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Analysis and optimization of the production system using Lean Manufacturing tools in Cikautxo Slovakia

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PALABRAS CLAVE

- **LEAN MANUFACTURING** – Systematic method for the elimination of waste within a manufacturing system.
- **VALUE STREAM MAP** – A lean-management method for analyzing the current state of the process.
- **KANBAN** – Visual process management solution that helps teams to work more efficiently and visualize workflow.
- **PUSH** – Production is based on forecast demand.
- **PULL** – Production is based on actual or consumed demand.
- **INVENTORY** – Raw materials, work-in-process goods and completely finished goods.
- **DEFECTS** – Products or servic deviate from what the customer requires or the specification.

1. SCOPE

The idea for this project arises with a stay of almost half-year in one of the plants producing automobile parts that has the multinational Cikautxo Scoop around the world. In this stay was observed how the company works, how the material flow is and how it could be improved. Analyzing problems, studying different alternatives and finding solutions has been the aim objective of this project in order to increase the benefits of the company. These will make the plant profitable without investing large amounts of money.

The objectives of this project are focused on the explanation of different techniques that "Kaizen Team" has used to reach the aims, as well as real cases that have been resolved during this stay.

2. OBJECTIVES

The project focuses on the study and improvement in the manufacturing process of Cikautxo Company in Slovak.

Main objectives of this project;

1. Improving knowledge of Lean Manufacturing and its application through the Value Stream Mapping tool.
2. Analyzing, studying and propose an adequate material flow to improve the efficiency and performance of production.
3. To acquire knowledge on the production lines, processes and work methodology in a real factory as Cikautxo Group.
4. Apply knowledge of Lean Manufacturing to an assembly line through value stream map, locate sources of waste and eliminate or reduce them.

Specific objectives developed;

5. Implementation of the Kanban system for the feeding of the assembly cells.
6. Organization and identification for the packaging and racks.
7. Define the different tasks for the operator, commodin and team leader to reduce the time in movements and improving its productivity.
8. Analysis and assessment of the current production methods and proposed changes in the process searching a continuous flow without intermediate storage (eliminating waste and improving the customer service).

3. INTRODUCTION

At the beginning of this project it will be made a brief summary about the multinational, it will be talked about Mondragon Group and it will be specify the different modules which the company is divided and the different products they do.

It continues with the specific plan details. Where it is located, the customers they have, its production area organization and what is more important, what have been the main problems which led them change the management model of the plant.

It will be studied what the philosophy Kaizen is, (Japanese word translated into Spanish as continuous improvement) in order to present it as a philosophy, a way of working which includes a set of tools or systems that are dedicated to ensure the good operation of the factory. It will be included;

- Lean Manufacturing
- Value Stream Map
- Kanban
- Material flow
- Spaghetti diagram
- Gant Diagram

After analyzing the current situation and doing the implementation of the Kanban system, it will be explained the advantages of using this tool and the problems founded in the trial area.

To conclude it will be propose some ideas in order to improve the problems aroused and some other things, which will be translated as percentages of improvement.

3.1. CIKAUTXO GROUP

Cikautxo is part of the Mondragon Corporation, which was born out of the cooperative movement that began in the Basque Country in 1956. It is currently the leading Basque business group and ocupes the seventh position at the Spanish ranking with a strong presence in the international market.

The mother company is located in Berriatua, Spain. It established in 1971 with the specialization for development and production pieces of rubber. Over 40 years' experience in a sector where technological innovation is the foundation of growth and future development of the company. It is a young and dynamic team with international presence, providing customer service worldwide.

Cikautxo believes that people are the most important factor in the future of their business. Committed employees working well in a team are the key to sustainable results and the basis of their management model.

The main reason why Cikautxo has reached more customers in the recent years is justified by offering customers its key values for the development of the company:

- **Solidarity and involvement with the community**

  Since its beginnings, Cikautxo has been characterized by its commitment to solidarity and to social responsibility in its local area; this is one of the hallmarks of the company.
  Solidarity can be seen, firstly, in significant contributions to the wellbeing of the communities where their companies are based by improving their quality of life: creating jobs, generating work through other companies and encouraging a diversity business activity.

- **Transparency**

  Making it easy creating a flow information and acting consequently the politics and ethical rules of the customer company. The transparency generates confidence and gives it an attractive image.

- **Environmental commitment**

  Their systems, prevention and environmental teams are decisive forces that drive environmental responsibility leading projects in this field and performing functions related to monitoring legislation and controlling the activity of the group.

- **Commitment to people**

  Cikautxo's employees are a deciding factor in its future due to their creativity, initiative, commitment and responsibility. The ultimate purpose of people management is to converge the interests of these people with the goals of the company.

  One of the most important functions of the management team is mobilizing and orientating the skills of employees around business objectives, publicizing the project, creating favorable work conditions, and promoting the development and involvement of different groups through organizational models of flexibility and participation in a context of freedom of information.

Characteristics mentioned before and its international presence makes Cikautxo an exemplary company growing every day more and more. The four different sectors that they work with are; automotive, household appliances, elastomeric materials and medical components.

- For **household appliances** has products that offers solutions for the following functions: washing machine gaskets, inlets and outlet pipes for washing machines, not so many products but enough for today's market. It is shown in the picture below some household products.

Picture 2 - Inlet and outlet pipes

Picture 1 - Washing machine gaskets

- For **elastomeric materials** which the material's business is divided into two categories, for athletics tracks and for children's playgrounds with technical rubber. These two types are shown in the picture below.

Picture 4 - EPDM for playgrounds

Picture 3 - EPDM children's playgrounds

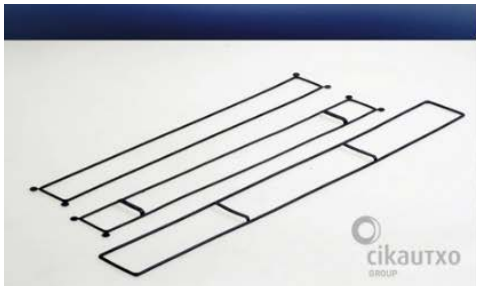
- For **medical components**, Cikautxo is a leading European manufacturer of medical devices made from thermoplastic and silicone materials. They use their knowledge of materials (injection and extrusion manufacturing expertise with the final assembly skills) to develop and produce complete and innovative polymer solutions to satisfy the need of their customers and achieve the comfort of patients. In the picture below it is shown how the catheters, silicone tubing and components are.

Picture 5 - Catheters, silicone tubing and silicone components

- For **automotive products** it is important to know that they have an extensive experience at the production and development of; fluid conduction components, anti-vibration pieces and sealing products. In the three pictures below are shown each type of product.

Picture 8 - Fluid conduction

Picture 6 - Anti-vibration pieces



Picture 7 - Sealing products

This group has important customers around the world demanding vehicle manufacture pieces, household appliances products and medical parts. Cikautxo's size and flexibility helps to establish direct relationships with their clients.

Cikautxo operates in Spain, Czech Republic, Slovakia, Romania, USA, Mexico, China and India, meaning that it can offer a worldwide service to its customers. In the picture below is possible to see where this group has their companies.

Picture 9 - Cikautxo around the world

As it can be seen, Cikautxohas more production plants in Europe, therefore it could be say that it is more dominant in the European side.

Regarding the situation of this multinational worldwide should be noted that each year increases its presence inside Europe, suggesting it is carrying out an important **offshoring policy**, with the aim of reducing costs.

It has been opened a new Cikautxo plant in Rumania last year, increasing the companies situated in Eastern Europe. This increase has become more noticeable even for the automotive companies.

It is currently common to see the increase of automotive companies which have moved to Eastern Europe searching two factors: the first is obvious, reducing spending on labor, while the second is justified by quality, people of these countries learn fast how the things work offering them more high performance.

3.2. CIKAUTXO SLOVAKIA

Cikautxo Slovakia was established in 2005 with the specialization and development of rubber pieces. With its headquarters in Berriatua behind more than forty years' experience as it has been mentioned before it could be say that it is a young and dynamic team with international presence, which provides customer services worldwide.

This company is located in Nové Zamky, around 60 km of distance from Bratislava (Slovakia). It is a young company with few years experience but with a big exponential growth in terms of customers. It has many well-known customers and really important in the automotive sector. Their varied range of clients provides the best endorsement for Cikautxo, their satisfaction is their motivation. Audi, Renault, Ford, Volkswagen, Peugeot, Seat, Skoda, Nissan are some of the most important customers as it can be shown in the picture.

Picture 11 - Cikautxo SCoop Slovakia

Picture 10 - Cikautxo's principal customers

Right now Cikautxo counts with 934 employees who are distributed in three shifts per day, from extrusion and autoclaves to quality area and warehouse. Almost all the work done in the company is manual and it is not needed any specialist employee to use the machines.

It is important to know that this company had to adjust all the orders from their customers in a very short period of time. This situation has made them grow 50% more less than two years. It could be said that this company has been able to adapt and manage their customer's needs along the five continents.

Cikautxo Slovakia is dedicated especially to the automotive sector and more specifically to fluid handling products. From heating and cooling, ducts for air intake circuits, ventilation oil vapor and components for regulation and control circuit.

They have 83000 m^2 around the building for a possible expansion and 14000 m^2 total area with the possibility of construction.

This factory has a single building but they had to annex more areas because of the faster growing. It has two different process with different organization.

1. **"Injection";** It is not a big area and they do not have even many workers but it has all the necessary staff to take over the customer's orders.
2. **"Extrusion";** It has more workers than the first and the largest area of the company. The final work has been done in the area.

Around 600 different references which mean 600 different products that they fabricate because of the customers' orders. This final masterwork has been done in this "Extrusion area" at the "Kaizen department".

- **Kaizen team**

From the beginning the department I have been taken part of is "Kaizen team". This department has 5 workers, all of them trainees including Spanish students doing their final project. Kaizen is a Japanese word which means "Continuous Improvement" and that is what the team has been doing. All the members of the team knew about the methodology "Lean Manufacturing" and have been using it to improve the efficiency and quality of the company.

The aim of this team is to increase the efficiency of all the organization, allowing to do all the functions in a constant and effective way. Doing needed process to improve the customer service, quality, cycle time, expenses and benefits.

- **Infrastructure and means**

The company where it has been made the project has a single building but they had to annex more areas for the sudden expansion. It is easy to identify different types of machines; 6 extrusion lines, 9 autoclaves, 5 injectors for over-molding and 5 vulcanization machines for the plastic injection lines. It has two different process organized in a distinct way.

1. Injection → It is not a big area of the company, it doesn't have too many employees but they really have what they need in order to supply all the orders that they have.
2. Extrusion → It is the largest area of the factory so it means that it has more space and employees than injection area. It has around 600 references what it means around 600 types of different products which are able to produce. It has also hundreds of square meters around Cikautxo if one day they decide to expand.

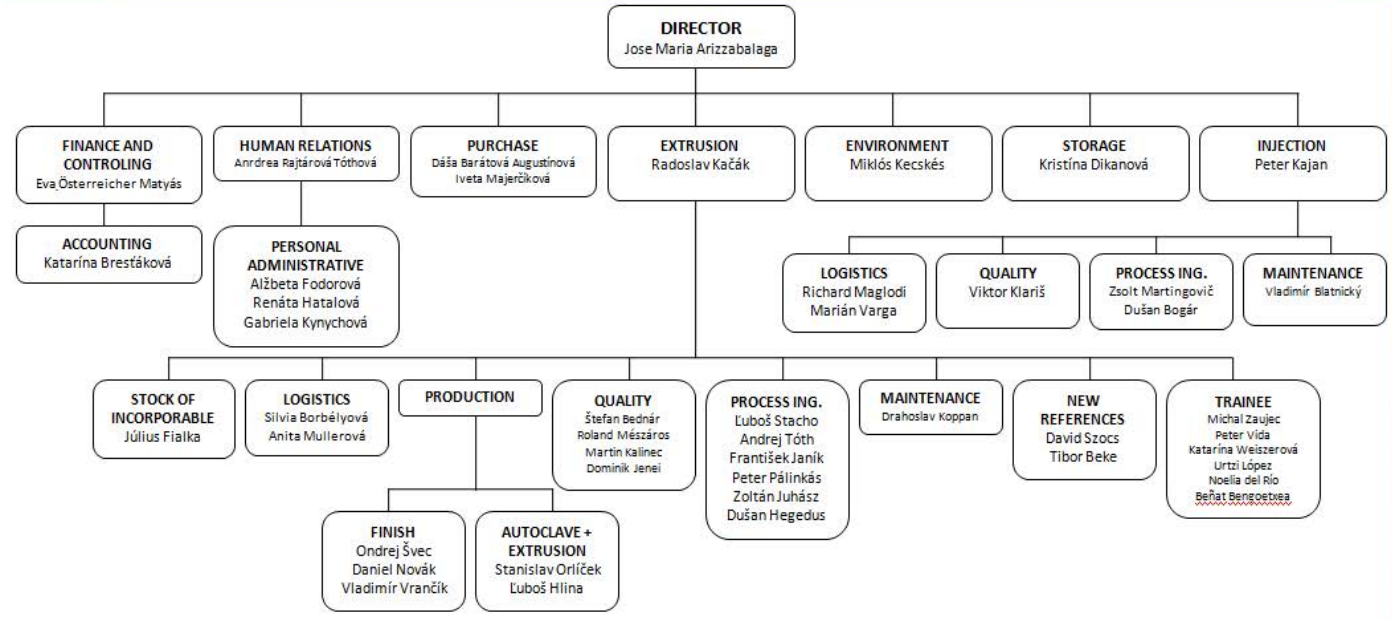
3.2.1. Organizational structure Cikautxo

The Cikautxo's organizational structure counts with a "functional departmentalization" which means that it is grouped by activities around the typical functions that take place in a factory.

The principal advantages of this organization are;

- Logical and widely proven method in reality
- It is a way of creating competition between the different areas of the company.
- It encourages specialization and efficiency in their tasks.
- It facilitates the control of various functions which have a unique responsible.

It is shown in the picture below how the organizational structure is at Cikautxo.



Picture 12 - Cikautxo's Organizational Structure

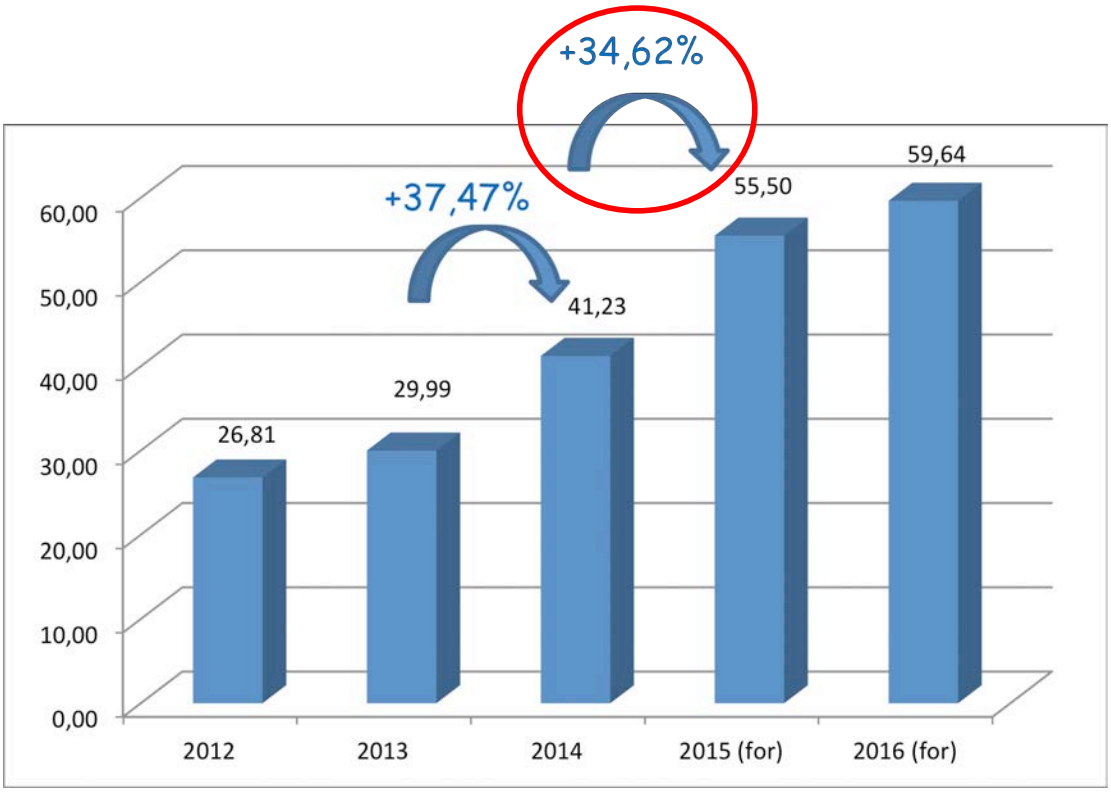
It has different departments with a vertical hierarchical structure as it can be shown in the image. They separate departments depending on the principal functions of the company as: finances, human resources, purchase, extrusion, environment, storage and injection. It is logical that there are more internal departments in extrusion and injection areas because this fabrication process needs too many people.

As it is represented in the diagram, they need the double percentage of workers in extrusion than in injection. But the principal problem of this organization is not the quantity of workers that they have, it is about the relation and the team work that they should do to solve their problems. They all have a desk in the office without windows or doors, but sometimes they don't talk to each other to solve the problem. They just do what it is explained and that's all.

3.2.2. In the recent years

3.2.2.1. Sales evolution

It has been a crazy and exponential development in the last years, it is difficult to see a company growing this much in a few period of time. Furthermore they have not rejected any customer's orders. In the picture below it is possible to see how the growth has been from the 2012 until today.



Graphic 1 - Evolution sales from 2012

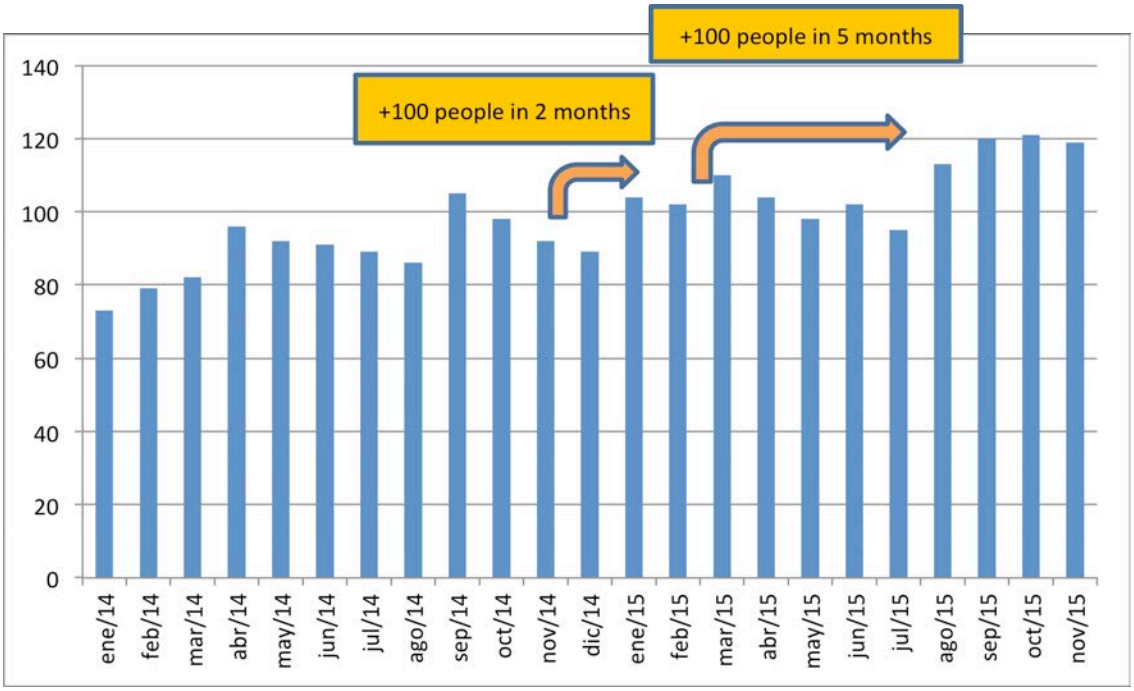
As it can be seen in the picture, there have been two big increases from 2013 to 2014 and from 2014 to 2015. What these events produced in the company was the new hall[1] part and the nano hall part[2] .

- New hall part → it was necessary to join this part to the company because they wanted to have all the assembly cells in the same area. They moved the quality control with some of curso warehouse there in order to improve and trying to organize a little bit more the company.
- Nano hall part → it was essential to annex because Nissan made a really big order. Today, this part still work only for Nissan and it counts with almost 25 employees per shift working in assembly and quality control.

[1] New hall → The annex area in the bottom part of the company which has approximately 1600 m^2
[2] Nano hall → The annex area in the left part of the company which has approximately 510 m^2

3.2.2.2. Finishing area employment

As it is possible to see in the picture above it existed a boom expansion from 2014 to 2015, which produce several employment at the finishing area. In the picture below it is shown how the factory had to take more employees in some specific moments.



Graphic 2 - Assembly area employment (2014-2015)

It is easy to identify with the graphic that they have been working with at least 70 employees and in some months they had to hire more temporary and contractual staff. It could be said that it if the company needs more workers is because it is growing and that is a good effect. But this is not at all true, what is important to understand here is that employees do their work, but in a chaotic way and without any training.

3.3. THEORETICAL FRAMEWORK: LEAN PRODUCTION

It is known as "Lean Production or Lean Manufacturing" too. It became in Japan after the Second World War and it had the same ideologies as Toyota. At that time the Japanese economy showed the particularities characteristics at the automotive sector.

3.3.1. History

3.3.1.1. How it started

First of all, before talking about this type of production we should talk about the person who made this possible. He was Taiichi Ohno, a Japanese industrial engineer who is considered to be the father of the Toyota Production System which became Lean Manufacturing in the U.S.

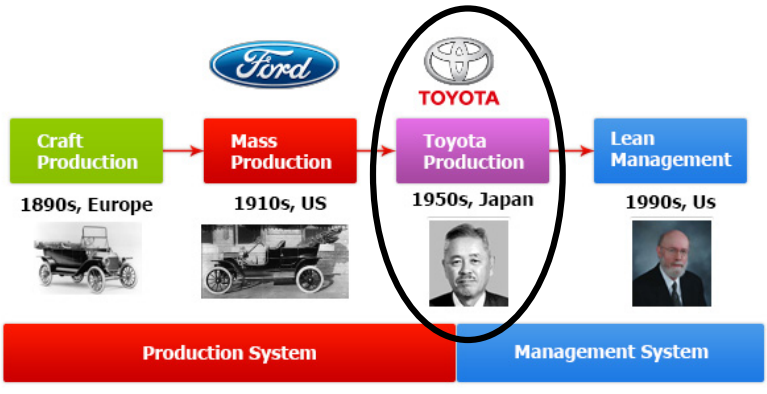
This type of production started with a small domestic market that demanded a wide range of vehicles. There were not only the customers, it was even the workforce who wanted more than just been "interchangeable", they did not want to work as guest workers and they fought to eliminate it.

The precarious economy existed after the war was another impact of losing a war. It was a really hard situation for the country and there was an aggressive foreign competition and internal political demand to merge and to create big manufacturers.

But not only this took this country to change their production style, Nissan and Toyota wanted to be the ones who offered variety of models.

These companies wanted to see the company as a community lifetime employment. They offered the employees a gradual salary based more on experience than in functions and linked to specific benefits. They also offered access to housing, entertainment places, etc.

They employees had more with this type of production than the other workers for western countries based in mass production. People remained in their company throughout their working life. They contributed with their physical labor and



Picture 13 - www.leaninstitute.in

intellectual knowledge.

Therefore the company tried to improve the training of workers to take advantage of their knowledge and experience, as well as their physical effort.

3.3.1.2. Assembly plant

In this global system there was a lot of waste (call muda) encompassing the lost in effort, materials and time. None of the specialists that accompanied the assembler added any value to the product. Assemblers could do most of the specialist functions doing them better because of the knowledge of the conditions of the assembly line.

However the role of the assemblers had the lowest status of the factory. Even in the western plants, these workers were considered necessary only if there were not any machine doing their work.

To change this entire situation, they decided to create teams with a leader who assumes assembly tasks, coordination and cover the absent workers. The tasks developed were:

1. Assembly
2. Cleaning, repairing and quality control
3. Ways to improve the process. Continuous improvement creating “Kaizen team”.

Ohno implanted techniques leading to the principal causes (find the last one). With his method “Five whys” started constant stops on the assembly line until they found the failure.

Today, Toyota lines have a yield of almost 100% while the mass production are considered effective yields on the order or 90%. Quality in this type of production increases all the time offering a exceptional product for the customer. Over 20% of the time working hours is dedicated to improving.

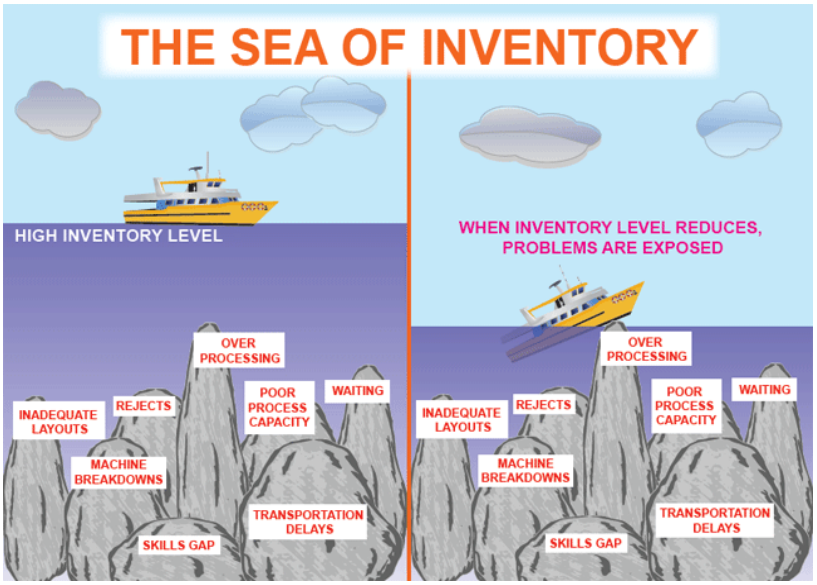
So it could be said that Lean Manufacturing brings the best of all production systems together after analyzing its operation for more than 30 years.

A “Lean Production” system is one that can offer products and better services in quality, cost and delivery based primarily on eliminating wastage. As it is known, PRICE = COST + PROFIT : If we reduce waste, we reduce cost and what we are increasing is the profit or benefit and this benefit can be for the company or for the customer.

It is very important to know that if you talk about this production, you are talking about:

- Continuous workflow with minimal inventory
- Small batch production
- Synchronized production adjusted to demand and not based on the use of the machine.
- Defect prevention
- Functional teamwork
- Everyone have to be involved in reducing waste
- An association customer-supplier.

In conclusion, "Lean Production" means the elimination of waste through the production process to meet customer expectations in quality, costs and delivery times to maximize profit.



Picture 14 - www.shmula.com

3.3.2. Why this is the right philosophy

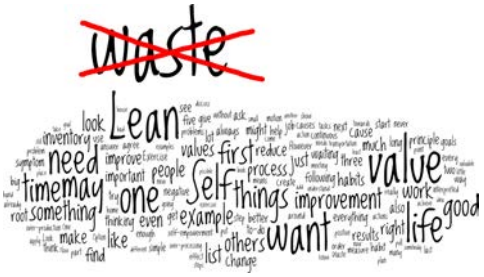
Because of the need to respond more demanding customers orders and more aggressive rivals, implies reducing costs, delivery times, increasing reliability, improving flexibility, having an excellent quality product and service…

It gives companies the tools to survive in a global market that demands higher quality, faster delivery, lower price and with the required amount. Specifically it reduces the

waste stream, the stocktaking, the space on the production floor, creates appropriate delivery systems suitable materials and improves the lay-out distributions.

It can be used for all the companies because all of them have manufacturing process that gives them the opportunity to improve his operations.

Productive companies and service see this philosophy as an agile system production that brings them the opportunity to improve their operations. “Agile” means improvement; decreasing money, people, big teams, stocktaking and space, with two simple aims; No waste and reducing variability.



Picture 15 - Waste (www.linkedin.com)

3.3.3. Tools

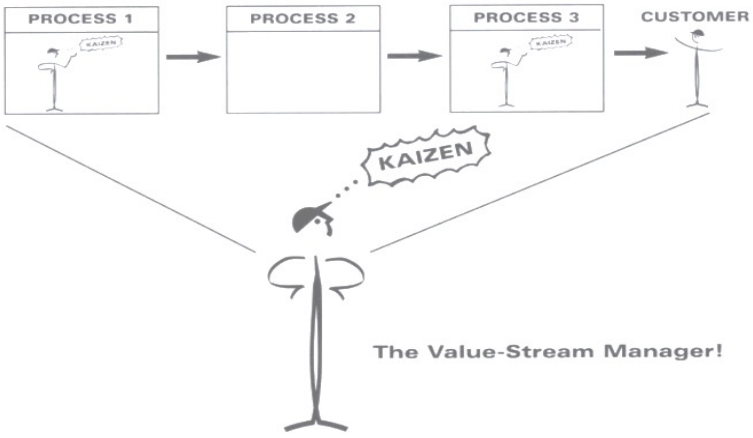
3.3.3.1. Value Stream Map (VSM)

It is a technique developed under lean production in order to support manufacturing companies in the process of redesigning their production environments.

It is a tool of paper and pencil which helps to see and understand the material flow and gives the information of the product when it passes through the value chain. It is a graphic document indicating the activities of a process, identifying those that add value and those that do not.

As the name suggests is proposed to design this intuited flow in a simple and clear outline that focuses on critical data such as production time, accumulation points and activities that do not add value.

Next to the product flow and type of material, a parallel flow of information is disclosed. Each step requires a real transfer of information from the production process for auxiliary functions such as warehouse, management and production planning.



Picture 16 - Value Stream Map

A team work in which the functional structure is not hierarchical and every worker regardless of rank can contribute ideas and objections.

The study's conclusions indicate that the VSM is shown as a useful and applicable technical, to face different logistic problems in the plant, to redesign the production systems in different environments. However, the analysis also results in a need for adaptation and refinement of technique.

It is not only the time what you have to measure, furthermore (but also?) a number of other features such as:

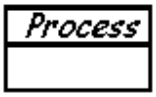
- **Number of operators**: How many people are working with the machine or the function that puts in the box. [Person]
- **Cycle time**: It is determined by the number of seconds in which it will take the process in any of the workstations from the time we started a product until it is ready to start the next. [Sec]

- **Takt time**: It is the result of dividing every second that we have measured with the number of units or products that need to be processed. [Sec]
- **Number of resources**: It is the result of dividing the cycle time with the takt time and it indicates the number of workers or resources that is necessary.
- **Lead-time**: It is the time from a production process begins until it is complete, usually including the time required to deliver that product to the customer.
- **Down time**: It is referred to a period of time that a system fails to provide or perform its primary function. The unavailability is the proportion of a time-span that a system is unavailable or offline.
- **First time quality**: It is the finished parts without rework.
- **Lot size:** It is the amount of land, which is being conveyed from the seller to the buyer.
- **Shifts:** One of two more recurring periods in which different groups of workers do the same jobs in relay.

Symbols used

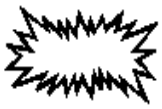
Before making the VSM must be known the symbols will be used.

- **Customer/Supplier**→ The icon represents the "Supplier" when in the upper left, the usual starting point for material flow. The "Customer" is represented when placed in the upper right, the usual end point for material flow.



- **Dedicated Process** →It is a process, operation, machine or department, through which material flows.

- **Electronic flow** →Such as electronic data, the intranets, internet, LANS. It indicates the frequency of information/data interchange, the type of media used and the type of data exchanged.



- **Kaizen Burst** → These icons are used to highlights improvement needs and plan kaizen workshops at specific processes that are critical to achieving the future state map of the value stream.

- **Warehouse**→ This icon can represent an internal or external warehouse.

Define the scope

Define which are going to be the limits to the scope. It will be studied the entire production process of the company or if it will be added the suppliers or customers.

Before starting it is good to know the parameters that we are going to use[3].

