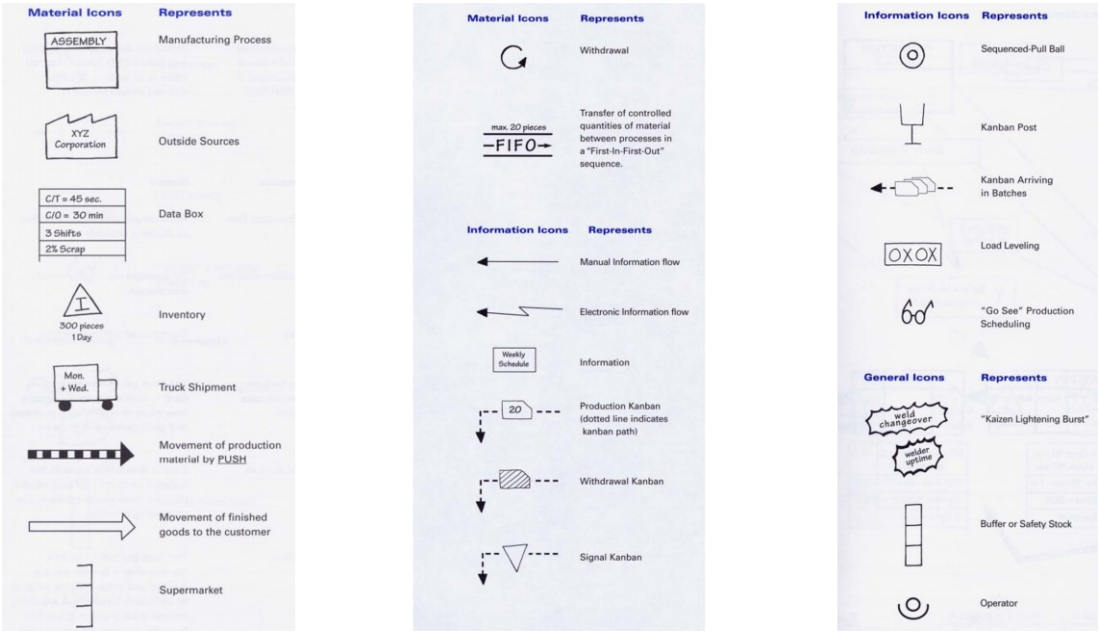

Figure 1: Icons used for value stream mapping

Source: Adapted from Rother & Shook, 1999.

First step to be followed in a value stream map creation is choosing a product family as a target for improvement.

After selecting a product family, the next step is drawing a current state map to observe how activities are being performed. At each process of current state drawing, lead-time, cycle time, inventory levels and changeover time are recorded. Another important aspect of the current state is the information flow, which is drawn from right to left on the map.

Third step consists of future state map creation, with the aim of highlighting sources of waste and to set an improvement plan in which it is possible to see what lean tools are more suitable and where they are needed in the product value stream.

Some of the benefits of this tool, (Braglia et al., 2006; Rother & Shook, 1999) are:

- helps to visualize an entire flow (information and product);
- helps to discover the source of waste in the value stream;
- includes information related to production time and inventory levels;
- Forms the basis for lean production implementation.

CHAPTER 3
METHODOLOGY

This chapter aims to help the reader to understand which methodology will be applied to this investigation work, to clarify the way the study was conducted and how the data was collected and analysed.

3.1 Investigation definition

The following chapter pretends to explain the general problem of the investigation, the methodology that will be used, the strategy of adopted investigation and ways of collecting and analyzing of data.

In case of the company studied, it became possible to understand that the problem is related to three different departments, namely the way the work is performed.

Through the literature review it was possible to explore the lean concept, namely which are the main wastes and which tools are capable of eliminating or reducing those wastes.

With this in mind, the steps were taken to understand how the processes are performed, analyzed, the wastes have been identified and possible improvement actions were suggested.

To answer the main problem referred above, the research question is the following: “How can lean improve logistics company’s processes?”. It is expected that this work could answer this question.

3.2 Methodology nature

As indicated at the introduction chapter, the purpose of this work is to understand how the lean could improve logistics companies' processes and in order to start and lately conduct the overall work the qualitative method has been used.

Qualitative research method is a context-based method and the information was collected in real life, demonstrating how and why some events and activities have happened (Gray, 2004). This information could be expressed in images, drawings, pictures or music (Tesch, 2013).

For other authors the qualitative research is associated with an interpretive philosophy, where researchers need to give a sense to subjective and socially constructed meanings by those who participate in the research (Saunders et al., 2012).

On the other hand, quantitative data should be processed and transformed into concrete and clear information. Among many ways of quantitative data analysis, graphs and statistics could be highlighted. They allow us explore, describe, examine relations and trends in data (Saunders et al., 2012).

The main advantage of the qualitative research method is the possibility to contact the participants at different levels that allows us to investigate deeper. (Bryman, 2012).

3.3 Investigation strategy

After comparing both investigation methods (quantitative and qualitative), it was concluded that the most suitable strategy for the research is a case study. The case study focuses on collecting information about specific objects, events or activities connected to the specific case and which the investigator is interested in (Serakan & Bougie, 2016).

It was also considered to use an action research strategy, but in this one, the investigator makes part of the investigation, delving directly into the problems (Saunders et al., 2012), which was not the case in this work.

3.4 Data collection methods

Regarding the data collection methods, the different ones were used. One of them was the documents and files analysis to understand the overall context of the work. One significant advantage of document analysis is that the information which is registered in a written form is done more carefully than the information which is transmitted orally. Thus, analysed documents can describe and specify issues with higher accuracy and details. After choosing specific departments of the company to analyse, some documents were provided by the head office department.

Another method used was direct observation. This method allows us to understand people's actions and behaviours, if registered, described and systematically analysed (Saunders et al., 2012).

There are two types of observation (Saunders et al., 2012):

- participant observation, which represents qualitative observation and is linked to behaviours and actions analysis;
- structured observation, which represents quantitative observation and is connected to frequency of actions.

In this investigation the structured observation was done, having as a main target to understand how to organization works, namely Intermodal, Maghreb and warehouse departments.

Initially the type of work done by those departments was observed to understand the overall process. Later, a smaller process was chosen and only processes which form it were observed, namely: claims registration, cargo unload and load, documents arrangement (printing and signing).

The last observation method which has been used was the interview method. The (Wengraf, 2001) interviews were carried out with the aim of improving knowledge and addressing the issues deeply. Also, this method allows the investigator to understand what the employees really think and discover some hidden facts which could not be observed directly.

It is important to refer that interview can be carried out in three forms (Saunders et al., 2012):

- structured interviews, which are performed in a survey form, by filling out a questionnaire with predetermined and ordered questions;
- semi-structured interviews, which are based on a question guide, offering a possibility to add questions during the interview if relevant for the study;
- unstructured interviews are known as informal conversations, where there is no question guide. However, it is important that the interviewer has a clear idea about what to explore.

In accordance with what was mentioned above and considering the company to be studied, semi-structured and unstructured interviews were carried out. In case of semi-structured interviews, those were performed to understand procedures followed and to identify in which stage there are more wastes. Unstructured interviews were done to figure out the role of each employee in the process chosen and to identify problems discovered by them.

3.5 Investigation development

The following investigation was divided into four different stages as could be seen at the figure:

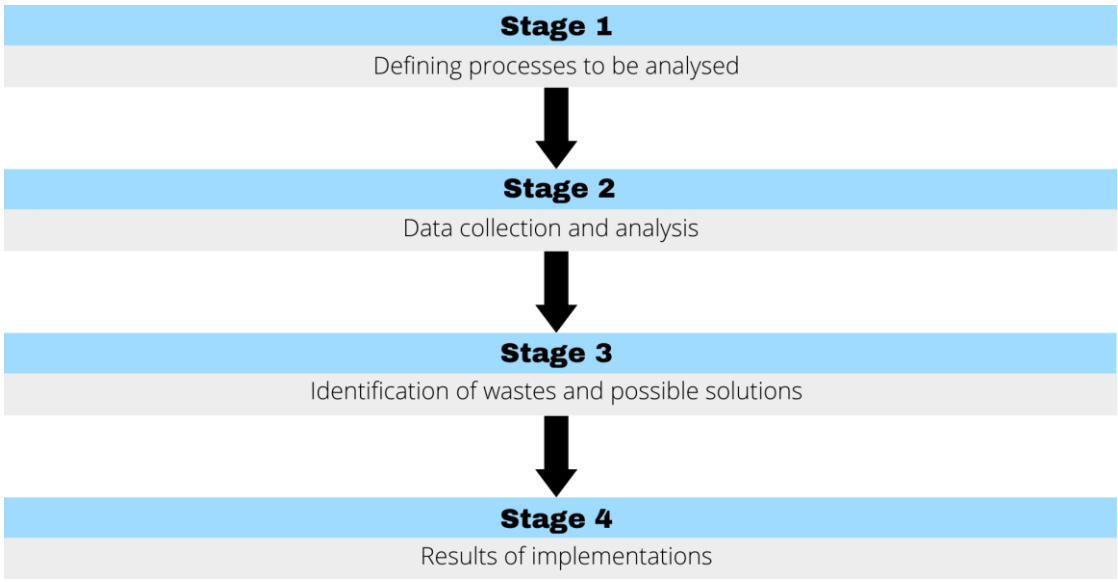

Figure 2. Phases of the investigation.

Source: own elaboration

First stage consists of defining processes to be analysed, carrying out unstructured interviews with different departments with the aim of understanding what processes need more help and improvement.

After finding out those processes, the second stage initiates. Documents related to those processes are analysed, direct observation method is used to identify main activities of each process and after, flowchart and value stream mapping are done to have a more precise image of how the processes are done.

Third stage is dedicated to the identification of wastes within the processes, presenting then, suggestions based on lean tools in order to reduce or even eliminate those wastes.

Last stage shows results of the lean tools implementation.

CHAPTER 4
DATA ANALYSIS AND RESULTS

4.1 Introduction

The purpose of this chapter is to expose data analysis and results following next steps:

- presentation and brief description of the company;
- description of chosen situations and processes, namely resources consumption, work division, complaints recording, Maghreb reservation process and warehouse operations;
- analysis of chosen processes and improvement suggestions.

4.2 Company description

The company operates in the logistics and transport sector, having 500 thousand euros as social capital and being 100% national. It was been formed on the 27th of July 2012.

Its main activities are defined by *Classificação Portuguesa das Atividades Económicas* (CAE):

- main CAE: (52291) – Transport Organization.
- secondary CAE: (52292) - Customs and Similar Transport Support Agents.

Having 150 employees in the national market, this organization has a big international network of agents.

As an example, Geodis Wilson, at the Air and Sea sector - one of the biggest load management companies of the world, being present in more than 120

countries, at 5 continents, and Millitzer & Münch, in Maghreb and Turkey market – a network with more than 130 years of experience, being composed by more than 100 agencies, in 30 countries, a leader in North Africa region.

The studied company knows deeply different market segments, including high technology, textile, shoe, cork, construction materials, automotive, pharmaceutics, etc.

This company provides global, integrated, and personalized transport and logistic solutions, because of the network that permits to offer different services such as daily groupage; complete batch and load to every European country, Maghreb and Turkey, having reduced transit time; distribution and storing personalized solutions.

At this moment, the organization has it headquarter in Maia, and one filial, at Lisbon.

4.2.1 Company organization and divison

The company is divided in 3 sectors, presented below:

- Head Office;
- Air & Sea Division;
- Intermodal Division

Figure 3. Company division

Source: Company internal report

Bigger part of the investigation will focus on the Intermodal department, so it is important to explain its construction and business area with more details.

Intermodal division

The intermodal division consists of six teams which are described below:

1. Customer Service

This department supports Rail, Road, and Sea freight departments. Essentially it deals with the possible route or time changes and delays. There is a 24/7 support line to ensure that at every time of the day these departments are monitored and helped. The team consists of three persons responsible for bigger clients in terms of revenue and two persons who work with smaller clients.

2. Rail Operations

This department is divided into three teams:

- iberia exportation team which organizes pick-ups of goods within Portugal territory and then exports them to Spain (transporting them in mega combis and plate containers) which has two persons;
- importation team which operates through Spain, by picking up goods and then importing them to Portugal, using the same mega combis and plate containers. This team englobes two persons also;
- internacional team which combines the service through the whole world like Czech Republic – United Kingdom; Italy – Ireland. Only plate containers are used due to this service and only one person is working on that.

The main partners are TVM and TEC that plan pick-ups and drivers' distribution.

3. Road Operations (FTL Inbound, FTL Outbound, and Land)

- FTL Outbound

This division is broken down into two small teams:

- Iberia team, which deals with exportation and importation through Spain (Sevilla, Jerez, Tarragona, Madrid, Zaragoza, Valencia, Murcia, Valladolid as cities to export to and Valls, Coruna, Valladolid, and Valencia as cities to import from). This team consists of five people, two of whom are planners of the goods, two are truckers (transfer the orders) and one is charter (looks for the truck and goods);
- International team, which deals with exportation from Iberia to any interested country. This team consists of two people – one of whom is responsible for the transport of goods by land and another person who is responsible for "roro" transport (land – ferry – land).

