Final Project

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Continues improvement and search of flexibility in the production plant

Non- confidential

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Abstract

The objective of this paper is to explain the culture of the company, based on workers' personal development, and see how this approach produces positive results of continuous improvement. In addition to this, I would like to expose how the union of objectives among the different areas of the production process, is a key factor to achieve flexibility, as well as to reach the main goals of the plant.

Keywords: Lean management, operators, flexibility, improvement, performance, supply, production, bottles.

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1.Introduction

FONT VELLA Sacalm, is one of the 95 plants of Danone Waters Division and one of the 4 Danone Waters plants located in Spain. The plant has a production forecast of 342 Million bottles for 2.013, with 100% sold in the Spanish market.

The objective of this paper is to explain the culture of the company, based on workers' personal development, and see how this approach produces positive results of continuous improvement. In addition to this, I would like to expose how the union of objectives among the different areas of the production process, is a key factor to achieve flexibility, as well as to reach the main goals of the plant.

To elaborate this paper, I worked seven months at Danone's headquarters in Paris, developing a comprehensive global performance analysis on the bottled water industry from the production point of view, and how to improve productivity and reduce costs. In addition, I developed a two weeks field work in FontVella's plant in Sant Hilari, Girona, Spain.

This experience in the plant has helped me to have a real contact with the mission of the company: to produce water bottled with the highest quality and service to the customer. Moreover, having been immersed in the plant, and considering the new Danone working mentality focused on the continuous improvement, has allowed me to identify actions to improve the production process.

The paper has two parts. First is focused on explaining the mentality of work of the operators and workers in the production plant. This part will show, on a day to day basis, how is the work in a plant which targets the continuous improvement culture.

In order to summarize this culture, I will center my studies on the Lean Manufacturing philosophy, which is the base of DaMaWay (Danone Managment Way). I will focus on the main aspects that have changed the way to face performance improvements. In addition, I will explain the practices and tools of this new methodology used in the plant of FONT VELLA Sacalm.

The new DaMaWay (Danone Management Way) to achieve production excellence, is based on the idea that personal and professional development of all those involved in the production process, is the best way to achieve continuous improvement in the plant. This project is a research job on the practical results of DaMaWay process in a particular Danone plant in Spain.

The second part of the project is called flexibility in the production plant. Firstly, I will explain the reason why the flexibility is a crucial factor of the Lean Manufacturing philosophy, and secondly I will take into account a practical example of one production line.

With these two parts of the paper, I hope I have been able to expose, both from the practice and the results points of view, the DaMaWay culture reflected in one of the more than 95 plants of Danone Waters. The benefits of this, has an important positive influence into the global economic opportunities of the group.

2. Group Organization

The Central Office, the Country Business Unit (CBU) and the factory are the three structures that work together in order to reach the vision of the Water Division. Each structure has a different role. The division of roles is going to be synthesized in the following paragraphs.

Central office at Paris:

The central office, located in Paris, is the point that unifies the work developed by all group plants. The performance, economic situation, investments projects, etc. of the local CBU is reported to the central office every certain period of time, by the Management Control, the Finance Department and others local departments.

Overall results are transferred to the Central Office which is the responsible of determining the global vision of the company, and its strategic global and local plan.

There are different departments in the central office, each of them focus on a different area of the production process or on any other added value area of the group. The Operational Department, in which I worked, has not only the mission of defining the strategy plan for each CBU office, but also to adapt it to each CBU situation.

Moreover, having a global vision of the company and working for all CBU allows the Central Office to compare the results of each of them, and to assess the good practices. For this reason, the Operational Department has also the role of challenging CBUs developing benchmarking comparisons, offering examples of others CBUs.

Finally, the unity and commitment of all the people of Danone is an essential part of the culture of the company. The Central Office, that has the overall vision, is responsible for defining this commitment strategy and makes sure that reach to all employees of the corporation.

Country Business Unit, CBU:

In DANONE Waters Division there are 12 CBU. Each CBU has a certain number of plants and volume of production.

Danone's Business Unit in Spain is called ADE (Aguas Danone España), and produces Font Vella and Lanjaron brands. Both, Aguas de Lanjaron S.A and Fontvella S.A, became part of Danone Waters in 1974. They are considered long-term brands of the group.

The four plants of ADE are the following:

- Sacalm, Placed in Sant Hilari, provincial de Cataluña
- Siguenza, Placed in Siguenza, provincia de Guadalajara
- Lanjaron, Placed in Lanjaron, provincia de Andalucia
- Fonter/Viviaris, Placed in Amer, provincial de Cataluña.

Factories and Sales influence areas

The central office of ADE is located in Barcelona. Supply chain, sales, finance and master data, human resources, IT etc. departments, have the mission of supporting the four production plants and make them competitive.

For instance, logistics department provides the transportation of the water bottles from the plant to the client. The SSD (Sourcing & Supplier development) department would provide the material resources for the production of the bottles. All the functions of ADE central office supply the necessary resources to produce the bottles water in the plant and to delivery them to the client, with the appropriate service level and quality product.

Plant:

The last stage of the production chain is the fabric. This structure is physically essential for the production of water bottles. The resources provided by the social office and the challenge given it by the central office have it results in the performance and improvement of the production plant.

There exist four different levels in the organization of the plant:

1. Operators
2. Middle Managers
3. Managers
4. Director Plant

The improvement of the results in the plant is the consequence of the development and promotion of the capacities of each organization level.