- **Overall Equipment Effective (OEE) →** This parameter is a hierarchy of metrics to evaluate how effectively a manufacturing operation is utilized. The results are stated in a generic form which allows comparison between manufacturing units in differing industries. It is not however an absolute measure and is best used to identify scope for process ferformance improvement, and how to get the improvement.

$$OEE = Avaiability\ x\ Performance\ x\ Quality$$

- **Avaiability →** It represents the percentage of scheduled time that the operation is available to operate. It is a pure measurement of uptime that is designed to exclude the effects of Quality, Performance and Scheduled Downtime Events. The losses due to wasted availability are called "availability losses".

$$Avaiability = \frac{Run\ Time}{Planned\ Production\ Time}$$

  - **Run time →** It is the operating time that it is producing.

$$Run\ time = Planned\ Product\ Time - Stops\ time$$

- **Performance →** It takes into account anything that causes the manufacturing process to run at less than the maximum possible speed when it is running. Performance should never be greater than 100%, if it is, that usually indicates that Ideal Cycle Time is set incorrectly (it is too high).

  - **Ideal Cycle Time →** It is the fatest cycle time that your process can achieve in optimal circumstances. There fore, when it is multiplied by the Total Count is the fastest possible time to manufacture the parts.

[3] The parameters have been explained in the introduction part.

$$Performance = \frac{Real\ production}{Production\ capacity} = \frac{Ideal\ Cycle\ Time\ x\ Total\ Count}{Run\ time}$$

- **Quality** → It takes into account manufactured parts that do not meet quality standards, including parts that need rework. This OEE Quality it is similar to First Pass Yield, in that it defines Good Parts as parts that successfully pass through the manufacturing process the first time without needing any rework.

$$Quality = \frac{Good\ Count}{Total\ Count}$$

3.3.3.2. SPAGHETTI DIAGRAM

A spaghetti diagram or spaguetti chart is a representation of how workers move within the workplace, it is used to know every move of the employee in order to find which is the most logical machines order, cupboard, and other workplaces improving the efficiency of the company.

This tool is a very powerful tool combined with 5S, expediting the maximum efficiency of the job. Before starting the mapping, it must be the representation of the job it will be analyzed, it is important to maintain a real size scale to have known exactly the distances he will move.

After this, it will be necessary to choose an operator and see how it is moving and tracing the steps on the map that it is built. It is not necessary to monitor him until the shift is finished, it can be chosen just some hours.

With the spaghetti diagram it is shown also how there are a number of lines that indicates the positions that the operator crosses. It is very important here to set the direction and order the sequence of its steps.

Sometimes it is helped of elements in the map highlighting the points of more assiduously or where there may be conflict between workers and places (where space is limited) and not easily accessed.

Making an exhaustive study of how the objects are placed in the workplace and perform a physical reorganization is good to start with work done frequently and where there is involved a lot operators. From here you can make a brainstorming where you can share ideas and reflect on what is the most successful.

In the redistribution of objects employee becomes a really important figure because it is him who in their day per day find everything more accessible and the distance will decrease considerably. This is an added because indirectly is helping to improve employee satisfaction, these techniques are good to promote them within organizations, start with frequent exercises and extend this methodology to the rest of the organization.

It is important do not forget that it can be applied the diagram spaghetti using the figure of the client, it will make the study of how the client needs to move throughout the organization to get what he want. To avoid unnecessary movement between departments, gaining satisfaction, reduce time, increased the capacity to serve customers, etc.

3.3.3.3. KANBAN

3.3.3.3.1. Introduction

After The Second World War, Japan became a country with a disastrous economy and obsolete technology.

However, their production systems suffered a hard change of such magnitude that managed to revolutionize the world economy through the introduction of new production techniques that avoid waste. If it is united with the quality concepts, allowed to Japan one of the leading countries in industrial manufacturing.

Many Japanese manufacturing companies visualized assembly of a product as a continuous process based on the design, production, distribution sales, and customer service. For many of these companies the heart of this process is the Kanban system that handles much of the manufacturing organization.

The Toyota car company originally developed this technique in the 50s as a way of managing the flow of materials in an assembly line.

When it appeared, the Kanban process has been established as a production system highly effective and efficient wrapped in a global competitiveness.

Today, the need to produce efficiently without causing disruption or delay in delivery of a product, is an important factor for companies who wish to remain active in a market like today's, which requires quickly responses and fulfillments in the quality, quantity and delivery times.

The implementation of this production systems that manage to meet the demands of the market, does not necessarily have to carry out more investments in expensive automation systems. In fact, with a proper analysis of the situations and with the elements, it can be achieved the development of an effective system that fulfill the needs and not a huge investment.

3.3.3.3.2. Origin

Before introducing the Kanban system, it is important to fully understand the context in which they originated. Well, as it will be seen below, the Kanban system works only after prior introduction of a number of principles, such as Toyota did. They had to change its production system because they were suffering with problems related with waste, overproduction and inventory.

Trying to solve this problem, Toyota studied and classified waste that they generated, which served to establish future rules in Kanban.

In the 50s, many Japanese companies, estimated the demand and according to these results produced. But what really happened was that they did more than what was required by the public.

The market was not able to consume such amounts, and customers did not feel satisfied, since their tastes and preferences were not taken into account. When it happened, it was produced the "Bullwhip effect": that it is defined as a higher production, more stock and less service.

To face this problem, Japanese engineers made a study tour to the United States, where they observed the way of functioning of supermarkets and they discovered two important events that it were all the time repeating:

a. The sections of the supermarket have a limited capacity for products available to customers.
b. When these products reach a minimum level, the head of the section go to the warehouse and takes the products in the amount that has been consumed.

The Japanese interpreted the fact that a product section is empty as an order (order replacement products). This aroused in them the idea of a card, ticket or label instruction (Kanban) in which show the task to perform, and subsequently, the idea of a new technique production. The Production tight flow, when product is sent to a job only when the order has been issued by this position.

Expanding this idea; satisfy actual consumer demand would be the principal aim, while minimizing delivery times, the amount of stored goods and costs. Allowing the order to be the one, which put in up production, not production, which search a buyer. The main aim is to supply the order schedule, the schedule day and with the minimal cost.

3.3.3.3.3. Definition

Kanban is a Japanese word that can be translate as label or ticket instruction. However, in practice this system is not limited to a label (card). This card does not help much if it is not applied according to certain principles and rules.

The relationship between Kanban and Kaizen or philosophies such as Just in Time is that it represents the engine of the system. It is the further help to achieve the objectives that have been in the previous chapter. Both are within the philosophy Kaizen.

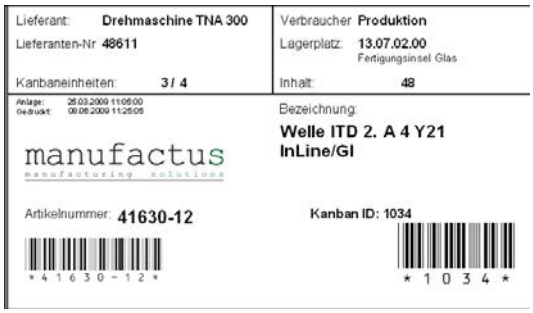
To define this new concept must take into account two aspects:

1. **Kanban as physical system:**

It is a card or board containing all the information required for the product in all their stage of the production process. This card has the form of a laminated cardboard box of small size and can be attach to a container of the products, which offers information.

A Kanban card contains information that varies according to the companies but it exits some information, which is indispensable in all:

- Component part number and description.
- Name/Number of product.
- Required quantity.
- Type handling material required.
- Where it should be stored when finished.
- Assembly/Production sequence of the product.



Picture 17 - Example of kanban card (www.altacuncta.wordpress.com)

The main and immediate function of Kanban is to be a work order, it is not only a guide for each process, is an order which must be fulfilled.

Another function is the material movement, the Kanban card must move along the company with the material.

Their aims:

- For Production:
  - Give instructions based on current conditions in the work area.
  - Prevent unnecessary work is added to those orders and begun and prevent excessive paperwork and unnecessary time.

- For Material Flow:
  - Priority in production, the Kanban (instruction) with more importance will be the first.
  - Better communication.

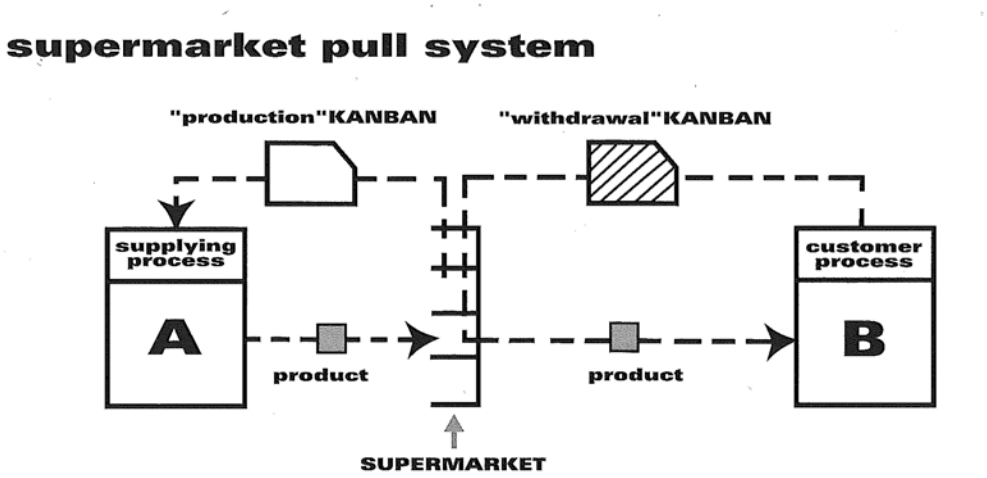
2. **Kanban as an abstract system**:

The traditional system for production planning in a company has issued hundreds of orders to suppliers to produce Product A, but imagine that suddenly in the market customer want aggressively the Product B. If the company has a traditional supply system, they will generate waste at each step of the process. A large excess of raw material is observed by a bad management shopping.

Through the history of many companies, they have had problems with information and it was mainly because of the low accuracy of information. The companies hide their ignorance of the market holding additional inventory. In order to respond this change, they must be instructed to constantly work area. Instructions can be given, as they are needed.

Therefore, it can be seen that it is not convenient make orders excessively big, trying to anticipate the market demand, but it is not convenient make unit orders too. The best way to do orders is making small lots which are based on the fundamental concept, adjust to customer demand.

It can be define the Kanban system as a production technique where work instructions are provided by cards called Kanban to the different production areas, constant instructions (at intervals varied time) ranging from one to the other before this process. It is based on the customer requirements; it is only fabricated for the client and not for the inventory.



Picture 18 - How it works (todaysleanmanufacturing.com)

This Kanban affects to:

- **Production control** → Integration of different processes, reducing directly the supervision in which the materials arrive on time and the quantity required at the different stages of the manufacturing process. To do this, it would be appropriate to include the suppliers in the system.
- **Reducing inventory levels** → This reduction helps them to bring up any loss of time or materials (waste), the use of defective parts and improper operation of some equipment. It is the same as the picture shown at the beginning of the work.
- **Elimination of overproduction** → Doing only the necessary quantity, there is not any surplus production, which means that may reduce the storage areas of post-production. It also represents a reduction in the daily plan to produce parts which can lead to a reduction of the necessary hand-made or time to get the number of parts required. Doing this, it will be improve in a productive and economic way.
- **Continuous process improvement** → Facilitating improvement in the different activities of the factory, full participation staff, better organization of the work area and faster communication between the different work areas.
- **Minimize waste**

2.4. MATERIAL FLOW

Material flow represents the elements in the factory that is moving like material, men, equipment, documents; all that it is included in manufacture a product or a service. The term material flow refers to the determination of the most effective sequence of movement of material through the process steps involved and the intensity of magnitude of these movements.

An effective flow means that the materials move progressively throughout the process, always advancing to completion and without excessive diversions or withdrawals. The material flow analysis is the heart of the planning layout wherever the movement of materials is an important portion of process. The space requirements are reflected then in the flowchart and a small service support for research is performed

2.4.1. Why it is important

The importance of a good design pattern material flow lies in the fact that constitutes one of the bases of the plant design, in other thus, when a plant it is been designed, one of the steps consists in the selection of the manufacturing process. This implicitly defined in many cases the material handling system that it should be used due to its characteristic and operating techniques.

It is obvious then, that the selection of the manufacturing process must be done under a consistent analysis in the investigation of a flexible process that allows the consideration of different flow patterns, trying after find the pattern that lead to an effective settlement of facilities. All of this information has to be translated into minimum production costs and higher productivity.

The material flow is a potential source to improve the productivity of the plant and consequently the company. It is an evident need for flow pattern facilities that the company has to be oriented to the production.

4. CIKAUTXO' SITUATION BEFORE THE KANBAN

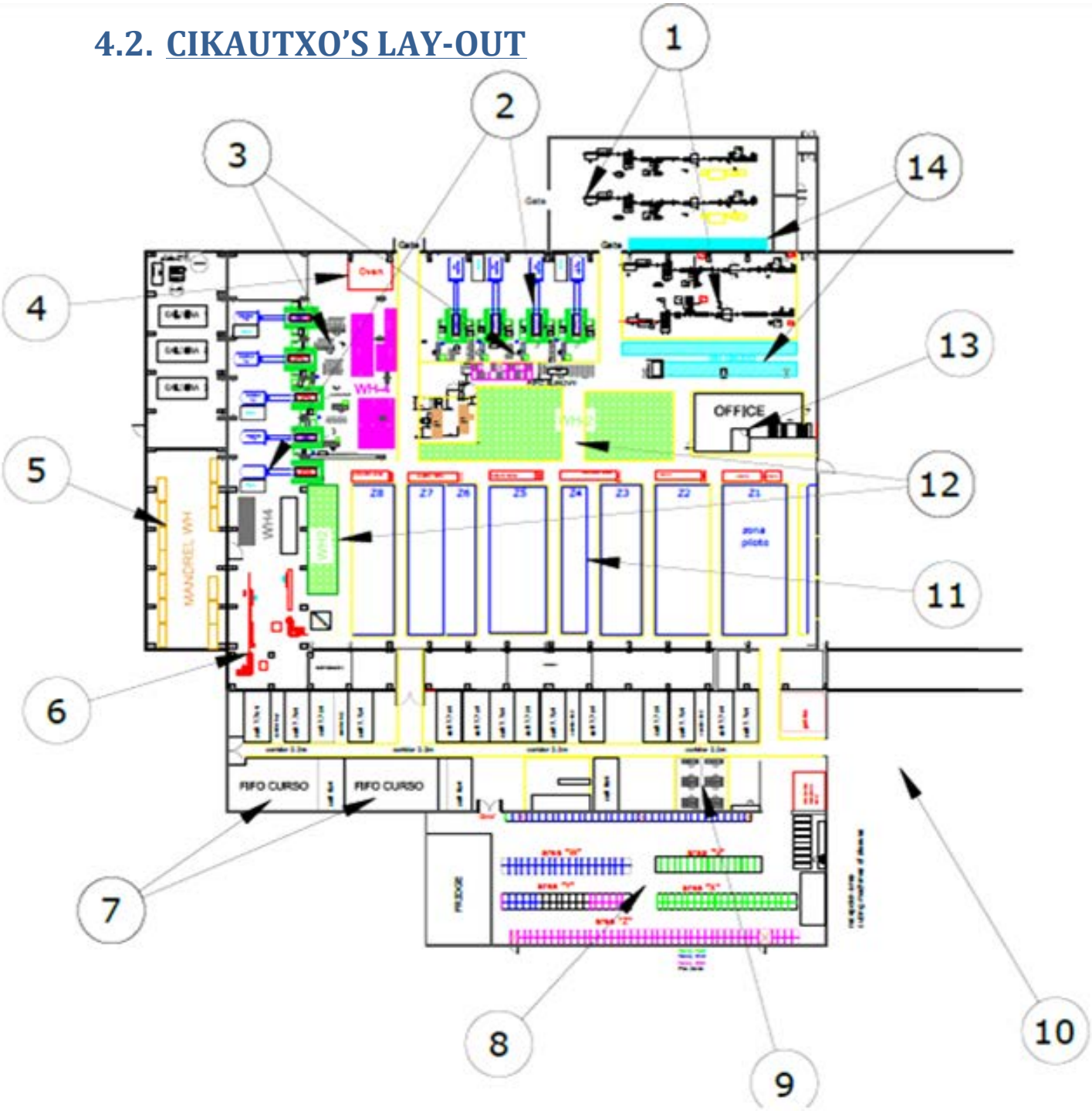
4.1. MATERIAL FLOW → Steps of the manufacturing process

In this part of the work, it will be followed the material in all its manufacturing process. This is why it has been lowered to the production plant to make an exhaustive tracing. This was the result:

1. Rubber arrival into the factory.
2. Extrusion of the rubber by the appropiate machines.
    a. First layer
    b. Introduction of a mesh
    c. Second layer to make a thicker material
    d. Cutting machine
3. Brief waiting before collecting all the references they want to do.
4. Storage in boxes on the floor
5. Small wait until they put the material in the mandrels
6. Autoclave (vulcanized)
7. Cooling by a shower
8. Place the fresh material in boxes.
9. Quality → Check if they are made correctly and distribute them in boxes with a certain number of pieces.
10. Waiting until they go to the washing machine
11. Washing machine with a short wait until they get 2 or 3 boxes
12. Intermediate storage in wharehouse 2 indicate by papers at the top of the area.
13. Comodin collects the material and brings it to the cell
14. Assembly in cells.
15. Transporting the finished pallet to quality
16. Waiting
17. Control of each of the finished product boxes
18. Storage of finished product in the wharehouse outside.
19. Shipping.

In order to increase the understanding of these steps, it has been made a lay-out summary to which can be found after this pharagraph. It has been separated in the different steps of production depending in the way of working.

4.2. CIKAUTXO'S LAY-OUT



Picture 19 - Cikautxo's lay-out in Autocad

In the picture above it can be seen all the lay out of the company, which has been divided with numbers means one number, one part of the factory that is forcefully doing one particular issue. It has been divided in zones because it will be easier to understand the way of work of the company.

So the first process that they start with is:

1. **Extrusion** → Rubber to produce the hoses came rolled in 500metres strips which were joined to the extruder machines. These strips went through all the sub-phases in the extruder, where a polyamide thread was added outside, and then, another rubber layer on the top of it. Finally, the strip was cut according to the specifications and small rubber parts were got. An operator took them and filled an empty box. It is a continuous process where they push the rubber into the corresponding equipment and it is formed tubes with the diameter and length that it is supposed to be.

   Depending on the type of orders that they receive they have six lines.

Picture 20 - Extrusion machine

Picture 21 - Extrusion process

- Four of them work with two levels of rubber, it means that they put the form of the rubber with the first diameter and later they put a mesh layer to give the material more resistance and finally they put the last layer of rubber. In the picture above it can be seen in *number 1.*

- They have another type of tubes that are smaller and they don't have two layers of rubber. These orders are fabricated in the *number 6* of the picture.

It cannot be forgotten that they are working always with big lots because it is cheaper to fabricate a big quantity of tubes than changing the reference all the time. So with this though they try to do in one day all the orders that they have with the same diameter and they will only have to change the length.

As it can be shown in the picture, they keep them in boxes (ten boxes per lot approximately), when this boxes were covered, this operator created a new batch and moved these boxes to the Warehouse 4 after entering new data in the system with scans. After going to the computer to print the paper he had to collocate in the box and after this, they carry all of them to the warehouse.

Picture 22 - Crudo product finished

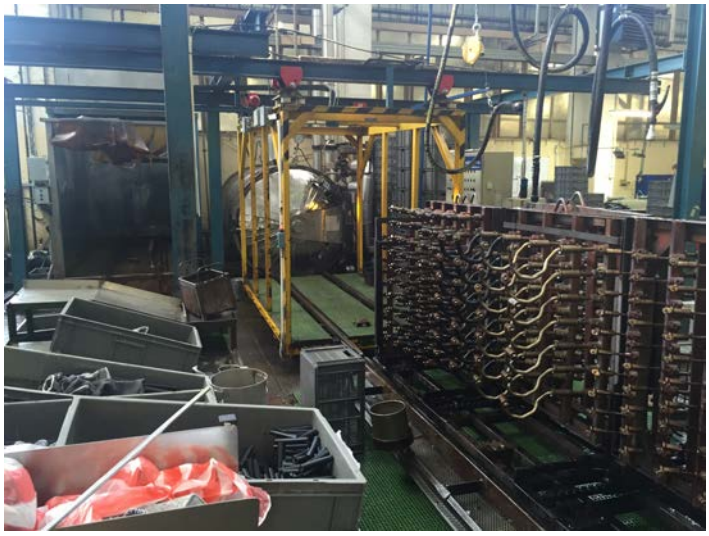
2. **Crudo warehouse** → What they do after this is taking all the boxes (all of them should have the paper) and put it in a place which the operator has to choose. It has not have an order or specific position but the worker has to introduce it into the "Izaro"[4] program because later it is supposed that the next operator has to look into the program to know where the curso is. It is a caotic warehouse where they have 151 positions to have all their crudo but in the company works with more than 600 references.

Picture 23 - Crudo warehouse

Positions in the warehouse are in papers above the boxes as it is shown in the picture. Sometimes this is not the best solution because it has some problems: the first one is that there are too many crudo because they produce too much. The second one is that the workers do not look in the software where do they have to go and they just go and start searching for the reference that they are looking for. It is represented for *the number 14* in the general lay-out.

[4] This is the software program with which the company works.

3. **Autoclaves + Shower (Vulcanization)** → When a specific reference needed to be produced, the necessary quantity of it was taken from the WH4. The rubber was fitted in the mandrels, which in the same time, were in a trolley as it can be show in the picture above. This trolley went directly to the autoclave. Here what they do is sterilizing and giving the form to the product that they want with the help of the mandrels. It is shown in the picture how the mandrels are and it is shown how they put them. It depends on the length and the size of tubes to define which of the mandrels they are going to use, but they always put 6 different types of mandrels. One in the bottom, another in the back and four in the sides.



Picture 24 - Autoclave + Shower + Mandrels

Once all the mandrels are prepared, they introduce them on the autoclave where the pressure and temperature in the chamber is increased. It increases the pressure until the temperature works at least at 150 degrees. This temperature and pressure will remain at this level for at least 15 minutes. This is a high enough temperature for a long enough period to get the form. Operators took out the trolley and emptied the mandrels to fill the boxes again. At this point "crudo" was converted to "curso". Cikautxo counts with autoclaves, which are able to work as 21 cycles of time per shift with nonstop work. It is represented with number 2.

4. **Quality control I** → It exists for each autoclave a table for quality. As it is shown in the picture what they do is to control that the product has the correct form and comply with the requirements. When the tubes came of the shower the operators take them off and put them on the box which depending of the reference and the quality worker gets and corroborates that all the tubes are ok one per one. After checking the rubber, they created a new "curso" batch. This batch had a specific quantity of pieces in each box, according to each reference's specifications.

Picture 25 - Visual quality control I

It is represented with the number 3 and it is logical that they have 8 tables, the same as autoclaves.

5. **Washing machine** → Operators had two washing machines for all the company who work all the time. In each washing machine it is separated in different zones for the different boxes that they receive. These hoses were cleaned with water to remove the lubricant used in autoclaves and then dried. That way, the rubber was ready to be assembled. This process was about 1 hour and it has a big capacity, about 16 boxes per hour, which means 128 boxes per shift. It is really close from the warehouse 2 because after the washing they put the curso[5].

Picture 26 - Washing machine with the board

Picture 27 - Boxes inside the washing machine

6. **Warehouse 2** → The place where they storage all the curso. It has a numerical position system. Right now they are working in an "orderly" way, this means that they put the product in one position, which is defined in the paper on the closet where everybody can see it. They have a paper in the top of the boxes to identify the position number and they stack the boxes on the floor. Sometimes you can find boxes made more than 5 months ago which are at the bottom and they don`t use them because it`s heavy to get the latest one.

   In the picture it is shown how the paper is and how they storage the boxes. It is a project to change this into a FIFO system warehouse, where the first box coming in will be the first box going out. Throughout the work it will be explained how they are going to change and what are they going to use.

   In the lay-out picture is represented with number 12 but it is growing day per day.

[5] Crudo after vulcanization.

Picture 28 - 4 pictures of curso warehouse in different places

7. **Assembly** → Through this process it is important to know that they work in cells, which are around the factory. It was the place where different hoses and incorporables were linked together, cut, painted or added to other hoses. Commodins brought the "curso" from WH1 and WH2 and operators assembled them. Sometimes, these hoses needed to go through more than one assembly sub-processes, but they always ended as final products. They put customer's packaging in pallets for the next process until a commodin took them out. They didn`t have any order before but they have been changing all of them to a better lay-out distribution. Depending on the type of reference that they are making it is necessary to have one, two or three operators.

   Finishing area or assembly process the hoses and incorporables were linked together, cut, painted or added to other hoses. The finishing cells were divided in 3 different halls, "Old hall", "New hall" and "Nano hall". 112 assembly cells were at disposal, which covered 4044m^2. Specific references were produced in each cell, and normally, these never changed. Usually, same customer's references where produced in one cell, and they were not mixed. But sometimes, due to the similar needs in different customers' references, they were combined.

In total, almost 1200 operators were working in 3 different shifts. Every shift, 6 team-leaders, one per every set of 15-20 cells, were assuring that production was running. Moreover 4 commodins were feeding the cells and collecting boxes and full pallets. There were also 4 maintenance guys, and a responsible to collect the waste.

There are 386 different references produced by Cikautxo SK, taking spare parts and low produced items also into account. The "Izaro intranet server" decided the production according to the sales that came directly from the customer. Every day, and only after checking available workers, current stock and new orders, finishing supervisors decided what to produce in each cell. On the other hand, extrusion supervisors decided what to produce in autoclaves. Even if the orders where the same, every process managed its production by itself, without a real link between them.

Right now they have eleven lines close to the warehouse 2 and around 25 cells close to the warehouse 13. It is represented with number 11 and in total there are around 70 cells in all the company.

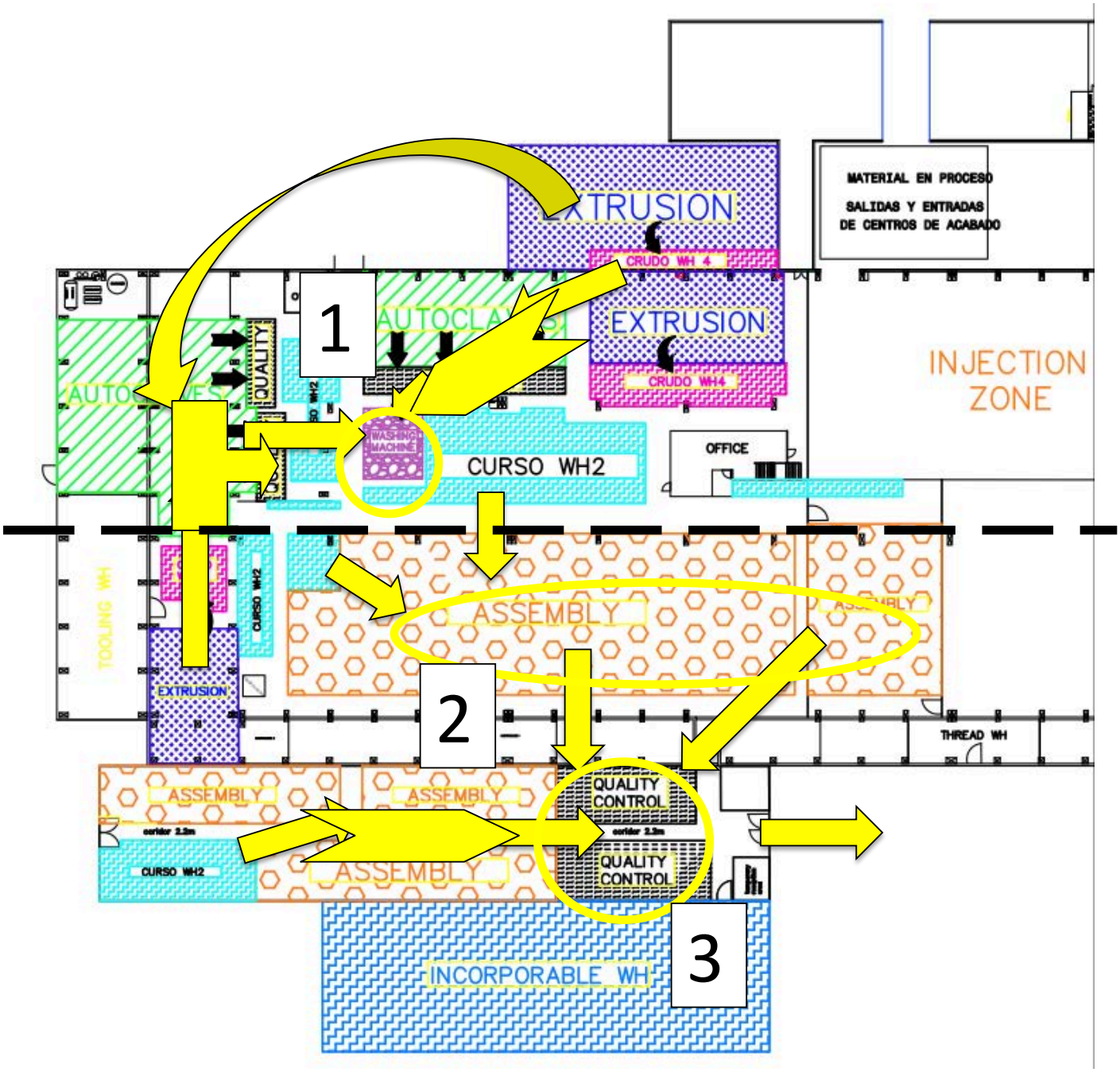
Picture 30 - Assembly cell

Picture 29 - Line 1 and Line 2

8. **Quality** →After the assembly process commodins brought these pallets to the final control area, where some pieces passed a control. There were 10 tables with 10 people working in quality final control. They do a visual control of the product detecting possible defaults. They don`t check all the references, only with some customers in particular because they want to make sure that the entire product that they receive are OK.

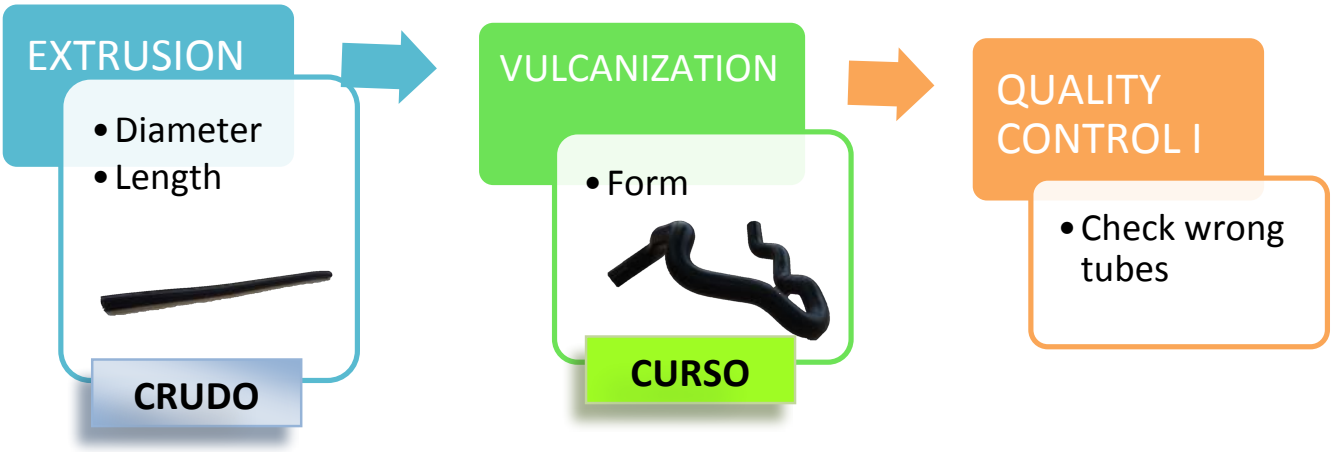
Picture 32 - Red gauge for Quality

Picture 31 - Quality desks



cikautxo	**EXTRUSION LAY OUT**	E 1:1
Kaizen T	Flow material	04/03/16

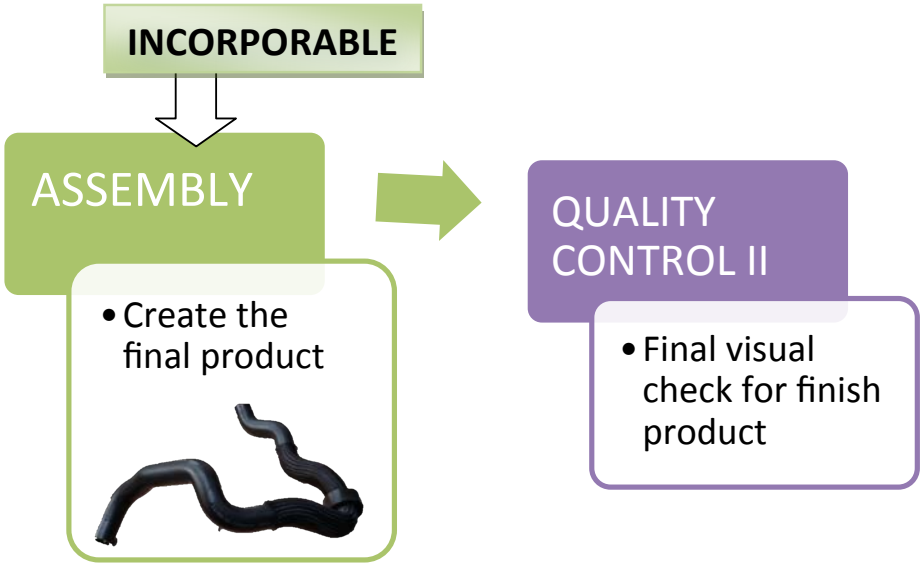
It is important to understand the general idea about how the material flow does because it will be used during the project. In the picture above it is easy to identify three parts. In the picture above it is represented the lay-out of the company. It is shown how



1. The first area transforms the rubber into tubes with the diameter and the length that they want. In this section it is included the extrusion, the vulcanization and first quality control that it has been explained before.

