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How to reduce the Quality Wall inspections and Standard Work and Line Design workshop at Megatech Industries Marinha Grande

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Coimbra, Janeiro de 2021

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How to reduce the Quality Wall inspections and Standard Work and Line Design workshop at Megatech Industries Marinha Grande

Relatório de Estágio de Natureza Profissional para a obtenção do grau de Mestre em Engenharia e Gestão Industrial

Escolha um item. Escolha um item.

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Coimbra, Janeiro, 2021

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"Palavra, gratidão e humildade, os valores fundamentais para se ser Homem de verdade"

"Word, gratitude and humility, the fundamental values to be a real Man"

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Acknowledgment

First, I want to thank to my family for my education and values that were pass to me. My father and my mother that did the maximum to give me the best possible education and life conditions. To my grandfathers that were and are always with me and support with what they can.

In term of academic life, I want to thank to every teacher, since the first day of school, that helped and taught me from linguistics to science study area and did part of my education as a man.

And finally, I want to thank teacher and supervisor José Manuel Torres Farinha to do the first contact with Megatech Industries Marinha Grande and to help me when I needed. I want to thank to Mr. Fernando Gaspar, Megatech Industries Marinha Grande's Plant Manager, to accept me and give me this opportunity to have the first experience in the work market. The last but not least, I want to thank my supervisor at Megatech, engineer Rita Rodrigues, Quality Manager, for receiving me in the Quality department and to share his knowledge that helped me to have a good performance in this internship.

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Abstract

This monograph describes the author’s curricular internship in a plastics injection company. The internship was based on the author's passage through the Quality department.

The internship aimed to obtain a deeper knowledge of the Plastics Injection industry, which is very relevant in the area of Marinha Grande, as well as the culture, working methods, philosophy and theoretical tools applied in real context.

The internship took place in the quality department, with the, focusing on the management of the Quality Wall. His management was carried out dynamically between the department of quality, logistics and production, where a harmony between the three departments was necessary.

Beyond passing through the quality department, during the internship there was also an workshop about standard work and line design, where problems and improvement opportunities were identified, mainly in the production line 2 of the factory, in which improvements were made at the level of workstations and all his inherent elements, achieving satisfactory results, in terms of organization of the workstations itself, cycle time and results in financial terms.

It was a very productive stage, which allowed to obtain a wide knowledge of various sectors of the company, providing a very rich experience in this industrial aspect, enhancing an easy future introduction in the labour market.

Keywords: Quality Wall, Quality Problems, Maintenance, Standard Work, Plastic Injection

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Table of Contents

List of Figures

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List of Tables

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Abbreviations

CAD - Computer aided-design

I&D - Innovation and Development

ISEC - Instituto Superior de Engenharia de Coimbra

ISO - International Organization for standardization

KPI - key performance indicator

LL - lessons learned

MEBO - Megatech Industries Technical Center

MIA - Megatech Industries Amurrio

MIB - Megatech Industries Brno

MIM - Megatech Industries Marinha Grande

MIO - Megatech Industries Orense

MIPI - Megatech Industries Peninsula Ibérica

OEE - overall equipment effectiveness

PDCA - plan, do, control, act

PPDCA - proposal, plan, do, control, act

PSA - Peugot Société Anonyme

QC - quality control

QW - quality wall

rfid - radio-frequency identification

RM - raw material

SFG - semi-finished-goods

VDA - Verband der Automobilindustrie

WIP - work in progress

WWII - World War II

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1. Introduction

This report was developed within the scope of the *Internship* discipline of Master's Course in Engineering and Industrial Management at the Instituto Superior de Engenharia de Coimbra.

This first chapter describes the department where the author performed his functions as well as the improvement that he and his team did in terms of standards implementation and design improvement done.

This chapter begins by framing the internship, presenting the objectives and the methodology that was used, as well as the structure of the report and the company presentation.

1.1. Internship background

The internship corresponds to the homonymous Unit Course of the Master's Course of Engineering and Industrial management of ISEC.

Since the last century we have been witnessing an intense industrial evolution. In the early 1900s, industrial massification emerged, through Henry Ford, founder of the well-known Ford car brand, who started producing the Ford T model, a model that became known for later being produced only in black. This type of production later came to replace much of artisanal production. With this, production lines were created, where products with the same characteristics were produced, thus reducing unnecessary tasks, increasing productivity.

In this way, products started to be sold at a lower cost with quality, thus increasing competitiveness.

After this industrial impact, with more attractive prices, companies, in order to survive, had to find ways to differentiate themselves and distinguish themselves from the others. As a result, the market has become increasingly difficult and many companies have difficulty surviving, either because they are unable to compete at the price level or because they do not adapt to the needs of consumers, not innovating and continuously improving.

It was this good pressure that made the author want to be part of the Megatech Industries Marinha Grande team, which with a culture of wanting and always looking to evolve and with the courage to face new challenges. The internship was spent in the quality department and collaborated with all the others, thus allowing good coordination.

1.2. Objectives and Methodology

The objective of the internship is to insert the finalist student in the business environment through professional activities within the ambit of the Master's Course, having as deliverable a report that will be publicly discussed.

The methodology was based on the quality and management standards that Megatech Industries has adopted as well aiming the best solutions to answer daily problems, supporting decisions and avoid further occurrences.

1.3. Megatech Industries Group

This subchapter talks about Megatech Industries Group, an automotive group that his activity is plastic injection, more precisely at Marinha Grande's plant, where the author did the internship

1.3.1. History

The Megatech Industries Group is an automotive industry group being its main activity the plastic injection, with more than 250 injection machines with a maximum capacity of 2300 tons of clamping force. Megatech has numerous production technologies:

- Convection injection;
- Two to three injection components;
- Gas injection;
- Low pressure injection;
- Lamination;
- Assembling (application of glue, welding);
- Painting and laser marking;
- Cutting (manual, laser, water jet, leather cutting and sewing);
- Others.

In 1889 the Redlhammer Brothers set up a factory in Jablonec, starting to produce porcelain and glass buttons.

Along these years the group has grew with the acquisition of factories, especially in Europe and turned to the plastic injection activity. In 2009 it has been named as Megatech Industries. In the same year it opened the first sells office in Germany and France and acquired the Plastkov Group of Czech Republic.

2011 was the year that Fatraplás in Portugal was acquired, actually known as Megatech Industries Marinha Grande (MIM). Also, in 2011 it was funded Megatech Industries India.

Two years later, the second sale office in Germany was opened.

In 2016 the group opens Megatech Industries Brno (MIB) and acquires Toyota Boshoku's European Non-Toyota-Interior Business with five factories, three in Germany, one in Poland and one in the Czech Republic.

Today, Megatech Industries Group is located in nine countries: Germany; Austria; Brazil; Spain; France; Liechtenstein; Poland; Portugal; and Czech Republic.

In Iberian Peninsula the group is represented by MIM; in Portugal and in Spain it has factories in Amurrio (MIA) and Orense (MIO) and one technical center in Amorebieta-Etxano (MEBO).

Beyond MEBO, the group has four more technical centers that does:

- Product development;
- Software management;
- Dynamic and static simulations;
- Computer-Aided Design (CAD);
- Construction / design of products and tools;
- Others.

The next figure shows some relevant information about the year 2019.

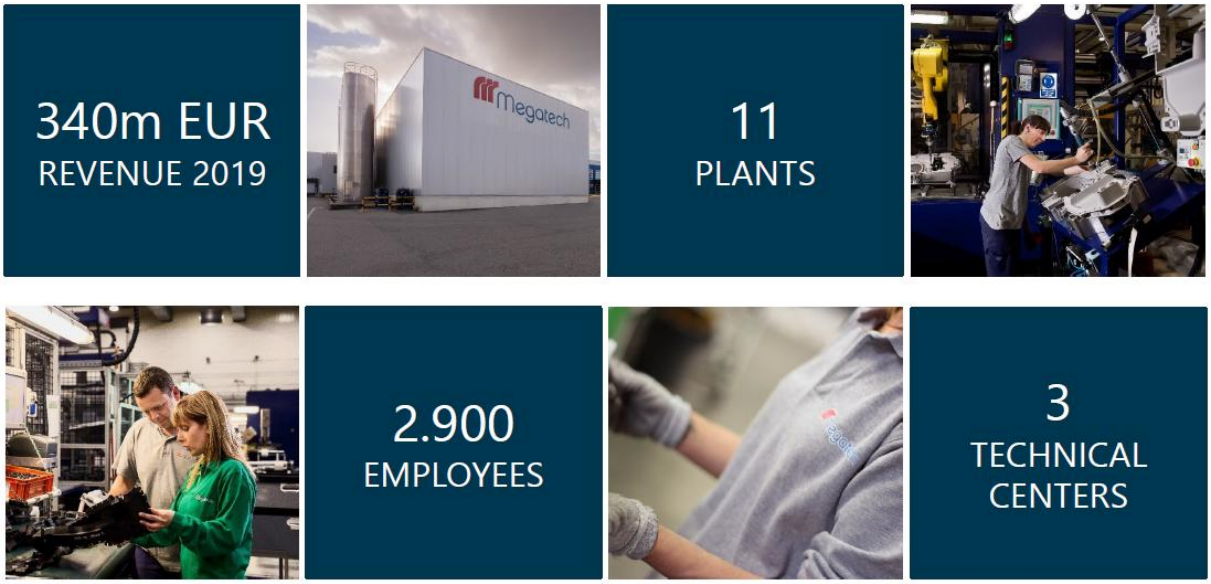

FIGURE 1.1 - MEGATECH INDUSTRIES GROUP 2019 OVERVIEW

1.3.2. Megatech Industries Identity

Megatech stands for state-of-the-art technology, high-quality products and passionate experts and work closely with the automobile manufacturers on perfect technical solutions.

The goal is a continuous growth, to continue to become better, more professional and more successful in the future.

FIGURE 1.2 - MEGATECH INDUSTRIES CORE VALUES

1.3.3. Megatech Industries Marinha Grande

Megatech Industries Marinha Grande is the only factory in Portugal, located at Moita, Marinha Grande and has a great road access (Figure 1.3).

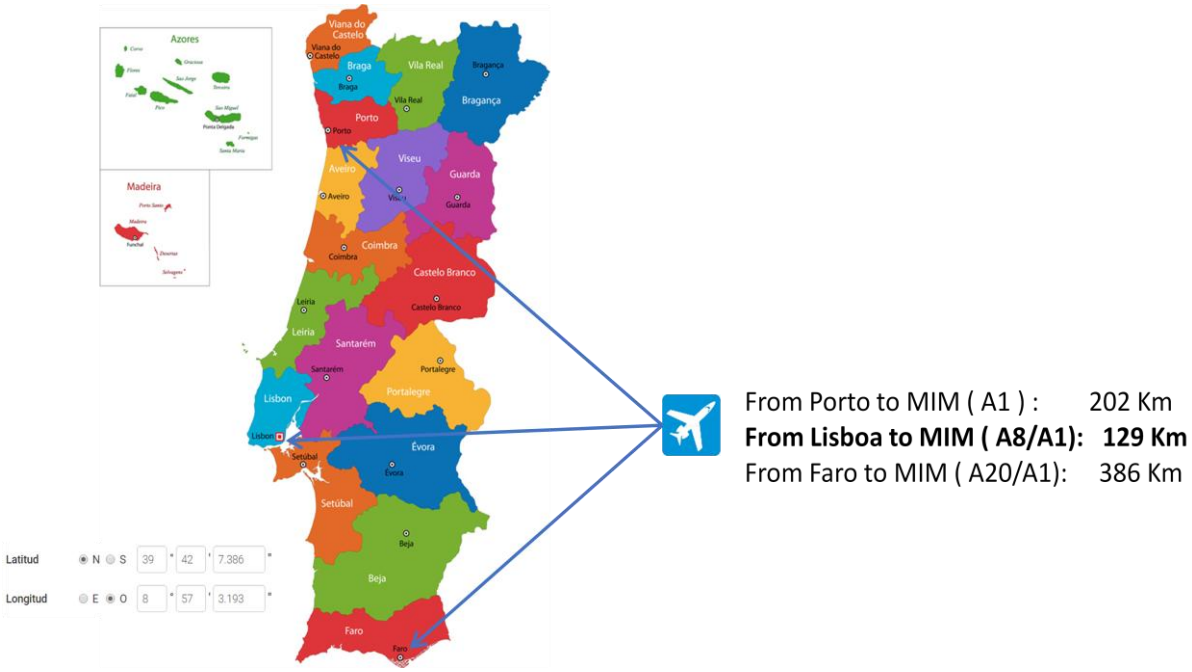

FIGURE 1.3 - MEGATECH INDUSTRIES MARINHA GRANDE LOCATION

FIGURE 1.4 - MEGATECH INDUSTRIES MARINHA GRANDE'S PLANT

Before the acquisition of Megatech Industries Marinha Grande (Figure 1.4), the factory was known as Fatraplás, founded in 1979. His main activity was also plastic injection, and, initially, produced boxes for batteries; 1987 was the beast year with the production of remote controllers for Philips. In the beginning of 2001, Fatraplás started working for automotive industry, for its first customer Valeo and, further, in 2006, with the customer Faurecia.

In 2011, Fatraplás was acquired by the Megatech Group. The company remains in automotive industry and still working with Valeo and Faurecia, and expanded the production of previous solutions in 2012 with the new customer Plastic Omnium. In 2013 it started working with PSA Group and, further, in 2015, with Renault.

With an increasing demand, in 2016 the factory has built a new production line, with an expansion of three thousand square meters and acquisition of more injection machines, with an extra capacity of clamping force. This expansion allowed to start a new project with Volkswagen Group, in 2017, and, in 2018, other new project with PSA Group.

In 2020, another new project will be started by the customer PSA, with a new similar expansion as was in 2016, with a new maximum clamping force machine of 2300 tons.

Today, the company has 28 injection machines, with a clamping force between 50 tons to 1700 tons. Megatech in Marinha Grande has the following production technologies:

- Conventional and gas injection;
- Laser marking;
- Two injection components (bimaterial) in one 350 tons and another 1000 tons injection machines;
- Automatic assembly of components.

1.3.4. Organizational structure

Nowadays (2019), Megatech Industries Marinha Grande has 113 employees and has eight departments:

- Controlling;
- Human Resources;
- Production;
- Maintenance;
- Quality;
- Logistic;
- Methods;
- Projects.

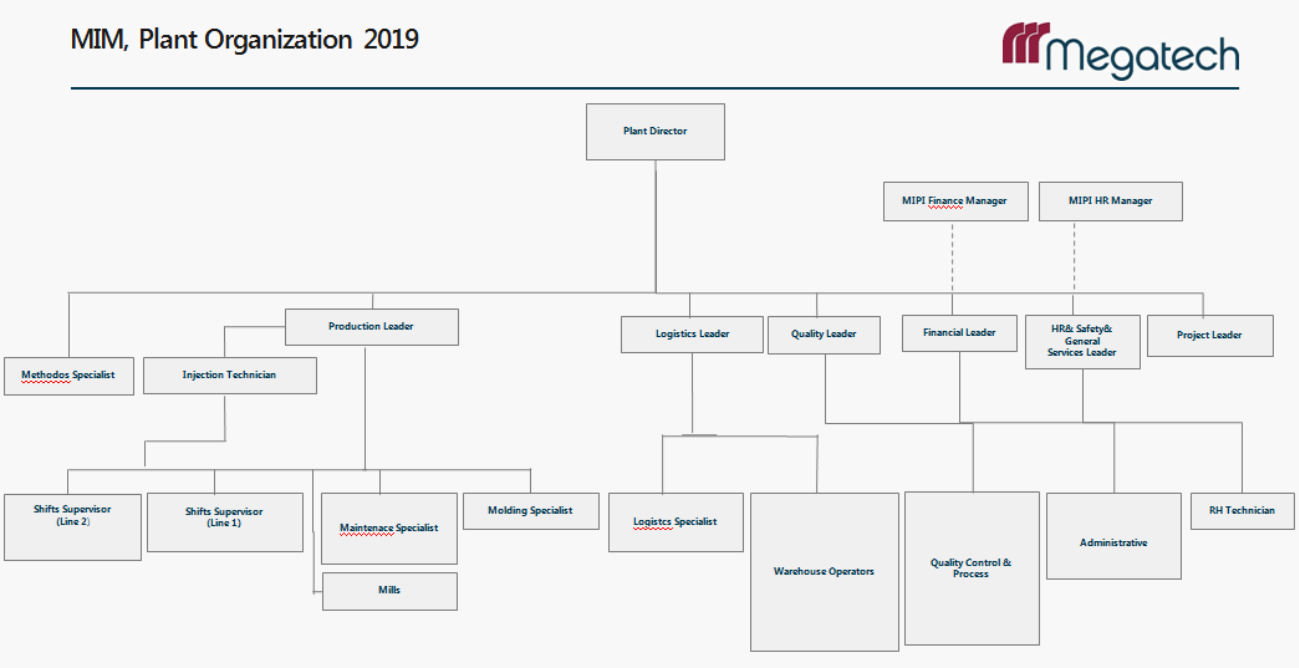

FIGURE 1.5 - MEGATECH INDUSTRIES MARINHA GRANDE PLANT ORGANIZATION

The company in Marinha Grande is managed by a plant director who answers to a person in charge of the plants in the Iberian Peninsula, given that it is a very large organization, there are several hierarchical levels.

It is also visible in this organization chart that there is a financial officer from MIPI (designation for the group of factories located in the Iberian Peninsula), in addition to the financial officer of MIM. Because of this structure it is possible to conclude that there is a very strict management by the organization to ensure that the objectives are properly accomplished.

1.3.5. Analysis of the processes

The company has a 24 hours' production, starting at 9 p.m. of Sunday to 9 p.m. of Friday, with three eight hours shifts. Megatech in Marinha Grande has 28 injection machines, all operational, where the assembly of small components, when necessary, are done in the respective machine that injects the part. There are also two areas where it is doing the quality control.