- FTL Inbound

The present division finds trucks to deliver and load goods between Germany, Belgium, Holland, and France that are produced by IKEA and Volkswagen.

The team comprises two persons who are responsible for planning the routes and tracking the whole process in terms of communication with suppliers, delivery schedules, and utilized equipment.

- Land

The way this division works is completely different than the other ones. Land department provides daily groupage service which is done in a company's warehouse, complete batch, and load to every European country. This is the biggest team in terms of people involved because there are four small divisions that form the one big:

- distribution team, which counts with one person responsible for the whole distribution process, one who plans a full load truck and a less load truck in batches, being this a national service, and one person who deals with the administrative part of the process;
- the warehouse team englobes five operators who are responsible for receiving, put away, internal replenishment, order picking, accumulating and sorting, packing, cross-docking, and shipping processes;
- the international team which counts with one person responsible for the entire operation, two as customer care, one focused on the commercial part, one responsible for sales and the last one carried out the data entry and logistic planning;
- Lastly, there is one person responsible for general billing and one as a controlling employee.

4. Sea freight Operations

Mainly working for IKEA, this department provides four types of service:

- pre-carriage - responsible for goods that are loaded in Portugal;
- short-sea - search for the company that will transport and delivers goods to the end customer;
- importation – goods shipped from Dortmund to Portugal or Spain;
- cross–trades – goods that don't arrive in Portugal, being exchanged between other countries.

Beyond these four services that are done for IKEA, this department also imports from China to Portugal.

The construction of this department is the following: one person working in a pre-carriage service; two dealing with short sea operations; one dealing with all necessary documentation; and two last persons responsible for establishing new business relations.

The main partner is called ECS, which provides containers used for goods exportation and importation.

5. Maghreb Operations

This division organizes frequent deliveries of automotive parts, ceramic, cork, wine, retail, furniture, etc. to Morocco and Tunisia having as a solid partner Militzer & Munch with its local warehouses in Casablanca and Tangier. The team consists of eight employees, one as a controller, one who focuses on product management, one as a business developer, two who communicate with suppliers, end customer and take care of documents emission; one person responsible for invoicing and expenses control, one who monitors the service and

solves any possible issue during the journey and lastly, one person who supervises the whole division.

6. Invoicing and Administrative

This department is responsible for all filling, controlling of all the intermodal division bills. Also, financial reports are done by this team which consists of three persons.

4.3 Resources consumption

In different locations of the company, namely in the bathrooms, dining room, and the warehouse there are information boards that appeal to a conscious use of resources such as water, electricity, paper, and in case of the warehouse to follow some essential rules to guarantee staff safety. Those boards have too much text, so employees do not pay much attention to them and do not read those messages. This ignorance provokes a big waste of resources and increases costs for the company.

To illustrate the consumption of resources the following graphs were created and then analyzed.

Graphs

Regarding electricity, the utilization decreased a little bit from 2019 to 2020 as a result of two months of lay off provoked by the pandemic scenario.

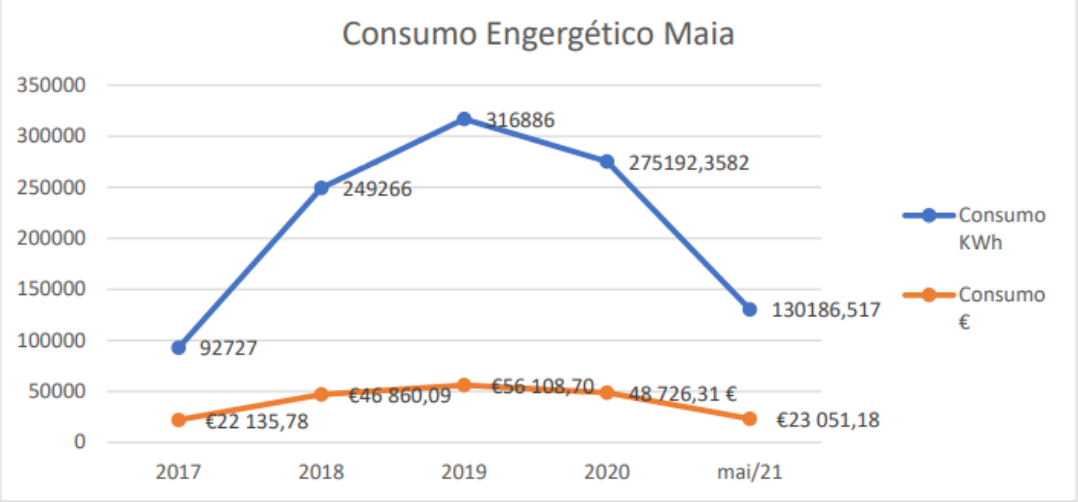

Figure 4. General energy consumption

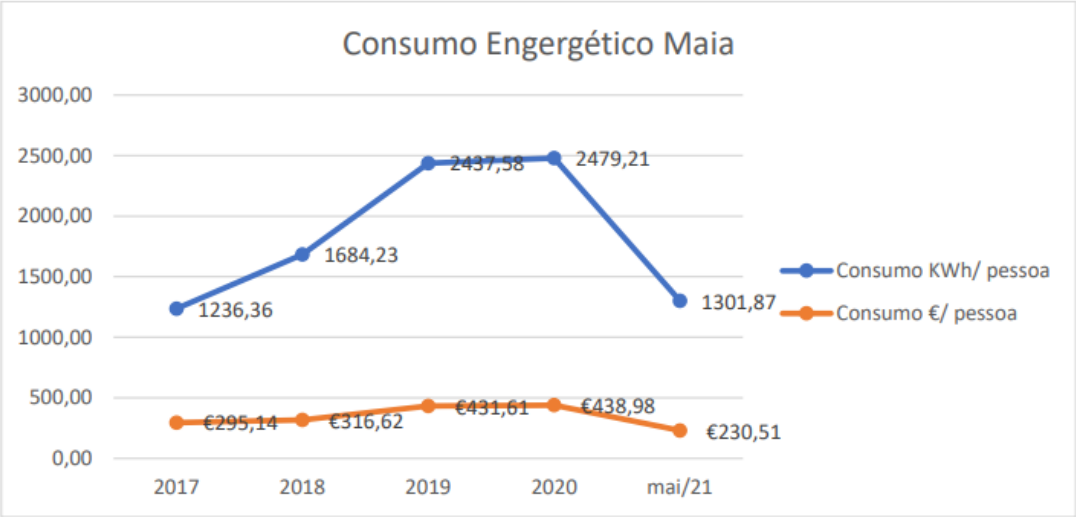

Figure 5. Energy consumption per person

One of the reasons for increased water consumption was more often cleaning cycles frequency.

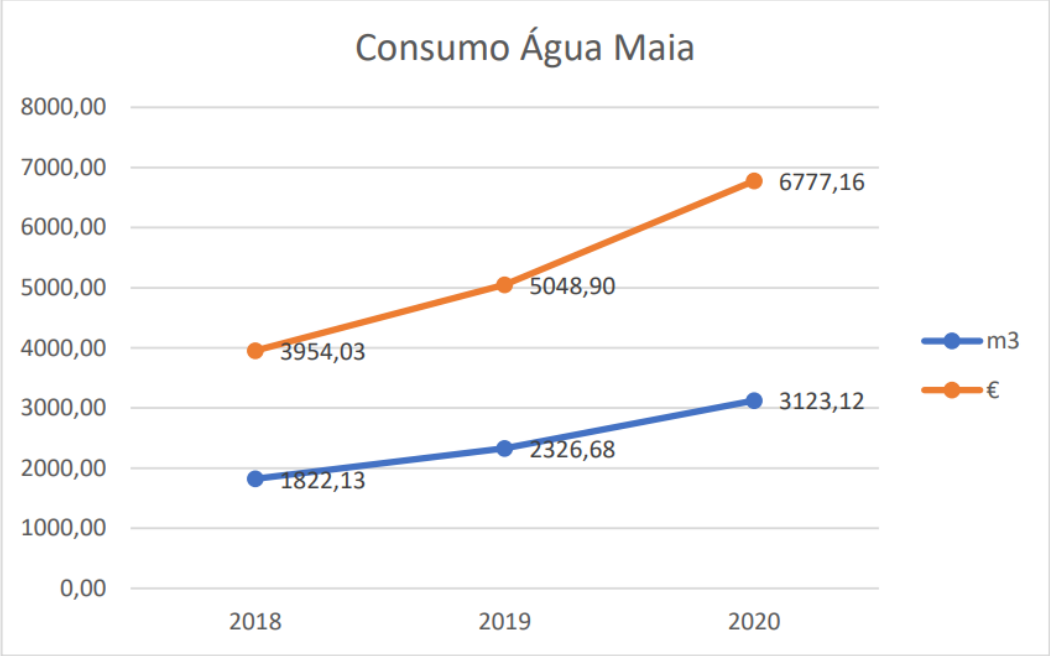

Figure 6. Water consumption

Looking at paper consumption, it was utilized a lot due to the absence of electric equipment or any other equipment for the hand drying procedure.

Another reason responsible for the increased paper consumption was the necessity of disinfection of different locations as was indicated in the contingency plan due to the Covid-19 scenario.

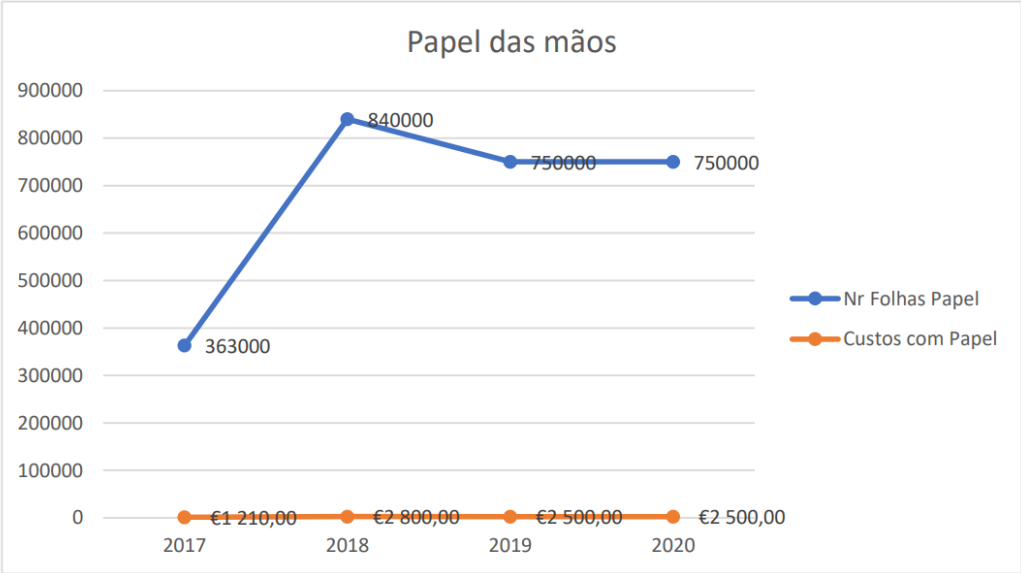

Figure 7. General hands paper consumption

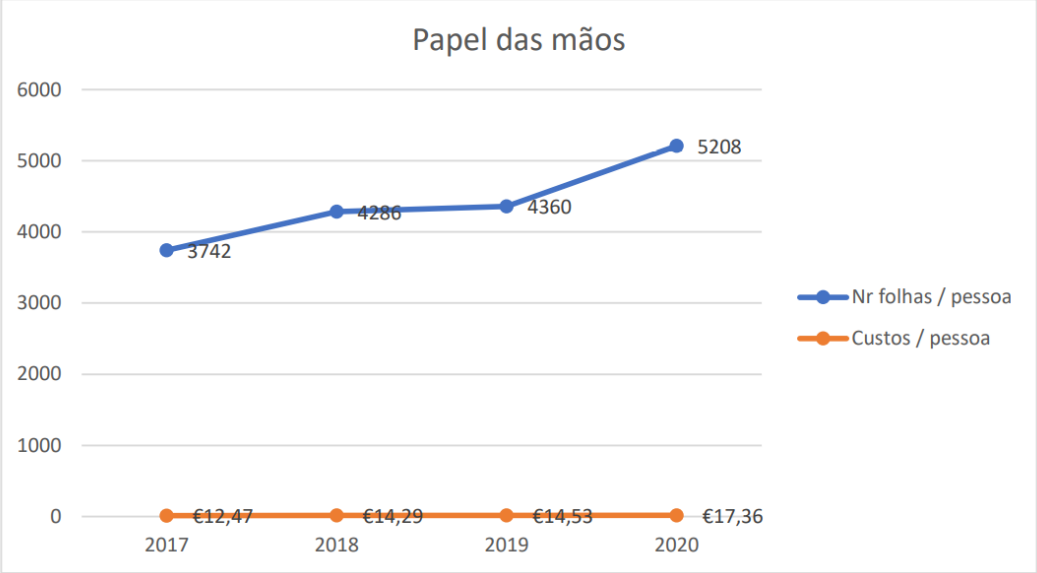

Figure 8. Hands paper consumption per person

In terms of waste production, the biggest waste was related to wood pallets, followed by the undifferentiated trash (observing *Maia* 2018/2019/2020).