   So they change the simple rubber into tubes, they give them the form and they finally wash them and take them to the visual quality control.

2. The second part is after the warehouse 2, where they storage the curso to feed the cells. In the assembly process they need also incorporables, this means that they put this "incorporables" to the tubes depending the customer or the product that they are making.

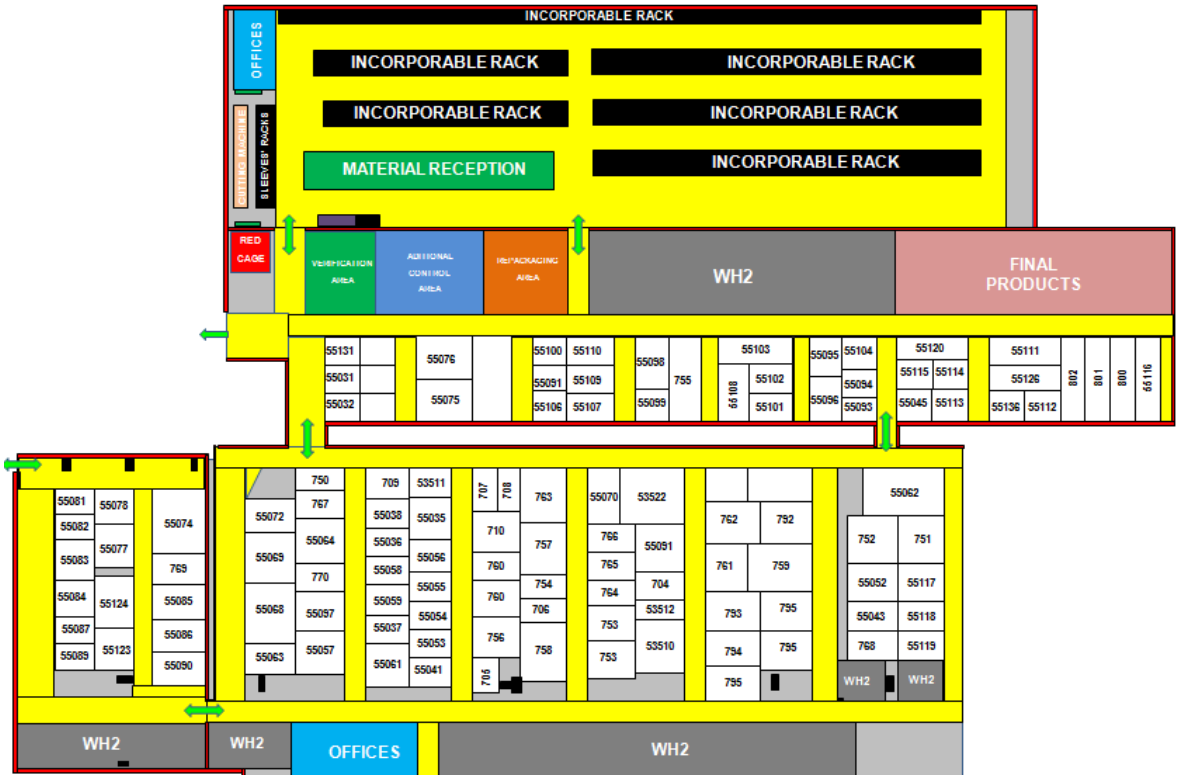


4.3. LAY OUT

Other of the pillars to improve the material flow in the company, was to improve the current lay-out. It was directly related with the objective, as the former lay-out prevented of having optimized production process, standard organisation, stock keeping, control in the cells and visual management. An optimized lay-out would not only bring improvements in the material flow, but also in normas increasing and defect parts decreasing, which may have direct consequences in the billing.

In the past, assembly cells were added in free space anyhow, with no determined rule. The company has tripled the quantity of assembling cells in last 4 years, which made the finishing area be disorganized.

Therefore, before starting with any change, it was necessary to have the real situation of all the finishing area. All the 120 cells were measured and drawn one by one as we found them in that moment; and then, the general lay out was done.



Picture 33 - Old Cikautxo lay-out

4.4. FEEDING ASSEMBLY CELLS

There are different processes but most of the times, the following is held: Items are cut, painted, and joined new incorporables or sleeves. Usually, various hoses are linked together with help of "incorporables". The main equipment used at the assembly cell are explained below:

Machines in the cell

- Painting machine
- Assembly table
- Cutting machine
- Gluing machine
- Leister
- Leak tester
- Inclined support for incorporable and curso
- Barriers for checking amount of parts put into the final box

Gauges

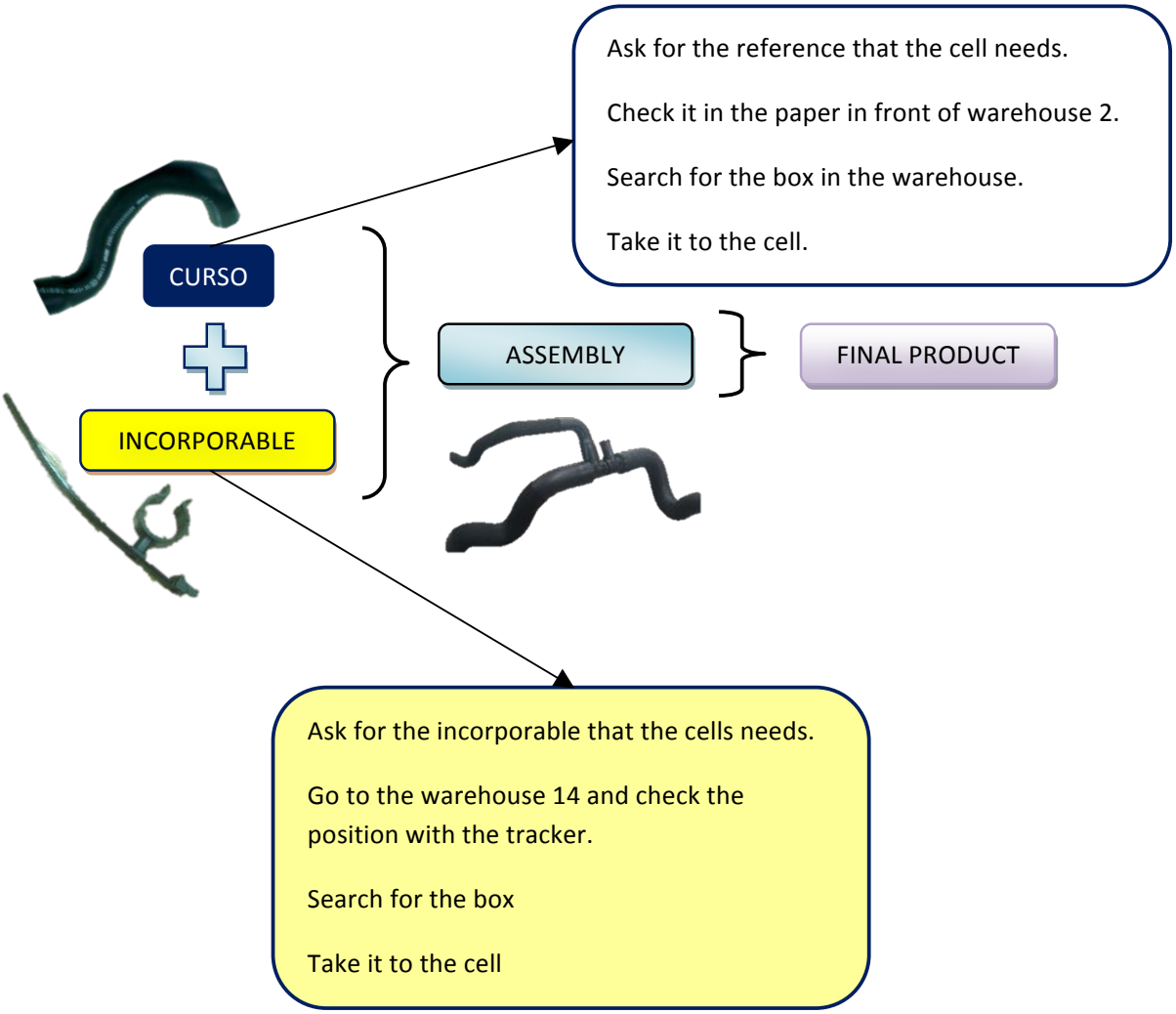
Gauges are measuring instruments that are used for different purposes in assembly. According to its colour, red, yellow or blue, the function is different.

Red gauges are used to make the quality control of components. They must be used every start of the production of a new reference. The first 3 incoming hoses to be assembled are checked in the gauge, and if all of them are good, it is supposed that the batch is correct as well. Therefore, the production continues without any problem. In the other hand, if any mistake is detected, the production must stop. The team-leader is informed and they take the proper corrective actions. If there is enough stock to produce, operator checks this new batch and starts the production; if not, they change the planning and produce another reference. When finishing the production of a reference, the last 3 parts also have to be checked in the gauge, following the same procedure mentioned before.

The use of blue gauges is only for painting. Some references, according to customer's requirements, need to have some information written in them, such as the production date or some internal code for identification. Thus, in some cells, the references are painted, or assembled and painted afterwards. For that purpose, these gauges are fixed between the table and the painting machine and the hose is placed inside while painting.

Finally, the yellow gauges are used for assembly processes. Sometimes, they are already fixed in the table, but most of times they are independent. Hoses are placed in them for being linked or incorporables joined.

It is important to know how they are working right now to identify and check what is important to change or redefine. In the theory is easy to have a general idea about how they work, they need curso and in some references they need incorporable in order to finish the assembly. In the following explication it is represented what they should do;



Feeding the cells is not an easy job; there are too many problems to deal right now. When they are producing one reference they already have all the curso and incorporable material in the cell, but they don`t have only what they need, they also have for the other references that they will produce later.

This is translated as a stock and a mesh view inside the cell with too much material where sometimes the curso or incorporable that they need it isn't there.

Even finished parts are placed into the empty packaging that is kept in the cell, either in the customer's or in the own carton packaging. After the determined needed quantity is reached, the box is covered with a plastic bag and positioned in the empty pallet. In the same way, when the needed quantity of boxes is in the pallet, it is finished and ready to be retired. These pallets go to the visual control area or are stored in warehouse for finished items.

4.5. VALUE STREAM MAP

4.5.1. Choicing a group

It is necessary to focus the mapping process in a single family of products. It could be define a product family as a group of pieces that go through similar processes and equipment operation.

It is exposed in the Excel table below the matrix of a product family as an aid to select one. When the number of references is high, it is advisable to pre-focus the study on the references involving higher production volume.

	Extrusion	Vulcanization	Quality	Washing	Oven	Assembly	Control
Reference A	●	●	●	●	●	●	●
Reference B	●	●	●	●		●	●
Reference C	●				●	●	●

Excel table 1 - Choicing a reference for the VSM

The first group "Reference A" has all the process, but this has not been selected because it is not that common in the company, it is only about the 23% of the products. They want to change this because in a short future almost all the customer's orders will have to pass through the oven.

The second group "Reference B" has almost all the process, it is the same but just with one difference, the oven. This type of reference is around the 72% of the entire customer's orders that they have.

The third group "Reference C" has just the 5% of the process in Cikautxo's manufacturing, that's why this family hasn't been chosen.

4.5.2. Reference 5791200

This analisys will be started with a chronometer and a selected reference that they are going to produce for a client.

- ✓ **Customer**→ NISSAN
- ✓ **Crudo quantity** → 1500 pieces
- ✓ **Custormer order**→ 400 pieces

- **Extrusion** → 1 hours and 12 minutes → 4320 seg
  Measuring the time and observing, the extrusion process which is just measure how long does it takes from the rubber to the defined tubes were these results;

  ✓ $\boldsymbol{OEE} = Avaiability\ x\ Performance\ x\ Quality = 0{,}9375\ x\ 0{,}9875\ x\ 0{,}99 = \mathbf{91{,}6}\ \%$

  o $\boldsymbol{Aviability} = \frac{Run\ time}{Planned\ Production\ Time} = \frac{67{,}5}{72} = \mathbf{93{,}75\%}$

  $$Run\ time = 72 - 4{,}5 = 67{,}5$$

  Where 0,281 is the time that they have for rest in that time.

  o $\boldsymbol{Performance} = \frac{Ideal\ cycle\ Time\ x\ Total\ Count}{Run\ Time} = \frac{0{,}166\ x\ 400}{67{,}5} = \mathbf{98{,}75\%}$

  o $\boldsymbol{Quality} = \frac{Good\ count}{Total\ count} = \frac{396}{400} = \mathbf{99\%}$

- **Crudo warehouse** →1 day and 6 hours
  This stopped is since the material of crudo is stopped from the extrusion machine to the vulcanization process.
- **Put the material in mandrels** →9 minutes and 30 seconds (48 pieces)
  All the reference takes 85 minutes and 30 seconds.

- **Waiting** →18 minutes and 45 seconds (48 pieces)
  All the reference takes 168 minutes and 45 seconds.

- **Vulcanization + Shower** →20 minutes and 50 seconds (48 pieces)
  All the reference takes 187 minutes and 50 seconds.

- **Waiting** → 4 minutes and 20 seconds
  All the reference takes 39 minutes

- **Quality Control I** → 12 minutes and 25 seconds
  All the reference takes 108 minutes and 40 seconds.

  ✓ $\boldsymbol{OEE} = Avaiability\ x\ Performance\ x\ Quality = 0{,}938\ x\ 0{,}993\ x\ 0{,}9675 = \mathbf{90,11}\ \%$

  o $\boldsymbol{Aviability} = \frac{Run\ time}{Planned\ Production\ Time} = \frac{108{,}66}{115{,}8} = \mathbf{93,8}\ \%$

  o $\boldsymbol{Performance} = \frac{Ideal\ cycle\ Time\ x\ Total\ Count}{Run\ Time} = \frac{0{,}27\ x\ 400}{108{,}66} = \mathbf{99,3}\%$

  o $\boldsymbol{Quality} = \frac{Good\ count}{Total\ count} = \frac{387}{400} = \mathbf{96,75}\%$

- **Waiting and transport** →15 minutes
  All the reference takes 135 minutes

- **Washing Machine** →1 hour and 1 minute

  All the reference takes 559 minutes or 9 hours and 30 minutes

  In this washing machine, the operator has just a limit quantity of boxes and after the process, he has to keep each box in the warehouse 2 finding the positicion and placed for it.

  ✓ $\boldsymbol{OEE} = Avaiability\ x\ Performance\ x\ Quality = 0{,}941\ x\ 0{,}954\ x\ 1 = \mathbf{89,77}\ \%$

  o $\boldsymbol{Aviability} = \frac{Run\ time}{Planned\ Production\ Time} = \frac{559}{594} = \mathbf{94,1}\%$

  o $\boldsymbol{Performance} = \frac{Ideal\ cycle\ Time\ x\ Total\ Count}{Run\ Time} = \frac{1{,}33\ x\ 400}{559} = \mathbf{95,4}\%$

  o $\boldsymbol{Quality} = \frac{Good\ count}{Total\ count} = \frac{400}{400} = \mathbf{100}\%$

- **Curso warehouse** →22 days
  Here it could be find all the different types of curso imagined. It is distributed around the entire company and in some cases they have stock for more than 22 days.

- **Assembly** →10 hours

✓ $\boldsymbol{OEE} = Avaiability\ x\ Performance\ x\ Quality = 0{,}9411\ x\ 0{,}8\ x\ 0{,}96 = \mathbf{72\%}$

o $\boldsymbol{Aviability} = \frac{Run\ time}{Planned\ Production\ Time} = \frac{600}{637{,}5} = \mathbf{94{,}11\%}$

o $\boldsymbol{Performance} = \frac{Real\ production}{Production\ capacity} = \frac{40}{50} = \mathbf{80\%}$

o $\boldsymbol{Quality} = \frac{Good\ count}{Total\ count} = \frac{384}{400} = \mathbf{96\%}$

In assembly in norma puts they can do 42 pieces per hour but they do 40 pieces per hour. There is also the quality part that takes the 4 percentage of the total that they do.

- **Waiting** →45 minutes
- **Quality Control II** →6 hours and 40 minutes

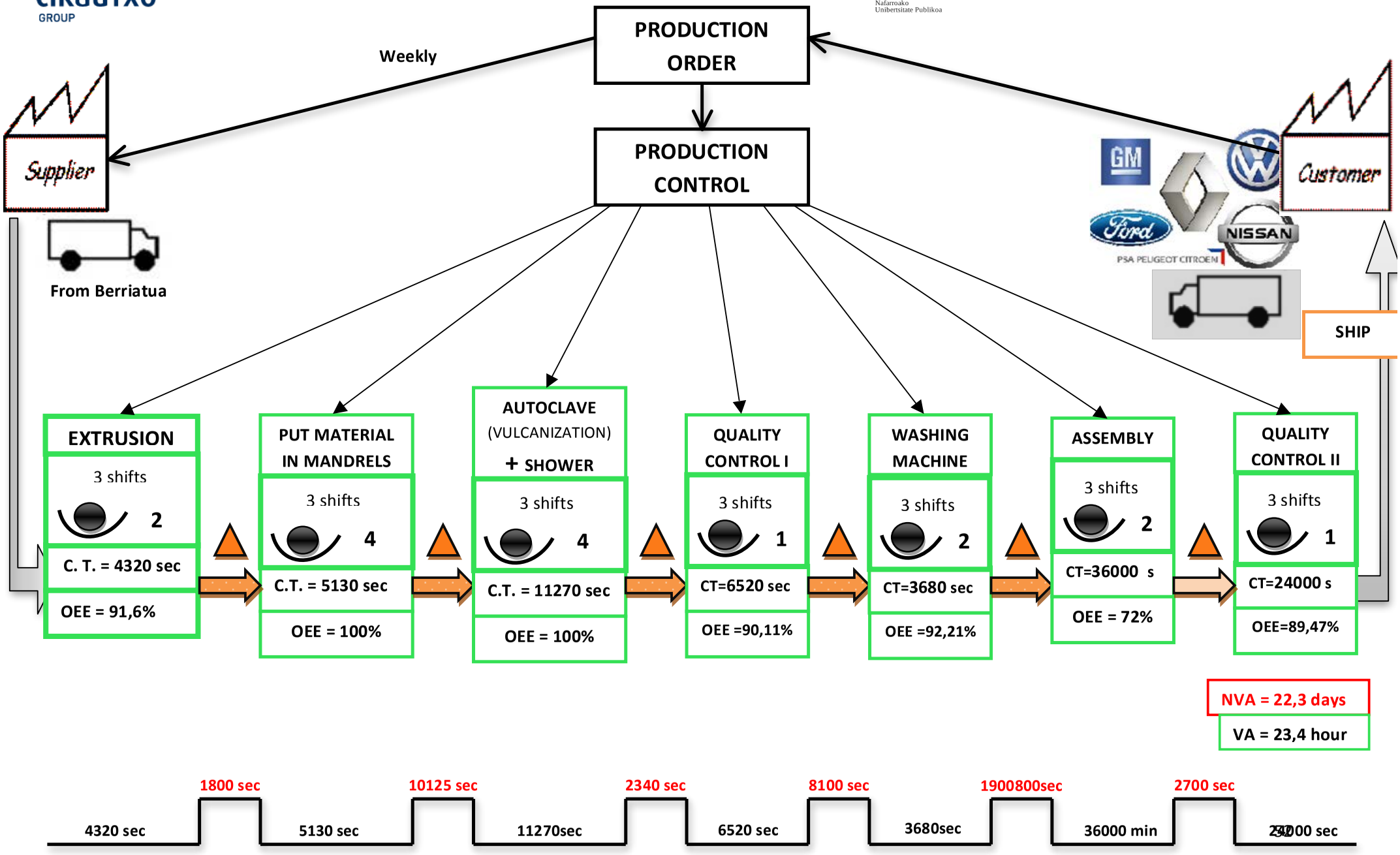
✓ $\boldsymbol{OEE} = Avaiabilityx\ PerformancexQuality = 0{,}9411\ x\ 0{,}9677x\ 0{,}9825 = \mathbf{89{,}47\ \%}$

o $\boldsymbol{Aviability} = \frac{Run\ time}{Planned\ Production\ Time} = \frac{400}{425} = \mathbf{94{,}11\%}$

o $\boldsymbol{Performance} = \frac{Ideal\ cycle\ Time\ x\ Total\ Count}{Run\ Time} = \frac{0{,}96x\ 400}{400} = \mathbf{96{,}77\%}$

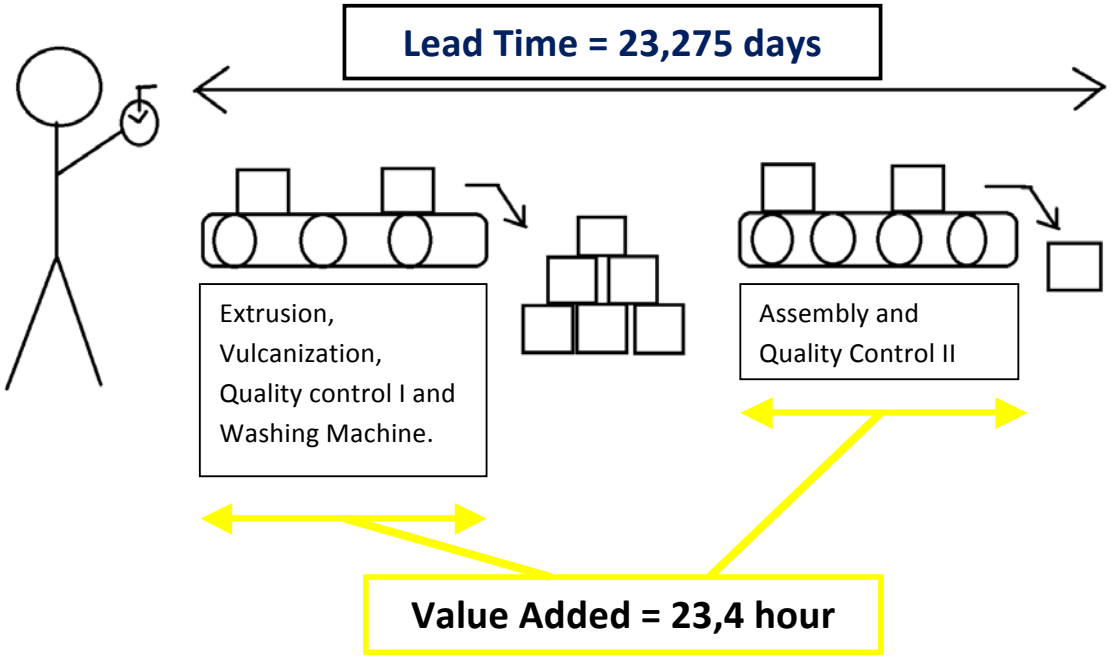
o $\boldsymbol{Quality} = \frac{Good\ count}{Total\ count} = \frac{393}{400} = \mathbf{98{,}25\%}$

In quality control norma puts that they can do 62 pieces per hour but they do 60 pieces per hour.

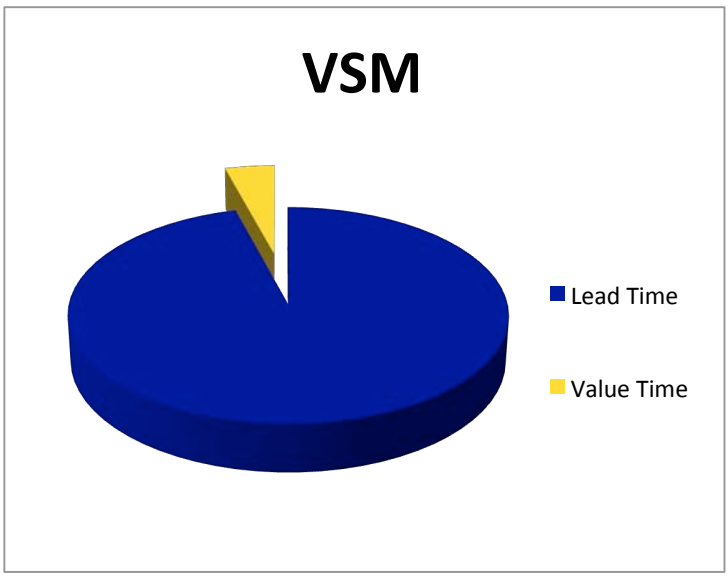

PRODUCTION ORDER
Weekly
PRODUCTION CONTROL
Supplier
From Berriatua
Customer
SHIP
EXTRUSION
3 shifts
2
C. T. = 4320 sec
OEE = 91,6%
PUT MATERIAL IN MANDRELS
3 shifts
4
C.T. = 5130 sec
OEE = 100%
AUTOCLAVE (VULCANIZATION) + SHOWER
3 shifts
4
C.T. = 11270 sec
OEE = 100%
QUALITY CONTROL I
3 shifts
1
CT=6520 sec
OEE =90,11%
WASHING MACHINE
3 shifts
2
CT=3680 sec
OEE =92,21%
ASSEMBLY
3 shifts
2
CT=36000 s
OEE = 72%
QUALITY CONTROL II
3 shifts
1
CT=24000 s
OEE=89,47%
NVA = 22,3 days
VA = 23,4 hour
1800 sec
10125 sec
2340 sec
8100 sec
1900800sec
2700 sec
4320 sec
5130 sec
11270sec
6520 sec
3680sec
36000 min
24000 sec

4.5.3. Analisys of the VSM

Once it has been analized all the processes in the company it is important to represent and understand the obtained data in order to make changes and think in diferent strategies to improve them. First of all it is important to know what Lead time means; it is the measurement of time that takes one unit to make the manufacturing process from the begining to the end. It begins with the first process and stop when it is finished and prepared for the shipping.



Studying times with the order mentioned before has taken us this percentage which is not efficient for a multinational company. It is something that they have to change if they want to improve and offer the customer good quality. It has been calculated and separated the percentage of added value time against the wasted of time.



Graphic 3 - Lead Time, Value Time (Conclusion VSM)

If it is transfered the lead time into hours will be:

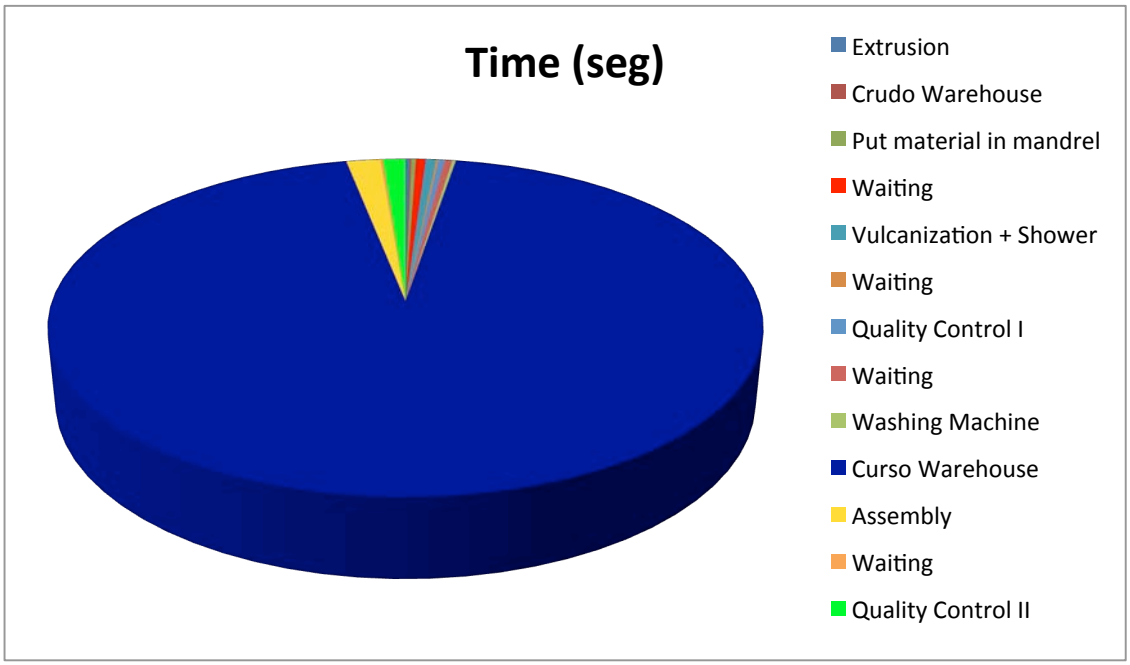
$$23'275\ days\ x\ 24\ hours = 558'6 hours$$

This means that if is compared the lead time against the value added time it will be:

$$\frac{23'4hours}{558'6hours} * 100 = 4'18\%$$

It could be said that only the 4'18% of the time this company is adding value to the product. This is something impermissible to a multinational company which is increasing every year and getting more orders for their customers.

But it is curious to analyze the invested time in each step of the process, including the transportation, the storage and the waiting time that it has to be stopped. In the following graph it is shown how it is spent the time producing the reference explained before.