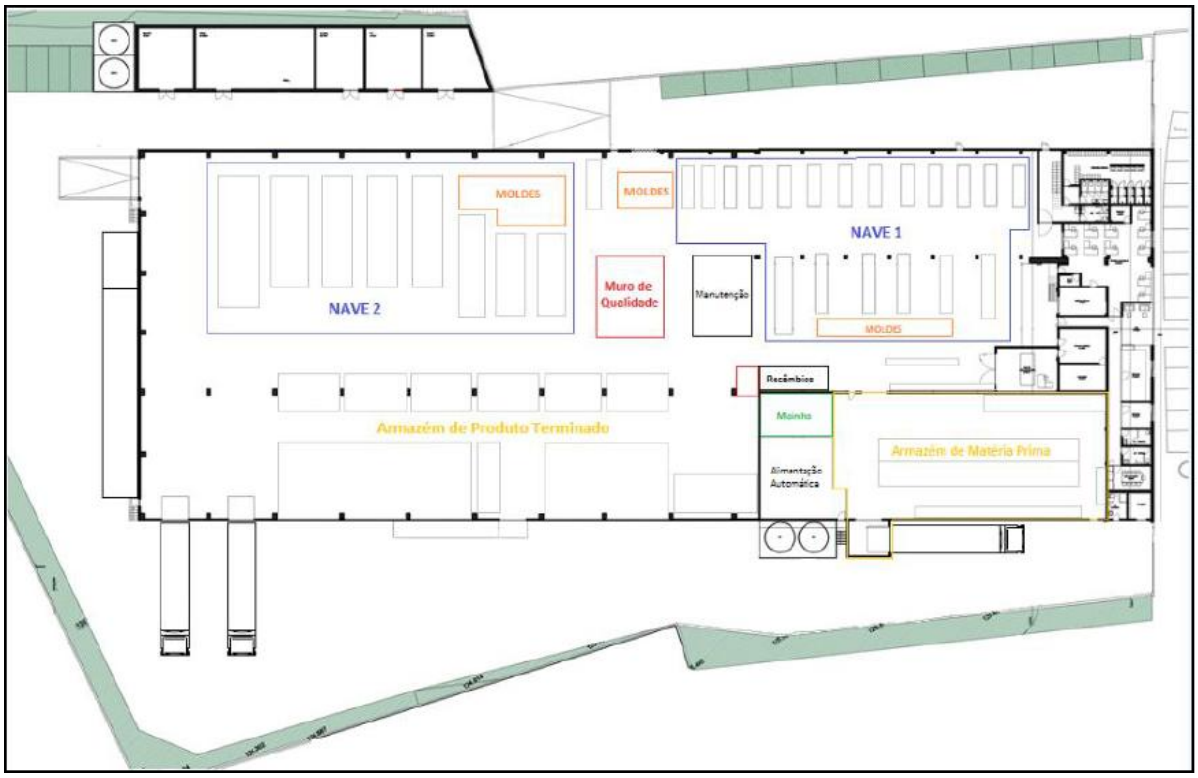

FIGURE 1.6 - MEGATECH INDUSTRIES MARINHA GRANDE LAYOUT

The factory has two production lines, "Nave 1" and "Nave 2", having the first one the older machines with a clamping force between 50 tons to 660 tons. "Nave 2" has injection machines with a clamping force between 250 tons to 1700 tons (Figure 1.6).

Figure 1.7 shows the material flow in the production process, since raw material reception to expedition.

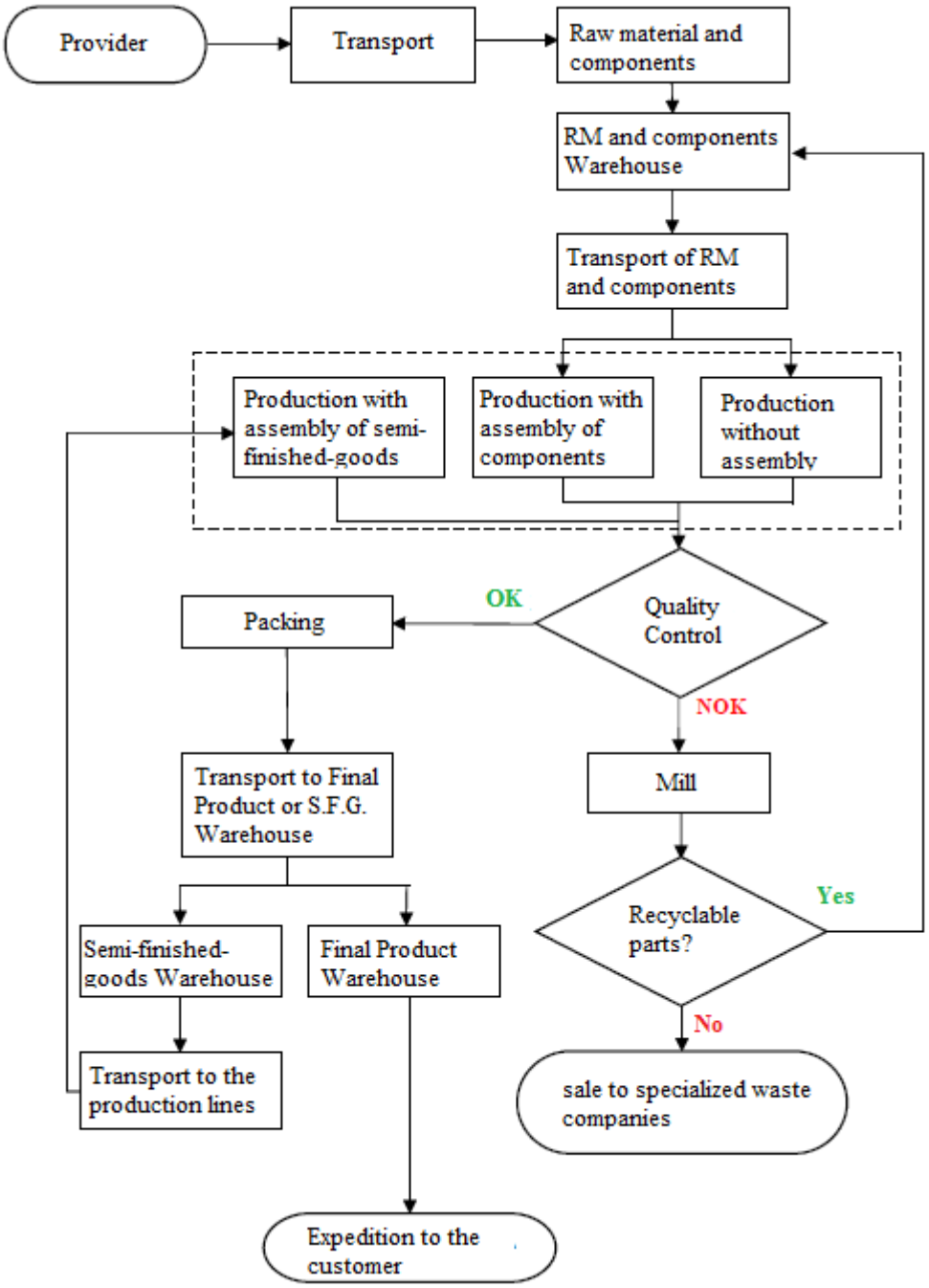

FIGURE 1.7 - FLOWCHART OF MATERIALS' FLOW BETWEEN PROCESSES

1.3.6. Quality Department

This chapter describes the department where the author did the internship.

During the time spent in the company, it was possible to understand how the quality department works in terms of information flow and response to situations, as well as its entire organization.

This department has a hierarchal organization that is presented in the Table 1.1, in descending order of hierarchy.

TABLE 1.1 - ORGANIZATION AND HIERARCHY OF QUALITY DEPARTMENT

Function	Hierarchy
Quality Manager	1
Quality and methods technician	2
Quality control	3
Metrology technician	3
Trainer	3

Quality department has every day at 9:15 a.m. a meeting, where the team discuss the daily quality problems, analyze indicators and show new ideas. (Figure 1.8)

FIGURE 1.8 - EAP QUALITY DEPARTMENT

1.3.6.1. Quality Wall management

Quality wall is an area where it is doing some type of parts inspection. The quality wall is necessary in case of internal and external quality problems and when new projects are launched. The management of the Quality Wall should be done with a connection among Quality department, Production department and Logistic department.

The quality wall may work during the three shifts, depending of the amount of parts that must be inspected (Figure 1.9).

There are some rules to respect during the inspection (Annex I):

- The operator just inspects one reference at the time;
- There is a work flow that must be respected;
- The quality wall doesn't do rework;
- If some part need some type of rework, it should be done by another person and, further, the part is again inspected by the quality wall operator;
- The parts that are ok must have a green label.

FIGURE 1.9 - MEGATECH MARINHA GRANDE'S QUALITY WALL

The quality wall operator must respect the 5S standards (Annex III) and keep the work station organized and cleaned.

Figure 1.10 shows the quality wall management steps that must be taken into account when a quality problem happens.

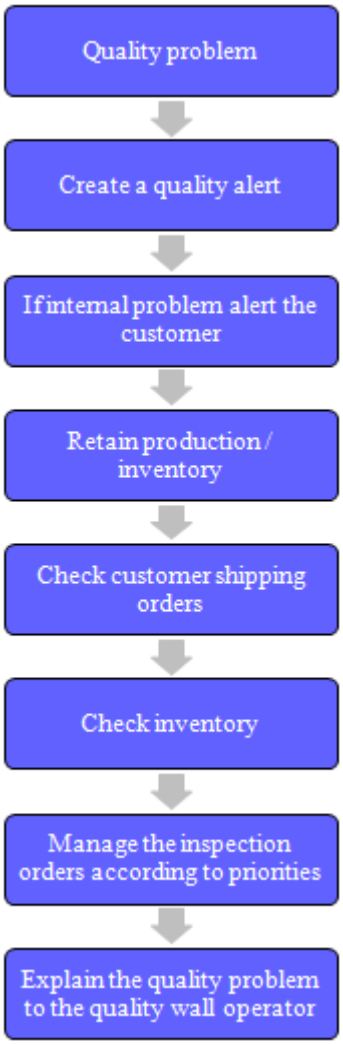

FIGURE 1.10 - QUALITY WALL MANAGEMENT STEPS

The inspection orders list (Annex I) should be updated at least one time per day, or more if necessary. It is sent an email to the warehouse with the list of the parts that should be provided to the Quality Wall.

Quality Wall (QW) operators should follow the inspection list priorities, according to the daily loads, and record the quantity that was inspected, the quantity of ok and not ok parts, the batch, inspection time and date of inspection. All the parts that were inspected should have a green tag with the QW operator number and date, on the product label. All the documentation (quality alert, quality control instructions, packaging instructions) related to the part that is being inspected should be at the workstation and be consulted and the standards respected. After the inspection, the QW operator should revise the pallet with a RFID portable device, according to a work instruction (Annex II) and, then, with a hand pallet truck, putting the pallet in the entry warehouse area.

1.4. Structure of the Report

The report is organized in four chapters, whose includes the following sections and subsections:

- The first chapter is about the introduction, where is presented the subject background, the objectives to reach, the methodology adopted, the organization of the report as well the company group and the factory where the internship was developed and describes the quality department, where the author performed his functions and the quality wall, where is done the inspection of suspected parts;
- In the second chapter, it is presented the state of art, in the academic and business way, about the internship theme, beginning with the concept of quality and its importance, the quality wall meaning, ending with the Lean philosophy;
- The third chapter is about the improvements done, like standardization of the process, border line changes, visual management implementation and machine's cycle time reduction; it is also about to show the impact of this improvements, in terms of costs.
- The last chapter, in the fourth, are presented final conclusions about the internship and future objectives to pursue in the company.

2. State of art

This chapter aims the introduction of the concepts used in this report, which is based on the Quality subject; so, it is necessary to define quality, its evolution since the early 1900's until these days and the problems and procedures to avoid and react them. Beyond this, they are defined some concepts about Lean philosophy, as the seven types of waste (*mudas*).

2.1. Quality concept and its importance

On the way to be a successful company, the Quality concept plays a very important role. In order to satisfy the customers, the products and services they purchase must be as they expect. As said before, it is very important to identify what are the product requirements for the customers; based on this, companies can answer easily and have a better quality management.

In industry, quality means *best for satisfying certain customer conditions* (Feigenbaum, 1991). Feigenbaum also say that *Important among these customer conditions are (1) the actual end use and (2) the selling price of the product or service*. In turn, these two conditions are reflected in 10 additional product and service conditions:

1. The specification of dimensions and operating characteristics;
2. The life and reliability objectives;
3. The safety requirements;
4. The relevant standards;
5. The engineering, manufacturing, and quality costs;
6. The production conditions under which the article is manufactured;
7. The field installation and maintenance and service objectives;
8. The energy-utilization and material conservation factors;
9. The environmental and other "side" effects considerations;
10. The cost of customer operation and use and product service.

So, the concept of quality depends on what the customers expect and satisfy them. For example, *a punch-press manufacturer in upstate New York was faced with two alternatives in the manufacture of a 4-inch washer. On the one hand, the company might use a stock die and standard materials to produce a washer that would sell for 1/4 cent but whose quality could not be guaranteed for any conditions of excessive load or temperature. On the other hand, the company might purchase a special die and special materials to produce a washer which would sell for 2 cents and which could be guaranteed for high-load and elevated-temperature conditions.*

The customer for the washers, who was contacted by the manufacturer's sales department, had an application where load and temperature conditions were of no consequence but where price was very important. The manufacturer's decision, therefore, was in favour of the 1/4-cent washer, made from standard materials, which became the company's "quality" product and whose requirements were reflected back into the product conditions for the factory. (Feigenbaum, 1991)

After defining the product requirements, raw materials/components and all the conditions associated, the next stage is the production. In order to guarantee satisfactory results is necessary to control the production. For that, quality control (Q.C.) plays a fundamental role. Q.C. is defined as *a process for delegating responsibility and authority for a management activity while retaining the*

means of assuring satisfactory results. (Feigenbaum, 1991). According to this author, usually there are four steps in such control:

1. *Setting standards* - Determining the required cost-quality, performance-quality, safety-quality, and reliability-quality standards for the product;
2. *Appraising conformance* - Comparing the conformance of the manufactured product, or the offered service, to these standards;
3. *Acting when necessary* - Correcting problems and their causes throughout the full range of those marketing, design, engineering, production, and maintenance factors which influence user satisfaction;
4. *Planning for improvements* - Developing a continuing effort to improve the cost, performance, safety, and reliability standards.

2.1.1. Evolution of Quality Control

Quality control was not always as we know; in the last century it has evolved a lot with the intensive industrial development. According to Feigenbaum (1991) we had:

In the nineteenth century, quality control was based on the inherent manufacturing job; the operator was responsible for the manufacture of the entire product, having total control of the work - *operator quality control*.

In early 1900s starts the large-scale modern factory concept. At that time, the quality responsibility has changed; if in the century before each operator had self-control and were grouped by similar tasks, being directed by a foreman who assumed the responsibility for the quality of their work - *foreman quality control*.

During the World War I, the manufacturing turned out a more complex system, from a small group of workers to a large group whose were leaded by a foreman. Based on that, the foreman could answer every problem and, then, the first full-time inspectors appeared, what was called *inspection quality control*. This step peaked in the large inspection organizations in the 1920s and 1930s, big enough to be headed by superintendents.

Until the World War II, this type of quality control remained; with the mass production requirements of WWII, it was necessary to take another step in terms of quality control - *statistical quality control*. The difference between the previous program was basically because the inspectors were provided with a few statistical tools, such as sampling and control charts. With the analysis of this data, the big inspections organizations became more efficient.

Small changes on the development of the technical and statistical ideas slowed down the quality-control growth. Due to some decisions based on the recommendations resulting from the statistical techniques were not easy to handle, it was necessary to step up the level the decision making, so it comes up *the total quality control*. This fifth step appeared when companies began to develop a specific decision-making and operating framework for product quality, which was so effective to have a suitable action on the quality-control findings, as well as to permit the companies to obtain genuine results in a better quality and lower costs. With these changes were possible to review designs regularly rather than occasionally, to analyze in-process results and take control action at the manufacturing or the supplier source, and, finally, to stop production when necessary. Furthermore, it provided the structure into which the early statistical quality-control tools could, later, to be joined through many additional techniques of metrology, reliability, quality information equipment, quality

motivation, and numerous other techniques now associated with the field of modern quality control and, also, with overall quality functional framework of the business.

This impact of total quality control on management and engineering practices has provided foundation for the evolution in the decade of the 1980s and, beyond of *total quality control organization wide*, *total quality management*, and *quality as major new business strategy*. Quality became as a primary business strategy; so, companies started to be focused on customer-satisfaction quality and cost which brought companies to be profitable. So, with this progress and all the commitment with the engineering, production, and sales, all areas of the companies had positive impact. Figure 2.1 shows this progress, chronologically.

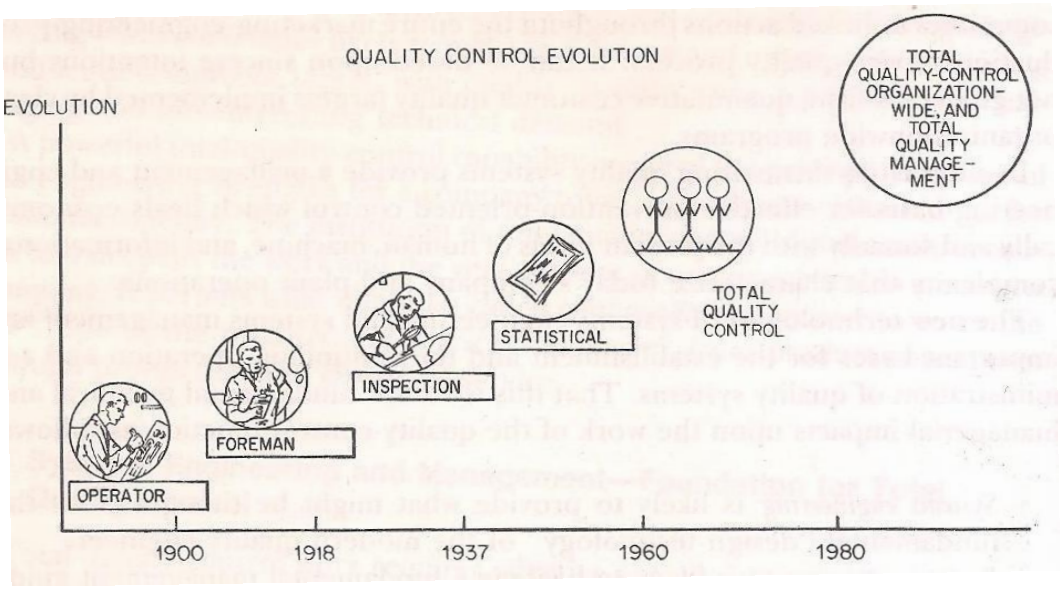

FIGURE 2.1- QUALITY CONTROL HISTORICAL EVOLUTION (SOURCE: TOTAL QUALITY CONTROL)

2.1.2. Total Quality and Certification

A company starts its business aiming to satisfy some customers' needs. The meaning of quality is the success key with their customers; it is what make companies run and to contribute for the society. We can say that the quality is a social function of the company (Pires, 2016).