Nowadays wood trash is better managed due to the reuse of pallets but there are still a lot of actions to take to reduce all other wastes.

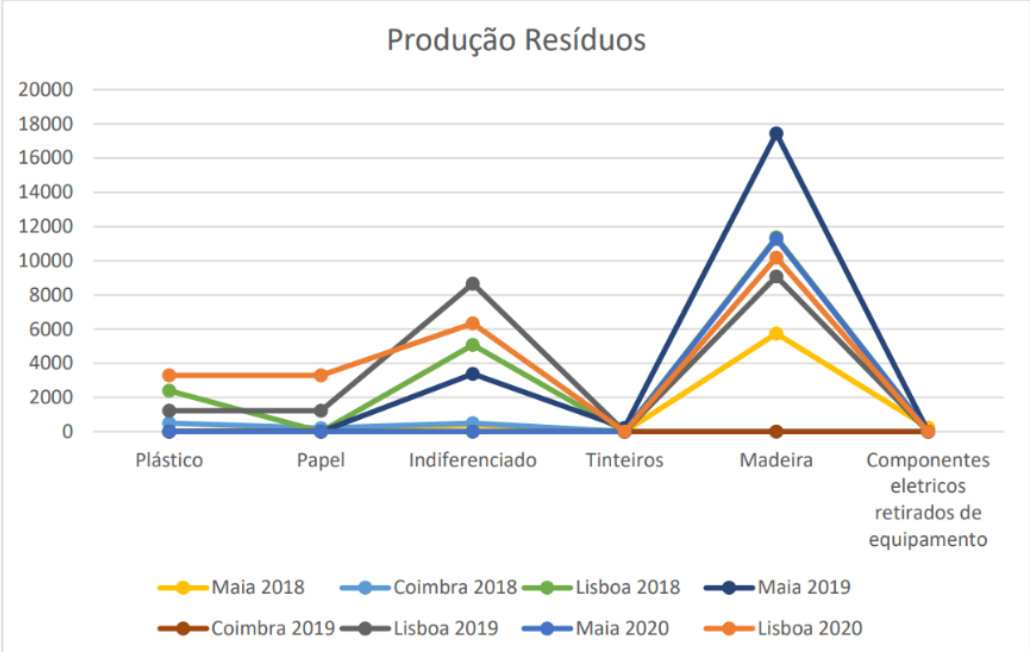

Figure 9. Waste production

When looking at these graphs it is visible that the utilization of resources between 2018 and 2020 increased and even at the periods when they decreased, it wasn't that much.

After the graph's interpretation, information boards were collected and analyzed to have a broader idea of the issue.

Old information boards could be seen below.

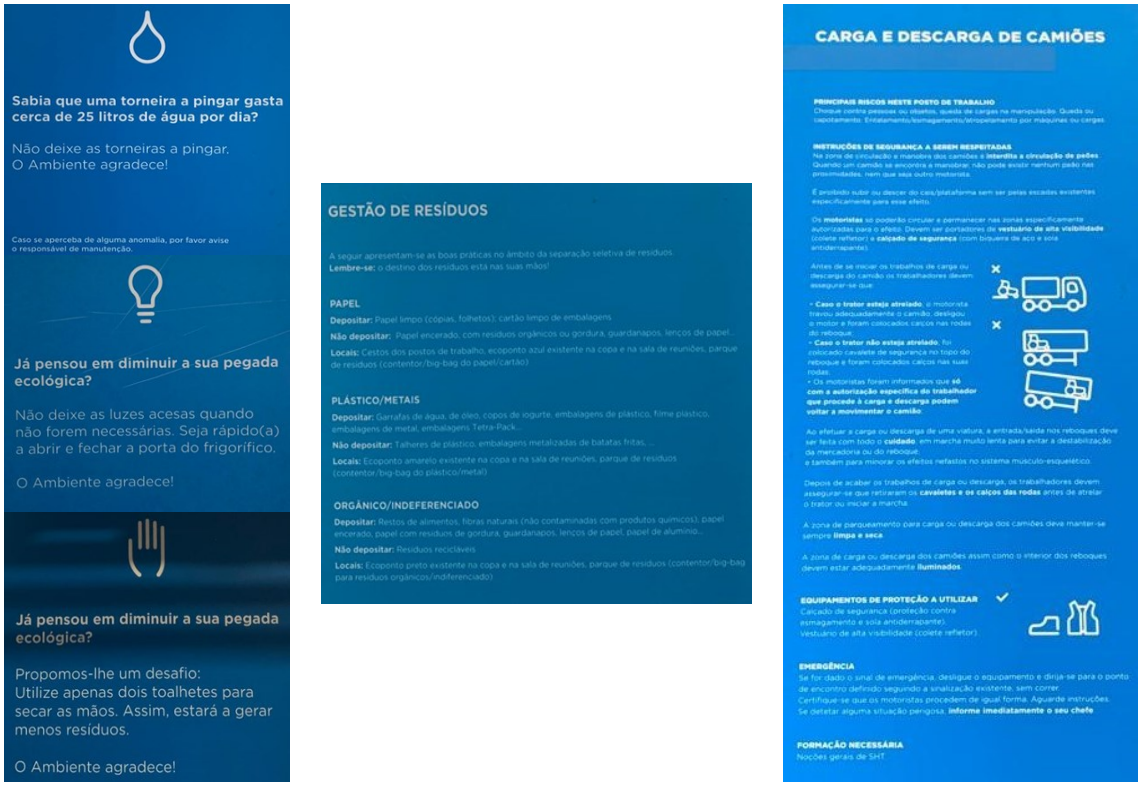

Figure 10. Old information boards

As a matter of fact, these boards have a lot of text, and the design is poor, so the numbers presented in the graphs are better understood now. This issue provokes wastes, specifically waste of resources which has already lasted for three years and will go on if nothing changes.

4.3.1 Proposed Solution

Facing this problem with the lean eyes and searching for improvement actions it was suggested to use visual management, namely Kanban visual boards to check if new, better-designed information boards can reduce resources utilization by changing employees´ mindset and, consequently saving costs for the company.

The new proposed information boards could be seen below.

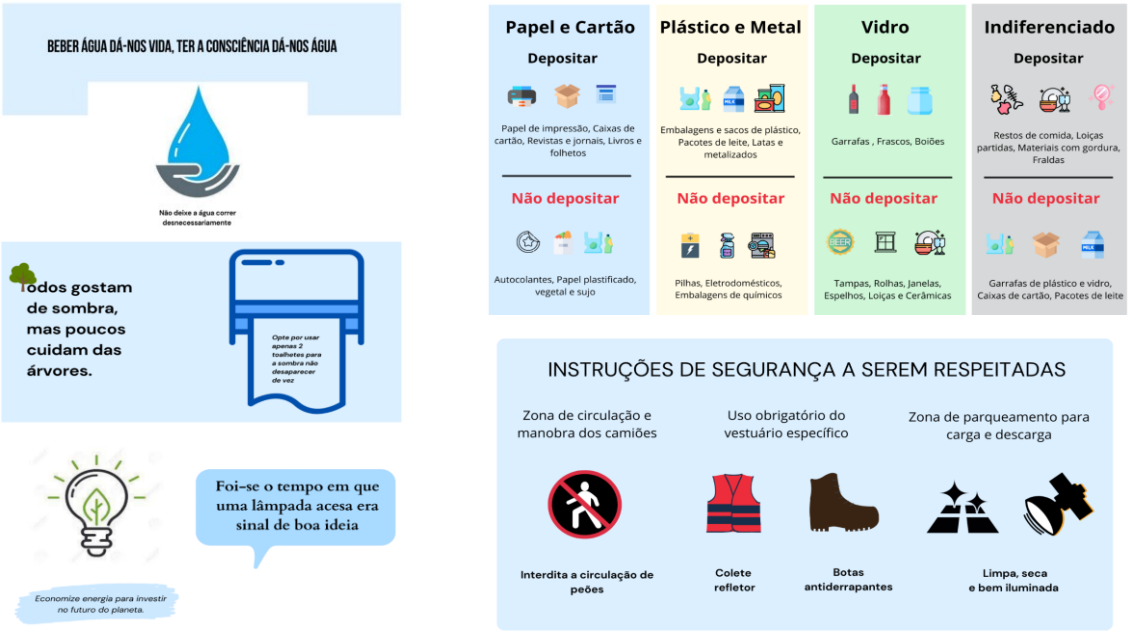

Figure 11. New information boards

4.4. Intermodal Department

4.4.1 Work Division

As a new person at the company with the aim to find wastes and to eliminate them for improving the workflow, the starting point was to get the information from employees of Intermodal department (Rail, Short Freight, FTL export and FTL import) by asking how the work is performed in terms of work volume, more concretely if the volume of the work is well shared out through all the teams. After some semi-structured and unstructured interviews, it became obvious that there were not enough people in each department that caused extra work for the employees, higher number of errors during operations (such as preparing documents for the end client, updating time arrivals, email follow up

conversations, cargo monitoring), stressful environment and lack of employee motivation.

Beyond these issues, each department team used to organize internal wrap up meetings, each two weeks, with the purpose of analyzing some essential work aspects, especially:

- the work performed;
- how the work was performed;
- improvement actions.

It was observed that as the meetings were not organized frequently, there were a lot of information accumulated and a lot of topics to cover and usually when it happened, there were not enough time to cover it during the meeting or in situation when all topics were covered, usual work process was delayed and, as a result, causing an extra work. This frequency of meetings is not enough if we analyze the volume of the work and the general revenue of three main clients from January of 2020 until March of 2021. The table could be observed below.

CLIENTES	JANEIRO	FEVEREIRO	MARÇO	ABRIL	MAIO	JUNHO
IKEA SUPPLY AG	2 599 523 €	2 649 033 €	2 079 673 €	507 106 €	1 538 250 €	3 203 382 €
VOLKSWAGEN KONZERNLOGISTIK GMBH & CO. OHG	535 263 €	555 871 €	538 186 €	79 871 €	289 357 €	480 080 €
CONTINENTAL MABOR, INDUSTRIA DE PNEUS, S.A.	468 839 €	475 326 €	405 876 €	155 344 €	115 891 €	252 033 €

CLIENTES	:020					
	JULHO	AGOSTO	SETEMBRO	OUTUBRO	NOVEMBRO	DEZEMBRO
IKEA SUPPLY AG	3 950 569 €	3 242 914 €	3 370 341 €	3 483 375 €	2 996 291 €	2 788 458 €
VOLKSWAGEN KONZERNLOGISTIK GMBH & CO. OHG	310 176 €	262 855 €	542 469 €	597 655 €	613 215 €	358 338 €
CONTINENTAL MABOR, INDUSTRIA DE PNEUS, S.A.	299 669 €	227 471 €	351 645 €	406 299 €	361 665 €	241 723 €

CLIENTES	2021		
	JANEIRO	FEVEREIRO	MARÇO
IKEA SUPPLY AG	2 862 924 €	2 203 805 €	3 050 824 €
VOLKSWAGEN KONZERNLOGISTIK GMBH & CO. OHG	381 335 €	498 494 €	566 596 €
CONTINENTAL MABOR, INDUSTRIA DE PNEUS, S.A.	377 163 €	466 491 €	456 403 €

Figure 12. General revenue from January of 2020 until March of 2021

4.4.1.1 Wastes and possible solutions

Analyzing these issues and thinking about them in a lean perspective there are clearly signs of wastes which are:

- increase of inventory by having a few employees dealing with a lot of clients;
- waste of waiting (as clients had to wait for email replies from the company staff because of work overloading);
- waste of defect due to high volume of work and small timings to perform it, it turns more propitious to make mistakes in some part of the procedure (preparing documents, time arrivals updates, sending and answering to the emails);
- waste of human potential due to extra work which creates stressful environment, lack of communication between each team and, consequently lack of staff motivation.

After analyzing these wastes and connecting them with the lean tools, the idea of implementing a cellular layout of work through the teams seemed very appropriate. It could be performed by hiring more people and sharing out the work through the whole team to facilitate each employee to focus on some previously well-defined tasks and perform them in a most efficient way.

Regarding meetings organization, it could be suggested to organize short daily meeting within each department. For example, from 9:30AM to 10:00AM every day except Monday. This meeting can offer an opportunity to each team member to talk about any issue or problem that has happened, is happening or may happen soon.

Once all team members talk every day, they immediately feel more integrated and realize that they are responsible for making decisions all together and not just the supervisor of the department.

Beyond everyday meetings of each department team, it could be beneficial for the company to organize one meeting per week (could be also around thirty minutes on Monday for example) with the administration to have a weekly overview through all the work done. This more frequent meeting could improve the internal communication and the whole work process which would prevent the company from big losses and long problem solving.