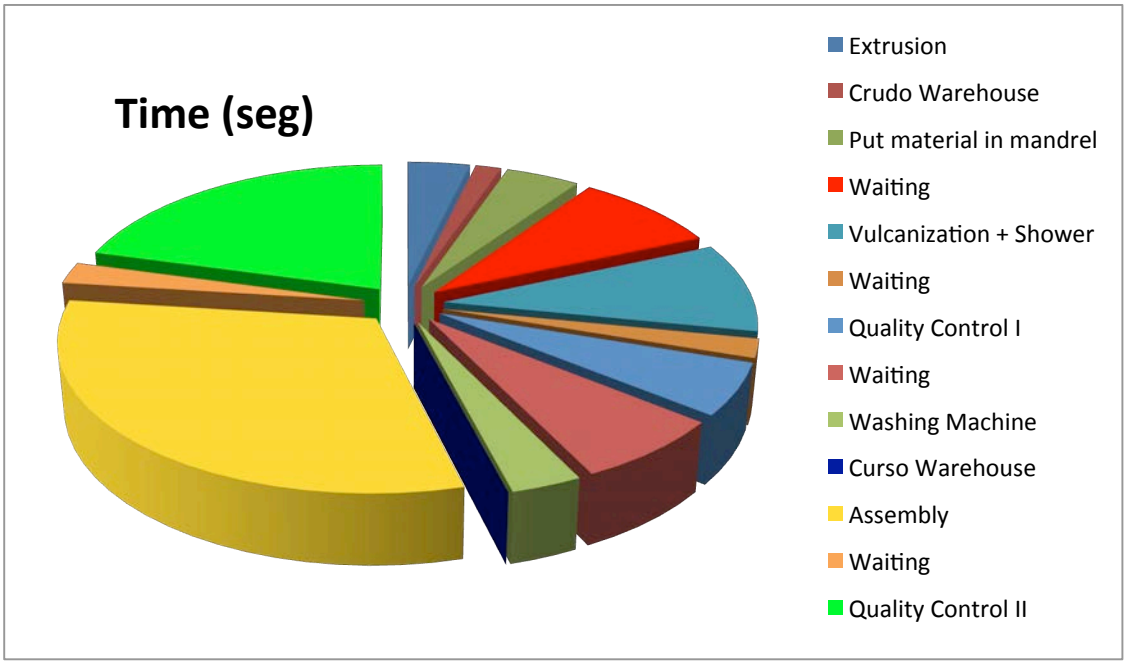


Graphic 4 - Specific times for the process

As it could be seen above in the value stream map, it was easy to identify that the reference has stayed too much time at the warehouse 2 (the "curso" stockage). In this company, warehouse 2 represents the most critical area of the production. In spite of being defined the time of storage as 5 days maximum, Cikautxo can't afford this aim. All of the other processes represented in the graphic above are common or aren't as bad as the storage of curso. This is something that they are not able right now to achieve if they don't change the way of work. Going through the warehouse again is seen boxes made since september or november but it hasn't been used them because they are at the bottom of the column. For the comodin it is really dificult to get into the last box if the column has more than 7 boxes above it.

In this project it will be explanied which measures are taken in order to change this way of work and what things should they change to making it a profitable investment.

After talking about the warehouse 2, it has been though that it would be a good idea to show the other processes to know which of them are the others that take too long. It is important not to focus only in the worst one (warehouse 2 in this case) because sometimes small changes make big differences to the company.



Graphic 5 - Processes without curso warehouse

In this graph is easy to identify which are the second and the third process that takes longer.

1. Assembly → It is normal that this is the second position because it is a handmade work. It isn't any machine doing and joining the pieces, the machines which have been explained before just help the operator in its tasks. In each cell there are one, two or three operators depending on the type of product. Operator takes the tubes, introduce them in the incorporable and put them in boxes to the quality control II.

2. Quality Control II → It is in the third position because is all its work is a handmade work. It is the same as the assembly one. In the reference studied the customer wanted 400 pieces, they put them in 20 boxes with 20 pieces in each. It means that only a woman (always woman) is responsible of the order and she has to look into the 20 boxes and check all the pieces one per one making marks on the tube with a pen.

This is a simple analysis of a common reference but they repeat this process for almost all the products that they have. They have around 600 references which means too much wasting time or what is equivalent, time without adding value to their pieces.

4.5.4. Problems found at the VSM

The entire process was checked from the start till the end and we took note of different points:

- Excessive intermediate stock before assembly cells. "Cikautxo Cooperative" decided that 4-5 days of stock would be fine, but some references seem to have 3 or 4 times more quantity than the defined one.
- Previously mentioned stock did not follow FIFO rules as they were stocked one on the top of the other and taken out anyhow (sometimes all of them, other times just upper ones).
- Disorganized working areas. Even if the process is defined in each assembly cell, workers do not follow these step by step, and they modify, add or delete some items.
- Similar technologies' cells were sometimes far one from each other. The lay-out seemed not to make sense in some occasions.
- No rules for keeping row material, attachments, boxes, gauge, pallets and documentation in the cells. Each cell had its own internal management and they placed things wherever they could.
- Feeding of assembly cells and taking out of output is not determined and is managed randomly, without a defined system, frequency and assignment of responsibilities.
- Incorrect identification of material during the process. There was lack of information or incomplete data fulfilling.
- Big batches production in extrusion process, without changing the reference production frequently and this way, generating big intermediate stocks.
- It was not clear the real tasks team leaders should do as in each area, these people used to do different things such as transporting pallets, arranging cells, or feeding the cells.
- **Extrusion** → For a customer lot of 450 pieces, they do 1000 pieces. *Is it cheaper if later we have more stock?*
- **Crudo warehouse** → It is a chaotic warehouse where the workers search the number one per one of all the boxes. It is not defined who has to go to pick up the curso.
- **Vulcanization** → It is all the time working. *Is it necessary?*
- **Quality** → Worker have time enough to do it although they are all the time complaining
- **Curso warehouse** → Too much stock everywhere. Workers are all the time looking to the papers and searching their references. Sometimes they don't find it.
- **Assembly** → They don't have curso. They stop because they don't have all they need

4.5.5. Some conclusions of the VSM

- **Working rythim**→It is extrusion that is producing a lot almost without control because they say is cheaper. It is true that the machines are working with a very high efficiency, but they are working with a push system and the one that has to indicate the rhythm is the cell. Cells should be the ones, which has to produce what the customers want, and all the processes should adapt at this way.
  Try to change to a pull system

- **Stock** →The quantity of stock that it is in the warehouse is huge. In some reference they have stock for more than 3 months. This is the reason why they don't have space enough if they want to grow and they have to invest in another building. Having just the stock needed they should have more spaces for more cells.
  It is also unknown the quantity of material that they have and until when they should have it. Production personal has to go every day in the morning to check if they have the reference that they want to assembly that day.

- **People** →Languages problems and changing their minds in the way that they should or they will have to work. Most of the employees should know Slovak because they are working in Slovakia, but this is not true at all. Too many people are from Hungary and they just know Hungary, this is a really problem when they have to complete some papers with information because they don't really understand what they are doing and they need the job.

- **OEE** →The lowest efficiency that we have it is in the assembly and Quality Control II, and it is common because is a really manual work which need lots of hours to just do one order. Even for the ladies is quite difficult because they have to look one piece per one of an order which has 600 pieces.

4.6. TASKS

Employees in Cikautxo work as they have been taught in the past. But in these years the company has grown too much in a chaotic way, which means that people do what they think they have to do but without any logical structure.

In Cikautxo exists a problem right now, people do what they want because they don't really know what they have to do. This means that they do disorganized tasks and without any control. The purpose of this part of the work is to define its skills with a logical structure.

Using the spaghetti diagram tool it has been studied how the material flow is, and how many workers are necessary to do all the manufacturing process. Looking and observing how employees were doing things, it was easy to find that there were lot of people moving without any sense. That is why I decided to follow a "Comodin".

4.6.1. Commodin

The "Comodin" is the person who supplies and takes care of the crudo feeding for the cells. He is the responsible to collect the cartoon and empty boxes from all the cells. These simple tasks are not difficult but if it is not organized adequately, it is a waste of time.

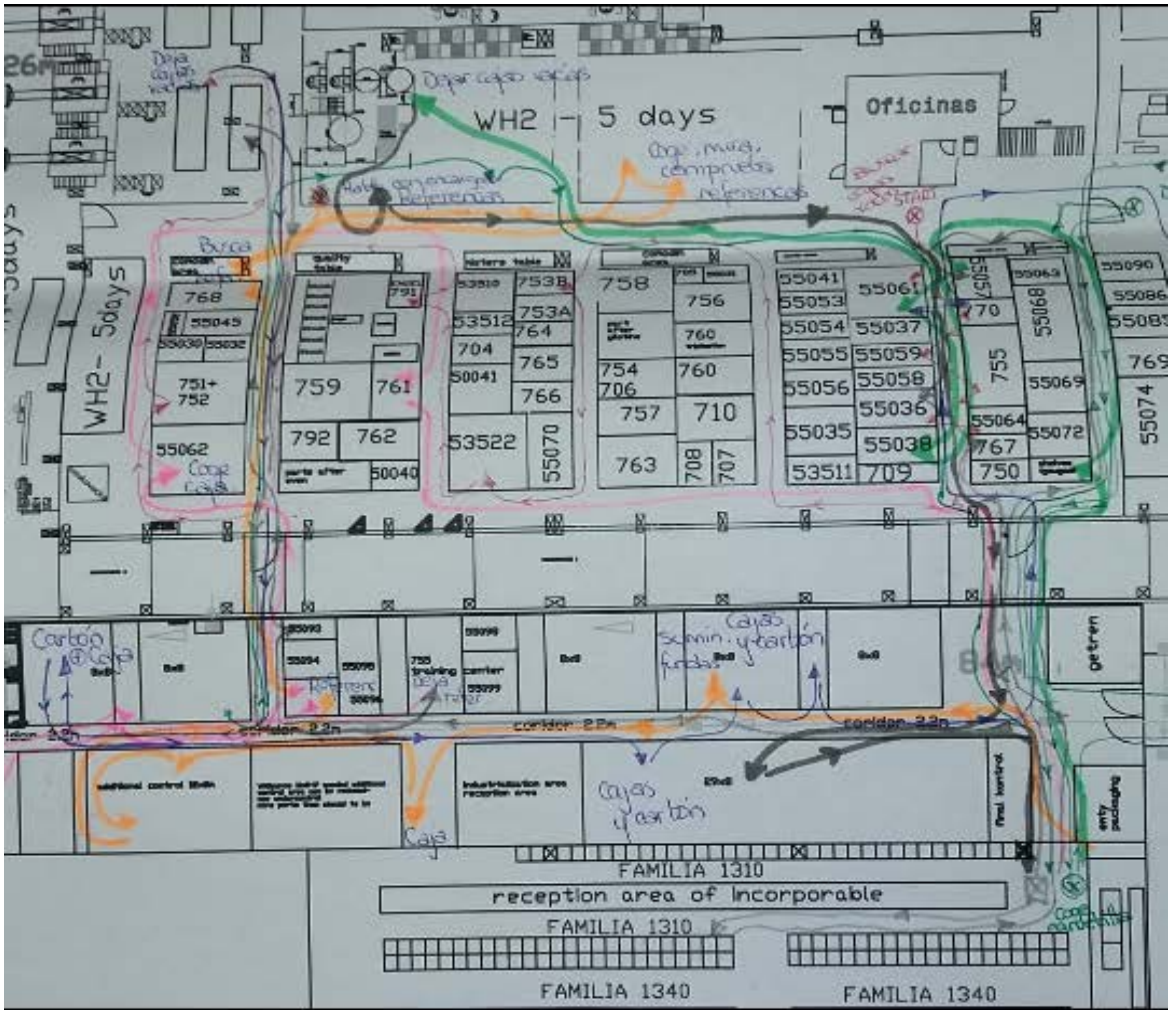
It is common to see the commodin walking around the company without any specific task and looking for empty boxes or carton inside the cells. Operators also ask them for some references and they leave what they are doing to search the curso or incorporable that the cell needs.

It has been studied all the journeys and movements that the commodin does in one random hour and day. This is what it shown

So following the necessary guidelines, I went with the comodin for 1 hour and I exactly what their movements were, and what were the tasks that he did.

29 of Frebruary

Turn → 11:00 – 12:00 AM



Picture 34 - Spaguetti diagram of a commodin

After this it was easy to define which skills he had to do:

1. He searched empty boxes.
2. He left the boxes in Warehouse 4 (near the oven).
3. He went to the new-hall and took the empty boxes and cardboard. He crossed through all new-hall and went to the nano-zone.
4. He gave the empty boxes to another comodin.
5. He went to the warehouse 13 and took a forklift. With the forklift went outside to take 2 pallets and carried them to the nano hall.
6. He returned to the warehouse 13 and left the forklift. Then he went to the scanner and searched the incorporable.
7. After this, he delivered the incorporable to their respective cells, in pilot zone and in new hall.
8. He took one curso reference in warehouse 4 (near autoclave 718) and carried to some cells that are in new hall.

If it is analyzed what he has done, it is observed that he does not follow any type of rules. He walks around the cells looking for tasks to do and this is not the best way to work.

4.6.2. Team Leader

Once it was studied with the commodin, it was thought that it would be a good idea to analyze what the team leader does. It was chosen a random day and hour, to see and study all the journeys and movements that he does, but it was decided to study it in two hours because the first one he was repairing and solving some problems.

Other member of the "Kaizen team" used also the spaghetti diagram to define the tasks that team leader is used to do and these were the results:

1. Checked the quantity of pieces of previous shift in each cell
2. Took another paper from de "check point" and wrote down the people who have been working that day
3. Returned to the "check point" and took another paper to point the references in each cell and asked if they need stickers.
4. Printed the stickers and got tools for one cell.
5. Went to the warehouse 13 to take a forklift. Changed the matrix for one ENGEL. Gave back the forklift to the WH13
6. Checked some documentation in two cells and went to take a red gauge for one of them to the warehouse
7. Took the 4 pieces from one cell and went to the quality table in the new hall. There checked if the pieces were OK and went back to the cell
8. Reviewed the documentation of the last cells that were missing.
9. Put paper in "check point" and took a lift to take a jail with final parts of one cell.
10. Placed the final parts in other point, and took an empty pallet and giving back to the same cell
11. Took another jail and put in other position and left the lift.
12. One operator told him that he had a problem with the AURBURG machine. Talked with Dano, took some tools and with another guy fixed the machine
13. Turned back to the "check point" and printed more stickers.
14. Went to the office, a looked for some paper and someone told him that he had to go to the final warehouse. In final warehouse talked with Dano and returned to his zone.
15. Tested one piece in a red gauge and carried another red gauge to the warehouse.
16. Took another red gauge and carried to the cell.
17. Picked up a lift, took final product from one cell and delivered to the ENGEL. Left the lift
18. Went to the "check point", took papers and went to the office.

4.6.3. Operator

It was also important to define the tasks of the operator because some of them were going to change with the new Kanban system. It was not used a spaghetti diagram but it was easy to define which were their tasks observing them.

1. Took carton out of the cell
2. Good quality assembly.
3. Checked that all the machines were OK.
4. Took and put all the gauges.

In order to change this, it has been though that it would be a good idea to define new skills and tasks based in these parameters:

- Simple tasks
- Economize the movements
- Logical routes
- Decreasing time and meters
- Dividing the plant in zones

With this approach the “Kaizen Team” has though in some changes in the way of work. With the aid of Kanban system (that it will be explained on the following pages) it has been reorganized all the assembly process.

4.7. IDENTIFIED PROBLEMS IN CIKAUTXO

Cikautxo Slovakia is the company where the "Kanban" system has been implanted. After the growing this factory presented serious shortcomings in its organization and in its production.

The aim problem was that nobody cared about the company's problems, not only the operators even the management. Although they didn't have any order in the factory and they had deficiency, they didn't change anything because they had stock to prepare all the customer's orders and they weren't late to the delivery date.

The problems detected at Cikautxo Slovakia join to a really bad organization and a not very good plan production, meant lot of stock and high manufacturing lead-time.

Even though the **high manufacturing lead-time** was really large, it was really common to have a delay in the delivery date. This happened because they were changing the production planning all the time to make the delay orders first.

Let's see this with an example; one of the customers Nissan makes the order every week of 450 pieces. Cikautxo is able to make in the average of 20 days doing all the process, extrusion, washing, assembly, quality and displacements. In this time and knowing that they work in 3 shifts, which means 22.5 daily hours, they were able to make 1000 pieces. Now that we have the information it could be said that they should have been able to do the order in 8 days. However, it is not a surprise to say that they were late in most of the orders.

The problems generated with this model of production were:

1. ***Lack of flexibility to manufacture any urgently parts***; it means that in the case that there was an order of 450 pieces and they produced 400, but for organization problems were missing 50, there was no way to make them. They had to wait for the next tool change to make them, later the time to assembly and the quality control and all the displacements that they had to do.

2. ***Excessive time changing machine's tool***; Extrusion machine is organized in order to the diameter of the tube. It means that at least one shift will be only producing tubes of different length but without changing the other parameters. The size of lots that they are producing is too big comparing with the customer orders. With the same example as before, if Nissan wanted 450 pieces, they were producing 1500 pieces because with this way, they won't produce more during the week.

3. ***Bottlenecks***; These are the results of the unsynchronized production planning and the assembly cells. If Nissan needed 450 pieces and the assembly cell was working only in the order, it is 1050 pieces that they had to be stock at the warehouse. This

was just with the Nissan order, just with one reference but Cikautxo works with 600 references, which meant more products stored at the warehouse. Hundred and hundred of boxes stacked one above the other.

Regarding the changing machine's tool mentioned below, it is important to mention that the company showed some fear in order to change their modus operandi because it was something complicated, costly in time and money, and needed several employees dedicating their time only for this.

Another problem detected was related to ***the layout*** ("plant design") ***was not the ideal***. Checking the route that the parts of rubber have to do since the beginning production until the shipped to the customer was observed not only excessive distances but also the means of transport materials were slow and inefficient.

On the other hand, the ***machines failures*** were frequent and were not controlled; operators didn't mind of the monitoring fault that they had. The way that Cikautxo solved this problem was producing a certain percentage more what was needed, "Just in case it appeared any kind of damage". This situation created another problem that has already been previously presented and was what to do with the ***leftover pieces***. The excess production caused the storage of boxes, the disorder, the lack of space, the disorganization and difficulty in managing and locate the thousands of leftover pieces.

Talking about ***quality***, company's policy was "trust at the intermediate process" which consists in checking the final product in the last process, before being packed and sent. It is done like this because checking the quality conditions before and after each process involved a great lose of time.

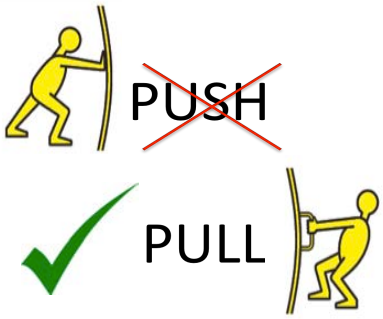
4.8. GENERAL CONCLUSIONS

Once it has been explained all it is easy to conclude that they have several problems because they have too many stock at the warehouse 2. But once it is seen this, it is necessary to ask why do they have all these stock because they will have stops like in the right picture with the water.

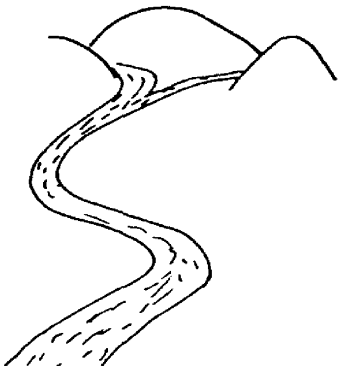
Picture 35 - Not a fluid process

1. **Extrusion →** They produce more quantity of tubes than the quantity that they need because it is cheaper. In conclusion, they work with big lots producing too much stock and putting it on the floor waiting for the vulcanization.
2. **Warehouse 2 →** Producing this amount of tubes that they are not going to use means that they have to storage somewhere. They should have stock only for five days in this warehouse but sometimes they have stock for months.
3. **Cell →** In the assembly process the rhythm is different, they are not be able to do all the company need and sometimes they have to come on Saturday to continue with the job. It's three shifts per day of eight hours each but it is not enough to cover all the orders.

All this things explained above means that they are working with a "PUSH" way, and for the Kaizen culture this is not fine. It is important to change this to a "PULL" way of work but the main question is how are we going to achieve it?



Picture 36 - Push or pull



Picture 37 - Continuous flow

After collecting all the needed data, the next step was to analyse them, make proposals and suggestions. It will be important to change these things if it we want to reduce the stock and improve the way of working. Some changes could be:

- Reducing the size of the lots in extrusion.
- Introducing the Kanban system.
- Making a FIFO warehouse 2.
- Knowing the tack-time.
- Improving the lay-out.

4. CURRENT SITUACION WITH THE SYSTEM IMPLIMENTATION

4.1. OPTIMIZATION OF THE LAY-OUT

With the global view of the general lay out it was difficult to make any conclusion. It was necessary to rise the analysis phase in 2 different steps: optimisation of every cell and new location of cells.

4.1.1. Optimization of assembly cells

Few problems were found referring to the lay-outs of assembly cells:

- There is excessive curso and incorporable stock in assembly cells.
- Cell's lay-out not optimized
- Some items missing, other ones not needed
- Not determined place for the items

To solve the problems and before giving any solution, every cell was first drawn and then measured. Right after, the same procedure was followed in all of them:

1- Decide which things were unnecessary and needed to be taken out.

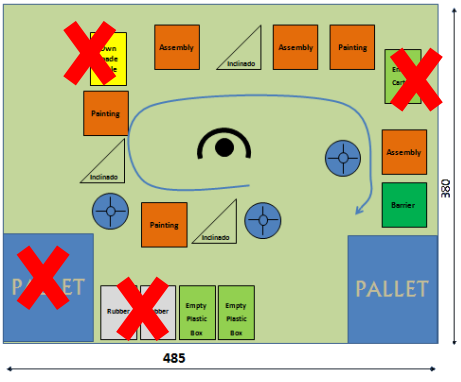
2- Find which things were necessary and needed to be brought.

3- Determine specific place for incorporable, curso, empty packaging and final good pieces.

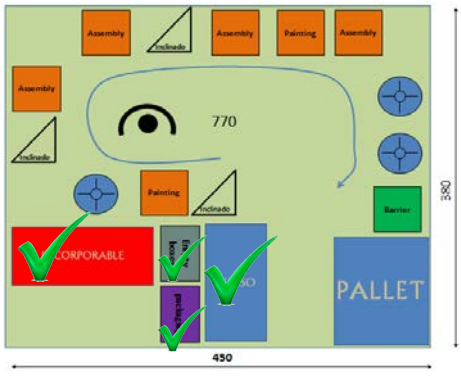
4-Optimize production flow by eliminating free spaces, squeezing processes, reducing movements and taking into account ergonomic issues and security.

5- Keep space for the entrance in the cell, wastage, personal belongings and documentation.

Down below, an example of cell optimization is shown, exactly for assembly cell 770.



Picture 38 - Old lay-out of a cell



Picture 39 - New lay-out of a cell

FIGURE	DEFINITION
INCORPORABLE	Incorporable rack
CURSO	Place for curso
Painting	Assembly machine
Barrier	Barrier
Inclinado	Support for curso and incorp.
	Dryer
Empty boxes	Place for empty boxes
Packaging	Place for packaging

Excel table 2 - Components of the cell

As it can be seen in the image and with the aid of this Excel table, some things and positions has changed.

Repeated place por final good pallet has been eliminated to create an organize assembly process.

Rubber and empty boxes has taken out from the floor and has specific place determined for them in order to not have mesh inside.

Take out the tables made by the operator with plastic or carton boxes because in most of the cases they didn't need them.

It has been introduce racks for incorporable on the cell because they were keeping it on the floor and sometimes they didn't have what they need for the order.

Dryers has been puting in its proper place and fixed to the floor not to move them, because in some cases, operator used to move them.

It has been reduced around the 7% of the used space in each cell.

BENEFITS

- It has been kept in racks only the needed stock.
- It will be easier to implement the 5S in a short future.
- Norma has been increased from 7-20% in some references.
- Wrong parts have been decreased, improving the quality and the order.

4.1.2. New location of assembly cells

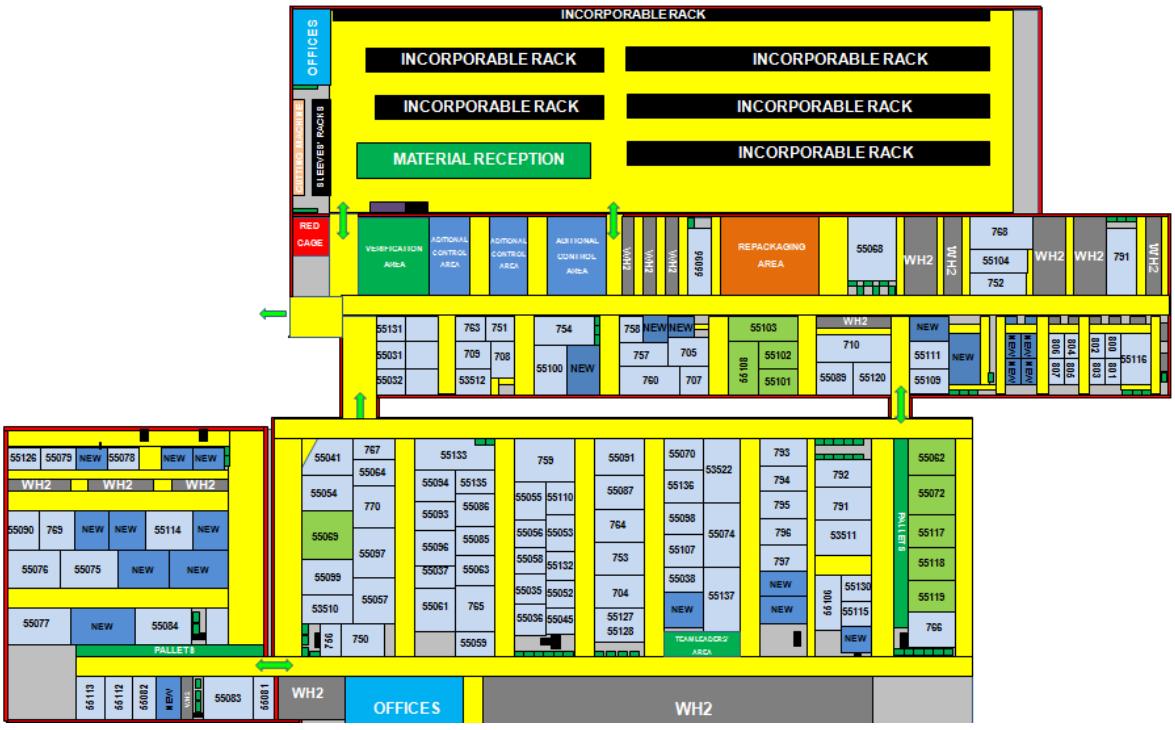
In the same way, regarding the general lay out there were so many problems: Curso stocked in different places without following **FIFO** rules.

- Difficulties for **controlling operators** and cells for team-leaders.
- Cells with **similar** processes and technologies **far** from each other.

After having all the cells' lay-out optimized, the next step was deciding the new location of them around the halls in the best way to solve the problems mentioned before. So, we started from 0 point, placing the cells depending on the following requirements in one place or another.

- Keep free space for incoming cells in the future.
- Similar processes should be placed in the same area to facilitate team leaders controlling people with similar know-how and make easier the translations of operators between cells.
- Keep enough space for gauges' racks, pallets, curso, dynamic racks for curso in some cases,

Here after it is shown the final lay-out after many intermediate changes. All the points mentioned were taken into account and it is believed to be the most optimal solution for solving the problems:



Picture 40 - Cikautxo lay-out with improvements

FIGURE	DEFINITION
	Gauge's rack
55069	Intact cell
55085	Moved cell
NEW	New cell or free space kept
WH2	Curso warehouse
PALLETS	Space kept for pallets
	Corridor

Excel table 3 - New components of Cikautxo's lay-out

Green color cells are the ones that were not moved, light blue color cells were the moved ones and the dark blue color ones were kept for new cells or free space for the cells that will come in the future.

Plastic assembly cells were put together to have an organize lay-out.

It was the same for the ovens and leaktesters, which were put together.

Overmoulding cells were put together.

Cells, which had gluing machines, were also put together.

The same was for the nano cells creating the nano area.

Space for gauge's racks and pallets was kept and corridors of more than 2 meters were to be implemented to allow the trolleys move without any problems.

To sum up;

- 8 cells were eliminated or moved to other plants
- 23 new cells or space kept for new cells
- 305 m^2 in new cells and racks, 102m^2 of old cells → **203m^2 saved**

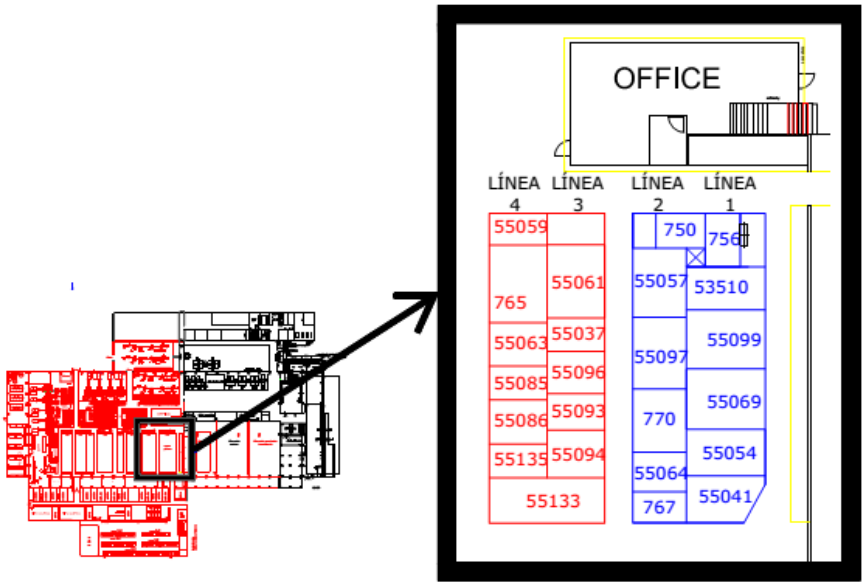
Benefits

- Intermediate stock should have decreased but right now it is difficult to see and to check because it is just the start up.
- Better keeping of the material knowing all the time where is every material and having a position for each type.
- Proper keeping of gauges, which gives the company a really good visual improvement, and gives operator the opportunity to find easily the gauge.

4.2. PILOT AREA

It will be explained one of the methodologies that have been used in Cikautxo plant to improve and change the way of work that they used to have. They started only with one part of the company because they wanted to see how it worked and solve the problems with just few cells and not all of them.

For this reason it has been chosen 4 lines which are 24 cells as it can be seen in the picture below. These four lines will be named as "Pilot area" and it is located at "Old hall"[6] which have been mentioned before. It is important to know that Cikautxo Slovakia is the biggest company of the group and the others companies have only around 20 cells. In this pilot area has been working 60 persons and 3 team leaders. If this system works in Slovakia it would mean that it should be done in the other companies.



Picture 41 - Pilot area with its corresponding cell

This area has recreated the situation according with the system and the way of work explained in the following pages. Right now, the company has more than 120 cells, which are working in a chaotic way so it will be easier to look the problems in these 24. Once that it will be proved that the system works it will be just time that it will be implant in all the assembly area. To be continuing it has been explained everything step-by-step and even with some of the problems founded after the first trial. This organization has been decisive in order to improve the quality and server to the customer.

[6] The previous area in the company that is represented as the "Assembly area" Cikautxo's general lay-out.

4.3. KANBAN SYSTEM

A Kanban system has been used for feeding both, incorporables and curso to the assembly cells. The concept was explained previously, but now, we're going to deepen and outline the main points.

It is important to understand that at the beginning all the decisions that have been taken were just with theory data that it has been done but it is something really different after simulating the system and finding the problems. What it is founded after the simulation is that sometimes the solutions are not as easy as they seem to be and even when you think you have been though in everything, the system just surprised you.

Doing a presentation for the office people (who have never hear about this system) and finding some new things that they asked for and we didn't take into account have been really useful to continue improving this system.

It is really good to know the employee's thoughts because it means that they are getting involved and they believe in the system. It is common that most of them express their doubts in their field as logistic or production but all of them were welcomed and solved in a brief period of time.

4.3.1. Frequency

In order to determine the best frequency of feeding both, curso and incorporable, a detailed analysis was done in the pilot area.

Every cell was analysed independently to know the average number of boxes that commodins would need to feed, and also the critical case was studied; even the maximum amount of boxes that would be necessary to be brought to the cell were calculated. These operationss were repeated for 1h, 1,5h and 2h consumption. The aim was to calculate the different amount of boxes consumed in that time ranges, and simulate the circuit to know if it would be possible to go ahead with these proposals.

Knowing the possible frequencies it has been divided the work as a team and each member of the Kaizen team has studied one of the three frequencies mentioned before of feeding time.

For this project has been studied 1-hour frequency and it has been simulated and seen how the commodin would work and how many cells should feed in that period of time. In the picture below is represented how it has been studied for only one cell, but in the annex of the work are all the excel tables that have been made.

It was really useful using excel tables as it can be shown in the annex to define times and routes that it was wanted. At the beginning it was started with the "Assembly Frequency", which is included in the annex. In this excel it has been written the four lines with the 24 cells, the curso and incorporable for each cell and the references needed and the number of boxes for each reference.