3. FIRST PART: Methodology of work

3.1. Lean Manufacturing

3.1.1. PERFORMANCE WAR

"Preserving value with less work" is the goal of DaMaWay (Danone Management Way) in all Danone Water Plants now a days. In other words, obtain the same value with less cost: reducing time and resources in order to decrease the production cost for finish products.

The importance of reducing cost in our current more global and competitive market seems very logical. In fact, reducing cost is the "driving force" that leads companies to innovate, grow, and improve its performance.

But this mentality is not so old. Before, production and industrial companies were focused on adding value with less costs and the price of the products were calculated according with the formula:

Production Cost + Margin benefit = Product Price

The price was calculated by the accounting department based on real production cost and the "standard" margin benefit of the company. There was no real competitiveness as we understand it today. In this scenario, the main focus was to product more and more without losing quality. It was understood that sales was not a problem, and with this price structure, the more you sale the more you gain. Another symptom of this situation was that marketing departments did not exist or were irrelevant.

This formula for price calculation is no longer valid. Customers have become more powerful because of their easy access to information, huge increase of choices they can make and the permanent improve of quality at similar prices. Actually, the formula is as follows:

Prices (fixes or reduce) – Cost = Margin benefit

For industries to increase benefit and therefore grow up, they have the need to reduce costs and maybe prices. At this point, the production industry started to ask how to reduce cost. "The great challenge of the twenty-one century is not information technology. It is cost reduction."[1]

[1] Pascal Dennis. "Lean Production Simplified: A Plain Language Guide to the World's Most Powerful Production System."

The Production of Waters in Spain is getting more and more competitive. The constant decrease of water bottle consumption since 2006 cause by the economic crisis; the distribution market gaining margin and the increase of top water quality supported by the organizations, are provoking a decrease in the bottle volume market in Spain.

"With Spain still very much immersed in the economic crisis, consumers continued to make adjustments to their spending habits. They cut down on their leisure activities, including visits to bars and restaurants. "[2]

The economic crisis has reduced the water bottled market in Spain in the last seven years. Aguas FontVella and Lanjaron, although it maintain its leadership position with 16% of market share in 2012, has reduce its production from 516 Million bottles in 2008 to a forecast of 351 Million in 2013. The challenge now is to keep its strong market image of quality and reduce cost to increase the margin and compensate the volume reduction.

Spain now is a country in which the market of bottle production has become a price war and therefore a productivity war. There are several ways to reduce cost in a plant: reduce wage cost, buying cheaper row materials, slow down non urgent projects, etc. This aspects might reduce cost in the short term, but does not make the plant more efficient and flexible for new and future situations.

In order to transform its own situation into a challenge for all Danone Water Plants in Spain, the methodology of Danone Group called DaMaWay has impulse a transformation in the way operators and all Danone workers in the plant face their daily work. It has also encouraged the plants to be more flexible, less speeding and more efficient.

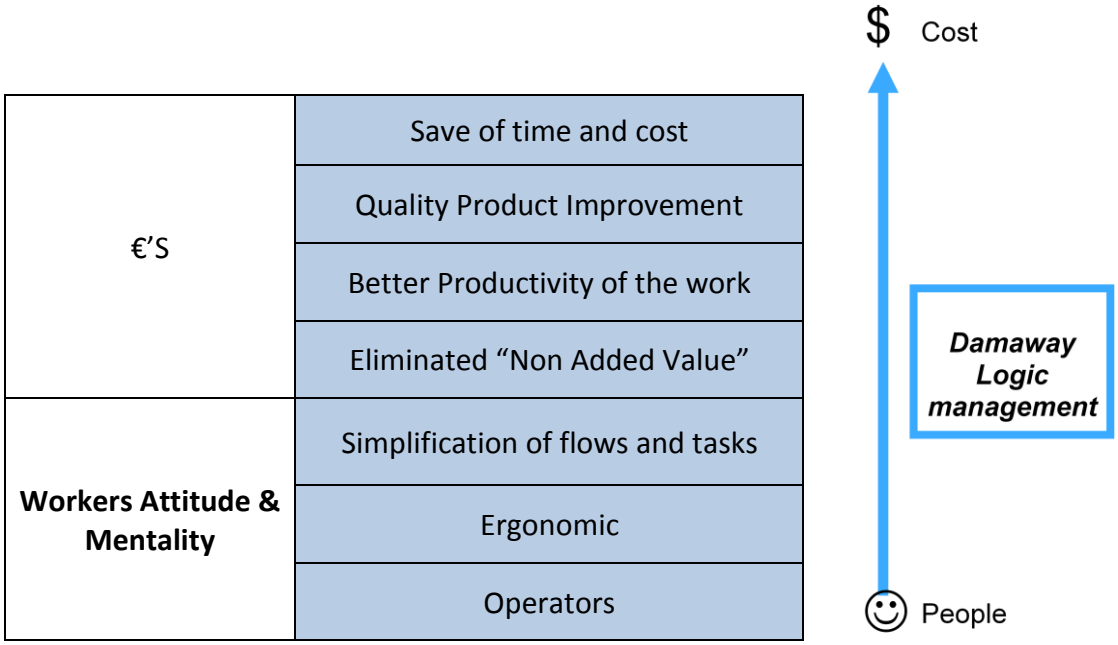
[2] Euromonitor.com *Bottled water in Spain* Report – June 2012

3.1.2. DEFINITION

As said, in a short term strategy probably the best and easy way to reduce costs is to directly cut resources: reduce preventive maintenance costs, cut operators and machines conditions,

In the following figure, the right column illustrates the logical order of the issues that might be used to optimize cost. The first four aspects are directly related to cost production and the last three (Simplification of flows and tasks, Ergonomic work conditions and Operators) are related to the workers attitude and mentality of their work.