It is very important to identify the customers' needs, but not enough. It is necessary that every person on the company is committed with the quality, regardless the department. The quality total should be believed by everybody and be part of the product cycle, since the design to the final customer. For that it is necessary to create a culture that allow and promote it.

The total quality can be understood as company's culture that allows to provide services and products able to satisfy the necessities and expectations of the customers, (Pires, 2016).

It is necessary to define the policy and goals, responsibilities, communication channels and follow-up actions as an essential base of relationship rules. This means changes on work mechanisms and problems resolution, carrying out the creation of multidisciplinary workgroups and development of the interpersonal relationship.

A company with total quality culture has five main principles (Pires, 2016) - Figure 2.2:

1. Top management commitment;

2. Customer satisfaction goals;
3. Continuous improvement;
4. Quality as a problem for everyone;
5. Quality economical results management.

This is according to the objectives referred in the Guide of the Quality Management, of the International Organization for Standardization (ISO) - ISO 9000.

First of all, it is necessary to distinguish two groups of the standard:

1. NP EN ISO 9001 - Establishes the requirements that can be used as contractual document. It certificates;
2. NP EN ISO 9004 - Establishes the guides for a development of the quality systems.

So, the ISO 9000 has the next quality management principles:

- Client focus;
- Leadership;
- People's involvement;
- Approach by process;
- Improvement;
- Decision making based on evidences;
- Relationship management.

The benefits of a total quality culture are:

- Customer satisfaction;
- Continuous improvement;
- Elimination of waste;
- Internal customer satisfaction;
- Effective communication;
- Positive attitudes.

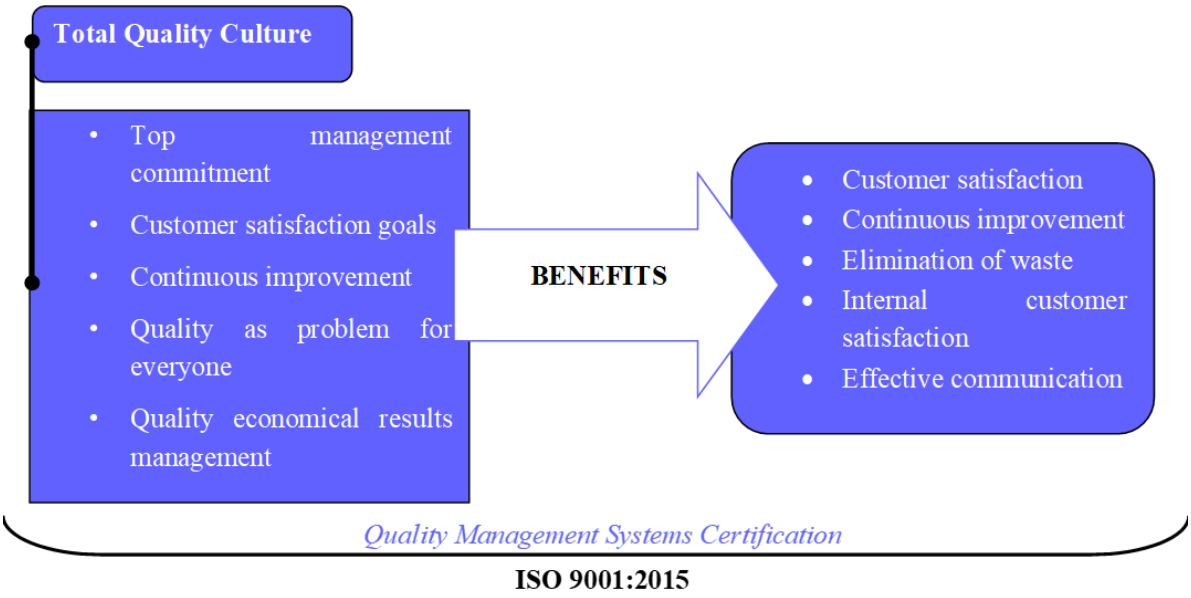

FIGURE 2.2 - TOTAL QUALITY MANAGEMENT

Beyond ISO 9000, there are specific standards for sectors and customers based on it. For example, in the automotive sector, the International Automotive Task Force certifies with IATF 16949:2016. For the German automotive manufacturers and their providers, it is required certification on the VDA 6.x standard. This one is according with the IATF 16949:2016 (Figure 2.3).

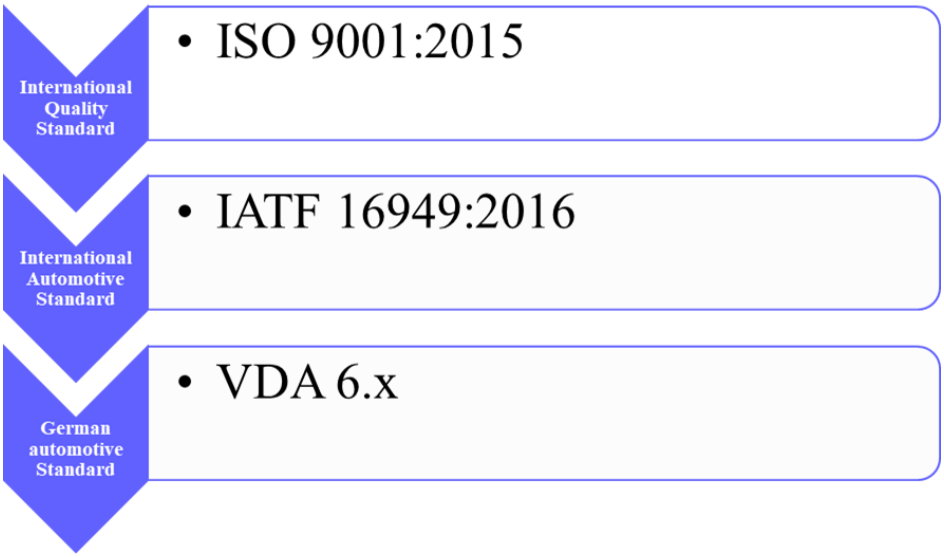

FIGURE 2.3 - QUALITY STANDARDS CERTIFICATION

2.1.3. Quality problems

A good quality control is involved directly or indirectly with all the departments, increasing the company's income. So, an effective control is a must for a successful management.

From the preparation of the raw material to the final product (assuming that the R&D process was done successfully) it is important to minimize and detect errors earlier as possible. The further an error is detected the more expensive is the cost (Figure 2.4).

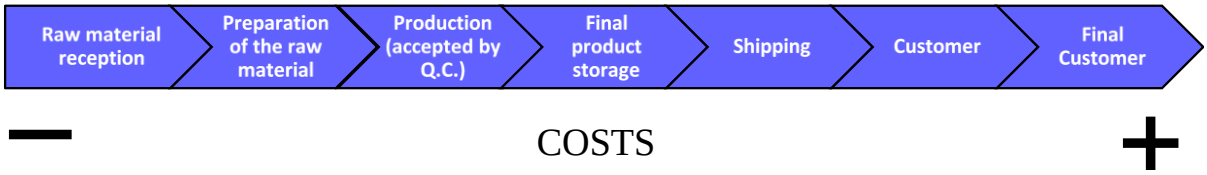

FIGURE 2.4 - QUALITY COSTS PROGRESSION

Along this diagram, we can identify typical errors based on the quality of the product that contribute for a bad company performance.

- *Raw material reception* **-** One of the problems that can occur is the damage on the package, if it is not notified the raw material can be contaminated.
- *Preparation of the raw material* - When we talk about preparation of the raw material, in case of plastic material, there are some types that need to dry before the injection process, mainly, in parts that has good aspect as requirement. In case of the material don't be absolutely dry, it may cause defects in the parts like burn marks and bubbles. It occurs because the material has humidity and happens a chemical reaction between the H_2O molecules and the polymer chain by hydrolysis degrading the plastic. In order to avoid this errors, when the preparation of certain material is done, the technical data sheet of each material must have the time and temperatures of drying, which should be checked.
- *Production* **-** The production starts when the part is validated by quality control. The part must match with the requisites (dimensional, aspect and other technical) that are established by the project. If one the parameters are not *ok*, that value reflects a cause that must be detected and solved. For example, in case of the weight be lower than the reference, one of the causes may be the wrong material. So, the earlier it is detected, less *not ok* parts will be produced, then the cost will be lower and vice-versa. The production is the core of an industrial company; therefore, it is important to have less errors and use the capacity to produce good products.
- *Final product storage* - When the production is finished, the products are stored in the warehouse. The products should be packed correctly in a container that is resistant to weather conditions and do not be damaged easily. If the warehouse has humidity, in the case of carton boxes, and if these are not resistant enough, they may crumble and the products be damaged. Another point, is how the containers or the pallets are stack. The height limit is very important in these situations because of the self-security of the operators, the balance of the stack and the weight that is holding out.
- *Shipping* **-** The transport of the goods can be responsibility from the provider or the customer. The problems that can occur are the late load scheduling and delivery, damaged package or accidents.
- *Customer* **-** When some problem happens on the costumer, it may imply high costs, especially when stops the production, force rework of the parts during production or out of

production (or in the final product). These problems can be avoided if, in the stages before, every problem was detected and solved.

- *Final customer* – The problems at the final customer are very serious, namely when they are in serial productions. We can relate few type of problems: early product degradation; technical problems; environment laws; etc.

2.1.4. Quality Wall

When a problem occurs, the first thing to do is to take containment actions. For example, if the customer detects in his production line a plastic part with an injection defect, he reports to his provider and both take containment actions, sorting in the customer line and sorting all the parts that are in the provider's storage. The specific area that is doing the sorting is called Quality Wall.

The Quality Wall is used to inspect parts due to several reasons like:

1. Part's Development Phase (new projects);
2. Internal production problem;
3. Process problems;
4. New operators that are in formation;
5. Final products with the package damaged.
6. Problem at customer;

Figure 2.5 shows the difference between normal production and production with Quality Wall.

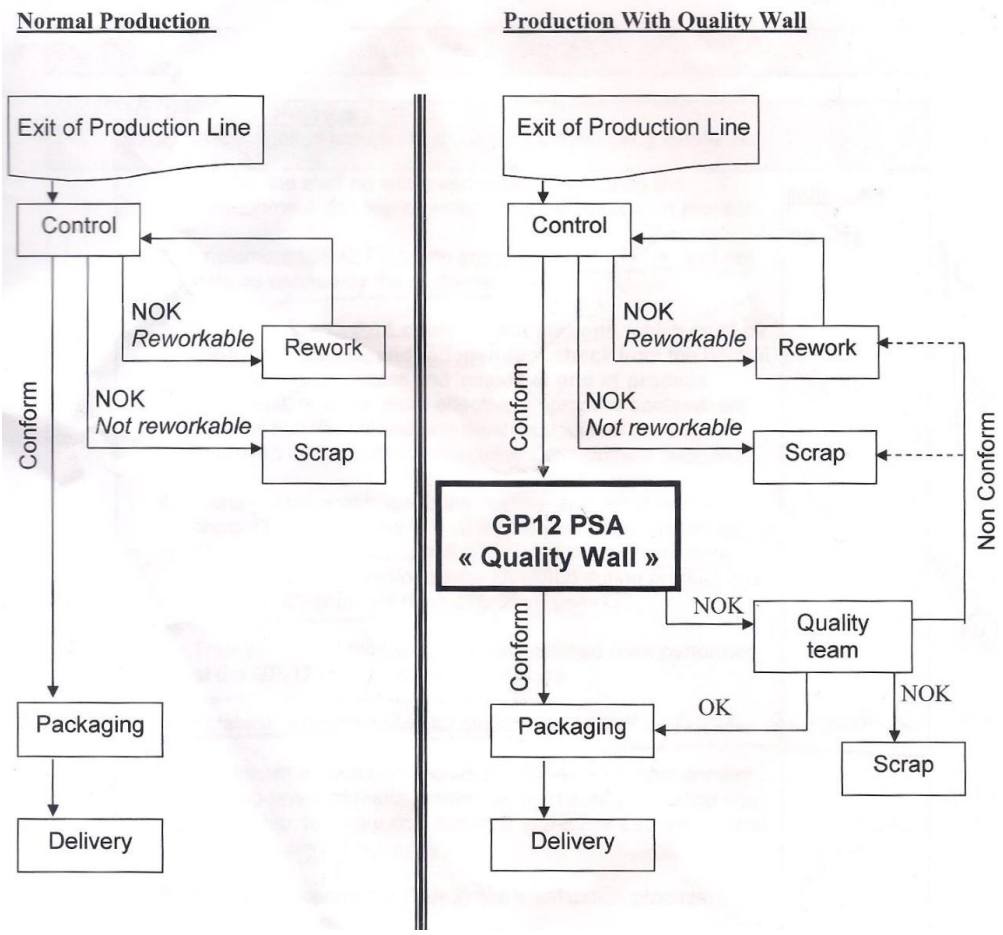

FIGURE 2.5 - NORMAL PRODUCTION *VS* PRODUCTION WITH QUALITY WALL (SOURCE: INTERNAL DOCUMENT)

Although problems/errors may occur during production, when the parts are inspected the quality wall operators must detect that errors; so, aiming to minimize the human error in Quality Wall, the process should be well defined.

The work flow well defined, good inspection work instructions to ensure standardization, examples of OK and NOK parts, customer and internal quality alerts, green labels for the inspected parts, a well-defined work-order and document evidence of the work execution are good elements for an effective quality wall management (Figure 2.6).

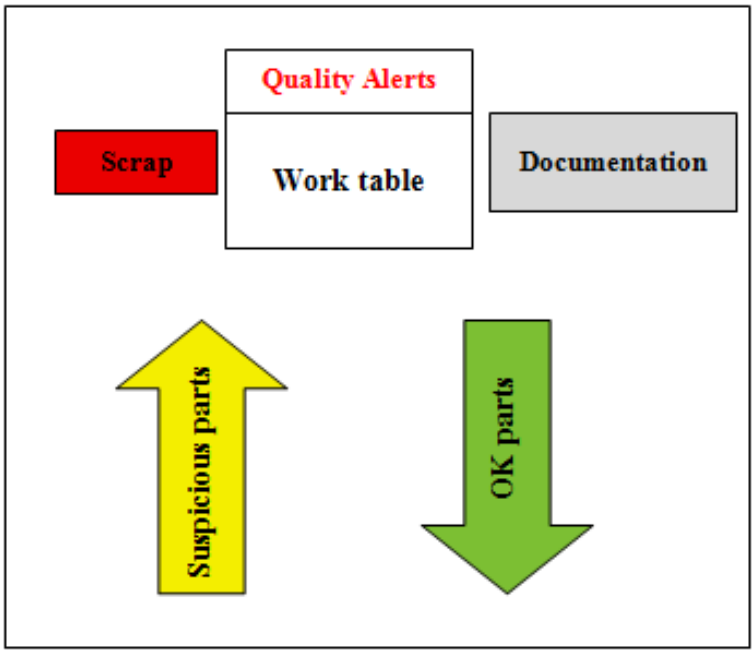

FIGURE 2.6 - QUALITY WALL LAYOUT

The next section talks about the next step to take after the containment actions, and the procedures to take when a problem occurs.

2.1.5. Quality problems reactive procedures

It's normal to occur problems, especially if the parts are new. All of us should learn with that and replicate solutions for other potential cases.

Every problem has one or more causes that should be identified, existing some tools that can be used; one of them is the Ishikawa Diagram, usually also called fishbone diagram or cause-and-effect diagram.

The Ishikawa Diagram was created by Kaoru Ishikawa during the 1960s and it shows the causes of a specific event.

Once identified the problem, there are some categories of causes that are used for the problem (Figure 2.7):

- Method;
- Machine;
- Man;
- Materials;
- Measurement;
- Mother Nature;
- Management.

The next step is to ask "Why does this happen?", associated to the respective category (can be one or more for each "why"). Then ask again "Why does this happen?" and write the sub-causes branching off the causes. Continue to ask “Why?” and generate deeper levels of causes. When the group runs out of ideas, focus attention to places on the chart where ideas are few (Figure 2.8).

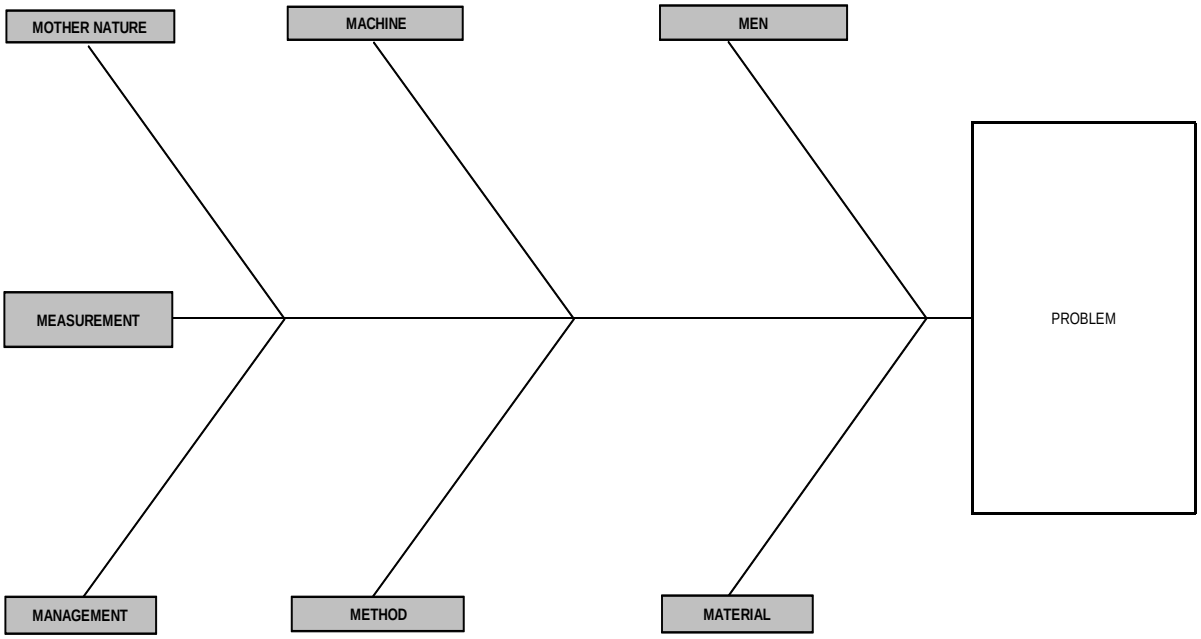

FIGURE 2.7 - ISHIKAWA DIAGRAM

The Ishikawa diagram can be followed by an action plan that has improvement actions, and the responsible that will implement them. These actions should be monitored with Deming cycle, known as PDCA (Plan-Do-Check-Act) that have the objective to eliminate or reduce the cause effect.