Next step was to recollect all the data and knowing the references of curso and incorporable that cells were producing with the quantity of boxes and the period of time that a commodin should go there before it runs out of curso or incorporable. All the operations are shown at the table name of "Critical and average curso&incorp" in the annex. In the picture below it is represented just a small part of the Excel.

CURSO FREQUENCY							1 HOUR	
REF	CELL	LINE	Position	Boxes	Hours	Hours/box	exact	rounded
5050714	756	1	2	6	8,78	1,46	0,7	1
4112574	53510	1	1	1	21,10	21,10	0,0	1

Excel table 4 - Curso frequency excel (1 hour)

INCORPORABLE FREQUENCY						1 HOUR	
REF	CELL	LINE	Boxes	Hours	Hours/box	exact	rounded
1320783	**770**	2	2	2,7	1,4	0,4	1
1320783	**770**	2	2	2,7	1,4	0,4	1

Excel table 5 - Incorporable frequency excel (1hour)

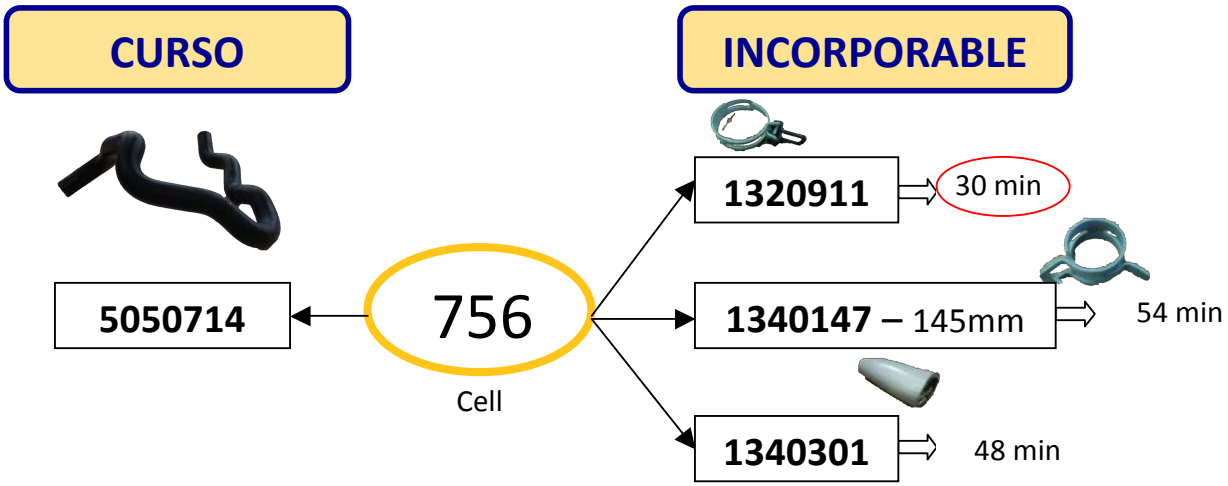
In the Excel table is represented just a little part of the references produced at the cells. The first excel shows 2 curso references with their corresponding line and position in the rack. It is also established the number of boxes per position and references that it can be fixed inside.

The column of "hours" means how long will take the cell to run out of curso or incorporable. Knowing this, it is easy to calculate how long does the cell takes to consume just one box of its reference. So if it important to study the boxes that the cell will consume for the frequency of one hour it would be the inverse.

For example, the reference "5050714" shown in the picture above belongs to the cell 756 and it is situated at the "Line 1". There should be six boxes in the cell and it will be necessary almost 9 hours to consume all the rubber (6 boxes). This means that it will need almost two hours to consume one box or what is the same, it will use the 70% of one box in hour.

Studying all the references of each cell and for the four lines, which are the pilot area, it was decided to get the most critical situation supposing that in the cell were producing the reference with the lower time feeding frequency. Let's see the example:

In the cell 756 are producing this curso and incorporable references:



As it can be shown before, it has been chosen the most critical time references in each cell knowing that this case should be almost impossible. This choice has been selected because if the problem is resolved with the most critical situation, there won't be any problems in a workday.

After doing all the studies with the three frequencies, it was necessary to simulate some tasks as taking the empty boxes, getting the kanban card for the cells and feeding the cell with the staff. In conclusion, it was simulated what the commodin was going to do because it was important to know all these times to have everybody the same time, and these were the times and results of the simulation.

Carton	8 min and 50 sec
Empty boxes	9 min and 10 sec
	501 meters
	TOTAL: 17 min and 50 sec

Feeding curso	**46 minutes**
Kanban cards	**8 minutes**

Excel table 6 - Timing of some commodin's tasks

Once it was established these information, it was easy to simulate the stop and taking the kanban cards that it was needed in the pilot area with the frequency defined. With the previous study of the cells were the most critical and the frequencies that could be possible to define for the commodin it was compared my 1-hour frequency against the other. The other frequencies chosen were 1½ - hour and 2 hours, which was done by 2 components of the Kaizen Team, and this were the results of each specific frequency.

	CURSO		
	1 hour	1 ½ hour	2 hours
Boxes consumption	52	38	26

	INCORPORABLE		
	1 hour	1 ½ hour	2 hours
Boxes consumption	15	12	9

Excel table 7 - Consumption of Curso and Incorporable boxes in each frequency

Knowing the quantity of boxes that the commodin should have to get and feed in the cell, it was easy to define the route and make an estimation of how long will take him to do the feeding of course and incorporable.

	CURSO			INCORPORABLE		
	2 h	1 ½ h	1 h	2 h	1 ½ h	1 h
Total time for all the process	49min	39min	31min	38min	32min	27min
"Free time" for commodin	71min	51min	29min	82min	28min	33min
Saturation of commodin	**41%**	**43%**	**52%**	**32%**	**36%**	**45%**

Excel table 8 - Timing and saturation of the commoding depending on the frequency

As it is shown in the picture above, the conclusions obtained were:

- **1 hour** → Having only one commodin for the pilot area it would be almost impossible for the commodin to take the kanban cards of incorporable and curso and feed the cells in only one hour. It would be 58 minutes and he would only have 2 minutes left. That's why this frequency was refused.
- **1 ½ hour** → It was really a really considered decision because the commodin would be working around 1 hour and he will have almost 30 minutes to do other staff. After discussing this possible frequency for a long time, it was decided not to start with this one for the pilot area, but maybe use in the future for all the company.
- **2 hours** → It was the best choice to start with. He will work for almost 1 hour and 30 minutes and he will help with other tasks in the other 30 minutes free.

To have a clear idea of what was the situation in which the commodin would be found doing both tasks (curso & incorp), it was made the following excel in order to understand it better:

	2 hours	1 ½ hours	1 hour
Total time for all the process (cur&inc)	87 min.	71 min.	58 min.
"Free time" for commodin	33 min.	19 min.	2 min.
Saturation of commodin	73%	79%	97%

Excel table 9 - Saturation and frequency for the commodin doing both tasks

The commodin was supposed to work at the 73% of his possibility so he will be able to do more tasks or help in other areas. It is remembered that it was just the beginning and something theoretical so the problems were founded with the implement of the system.

With the excel and simulations it seems to be the best way to work, but the real situation day per day will tell us the truth.

After deciding the frequency of the commodin it was possible to analyse all cells of the pilot area to have the critical situation of each cell. As an example, the analysis of one cell is explained bellow. The rest of the cells are attached in annex number 1 to 4.

					a	b	Feeding freq 2h			
							0,7	c 0,1	1,1	
CELL	LINE	REF	MAX ORDER REF	NORMA	h/producing	% time prod.	4894252	d 5363720	4894263	CRITICAL REF
770	2	5363702	3000	40	75	42,9%	1	1		1
770	2	4894206	5000	50	100	57,1%	1	e	1	2 i
						f	100%	42,9%	57,1%	
						g	0,7	0,1	0,6	
						AVERAGE		h 1,4		

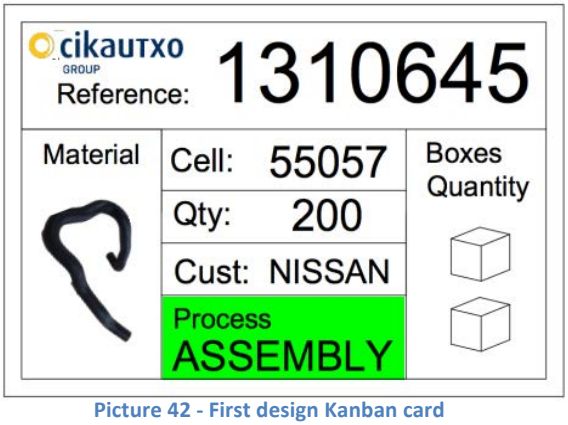
a. Total of hours producing that reference in a week
b. % of the total amount of hours producing that reference in the cell
c. Quantity of boxes of that subhose consumed in 2 hours
d. Subhose reference (Sometimes subhose and the reference itself have the same naming)
e. Matrix of references/ subhoses used
f. % of the total amount of hours producing that subhose in the cell
g. Quantity of boxes of that subhose consumed in the % of the corresponding time in 2 hours
h. Average total consumption of boxes in the cell
i. Most critical reference's consumption of boxes (rounded up, to simulate the worst case)

4.3.2. Kanban cards designs

Customer demand has taken the form of Kanban card in a board sequencer; the order has been done depending on what they produce. With regular intervals the operator has been removing the product from the warehouse and has returned with the card. It has been transmitted the supplier needs to the assembly lines including the quantity of boxes. The principal aim of these is to create a fluid flow.

4.3.2.1. First posible card

The first design though and shown to the team was the one above. It was a really complete card which contains; the reference number of the product, its picture, the quantity of boxes, the customer to whom it was produced for, the process it was used for and the quantity of pieces there were in one box.



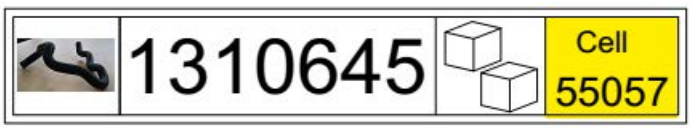
Picture 42 - First design Kanban card

This card was refused for many reasons, the picture was not a really necessary part of the card because for rubber was easier to identify it just with the reference number. It was even not necessary the quantity of the pieces inside the boxes because they don't have a system to count them in the extrusion machine. It was the same for the customer, it is true that the cell usually works for only one customer but not always, because they have too many orders and too many work.

In conclusion, this design was just the first idea and it was able to make some changes in order to adjust more the design to the specific requirements.

4.3.2.2. Second posible card

Once the first design was shown and refused, it was necessary to suppress some of the characteristics before. That's why it was purposed the next kanban card which was totally different, more visual and with the minimum data possible;



Picture 43 - Second design Kanban card

It was also refused, for the same reasons as it has been mentioned before. The picture was unnecessary and the quantity of boxes shown with a draw could be written at the rack to be shown for everybody because it doesn't change.

4.3.2.3. Final design

After the brain storming, it was decided to get the following card because it has all the necessary data and it was really simple to understand and to explain for the operators, commodin and team leaders.

Picture 45 - Incorporable card, final design

Picture 44 - Curso card, final design

In the picture is shown the two Kanban cards that it has been used for incorporable and for curso respectively. Even though Cikautxo is an international company, it was decided to do the cards in Slovak because most of workers don't understand English.

- **Karta montazneho material (Incorporable card) →** It has been specify the reference (referencia) number of incorporable, the cell (bunka) in which are producing it, the line (rad) where the cell is in the lay-out, the position (pozicia) in the rack and it was introduced the bar code. At the beginning it was thought to do it exactly the same as the curso one, but the warehouse for incorporable is completely different and they work with trackers. So it would be less complicated for the commodin to check the bar code and not to type the reference number in the system.

  This warehouse is a chaotic system where it is indicated the place where the reference is located. It is easy to follow the FIFO rules and for the references the first in is the first out. With the bar code it also would be faster and also avoided possible human errors typing the number.

- **Karta gumovej hadice (Curso card) →** It has been also specify the reference (referencia) number of incorporable, the cell (bunka) in which are using that curso, the line (rad) where the cell is, the position (pozicia) in the rack and the only difference is the bar code. It won't be necessary the bar code with the curso cards because the warehouse is on the floor and it is indicated with papers their position at the warehouse. This is not the best way to search the boxes that the cell needs but it would be solve in the future. The way of storage the curso is shown in the picture below where the commodin has to go to the paper in the middle of the warehouse and search for the position number.

4.3.2.4. Size

At the beginning it was thought to design a card with a standard dimension like a mobile. It had to fix on the hand and it would be something easy to keep in the pocket of the trouser. But there was a problem when the provider gave us a sample of the holder. It was too thick and big for the cards, so finally it was decided to do the kanban cards a little bit large. The results should be something like this;

But as it is common, the theory is far from reality and it means that the card designed was still small for the holder. Finally with the holder at Cikautxo it was easy to establish the dimension of the card.

After changing the size three times it was at least defined. It would be 7'5 x 13'5 cm long and the thick would be the same as a paper. The last step necessary to do was to plasticize and laminate the cards. It was thought like this in order to not break them the first week.

The card was designed with autocad program and was given it to the company for future kanban implementation in all the company.

Picture 47 - Holder and kanban card

Picture 46 - Real holders with it kanban cards

4.3.3. Trolley

To make this system real it was thought about introducing trolleys. The way of work of the commodins for feeding the cells was depending on the boxes or type of material they were carrying. In the next image it can be seen which machine they use for the different type of material.

PALLET TRUCK
- Empty boxes and carton - Curso

FORKLIFT
- Incorporable - Finished product

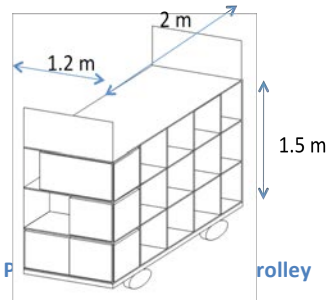
Picture 48 - Pallet truck and forklift

Right now Cikautxo works with these two different types of transport. The pallet truck is for the empty boxes and carton, the commodin gets them from all the assembly cells and he walks around the assembly area to do it. It is the same for the curso, when a cell is running out of curso, the operator inside the cell tells the commodin to find him the box at the warehouse 2. These tasks are able to do with a pallet truck because there are not heavy.

The forklift is used for incorporable because they storage the material in the warehouse 13 which has chaotic system with 4 different heights. All the staff they have there is to supply all the company so it is really big and to get the material from the 3rd and 4th floor is needed the forklift. Even for the finished product is necessary to use it because when the cell finish the assembly, they leave the pallet with lots of boxes on it and wait for the commodin or team leader to get it. This pallet is really heavy and it would be really difficult to move it for the quality control with a pallet truck.

After studying the capacity of these means of transportation it was thought how to offer the commodin a way to get more boxes in the same route. At the beginning the idea was two trolleys with 40 positions, one for the curso and the other one for the incorporable.

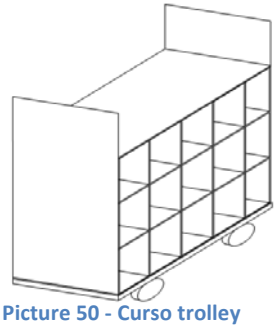
Incorporable trolley → The measure of the trolley was studied for 1'2 x 2 x 1'5 m. It was though to have at least 20 positions supposing that the boxes were all of them not the standard. This was something would never happen so it was going to have even more than 30 positions, it was depending on the dimensions of boxes to join more or less. The picture, which is on the right, shows how the trolley would look like.



P rolley

The standard boxes dimensions of the incorporables are 40x60x30 but sometimes are not standard and the biggest measure could be 40x100x47cm. So the trolley has been useful also in these cases. It is shown at the picture how would it looked like if there were different types of boxes.

Curso trolley → Measurement of the trolley would have been also the same as the incorporable trolley. The only change done was the capacity of the trolley because all the boxes are the same. It means that the standard box is 40x60x20cm so one box would have fit perfectly for one position in the trolley. In the picture is shown how it would have looked like.



Picture 50 - Curso trolley

Once it was studied and analyzed all the structure of the trolley, it was supposed not to have any type of problem, in spite of this a faulty characteristic, which was shown after, took the first design out of the system. This design was the first trolley made but the result wasn't as expected, it arose too many problems which weren't thought before. In the picture below it can be seen how the trolley was and how big it was. This means that it was really difficult to drive, the corridors in Cikautxo are quite narrow and to turn left or right the trolley had to encroach some cells. One more time it was shown that the theoretical studies not represent always the real situations and what is more important, it is quite important to simulate the system.

Picture 51 - First real design of the trolley

Picture 52 - Final real design of the trolley

The first design, which is in the left picture, wasn't the want as expected so it was necessary to change it to the right one. It was made as a caterpillar tractor, which means that he has to use at least two or three parts in order to feed the cells. In spite of having two compartments, it has only position for 1 box in each level to make easy to the commodin the task of organization making even easy to put all the boxes in the trolley. Depending on the parts it would be possible to add more trolleys in order to have more different positions and consequently being possible to have all the parts that it would be wanted.

4.3.4. How it is going to work

It has started with the pilot area, which has four lines, and occupy around 40 m^2. These four lines have 24 cells, which produce in a non-stop way during three shifts per day. The aim of this system is to established an organize the way of feeding the cells and giving the cells what they need when they need and nothing else.

To be continuing it has been studied how they would be working in a real day and with the frequencies mentioned before.

4.3.4.1. Cell

Operator has been assembling rubber and incorporable to supply the order of the customer. Before explaining all the system it is important to know that the cell works per order, it means that it has to change the curso and incorporable and it is common to see all the cells with lots of boxes and a stock for more than 2 days. What it is looking for with this project is to define a place for these boxes and curso and work in a organize way in order to have only what it is needed.

In each cell is defined which are the references that they usually produce, they don't really change. For example, the cell 756 will produce 5 different types of references and it is distributed in different times, for one reference depending on the order it will be 2 hours, the next 3 hours will be producing another and all the time like this. The team leader is the one that tells the operator how many boxes and pieces he has to prepare for the order and control it.

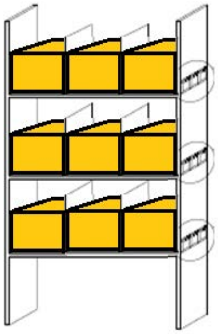
Trying to change this way of work it has been defined that all the boxes for curso and incorporable will have a Kanban card (it has been thought like this because it would be the easiest way to understand it) with white color for rubber and yellow color for incorporable as it has been mentioned before. It has been differentiated two type of storage.

- **Incorporable** → It has been located in racks. These racks have from 5 to 16 positions depending on the cell. It doesn't mind which reference the cell is producing, all the incorporable items have a position in the rack and when it has to change for other reference, they don't have to be worried about the stock or to ask the commodin.

- **Curso** → It has no defined position in rack for all the cells. It has only in some of them, but for the others it should be one above the other until they have 6 boxes. It is important to know that for curso they only have the boxes which are producing in that moment and nothing else. Once they finish the required quantity of the order, the commodin takes the remaining boxes and puts them for the warehouse.

4.3.4.2. Operator

After knowing how is the lay-out of the cell and how it has to be storage the material, it has been explained in the following pictures they way of work that the operator should do. Every position in the rack has its own number as well in the Kanban mailbox. This position is marked to ensure that commodins put them in the proper place. Curso that is placed in the floor, also have one card/reference placed in another mailbox.



Picture 53 - Rack full

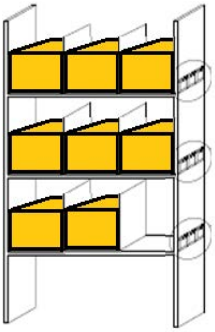
First of all the rack should be full of all the incorporable boxes as it is shown in the picture. In some positions are more than just one but for understanding the way of work is enough.

For the three floors of boxes that they have, it also has three floors of holders too in the left or right side. It means that they have 9 holders with 3 holders per floor. This mailbox is full of cards depending on the quantity of boxes that are in the position of the rack.

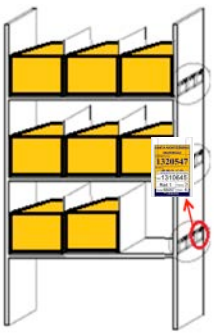
Secondly, it is very important to explain the operator that once the operator takes the box he has only one option.

He has to go to the mailbox and get one Kanban card that corresponds with the position and reference of the rack. It the box is not consumed but there is another box in the rack, he should put it on the corridor and the commodin should take the box again to the warehouse.

This training is also explained with a Power-Point that has been used to explain the employees how to work and it has been added to the annex.



Picture 54 - Rack without one box



Picture 55 - Kanban card in the holder of the rack

Finally, when a box has been consumed and the card has been taken from the mailbox and put it on the holder that is on the front (as it can be seen in the picture) and later the operator can continue with the assembly and take the other box of incorporable that is in the rack.

This simple task warns the commodin that the cell needs another incorporable box of the reference in the card. The operator has two holders in the front, one for curso and the other one for incorporable.

4.3.4.3. Commodin

As it has been explained before, one principal thing that it will be changed with the kanban system will be tasks for commodin, operator and team leader. It will be really important to define specifically which routes they will have to do. The frequency has been calculated and explained before as two hours per route to satisfy the most critical time of some of the cells. Knowing this information, it has been really important to define the same route all the time to give no choice for the commodin to fail.

First of all it will be necessary to divide and organize all the tasks that it is wanted them to do in their shift. It has been thought to teach them in different tasks from simple tasks to more complex. Following this methodology has been decided;

- **Carton and empty boxes** → This task will be the easiest and it has been thought like this because if some day the commodin decide not to come (very typical problem in this country) to work, it would be really easy to explain another worker what he has to do.
- **Incorporable** → One person will only have to supervise the incorporable material. Later will be explained with more detail how he will have to work but in a general view; he will have to do the route defined getting the kanban card, later he will have to take them to the warehouse 13 and help the other commodin who is preparing the trolley with incorporable material to feed the cells later. It is important to highlight that he will always do the same route.
- **Curso** → It will be something quite similar as the incorporable commodin but with the difference that the warehouse will be different. It means that he will be getting the kanban cards with the trolley, once he has occupied with the cards all the positions in the trolley, he will go to the warehouse which is close from the cells and get the box. After this, he will feed the cell and start with the kanban card route.
- **Picking area** → Other commodin will be located at the warehouse 13 preparing the material and putting it in the trolley. It will be faster for the incorporable commodin to pick up the trolley and feed the cells if the trolley is already.

Secondly the number of commodins that it will be necessary will be depending on the area it wants to cover. For the pilot area it will be needed just three because one of them will be able to do the incorporable and curso tasks, the other will be at the picking area preparing the trolley and the last one will be taking the carton and empty boxes.

4.3.4.4. Team Leader

Not only operators and commodin should change their way of work, even for team leaders tasks will change. It means that there were some tasks that they won't do it again and some others that they will have to do. In the next excel is explain in a simple way which were their tasks and how they are going to change.

BEFORE	AFTER
Check the cells are OK	Check the cells are OK
Check the quantity of pieces of previous shift in each cell.	Check the quantity of pieces of previous shift, the people who is working, the references will be done in each cell
Write down the people who is working in each cell	
Point the references will be done in each cell	
Print the stickers	Print the stickers
Checks documentation of cells	Checks documentation of cells
Take and bring red gauges	Take and bring red gauges
Fix the machines	Fix the machines
Take documentation for the office	Take documentation for the office
Bring final product to quality	**X**
Changes the matrix for one ENGEL	**X**
	Control incorporable and curso Kanban cards
	Be responsible of changing curso cards when the references changes

Excel table 10 - Team Leader tasks

As it can be shown there are two new tasks that they have to do. Control incorporable cards in each cell (quantity and placement), and taking care about the references changes. These two tasks adding will be replaced for bringing the final product pallet to quality (which they do it with a pallet truck) and changing the matrix for the ENGEL, which will be done by the commodin.

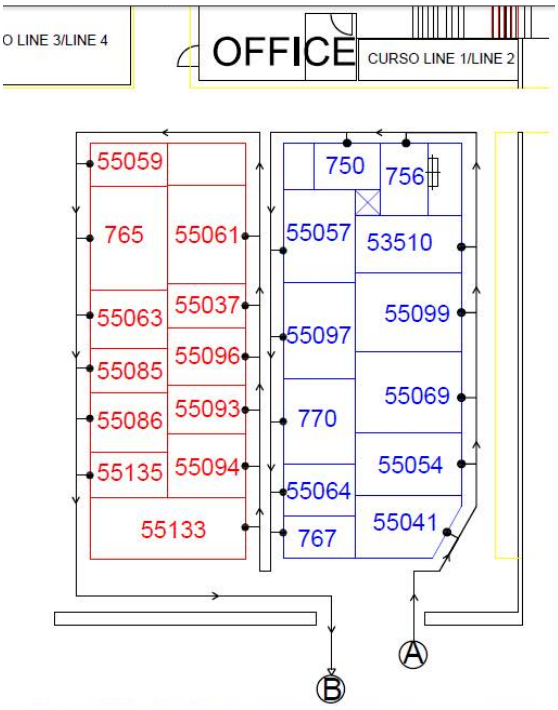
4.3.4.5. Routes

- **Incorporable commodin**

Kanban cards

Viewing the weakness in the actual system has been decided changing to a new way of supplying. The first thing is design routes for the comodin supplier, thus will normalize the routes eliminating the wastes in time and journeys. For supply the cells is necessary one comodin, and another comodin helping for the picking in WH13.

The comodin will start taking the Kanban cards of the cells in the mailbox, starting in the point A. If cards were in the mailbox of the cell, he must take them. He will travel around the lines following the route in the picture and take cards. First he will start with the Line 1, and then he will continue with Line 2, Line3 and ends with the Line4.



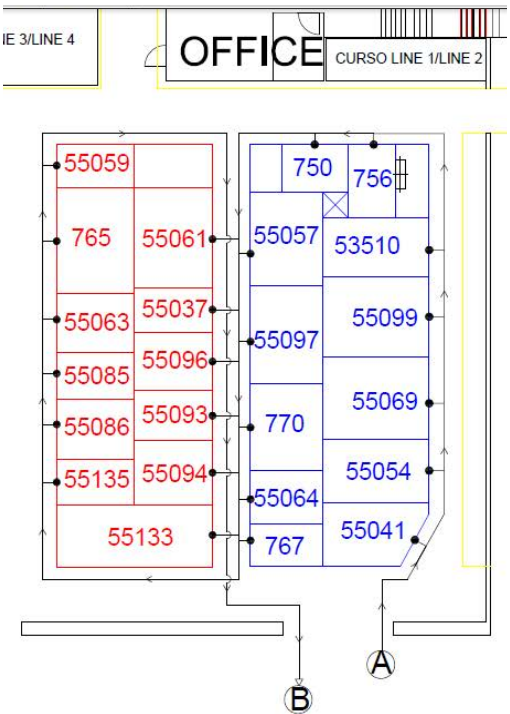
Picture 56 - Route for taking Incorporable Kanban cards

When he has picked all cards, he will bring to the WH13 and start doing the picking, point B.

Warehouse & preparing trolley

Once finished the picking, he will take the trolley and goes to the assembly lines. While comodin supplies the boxes in the cell, leaves the cards in the holders. This route is much like the previous one, start in the same point A. The difference is in the corridor, which is between the second and the third line. The trolley can´t turn around, so the comodin must supply both lines at the same time.

If there are lots of incorporables, he will supply until empty the trolley. After, he will



Picture 57 - Route for feeding with Incorporable boxes

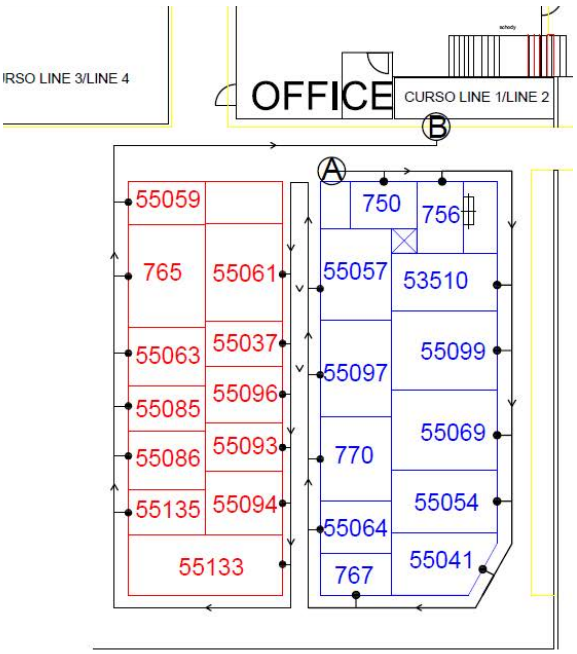
return to the WH13 to pick the second trolley that it will have been prepare by another comodin. Finally he will finish to feed all lines and returns to the WH13 to leave the trolley, point B.

Once he is on the way, he will stop in the cell that the kanban card indicates (always in order, first line 1, second line 2…) and he will take inside all the boxes that the cell needs. After feeding the cell, he will put in the holders the incorporable kanban card again and continue with the feeding of the other cells.

- **Curso**

Kanban cards

The work will be like the incorporable comodin. The comodin will start taking the Kanban cards of the cells, starting in the point A. This route will start near the Team Leader zone for this lines, and the will start with the first line. If cards were in the mailbox of the cell, he must take them. He will travel around the lines following the route in the picture and take cards. First he will start with the Line 1, and then he will continue with Line 2, Line3 and ends with the Line4. When he has picked all cards, he will bring to the curso zone that it will be changed near the pilot area to reduce the picking time.

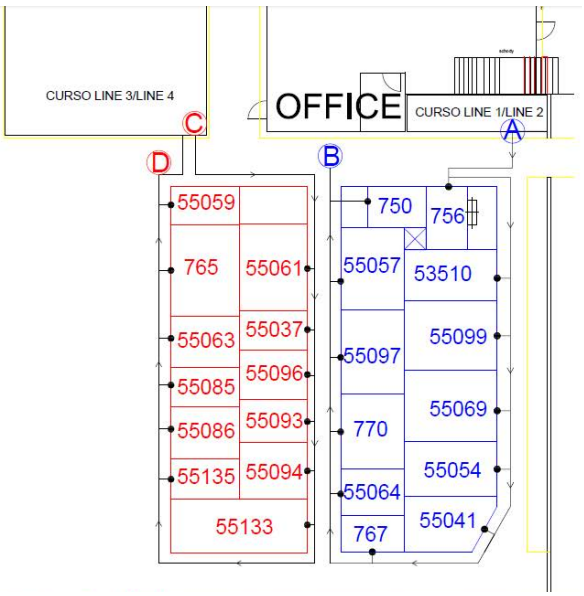


Picture 58 - Route for taking Curso Kanban cards

Feeding

The curso will be in two different zones. For the lines 1 and 2 curso will be on the right side of the office. The trolley will have capacity for 40 boxes of curso, and for this task it would be diffent routes, one for line 1 and 2 and other route for line 3 and 4.

The trolley will start in the point A and then supplies the first line and the the second, until they trolley is empty. Maybe he will return again to the point A and continue the trip. He will finish at the point B.



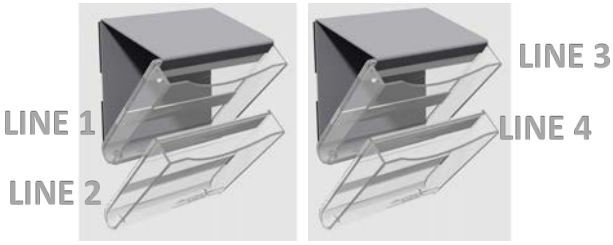
Picture 59 - Feeding with curso boxes

After he will go to the second curso zone in the point C, to take the curso for lines 3 and 4. The same actions done in the line 1 and two, supply all the cells that they have the cards and return.

Once completed the trip, it will start again from the beginning, taking the kanban cards.

- **Picking area commodin**

Once the comodin has all the cards, he will go to the Warehouse 13 where he will put all the cards in order depending the line, which they belong. At the beginning we will start with only the "Pilot area" so it means that we will only have 4 lines. So it will be something like this:



Picture 60 - Holders in the warehouse 13

The person who works in the warehouse will have to take the Incorporable cards from the holders shown in the picture and start searching the incorporable at the warehouse. After taking the reference needed, he will put the box in the trolley with their respective card following always a FIFO system.

It's something new introducing to this company, but having a commodin putting the material in the trolley will give the other one more free time to feed all the company.