The logical business model will give more importance to the aspects that directly save money, and will barely use time improving workers attitude aspects that apparently not provide any direct benefit to the company. I wrote in the right side of the table the logic DaMaWay management, based on Lean Manufacturing System, that focus on the workers and operators which are in direct contact with the production process.



DaMaWay is a mentality and a manufacturing methodology of the Danone Group based on Lean Manufacturing System originally designed by Toyota that pursues a continuous improvement of the results, making all levels of the organization increase/enhance/obtain the each level capacities. It represents a change in the daily work of all employers of the organization, including suppliers with the objective of reaching the final vision of the group.

DaMaWay was "designed" in Mexico during a congress by representatives of each country and Middle Management coming from different factories. During 3 weeks, DaMaWay was defined in a process to implant concrete tools and procedures adapted to the structure and functionality of the plants.

3.1.3. ORGANIZATIONAL ROLS AND UNION

The actions and attitude of the operators is an essential factor for the performance of the plant, and their motivation and positive attitude a key factor for the improvement. Before it was thought that the best and fast way to improve and reduce cost was to attack directly the "non value actions", mechanic problems or, for example, any possible issue of the production line. This change of mentality supposes an important change in the methodology of work at all organizational levels.

Implementing this idea, a middle manager in the plant of FONT VELLA Sacalm explains that one of the first planed DaMaWay actions was to ask each operator, about the aspects he thinks should change in his specific area in order to make his work more efficient. In addition, he include any tool that the operator said he needed to be change or added to facilitate their work. The main objective of this action was to make understand the operator that he/she is the final responsible of his work area and give them the tools to perform the improvements determined.

For the company, all money spent on these action plans was invested. The objective was to transmit the new culture of the company focus on the operator: excellent work conditions, continues training and skills development.

Managers and middle-managers have to convey operators that the machine lines belong to them and they have the authority to implement the needed changes. The more authority and motivation of the operators, the more they are moved to improve the performance of the lines.

Leaders of the lines should transmit to operators that they have the authority to stop the production line whenever they believe it is necessary, regardless of the origin of the problem. They should know that they have complete authority in their work area; this is a critical task for managers.

"Companies often introduce new schemes for raising productivity and quality. But they rarely stick with demanding regiments unless required to do so. Even inefficient companies can get by when business condition are good" [3]. This sentence can make us understand that the changes proposed by the top management asking for a high commitment of all employers are critical for a long term success. For this reason, top management should have a strong and visible commitment to the system. They should be closed to the production line and the operators, not only to be find out possible problems, but also to be in permanent

[3] J. Temple Back, "Lean Manufacturing Systems and Cell Design"

and easy contact with middle manager and operators. ***It is also very important to develop the mutual trust between labor and management.***

Top and Middle managers in Sant Hilari plant had their office in the middle of the factory since 2008, as we can see in the following figure. It is important to underline that the transparent walls, the high vision and the easy access from the lines helps the contact with the operators and help them to understand that their work is crucial for the well running of the whole plant. It creates junction among all workers.

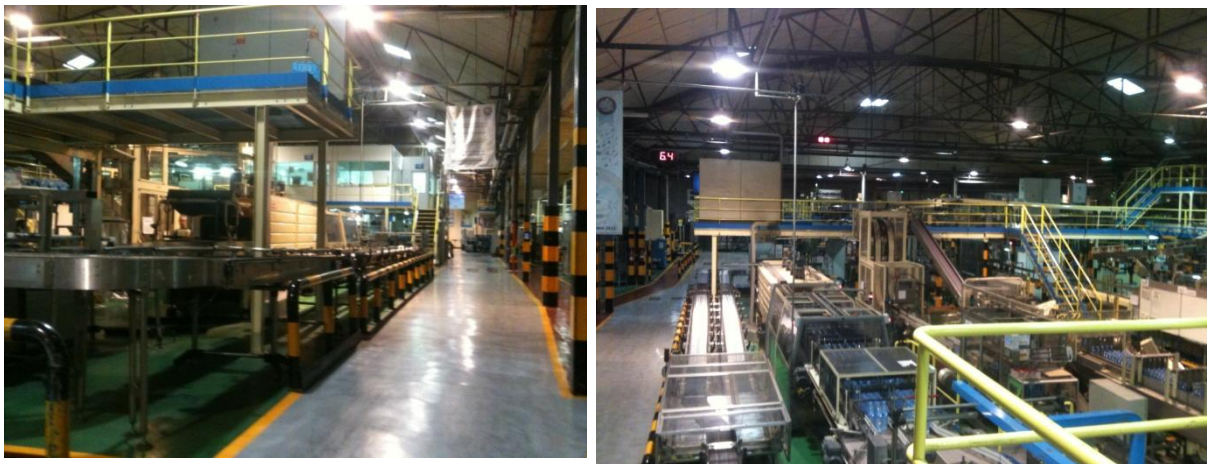


Figure 3.1.3. Picture of the plant of FONT VELLA Sacalm with the Managers office in the center.

Employees must participate 100%, be committed and not just involved in their role. For example, the well running of one machine in a production line because it's good mechanical preventive actions, allows the good performance results for the following machine in the line, not stopping causing works pills. The spirit of team work helps the well coordination and better results.