Meetings could be held at the meeting room inside the company or via Microsoft Teams application. Choosing the last option could reduce meeting delays that happen frequently that are caused by the time that the employee spends in the process of leaving its workplace and moving to a meeting room, which could be seen as a waste from the lean perspective. Beyond this advantage, any employee could access the meeting from any device, having as a unique meeting internet access requirement. Even if for some reason someone misses the meeting, Microsoft Teams offers a possibility to record the meeting and automatically generate meeting insights which could save a lot of time that would be spent watching the whole meeting and provide all important information during the meeting.

4.4.2 Complaints

First analysis

Like any company that always has complaints, the studied company is not an exception. But the way complaints are registered and solved is not as efficient as

it could be. Below, it is possible to see how a typical complaint is recorded and sometimes solved.

Table 2. Claims recordings model

Date	Client	Claim	Claim codification	Supplier	Incidence	Action taken
14/07/2020	Ikea	Road accident	Cargo damage	JCarrion	Litigation department	
31/07/2020	Ikea	Cargo damage	Cargo damage	Investigating	Litigation department	
10/08/2020	Ikea	Cargo damage	Cargo damage	Investigating	Litigation department	
14/08/2020	Ikea	Segregated wagon	Delay	Transfesa		Delivery rescheduling
18/08/2020	Ikea	Cargo damage	Cargo damage	Investigating	Litigation department	
26/08/2020	Ikea	Accident in the terminal	Cargo damage	Transfesa	Litigation department	
28/08/2020	Ikea	Damage on the building structure	Other	Gonzaga		Communication between both sides
31/08/2020	Ikea	Wrong unload time	Delay	Transmurf		Intervention with the transport firm
17/09/2020	Ikea	Damage of the truck load cover	Other	Loja Ikea	Litigation department	
21/09/2020	Ikea	Exchanged unloads	Delay	Transmorro		Intervention with the transport firm
19/11/2020	Continental	Documentation mistake	Other	WEC		Intervention with the transport firm
08/12/2020	Ikea	Property damage	Other	Ewalls		Intervention with the transport firm
14/12/2020	Ikea	Non-compliance with the rules	Other	JCarrion		Intervention with the transport firm
19/12/2020	Ikea	Lack of security	Other	Jcarrion		Intervention with the transport firm
22/12/2020	Ikea	Delay in two deliveries	Delay	Transmorro		Intervention with the transport firm
11/01/2021	Ikea	Incorrect behaviour	Other	Jcarrion		Intervention with the transport firm
11/01/2021	Ikea	Train cancellation	Delay	Transfesa		Client informed
18/01/2021	Ikea	Incorrect behaviour	Other	jcarrion		Intervention with the transport firm
19/01/2021	Ikea	Property damage	Other	Jcarrion		Intervention with the transport firm

There is one document where all complaints are recorded. The first step is to open a file, then fill out the spaces designed for obtaining all necessary information and the third step is to notify the Quality department about a new complaint via email.

As it is seen in Table, there is a lack of essential information so with the aim of better understanding of root causes of these claims, small meetings with each department coordinator have been scheduled. Firstly, it was difficult to find almost all those claims because they happened a long time ago and the table shows that there is a booking number column missing. The fact that this column doesn't exist obligates an employee to search between hundreds of emails that already exist and between those that are received daily. This way of finding an email that contains information about the claim takes a lot of time and doesn't permit to analyze the claim in detail. Secondly, as it could be seen in the *Ação tomada* column, there isn't any concrete solution recorded because most of the claims were solved through the phone call between the client and the company in analysis or the company studied and transportation company. This

way of solving complaints is complicated to investigate and to understand the root of claims.

Second analysis

Claims file, which contains information about all departments was analyzed intensely to find the claims pattern and understand why it happened. The department which had more claims was the Intermodal, so it was decided to focus on that one.

Table 7 (see Appendix B) illustrates the type of claims and its frequency between June 2020 until March 2021.

After analyzing the table and with the aim of having a simplified view of claims causes, pareto chart tool was implemented and could be observed in Figure 13.

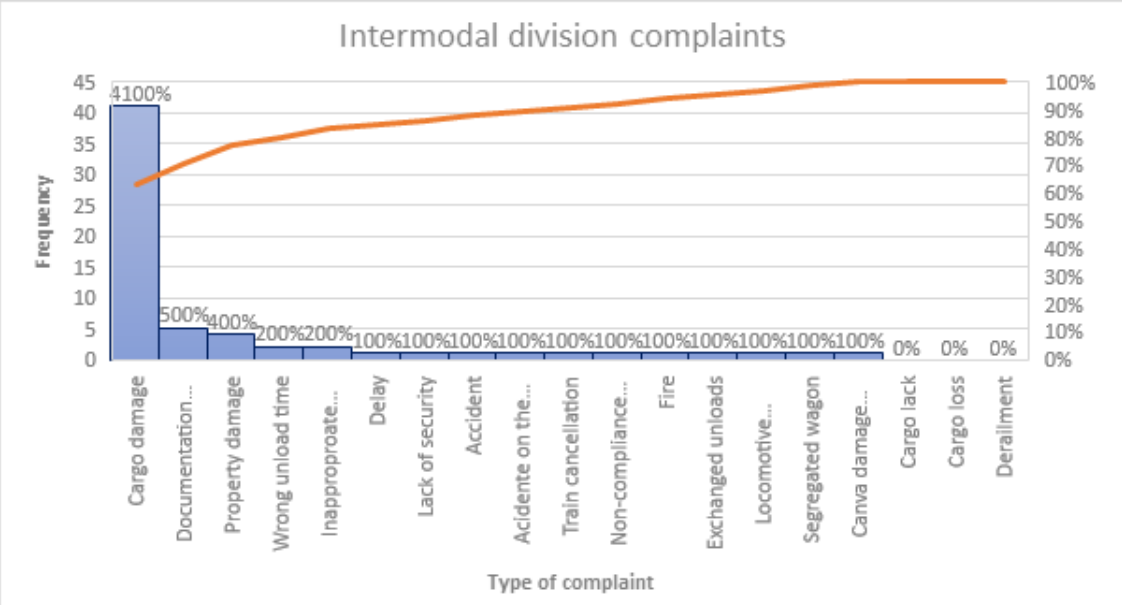

Figure 13. Pareto analysis of intermodal division complaints

It is possible to conclude that issues that happened and were recorded more, were cargo damage, documentation mistakes and property damage. This means that these first three bars of the pareto chart are responsible for 80% of complaints and consequently, bad performance of the company.

Regarding **cargo damage**, when the cargo is damaged, the complaint process starts and could take a long time to be solved because different procedures must be done. The first step takes place when the end customer sends an email to the company's employee who was responsible for the cargo delivery explaining what happened. After this, employee opens the claims file and fills it out with all information received from the end customer, which is required to transfer the process later, to the person who deals with the claims. When the file is filled out and sent to the employee who is uncharged to fix the problem, the last one must communicate with the transport firm which was subcontracted for the cargo delivery to understand what went wrong and after that arrange the best solution for both parts. Images of cargo damage could be seen at the Appendix C.

All this process doesn't add any value, by the cause of consuming end client's, company employee's and transport firm's time, while solving the problem; beyond this, costs increase immediately if the company assumes responsibility for the cargo damage; lastly in the situation of cargo damage some clients doesn't accept the goods so the transportation firm must deliver them back to the warehouse which is clearly a sign of transportation waste (costs with the fuel and space in the truck which could be used for shipping other goods to bring more revenue).

In terms of **documentation mistakes**, the second bar represents situations when the necessary documents have some mistake, namely wrong cargo weight, wrong number of pallets, and wrong destination.

When this type of problem happens, some clients don't accept those goods until the documentation is corrected.

The document's correction process displays clear signs of wastes, namely:

- overprocessing and time, while correcting documents mistakes made by supplier or end customer;

- WIP inventory increases because warehouse employees can't unload the truck and could have more trucks to unload;
- motion and overprocessing, because even when the truck is unloaded, before accepting and storing delivered goods, warehouse employee(s) need to count or weight all the cargo again to confirm the real quantity or weigh.

All these wastes represent higher costs for everyone who is engaged in this process.

This type of mistake is happening because a bigger part of the document preparation is done by filling in the documents manually, which increases the chance of human mistake.

About **property damage**, this problem happens rarely but still represents costs for the transport company and provokes a waste of time to make a report of an accident, send it to the responsible, invite the specialist to see the arrangement budget and time which would be spent to fix the damage.

This problem depends on 100% of the conditions that the driver has, concretely if the legally allowed driving time is respected and the driver is not forced to work some extra hours which could provoke tiredness and consequently accidents; if the driving knowledge is good enough to let the driver travel to any location. Images of property damage could be seen at the Appendix C.

4.4.2.1 Wastes and possible solutions

First analysis

After considering this process from a lean point of view, two types of waste were identified:

- waste of waiting time when some claims should be found between all emails that are received daily; Waste of employee's time who needs to fill the file manually when new complaints are coming;
- waste of motion when someone needs to understand the root cause of the claim, he or she needs to perform several tasks to identify the genuine cause. Several tasks can involve contacting a responsible person, finding time to talk to the person, even contacting, if necessary, the company and the driver who realized the journey and delivery, entering new information or data.

To correct this inefficiency, Poka-Yoke tool could be implemented by the following way:

- the column **shipment number** must be created and fulfilled to turn the search process more efficient (this could reduce the WIP compliant search, being possible to quickly find any claim in the email box by anyone); See Appendix D.
- the **name** column must be created and fulfilled by the person who is responsible for the claim, because if, for some reason, it is necessary to talk about one specific claim, an interested person already knows who contact to (this detail saves interested person's time and reduces unnecessary motion);
- claims form could be created by the company and must be attached to its website. The client who wants to make a complaint must open an online form, fill it out with all details that are defined in advance by the company and finally submit it (this way the company in analysis saves its employees time because they don't receive calls or emails from end customers saying what could be said in the online form (see Appendix E);

- an automatic claim model response could be created and automatically sent with the help of any automated application when a new complaint is received. It shows company's concern in solve an issue as soon as possible;
- claims folder could be incorporated in company's email to avoid the inventory of received claims to general email box;
- *resolução* and *prevenção* columns must be created and fulfilled to be seen how the specific claim has been solved and what should be done in future to avoid it from happening again.

Second analysis

Cargo damage

Regarding **cargo damage** and with the aim of understanding the root cause of this problem, small meeting was held with Intermodal division coordinator and the answer that was presented for this problem was the following:

"We can't control the way the driver drives, if trucks are revised frequently to avoid any damage by meeting all security conditions, and how do warehouse employees unload the goods shipped".

Understanding the complexity of the problem and as a first step of remediating it, a quality tax table which shows transport firms that delivered damaged cargo was created.

Table 3. Quality tax table

Transportation firm	Clients	Quality taxes
Neves	Decathlon	67%
ECS	Decathlon	80%
WEC	Continental	46%
TPG	Michelin	67%
BTS	VW	87%
OldTrans	VW	76%
TEC	VW	89%
Transroman	IKEA	84%
Transmorro	IKEA	86%
Eurosalvador	IKEA	85%
Containerships	IKEA	87%
Jcarrion	IKEA	88%
Santiago Penaranda	IKEA	82%
Cofetra	IKEA	45%

Considering the table, it is visible that Neves, WEC, TPG, and Cofetra present a poor-quality tax which impact the company's overall performance at the period between June 2020 and March 2021.

The solution that emerged as a second step passed through scheduling online meetings with the representative of each company to analyze those low numbers.

After four meetings it was detected that firms don't comply with all necessary rules and requirements that are essential for providing the best service quality for the end customer, namely frequent revisions of trucks utilized for performing the service, working with old trucks to transport goods, warehouses that have too much work to perform and few employees which present the work done in a chaotic atmosphere, increasing the number of errors made during the loading or unloading procedures (fixing cargo inside of the truck without paying attention during the loading process; bad space management while unloading which provokes accidents).

Analyzing these firms' weaknesses and performing a third step related to this problem solving, it was decided to establish three months of improving experience since the meeting day to offer them an opportunity to improve their service quality. If after three months nothing changes, the company will audit them to correct those issues, and this will be the last chance before they stop working with them.

Understanding that there are more clients an organization works with and that some of them generate bigger revenue that the previous four, and with the aim of preventing previous types of errors, it was thought to analyze firms that generate the biggest revenue for the company and schedule the same type of meeting to monitor their quality service, adding the quality frequent reports to have data to analyze and monitor.

Table which demonstrates these firms, could be seen below.