When the action plan is closed, it is a good idea to have a record of the lessons learned and replicate that for further situations.

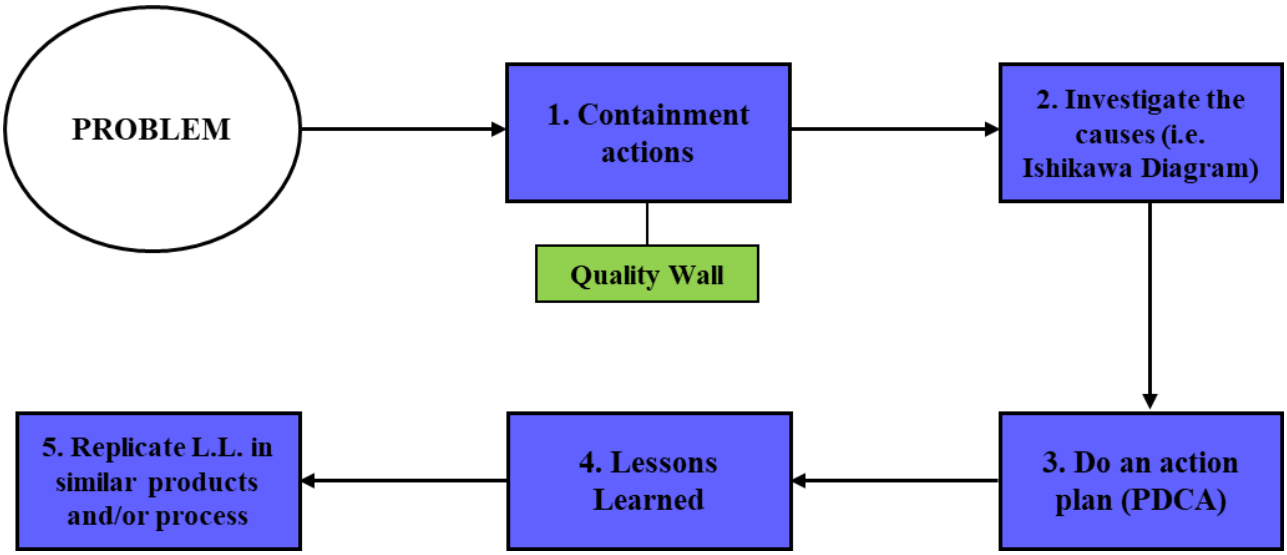

FIGURE 2.8 - PROCEDURES OF THE QUALITY PROBLEMS

2.1.6. How to avoid the Quality Wall?

A profitable company wants profit, that's the reality. For that the earnings should be superior than the costs. With that, every situation that provides unnecessary cost shall be avoided.

The truth is that, Quality Wall is an extra cost, but it is an utopia to remove it. There are situations where it is not necessary to use it, as in pre-series parts or other situation like in the formation of new operators; this last situation may have a lesser impact.

So, as said before in section 2.1.4., there are some situations in which Quality Wall should be used (Figure 2.12):

1. *Part's Develop Phase* - This is a required situation from the client. During the project development and in the initial batches of production, every part must be inspected until in three batches in a row that has no problems detected. This is a fundamental phase to correct mould/product development, process and package problems.
2. *Production problem* - The production problems sources can be from mould or during the plastic injection process. For a good mould performance is necessary to do preventive maintenance (Figure 2.9). So, a good preventive maintenance plan is necessary to avoid further problems that were not planned. Maintenance is fundamental to minimize problems and especially in a strategically way, to avoid reactive actions. So, when a mould has some unexpected problem, for example need to polish, it is included in the non planned Maintenance (Figure 2.10). During the injection process, it is usual to happen some quality problems on the produced parts, like burrs, unfulfilled, burn marks, vacuum voids, etc. The operator should alert the quality control operator when some quality problem appears and the shift leader will solve it, if it is possible.

FIGURE 2.9 - ANNUAL MOULD MAINTENANCE PLAN

FIGURE 2.10 - MOULD WORK MANAGEMENT

3. *Process problems* **-** As said before, process problems can trigger off further problems and, consequently, expensive costs. So, during work, every possibility of error from the operator should be eliminated. It is necessary to respect 5S philosophy, do the work standardization and eliminate the unnecessary. Other problem is when are parts that need an assembly machine and that machine is not working or with problems; when that happens the operator do manual assembly (i.e. Poke-Yoke) and it is necessary an afterwards inspection. Maintenance has an important role when we talk about equipments. To support the maintenance planning (Figure 2.11), the methodology of FMEA can predict some problems and trace preventive maintenance plans. Thus, when preparing preventive maintenance plans, the FMEA will serve as the basis for solving possible problems / failures in the equipment, managing to combine maintenance with good asset management**.**

FIGURE 2.11 - ANNUAL EQUIPMENTS MAINTENANCE PLAN

4. *New operators that are in training* **-** No one has a lifetime job; one day it will end; then, new people come in and need the right training. The big problems are with people. In order to have a solid company, it is important to have stability among the different departments. So, when we talk about quality problems, the high operator turnover is not good for that. To solve this, the goods should be "grabbed" and "less good" should be dismissed if possible.
5. *Final products with the package damaged* **-** During the product handling at the warehouse incidents may happen. The reasons for that are distraction, inexperienced operator or others. Immediately, after the incident occurrence, the quality control should be alerted and the product should be identified with a red tape, and, further, be inspected.
6. *Problem at customer* - Problem at costumer means that quality control has failed (apart from when it is a problem occurred during the transport). The reasons this happen are: unstable productions; non-detected wrong material changes and/or contamination; non-detected process problems; operators with lack of formation; and new problems that were not identified previously.

Part's Develop Phase
•Good I&D mould •Robust Process •Right Package choice •Process well defined
Production problems
•Stable productions •Good preparation of the raw material •Respect of the process •Good operators •Preventive machines and equipments maintenance •Preventive mould maintenance
Process problems
•5S philosophy •Standardization •Eliminate waste •Preventive maintenance of assembly/detection equipments
New operators in formation
•Reduce hiring rotation •Hold the good workers
Final products with the package damage
•Height pill restrictions •5S philosphy •Respect the standards
Problem at customer
•Good Quality Control •Good detection of problems

FIGURE 2.12 - HOW TO REDUCE QUALITY WALL COSTS

2.2. Lean Thinking, Waste and Standard Work

Standardization guides us to the Lean Thinking philosophy, which has as objective people, process and systems development, with the purpose of the reduction or elimination of the waste across the organization and added value to all stakeholders (Pinto, 2014).

Waste corresponds to all activities that are done and don't add value. These activities have the name of "muda" because they consume resources and time. So, it is an extra cost that increase the price of the products and services. According to Taiichi Ohno there are seven waste categories: excess of production; waiting time; transport and movements; waste of the self process; inventory; defects; unnecessary work (Figure 2.13).

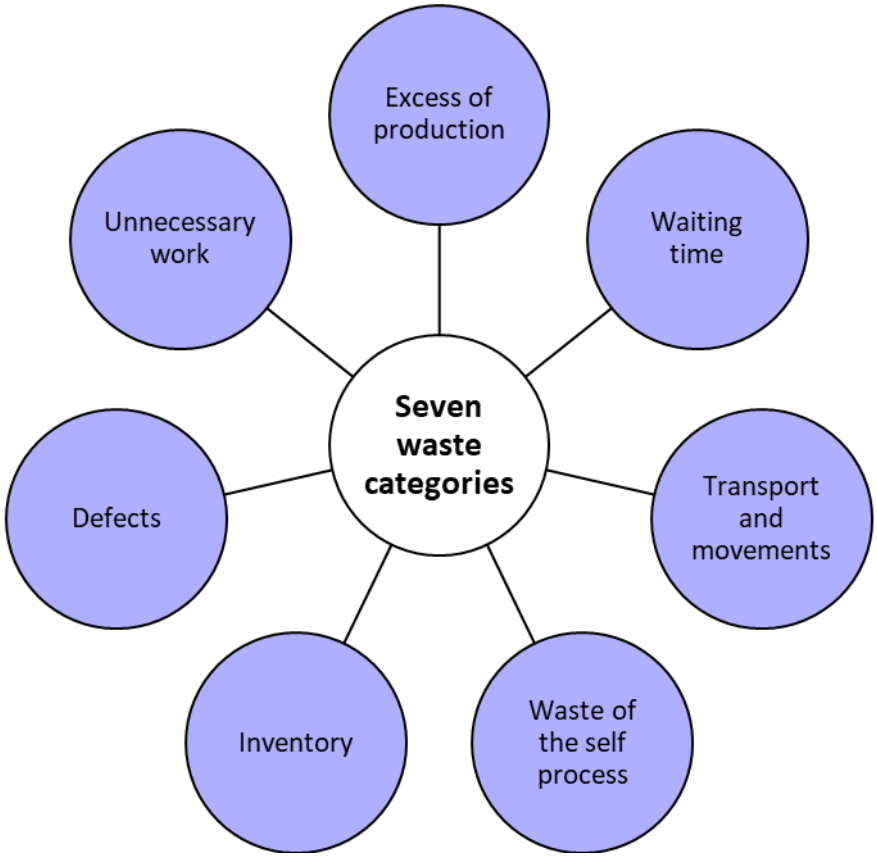

FIGURE 2.13 - SEVEN WASTE CATEGORIES

These types of waste should be aware of everyone in the organizations.

1. *Excess of production* **-** This waste happens when is produced more than the necessary, when is not necessary. It is the opposite of Just in Time. Long production batches and production anticipation with the expectation of sale may causes waste.
2. *Waiting time* **-** It refers to the waiting time of an equipment or a person. Layout problems imply delays or problems, as well as wrong production planning are examples of causes of this type of waste.
3. *Transport and movements* - Transport is any movement or transference of raw material, semi-finished-goods or final product from a place to other one for some reason, (Pinto, 2016). During the transport may occur incidents that damage the products; so, to reduce the transport and movements it is necessary to refine layouts, change the operation planning and use transport systems more flexible.
4. *Waste of the self process* - In this point, all the operations and processes that are not necessary are waste. Lack of formation and/or standardization, increasing number of defects are causes of wrong and waste processes (Pinto, 2016).
5. *Inventory* **-** In the modern times, inventory is considered stopped money. It takes up space, increase the probability of damaged goods and incidents. A way to find waste is to look for where tend to exist inventory.
6. *Defects* **-** A product with quality is the one "with conformity with the specifications" (Crosby, 1979). So, if there are any product that don't respect the customer specifications it has a

defect. It represents an extra cost, especially because of sorting and/or rework. Human errors cause defects. When they occur customers complain which increase the inspection and, consequently, the inventory (it is a snowball effect).

7. *Unnecessary work* **-** Operators movements that are not really necessary to execute the operation. Some causes are: incorrect workstation layout, lack of formation, non-motivated operators and isolated operations.

Standard work means that everyone do the same work with the same operation, in the same sequence and with the same tools.

The advantages are: increasing of the process predictability; reduction of deviations; and lower costs. Standard processes contribute to a continuous improvement (Pinto, 2014).

The Standard work has three basic elements:

- *Cycle time* - The required time to finish each productions stage;
- *Production sequence* **-** The best sequence of operation that accomplish a task;
- *Work in progress (WIP) level* **–** The maximum inventory that flows throughout the multiple operations, when the process occur without variability.

3. Standard Work and Line Design Workshop

During the internship the author participated in Kaizen's workshop, *Standard Work and Line Design.*

The workshop had a leader and a respective team, as Table 3.1 shows.

TABLE 3.1 - STANDARD WORK AND LINE DESIGN TEAM

Workshop Leader	Team
Quality Manager	**Francisco Penas** (Author) **Trainer** **Engineer of Methods and Process** **Methods Technician** **Chief and quality control** of the shifts

The initial actions were about auditing the present level of the situation, like the piloting injection machines, the cycle time of each part and the Overall Equipment Effectiveness (OEE).

During the workshop they were established some goals with the support of A3 tool. Figure 3.1 shows an example of an A3 sheet, with its phases.

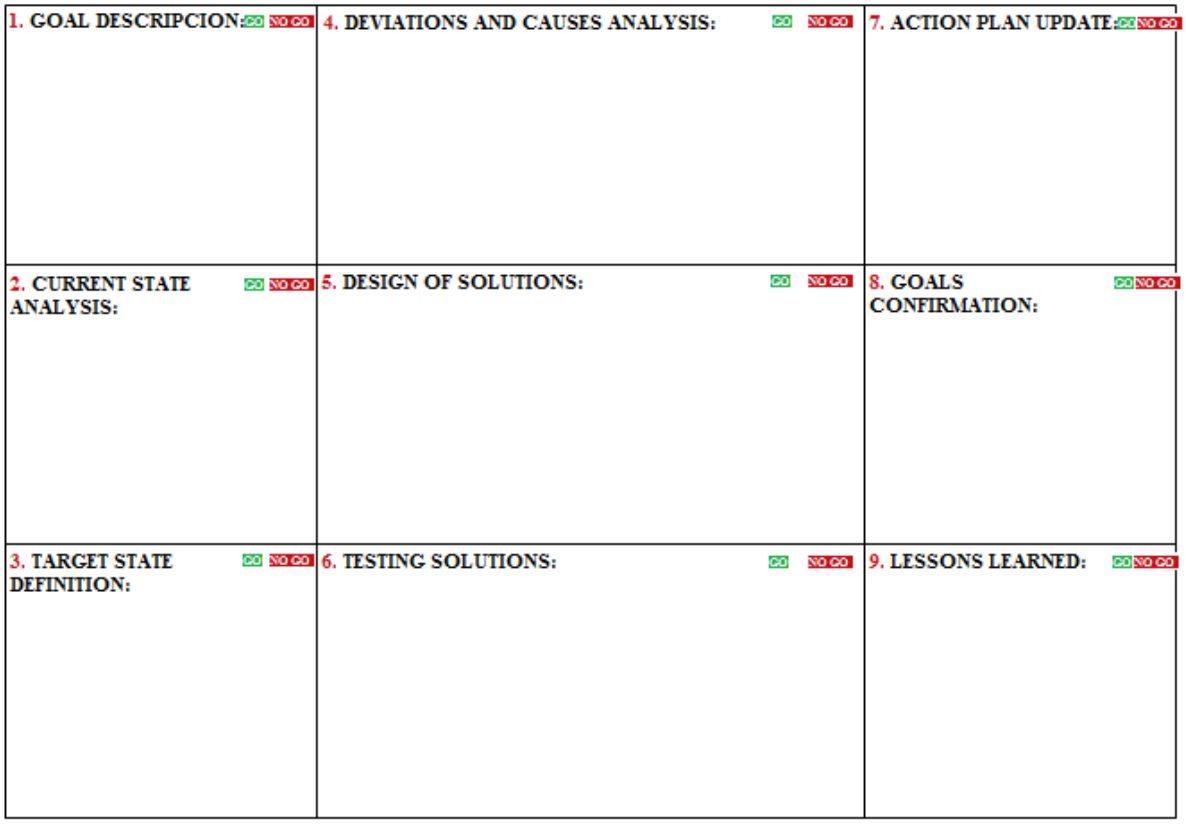

FIGURE 3.1 - A3 SHEET

Standard work and line design workshop had the support of ideas from all the team members and too from the production operators thought out the PPDCA (Figure 3.2).

PPDCA, proposal, plan, do, control and act, is based with the operators' ideas. Every time an operator has a new idea, it is recorded and further analysed by the department managers. This ideas can be to improve workstation and process, to have better work conditions or any benefit to the company and the operator's work. With this PPDCA, everyone is integrated and can do his own contribute to a continuous improvement.

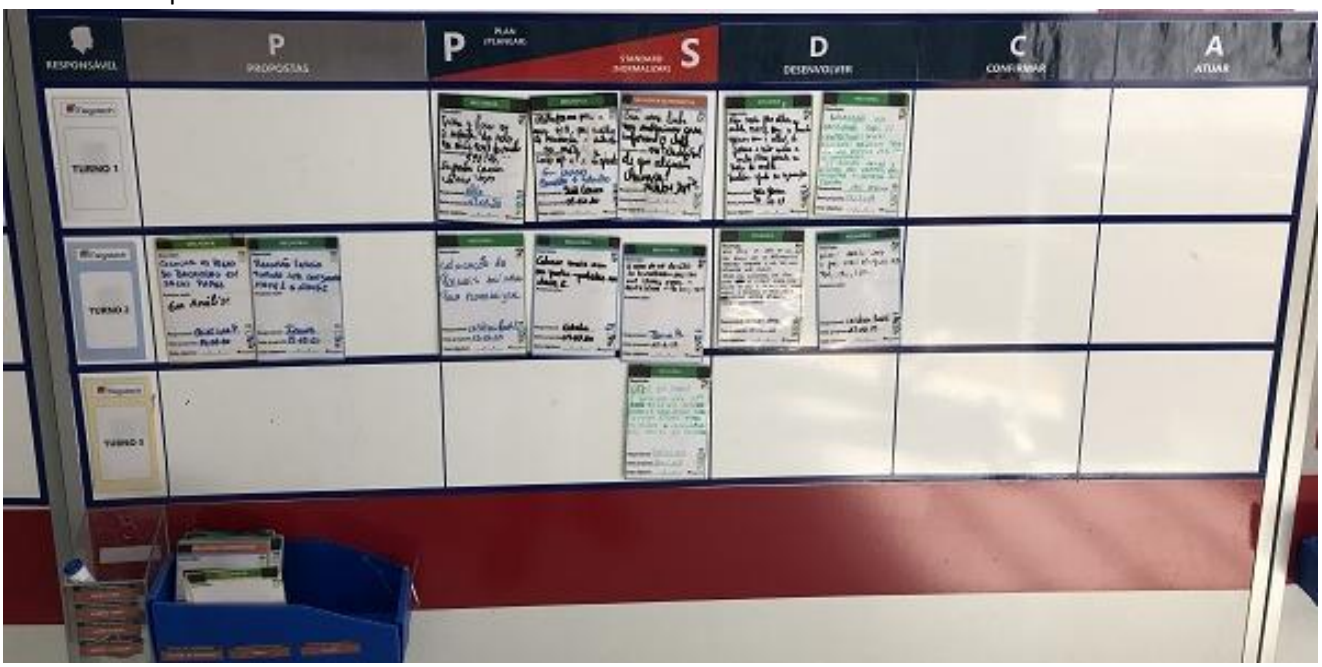

FIGURE 3.2 - PPDCA

The ideas from PPDCA that could be applied in this workshop were analysed and had the possibility to be implemented.