I would like to mention, at this point, an anecdote that happened in the plant of Sant Hilari during the start of the implantation of the DaMaWay System. A new blower machine was installed in one production line, causing problems of undefined mechanic problem. No result was found after a first analysis of the machine. The General Manager of the plant and the Suppliers that sold the machine met during a day in order to detect the problem and give a possible solution. As the inversion of the machine was significant, this issue was directly managed by the director of the plant.

The director asked one middle manager to assist at the meeting and participated to give his personal experience of the blower machine mechanical problems. The discussion with the supplier's directors developed as normally analyzing the performance results of the machine.

At one moment, the middle manager proposed the director to ask one the operator in charge of the blowing area to assist the meeting and he accepts the proposal. The operator

explained in a simple way to the directors that the blower machine was making a strange noise at one specific point but no solution or cause was found.

After this comment they started making question to the operator: type of noise, frequency, logger of the stopped, etc. aspects that only operators can correctly determine for their continued contact and experience in the line. Finally the managers identify the problems of the machine. Operators have a key position in the performance of the plant.

The fact is that the operators working in the production line are the ones that have more information about the running of the machines: the most frequent problems, the more delicate areas in the machine, etc. They are the best persons to detect problems and therefore to solve them. This is one of the reasons why DaMaWay looks forward to improve the operators' skills in the maintenance and quality domain: they are the right person to solve the problems.

3.1.4. PULL SYSTEM: Just In Time production JIT

Just in time production is a way of working that make employer produce what is needed, when needed and in the quantity needed and asked by the customers.

Before JIT industries were focused on producing goods and, afterwards, try to find buyers for those products. This way of working called **push system** has dramatically changed buy the JIT production, which primary focus on client needs and then performed and adapt the production process and raw and middle inventory according to their needs: **pull system**.

Working with a pull system it is much easier to reduce inventories and costs. The objective is to only produce the goods that are going to be sold by the costumer at the time they are declared finish goods. "Items should proceed one at time through the entire production sequence in order to minimize the amount of material process at all stages of the production." [4]

Two factors are needed to be integrated in the plant in order to make JIT possible and effective:

1. Integration of the team members, plant and systems
2. Continues improvement and therefore an increase of the flexibility in the plant.

The production starts by the inventories created by the planning department and finish when the finish good is given to customers. Each employer action can add or not value to the production chain. For this reason, the communication and integration between stages is crucial because changes and problems may have a repercussion to the following stage.

[4] J. Temple Back, "Lean Manufacturing Systems and Cell Design"

Behind the production of a bottle, there is not only the work of the operators and machines that are in a direct contact, there is also the sales people that contact the client, the purchase workers that buy to the suppliers the PET, caps, labels, films, cartons, etc. and make sure they are **just in time** in the plant. Production manager and the expedition managers determine the quantity and SKU to be produced in each line, in order to not exceed in a specific product in the warehouse.

FOTO

These activities might be organized and joint to reduce the inventory and therefore the production cost.

The second point is the continuous improvement in the plant, it is also necessary the spirit of continues improvement at all levels . This means that there are no limits or barriers that can stop the improvement and the reduction the cost in the long term.

Continues improvement make the plant accomplish more flexibility to adapt to new situations in the market place, the integration of new products, etc. The mentality of workers for acquiring new skills in maintenance and quality, the reduction time in their operations and many other improvements makes the plant more efficient and flexible.

3.1.5. CONTINUES IMPROVEMENT AT ALL LEVELS

Measure, identify, analyze and implement is the procedure followed by all Danone workers with the goal of having continues improvement. For this reason, it is important to quantify the results with indicators that quantify the performance of the production line in numbers.

There are 6 aspects to cover the perimeter of work in the plant in the following order of importance:

1. **Safety**
2. **Quality**
3. **Cost**
4. **Delivery**
5. **Motivation**
6. **Environment**

It is necessary to study the six to have a global vision of the performance of the plant. For each of them, there are indicators to measure its performance area.

Each action developed in the plant needs to be qualify in the 6 aspects. Every production line, for instance, has its visual panel with the 6 aspects results quantified in indicators.

Moreover, the results are marked by the operators in red or green to show the level of accomplishment of the objective.

Figure 3.1.5. Line Panel E with the 6 indicators

The indicators are adapted to each situation or level of proximity to the production and global vision of the plant. In the following picture I show the pyramided of indicators for each level in the plant. This picture was posted in the board of the plant so that every worker can have access to it. It shows the objectives to reach in the whole plant for each one of the SQCDME aspects, and the translation of these objectives into indicators, adapted to each level: operators, middle managers, comafas (plant managers) and plant director of the plant. Plant director works with global indicators of the plant considering its overall performance.

Figure 3.1.5.b. Objective indicators for each one of the levels in the organization.

3.2. DaMaWay Tools and Procedures

Procedures and tools to put in practice the DaMaWay culture of work. Zonning, AIC and SMED are going to be describe in the followings points.

3.2.1. ZONNING

Zonning is a methodology to create and organize the place of work. Its goal is to avoid excessive movements with a complex design of the line. In order to make the work easier and more ergonomic it is important to determine the actions that are necessary and the unneeded ones. The observation of the production line is the first step to be done.

The optimum efficiency comes when each operator knows the area of responsibility and takes its responsibility. The area of work of each operator delimits its responsibility in the production line. It is “his territory”. He is in charge of production, quality, security, cleaning and order of his area.