Table 4. Analysis of revenue per firm

Transport firm	Location	Value
NV ECS EUROPEAN CONTAINERS	Belgica	6 393 825,13 €
Transfesa Logistics S.A.	Madrid	3 959 735,91 €
TRANSPORTES EDUARDO CARDOSO LDA	Castelo branco	2 701 740,11 €
K-LOG - Transportes, S.A.	Maia	1 934 612,47 €
Containerships – CMA CGM GmbH	Perafita	1 889 699,20 €
TRANSPORTES BERNARDO MARQUES, S.A.	Guarda	1 687 063,65 €
TRANSMURF LDA	Famalicão	989 174,39 €
TRANSROMAN SL	Huelva	856 520,00 €
CLDN RO-RO S.A.	Perafita	772 190,95 €
TRANSPORTES MESTRE D´´AVIZ S.A.	Batalha	493 527,00 €
MILHAS & SEQUENCIAS - TRANSPORTES NACIONAIS E INTERNACI	Vila Nova de Gaia	410 950,36 €
SUARDIAZ TET	Madrid	279 019,03 €
CODOGNOTTO ITALIA S.P.A.	Vila Nova de Gaia	236 026,00 €
TRANSVAGA E HIJO, S.L.U.	Vigo	235 248,50 €
TCO TRANSPORTES LDA	Braga	232 550,00 €
TRANSPORTES PASCOAL, LDA	Pombal	201 350,00 €
TPG - TRANSPORTES PORTUARIOS GALLEGOS, SL	Vigo	196 189,06 €
Transportes Marginal do Mondego, S.A.	Coimbra	193 900,00 €
MARMEDSA AGENCIA MTMA. - PORTUGAL - LDA	Perafita	183 390,61 €
FAMALITIR - TRANSPORTES, LDA	Famalicão	178 716,96 €
TMM - TRANSPORTES MARINHO & MIRANDA, LDA	Maia	174 605,00 €
NOBRE MARQUES - TRANSPORTES RODOVIARIOS DE MERCADORIAS	Guarda	152 615,00 €

Documentation mistake

To avoid **documentation mistake**, automated verification systems must be set up to auto confirm all the filled-out data.

Another solution passes through KPIs definition, namely monthly percentage of documents prepared without any mistake – Documents zero error preparation, which could be awarded monetary, by giving an extra day off per month, etc. to motivate employees.

Lastly, in case of checking goods inside of the warehouse before being shipped, RFID optimization could be deployed to have an immediate confirmation of goods (quantity and weight).

Note: RFID optimization will be broader explained at the warehouse operations part.

Property damage

One possible solution to reduce **property damage** is to monitor this type of complaint to find out which are the firms that provoke this issue and then, stop to work with them if it is not harmful for the company (if it is possible to find other transport firms to contract for the same service).

4.5 Maghreb division

4.5.1 Process description

To have a macro view of Maghreb division and to identify possible non-adding value activities, flowchart was created.

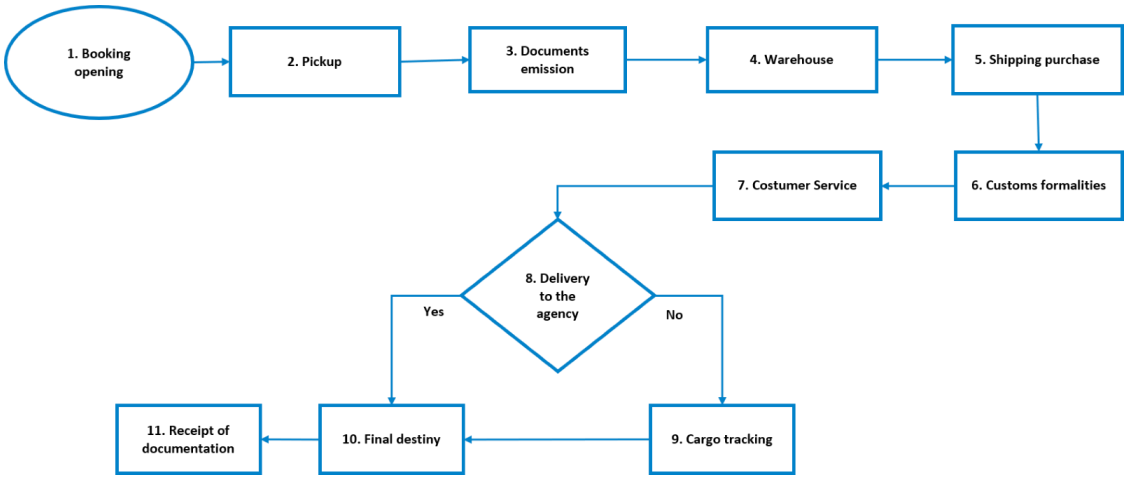

Figure 14. Maghreb division flowchart

To understand precisely what type of activity each step represents, the author described each of them deeply.

1. After the commercial process, it is transferred, via email, to an operator who is responsible for shipping goods. The order for land transport is done by opening the booking and as soon as there is all necessary information, the process should be opened. If it is a spot (occasional) proposal, the operator must register the value. In case of prompt payment to a follow-up customer, operator must directly inform the invoice department (to prepare the invoice) and someone from administration (to collect the payment from the client by sending the invoice to the client). When the customer pays, the administration must inform operators so they can proceed with the transport. The reservation is opened in PHC Software.
2. During the pickup, operators must send the loading instruction or cargo list to the supplier that was subcontracted in order to continue the pickup

process. This service must guarantee that the supplier is not in a blacklist (suppliers who, for some reason can't work with the company studied).

3. Emission of all documents related to the whole procedure such as invoice, packing list, CMR (service contract), insurance documents (insurance certificate and policy), documents related to the origin of goods shipped, that are then printed to stamp. After being stamped, these documents are digitized and sent to the client and transport company. When documents are all ready, the process cover (transportation order) could be opened. Copies printed during the entire process are later stored in a physical archive.
4. The cargo which is received in the company's warehouse is checked, weighted, tagged, chopped, to print a DME (document which proves that goods are in the warehouse already checked and ready to be shipped) and placed in the special zone for the future expedition. Every time goods are unloaded at the warehouse, special documents called "Reception-Loading of cargo" and "Loading and unloading of extra-community goods" must be filled out.
5. The availability and feasibility of the service delivery to a regular supplier is checked, beyond this, also the journey is checked to verify if it is optimized. When there is no regular supplier available and/or optimized journey, transport exchange is used to verify if there is a supplier or goods in which the presented company is interested. The supplier is selected, verified if it is not on the company's blacklist and after this, transport purchase is done. If it is necessary to pick up the goods directly from the client, document called "Goods Pick up-Delivery" is filled up and followed. Regular suppliers should be evaluated in accordance with the "Supplier Assessment" document. If the supplier is new, the supplier opening process must be requested using the Supplier Opening form.

When the supplier becomes regular, the Supplier Registration form must be filled out.

6. Communication with AEO responsible.
7. Cargo follow up information passed to the Customer Service for future journey monitoring and any possible issue solving.
8. Delivery to the agency?
9. Cargo is distributed to the destination determined in the order, being followed by a Customer Service until the final destiny.
10. Cargo is distributed to the destination determined in the order. In case of any issue that prevents the cargo from reaching its final destination, the "Operational Contingency" procedure is activated.
11. Once the order has arrived, an organization receives a CMR and the invoice for the transport carried out by the supplier. If requested, it is also sent to the client.

4.5.1.1 Wastes and possible solutions

The author had a chance to observe how the whole process of exporting goods to Morocco or Tunisia occurs and focused his attention at the third step of the diagram.

This step shows that all documents related to the whole procedure are printed to stamp and after that these documents are digitized and sent to the client and transport company. Copies printed during the entire process are later stored in a physical archive. In the next figures is possible to observe the different parts of this process.

Figure 15. Printed copies and psysical archive

After observing this process, three types of waste were founded:

- overproduction of paper by printing too many copies;
- increased inventory of documents, by storing all the copies at the physical archive that also occupies space in the office;
- extra motion because of taking copies, signing them, and then digitizing documents that were printed previously to send to the client.

Some of possible solutions pass through:

- use the electronic stamp to avoid printing so many copies;
- create a QR code which contains all the documents in one folder;
- use SharePoint application to store all the documents related to each shipment in the cloud to never lose them and give a possibility to any worker access to any shipment at any time and place, and lastly, put away physical archives that occupy space which could be used for another purpose.

4.6 Warehouse operations

4.6.1 Company's warehouse description

The warehouse is divided in two areas, the general warehouse which has 2878.23 m2 and logistics warehouse which has 1902.64 m2.

The general warehouse is used for unloading and loading procedures, cross-docking and for storage of high demand goods which leave the warehouse every day. There are seventeen gates, which are used to support its business activity.

Logistics warehouse is used for storage of the goods which may stay longer before being shipped, having 95 racks to store them and six gates used to unload or load procedures.

The general plant (Appendix F) could be observed to visually understand the explanation done in the past two paragraphs.

4.6.2 Warehouse operations

To understand how the warehouse operates, flowchart of unloading and loading goods was done and each step was deeply described.

Unloading procedure:

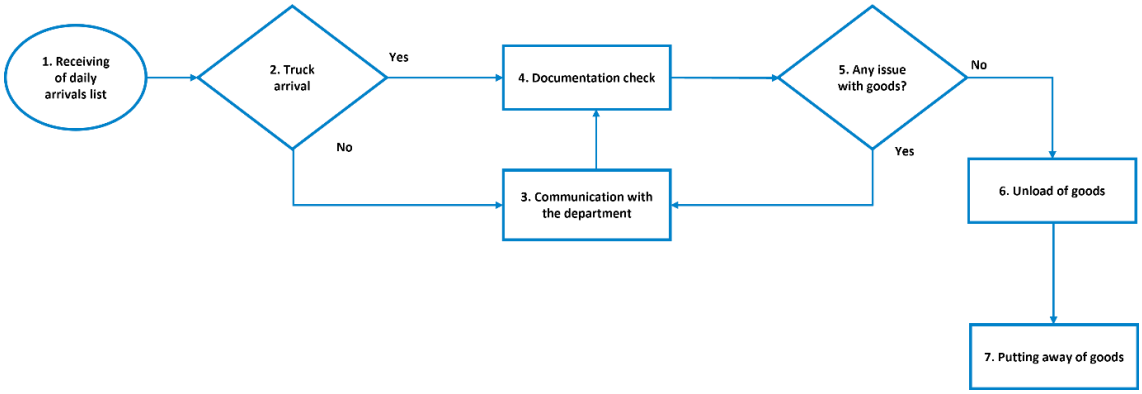

Figure 16. Unloading process flowchart

1. Land and Maghreb employees inform the warehouse responsible in advance about daily truck arrivals, by preparing the list of transport firms which will arrive to leave the goods. That list is then delivered to the warehouse responsible (an employee who is responsible for planning daily service elaborates the list, prints it, and then goes to the warehouse office and gives the list to the warehouse responsible).
2. When the driver arrives at the company's facilities, he or she goes to the office to deliver the transport documents (which contain information about daily collections and services in general) to the distribution operator.
3. If the truck didn't arrive within the allotted time, the warehouse employee informs the department that is responsible for the requested service (Land or Maghreb) and waits for the operators' updates.
4. Distribution operator proceeds to the documentation check process. After the documentation checkup, the distribution operator prints the respective labels and indicates the gate which will be used to unload the truck.

5. The cargo is checked by the warehouse employee in accordance with the documents and labels that the driver brings (quantities and recipients, as an example). During the unloading process, if there are any damaged goods, these are rejected temporarily and moved to a special area for future checkup.
6. If everything is in accordance, the warehouse employee signs the guides as a proof of receipt and unloads the goods.
7. After all goods had been unloaded, warehouse operator places them in respective aisles.

Loading procedure:

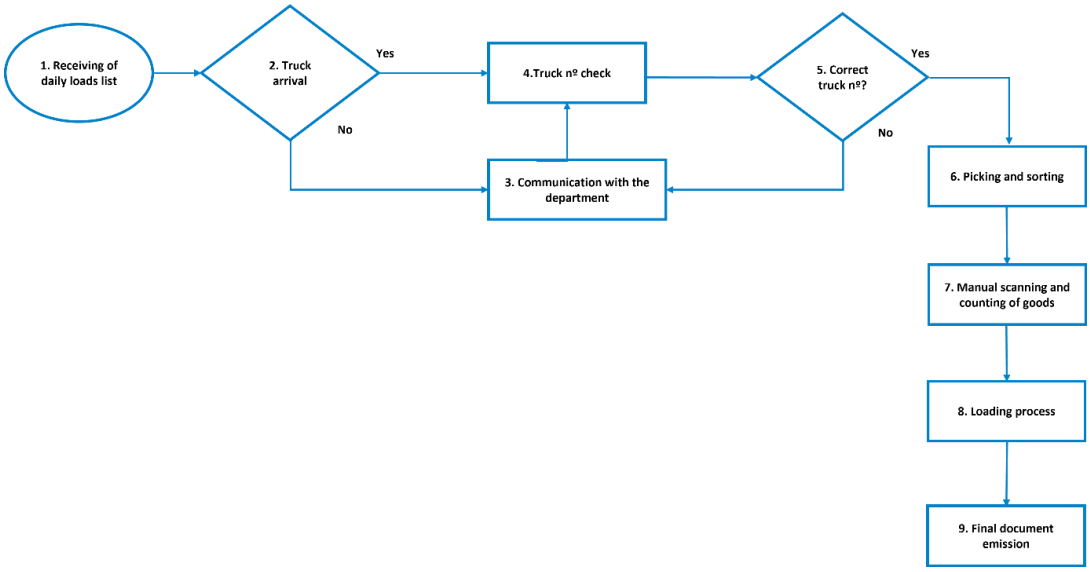

Figure 17. Loading process flowchart

1. A loading list where is described which transport firms will arrive and what goods will need to be loaded is provided by the Land or Maghreb team, which is then delivered to the warehouse operators (one person who is responsible for planning daily service elaborates the list, prints it, and then goes to the warehouse and gives the list to the warehouse responsible).