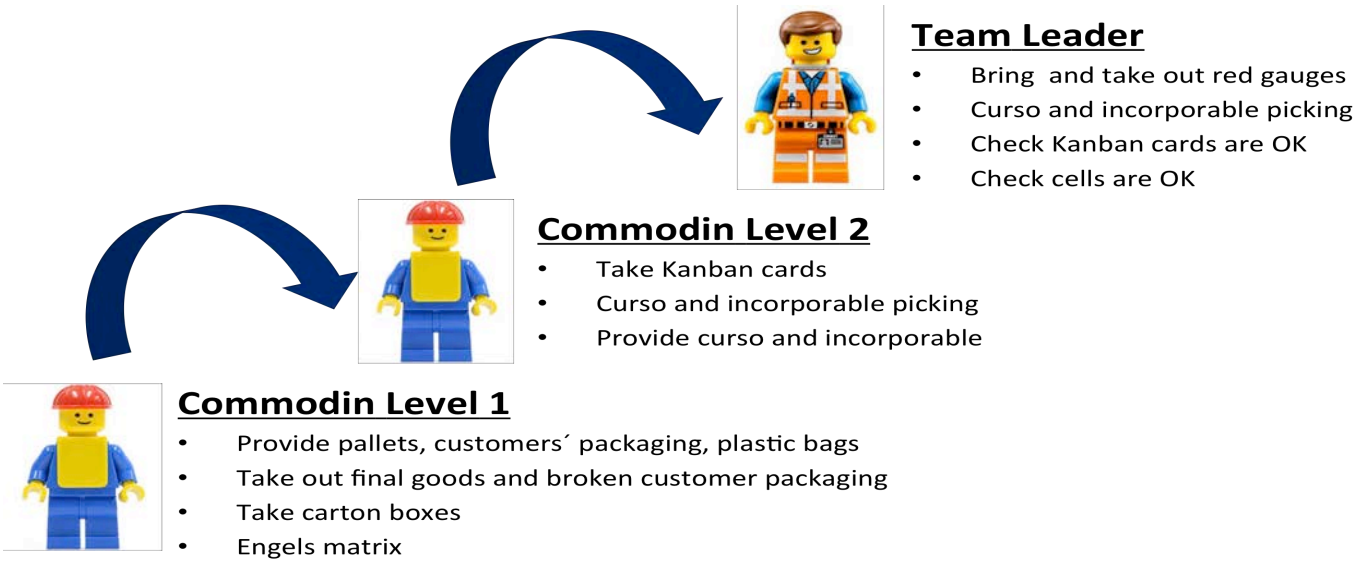
4.3.4.6. Employees training

It has been talked all the time about changing the way of work, but it is not what three people want to do if later the operators, commodins and team leaders don't believe in the change. This system needs to work because people believe in it and it makes them an easy way of work.

It has been explained to the operator how they should have to do once the racks were installed in each cell. Holders have their label with the position in the rack and the number of cards that should be in the holder.

Something exactly the same was for the commodin but with the trolley and showing always the route that he should do. Same routes have to be done for getting kanban cards and feeding with incorporable and rubber all the cells.

As it has been mentioned before, it has been looking for a simple system which define simple tasks to make a non-think work which



Picture 61 - Different levels of employees

As it can be shown in the picture and following the established rules, it has been decided to make 3 levels.

- First level it will be the easiest one, commodin will have to pick the empty boxes and carton boxes. He will also be responsible about the changes of the engels matrix and taking out the final pallets.

- Second level will be a little more complicated. Commodin will have to take the kanban curso and incorporable cards and provide all the cells. He will have a defined route and he will have to take care that cells don't run out of the material.
- Last level and the most difficult one it would be "Team Leader" which will have to be responsible that the system is running well. Taking care of the red gauges, the kanban cards and the cells. This group will be really important because if they believe in the change, they will transmit to the others.

It has been decided doing this way for many reasons. First of all it is common to see that here people rotate a lot, they are changing all the time the company and it is not common to see people workers with more than 10 years in a company. This makes a really disadvantage to improve because you are not sure that people will be there next day.

Knowing this inconvenient and trying to do simple and organize tasks, it was though in this three levels to have a proper way of work. It will be easier to explain simple tasks if somebody decides not to come. It means that;

- If commodin level 1 doesn't go to work, it will be taken another operator or worker and it will be explain in 1 hour the routes and the tasks that he has to do.
- If commodin level 2 doesn't go to work, one commodin of the level 1 will be taken and explained their new tasks. It will be easier because the routes are always the same, even for carton or empty boxes or to feeding.
- If team leader goes to other company, one commodin of level 2 will occupied its position. Tasks are more difficult and they will have to take care about one area (which is 4 lines, 24 cells).

Once this problem has been solved and showing and teaching them how to do it were the latest things before making the system start up.

It is added in the annex of this work some powerpoint with the name of "Formation PowerPoint" that it has been done for this training depending on the tasks that they had to do. A simple and easy way to understand what is the system, how the company wants to work and explaining in detail what do they have to do.

4.3.4.7. Timing

Once everything was started up, it was done timing, which is included in the annex. In this excel is represented the times of each different activity. This measure of time was done with a chronometer but it is known that this is not always the same and it will depend of the reference.

To do this task I stay in the trolley with the commodin while he was doing his tasks and I was measuring the time in order to know if the calculations from the beginning were right or not. It is better if it is seen with the Excel table below.

FEEDING THE CELL WITH CURSO		
MOVING TO CELL - PICK UP THE BOX - PLACING THE BOX INTO THE CELL - MOVING THE CARD TO THE POSITION - MOVING TO TROLLEY		
1	CELL 1	**26**
2	CELL 2	**27**
3	CELL 3	**28**
4	CELL 4	**28**
5	CELL 5	**25**
6	CELL 6	**26**
7	CELL 7	**28**
8	CELL 8	**27**
9	CELL 9	**28**
	AVERAGE	27,00
PLACEMENT OF BOXES AND CARDS INTO THE RACK		**27**
PLACEMENT OF 18 BOXES AND CARDS INTO THE RACK		**486**
TOTAL TIME PER 1 CYCLUS (sec)		**486**
TOTAL TIME PER 1 CYCLE (min)		**8,1**

Excel table 11 - Timing of feeding the cell with curso

As an example it is represented the case of "Feeding the cell with curso". It is explained which are the principal movements that he has to do like going to the cell with the curso box, placing it into the cell at its position, moving the card to the holder and going back to the trolley again.

After having explained how many positions has the trolley (which are 9), it could be said that timing was only done with this 9 positions. In the table is represented which are the times that has spent in each cell doing the specific work mentioned before and the average calculated, 27 seconds per cell it will be taken to do all the conclusions.

These 27 seconds must be multiplied per 18 positions because the commodin must carry at least two wagons. This easy mathematical operation gives us an idea of how long will take the commodin to feed the cells if he has the trolley full.

486 seconds is the result of the easy operation mentioned before which means 8'1 minutes. It has been considered this time as a "Total time per 1 cycle" because at the beginning the commodin will work just with two wagons as it has been mentioned.

It has been done this timing for all the tasks that he is supposed to do and even the time that he has to spend in each task. These Excel tables can be founded at the annex of this work. These tasks have been explained to understand it better;

1. **Picking the cards from racks** – Going down from the train, moving onto the cell, taking the card and going up on the train again.
    1. Average – 9 seconds per cell
    2. Estimated time per area – 3'6 minutes
2. **Preparation of the incorporable at the warehouse 13** – Starting up the tracker, moving to rack, picking up the box, placing the box onto pallet truck, moving to other position and moving to the trolley.
    1. Average – 40'57 seconds per item
    2. Estimated time per cycle – 14'4 minutes
3. **Filling the rack with incorporable** – Moving to trolley, picking up the box, placing the box onto rack, moving the card to the position and moving to the trolley again.
    1. Average – 22'29 seconds per cell
    2. Total time per 1 cycle – 6'9 minutes
4. **Preparation of curso from the warehouse 2** – Picking up the box, placing the box onto the trolley and moving to the cell
    1. Average – 20'44 second per cell
    2. Total time per 1 cycle – 6'1 minutes
5. **Feeding the cell with curso (which have been the one explained before)** – Moving to the cell, picking up the box, placing the box into the cell, moving the card to the position and moving to the trolley again.
    1. Average – 27 seconds per cell
    2. Total time per 1 cycle – 8'1 minutes
6. **Transportation between the cells** – Moving onto the cells
    1. Average – 8'25 seconds per cell
    2. Total time per pilot area – 3'6 minutes
7. **Transportation from the warehouse 13 to production and from lines to warehouse 2.**
    1. Moving from WH 13 to line 1 – 35 seconds
    2. Moving from cells to WH 2 – 52 seconds
    3. Total time – 2'9 minutes

Having real data and calculating the total time that takes the commodin doing these tasks;

$$3'6 + 14'4 + 6'9 + 6'1 + 8'1 + 3'6 + 2'9 = \mathbf{45'6\ \boldsymbol{minutes}}$$

It can be said that the commodin takes around 46 minutes to feed the cell with the curso and incorporable. Taking kanban cards and preparing in both cases the trolley.

4.4. PROBLEMS & QUESTIONS ARISING IN THE TRIAL AREA

4.4.1. Training

OPERATOR

Doesn't put the curso card → Operator thinks it is enough for their shift with the curso that they have and they don't care about putting the kanban card in the holder. It means that they won't have the proper quantity of boxes if they want to produce in the next shift and it will be started all the problems.

Doesn't use the incorporable card → Operator has been taught how he should be working with the kanban card in spite of the training he doesn't put the kanban card in the holder. It is also a problem as with the curso card because they maybe for their shift is enough but not for the next one.

These both problems are represented in the right picture. There is no box in the rack, and there is also no card at the commodin's holders.

Picture 62 - Without using Kanban card

Number of cards → They only put one card even if it has been consumed three boxes because operator thinks that is enough with one.

Picture 63 - More boxes in the position

Number of boxes in the rack → Don't respect number of boxes in the rack. It should be an easy way to them to compare that they have the same number of boxes as it is indicated in the label of the rack, but they don't do it.

As it can be seen in the picture, in the label of the rack indicates just 2 boxes per position, but they put more because they don't respect or understand the system.

Is it good for the system that the operator could think about what he would have to work? Or ¿Is it better to define the system and don't give them the choice?

COMMODIN

Routes are not follow → Commodin doesn't care about the defined routes; he just goes and looks where the kanban card is.

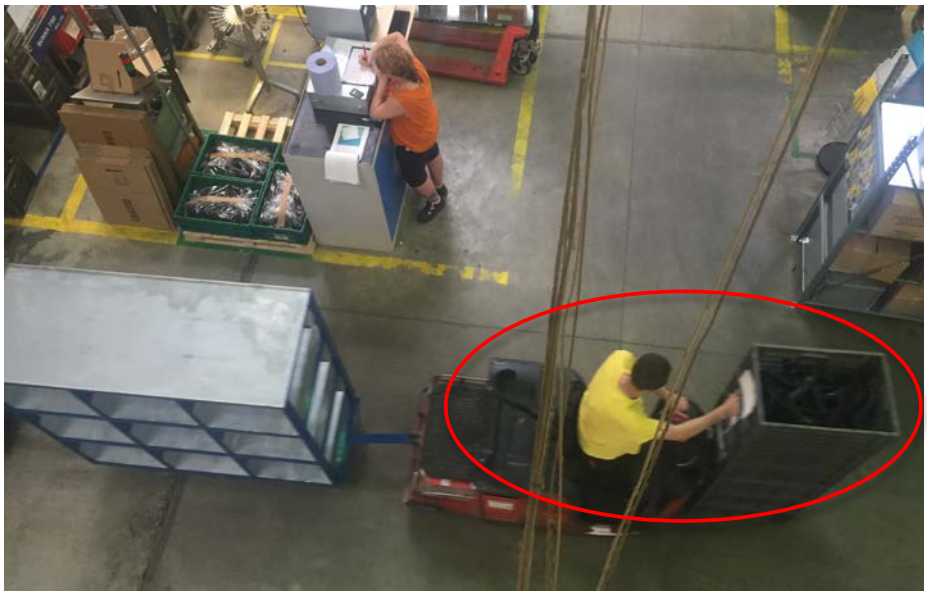
Not used trolley → They are told to use the trolley every time they have to go to the assembly area.

Don't put the cards in the holders → It has been seen in the holders of the rack that commodin doesn't want to search for the position of the kanban card with the position in the holder so they just put all the cards in one holder. It is found later too many cards in one holder.

Picture 64 - All Incorporable cards in one holder

As it can be seen in the right picture, incorporable cards are in the same holder because commodin doesn't follow the indicated routes and he has to look in all the cards.

Carrying curso → Still doesn't use the trolley in the proper way, as it can be seen in the picture he carries the boxes in front of the trolley and not one per position as it has been explained in the system. This is not just a bad way, it is even a dangerous way, which should be forbidden even if the trolley is full, and he shouldn't use the trolley in that way.



Picture 65 - Not correct use of the trolley

Is it good for the system allows the commodins the opportunity to work without the trolley?

TEAM LEADER

New tasks → He will have to take care and see if the racks are full at the start of each shift. He also will have to check the kanban cards and the curso cards.

New paper to fill → Team leaders at the beginning of their shifts will have to go cell per cell watching and writing which are the cells that haven't put the kanban cards and controlling if they have understood the system.

Should the team leader do it? Or should the operator take care about this?

4.4.2. Feeding

Incorporable feeding → It is clear that every time a box is consumed the respective card must be put in the commodin's holder. Nevertheless, when incorporables are not placed in a holder inside the cell, but the box is taken, the box could happen not to be finished, and when returning it back to the racks, a new box placed. In this case, operator should take the new full box, and put it in the corridor to be brought to the WH13 back by the commodin.

Is it good a smart solution or is better to place big holders in the cell not to allow entering carton boxes to production?

Curso feeding → In most of cases 6 or 12 boxes for curso are placed for production. However, in some cases, the production is so low and operators know it. For this reason, they ask for fewer boxes than needed.

As it can be seen in the picture, sometimes they have more than six boxes, which are the indicated. They should have 6 boxes to produce that reference and another 6 for the next references, but this is not respect.

Picture 66 - Curso boxes in the cell

Should team leaders inform every operator to know hay many curso boxes they need and let them think, or force operators to have always all the 6/12 positions full?

Curso for the change → Even if the team leaders know the production for next 4 shifts, sometimes Kanban cards do not ask the curso for the next production. This is a problem because if production says what it is going to be produce with 30 minutes in advance, the commodin is not able to feed 24 cells in that period of time. He needs at least 1 hour and a half or he will get crazy.

Should team leaders inform every operator when to ask it or do it by themselves?

4.4.2.1. Inside the cell

Holder too high → In some cases operator has to stand on her toes to get the cards from the holder. Holder is located at 2 meter and 10 centimeters tall, and in most of the cases the employee can reach it, but some of the workers are not that tall and they can't put the kanban cards there. And it is true that if they tell you that you are going to change your way of work for an easiest way and you can even reach the holder, your mind won't be kind for the change.

Where should we put the holders? Is it better there not to break them?

Picture 67 - Holders in cells too high

In the left picture it is possible to see one employee with difficulties to put the kanban card up there in the holder. This will be translated as not following the rules of the system and not doing what she has to do. This problem arises at least at more of 5 cells from the 24 that there are at the pilot area.

Curso cards in the holder → In the cell, which has many references it is too many cards in the holder where the operator has to look. Operator has to look through this amount of cards searching the reference they are producing. Even to control that all the cards are OK, it's a little bit difficult.

Picture 68 - Too many cards of curso for one holder

As it can be seen in the picture, inside the holder will more than 70 cards, which means 70 times searching for one card. Even for the operator sometimes is difficult to put the kanban card inside when he has just feed the cell so it could be said that it is not the best way to keep the cards.

Should the cell have all the cards? Team Leader should take care about them? Is it better to put a holder for each reference?

Picture 69 - Different types of packaging

Packaging → Who will take care of this? How will it be define? Think a easy way for the operator to look to the cell and know what does he have to bring; blue, yellow, green boxes, carton boxes…

It is shown in the picture the different types of boxes that they use. The operator is using one green box which means that is for one specific customer, and he has also two types of different carton more for the next reference.

Boxes founded with different references in one position → One position in the rack should have only one reference but with different number of boxes for each. It means that in one position can be 1 to 4 boxes but always with the same reference. It has been founded different references in one position as it can be seen in the picture.

More boxes what is defined → In some cases it has been seen more boxes which has been defined in the label. It means that if a position should have just 2, there are 2 or 3 boxes more. The problem is that it will be an excessive stock in the rack which means that it won't be follow the FIFO rules and they even don't have kanban card for the cards. In the picture below it is represented this problem.

Placed boxes invented → In most of the cells are defined the upper shelf for gauges, carton used boxes and plastic bag. It has been founded a problem because they have put more boxes encroaching the limits. For example, in the picture is shown how the reference is marked in three positions with 4 boxes in each and they have put more up on the shelf. This must never happens if each type of material has an established position as it has been mentioned before.

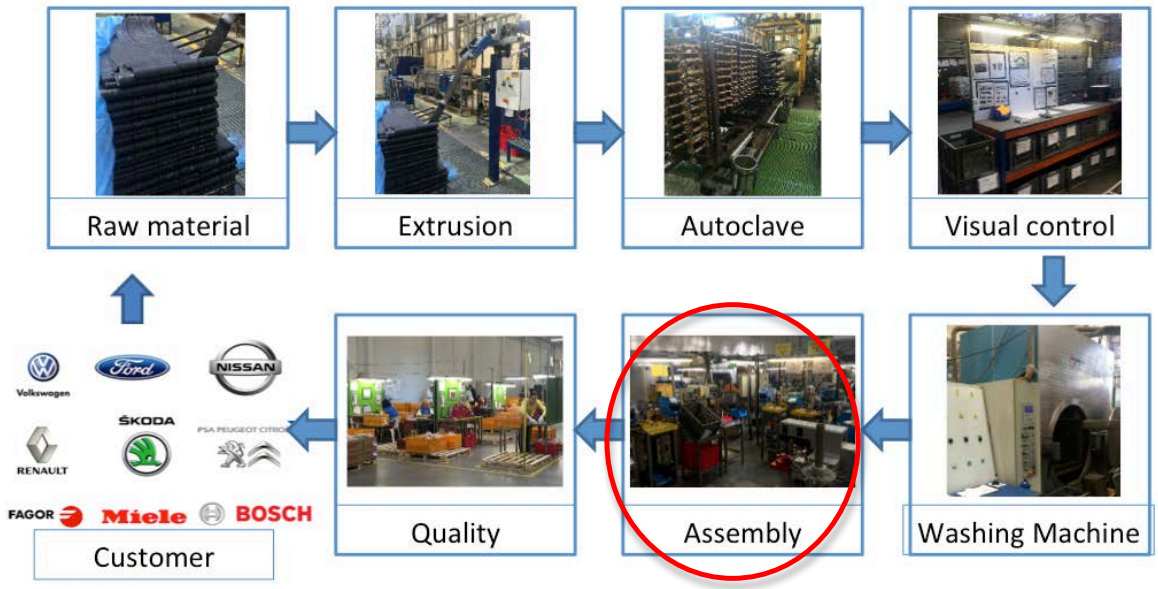
Picture 70 - Placed boxes invented

4.5. INTRODUCING CONTINUOUS FLOW TO ONE CELL

Before starting, it should be explained that this idea has been developed after all the knowledge that I have been acquiring in these 4 months. As it has been explained before, the principal problem of the company is that they are overstocked; this is translated as a big quantity of money, people and material dissipated and misused.

This is the reason why I though in something continuous, something as Volkswagen but adapted to Cikautxo with the means and infrastructure that our company has. In order to understand it better what I want to do, it has been done with a real case, simulating the orders and the times that it has to finish its job.

To start up, I have to think about the bottleneck and think about which of all the process it would be able to set the rhythm work. After thinking which one was the slowest and the one that would set the rate and having the previous estimations and studies, it was decided to take an assembly cell.



Picture 71 - Manufacturing process

As it has been mentioned before, I have chosen one cell, which is the 55054 and it is located in the first line of the pilot area. First of all, it is really important to know which are the references that they have to do, with the quantity of each order that it has to produce. With the below Excel table it is explain which is the cell, which are the references of curso that it has to use, also the incorporables and the quantity of pieces.

One cell doesn't change the references usually, it use to produce the same reference for the same customer until the production manager decides to change because customer doesn't want it more.

CELL	OFERTA	INCORPORABLE	MAX ORDER	PIECES/HOUR	TIME PRODUCING
55054	5280607	1321004	750	27	27,77 hours
		1310963			
		1340342			
		1340343			
	5494400	1310688	720	27	26,66 hours
		1321004			
		1340342			
	5778803	1310688	211	27	7,81 hours
		1321308			
		1340334			
	5294603	1310963	700	27	25,92 hours
		1320580			
		1340343			
		1340345			

Excel table 12 - References production in cell 55054

Producing 4 different references with the quantity required and using the norma that Cikautxo has with its employees, they should produce each reference in the time shown at the last column of the table.

Having these orders and knowing the times of each process thanks for the VSM, it has been done an approximately estimation of how long will take for each oferta;

	Raw material + Extrusion	Autoclave + Shower + Visual Con.	Washing Machine	Assembly cell	TOTAL
5280607	2,25 hours	18,43 hours	17,46 hours	27,77 hours	65,91 hours
5494400	2,16 hours	17,73 hours	16,77 hours	26,66 hours	63,32 hours
5778803	0,633 hours	5,18 hours	4,91 hours	7,81 hours	18,53 hours
5294603	2,10 hours	17,20 hours	16,30 hours	25,92 hours	61,52 hours

Excel table 13 - Timing producing each reference for cell 55054

In the total column is indicated the real time needed to produce the references without any warehouse. Three of them need around 3 days to make them, and the other takes just less than 1 day to produce it. This is the first point that it is needed to know to explain the continuous flow. Let's start with the explanation;

The customer for the reference 5280607 says to Cikautxo that in one month he will need the order weekly, Cikautxo accepts the order and start producing. With the way of work that it is doing right now, he will produce in big lots meaning that for the 750 pieces needed per week, it will be made 2000 pieces. What it happens is that they won't have to make again this reference for 2 weeks, what it means is;

CURRENT SITUATION IN CIKAUTXO'S PRODUCTION	
	750 PIECES/WEEKLY NEEDED
Cikautxo produces	2000 pieces → BIG LOT
Time waiting for the vulcanization	56,25 hours
Movements of crudo	20 boxes → 20 papers → 4 movements
Space in meters at crudo warehouse	1,6 m^2
Positions at crudo warehouse	Minimum 2 positions
Time waiting for the Washing Machine	1,21 hours
Time taking them to the warehouse	4,21 hours
Time at curso warehouse	7-14 days
Boxes in the curso warehouse and meters	40 boxes → 3,84 m^2

Excel table 14 - Current situation in Cikautxo's production

To calculate the storage of crudo, it has been done with the VSM and estimating how long will take for 750 pieces. Something quite similar was done for the movements of crudo, if they need about 20 boxes which means 100 pieces in each box, they have to print 20 papers, with at least 2 positions in the warehouse (and there is only around 140 positions).

It's not only the time or the movements of the worker; this means too many time for stock and wasting time doing nothing. If they produce for 2 weeks long, it means that they will have to storage at least the half of the product, which means stock for 14 days. This is translated as a space, stock and people moving material, which is not going to be used in a long period of time.

It is important to take an account that the movements of pieces doesn't add any value to the process and even the people who move all the time this boxes are doing an unnecessary job. In spite of thinking about this, they think that having stock for supplying the assembly cells means that everything is going OK.

It should be asked as another way, why the company is investing a big amount of money to grow, if improving their process would give them more space. Lots of the orders are sent late to the customer and employees think that they don't have enough time to do their tasks. Maybe distributing better the production and doing exactly what it is needed should give them the choice to achieve all the aims.

So what it is proposed to do is adjust all the process for the order doing just what it is necessary and nothing else. This is translated as;

CONTINUOUS FLOW IN CIKAUTXO'S PRODUCTION	
	750 PIECES/WEEKLY NEEDED
Cikautxo produces	800 pieces → ADJUSTED LOT
Time waiting for the vulcanization	22,5 hours
Movements of crudo	8 boxes → 8 papers → 1-2 movements
Space in meters at crudo warehouse	0,64 m^2
Positions at crudo warehouse	1 position
Time waiting for the Washing Machine	0,48 hours
Time taking them to the warehouse	1,68 hours
Time at curso warehouse	1 days
Boxes in the curso warehouse and meters	10 boxes → 0,96 m^2

Excel table 15 - Continuous flow in Cikautxo's production

It has been compared both Excel tables and in the following point it will be explain some conclusions which have been reach with all this information.

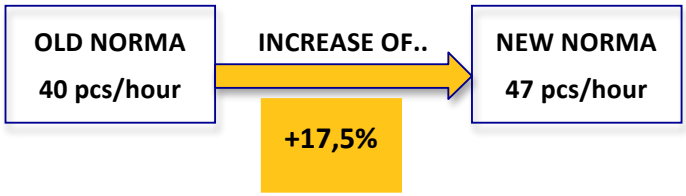
5. CONCLUSIONS

After having observed and analyzed the system working it could be taken some conclusions. **First of all** it could be said that as it has been mentioned before, this is a new way of work and if we want it to run, everybody in **the company have to be involved** in the system.

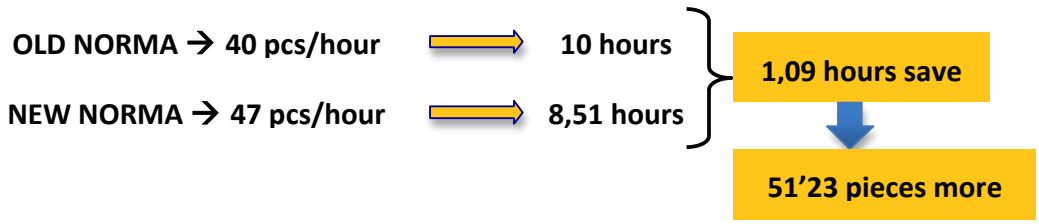
Secondly, it is quite important to understand that sometimes theory doesn't represent what it is going to happen and it is just when you start up with the system when the fails take off. It doesn't matter if you have done estimations and supposed tasks, everything could be change if people don't **follow the rules**, or if you just don't take in account with some material or job that it should have been explained before.

Thirdly, with the collected data it could be said some conclusions which the company will afford with this system, for example;

1. **Changing the lay-out of the assembly cell has raised the norma**, increasing the number of finished pieces in each cell. It could be translate as less time assembly pieces and saving time to do other references.
   As it can be seen in the Excel table below, there are some references that have increased after the new lay-out producing more pieces. In order to understand it better, and doing it more familiar, it has been chosen to see this increase the reference of the Value Stream Map.
   Remembering the reference 5791200 (which his customer was Nissan and the order needs 400 pieces), it was needed around 10 hours assembling in the cell to finish the order. It was calculated thanks to the norma per hour which the company has defined.



   Having this new norma, it is possible to make this order of 400 pieces in less time, exactly in;



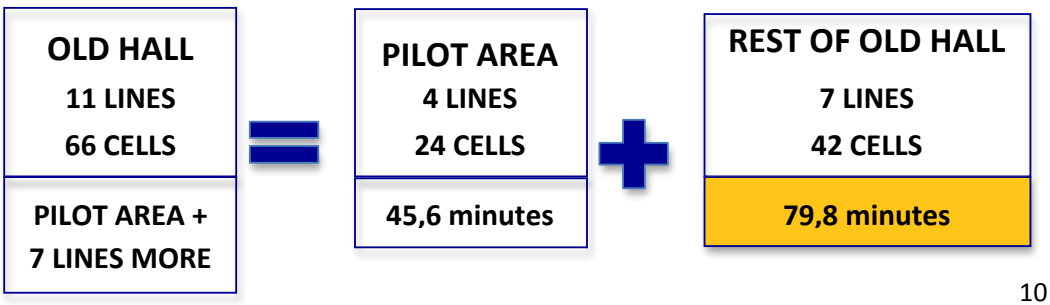
So it could be said that doing this new lay-out, depending the references, they will **increase the norma from 7 – 20 %** which means reducing the hours of assembly and incrementing the efficiency of the company.

2. **Timing the tasks of the commodin** as it has been explained before, it has been obtained the real time that he dedicates to his job. As it has been mentioned, theory doesn't represent the real way of work at all so with the actual time it has been possible to do some real conclusion.
   It has been calculated the real time that he dedicates to do all the tasks which is 45'6 minutes, with this period is possible to feed and prepare the material for 24 cells which means 4 lines.
   At the beginning it was supposed that he would be able to do their tasks in two hours frequency, if I compare both frequencies mean, it would be something like this;

As it can be seen in the graphic it is represented the 2 hours, which was the theoretical time against the real, which has been measured with a chronometer. Observing this, he will have;

$$120 - 45{,}6 = \mathbf{74{,}4}\ \boldsymbol{minutes\ free}$$

Knowing this, it is easy to conclude with some ideas. Remembering that the pilot area is in the old hall and trying to think in a future way, it could be said that the aim of this system is to introduce it in all the company. So commodin is not going to have 74,4 minutes free, in this period he will have more responsibility, taking care about more cells or even about the old hall. Let's see it more specific;



Having this data it could be said that commodin should be able to feed all the old hall, it means that in $\mathbf{45,6 + 79,8 = 125,4\ minutes}$ has finished with all the cells. Going one step more, if only with one worker is possible to take care about all the old hall it means that right now, they have more workers than they need. Right now, for all the assembly area, they have 4 commodins feeding all the time the cells. So doing some operations and estimations;

1 COMMODIN ⟹ **66 CELLS**

2 COMMODINS ⟹ **132 CELLS** ✗ **TOTAL IN CIKAUTXO 120 CELLS**

Knowing that Cikautxo Slovakia works with 120 cells means that two commodins are enough to take care of all the company. So there will be two commodins which will be not needed at least in this tasks. To conclude, it will be like this;

WITHOUT THE SYSTEM (RIGHT NOW)	WITH THE SYSTEM (IN A SHORT FUTURE)
4 commodins	**2 commodins**
120 cells	**120 cells**
Chaotic routes	**Organized routes**
Not defined tasks	**Defined tasks**

2 less persons, which means 2 salaries that right now Cikautxo is paying because they are not working in an organized way. Maybe they excuse that is understandable because of the big grown that Cikautxo has to do in the last 6 years, but now that they are trying to improve, they will have to change it. In this company, the salary of a commodin its around 550 € per month. It means;

$$550\frac{€}{month}\ x\ 2\ commodins = 1100\frac{€}{month}$$

$$1100\frac{€}{month}\ x\ 14\ pays\ = 15400\frac{€}{year}$$

But this is just the money that Cikautxo gives to their employees, it is not the real that he spent, because he also has to pay to the Social Security which is around the 30% more of the salary that they have, so it means;

15400 €/year (employees) ⟹ **19286 €/year (cost to the company)**

Maybe for a company it is not a big amount of money to save, but it could be seen that in the future they won't have to hire 2 more people.

3. The efficiency of the assembly has been increased too. As it can be seen in the Value Stream Map before, the OEE was 86%. With the new lay-out they are producing more in less time, so obviously the efficiency has been increased.

- **Assembly** →8,51 hours

✓ $\boldsymbol{OEE} = Avaiability\ x\ Performance\ x\ Quality = 0{,}9411\ x\ 0{,}94\ x\ 0{,}96 = \mathbf{84{,}92\%}$

o $\boldsymbol{Aviability} = \frac{Run\ time}{Planned\ Production\ Time} = \frac{510{,}6}{542{,}6} = \mathbf{94{,}11\%}$

If the norma has increase in a 17,5 %, the Ideal cycle Time too.