Thus, the isolation of each set of production and the limitation of his area of responsibility is an important tool of the operator. It is necessary to physically draw a visible line to isolate his isle. Everything that operator needs to perform his work is inside his area. The operator, then, is autonomous to develop the flow control.

Figure 3.2.1. Work area of the workers delimited by a yellow line

The aisles are the result of isolation: they are defined by islets. It is therefore important to consider the corridors to facilitate the flow of workers and make their work more visible on the ground. This also improves job security while avoiding obstacles and facilitating line control.

Workers should be involved from the early design stage of work cells. They are the ones who have to identify their areas of work, since then will be they who are working on I Standards are essential to provide continuous improvement on the ground.

3.2.2. AIC: Animation Court Interval

Description

Once workplaces are isolated, and operators have received the necessary tools, it is easy to work in a synchronized way among departments and levels, even though they might have different objectives. For this reason, AIC is a structure focused on what it takes to serve the customer working with an organization synchronized. That is, put the plant in an effective position to maintain and consistently improve the level of results.

AIC is operated through a series of events to facilitate feedback between the operator, its supervisor, and workers of the support functions. This will allow to focus on key priorities, and solve potential problems. There are three types of meetings, in order to follow up all possible problems, and to analyze the SQCDME result of the production line.

Every shift → The production leader in the line goes to each operator area of the flow of the line. The operator explains the possible problems occurred during the shift and show his manager the results paper.

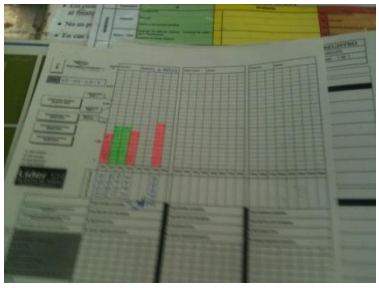


Figure 3.2.2.a. Document to be fill every hour by the operator

Figure 3.2.2.b. Operator comments to the supervisor the situation of the line

Figure 3.2.2.c. Operator solves a problem in the line.

It is important for the supervisor to be physically close to the operator, being therefore close to the problems. Operators give to their supervisors their proposition for the mechanical problems, in case the problem can be solved directly, it is approved, but in case feedback is needed, managers will discuss the problem on the daily board.

Every day→ the manager, the supervisor and support worker area have a meeting together in order to discuss the results of the 6 indicators for each of the lines. There are situations where feedback from managers and supporters is needed to solve any possible problem of the line.

Line supervisors discuss the results of the previous day with quantitative indicators. They also explain the reasons of the performance of the line according with the facts and problems that have arisen on the lines.

This half an hour is also a key time to solve any problems and conduct quality projects, security, and mechanical ... in sync across all work areas

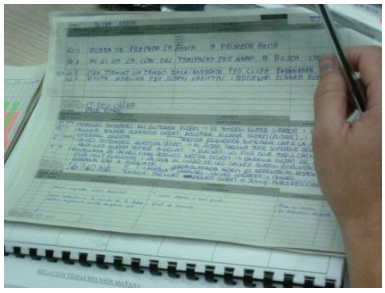


Figure 3.2.2.d. Document to be fill by the supervisor every day

Figure 3.2.2.e. Dairy meeting AIC

Figure 3.2.2.f. Dairy meeting AIC

Every week → The supervisors along with the operators of each line or group of lines meet in front of the blackboard and discuss indicators for each of the 6 indicators.

Figure 3.2.2.g. Panel with of the line E with the results of the week

Figure 3.2.2.h. Meeting at the end of the week with operators and supervisor

The purpose of these meetings is to cut the time between measures of indicators and faster time to identify a problem and solve the situation. In the event that the problem cannot be solved at the first level it is up-scaled until it is solved.

The escalation policy, established with the AIC, allows to take a proactive position to see, analyze, and solve problems through a standardized methodology.

COMMOM LANGUAGE AND VISIBILITY

To represent the results in the most easy way to visually understand them, we have chosen the colors green and red to indicate if the results are above or below the targets set.

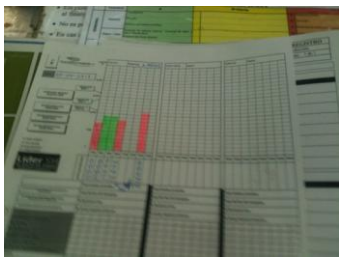


Figure 3.2.2.i. Document with the red and green language

Thus, all levels of the organization can have a quick overview of the latest results translated into indicators. Each production line contains a panel that shows the results SQCDME graphically and visually:

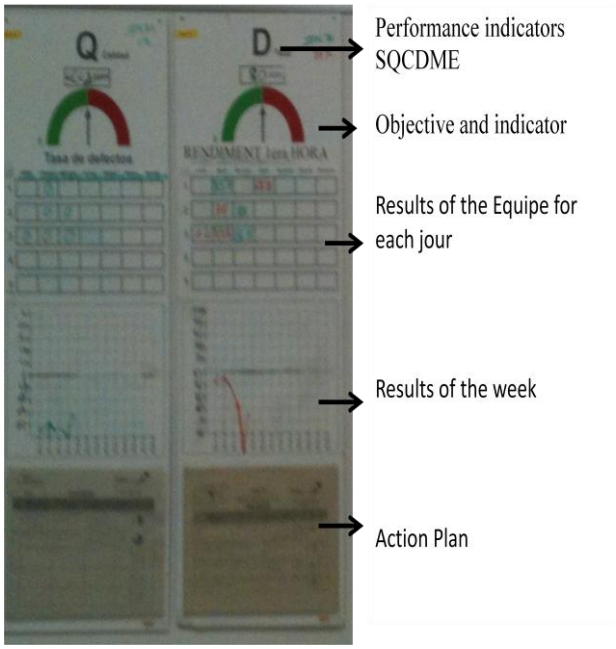


Figure 3.2.2.j. Analyze of the Quality and Delivery areas in one line

It is also important that all workers can distinguish between the stages of work that contribute to the process of manufacturing the product and those that have barely add value to the customer.