2. The truck arrives at the gate, then the driver goes to the distribution office to inform them about his or her arrival.
3. If the truck did not arrive within the allotted time, the warehouse informs the department that is responsible for the requested service (Land or Maghreb) and waits for the operators' updates.
4. The distribution operator informs the warehouse employee about the arrival and the last one confirms the truck's number in accordance with the daily loading list.
5. If the number of the truck corresponds to the one indicated at the daily loading list, the loading process initiates.
6. Operator travels to the location of the goods, confirms the product and its quantity, then collects and delivers goods to the shipment area.
7. When all goods are at the shipping zone, operator must scan all the barcodes to transfer the updated status of the goods to the warehouse management system.
8. After all goods had been scanned, these are loaded in the truck. The loading process is completed by taking a photo as a proof in case of anything happens during the journey.
9. Documents about the goods which will be shipped are delivered to the distribution department to double check and to print the final CMR document. If goods that were in the list were not loaded for some reason (the total amount of goods did not arrive or it just did not fit in the truck), before printing the CMR operators must remove what is left to be loaded. Once the CMR is printed, it is given to the driver, who signs the first page as a proof that goods have been loaded. The first page is saved at the distribution department physical archive and the second page is given to the driver. After that, the driver can leave the warehouse.

4.6.2.1 Wastes and possible solutions

Considering the first step of **unloading** procedure, two wastes are immediately identified:

- waste of motion (the average time spent to deliver the daily list of the arrivals from Land or Maghreb division to the warehouse office is 3 minutes and half (print the list, pick it up from the printer, go from the floor 1 to floor 0, arrive to the warehouse office, deliver the list, and come back to the workplace). This is the average time if nothing unplanned happens (the printer is working perfectly, no one is printing at the same time, warehouse coordinator is in the office) which results in and **seventeen minutes half** per week, **one hour and 10 minutes** per month;
- waste of overproduction in terms of paper consumption (every day one cargo list is printed which results in five copies per week and twenty copies per month if there is not any mistake).

Analyzing also the fifth step of unloading procedure in detail, it is known that there are two operators in the receiving zone who unload trucks and check the product documentation, quality, and quantity. If goods are damaged or if there is any problem with the data, goods are rejected temporarily and moved to a special area for future analysis. After the checking process which comprises scanning all the barcodes of the goods received to approve the quantity and enter their data into the management system, goods are accepted and then, located into related storage zones by the same two operators.

After some observation during the work time, it was possible to see that allocation of recently accepted goods is not always done in the right way. Normally on Friday, there are a lot of loads and unloads (could reach 300 pallets per day) and as there are few operators and too much work to be done, it turns chaotic. Goods are sometimes stored in any empty place to have the loading zone

free of pallets to be able to drive forklift; sometimes, arrangement of priority and high-demand goods is not done, and these goods are sometimes placed farther from the shipping zone.

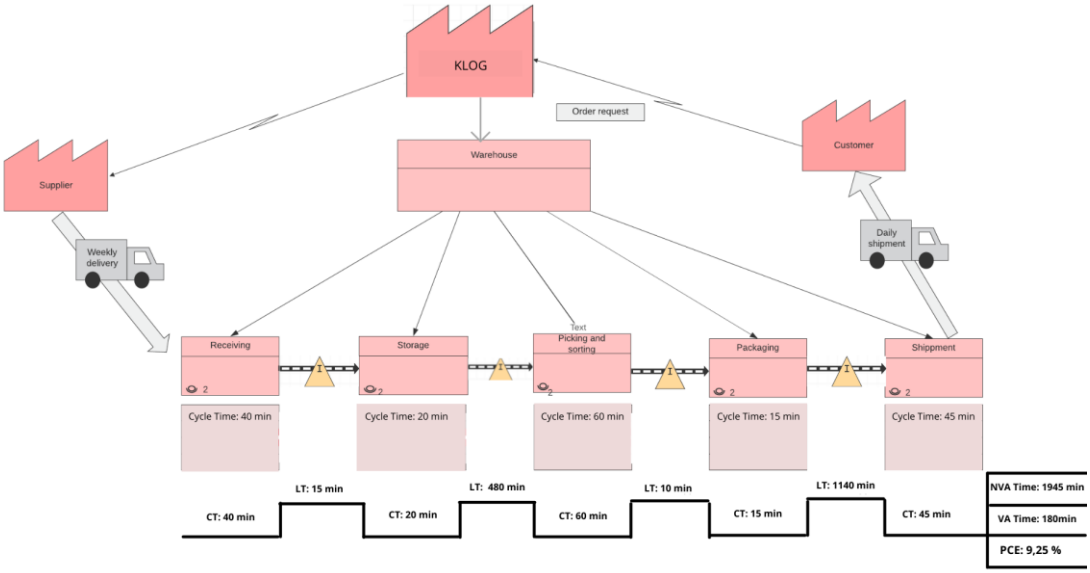

Figure 18. Current state map of warehouse operations

This way of inventory management provokes three wastes, namely transportation due to longer transportation distance, what immediately originates the waste of motion; waste of time spent during the whole process.

NOTE: the two wastes identified at the first step of unloading process also suits to loading process flowchart because the process is the same.

To eliminate both wastes identified at the first step (unnecessary motion and overproduction), the daily list could be sent through email to the warehouse coordinator or through Microsoft Teams channel, which will save employees' time, will enable to focus on other important tasks and lastly, will save printing paper and printer ink which consequently will reduce costs.

To better understand the overall warehouse operations and with the aim to find improvement areas, it was decided to create a current value stream mapping.

In the current state of value stream mapping, the attention is focused on the specific product from specific supplier with previously agreed truck delivery to avoid any possible issue.

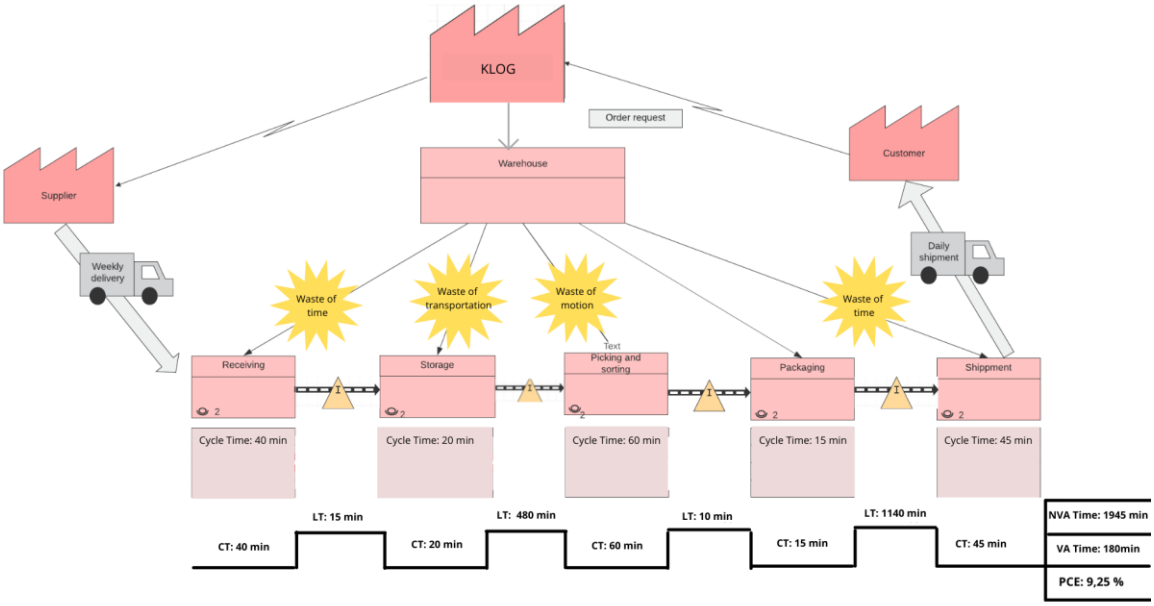

Figure 19. Future state map of warehouse operations

In the future state mapping, three types of waste were detected: waiting, transportation and motion.

Waste of waiting in the receiving process: there is lack of communication between the supplier and warehouse, there aren't receiving schedules of the goods so they can be created or at least the receiving process and schedule could be agreed beforehand to reduce employees waiting time and their daily work volume.

Waste of transportation in the storage procedure: as there are few operators and a lot of goods to load or unload, they try to allocate the goods to randomly

free space which creates waste of transportation while searching for those free places; warehouse management should implement fixed location to avoid this kind of waste.

Waste of motion in the picking process: priority and high-demand goods should be placed close to the loading zone to avoid longer travel and loading times. It will optimize the whole procedure and will reduce costs.

It could be seen that the manual barcode scanning activity delays a lot the whole process and as a suggestion to reduce the time and extra motion could pass via RFID labels.

RFID is a technology variation that use radio waves to define objects. A microchip and an antenna belong to RFID tags. The microchip is used to store data such as product serial number and antenna provides the microchip to transfer product information to a reader which converts the data in the RFID tag to understandable format in computers. It can be thought of as development over the barcode system which needs to be read by scanners which takes a lot of time. RFID tags are divided into three types: active tags, which have battery to broadcast signal to the reader; passive tags, which do not have battery and they are powered up by electromagnetic waves transmitted by a reader to cause a current in tag's antenna; and semi-passive tags, which can use both battery and waves, which are sent by the reader. For higher valued products, active and semi-passive tags are used for longer distance scans. The chip in the tag could be read-write or read-only. Read-only chips are normally used for tracking cheap items and read-write chips are for more expensive items (Angeles, 2005).

RFID systems work on four different frequency bands: low frequency (LF); high frequency (HF); ultra-high frequency (UHF) and microwave (MF). The most common and lowest cost option in the supply chain is UHF passive tags. RFID systems provides exclusive visibility in the supply chain by showing product

data such as manufacturing and expiration date, entity data such as telephone and address history data and unit group data such as dimensions and definitions (Tajima, 2007).

Table 5. Operating frequencies and performance characteristics

Source: Adapted from Tajima, 2007.

	Low frequency (LF)	High frequency (HF)	Ultra high frequency (UHF)	Microwave frequency (MF)
Frequency range[a]	125–134 KHz	13.56 MHz	860–930 MHz	2.45 GHz
Tag type*[b]	Passive	Mainly passive	Active and passive	Active and passive
Read range (passive*)[a,b,c]	<0.5 m	1.0 m	3.0 m	10 m
Tag size (passive*)[c]	Larger	Larger	Smaller	Smaller
Data transfer rate[a,b,c]	Slow	Medium	Fast	Fastest
Ability to read near metal or wet surface[a,c]	Best	Better	Worse	Worst
Tag cost[c]	High	Lower than LF tags	Lowest	High
Typical application[a,c]	Livestock tracking, card-key access control, beer keg tracking, Exxon Mobil Speedpass	Airline baggage handling, library book tracking, electronic article surveillance	Supply chain tracking, warehouse management	Electronic toll collection, railroad monitoring

Possible benefits of RFID

There are thirty-nine benefits of RFID utilization that (Suhong & Visich, 2006) present but to reunite only the most relevant for the research study, (Tajima, 2007) presents fifteen benefits which are separated into two groups: benefits that could be assessed throughout the supply chain and benefits that could be understood by major supply chain attender.

<u>The benefits throughout the supply chain:</u>

1. Reduced shrinkage regarding spoilage, misplacement, shoplifting.
2. Reduced material handling: it helps to decrease material handling and inspection time (prevents human labor related to manual data entry mistakes).

3. Increased data accuracy: it can improve inventory records by removing human errors in material handling and the accuracy of the shipment data.
4. Faster exception management: it provides on-time obtained data and better synchronization of material and data flows.
5. Improved information sharing: it could increase the product data sharing among the companies.

The benefits for manufacturers and suppliers:

6. Production tracking of raw materials, WIP inventory and finished products.
7. Quality control: to reduce product imperfections and defects.
8. Supply and production stability: by developing material tracking through the production process.

The benefits for distributors and logistics providers:

9. Material handling: material handling process can be decreased, since 50-80% of the cost is labor related.
10. Space utilization: better material handling can take advantage of space usage in the warehouse.
11. Asset management: different high volumes can be better managed.

The benefits for retailers:

12. Reduced stockouts: increased accuracy in finished goods inventory.
13. Customer service: RFID helps to count inventory efficiently, decreasing stockout situations and reinforce staff availability for customer assistance.
14. After sales service: warranty process and returns handling could be improved by effectively retrieving data (service history).

15. Lower inventory: could decrease safety inventory by developing inventory data and preventing out of stock situations.

RFID in warehouse operations

According to (Angeles, 2005) warehouse operations consist of:

1. Receiving and check-in: RFID portals placed in specific corners of the warehouse can be used to read tags and automatically update inventory levels while tagged pallets enter the warehouse.
2. Putaway and replenishment: having auto-IDs, putaway drivers will automatically find the defined storage locations without scanning unit barcodes so replenishment operators will also be free from scanning pallets or boxes.
3. Order filling: order pickers will be automatically led to the identified picking locations and once the items are picked up, the system will automatically verify picked quantities and remove them from actual inventory.
4. Shipping: RFID will avoid scanning of the physical goods for loading trucks which will save a lot of time for the operations process.