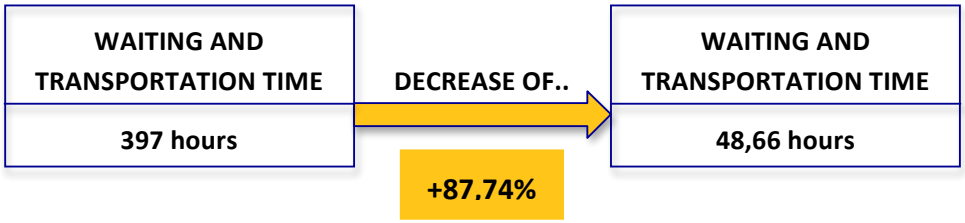
o $\boldsymbol{Performance} = \frac{Real\ production}{Production\ capacity} = \frac{47}{50} = \mathbf{94\%}$

o $\boldsymbol{Quality} = \frac{Good\ count}{Total\ count} = \frac{384}{400} = \mathbf{96\%}$

As it can be seen with the OEE, which means the efficiency of the assembly cell, at the beginning it was just the 72% and right now is the 84,92%. Just introducing the new lay-out it is supposing for the Cikautxo an improvement of the **12,92%.**

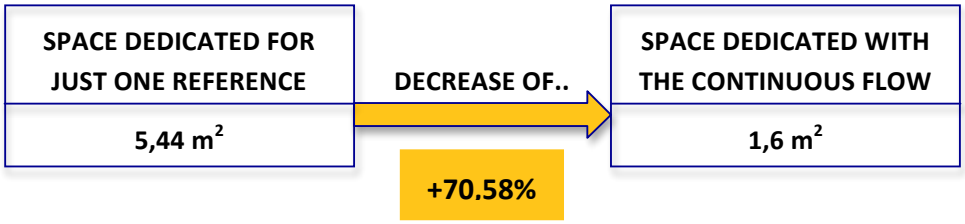
WITH A CONTINUOUS FLOW

To sum up and finish with this final work, it will be very interesting to analyze the continuous process proposed. Adjusting the pieces to the order will reduce all the processes, and doing the extrusion 4 days before shipping the order (because the entire manufacturing process need around 3 days) save too much space and time. It has been studied just with one reference for one cell and this has been the result;



As it can be seen, it would be very important this percentage save because the company would only focus in what is important → Continuous flow adding value to the product.

Doing the same with the meters save with this new way of work, it would be for just one reference of one cell,



It is important to understand that Cikautxo has grown up really fast and nobody has though about the production system or if they really need the new building. Space has converted in the most appreciated value for a company. It is around 70% for just one reference, but if I talked in a global way, supposing that the 65% of the entire references of the products have the same quantity of order it means that at least 390 references will be like the one explained before. In conclusion,

$$5{,}44\ \boldsymbol{m^2}\ x\ 390\ references = \mathbf{2121{,}6}\ \boldsymbol{m^2}$$

These meters are being using today in the company just to keep all the extra material that they are producing without any customer's order.

$$1{,}6\ \boldsymbol{m^2}\ x\ 390\ references = \mathbf{624}\ \boldsymbol{m^2}$$

These meters would be used in the company if they do a continuous material flow. Doing just a simple mathematical operation, it means that they will save;

$$2121{,}6 - 624 = \mathbf{1497{,}6}\ \boldsymbol{m^2}$$

It is an interesting result, which would permit them not to invest in another building and putting more assembly cells. Even if it is though as an amount of money, if the square meter is paid as a 450€ (consulting internet pages), they will save without any building;

$$\mathbf{1497{,}6}\ \boldsymbol{m^2}\ \boldsymbol{x}\ \mathbf{450}€ = \mathbf{673.920}\ €$$

This is only the price for the land, but later it should be added the money of the materials for the building and the contract with the constructor.

6. FUTURE LINES – Proposed Improvements

Once all the system has been observed and seeing that the Kanban system is a reliable way of work that allows the production adjust more the required amounts of pieces at the needed time, it has been decided to walk one more step. Thanks to the "Kaizen" concept, remember: "Continuous improvement", gives rise to think that Kanban system can be improved.

For this reason I would like to propose some improvements that I have been thinking and developing in this period of time and which are being studying by the company and could earn some time at the manufacturing process.

6.1. STORAGE OF CRUDO

There is one problem repeating every day, hour per hour, workers who have to carry the crudo to the autoclaves don't look at Izaro[7] to search the position of the reference. As it has been explained before, this warehouse has only space for 171 positions and they produce more than 600 so they have to be all the time doing a flow. What this action of searching means is;

- A waste of time because the operator has to look for the reference number in the paper of the box. If he has to look at all the warehouse it takes him around 10 minutes which the autoclave is stopped and is not producing.
- Sometimes boxes don't have the papers or they have it inside the box which means that is not easy to see the reference. Commodin should take the box out and look inside which a really waste of time and physical effort.

Finding a solution for this problem it was though in something more visual and easy. As it is known, they don't go to the computer to look the position and they prefer looking at the papers where the reference is.

Thinking about this I think it would be a good idea to identify the warehouse depending on the numbers of references. The idea is to mark the numbers on the floor in order of numbers from the lowest to the highest, it wouldn't be something specific of just one number but it would be a range of numbers.

[7] Software system of Cikautxo Group

For example, if the extrusion machine is producing the reference number 5449090 the extrusion operator will have to storage the box in the area which put on the floor 500000 to 550000. An easy system which helps the autoclave's operator looking and finding the reference number quickly.

6.2. QUALITY INSIDE THE CELL

It has been observed that some of the references must have the last visual quality which means that a person has to look all the pieces of the boxes checking if they are ok or not. Right now they assembly the reference in the cell and team leader has to take the pallet with all the boxes and take them to the visual quality area.

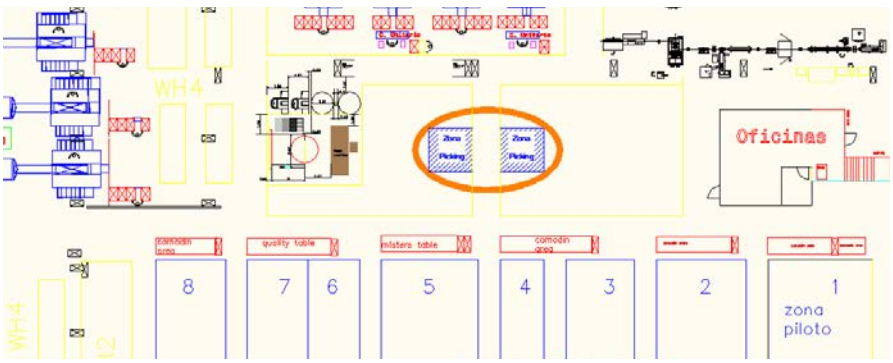
What I have been thinking is that it would be a good idea to put inside the cell a person who will take care about this quality process saving space and time because the product will be ready to send to the customer.

It will be needed more space in the cell and it should be ask for the customer if they accept this step because sometimes they define which is the specific process that they want the company to do.

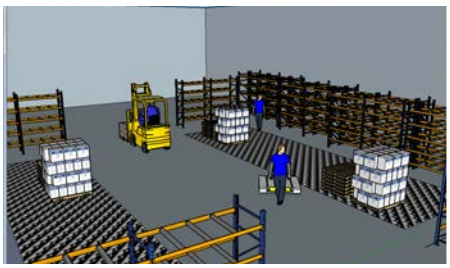
6.3. PICKING AREA FOR THE CURSO

As it has been explained the commodin who takes care about feeding the cell with curso has to collect the cards and search them at the Warehouse 2. This action means that he has to be driving through the entire warehouse searching the box with the trolley and sometimes this is a really difficult task to do.

What it has been though is creating a picking area exactly the same as the one of the warehouse 13. Having a space for the trolley and another commodin should only have to take the boxes and put them in the trolley.



Picture 72 - Cikautxo lay-out with the picking curso area



Picture 73 - A representative simulation

This will save time for the commodin, which only have to take the trolley once that it is full, shunting which won't do it with the trolley and distance walked. It will be important that all the curso that is needed for the cell will have to be next to the line.

Maybe this is not a current improvement but if I propose it is because I am thinking in the future and when the system will implant in all the assembly area, which are 120 cells producing all the time without any stop.

6.4. BETTER TRAINING WITH THE SYSTEM

It has been explained the system for the operators, commodin and team leaders but even of this, they don't understand the system and they don't work in this way because they don't believe in it.

What I have been thinking is to train them with a game, involving them in the change and forcing them to be part of it. The game though was producing 3 different types of cars with "Lego" pieces.

- Car 1 → It will be needed 2 pieces of type A and 2 of B
- Car 2 → It will be needed 1 piece of type A and 3 of C
- Car 3 → It will be needed 3 pieces of type C and 4 of D

It will be consisted in four parts, the first one will be the producing area, the second one will be the warehouse which has all the pieces to form the three types of cars, the third will be the assembly area and last will be the ship to the customer. They will only have to produce if they receive a customer order and only the quantity required.

For example, if the order is 2 cars type 3 they will have to get from the warehouse 6 pieces of C and 8 pieces of D. But they will have to give each card of each piece for the producing area in order to know how many pieces they will have to produce again.

A simple and easy game which everybody will understand and will participate asking doubts or asking the things that they are not agree with. I have this idea knowing that everybody always look for the easiest and simplest task. If they have a way to finish before their job, they will do it that way.

6.5. KANBAN BOARD

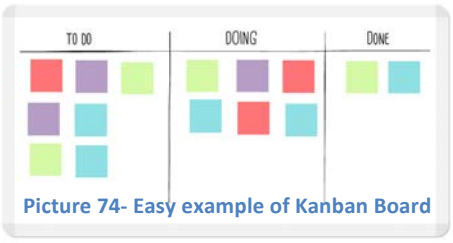
A Kanban board is one of the most popular tools to increase productivity. None of the existing methods of managing projects is both easy to use and effective as the Kanban method.

This useful tool improves the company with transparency, productivity and efficiency of your organization. It would be perfect to put one in each line specifying the cell and the reference, which will have to produce. It is a really easy tool because all the people will be able to see what they are producing in each cell, what they have just produced and what they are going to use.

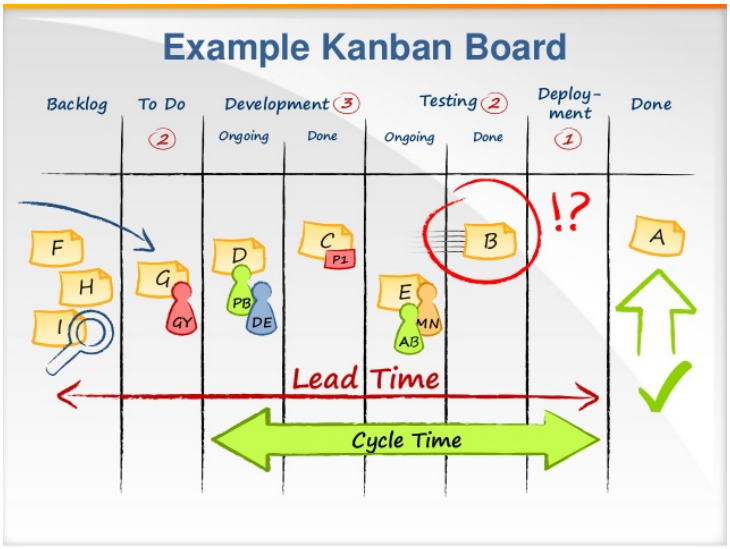
Commodin will only have to go there and look to feed the cell before it changes the reference and he will have time to prepare all the staff.

Even for the team leader will be an easier job because it will be more visual and they will know all the time which one has to change the reference.

Also for the operator if he doesn't know which one are first or how many pieces he has to do, he would only have to go there and see the board where it would be specify all the information that he needs.



Picture 74- Easy example of Kanban Board



Picture 75 - Kanban board

6.6. TEAM LEADERS SHOULD HAVE THE CURSO CARDS

One desk as it has been shown in the picture will be perfect to have all the curso cards for each cell. It would be distributed depending on the line and it would be easier for everybody.

Operators wouldn't have to look inside the holders and search for the cards in all that amount of cards. They would never lose them and they would only have to take care about their production.

Nothing will change for the commodin because the curso cards would be at the same holder as always and they would have to get them from there.

Team leaders would have to take care about the change of the reference production (right now is also taking care of it) and putting the cards into the holder 1 hour before the cell finish. The only difference about how they have to do now is that it would be no mistakes because they would know when they would have to tell the commodin to feed the cell.

Right now exits the problem that sometimes the operator doesn't look to the holder because he doesn't mind or he just is busy and forget it.

6.7. PAINTING THE FLOOR DEFINING WHERE THING SHOULD BE IN THE CELL

It has been though that it would be a great idea to put some sticker defining the form of each machine, pallet, bin, or shelf. Something as 5S, but only defining where things should be and how it should be collocate.

The problem right now is that it is indicated as it is seen in the picture. It means that there are too many papers in a very short area and the operator doesn't look up there so they put the material as they want. This is a really big problem because there is no room in the cell and if they start putting the boxes as they want, there is no space for the packaging or carton boxes.

Painting on the floor will be really easy for them to identify the best way to have their staff in the correct place. A simple task but really visual for everybody.

Picture 76 - Defining the place for each item

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8. ANNEX

ANNEX 1 –Feeding incorporable for the assembly cells

						boxes feeding (h)							
						2		1,5		1		0,5	
CELL	LINE	REF	Boxes	Hours	Hours/bo	exact	rounded	exact	rounded	exact	rounded	exact	rounded
55069	1	1320584	1	3,1	3,1	0,6	1,0	0,5	1,0	0,3	1,0	0,2	1,0
55069	1	1320584	1	3,1	3,1	0,6	1,0	0,5	1,0	0,3	1,0	0,2	1,0
55099	1	1340389	1	3,5	3,5	0,6	1,0	0,4	1,0	0,3	1,0	0,1	1,0
55099	1	1320580	2	3,5	1,7	1,2	2,0	0,9	1,0	0,6	1,0	0,3	1,0
55099	1	1340391	1	3,6	3,6	0,6	1,0	0,4	1,0	0,3	1,0	0,1	1,0
55054	1	1321004	1	3,6	3,6	0,6	1,0	0,4	1,0	0,3	1,0	0,1	1,0
55054	1	1321004	1	3,6	3,6	0,6	1,0	0,4	1,0	0,3	1,0	0,1	1,0
55054	1	1321004	1	3,6	3,6	0,6	1,0	0,4	1,0	0,3	1,0	0,1	1,0
55099	1	1340413	1	3,8	3,8	0,5	1,0	0,4	1,0	0,3	1,0	0,1	1,0
55099	1	1321001	1	3,9	3,9	0,5	1,0	0,4	1,0	0,3	1,0	0,1	1,0
55069	1	1320580	2	3,9	2,0	1,0	2,0	0,8	1,0	0,5	1,0	0,3	1,0
55099	1	1310800	2	4,3	2,1	0,9	1,0	0,7	1,0	0,5	1,0	0,2	1,0
55069	1	1321260	1	4,5	4,5	0,4	1,0	0,3	1,0	0,2	1,0	0,1	1,0
55069	1	1321260	1	4,5	4,5	0,4	1,0	0,3	1,0	0,2	1,0	0,1	1,0
55099	1	1321010	1	5,0	5,0	0,4	1,0	0,3	1,0	0,2	1,0	0,1	1,0
55054	1	1310688	2	5,0	2,5	0,8	1,0	0,6	1,0	0,4	1,0	0,2	1,0
55099	1	1310500	4	5,0	1,3	1,6	2,0	1,2	2,0	0,8	1,0	0,4	1,0
55041	1	1320921	2	5,3	2,6	0,8	1,0	0,6	1,0	0,4	1,0	0,2	1,0
55041	1	1320921	2	5,3	2,6	0,8	1,0	0,6	1,0	0,4	1,0	0,2	1,0
55041	1	1320921	2	5,3	2,6	0,8	1,0	0,6	1,0	0,4	1,0	0,2	1,0
55041	1	1320921	2	5,3	2,6	0,8	1,0	0,6	1,0	0,4	1,0	0,2	1,0
	1	1320921	2	5,3	2,6	0,8	1,0	0,6	1,0	0,4	1,0	0,2	1,0
55054	1	1340342	1	6,0	6,0	0,3	1,0	0,3	1,0	0,2	1,0	0,1	1,0
756	1	1320911	1	6,1	6,1	0,3	1,0	0,2	1,0	0,2	1,0	0,1	1,0
756	1	1320911	1	6,1	6,1	0,3	1,0	0,2	1,0	0,2	1,0	0,1	1,0
55069	1	1340400	1	6,3	6,3	0,3	1,0	0,2	1,0	0,2	1,0	0,1	1,0
55041	1	1320902	1	6,7	6,7	0,3	1,0	0,2	1,0	0,2	1,0	0,1	1,0
55041	1	1320902	1	6,7	6,7	0,3	1,0	0,2	1,0	0,2	1,0	0,1	1,0
55054	1	1321308	1	6,8	6,8	0,3	1,0	0,2	1,0	0,1	1,0	0,1	1,0
55069	1	1310688	2	7,0	3,5	0,6	1,0	0,4	1,0	0,3	1,0	0,1	1,0
55099	1	1321157	1	7,1	7,1	0,3	1,0	0,2	1,0	0,1	1,0	0,1	1,0
55069	1	1340333	1	7,8	7,8	0,3	1,0	0,2	1,0	0,1	1,0	0,1	1,0
756	1	1340147 - 145 mm	1	8,5	8,5	0,2	1,0	0,2	1,0	0,1	1,0	0,1	1,0
756	1	1340147 - 145 mm	1	8,5	8,5	0,2	1,0	0,2	1,0	0,1	1,0	0,1	1,0
55099	1	1321249	1	8,6	8,6	0,2	1,0	0,2	1,0	0,1	1,0	0,1	1,0
55054	1	1320580	2	9,3	4,6	0,4	1,0	0,3	1,0	0,2	1,0	0,1	1,0
55054	1	1320580	2	9,3	4,6	0,4	1,0	0,3	1,0	0,2	1,0	0,1	1,0
55069	1	1321283	2	9,4	4,7	0,4	1,0	0,3	1,0	0,2	1,0	0,1	1,0
55069	1	1321283	2	9,4	4,7	0,4	1,0	0,3	1,0	0,2	1,0	0,1	1,0
55069	1	1321283	2	9,4	4,7	0,4	1,0	0,3	1,0	0,2	1,0	0,1	1,0
756	1	1340301	2	11,6	5,8	0,3	1,0	0,3	1,0	0,2	1,0	0,1	1,0
756	1	1340301	2	11,6	5,8	0,3	1,0	0,3	1,0	0,2	1,0	0,1	1,0
55041	1	1321095	1	11,7	11,7	0,2	1,0	0,1	1,0	0,1	1,0	0,0	1,0
55099	1	1310963	8	12,8	1,6	1,3	2,0	0,9	1,0	0,6	1,0	0,3	1,0
55069	1	1310963	8	14,4	1,8	1,1	2,0	0,8	1,0	0,6	1,0	0,3	1,0
55054	1	1310963	8	14,4	1,8	1,1	2,0	0,8	1,0	0,6	1,0	0,3	1,0
55041	1	1310603	8	15,3	1,9	1,0	2,0	0,8	1,0	0,5	1,0	0,3	1,0
55069	1	1340334	2	15,6	7,8	0,3	1,0	0,2	1,0	0,1	1,0	0,1	1,0
55054	1	1340343	2	15,6	7,8	0,3	1,0	0,2	1,0	0,1	1,0	0,1	1,0
55054	1	1340345	2	18,5	9,3	0,2	1,0	0,2	1,0	0,1	1,0	0,1	1,0
55099	1	1321212	1	18,8	18,8	0,1	1,0	0,1	1,0	0,1	1,0	0,0	1,0
55099	1	1340427	1	23,4	23,4	0,1	1,0	0,1	1,0	0,0	1,0	0,0	1,0
55069	1	1340399	2	25,0	12,5	0,2	1,0	0,1	1,0	0,1	1,0	0,0	1,0
55054	1	1340334	2	35,5	17,8	0,1	1,0	0,1	1,0	0,1	1,0	0,0	1,0
53510	1	1310498	2	37,5	18,8	0,1	1,0	0,1	1,0	0,1	1,0	0,0	1,0
53510	1	1310498	2	37,5	18,8	0,1	1,0	0,1	1,0	0,1	1,0	0,0	1,0
55041	1	1310195	8	51,7	6,5	0,3	1,0	0,2	1,0	0,2	1,0	0,1	1,0
55041	1	1321040	2	93,8	46,9	0,0	1,0	0,0	1,0	0,0	1,0	0,0	1,0
55041	1	1340250	2	159,0	79,5	0,0	1,0	0,0	1,0	0,0	1,0	0,0	1,0
55099	1	1340343	2	231,4	115,7	0,0	1,0	0,0	1,0	0,0	1,0	0,0	1,0
53510	1	1310499	2	1406,3	703,1	0,0	1,0	0,0	1,0	0,0	1,0	0,0	1,0
55099	1	1340408	1	2343,8	2343,8	0,0	1,0	0,0	1,0	0,0	1,0	0,0	1,0

						boxes feeding (h)							
						2		1,5		1		0,5	
CELL	LINE	REF	Boxes	Hours	Hours/bc	exact	rounded	exact	rounded	exact	rounded	exact	rounded
55063	4	1340382	1	4,6	4,6	0,4	1,0	0,3	1,0	0,2	1,0	0,1	1,0
55063	4	1321157	1	4,6	4,6	0,4	1,0	0,3	1,0	0,2	1,0	0,1	1,0
55063	4	1321069	1	5,2	5,2	0,4	1,0	0,3	1,0	0,2	1,0	0,1	1,0
55135	**4**	1340330	1	6,7	6,7	0,3	1,0	0,2	1,0	0,2	1,0	0,1	1,0
55063	4	1340341	2	6,7	3,3	0,6	1,0	0,4	1,0	0,3	1,0	0,1	1,0
765	4	1321106A	2	10,4	5,2	0,4	1,0	0,3	1,0	0,2	1,0	0,1	1,0
55063	4	1320999	1	11,4	11,4	0,2	1,0	0,1	1,0	0,1	1,0	0,0	1,0
55063	4	1340335	2	11,4	5,7	0,4	1,0	0,3	1,0	0,2	1,0	0,1	1,0
765	4	1340352	1	13,9	13,9	0,1	1,0	0,1	1,0	0,1	1,0	0,0	1,0
55135	**4**	1340379	1	15,0	15,0	0,1	1,0	0,1	1,0	0,1	1,0	0,0	1,0
55063	4	1340349	1	17,1	17,1	0,1	1,0	0,1	1,0	0,1	1,0	0,0	1,0
55135	**4**	1340419	1	17,3	17,3	0,1	1,0	0,1	1,0	0,1	1,0	0,0	1,0
55059	4	1340311	1	21,4	21,4	0,1	1,0	0,1	1,0	0,0	1,0	0,0	1,0
55135	**4**	1340421	1	22,5	22,5	0,1	1,0	0,1	1,0	0,0	1,0	0,0	1,0
55085	4	1340331	2	23,3	11,6	0,2	1,0	0,1	1,0	0,1	1,0	0,0	1,0
55059	4	1340271	1	25,0	25,0	0,1	1,0	0,1	1,0	0,0	1,0	0,0	1,0
55059	4	1340318	1	28,1	28,1	0,1	1,0	0,1	1,0	0,0	1,0	0,0	1,0
55059	4	1340316	1	28,1	28,1	0,1	1,0	0,1	1,0	0,0	1,0	0,0	1,0
55063	4	1320879	2	29,0	14,5	0,1	1,0	0,1	1,0	0,1	1,0	0,0	1,0
765	4	1340177-200mm	1	31,3	31,3	0,1	1,0	0,0	1,0	0,0	1,0	0,0	1,0
55063	4	1340348	1	34,1	34,1	0,1	1,0	0,0	1,0	0,0	1,0	0,0	1,0
55086	**4**	1310338	2	37,5	18,8	0,1	1,0	0,1	1,0	0,1	1,0	0,0	1,0
55086	**4**	1320419A	2	37,5	18,8	0,1	1,0	0,1	1,0	0,1	1,0	0,0	1,0
55059	4	1340272	2	42,9	21,4	0,1	1,0	0,1	1,0	0,0	1,0	0,0	1,0
55135	**4**	1340420	1	45,0	45,0	0,0	1,0	0,0	1,0	0,0	1,0	0,0	1,0
55059	4	1340317	1	66,7	66,7	0,0	1,0	0,0	1,0	0,0	1,0	0,0	1,0
55063	4	1310194	8	72,7	9,1	0,2	1,0	0,2	1,0	0,1	1,0	0,1	1,0
55059	4	1340321	1	100,0	100,0	0,0	1,0	0,0	1,0	0,0	1,0	0,0	1,0
55086	**4**	1321050	2	1406,3	703,1	0,0	1,0	0,0	1,0	0,0	1,0	0,0	1,0

						boxes feeding (h)							
						2		1,5		1		0,5	
CELL	LINE	REF	Boxes	Hours	Hours/bc	exact	roundec	exact	roundec	exact	roundec	exact	roundec
770	2	1320783	2	2,7	1,4	1,5	2,0	1,1	2,0	0,7	1,0	0,4	1,0
770	2	1320783	2	2,7	1,4	1,5	2,0	1,1	2,0	0,7	1,0	0,4	1,0
770	2	1321016	2	3,4	1,7	1,2	2,0	0,9	1,0	0,6	1,0	0,3	1,0
770	2	1321016	2	3,4	1,7	1,2	2,0	0,9	1,0	0,6	1,0	0,3	1,0
770	2	1321016	2	3,4	1,7	1,2	2,0	0,9	1,0	0,6	1,0	0,3	1,0
767	2	5053502	1	4,2	4,2	0,5	1,0	0,4	1,0	0,2	1,0	0,1	1,0
767	2	5053502	1	4,2	4,2	0,5	1,0	0,4	1,0	0,2	1,0	0,1	1,0
767	2	5053502	1	4,2	4,2	0,5	1,0	0,4	1,0	0,2	1,0	0,1	1,0
767	2	5053502	1	4,2	4,2	0,5	1,0	0,4	1,0	0,2	1,0	0,1	1,0
767	2	5053502	1	4,2	4,2	0,5	1,0	0,4	1,0	0,2	1,0	0,1	1,0
767	2	5329306	1	7,5	7,5	0,3	1,0	0,2	1,0	0,1	1,0	0,1	1,0
55064	2	1340344	2	7,7	3,8	0,5	1,0	0,4	1,0	0,3	1,0	0,1	1,0
55064	2	1340346	1	8,0	8,0	0,3	1,0	0,2	1,0	0,1	1,0	0,1	1,0
55097	2	5116581	1	8,3	8,3	0,2	1,0	0,2	1,0	0,1	1,0	0,1	1,0
55057	2	1310645	2	9,6	4,8	0,4	1,0	0,3	1,0	0,2	1,0	0,1	1,0
55057	2	1310645	2	9,6	4,8	0,4	1,0	0,3	1,0	0,2	1,0	0,1	1,0
55057	2	1310645	2	9,6	4,8	0,4	1,0	0,3	1,0	0,2	1,0	0,1	1,0
55057	2	1310645	2	9,6	4,8	0,4	1,0	0,3	1,0	0,2	1,0	0,1	1,0
770	2	1321040	2	10,0	5,0	0,4	1,0	0,3	1,0	0,2	1,0	0,1	1,0
55057	2	1310644A	2	10,0	5,0	0,4	1,0	0,3	1,0	0,2	1,0	0,1	1,0
55064	2	1340347	1	12,5	12,5	0,2	1,0	0,1	1,0	0,1	1,0	0,0	1,0
55064	2	1340347	1	12,5	12,5	0,2	1,0	0,1	1,0	0,1	1,0	0,0	1,0
55064	2	1340340	2	12,5	6,3	0,3	1,0	0,2	1,0	0,2	1,0	0,1	1,0
55097	2	5632060	1	13,3	13,3	0,2	1,0	0,1	1,0	0,1	1,0	0,0	1,0
55097	2	5826020	1	13,3	13,3	0,2	1,0	0,1	1,0	0,1	1,0	0,0	1,0
55097	2	5632052	1	13,3	13,3	0,2	1,0	0,1	1,0	0,1	1,0	0,0	1,0
55097	2	5632060	1	13,3	13,3	0,2	1,0	0,1	1,0	0,1	1,0	0,0	1,0
55097	2	5826020	1	13,3	13,3	0,2	1,0	0,1	1,0	0,1	1,0	0,0	1,0
767	2	1321276	1	14,5	14,5	0,1	1,0	0,1	1,0	0,1	1,0	0,0	1,0
55097	2	5632020	1	16,7	16,7	0,1	1,0	0,1	1,0	0,1	1,0	0,0	1,0
767	2	1340253 - 100 mm	1	27,9	27,9	0,1	1,0	0,1	1,0	0,0	1,0	0,0	1,0
770	2	1310195	8	42,4	5,3	0,0	1,0	0,3	1,0	0,2	1,0	0,1	1,0
55097	2	1340232-18mm	1	58,8	58,8	0,0	1,0	0,0	1,0	0,0	1,0	0,0	1,0
55057	2	1340071 - 100mm	1	60,0	60,0	0,0	1,0	0,0	1,0	0,0	1,0	0,0	1,0
55057	2	1310362	2	66,7	33,3	0,1	1,0	0,0	1,0	0,0	1,0	0,0	1,0
767	2	1310355	2	72,5	36,2	0,1	1,0	0,0	1,0	0,0	1,0	0,0	1,0
770	2	1310612	8	80,0	10,0	0,0	1,0	0,2	1,0	0,1	1,0	0,1	1,0
55057	2	1310390	8	93,3	11,7	0,2	1,0	0,1	1,0	0,1	1,0	0,0	1,0
55057	2	1310048	8	96,0	12,0	0,2	1,0	0,1	1,0	0,1	1,0	0,0	1,0
55097	2	1321297	2	105,9	52,9	0,0	1,0	0,0	1,0	0,0	1,0	0,0	1,0
770	2	1340250	2	130,4	65,2	0,0	1,0	0,0	1,0	0,0	1,0	0,0	1,0
55057	2	1310176	8	173,3	21,7	0,1	1,0	0,1	1,0	0,0	1,0	0,0	1,0
55057	2	1310389	8	266,7	33,3	0,1	1,0	0,0	1,0	0,0	1,0	0,0	1,0
55097	2	1320831	1	294,1	294,1	0,0	1,0	0,0	1,0	0,0	1,0	0,0	1,0
55097	2	1320558	2	294,1	147,1	0,0	1,0	0,0	1,0	0,0	1,0	0,0	1,0
55057	2	1320856	8	1333,3	166,7	0,0	1,0	0,0	1,0	0,0	1,0	0,0	1,0
55097	2	1320637	2	2117,6	1058,8	0,0	1,0	0,0	1,0	0,0	1,0	0,0	1,0