Aggregate Value → Directly contributes to the production process. The customer wants to pay to have it. Activity that transforms the product for the customer's benefit.

Non Aggregate Value → Consumption of resources but does not contribute directly to the product nor helps to achieve customer requirements for product.

The identification of actions that does not bring added value are one of the key points to "preserve value with less work," goal of the Lean Manufacturing System.

Working with red and green makes all levels of the organization be aware all activities and resources that do not add value to the product. In addition, reduces costs, eliminates potential problems, and remove operators of doing unproductive tasks, allowing them to spend more time on activities that add value to the product, such as training or development in other areas.

3.2.3. SMED: Single Minute Exchange of Die

SMED is the method followed in Danone to make the change to multi-line format. A multi-line is one that produces more than one format. In this case the SMED method is used to change the volume of the bottles and therefore mold of the bottles in lines producing more than a measure of bottles.

During set up, line production must be stopped. Therefore, reducing this time, should be the main objective of the chosen method for changing the mold.

Reducing the time to make formatting changes, makes the plant gain efficiency by increasing the production capacity of the lines. The lower production time will take longer available to produce and therefore the efficiency of the lines will be greater.

In addition, the SMED method got to be more flexible and reactive to customer orders. We are better able to produce what the customer asks us in the format required and ordered quantity, thereby reducing the level of production and thus the costs of stock.

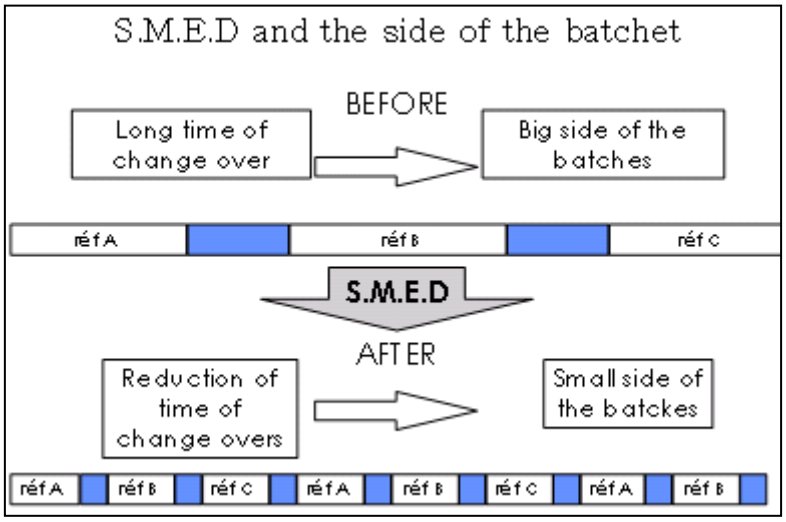


Figure 3.2.3.a. Reduction of the batches with the SMED method

Stages:

SMED methodology follows four stages to be followed by the operators and supervisors in order to reduce the time reformatting:

1. **Identification:** It is necessary to observe the operations performed during the reformatting and distinguish between:
    a. Internal operations (machine should be stopped)
    b. External operations (might be performed with the machine running)

2. **Extract:** External operations must be extracted from the change in format and be made before the machine will stop.
3. **Convert:** Internal operations that can be performed before the machines stop using technical solutions
   At this point it is important to analyze all the tools used by operators, and minimize the necessary elements that must be replaced in change, standardizing each operator actions.
4. **Reduce:** Reduce first the time of the internal actions, and then of the external ones. Actions such as functional connections, mold changes, cleanings, displacement.

Relation with AIC and Zonning:

DaMaWay AIC and ZONNING tools have a clear influence on the methodology followed in SMED:

AIC → for the good performance of procedures necessary that operators, supervisors along with service areas (quality and maintenance) work jointly. All standardized actions to change formats should be aligned with the requirements in quality and maintenance. Thus, all areas work for the same goal in a transversely way.

ZONNING → the provision of tools, the ergonomics of operations, standardization of actions, etc. have an essential role in the realization of the format change.

Figure 3.2.3. b. Shelf with the tools to make the change of format

3.3. FORCE:

From the performance department headquarters in Paris, is held every year a draft analysis of the opportunities in every factory performance division and CBU. This analysis is done at all levels of the Department of Operations: Supply Chain, Procurement and Industrial.

To search for potential opportunities the central office has the benchmarking of all plants and CBU. Each plant receives the benchmarking information, and from that performance indicator results in local barriers and adapts them to their own business. Thus, this tool helps plants to create their vision to 5 or more years away knowing that they can reach a given performance and cost reduction.

The role of central office for the right focus of the project is essential. They are not only responsible for determining the benchmarking between all results, but also to customize it to each production plant and adapt it to each local conditions. Having an overview of good practices of all CBU is extremely important.