The Overall performance is measured through the KPI expressed by Equation (1), which represents the impact of the actions that were taken.

$$\frac{Labour\ Cost}{Production\ Cost} \quad (1)$$

3.1. Machine 351

Along the year, this machine produces the same type of part, same mould, "A", but with two versions: The version that has more occupation, 85%, produces the reference "A1"; The other version, with 15% occupation, the reference is the "A2". Both versions produce left and right side parts.

In machine 351 there were made some improvements:

- Workstation improvements;
- Modification of the component (2 mm internal diameter wider - Figure 3.5);

- Reduction of the machine's cycle time with quality assured.

3.1.1. Workstation improvements

In the initial state they were identified some improvements opportunities. The operator had to perform a lot of movements, had to self-supply and the workstation had a lack of visual management (Figure 3.3).

FIGURE 3.3 - MACHINE 351'S WORKSTATION BEFORE

As Figure 3.4 shows, there were made some changes: Logistics supplies all components; the layout had some adjustments to reduce movements; it was implemented a visual management approach.

FIGURE 3.4 - MACHINE 351'S WORKSTATION AFTER

3.1.2. Component modification

In the assembly operation of some components, the operator had some difficulty, apart from the stress that it causes, the losing time was a problem. So, the solution that the team found was the modification of the component, increasing the internal perimeter, 2 mm wider (Figure 3.5).

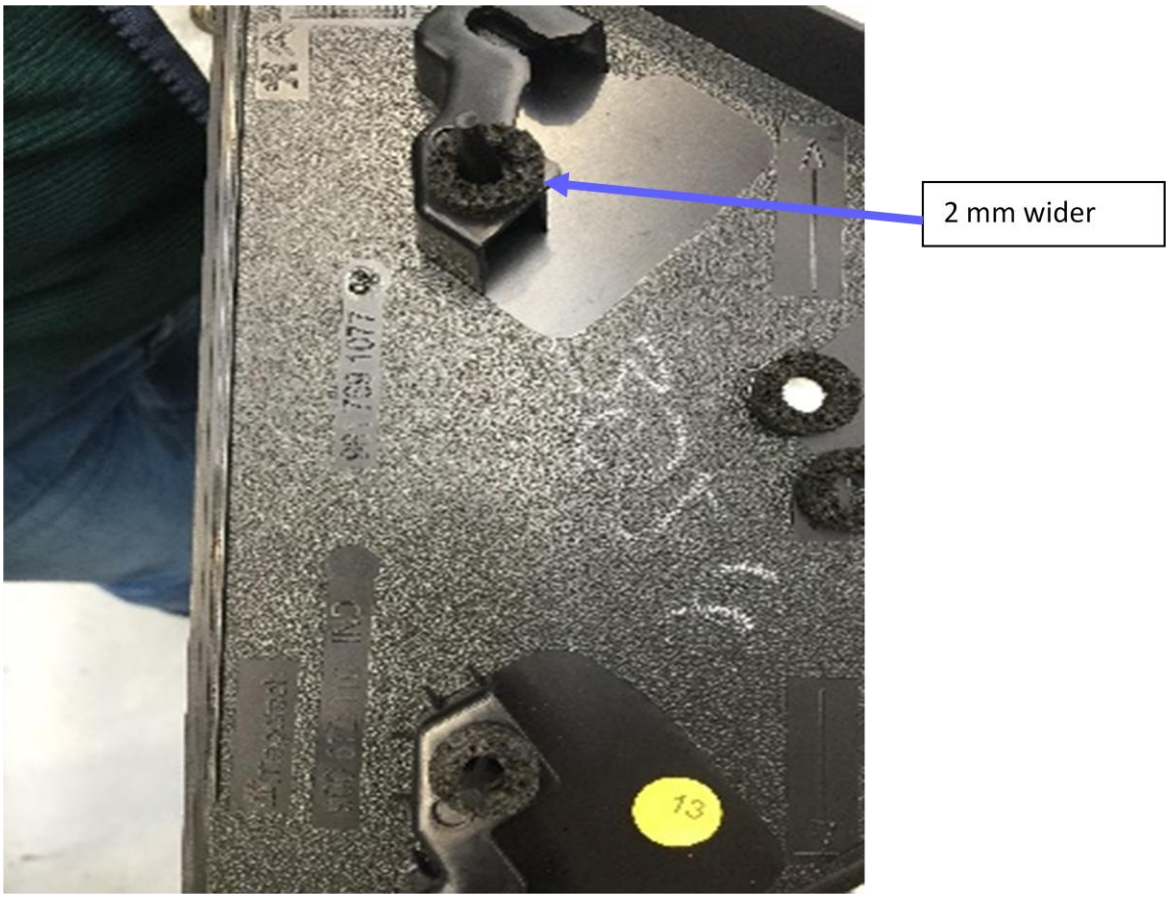

FIGURE 3.5 - COMPONENT MODIFICATION

This modification allowed the operation to be easier than operation with the previous diameter, which improved the time of assembly.

3.1.3. Machine's cycle time

With all the improvements that were made, it was possible to reduce the cycle time of the machine, with the quality of the part assured. That impact represents 13% reduction in the cycle time (Figure 3.6).

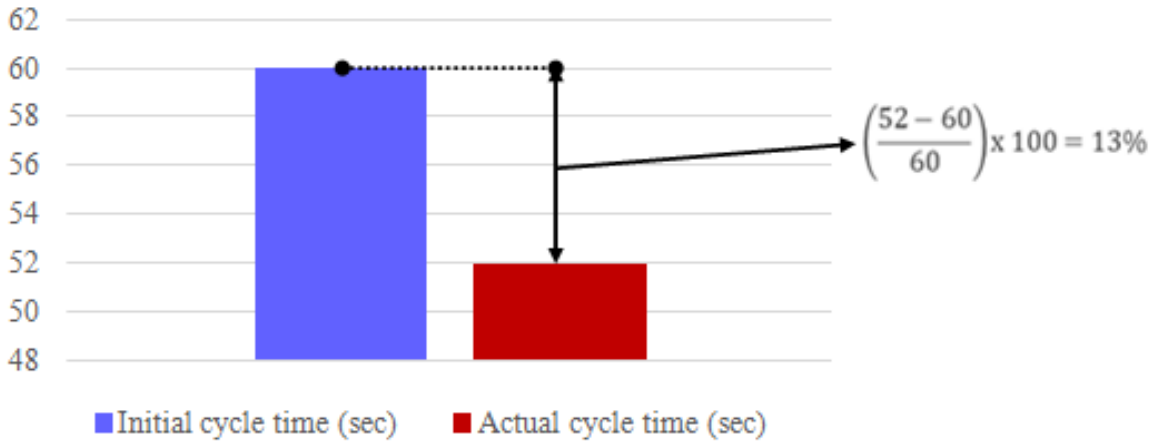

FIGURE 3.6 - MACHINE 351'S CYCLE TIME REDUCTION

3.2. Machine 1001

In machine 1001 they are produced two distinct moulds, the "B", and the mould "C"; both have two cavities, at right and left side. Their occupation is different, 34% for the "B" and 66% with the mould "C".

As in the machine 351, there were identified some improvement opportunities in both references:

- Workstation improvements;
- Reduction of the machine's cycle time with quality assured;
- The operator has to take burrs.

3.2.1. Mould "B"

There were some problems: the operator had to perform a lot of movements, had to self-supply the workstation, and had a lack of visual management. Figure 3.7 shows some improvements that were made.

FIGURE 3.7 - BEFORE AND AFTER - REF. "B"

Initially, the components' supply was made directly from the boxes; then, it was designed a rack and the components started to be supplied by logistics.

In relation of the machine's cycle time it was possible to reduce just two seconds, from 72 to 70 seconds, due to quality assurance. This reduction represents about 3% reduction (Figure 3.8).

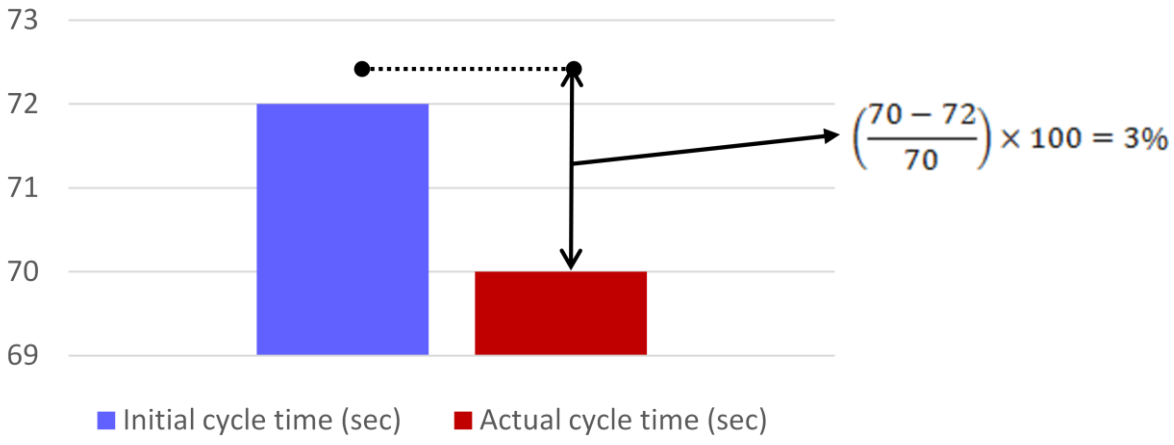

FIGURE 3.8 - MACHINE 1001'S CYCLE TIME REDUCTION - MOULD "B"

3.2.2. Mould "C"

In the production with this mould, they were identified some problems:

- Operator waits for co-worker to activate poke-yoke (he has to activate the two parts simultaneously);
- Operator has to take burrs;
- Operator spends a lot of time opening bags;
- Lack of Standard Work;
- Lack of Visual Management.

There were found some solutions like the adjustment of the layout, poke-yoke separation (one per part), best standard and visual management implementation (Figures 3.9 and 3.10).

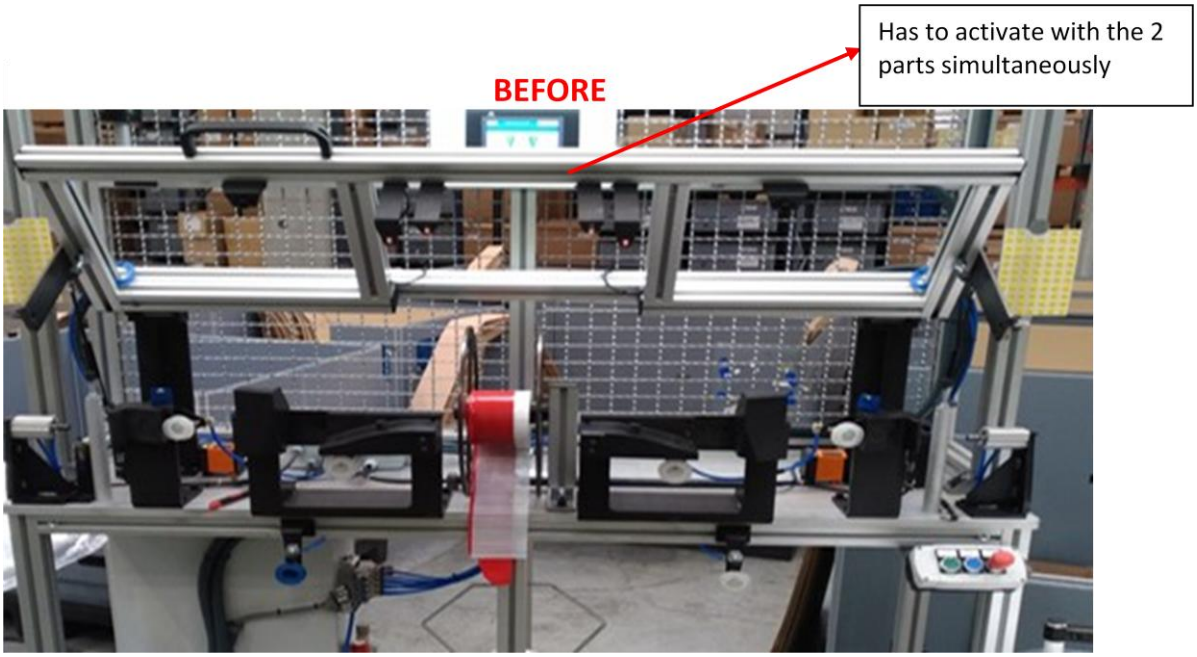

FIGURE 3.9 - BEFORE - REFERENCE "C"

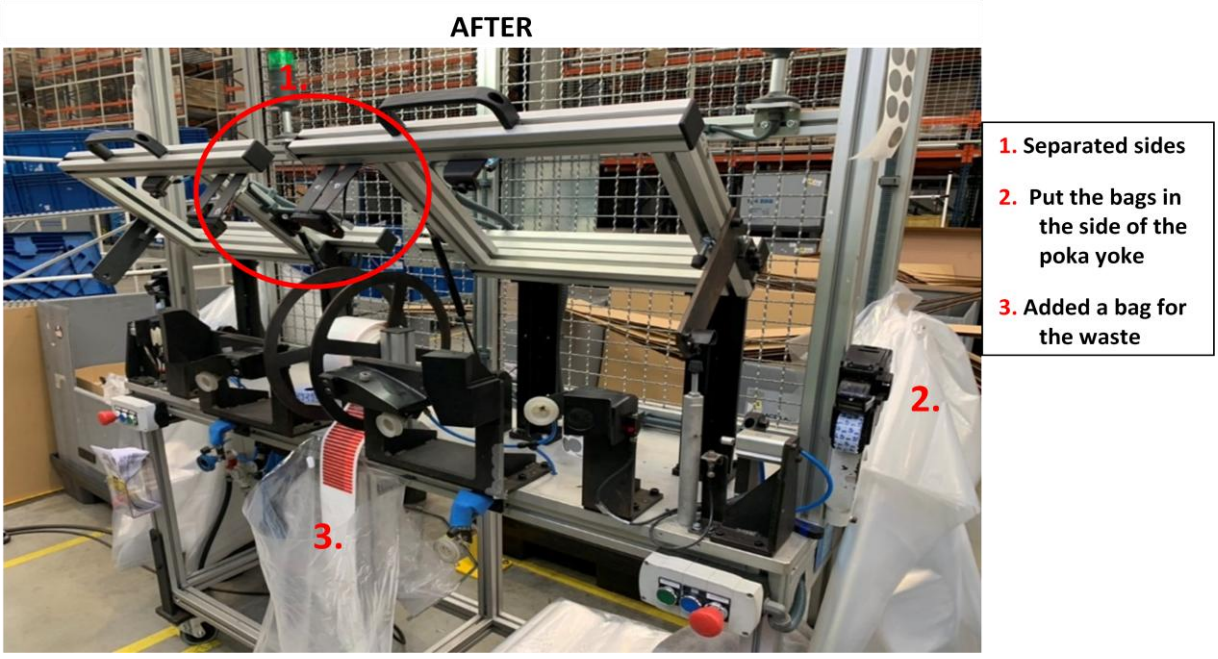

FIGURE 3.10 - AFTER - REFERENCE "C"

This changes allowed the reduction of the machine's cycle time in 10% ensuring the product quality (Figure 3.11).

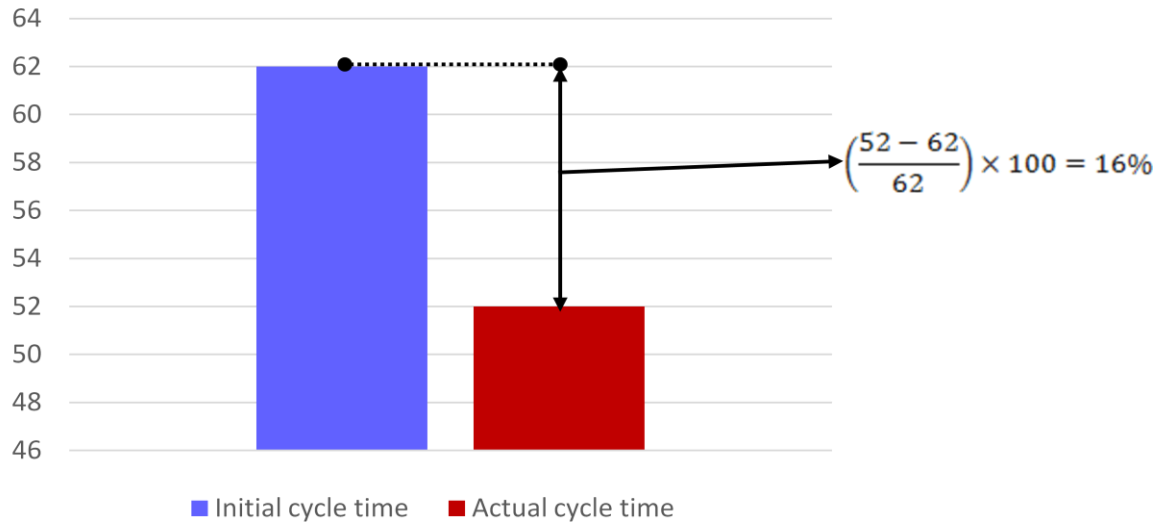

FIGURE 3.11 - MACHINE 1001'S CYCLE TIME REDUCTION - MOULD "C"

3.3. Machine 1002

The mould "D" is entirely dedicated to machine 1002, that has an OEE=100%.

Like in other machines, they were identified similar problems, like lack of standard work and lack of visual management.

In the machine 1002 they were made some improvements:

- Border of line adjustment to the operation;
- Reduction of the machine's cycle time with quality assured.

3.3.1. Border of line adjustment to the operation

The problem of the border line was not adjusted to the operation because the operator had difficulties in his own supply. So, the boxes with components were improved and was added a holder for the bags, making easier the supply movements (Figures 3.12 and 3.13).