ANNEX 2 –Feeding curso for the assembly cells

							2		1,5		1		0,5	
REF	CELL	LINE	Position	Boxes	Hours	Hours/box	exact	rounded	exact	rounded	exa	rounded	exa	rounde
5050714	756	1	2	6	8,78	1,46	1,4	2,0	1,0	2,0	0,7	1,0	0,3	1,0
4112574	53510	1	1	1	21,10	21,10	0,1	1,0	0,1	1,0	0,0	1,0	0,0	1,0
4112595	53510	1	1	1	70,32	70,32	0,0	1,0	0,0	1,0	0,0	1,0	0,0	1,0
5040880	53510	1	1	1	112,50	112,50	0,0	1,0	0,0	1,0	0,0	1,0	0,0	1,0
P5040830	53510	1	1	1	112,50	112,50	0,0	1,0	0,0	1,0	0,0	1,0	0,0	1,0
5081650	55041	1	1	6	6,55	1,09	1,8	2,0	1,4	2,0	0,9	1,0	0,5	1,0
5081260	55041	1	1	6	10,00	1,67	1,2	2,0	0,9	1,0	0,6	1,0	0,3	1,0
4894263	55041	1	1	6	10,58	1,76	1,1	2,0	0,9	1,0	0,6	1,0	0,3	1,0
5081660	55041	1	1	6	12,00	2,00	1,0	1,0	0,8	1,0	0,5	1,0	0,3	1,0
5081250	55041	1	1	6	16,00	2,67	0,8	1,0	0,6	1,0	0,4	1,0	0,2	1,0
5363720	55041	1	1	6	91,40	15,23	0,1	1,0	0,1	1,0	0,1	1,0	0,0	1,0
5280650	55054	1	1	6	2,85	0,48	4,2	5,0	3,2	4,0	2,1	3,0	1,1	2,0
5494420	55054	1	1	6	3,57	0,59	3,4	4,0	2,5	3,0	1,7	2,0	0,8	1,0
5280650	55054	1	1	6	3,75	0,63	3,2	4,0	2,4	3,0	1,6	2,0	0,8	1,0
5280661	55054	1	1	6	4,68	0,78	2,6	3,0	1,9	2,0	1,3	2,0	0,6	1,0
5280661	55054	1	1	6	5,55	0,93	2,2	3,0	1,6	2,0	1,1	2,0	0,5	1,0
5294651	55054	1	1	6	5,55	0,93	2,2	3,0	1,6	2,0	1,1	2,0	0,5	1,0
5778823	55054	1	1	6	12,80	2,13	0,9	1,0	0,7	1,0	0,5	1,0	0,2	1,0
5778832	55054	1	1	6	17,27	2,88	0,7	1,0	0,5	1,0	0,3	1,0	0,2	1,0
5625120	55069	1	2	6	6,00	1,00	2,0	2,0	1,5	2,0	1,0	1,0	0,5	1,0
5280450	55069	1	2	6	7,50	1,25	1,6	2,0	1,2	2,0	0,8	1,0	0,4	1,0
5280450	55069	1	2	6	7,50	1,25	1,6	2,0	1,2	2,0	0,8	1,0	0,4	1,0
5280450	55069	1	2	6	7,50	1,25	1,6	2,0	1,2	2,0	0,8	1,0	0,4	1,0
5625130	55069	1	2	6	9,00	1,50	1,3	2,0	1,0	1,0	0,7	1,0	0,3	1,0
5280460	55069	1	2	6	9,38	1,56	1,3	2,0	1,0	1,0	0,6	1,0	0,3	1,0
5280550	55069	1	2	6	9,38	1,56	1,3	2,0	1,0	1,0	0,6	1,0	0,3	1,0
5280460	55069	1	2	6	9,38	1,56	1,3	2,0	1,0	1,0	0,6	1,0	0,3	1,0
5625130	55069	1	2	6	9,38	1,56	1,3	2,0	1,0	1,0	0,6	1,0	0,3	1,0
5861120	55069	1	2	6	17,17	2,86	0,7	1,0	0,5	1,0	0,3	1,0	0,2	1,0
5786202	55099	1	2	6	2,25	0,38	5,3	6,0	4,0	4,0	2,7	3,0	1,3	2,0
5294520	55099	1	1	6	3,33	0,56	3,6	4,0	2,7	3,0	1,8	2,0	0,9	1,0
5294530	55099	1	1	6	3,33	0,56	3,6	4,0	2,7	3,0	1,8	2,0	0,9	1,0
5294230	55099	1	1	6	3,43	0,57	3,5	4,0	2,6	3,0	1,7	2,0	0,9	1,0
5294220	55099	1	1	6	7,28	1,21	1,6	2,0	1,2	2,0	0,8	1,0	0,4	1,0
5786120	55099	1	1	6	10,32	1,72	1,2	2,0	0,9	1,0	0,6	1,0	0,3	1,0
5579006	55099	1	2	6	16,88	2,81	0,7	1,0	0,5	1,0	0,4	1,0	0,2	1,0
5786130	55099	1	1	6	18,75	3,13	0,6	1,0	0,5	1,0	0,3	1,0	0,2	1,0
5786140	55099	1	1	6	18,75	3,13	0,6	1,0	0,5	1,0	0,3	1,0	0,2	1,0

							2		1,5		1		0,5	
REF	CELL	LINE	Position	Boxes	Hours	Hours/box	exact	rounded	exact	rounded	exa	rounded	exa	rounde
5280305	55063	4	2	12	2,00	0,17	12,0	12,0	9,0	9,0	6,0	6,0	3,0	3,0
5279905	55063	4	2	12	3,27	0,27	7,3	8,0	5,5	6,0	3,7	4,0	1,8	2,0
5473702	55135	4	1	6	3,60	0,60	3,3	4,0	2,5	3,0	1,7	2,0	0,8	1,0
5358601	55063	4	2	12	3,60	0,30	6,7	7,0	5,0	5,0	3,3	4,0	1,7	2,0
5449401	55063	4	2	12	3,75	0,31	6,4	7,0	4,8	5,0	3,2	4,0	1,6	2,0
5081500	55059	4	1	6	4,00	0,67	3,0	3,0	2,3	3,0	1,5	2,0	0,8	1,0
5418402	55135	4	1	6	4,50	0,75	2,7	3,0	2,0	2,0	1,3	2,0	0,7	1,0
5473902	55135	4	1	6	5,53	0,92	2,2	3,0	1,6	2,0	1,1	2,0	0,5	1,0
5123805	55085	4	2	12	6,00	0,50	4,0	4,0	3,0	3,0	2,0	2,0	1,0	1,0
5123906	55085	4	2	12	6,98	0,58	3,4	4,0	2,6	3,0	1,7	2,0	0,9	1,0
5216202	55059	4	1	6	7,20	1,20	1,7	2,0	1,3	2,0	0,8	1,0	0,4	1,0
5127173	55086	4	1	6	7,32	1,22	1,6	2,0	1,2	2,0	0,8	1,0	0,4	1,0
5212001	55059	4	1	6	7,50	1,25	1,6	2,0	1,2	2,0	0,8	1,0	0,4	1,0
5426503	765	4	1	6	8,33	1,39	1,4	2,0	1,1	2,0	0,7	1,0	0,4	1,0
5384704	765	4	1	6	8,43	1,41	1,4	2,0	1,1	2,0	0,7	1,0	0,4	1,0
5279506	55063	4	2	12	8,57	0,71	2,8	3,0	2,1	3,0	1,4	2,0	0,7	1,0
5451800	55063	4	2	12	10,28	0,86	2,3	3,0	1,8	2,0	1,2	2,0	0,6	1,0
5473801	55135	4	1	6	10,80	1,80	1,1	2,0	0,8	1,0	0,6	1,0	0,3	1,0
5127163	55086	4	1	6	10,98	1,83	1,1	2,0	0,8	1,0	0,5	1,0	0,3	1,0
5426704	55135	4	1	6	12,00	2,00	1,0	1,0	0,8	1,0	0,5	1,0	0,3	1,0
5216401	55059	4	1	6	12,85	2,14	0,9	1,0	0,7	1,0	0,5	1,0	0,2	1,0
5212300	55059	4	1	6	16,00	2,67	0,8	1,0	0,6	1,0	0,4	1,0	0,2	1,0
5426603	765	4	1	6	17,65	2,94	0,7	1,0	0,5	1,0	0,3	1,0	0,2	1,0
5081801	55059	4	1	6	18,00	3,00	0,7	1,0	0,5	1,0	0,3	1,0	0,2	1,0
5216802	55059	4	1	6	22,50	3,75	0,5	1,0	0,4	1,0	0,3	1,0	0,1	1,0
5127152	55086	4	1	6	25,62	4,27	0,5	1,0	0,4	1,0	0,2	1,0	0,1	1,0
5217901	55059	4	1	6	27,00	4,50	0,4	1,0	0,3	1,0	0,2	1,0	0,1	1,0
5217802	55059	4	1	6	50,00	8,33	0,2	1,0	0,2	1,0	0,1	1,0	0,1	1,0

ANNEX 3 –Consumed Curso and Incorporable boxes in the assembly area

							Feeding freq 2 (h)										
							1,6	0,0	0,8	1,7	0,9	0,5	0,2	0,4	3,0	0,7	CRITICAL REF
CELL	LINE	REF	MAX ORDER REF	NORMA	h/producing	% time prod.	5212001	6257000	5212300	5216202	5216401	5216802	5217802	5217901	5081500	5081801	
55059	4	5212001	300	84	4	10,1%	1										2,0
		6257000	300	80	4	10,6%											0,0
		5212300	225	84	3	7,6%			1								1,0
		5216202	500	160	3	8,8%				1							2,0
		5216401	175	85	2	5,8%					1						1,0
		5216802	200	60	3	9,4%						1					1,0
		5217802	225	56	4	11,3%							1				1,0
		5217901	200	56	4	10,1%								1			1,0
		5081500	450	65	7	19,5%									1		3,0
		5081801	175	72	2	6,9%										1	1,0
						100,0%	10,1%	0,0%	7,6%	8,8%	5,8%	9,4%	11,3%	10,1%	19,5%	6,9%	
							0,16	0,00	0,06	0,15	0,05	0,05	0,03	0,04	0,59	0,05	
						AVERAGE	2,0										

							Feeding freq 2 (h)				Feeding freq 1,5(h)				Feeding freq 1 (h)			
							2,0	2,0	1,0	CRITICAL REF	2,0	2,0	1,0	CRITICAL REF	1,0	1,0	1,0	CRITICAL REF
CELL	LINE	REF	MAX ORDER REF	NORMA	h/producing	% time prod.	5384704	5426503	5426603		5384704	5426503	5426603		5384704	5426503	5426603	
765	4	5384704	550,44	32	17	25,6%	1			2,0	1			2,0	1			1,0
		5426503	1800	72	25	37,2%		1		2,0		1		2,0		1		1,0
		5426603	1800	72	25	37,2%			1	1,0			1	1,0			1	1,0
							25,6%	37,2%	37,2%		25,6%	37,2%	37,2%		25,6%	37,2%	37,2%	
							0,5	0,7	0,4		0,5	0,7	0,4		0,3	0,4	0,4	
						AVERAGE	2,0				2,0				1,0			

							Feeding freq 2 (h)					Feeding freq 1,5(h)					Feeding freq 1 (h)				
							1,0	5,0	3,0	4,0	CRITICAL REF	1,0	4,0	3,0	3,0	CRITICAL REF	1,0	3,0	2,0	2,0	CRITICAL REF
CELL	LINE	REF	MAX ORDER REF	NORMA	h/producing	% time prod.	4777006	4776906	5437100	5691302		4777006	4776906	5437100	5691302		4777006	4776906	5437100	5691302	
55037	3	4777006	500	102,5	5	7,8%	1				1,0	1				1,0	1				1,0
		4776906	900	110	8	13,1%		1			5,0		1			4,0		1			3,0
		5437100	1600	145	11	17,7%			1		3,0			1		3,0			1		2,0
		5691302	4200	110	38	61,3%				1	4,0				1	3,0				1	2,0
											0,0					0,0					0,0
							7,8%	13,1%	17,7%	61,3%		7,8%	13,1%	17,7%	61,3%		7,8%	13,1%	17,7%	61,3%	
							0,1	0,7	0,5	2,5		0,1	0,5	0,5	1,8		0,1	0,4	0,4	1,2	
						AVERAGE	4,0					3,0					3,0				

							Feeding freq 2 (h)										
							1,4	0,4	0,4	3,1	0,5	3,7	0,6	0,3	0,7	1,0	CRITICAL REF
CELL	LINE	REF	MAX ORDER REF	NORMA	h/producing	% time prod.	5156310	5156406	5216601	5358701	5781501	5789302	5212151	5212160	5216751	5216761	
55061	3	5156310	1275	35	36	23,1%	1										2,0
		5156406	150	42	4	2,3%		1									1,0
		5216601	75	37	2	1,3%			1								1,0
		5358701	1300	46	28	17,9%				1							4,0
		5781501	350	30	12	7,4%					1						1,0
		5789302	1200	55	22	13,8%						1					4,0
		5212101	175	45	4	2,5%							1	1			1,0
		5216703	300	12	25	15,9%									1		1,0
		5216703	300	12	25	15,9%										1	1,0
							23,1%	2,3%	1,3%	17,9%	7,4%	13,8%	2,5%	2,5%	15,9%	15,9%	
							0,32	0,01	0,01	0,55	0,03	0,51	0,01	0,01	0,11	0,15	
						AVERAGE	2,0										

Annex 4 - Position, located reference in the rack and number of boxes in the rack from the pilot area

LINE 1

1320911		1320911	
1	6,0975	1	6,0975
1340147 - 145 mm		1340147 - 145 mm	
1	8,5365	1	8,5365
1340301		1340301	
2	11,5853333	2	11,5853333
756			

1310498	
2	37,5
1310498	
2	37,5
1310499	
2	1406,25
53510	

1310500		1340427		1321001		1321212		1340391		1310963	
4	5	1	23,4333333	1	3,90616667	1	18,75	1	3,57133333	8	12,7776667
1320580		1310800		1340408		1321249		1340343			
2	3,47216667	2	4,285	1	2343,75	1	8,59375	2	231,398056		
1321157		1321010		1340413		1340389					
1	7,14283333	1	5	1	3,75	1	3,472166667				
55099											

1340334		1340333		1320584		1310688		1321283	
2	15,625	1	7,8	1	3,125	2	7,01666667	2	9,375
1340399		1310963		1320584		1321260		1321283	
2	25	8	14,3666667	1	3,125	1	4,5	2	9,36666667
1340400				1320580		1321260		1321283	
1	6,25			2	3,90616667	1	4,5	2	9,36666667
55069									

1340334		1310688		1310963		1321004	
2	35,5333333	2	5	8	14,375	1	3,57133333
1340343		1321308		1320580		1321004	
2	15,625	1	6,75	2	9,25916667	1	3,57133333
1340345		1340342		1320580		1321004	
2	18,5185	1	5,95166667	2	9,25916667	1	3,57133333
55054							

1310195		1321095		1310603		1320921	
8	51,7	1	11,7166667	8	15,3333333	2	5,294
1321040		1320902		1320921		1320921	
2	93,75	1	6,66666667	2	5,294	2	5,294
1340250		1320902		1320921		1320921	
2	159,016667	1	6,66666667	2	5,294	2	5,294
55041							

LINE 2

5459704	
1	

5459804	
1	
750	

1310645		1310645		1310645		1310645	
2	9,6	2	9,6	2	9,6	2	9,6
1310048		1310362		1310390		1340071 - 100mm	
8	96	2	66,6666667	8	93,3333333	1	60
1310176		1310389		1320856		1310644A	
8	173,333333	8	266,666667	8	1333,33333	2	10
55057							

1320558		1321297		1320637		1340232-18mm	
2	294,116667	2	105,881667	2	2117,64667	1	58,8233333
1320831		5632020		5632060		5826020	
1	294,116667	1	16,6666667	1	13,3333333	1	13,3333333
5116581		5632052		5632060		5826020	
1	8,33333333	1	13,3333333	1	13,3333333	1	13,3333333
55097							

1321016		1320783		1310195	
2	3,375	2	2,7	8	42,4
1321016		1320783		1321040	
2	3,375	2	2,7	2	10
1321016		1310612		1340250	
2	3,375	8	80	2	130,4
770					

1340340		1340347	
2	12,5	1	12,5
1340346		1340347	
1	7,97833333	1	12,5
1340344			
2	7,692166667		
55064			

1310355		1321276		1340253 - 100 mm	
2	72,4636667	1	14,4926667	1	27,8695
5329306		5053502		5053502	
1	7,5	1	4,16666667	1	4,16666667
5053502		5053502		5053502	
1	4,16666667	1	4,16666667	1	4,16666667
767					

LINE 3

1320159		1321010		1310800		1340320		1340314		1340257-420mm		1340257-530mm		1321075	
2	12,12	1	14,58	2	12,50	2	171,43	1	75	1	6,12	1	6,17	4	18,18
1320508		1321001		1340257-140mm		1321006		1340366		1340257-460mm		1340257-530mm		1340257-375mm	
1	5,71	1	10,71	1	9,32	1	16,67	2	41,67	1	13,04	1	6,17	1	9,14
1320999		1310187		1310500		1340312		1340367		1340257-375mm		1340257-530mm		1340257-245mm	
1	10,87	2	28,57	4	34,29	1	10	2	41,67	1	9,14	1	6,17	1	5,32
							55061								

1320335	
4	25
1320335	
4	25
1320335	
4	25
55037	

1310776		1340425		1340441		1310805A	
1	42,9	1	31,58	1	125	2	3,94
1320999		1340426		1340439		1310805A	
1	22,5	1	25	2	62,5	2	3,94
1340424		1340402		1340440		1310805A	
1	56,3	1	42,11	1	93,75	2	3,94
			55096				

1310769		1340282		1340385	
1	42,86	1	30	1	25
1340339				1340164	
1		6,67		1	22,5
1340339				1340384	
1		6,67		1	56,25
		55093			

1310769		1321256		1340397	
4	173,9	1	9,1	1	28
1321107		1340431		1320897	
1	26,1	1	818,2	2	41,3
1340398				1340376	
1		5,2		1	304,3
		55094			

1310500		1340414		1340422		1321326		1340396		1340027-110mm	
4	21,8	1	13,0	2	400,0	2	19,1			1	14,4
1310688		1340415		1321339		1340100-490mm		1310879			
2	8,2	1	107,1	1	9,6	1	64,3	1		10	
1310688		1321329A		1321331		1321330		1310878			
2	8,2	1	6,8	1	7,3	1	6,6	1		10	
					55133						

LINE 4

1340321		1340317		1340272	
1	100	1	66,67	2	42,86
1340311		1340318		1340316	
1	21,43	1	28,13	1	28,13
1340271					
1		25			
		55059			

1321106A	
2	10,42
1340352	
1	13,89
1340177-200mm	
1	31,25
765	

				1340335	
				2	11,36
1321069		1320879		1340341	
1	5,21	2	29	2	6,67
1340382		1320999		1340348	
1	4,55	1	11,36	1	34,09
1310194		1321157		1340349	
8	72,73	1	4,55	1	17,05
		55063			

1340331	
2	23,26
55085	

1310338	
2	37,5
1320419A	
2	37,5
1321050	
2	1406,25
55086	

		1340421	
		1	23
1340330		1340379	
1	6,67	1	15
1340419		1340420	
1	17	1	45
	55135		

Annex 5 – Production quantity of order, Assembly norma per hour and measures of the boxes used

CURSO	PRO MAX
5546721	3600
5546731	3600
5546741	3600
5560706	650
5560721	650
5560731	650
5579006	1500
5579105	1700
5579202	1500
5608203	3500
5614301	1380
5616802	3600
5616820	3600
5616832	3600
5616880	3600
5617004	1500
5617105	1340
5617123	1340
5617132	1340
5617142	1340
5617181	1340
5618401	480

REFERENCIA	PRODUCCIÓN (ud/h)
5579006	32
5579103	68
5579201	129
5608201	93
5632007	15
5634802	300
5634901	300
5634904	185
5639703	300
5646502	55
5646602	92
5648600	53
5648700	80
5648800	53
5649000	53
5649300	45
5649400	53
5649500	40
5649600	53
5649700	1000
5649800	1000
5654000	41
5665002	30

curso	UD/BO
5579105	250
5579202	200
5595522	25
5595531	110
5595541	120
5595551	500
5595563	60
5595923	50
5595932	120
5595940	250
5596122	60
5596132	70
5608203	250
5614301	300
5616820	500
5616832	450
5617003	45
5617004	45

REFERENCE	a	b	c	QTY/BO
1310048	200	280	200	800
1310059	200	280	200	2500
1310073	200	280	200	750
1310110	200	280	190	2200
1310176	200	280	200	1300
1310187	290	390	180	1000
1310194	200	280	200	800
1310195	200	280	190	530
1310197	200	280	200	550
1310198	200	290	200	850
1310230	200	270	200	480
1310230	200	270	200	480
1310274	200	280	200	460
1310275	200	290	200	650
1310276	200	270	200	2000
1310278	200	280	190	1800
1310281	300	400	180	2000
1310296	200	280	200	250
1310328	200	280	190	500
1310338	210	380	190	1000
1310347	200	270	200	290
1310355	300	400	200	2500
1310357	310	400	190	8000
1310360	200	180	190	310
1310361	200	270	200	280

Annex 6 – Timing of the commodin's tasks

PICKING THE CARDS FROM RACKS		
GOING DOWN FROM THE TRAIN - MOVING ONTO THE CELL - TAKING CARD - GOING UP ON THE TRAIN		
1	55041	**9**
2	55054	**10**
3	55069	**10**
4	55099	**8**
5	53510	**12**
6	55088	**9**
7	750	**8**
8	765	**8**
9	55097	**8**
10	770	**9**
11	55064	**8**
12	767	**9**
13	55135	**9**
14	55086	**8**
15	55085	**10**
16	55063	**9**
17	765	**10**
18	55059	**8**
19	55061	**9**
20	55037	**8**
21	55096	**9**
22	55094	**8**
23	55093	**9**
24	55133	**10**
AVERAGE		8,96
ESTIMATED TIME PER CELL		**9**
ESTIMATED TIME PER AREA (sec)		**216**
ESTIMATED TIME PER AREA (min)		**3,6**

PREPARATION OF INCORPORABLE IN WH13		
STARTING UP THE TRACKER - MOVING TO RACK - PICK UP THE BOX - PLACING THE BOX ONTO PALLET TRUCK - MOVING TO OTHER POSITION - MOVING TO TROLLEY		
0	START UP THE TRACKER	**21**
1	ITEM A	**48**
2	ITEM B	**32**
3	ITEM C	**59**
4	ITEM D	**29**
5	ITEM E	**35**
6	ITEM F	**42**
7	ITEM G	**39**
	AVERAGE	40,57
8	MOVEMENT	**25**
	START	21
	MOVEMENT	25
	TOTAL	**46**
COLLECTION OF FULL TROLLEY - 18 POSITIONS		**730**
PLACEMENT OF BOXES INTO THE TROLLEY / BOX		**5**
PLACEMENT OF BOXES INTO THE TROLLEY / 18 BOXES		**90**
TOTAL TIME PERR 1 CYCLUS (sec)		**866**
TOTAL TIME PER 1 CYCLUS (min)		**14,4**

FILLING THE RACK WITH INCORPORABLE		
MOVING TO TROLLEY - PICK UP THE BOX - PLACING THE BOX ONTO RACK - MOVING THE CARD TO THE POSITION - MOVING TO TROLLEY		
1	CELL 1	**14**
2	CELL 2	**20**
3	CELL 3	**30**
4	CELL 4	**25**
5	CELL 5	**21**
6	CELL 6	**19**
7	CELL 7	**27**
	AVERAGE	22,29
PLACEMENT OF BOXES AND CARDS INTO THE RACK		**23**
PLACEMENT OF 18 BOXES AND CARDS INTO THE RACK		**414**
TOTAL TIME PER 1 CYCLUS (sec)		**414**
TOTAL TIME PER 1 CYCLUS (min)		**6,9**

PREPARATION OF CURSO FROM WH2		
PICK UP THE BOX - PLACING THE BOX ONTO TROLLEY - MOVING TO THE CELL		
1		
2	CELL 2	**20**
3	CELL 3	**24**
4	CELL 4	**19**
5	CELL 5	**25**
6	CELL 6	**17**
7	CELL 7	**18**
8	CELL 8	**22**
9	CELL 9	**21**
	AVERAGE	20,75
PLACEMENT OF BOXES ONTO THE TROLLEY		**21**
PLACEMENT OF 18 BOXES		**374**
TOTAL TIME PER 1 CYCLUS (sec)		**374**
TOTAL TIME PER 1 CYCLUS (min)		**6,2**

FILLING THE CELL WITH CURSO		
MOVING TO CELL - PICK UP THE BOX - PLACING THE BOX INTO THE CELL - MOVING THE CARD NTO THE POSITION - MOVING TO TROLLEY		
1	CELL 1	**26**
2	CELL 2	**27**
3	CELL 3	**28**
4	CELL 4	**28**
5	CELL 5	**25**
6	CELL 6	**26**
7	CELL 7	**28**
8	CELL 8	**27**
9	CELL 9	**28**
	AVERAGE	27,00
PLACEMENT OF BOXES AND CARDS INTO THE RACK		**27**
PLACEMENT OF 18 BOXES AND CARDS INTO THE RACK		**486**
TOTAL TIME PER 1 CYCLUS (sec)		**486**
TOTAL TIME PER 1 CYCLUS (min)		**8,1**

TRASPORTATION BETWEEN THE CELLS		
MOVING ONTO THE CELL		
1	55041	**7**
2	55054	**9**
3	55069	**9**
4	55099	**8**
5	53510	**13**
6	55088	**6**
7	750	**13**
8	765	**7**
9	55097	**8**
10	770	**6**
11	55064	**6**
12	767	**18**
13	55135	**6**
14	55086	**6**
15	55085	**7**
16	55063	**8**
17	765	**8**
18	55059	**16**
19	55061	**6**
20	55037	**6**
21	55096	**6**
22	55094	**7**
23	55093	**6**
24	55133	**6**
AVERAGE		8,25
ESTIMATED TIME		**9**
ESTIMATED TIME		**216**
ESTIMATED TIME		**3,6**

TRASPORTATION FROM WH 13 TO PRODUCTION AND FROM LINES TO WH 2	
MOVING FROM WH 13 TO LINE 1	**35**
MOVING FROM CELLS TO WH2	**52**
TOTAL TIME PER 1 CYCLUS (sec)	**174**
TOTAL TIME PER 1 CYCLUS	**2,9**

Annex 7 – Power-Point for the training of the employees

1.KANBAN SYSTEM

- The word Kan means "visual" and the word "ban" means "card". Kanban refers to "visual cards".
- System to control the flow of materials, products and information.
- Kanban cards are a visual tools that make a system of continuous **supply of components, parts and supplies, such that workers have what they need, where they need it, when they need it.**
- Pulling the product at the demand of the customer.

KAN BAN

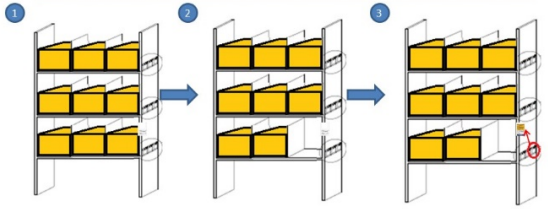
看板

1.KANBAN SYSTEM

Vídeo 1 → Kanban example 1

Vídeo 2 → Kanban example 2

2.1. OPERATOR



Rack is full of boxes

Mailbox is full of cards

One box is taken for production

One card is taken from the mailbox and put in the holder

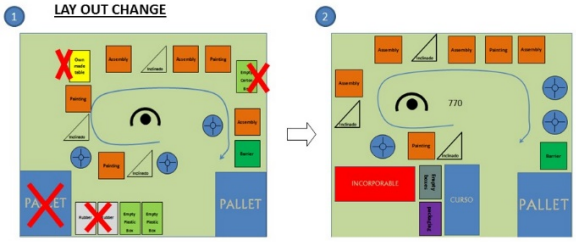
2.1. OPERATOR

BENEFITS KANBAN SYSTEM

1. **Not lack of stock** → Not needed to shout to team-leader/commodin to let him know ✓
2. **Not overstock** → Not a lot of boxes stacked one in the top of the other being a mess ✓
3. **Visual management** → Easy to know where is everything ✓

2.1. OPERATOR

LAY OUT CHANGE



2.1. OPERATOR

BENEFITS LAY-OUT

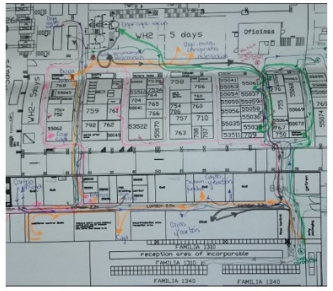
1. **Place** every **needed** machines/items → Not needed to find alternative solutions or make bad parts ✓
2. **Take out unnecessary** machines/items → More space in the cell and proper production conditions ✓
3. **More space** to produce → **Ergonomic** design of the cell ✓
4. Everything **fixed** in the floor and marked → **Avoid** having **mess** and keep order in the cell ✓

2.2. COMMODIN

CURRENT SITUATION

ILLOGICAL ROUTES
UNORGANIZED TASKS

More km walking
Walk through all the company
Not a specific job
Need more time



2.2. COMMODIN

IMPROVEMENTS

- Redefine **new routes** and **tasks**
- Do **more** in **less time**
- Follow an **organized structure** of simple tasks

2.2. COMMODIN

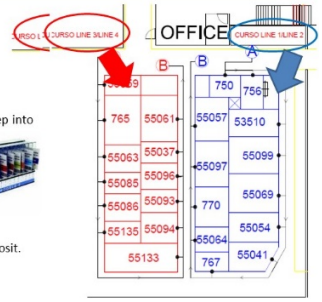
FUTURE SITUATION

1 COMMODIN

'CURSO'

1. Take Kanban cards & Keep into mailbox

2. Go to curso warehouse
3. Pick curso Boxes → 40 posit.
4. Suppy cells

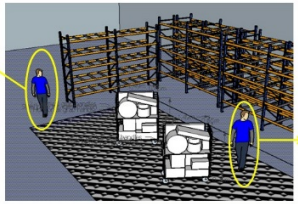


2.2. COMMODIN

FUTURE SITUATION

2 COMMODIN

'INCORPORABLE'



2.2. COMMODIN

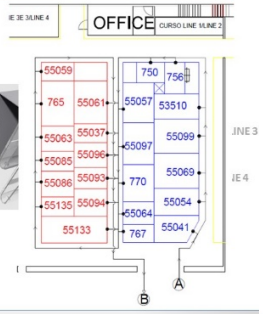
FUTURE SITUATION

COMMODIN A

'INCORPORABLE'

1. Take Kanban cards & Keep into mailbox

2. Go to incorporable warehouse
3. Separate the cards in holders
4. Pick incorp. Boxes → 40 posit.
5. Suppy cells



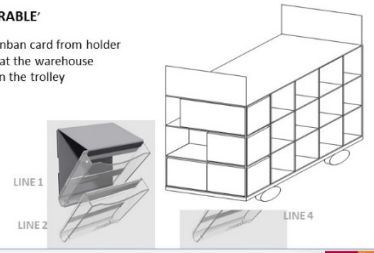
2.2. COMMODIN

FUTURE SITUATION

COMMODIN B

'INCORPORABLE'

1. Take kanban card from holder
2. Search at the warehouse
3. Put it on the trolley



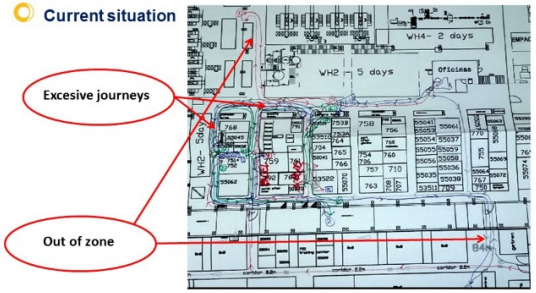
2.2. COMMODIN

BENEFITS

1. **More time** to do other jobs ✓
2. **Less km** walking ✓
3. **Focus** will be only for **one work** ✓

2.3 TEAM LEADER

Current situation



2.3 TEAM LEADER

IMPROVEMENTS

- Redefine **new tasks**
- 1 Team Leader →1 zone
- Stay in the zone
- Control of Kanban cards

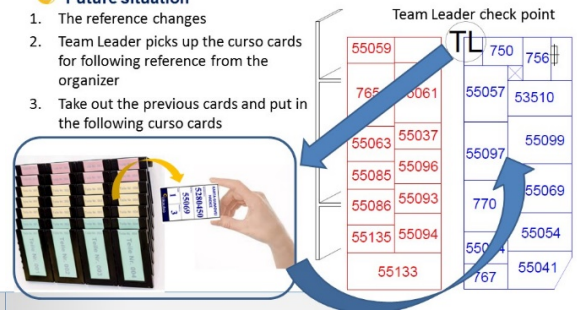
2.3 TEAM LEADER

BEFORE	AFTER
Check the cells are OK	Check the cells are OK
Check the quantity of pieces of previous shift in each cell.	Check the quantity of pieces of previous shift, the people who is working, the references will be done in each cell
Write down the people who is working in each cell	
Point the references will be done in each cell	
Print the stickers	Print the stickers
Checks documentation of cells	Checks documentation of cells
Take and bring red gauges	Take and bring red gauges
Fix the machines	Fix the machines
Take documentation for the office	Take documentation for the office
Bring final product to the quality	X
Changes the matrix for one ENGEL	X
	Control incorporable and curso Kanban cards
	Be responsible of changing curso cards when the references changes

2.3 TEAM LEADER

Future situation

1. The reference changes
2. Team Leader picks up the curso cards for following reference from the organizer
3. Take out the previous cards and put in the following curso cards



2.3 TEAM LEADER

BENEFITS

1. **Focus only** on cells ✓
2. **Less moves out of their zone** ✓
3. **Better** production **control** ✓
4. **Minimum control** on the supply of cells ✓