Indicators:

In order to compare performances it is necessary to translated it to indicators such as HMO / Kilo bottle, kbottles / hour, etc.. Where it does not take into account the cost but the resources used in the plant. The quantification of the results can not only compare the results, but also continuous improvement in plant.

These indicators are calculated taking into account the conditions of the plants in size, number of references produced, production volume, etc.. In order for these to be the translation of reality in a more forthcoming. The more clear impact factors in performance are taken into account, the indicator will be more adapted to the reality of the plant.

Therefore, when comparing indicators we must also consider the case loads of each case. For example, to compare the performance of a production line would not be fair if we did not take into account the number of formats that are produced on the line, or if they are glass bottles or plastic. You cannot compare the performance of a line just that only makes one change of format per month with a line that performs twice a week.

Stages:

FORCE Project have 3 different stages/functions:

1. Updated benchmarking accumulated for each of the areas of operations.
2. Work of the CBU and plants along with support from headquarters: own calculation of indicators and benchmarking adaptation considering local barriers that difficult reach to the business.

3. Analysis of economical performance opportunities for each CBU/plant/area.

DaMaWay tool:

FORCE is a tool for the decision of the group's vision locally and for plants and CBU. It is an analysis of the gap between the current situation and the reference to where we could get to each of the areas. The translation of this distance in economic opportunities allows to define the long term situation sought.

DaMaWay pursues that all levels of the organization working for the same goal. Thereby determining the view factor is to be worked from the actions nearest the output to the directors.

Analysis areas:

The project FORCE analyzes the controllable costs in the three areas of work. To do it, the different areas of work are divided by their different sections in order to analyze the performance of each of the resources that represents a cost in the production line.

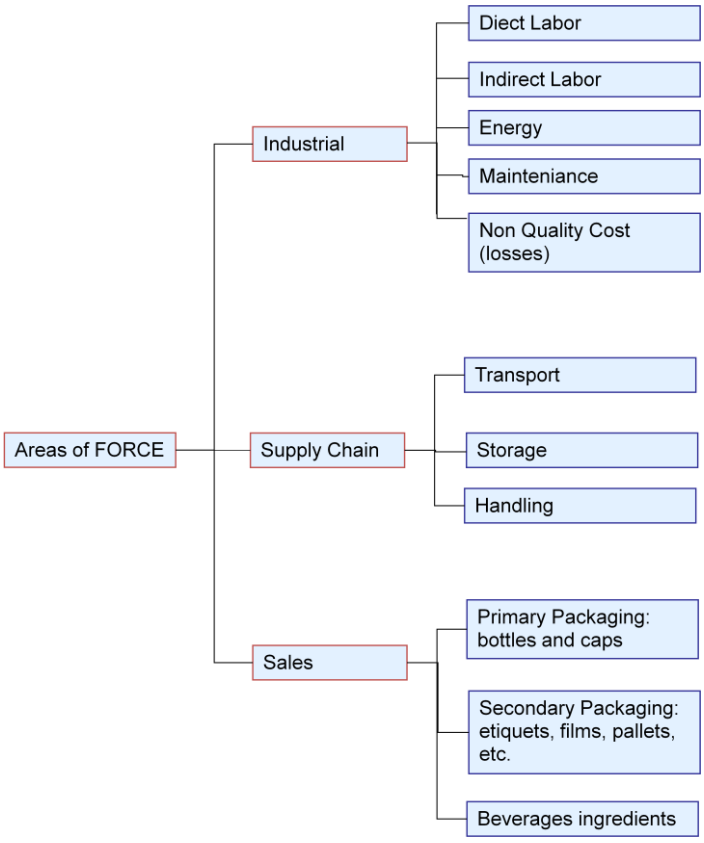


Figure 3.3. Opportunity areas in the FORCE project

4. PART 2: FLEXIBILITY IN THE FABRIC

4.1. FLEXIBILITY

Once explained the practical cases of implementation of DaMaWay and the objectives pursued, the second part of the project is to analyze the results of the production plant, looking for cost reduction through the analysis of indicators. This section explains the flexibility to be sought at the production and sale of bottled water.

Flexibility in plant production is a key factor for the correct implementation of Lean Manufacturing:

"Flexibility is a premier design feature for lean production and cellular manufacturing systems. Once implemented, cellular systems can react quickly to changes in customer demand, product design, or product mix."[5]

Flexibility can be defined as the agility of a plant to be faster, to reduce costs and to satisfy customers with better quality. In short, be more productive and agile to absorb the possible changes in the plant.

Existen 3 tipos de flexibilidad:

1. Volume flexibility: A measure of the capacity of the system to be operated profitably at different volumes.
2. Mix flexibility: The capacity of the system to operated profitably at different part types.
3. Manufacturing flexibility: A measure of how fast the company converts its process from making an old line of production schedule, to modify a part, or to hand multiple parts.

[5] J. Temple Back, "Lean Manufacturing Systems and Cell Design"

4.2. TRIATHLON: CUSTOMERS/INDUSTRIAL/SUPPLY

A project in flexibility called Triathlon was done during the years 2008-2011 involving customer, industrial and supply departments at Aguas Font Vella y Lanjaron. The project was aimed to analyze the value chain from the order to the production and synchronize the customer's service, the logistic function and the production in order to reduce costs and increase efficiency.

The alignment of the employees working in these three departments was for this reason a necessary step in the project. Before the project was carried out, each department was focusing its work and projects on the improvement of their own results and objectives without paying attention to the global results of the company, whereas the global result should be the final objective that efforts of all levels and sector should pursue.