FIGURE 3.12 - MACHINE 1002'S BORDER OF LINE - BEFORE

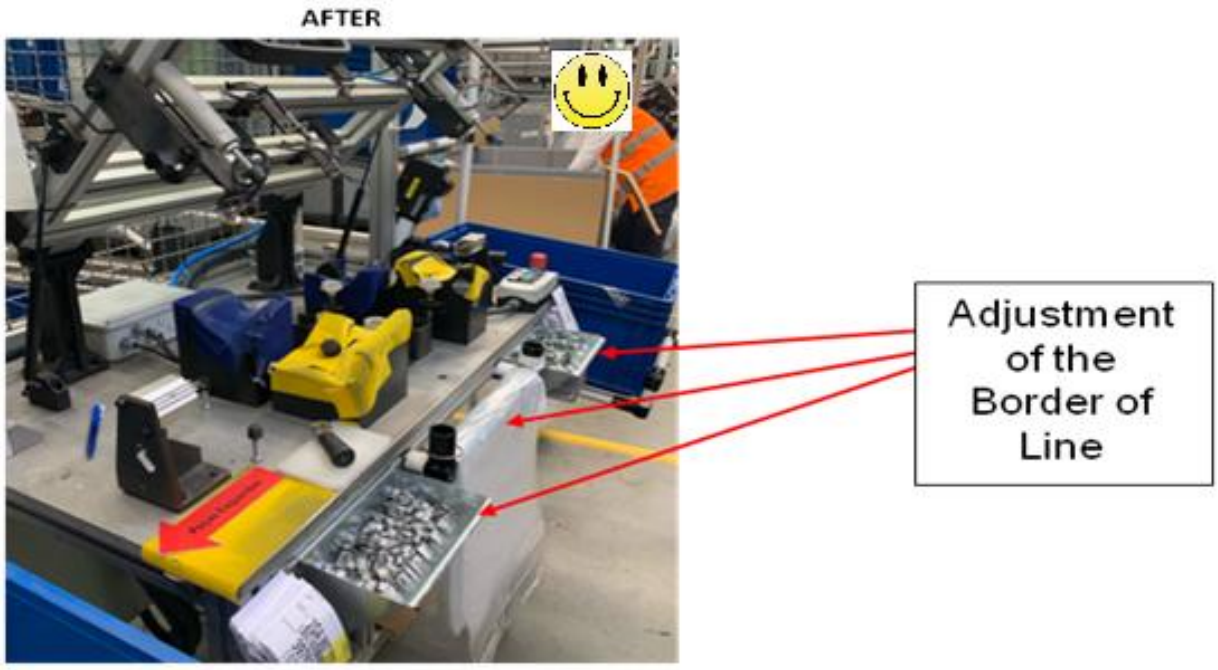

FIGURE 3.13 - MACHINE 1002'S BORDER OF LINE - AFTER

3.3.2. Machine's cycle time

With a new bottleneck found, it was necessary to reduce the machine's cycle time. The machine's cycle time was reduced, first, from 86 to 78 seconds, but the conclusions were that it wasn't possible, because the part did not have the quality requisites assured, for problems related with temperatures. After some tests, it was found a new cycle time of 80 seconds. Based on this, it was

possible to assure the part's quality. It was a good reduction, which is an interesting reduction of 6 seconds (Figure 3.14).

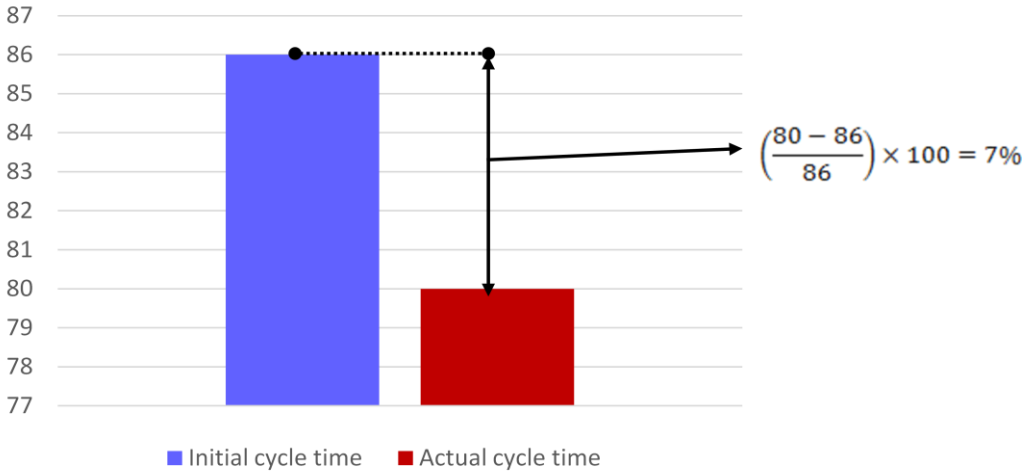

FIGURE 3.14 - MACHINE 1002'S CYCLE TIME REDUCTION

3.4. Machine 1003

In this machine there are produced parts from two distinct moulds: "E" and "F". For both, the processes need one operator and the production of the mould "E" was the focus of the team. After observing the process, packing was the "muda", where the operator had more wasting time (Figure 3.15).

FIGURE 3.15 - MACHINE 1003'S - PACKING BEFORE

In the operation of packing the part is put in a container. Each container has five layers and each layer has nineteen parts, with a total of ninety-five parts per container. In each layer they are used two carton partitions and are necessary four plastic blankets to protect the parts. The operator takes a lot of time to put the plastic blankets, so, the team had to found better solutions.

After a discussion about some ideas, they were found two scenarios:

1. To change the plastic blanket for a plastic roll;
2. To remove the plastic blanks and carton partitions for non-disposable sponge partitions.

In the second option, the difficulties were bigger because they need a contact with the client and further contract changes, so, for the moment it was discarded.

The option of changing the plastic blanket for a plastic roll makes the packing operation easier because the plastic roll has a dimensioned perforation for each layer, like a plastic bag for the fruit; so, the operator just has to pull the plastic in the start of the packing and as he packs the part, the plastic adapts and, at the end of completing the layer just has to cut it (Figure 3.16).

FIGURE 3.16 - MACHINE 1003 - PACKING AFTER

With this improvement, it was possible to reduce the machine's cycle time, from 30 seconds to 25 seconds (Figure 3.17).

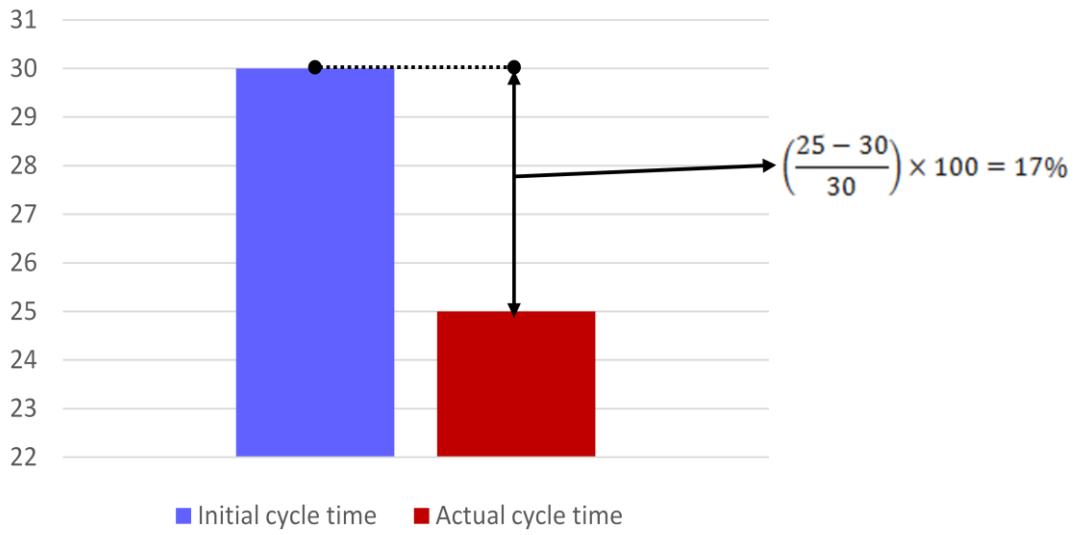

FIGURE 3.17 - MACHINE 1003'S CYCLE TIME REDUCTION

3.5. Overall workshop results

The standard work and line design workshop was very positive; small changes made a really big difference in the company results.

The KPI, direct labour cost / production cost, had a positive evolution as we can see in the Figure 3.18.

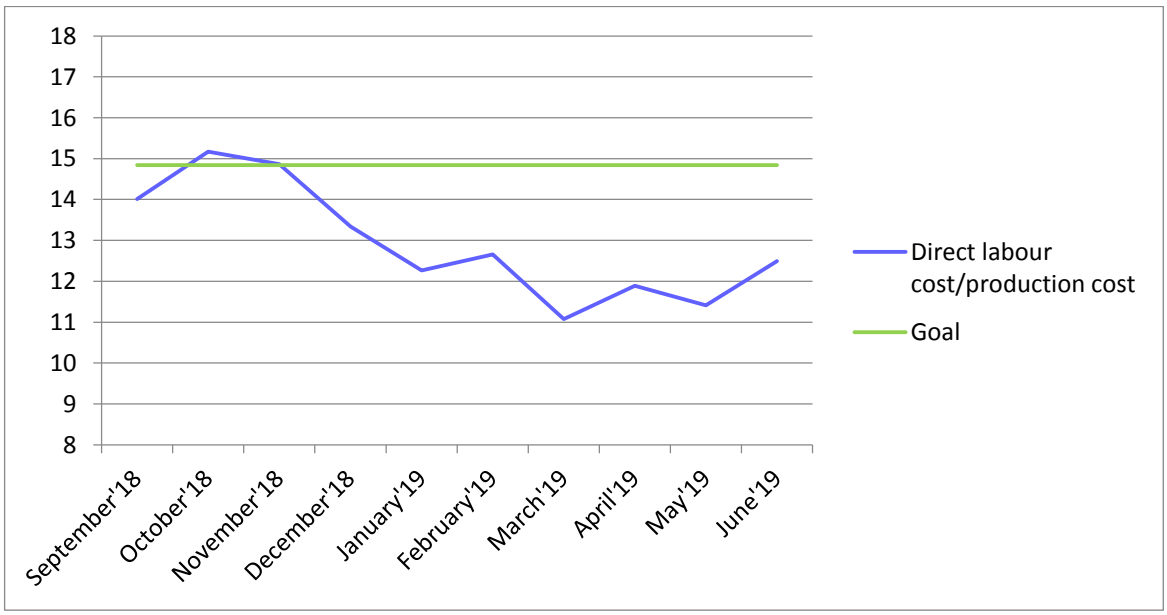

FIGURE 3.18 - CHART KPI EVOLUTION

As we can see, the ratio between direct labour cost and production cost got down as changes in the machines was implemented, what means that they were need less hours of direct labour work to produce the same quantity of parts.

The Table 3.2 shows the impact of the standard work and line design workshop in term of costs by machine.

TABLE 3.2 - MACHINES' COST REDUCTION

Machine	Cost Reduction / Year (€)	Machine's cycle time reduction (sec)
351 - Mould "A"	15.697 €	8 sec
1001 - Mould "B"	3.654 €	3 sec
1001 - Mould "C"	41.180 €	10 sec
1002 - Mould "D"	23.187 €	6 sec
1003 - Mould "E"	15.323 €	5 sec

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4. Conclusions

The Curricular internship of the Master Course in Engineering and Industrial Management, at MEGATECH Industries Marinha Grande, was very rich because it allowed to obtain an experience within the plastics injection industry that, otherwise, would not be possible in the transition from the University to the job market. I consider that it was a great added value for the intern, since, when entering the job market, he already has an idea very close to the reality of the area where he really wants to work, with the shock of entering the world of work being mitigated, since it has gone through this phase before, through the internship.

During the curricular internship was possible to understand how the behaviour of plastic inject affect the quality of the produced parts and with that help to be aware about the defects that can appear.

In the Standard Work and Line Design workshop was possible to do some improvements and consequently obtain saving costs.

Further, the goal is to still doing this work in other machines and standardize the maximum number of references possible, getting better financial results and improve the quality of the processes and workstations.

The work continues in order to improve and reduce quality problems.

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Annexes

On the following pages you will find the annexes described throughout this report:

- Work instruction about the Quality Wall (Annexe I);
- Work instruction about the rfid in Quality Wall (Annexe II);
- Work instruction about Quality Wall 5S Audit (Annexe III).

Annexe I - Work Instruction - Quality Wall

Megatech	INSTRUÇÃO DE TRABALHO MURO DE QUALIDADE	Nº: IT/CC/201 - 04

1.-**OBJECTO**

Garantir que os processos de seleção/verificação no muro da qualidade (muro Q) são efetuados de modo a garantir a qualidade das peças verificadas.

2- Aplicação do Muro de Qualidade:

Aplica-se a todas as peças que tem muro de qualidade fixo. Essas peças são bloquedas automaticamente através do sistema PRC.

Aplica-se a peças no arranque dos projetos novos, até que se efetuem 3 entregas com zero defeitos ou até acordo com o cliente.

Aplica-se às peças detetadas com algum tipo de não conformidade pelos controladores volantes numa produção em serie.

Aplica-se ás peças devolvidas pelo cliente por motivo de reclamação ou alerta da Qualidade.

04	12.06.2018	Atualizar procedimento	M. Vieira
03	12.01.17	Actualizar procedimento	A.Morgado
02	13.09.16	Actualizar procedimento	A.Morgado
01	06.11.15	Auditoria de Cliente (adequar o material associado ao procedimento)	A.Morgado
00	05-05-2013	Criação da Instrução	
I.MDF.	**DATA**	**MOTIVO DA MODIFICAÇÃO (PÁGINAS AFECTADAS)**	**VISTO RESPONSÁVEL**

EMISSOR RESP.:	**Cargo** Dtor de Qualidade	**Dpto.** CC	**Data / Assinatura**
DIVULGADO A:	Todos na rede informática		

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Megatech	INSTRUÇÃO DE TRABALHO MURO DE QUALIDADE	Nº: IT/CC/201 - 04

3- **MURO QUALIDADE – PROCEDIMENTO**

As peças bloqueadas e identificadas para verificação em muro Q., provenientes:

-diretamente da produção,

-do armazém

-ou provenientes da área de quarentena devido a devolução por parte do cliente devem ser colocadas na zona demarcada a amarelo no muro Q. (zona de entrada).

A inspeção/verificação das mesmas é efetuada na mesa de trabalho, com recurso a dois cavaletes de apoio, onde deverão ser colocadas as caixas com peças a verificar e peças verificadas, sinalizadas por uma placa amarela e uma placa verde respetivamente.

No painel acima da mesa deve constar toda a documentação necessária à verificação da referência (peça) em questão, nomeadamente, gama de controlo ficha de embalagem e alerta(s), caso exista(m). Devem ainda ser colocadas na mesa de trabalho exemplos de peças OK e NOK quando aplicável e/ou sempre que seja possível, exemplificando assim o tipo de defeito que está na origem da necessidade de verificação.

Após a correta verificação das peças, de acordo com o motivo de bloqueio das mesmas, as caixas com as peças OK deverão ser colocadas na zona delimitada a verde (zona de saída) e as peças nas quais foram detetados defeitos (peças NOK) deverão ser colocadas na caixa de peças suspeitas, enquanto aguardam decisão do Técnico de Qualidade ou Controlador Volante durante as respetivas rondas, tomada decisão sobre as mesmas, as peças OK deverão voltar ao fluxo normal e as NOK deverão ser colocadas na caixa vermelha que se encontra debaixo da mesa de acordo com o lay-out definido na ficha de posto.

Por norma as peças verificadas em muro Q. são identificadas pelos operadores com etiqueta verde, onde consta o seu número e a data de verificação das mesmas.

No caso de peças selecionadas devido a alerta ou reclamação do cliente deverá colocar-se identificação específica mediante acordo com o mesmo. Para peças consideradas com muro de qualidade direto, deverá ser adotado o procedimento

Megatech	INSTRUÇÃO DE TRABALHO MURO DE QUALIDADE	Nº: IT/CC/201 - 04

padrão, colocando assim etiqueta de cor verde (identificando o operador que efetuou a verificação e a data da mesma).

Eventualmente, poderá ser utilizada ainda outro tipo de identificação se assim for solicitado por parte do cliente.

Os registos das verificações efetuadas em muro Q. são feitos no impresso MP 5_20 Registos Muro Q. ou no impresso MP 5_22 Controlo de peças rejeitadas em Muro de Qualidade, onde devem constar o número de operador que efetuou a verificação, a quantidade de peças verificadas, quantidade de peças OK, quantidade de peças NOK, lote, tempo despendido e data de verificação.

MURO QUALIDADE – PROCEDIMENTO AO LONGO DO TURNO

Antes de iniciar a verificação propriamente dita os operadores de muro devem analisar a lista de peças bloqueadas verificando as necessidades existentes. Esta lista é disponibilizada pelo Técnico de Qualidade diariamente e encontra-se no painel lateral do muro Q.

1.1-Seguir as ordens definidas na lista de peças bloqueadas em armazém de produto acabado. Estas prioridades são estabelecidas, pelo menos, uma vez por dia com base nas cargas diária, estabelecendo assim uma sequência para os operadores seguirem no seu turno.

1.2 -Em casos específicos de bloqueio de produto suspeito detetado durante a produção em série, os Controladores Volantes podem dependendo do caso em questão ativar o bloqueio automático ou bloquear somente as paletes em questão, desta forma, poderão existir paletes com todos os rótulos ou apenas alguns dos rótulos bloqueados, como pode, eventualmente, acontecer em casos de operadores em treino na produção das peças em causa. Nestes casos os Controladores Volantes identificarão todas as caixas que necessitam de verificação em muro Q. com etiqueta

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Megatech	INSTRUÇÃO DE TRABALHO MURO DE QUALIDADE	Nº: IT/CC/201 - 04

laranja, indicando a referência, lote, motivo da necessidade de verificação e o número do operador em questão. Assim os operadores de muro, neste tipo de situação, deverão selecionar as caixas que necessitam de verificação, analisando com atenção as etiquetas laranja e as indicações dos números dos operadores associados ao problema.

1.3. A partir do momento em que têm as prioridades definidas e as peças disponibilizadas na zona de entrada devem colocar no painel do posto, a documentação necessária, tal como referido anteriormente, a gama de controlo, alerta(s) caso exista(m) e correspondente ficha de embalagem (segundo o Standard 5S).

1.4. Analisar o(s) alerta(s) e gama de controlo para saberem como proceder e quais os pontos criticos a verificar em cada referência.

1.5 Ter sempre em conta que não se podem verificar 2 versões ou 2 lados diferentes da mesma referência ao mesmo tempo, por exemplo, duas versões da peça Cowl Top 5960095100 e 5960095110 ou 5960095100 e 5960095200. Não pode ainda haver verificações da mesma referência verificada por operadores diferentes, em simultâneo, no muro Q..