RFID warehouse process – an example

RFID implementation has the aim of optimizing the manual barcoding process which takes the most time during the warehouse procedures. RFID readers can be installed near receiving and shipping gates to collect the data from RFID tags which are affixed to the pallets or boxes. Passive RFID tags will provide information about the ID number, model or type and quantity of the product.

Possible RFID process is described below:

1. Pallets, which have RFID tags attached, arrive at the warehouse.

2. Operator unloads the pallets and passes through inbound gates and immediately RFID reader obtains the information on RFID tags and sends it to the WMS in real-time.
3. During the loading process, the operator uses the forklift to load the pallets and while passing from outbound gates to the truck, the RFID reader receives and records the data.
4. After reading RFID tags' data, WMS obtains the whole real-time information, and the shipment process is completed.

It could be seen that by implementing this technology, there are fewer human interventions and manual processing, less procedure period and consequently, less cost.

4.7 Analysis of results

All suggested improvements were considered by the company but probably some of them might be implemented in the future. The suggestions that were successfully deployed were the cellular layout (see 4.4.1.1 section), improved claims recording file (see Appendix D section) and a daily list which started to be sent by email instead of printing it daily (see 4.6.2.1 section).

Due to implementation of the cellular layout some divisions increased in terms of number of people and all the tasks became better divided.

Regarding Short-Sea Operations, it was increased to seven employees, namely in two who deal with export process; one who deals with importation from Dortmund and one in a pré-carriage service in Spain and ECS loads (loading and unloading of containers, boarding instructions); one who deals with the documentation (Sea Way Bill, which specifies the type of goods that are shipped, weight, departure date and arrival estimate date); two commercials, who are responsible for establishing new relations with potential clients.

FTL Outbound team maintained the number of employees (7) but distributed the tasks properly: one cargo planner; two who pass the orders, also called trackers; two charters who search for trucks and goods to ship. Regarding international service, there is one person responsible for exportation through land and one person responsible for "roro" (truck – ship – truck).

FTL Inbound team was reinforced with two new persons and since then, the team was consisted of one planner, who knows which loads should be done; one tracking, who is in connection with suppliers, schedules, equipment; one charter, who tries to find the best solution when there is lack of trucks or cargo and one leader who supervises the whole division.

Rail division received one more person and since then two persons became responsible for the export process, two for the import process (both in the Iberian Peninsula region), one for international business and one as a supervisor of the whole division.

Regarding the improved claims file, new columns were created, namely shipment number, transport type, insurance reference and the date of claim resolution.

Daily warehouse list started to be sent by an internal email to eliminate the unnecessary journey done by the Land or Maghreb employee and also to reduce the paper consumption.

CHAPTER 5
DISCUSSION AND CONCLUSIONS

5.1 Introduction

This chapter pretends to discuss and conclude the results of the work done inside the logistics company, explain some limitations and make suggestions for the future works.

5.2 Discussion of the investigations' purposes

In the beginning of this work, the author described the main goals, namely eliminating or reducing the wastes identified in the chosen processes with the help of lean methodology. These objectives were theoretically accomplished during the internship period, since different solutions were presented for the wastes identified. Practically these objectives were not accomplished since the presented suggestions were not immediately accepted and deployed. Many of them are still under analysis of the company direction.

In general, the answer for the research question "How can lean improve logistics company's processes?" has been answered along the chapters, illustrating the most appropriate lean tools for that.

5.3 Conclusions of the investigation

This work was performed at the logistics company, namely in the intermodal and warehouse departments in connection with lean philosophy and approaches

to highlight the importance of this methodology for the success of the studied company.

Literature review helped to find out that lean thinking can increase the organization's competitiveness, simplify internal processes, boost customer's satisfaction, and reduce costs due to less wasteful processes.

Beyond literature review, semi-structured and unstructured interviews realization, documents analysis and direct observation were other vital research methods to collect data and information that act like a foundation for this work.

After deep analysis of chosen processes it was found that there are different types of wastes which harm the overall department's performance, and these issues immediately motivated the author for correction suggestions and actions.

Different suggestions were presented with the aim of reducing and, in some cases eliminating wastes identified to ensure the smooth flow of the processes.

New information boards (see 4.3.1 section) were accepted by the direction and the next step consisted of forwarding those images to the designer in order to improve them and then, print and fix within the company installations. This will probably happen, but the author won't be able to see those boards.

An adopted cellular layout (see 4.7 section) simplified the work execution, increasing the overall department's performance. Client's inventory decreased, the waiting time to answer an email also. People reduced their stress, could focus deeply on some important tasks which reduced errors. An idea of using Microsoft Teams for meetings (see 4.4.1.1 section) was also accepted and bigger number of meetings were held using that application. Author hopes that it will continue in the same way or even better. Also, workers started to have some time to talk about normal day-to-day things which is very important to not be completely absorbed by the work.

The claims file (see 4.4.2.1 and Appendix D section) was updated with new columns, namely shipment number, transport type, insurance reference and the

date of claim resolution which made the process of searching for some claim way easier and consequently saved a lot of employee's time.

Maghreb division (see 4.5.1.1 section) considered to start to use an electronic stamp instead of the normal one, they are searching for the most suitable software for that. Another consideration was the usage of SharePoint but as the author finished its work earlier, he couldn't explain how it works.

Referring the warehouse improvements (see 4.6.2.1 section), Maghreb and Land division workers started to send a daily arrivals list through the internal email what eliminated the unnecessary journey done by the Land or Maghreb employee (1 hour and 10 minutes per month lost) and also reduced the paper consumption.

As a summary of what was said, the author defends that nowadays, in the fast-changing world it is very important to analyse the processes constantly to identify wastes and improvement actions. Even if these processes have been already improved using lean techniques, they must be also analysed in order to to improve continuously its effectiveness.

5.4 Investigation limitations

The author had an opportunity to conduct this investigation but with some limitations on his way.

The time of the internship was short, which didn't allow the discussion and implementation of all improvement suggestions and their future analysis to check if they were effective.

The pandemic situation (COVID-19) also had very harmful effect because the company used to work remotely during long period of time, what incapacitated the author to analyse certain documents (many of them were confidential), to have more direct observation on the processes and to conduct more interviews

or informal conversations with employees to explain in details what is lean, understand which could be their personal barriers, conducting then a resistance analysis (what messages to address, when and who should they come from) to overcome those barriers and increase the awareness of the possible change and a desire of taking part of it because it is actually employees who must change in order to company change.

Lastly, only one person in the company had some knowledge about lean methodology which was obviously not enough considering the authors' experience in this field.

5.5 Future recommendations

Analysing some of the limitations explained above, it is important to explain to the employees what is lean and why it is so beneficial for any company in any business area because only at that point something could change.

Another suggestion passes through the consideration of all suggestions made during this work since the time didn't allow it to be done earlier.

It could be reasonable to hire one or two lean specialists to continue the initiated work or to create some different approach with different points of improvements.

Beyond this, the author recommends stop using on-premises servers and adopt digital workplace environments since (Microsoft, 2021) 70% of workers want flexible remote work options in order to continue to work; 66% of managers are considering to change physical workspaces to hybrid ones. An example of this digital workplace is Microsoft 365, which offers a possibility to work remotely from any place, being easily accessed from any device at any time.

Microsoft 365 is a single cloud platform which englobes all the necessary tools (Microsoft Teams, Planner, OneDrive, Outlook, etc) to improve the collaboration between supplier-company-end customer, reduce servers' maintenance and

storage costs, increase the security of the data stored and last but not less important to give the employees an opportunity to choose what type of work is more suitable and healthier for them. Motivated and healthy employees are the key factor for the success of any company.

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APPENDIX

APPENDIX A – Question guide for the initial interview of the intermodal, Maghreb and warehouse departments.

1. What does your division do?
2. How many people are integrated in each team?
3. Which are the responsibilities of each team member?
4. Are there any inefficiencies in the current organization scheme?
    a. If yes, which?
5. In your opinion how could this division be improved?

APPENDIX B – Type of claims and its frequency

The present table shows what type of claim was recorder and its frequency.

Table 6. Type of claims and its frequency

jun/20	
CAUSE	FREQUENCY
Delay	
Cargo lack	
Cargo loss	
Cargo damage	
Property damage	
Lack of security	
Accident	
Acidente on the road	
Documentation mistake	
Wrong unload time	
Derailment	
Train cancellation	
Non-compliance with rules	
Fire	1
Exchanged unloads	
Locomotive derailment	
Segregated wagon	
Canva damage during the unloading	
Inapproproate behaviour	

jul/20	
CAUSE	FREQUENCY
Delay	
Cargo lack	
Cargo loss	
Cargo damage	2
Property damage	
Lack of security	
Accident	
Acidente on the road	1
Documentation mistake	
Wrong unload time	
Derailment	
Train cancellation	
Non-compliance with rules	
Fire	
Exchanged unloads	
Locomotive derailment	
Segregated wagon	
Canva damage during the unloading	
Inapproproate behaviour	

aug/20	
CAUSE	FREQUENCY
Delay	
Cargo lack	
Cargo loss	
Cargo damage	2
Property damage	1
Lack of security	
Accident	1
Acidente on the road	
Documentation mistake	
Wrong unload time	1
Derailment	
Train cancellation	
Non-compliance with rules	
Fire	
Exchanged unloads	
Locomotive derailment	
Segregated wagon	1
Canva damage during the unloading	
Inapproproate behaviour	

sep/20	
CAUSE	FREQUENCY
Delay	
Cargo lack	
Cargo loss	
Cargo damage	3
Property damage	
Lack of security	
Accident	
Acidente on the road	
Documentation mistake	
Wrong unload time	
Derailment	
Train cancellation	
Non-compliance with rules	
Fire	
Exchanged unloads	1
Locomotive derailment	
Segregated wagon	
Canva damage during the unloading	1
Inapproproate behaviour	

oct/20	
CAUSE	FREQUENCY
Delay	
Cargo lack	
Cargo loss	
Cargo damage	18
Property damage	
Lack of security	
Accident	
Acidente on the road	
Documentation mistake	
Wrong unload time	
Derailment	
Train cancellation	
Non-compliance with rules	
Fire	
Exchanged unloads	
Locomotive derailment	
Segregated wagon	
Canva damage during the unloading	
Inapproproate behaviour	

nov/20	
CAUSE	FREQUENCY
Delay	
Cargo lack	
Cargo loss	
Cargo damage	4
Property damage	
Lack of security	
Accident	
Acidente on the road	
Documentation mistake	
Wrong unload time	
Derailment	
Train cancellation	
Non-compliance with rules	
Fire	
Exchanged unloads	
Locomotive derailment	
Segregated wagon	
Canva damage during the unloading	
Inapproproate behaviour	

dec/20	
CAUSE	FREQUENCY
Delay	1
Cargo lack	
Cargo loss	
Cargo damage	4
Property damage	1
Lack of security	1
Accident	
Acidente on the road	
Documentation mistake	
Wrong unload time	
Derailment	
Train cancellation	
Non-compliance with rules	1
Fire	
Exchanged unloads	
Locomotive derailment	
Segregated wagon	
Canva damage during the unloading	
Inapproproate behaviour	

jan/21	
CAUSE	FREQUENCY
Delay	
Cargo lack	
Cargo loss	
Cargo damage	2
Property damage	1
Lack of security	
Accident	
Acidente on the road	
Documentation mistake	
Wrong unload time	1
Derailment	
Train cancellation	1
Non-compliance with rules	
Fire	
Exchanged unloads	
Locomotive derailment	1
Segregated wagon	
Canva damage during the unloading	
Inapproproate behaviour	2

feb/21	
CAUSE	FREQUENCY
Delay	
Cargo lack	
Cargo loss	
Cargo damage	5
Property damage	1
Lack of security	
Accident	
Acidente on the road	
Documentation mistake	
Wrong unload time	
Derailment	
Train cancellation	
Non-compliance with rules	
Fire	
Exchanged unloads	
Locomotive derailment	
Segregated wagon	
Canva damage during the unloading	
Inapproproate behaviour	

mar/21	
CAUSE	FREQUENCY
Delay	
Cargo lack	
Cargo loss	
Cargo damage	1
Property damage	
Lack of security	
Accident	
Acidente on the road	
Documentation mistake	5
Wrong unload time	
Derailment	
Train cancellation	
Non-compliance with rules	
Fire	
Exchanged unloads	
Locomotive derailment	
Segregated wagon	
Canva damage during the unloading	
Inapproproate behaviour	

APPENDIX C – Cargo and Property Damage

Figures 20, 21 and 22 show some examples of cargo and property damages that were analyzed at 4.2.2 section.