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Megatech	INSTRUÇÃO DE TRABALHO MURO DE QUALIDADE	Nº: IT/CC/201 - 04

1.6. As etiquetas que compõem uma palete estão associadas a uma matrícula, portanto nunca podem ser combinadas ou misturadas caixas de paletes diferentes, ainda que a sua identificação seja semelhante, em termos de referência e lote, pois cada palete corresponde a uma matrícula definida informaticamente. Nesta matrícula estão agrupados todos os rótulos da palete, estando assim combinados todos os números de etiqueta associados à mesma..

1.7. Ao terminar a verificação em questão os operadores devem efetuar o registo na lista de desbloqueios/registo de desbloqueios anotando o número de etiqueta, lote e referência das peças verificadas, devem ainda realizar o registo das mesmas no Painel de Muro da Qualidade (quadro) identificando a referência, a quantidade verificada, a quantidade de peças com defeito (NOK) no turno em questão, o tipo de defeito e nos comentários devem escrever o número do(s) operador(es) responsáveis pela verificação das peças na produção ou outras indicações úteis.

De seguida, devem movimentar as paletes até aos huecos (espaços) disponíveis no armazém 800 ao lado do muro Q., para que sejam arrumadas pelos responsáveis no armazém de produto acabado. Existe um standard definido com a calendarização das rondas do muro Q. afixado no mesmo, neste estão definidos os horários estabelecidos para o(s) Técnico(s) de Qualidade e Controlador(es) Volante(s) executarem as suas inspeções e as tarefas que devem, obrigatoriamente, realizar, estes deverão esclarecer eventuais dúvidas dos operadores e desbloquear as peças verificadas de acordo com o registo de desbloqueios atualizado.

1.8. Se, eventualmente, no término da verificação de determinada referência existirem caixas vazias, devido a alteração de embalagem e/ou rejeição de peças NOK, os rótulos deverão ser retirados das caixas e entregues a um dos Técnicos de Qualidade ou Controladores Volantes para posterior eliminação.

1.9. Ao terminar a verificação de cada referência proceder ainda ao respetivo registo em local apropriado para o efeito, nomeadamente, nos impressos de controlo de peças rejeitadas em muro de qualidade (impresso MP 5_22), constantes dos dossiers de cada cliente ou no impresso Registos Muro Q (impresso) MP 5_20), entregues no final de cada turno ao Técnico de Qualidade responsável pelo muro ou colocados na caixa de Resultados de Registos de Muro.

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Megatech	INSTRUÇÃO DE TRABALHO MURO DE QUALIDADE	Nº: IT/CC/201 - 04

Em caso de eventuais dúvidas sobre uma peça, guardar a mesma na caixa das peças suspeitas até à ronda seguinte, onde um dos Técnicos de Qualidade ou Controladores Volantes deverão esclarecer as mesmas ou comunicar aos superiores aguardando a tomada de decisão sobre as mesmas.

Deverão ser cumpridos sem exceção os critérios de escalada no caso de encontrarem peças NOK.

Recados" do muro da qualidade, uma peça de cada defeito encontrado no painel de peças NOK, assim como o posto limpo e organizado, de acordo com o definido no standard 5S para o muro Q. assinalando a verde, amarelo ou vermelho se foram cumpridos todos os pontos chave definidos no mesmo ao longo do turno e registando o número de operador e data do dia de trabalho em questão, atestando que todos os requisitos dos 5S foram cumpridos.

4-3- Antes do término do turno deixar toda a informação escrita no "Caderno de Recados" do muro da qualidade, uma peça de cada defeito encontrado no painel de peças NOK, assim como o posto limpo e organizado, de acordo com o definido no standard 5S para o muro Q. assinalando a verde, amarelo ou vermelho se foram cumpridos todos os pontos chave definidos no mesmo ao longo do turno e registando o número de operador e data do dia de trabalho em questão, atestando que todos os requisitos dos 5S foram cumpridos.

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Megatech	INSTRUÇÃO DE TRABALHO MURO DE QUALIDADE	Nº: IT/CC/201 - 04

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Megatech	INSTRUÇÃO DE TRABALHO MURO DE QUALIDADE	Nº: IT/CC/201 - 04

2 – Periodicamente (de acordo com o definido na ata da EAP Qualidade), um dos Técnicos de Qualidade ou Controladores Volantes realizam as rondas do muro Q. em concordância com os horários estabelecidos para executarem as suas inspeções, analisando também as peças NOK e os registos efetuados no painel, atualizando, desta forma, a Ata da EAP Qualidade em conformidade com as ocorrências.

3 – Em caso de quaisquer dúvidas em casos excecionais de urgência para as cargas, por exemplo, os operadores deverão chamar sempre um dos Técnicos de Qualidade ou Controladores Volantes, para examinarem as peças de acordo com as suas suspeitas.

5.- **DEPARTAMENTOS AFECTADOS**

QUALIDADE
PRODUÇÃO
LOGÍSTICA

6.-**MATERIAL ASSOCIADO**

Visual Standard – Muro qualidade

Ficha de posto – Muro Q.

MP 5_20 - Registo Muro Q

MP 5_22 Controlo de peças rejeitadas em Muro de Qualidade

IT-CC-019-1 Criterios de escalada-1

LISTA PEÇAS BLOQUEADAS EM ARMAZÉM

IT – Disponibilização de Peças Muro

IT – Bloqueio Produto Acabado

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Annex II - Work Instruction - RFID Quality Wall

Megatech	**INSTRUÇÃO DE TRABALHO** **REVISÃO PRODUTO ACABADO – RADIOFREQUÊNCIA MURO DE QUALIDADE**	**FOLHA 1/17** **Nº: IT/CC/221**

1.-**OBJETO**

Definir o modo e as condições aplicadas para a revisão de produto acabado (PA) pelos operadores do muro de qualidade.

2.-**CAMPO DE APLICAÇÃO**

Aplica-se sempre que as peças se encontram com muro direto, quando são detetados problemas na produção em série ou quando existem suspeitas sobre o produto, em caso de alerta e/ou reclamação do cliente ou devolução do cliente, tendo de ser necessariamente verificadas em muro de qualidade. Nesta sequência ao entrarem no processo normal de armazenamento de PA deve ser efetuada uma revisão específica pelos operadores de muro de qualidade. Deste modo informaticamente será efetuada uma recolha de dados significativa para a definição de medidas de controlo de defeitos.

01	07-01-2019	Atualização do procedimento de verificação com defeitos retrabalháveis	M. Vieira
00	21-09-2018	Atualização do procedimento de desbloqueio	M. Vieira
I.MDF.	**DATA**	**MOTIVO DA MODIFICAÇÃO (PÁGINAS AFETADAS)**	**VISTO RESPONSÁVEL**

EMISSOR RESP.:	**Cargo** Dtor de Qualidade	**Dpto.** CC	**Data / Assinatura**
DIVULGADO A:	Todos na rede informática		

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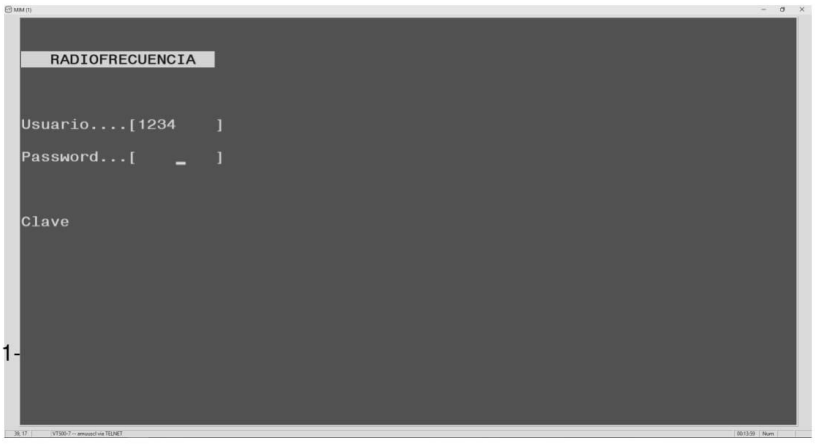
Megatech	**INSTRUÇÃO DE TRABALHO** **REVISÃO PRODUTO ACABADO – RADIOFREQUÊNCIA MURO DE QUALIDADE**	**FOLHA 2/17** **Nº: IT/CC/221**

3. PROCEDIMENTO DE REVISÃO DE PA NO MURO ATRAVÉS RADIOFREQUÊNCIA

Os operadores devem efetuar a revisão do trabalho efetuado em muro com recurso à pistola de radiofrequência sempre que possível. Para esse efeito os operadores de armazém PA devem seguir a instrução de trabalho de disponibilização de peças ao muro Q. colocando o produto acabado sempre no armazém 845, informaticamente, pois caso contrário não será possível efetuado o registo de verificação do mesmo.

1- Fazer com o login ***rfmumim*** relativo ao muro de qualidade, tendo cada departamento o seu, por exemplo, rfmpmim para o armazém de matéria prima.

De seguida deverão inserir o seu usuário (1234) e respetiva palavra pass.



1-

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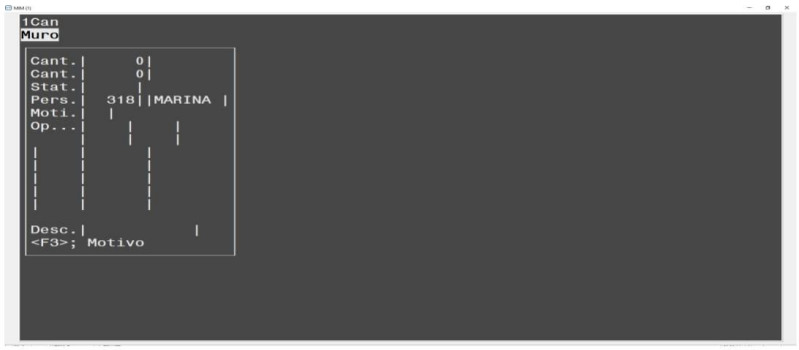
Megatech	INSTRUÇÃO DE TRABALHO REVISÃO PRODUTO ACABADO – RADIOFREQUÊNCIA MURO DE QUALIDADE	FOLHA 3/17 Nº: IT/CC/221

2- Escolher a opção (1) Muro e carregar na tecla ENTER,

3- Apontar a pistola para a etiqueta a revisar e carregar na tecla amarela que se encontra na parte de baixo do manípulo da pistola para ler o código de barras com a pistola de radiofrequência, aparecendo toda a informação sobre a referência automaticamente, devem então confirmar se todos os dados no ecrã estão OK.

VERIFICAÇÕES COM ZERO DEFEITOS

4- No campo Cant (designação para quantidade) deverão inserir o número de peças NOK (peças encontradas com defeito), no caso de verificação com zero defeitos deverão manter a quantidade igual a zero (Cant=0) e carregar na tecla ENTER entrando automaticamente no menu apresentado na imagem seguinte.



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Megatech	**INSTRUÇÃO DE TRABALHO** **REVISÃO PRODUTO ACABADO – RADIOFREQUÊNCIA MURO DE QUALIDADE**	**FOLHA 4/17** **Nº: IT/CC/221**

5- Na primeira linha devemos manter a Cant. = 0
6- Na segunda linha o mesmo
7- Na terceira linha o campo Status deverá manter-se em branco
8- Na linha seguinte deverão inserir o número do operador que verificou o produto acabado, sendo apresentado automaticamente o nome de operador.
9- Em função do tipo de verificação efetuada em muro, isto é, motivo de bloqueio deverá ser selecionada uma das opções no campo Moti (designação para Motivo) através das opções F3 (TECLA FUNÇÃO + TECLA 3), onde são apresentadas as seguintes opções:

1. Planeamento
2. Formação
3. Pré-séries
4. Reembalagem

10 -As opções devem ser selecionadas colocando a letra S à frente da opção que se pretende introduzir.

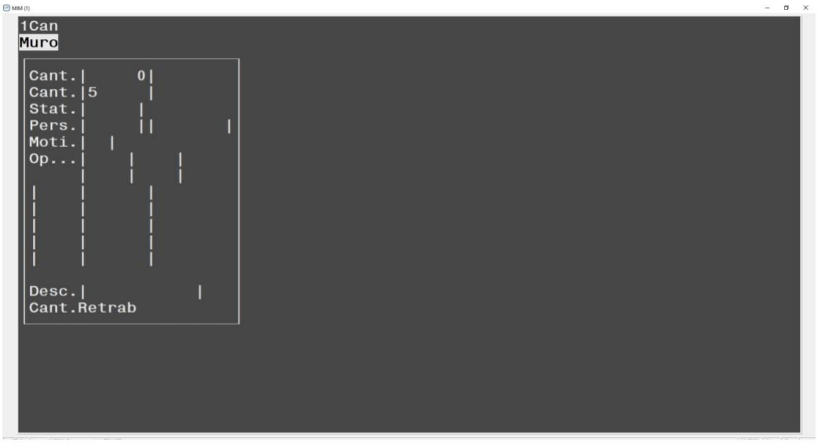
Voltando automaticamente para o menu anterior onde deverá ser guardado o registo efetuado até então selecionando a letra S para gravar ou a letra N para não gravar, caso tenha ocorrido algum erro no menu anterior.

Megatech	INSTRUÇÃO DE TRABALHO REVISÃO PRODUTO ACABADO – RADIOFREQUÊNCIA MURO DE QUALIDADE	FOLHA 5/17 Nº: IT/CC/221

VERIFICAÇÕES COM DEFEITOS RETRABALHÁVEIS

1- No campo Cant (designação para quantidade) deverão inserir o número de peças NOK (peças encontradas com defeito não retrabalháveis), no caso de verificação com defeitos que permitem o retrabalho das peças deverão manter a quantidade igual a zero (Cant=0) e carregar na tecla ENTER.

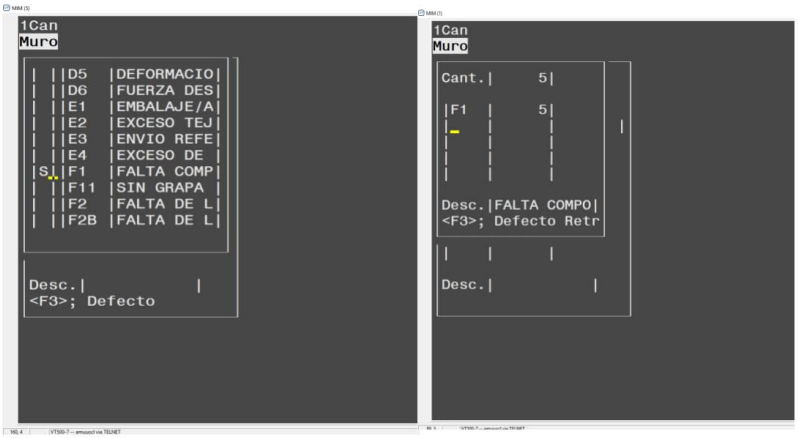
2- Na primeira linha mantemos a quantidade de peças NOK=0 e na segunda linha inserimos o número de peças retrabalhadas, por exemplo, para a ref.ª em causa (11240016300) 5 peças sem componentes, ou seja, estas 5 peças podem ser montadas em muro Q., sendo consideradas na pistola como peças retrabalhadas, esse é o valor inserido na segunda linha no campo Cant (Cant=5). Este **valor é independente do número de peças NOK** registados nos campos anteriores.



Megatech	**INSTRUÇÃO DE TRABALHO** **REVISÃO PRODUTO ACABADO – RADIOFREQUÊNCIA MURO DE QUALIDADE**	**FOLHA 6/17** **Nº: IT/CC/221**

3- Nos campos seguintes o preenchimento é efetuado tal como na verificação sem defeitos até ao menu apresentado na figura abaixo, no qual são atribuídos os defeitos às **peças retrabalhadas** em função de uma lista que poderá ser consultada através da função F3 (TECLA FUNÇÃO + TECLA 3) e impressa diretamente no painel de documentação do muro de qualidade.

4- Neste menu são apresentadas as opções que também devem ser selecionadas colocando a letra S à frente da opção que se pretende introduzir.



5- Selecionar a letra S para gravar ou a letra N para não gravar, caso tenha ocorrido algum erro no menu anterior.

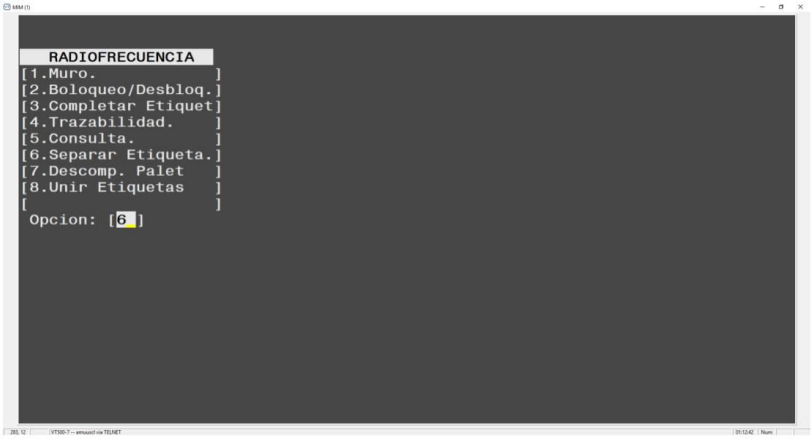
VERIFICAÇÕES COM DEFEITOS

1- O procedimento inicial é semelhante ao anterior, a primeira diferença baseia-se na mensagem apresentada após inserir o número de peças com defeito diferente de zero (peças NOK≠0), **indicando que a caixa deverá ser separada das restantes** para continuar este processo.

Megatech	INSTRUÇÃO DE TRABALHO REVISÃO PRODUTO ACABADO – RADIOFREQUÊNCIA MURO DE QUALIDADE	FOLHA 7/17 Nº: IT/CC/221

SEPARAR CAIXAS DE UMA PALETE

1- Neste sentido deverá retroceder para o menu principal e selecionar a opção 6 para separar a etiqueta.



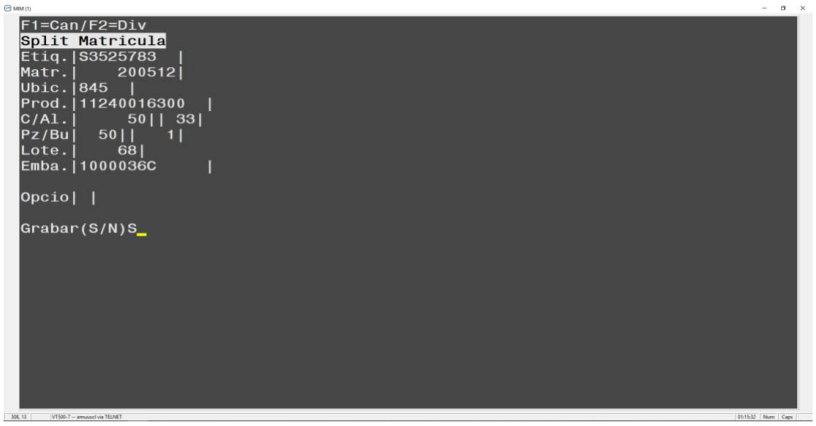
2- Ao selecionar esta opção torna-se a ler o código de barras da caixa em questão aparecendo novamente a informação relativa à mesma devendo utilizar a opção F2 (FUNÇÃO + TECLA 2) para dividir.

Megatech	**INSTRUÇÃO DE TRABALHO** **REVISÃO PRODUTO ACABADO – RADIOFREQUÊNCIA MURO DE QUALIDADE**	**FOLHA 8/17** **Nº: IT/CC/221**

3-De seguida confirmar neste menu a etiqueta em causa e, caso seja necessário, eliminar uma quantidade maior de peças que compreenda mais do que uma, duas ou mais caixas, adicionar as restantes nas linhas abaixo, sair do menu utilizando a função F1 (TECLA FUNÇÃO + TECLA 1).

4-Voltando automaticamente para o menu anterior onde deverá ser guardado selecionando a letra S para gravar ou a letra N para não gravar, caso tenha ocorrido algum erro anteriormente.

Megatech	INSTRUÇÃO DE TRABALHO REVISÃO PRODUTO ACABADO – RADIOFREQUÊNCIA MURO DE QUALIDADE	FOLHA 9/17 Nº: IT/CC/221



5- O próximo passo é sair do menu utilizando a função F1 (TECLA FUNÇÃO + TECLA 1) e voltar à opção 1 seguindo a revisão inserindo o número de peças com defeito diferente de zero (peças NOK≠0), no exemplo abaixo inserimos quantidade NOK = 5 + ENTER) para passar ao seguinte menu.

6- Na segunda linha inserimos o número de peças retrabalhadas, por exemplo, para a ref.ª em causa (11240016300) temos 5 peças NOK (5 peças falhadas e 3 sem componentes), ou seja, 3 peças foram retrabalhadas, esse é valor inserido na segunda linha no campo Cant. Este **valor é independente do número de peças NOK** registados nos campos anteriores.

Megatech	**INSTRUÇÃO DE TRABALHO** **REVISÃO PRODUTO ACABADO – RADIOFREQUÊNCIA MURO DE QUALIDADE**	**FOLHA 10/17** **Nº: IT/CC/221**

7- Na terceira linha o campo Status deverá manter-se em branco e na linha seguinte deverão inserir o número do operador que verificou o produto acabado.

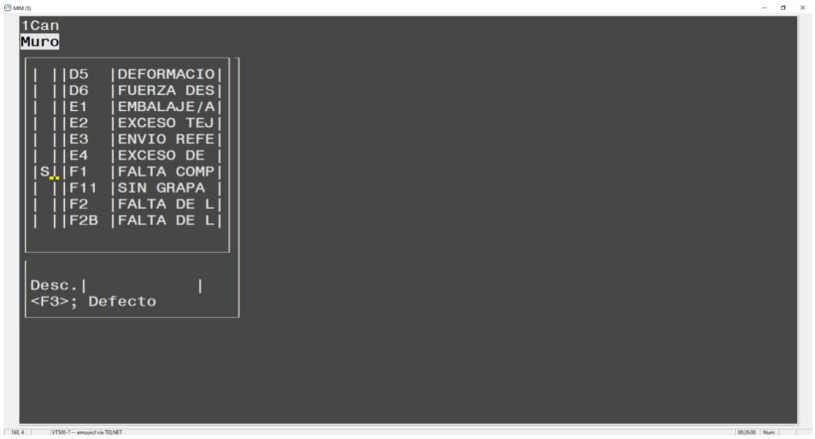
8- Em função do tipo de verificação efetuada em muro deverá ser selecionada uma das opções no campo Moti (designação para Motivo) através das opções F3 (TECLA FUNÇÃO + TECLA 3), neste menu são apresentadas as opções que devem ser selecionadas colocando a letra S à frente da opção que se pretende introduzir.

9-De seguida são inseridos o(s) número(s) do(s) operador(es) de produção das peças.

10- No campo seguinte são atribuídos os defeitos em função de uma lista que poderá ser consultada através da função F3 (TECLA FUNÇÃO + TECLA 3) e impressa diretamente no painel de documentação do muro de qualidade.

Megatech	**INSTRUÇÃO DE TRABALHO** **REVISÃO PRODUTO ACABADO – RADIOFREQUÊNCIA MURO DE QUALIDADE**	**FOLHA 11/17** **Nº: IT/CC/221**

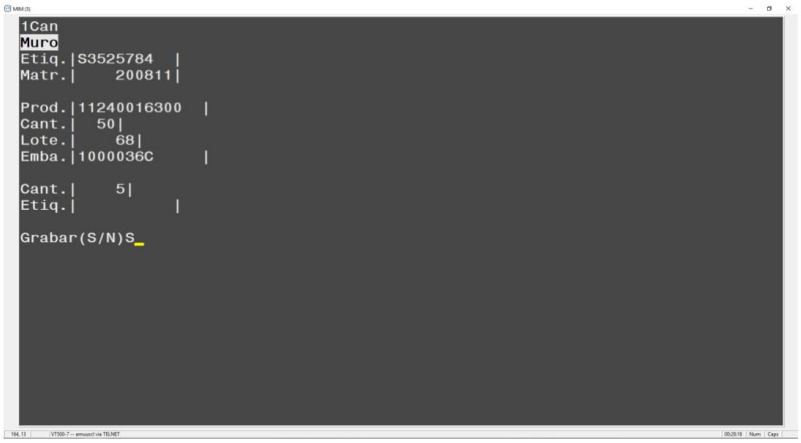
11- Neste menu são apresentadas as opções que também devem ser selecionadas colocando a letra S à frente da opção que se pretende introduzir.



12- Posteriormente à escolha do(s) tipo(s) de defeito(s) encontrado(s) deverá ser inserida a quantidade de peças verificadas com esse defeito, respetivamente, carregando na tecla ENTER para seguir para cada um dos campos e no final para voltar ao menu anterior onde serão gravadas as alterações.

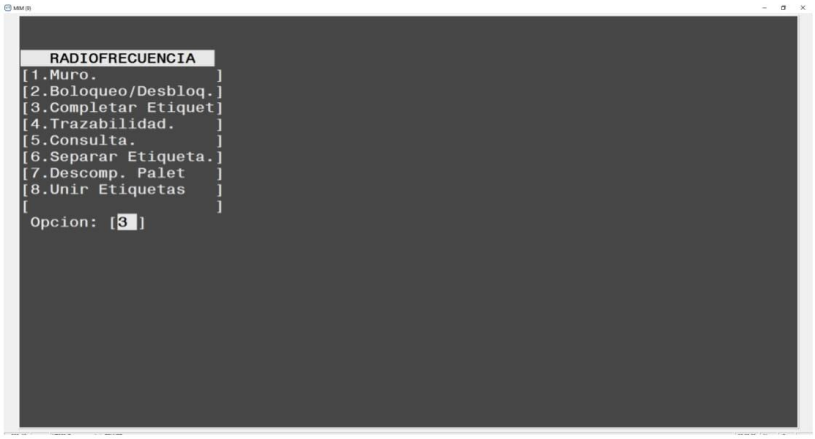
13- Selecionar a letra S para gravar ou a letra N para não gravar, caso tenha ocorrido algum erro no menu anterior.

Megatech	**INSTRUÇÃO DE TRABALHO** **REVISÃO PRODUTO ACABADO – RADIOFREQUÊNCIA MURO DE QUALIDADE**	**FOLHA 12/17** **Nº: IT/CC/221**



COMPLETAR CAIXAS

1- Este é o último passo de registo em muro quando existe a mesma referência na zona de incompletos/recâmbios (armazém 810) – Completar a caixa de onde foram removidas peças NOK durante a verificação em muro, no menu selecionar a opção 3 COMPLETAR ETIQUET + ENTER.



NOTA:

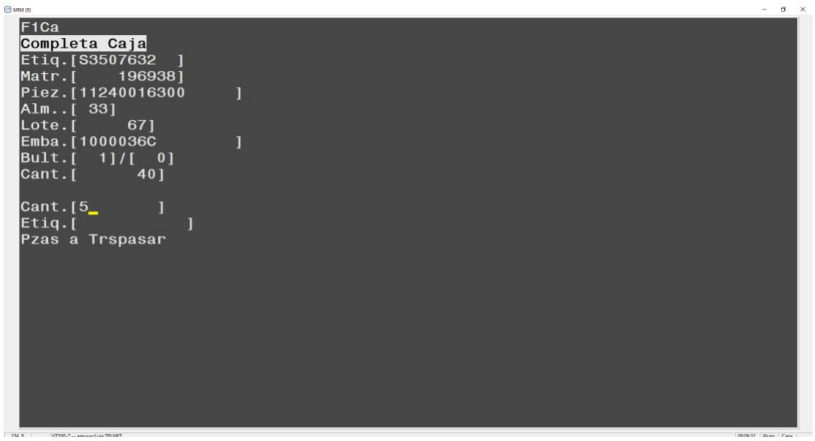
1º Ler código da caixa de onde serão retiradas as peças (Incompletos - 810);

2º Ler código da caixa onde serão colocadas as peças.

Megatech	**INSTRUÇÃO DE TRABALHO** **REVISÃO PRODUTO ACABADO – RADIOFREQUÊNCIA MURO DE QUALIDADE**	**FOLHA 13/17** **Nº: IT/CC/221**

2- Ler o código de barras da **caixa de onde serão retiradas as peças** com a pistola de radiofrequência ou caso esta se encontre em mau estado introduzir manualmente a etiqueta, começando por introduzir um S maiúsculo (TECLA SHIFT + S) e de seguida o número da etiqueta.

3- Automaticamente no ecrã poderá analisar toda a informação sobre a referência e confirmar se todos os dados estão corretos, introduzir o **número de peças** que serão **removidas da caixa da zona de incompletos/recâmbios**.



Megatech	**INSTRUÇÃO DE TRABALHO** **REVISÃO PRODUTO ACABADO – RADIOFREQUÊNCIA MURO DE QUALIDADE**	**FOLHA 14/17** **Nº: IT/CC/221**

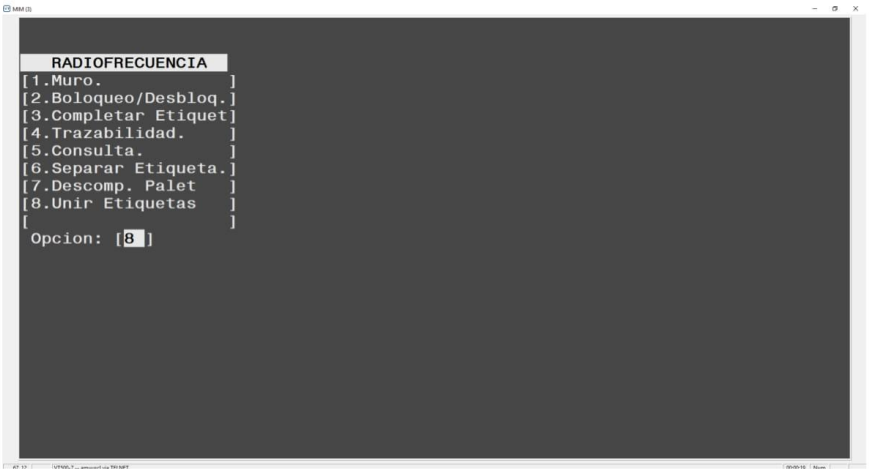
4- Ler o código de barras da **caixa onde serão colocadas as peças** de forma a completar a mesma e assim completá-la para esta dar entrada novamente em armazém de produto acabado. **É expressamente proibido colocar/entregar caixas incompletas no armazém PA.**

5- Por fim deverá mais uma vez ser guardado o registo efetuado até então selecionando a letra S para gravar ou a letra N para não gravar, caso tenha ocorrido algum erro no menu anterior. Finalizando assim este processo e voltando ao menu anterior por meio da função F1 (TECLA FUNÇÃO + TECLA 1).

Megatech	INSTRUÇÃO DE TRABALHO REVISÃO PRODUTO ACABADO – RADIOFREQUÊNCIA MURO DE QUALIDADE	FOLHA 15/17 Nº: IT/CC/221

UNIR CAIXAS

1- Retroceder para o menu principal e selecionar a opção 6 para separar a etiqueta.



2- Primeiro deverá ser lido o código de barras de uma das caixas da palete com **maior número de caixas**.

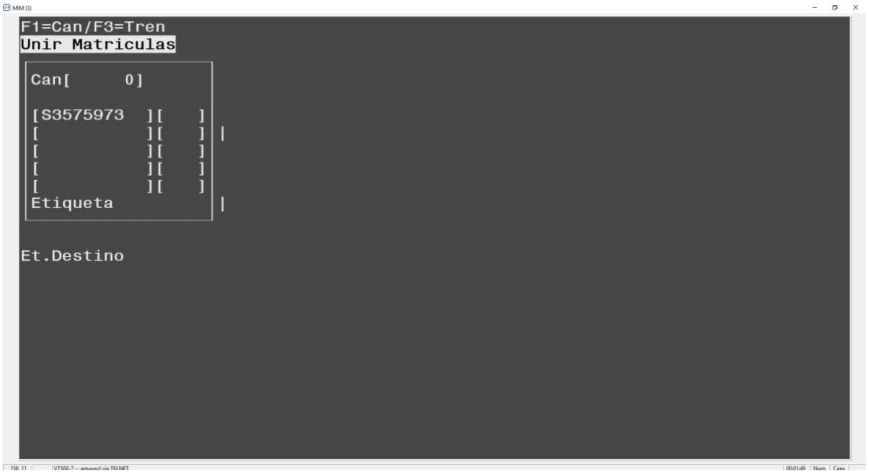
NOTA:

1º Ler código de uma caixa do grupo maior (palete com maior n.º de caixas);

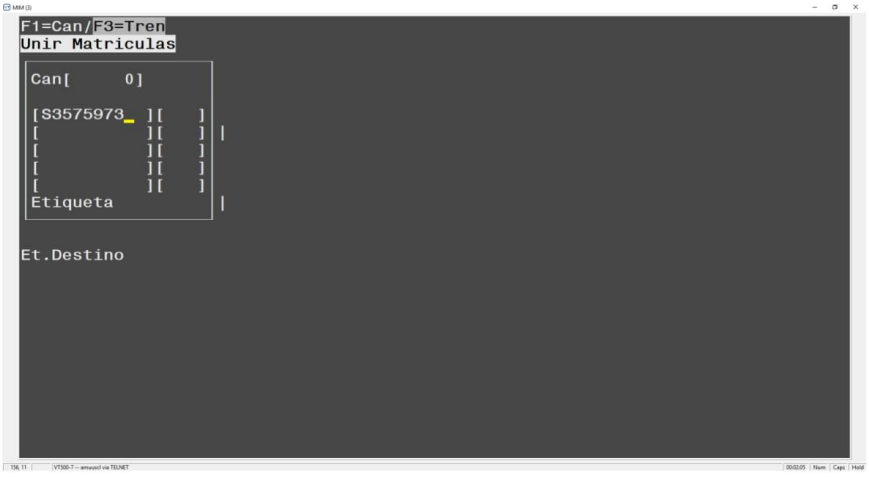
Megatech	INSTRUÇÃO DE TRABALHO REVISÃO PRODUTO ACABADO – RADIOFREQUÊNCIA MURO DE QUALIDADE	FOLHA 16/17 Nº: IT/CC/221

2º Ler código(s) da caixa(s) que tinha(m) sido separada(s).

3- De seguida inserir neste menu a(s) etiqueta(s) da(s) caixa(s) separada(s) e confirmar as mesmas, tal como, no menu representado na figura abaixo.



4- Depois de inserir a(s) etiqueta(s) que haviam sido separadas anteriormente utilizar a opção F3 (FUNÇÃO + TECLA 3) para voltar a unir.



Megatech	INSTRUÇÃO DE TRABALHO REVISÃO PRODUTO ACABADO – RADIOFREQUÊNCIA MURO DE QUALIDADE	FOLHA 17/17 Nº: IT/CC/221

5- Voltando automaticamente para o menu anterior onde deverá ser guardado o registo efetuado até então selecionando a letra S para gravar ou a letra N para não gravar, caso tenha ocorrido algum erro no menu anterior.

4. DEPARTAMENTOS AFETADOS

QUALIDADE
LOGÍSTICA

5. MATERIAL ASSOCIADO

Porta-paletes/empilhador
Pistola de radiofrequência

ANNEX III - Quality Wall 5S Audit

Mês:_____

Auditoria diária 5s Muro Q

	Nº	Pontos Chave	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
TURNO A	1	O posto de trabalho encontra-se limpo e arrumado																															
	2	Respeita o standart																															
	3	Respeita a ordem de entrada/saida das paletes (layout amarelo/verde)																															
	4	As caixas estão devidamente identificadas																															
	5	Encontram-se no máximo 2 referências em 2ª fila para inspecionar																															
	6	Não se encontram paletes que não correspondam a referências do Muro Q.																															
	7	A documentação do posto de trabalho está actualizada																															
		Nº de operador																															
TURNO B	1	O posto de trabalho encontra-se limpo e arrumado																															
	2	Respeita o standart																															
	3	Respeita a ordem de entrada/saida das paletes (layout amarelo/verde)																															
	4	As caixas estão devidamente identificadas																															
	5	Encontram-se no máximo 2 referências em 2ª fila para inspecionar																															
	6	Não se encontram paletes que não correspondam a referências do Muro Q.																															
	7	A documentação do posto de trabalho está actualizada																															
		Nº de operador																															
TURNO C	1	O posto de trabalho encontra-se limpo e arrumado																															
	2	Respeita o standart																															
	3	Respeita a ordem de entrada/saida das paletes (layout amarelo/verde)																															
	4	As caixas estão devidamente identificadas																															
	5	Encontram-se no máximo 2 referências em 2ª fila para inspecionar																															
	6	Não se encontram paletes que não correspondam a referências do Muro Q.																															
	7	A documentação do posto de trabalho está actualizada																															
		Nº de operador																															

+16

16-13

-13