Figure 20. Cargo damage

Figure 21. Property damage

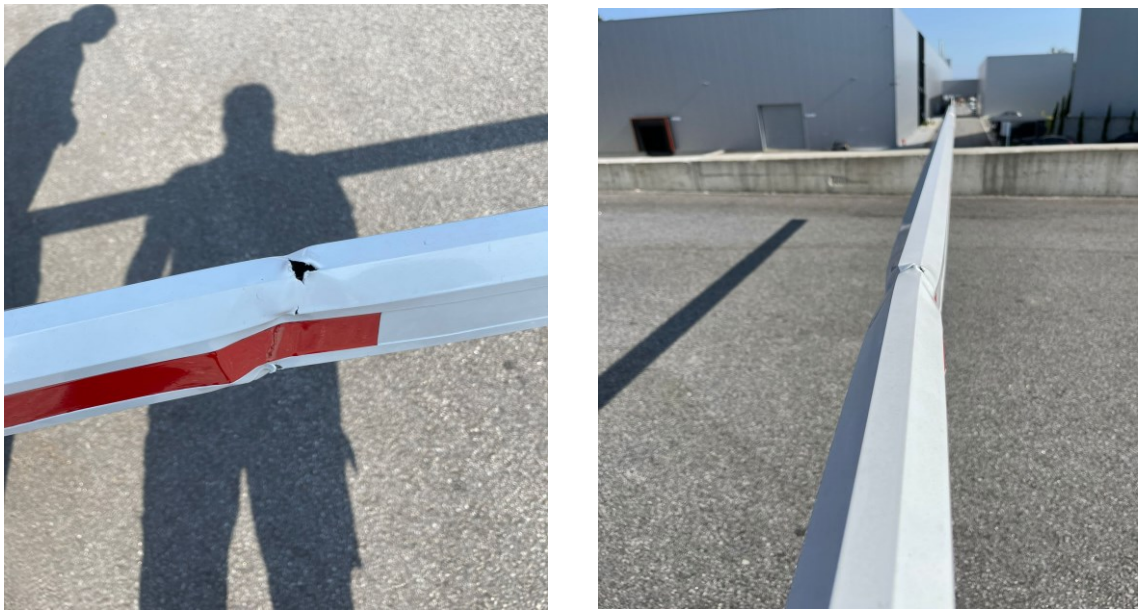

Figure 22. Property damage

APPENDIX D – New columns in the claims file

This table shows the new columns that were created, namely the process number, type of transport, insurance reference and the date of process closing.

Table 7. New columns of the claims file

Process Nº	Damage type	Client	Transport type	Shipping company	Open date	Insurance reference	Closing date
100-3925/2021	Damage	SA CIN CELLIOSE	INTERNATIONAL	HORATOTAL TRANSPORTES LDA K-LOG - TRANSPORTES, S.A. SAS GEODIS CALBERSON AQUITAINE	02/07/2021	2021003512	03/09/2021
100-3926/2022	Loss	RECLANGOL RECLAMOS LUMINOSOS PORTUGAL LDA	INTERNATIONAL	TRANSPOSEGUR - TRANSPORTES K-LOG - TRANSPORTES, S.A. SAS GEODIS CALBERSON AQUITAINE	02/07/2021	2021003525	13/08/2021
100-3927/2022	Loss	SANINDUSA - INDUSTRIA SANITARIOS S.A.	INTERNATIONAL	INTERMODAL DIVISION KLOG PINHO MOREIRA & LAGO LDA GEODIS DISTRI & EXP PARIS EUROPE	02/07/2021	2021003367	03/09/2021
100-3928/2022	Loss	SANINDUSA - INDUSTRIA SANITARIOS S.A.	INTERNATIONAL	INTERMODAL DIVISION KLOG K-LOG - TRANSPORTES, S.A. SAS GEODIS CALBERSON AQUITAINE	08/07/2021	2021003530	10/08/2021

APPENDIX E – Claim model

Here, we can observe the proposed online form created for incoming claims which was presented as a solution for the problem referred in 4.4.2 section.

Figure 23. Suggested claims form (Part I)

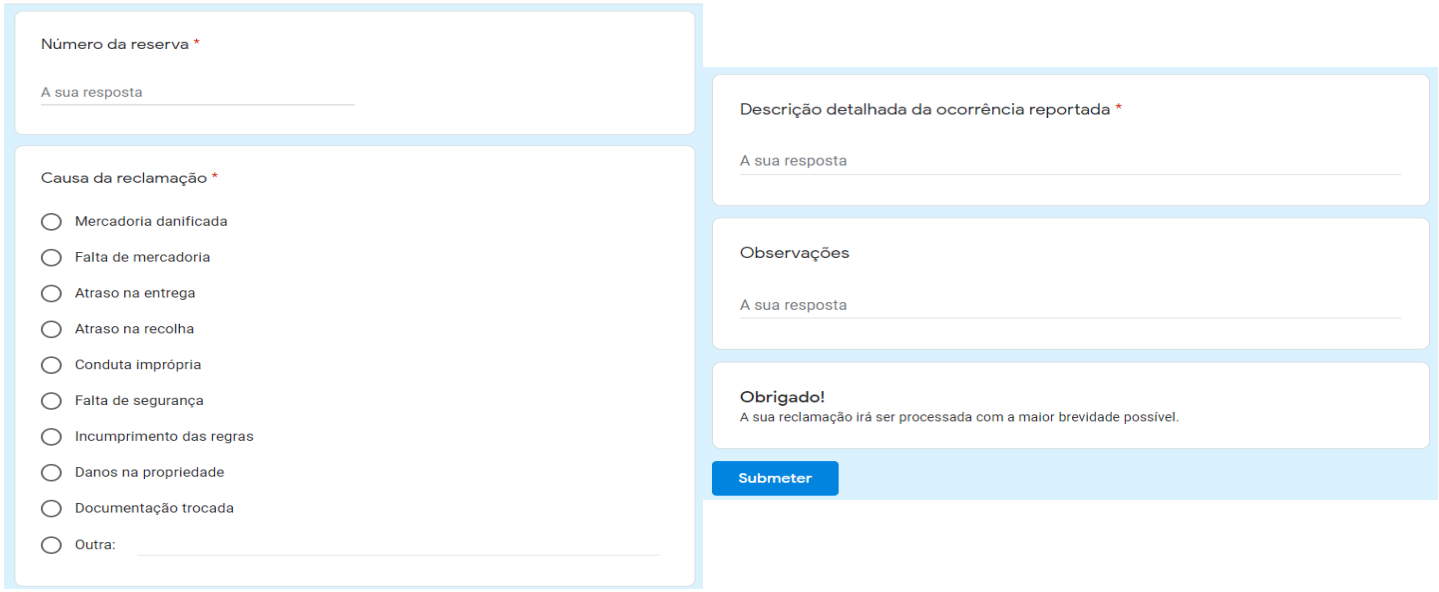

Figure 24. Suggested claims form (Part II)

APPENDIX F – Warehouse plants

Figures 26, 27 and 28 illustrates the warehouse plants mentioned in section 4.6.1.

Figure 25. Warehouse general plant

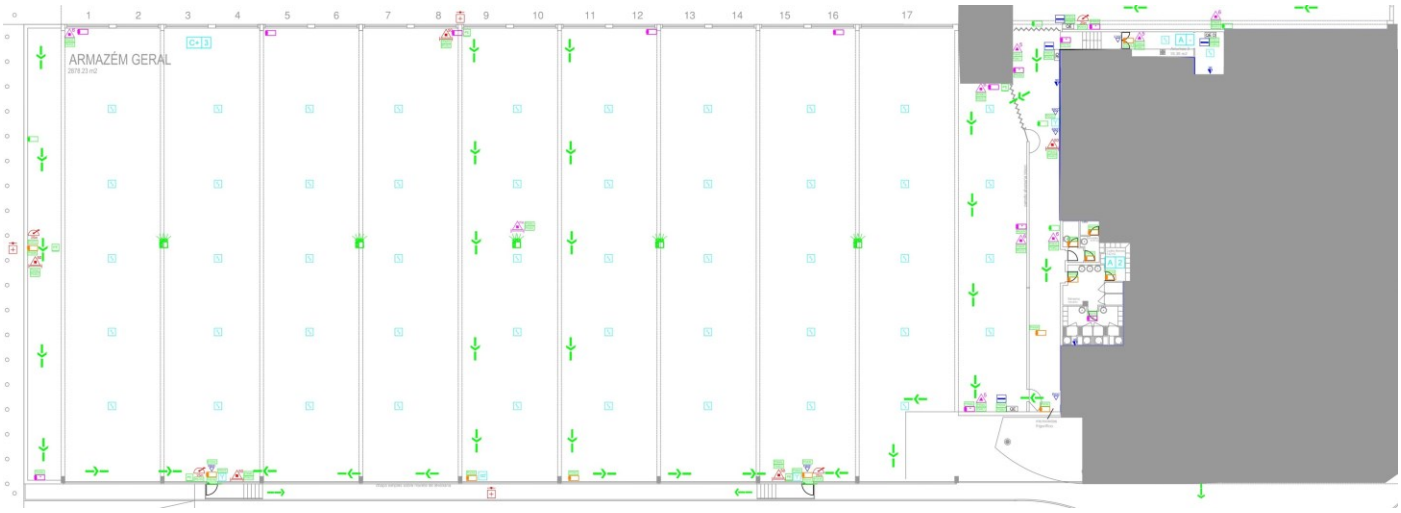

Figure 26. General warehouse plant

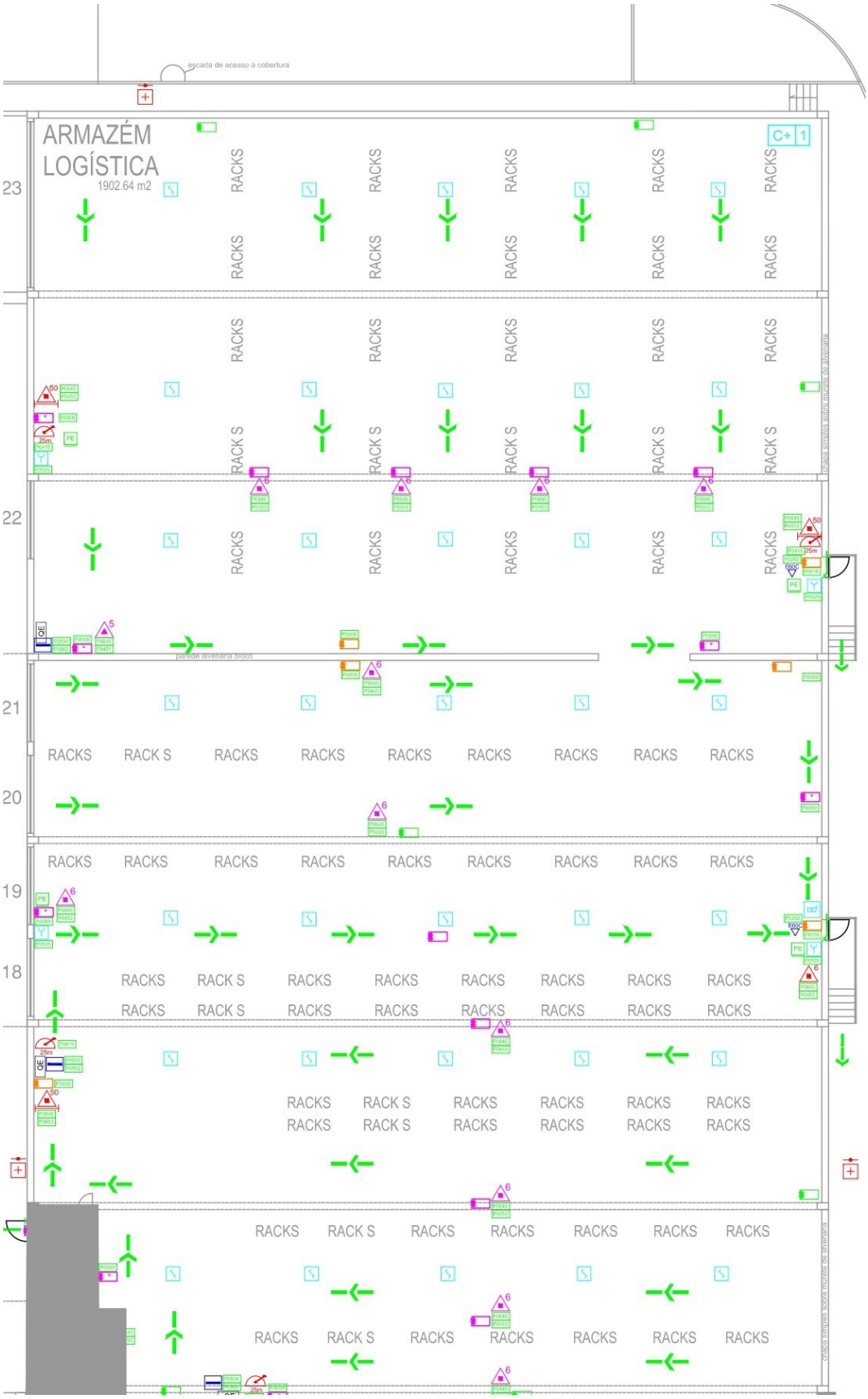

Figure 27. Plant of the logistics warehouse