All three departments agreed that their objective would be the stock reduction in the production plant, and to reach this objective it was necessary to change their way of work winning in flexibility in every area:

Same ambition → Reduction of total costs → Win in flexibility→ Reduction of stock

The customers department said: "**Orders cannot be influenced, they need to be executed"** They had the mission to provide clients a high level service and increase the amount of orders and customers. With the objective of reducing stock the customers service got more flexibility with the customers and won more than one day in the anticipation of the orders.

In order to reduce the stock and increase the global performance of the plant the middle manager and managers of the production plant made more format change in the lines.

The logistic service exposed the following barrier: **the reduction of stock can only be possible if the quality of service or the quantity of SKUs is reduced.** There were no other ways for the reduction of the stock but the reduction of the client service quality or the number of types of products. This barrier was broken changing their production monitoring from a monthly-based control to a daily-based control. This change allowed the company to make a stock reduction from 20 to 10 days of products in the warehouse.

If stock volume reduces, the fix logistic costs decrease becoming variable costs. The possibility to work with variable cost reduced €/liter 20% with a reduction of 15% of total volumes sold.

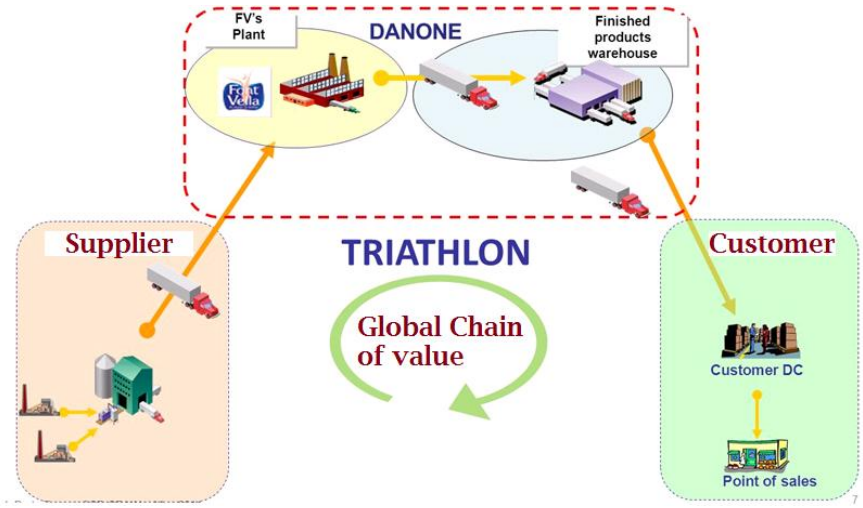


Figure 3.3.a Representation of three big stages in the Order to Delivery chain

The cost and value add optimization between the area of Supply Chain and Industrial is analyzed in the followings points. As we have seen the reduction in cost in the warehouse and reduction of stock leads to a decrease in **the level of production** of the lines. The reduction of inventories leads to reduction in time of the batches and lots and the reduction of batches lead to an increase of change over in the multiformat production lines.

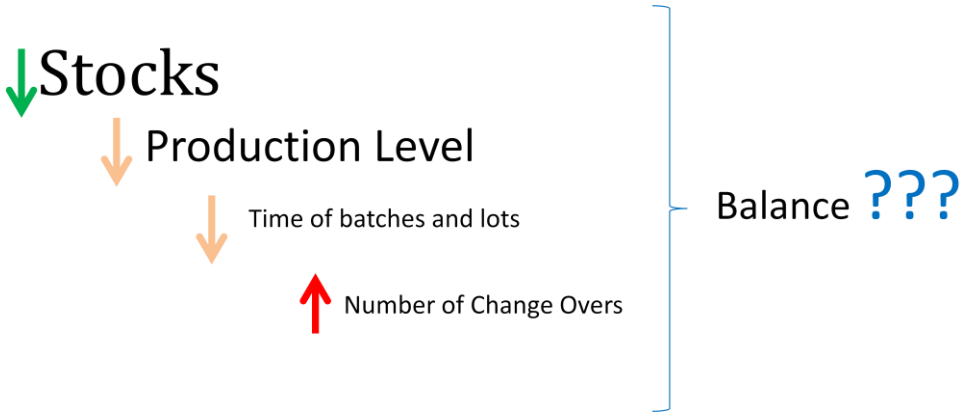


Figure 3.3.b. Balance between Industrial and Supply

The increase of number of change per day or week means on one hand the increase of dead time, where the production is null and on the other hand, it permits the adaptation of the customer's needs to the production reducing the quantity of stock in the warehouse and production lines.

The balance between the industrial and supply chain performance is a question that needs to be analyzed in each factory in order to reduce the total cost of the company. The following points describe the relation between both areas with more detail through the utilization of indicators. Moreover, there is disclosed a practical case of a production line.

4.3. Supply Optimization:

The reduction of inventories in the warehouse is one aspect that can help the plant to reduce costs. The warehouse has a limited space for stock and when it is full the stock is carried to a provisional warehouse close to the factory, whereas if there is available space less stock or no stock needs to be carried to the provisional warehouse.

Sant Hilary plant has a Warehouse in the Factory and a Regulator Warehouse in Moragas. The first warehouse has a capacity of 6000 pallets and is rented APORTA group, who offers Font Vella the service to manage all the pallets since they enter into the warehouse to their expedition by trucks. The group Font Vella pays for every pallet managed by Aporta.

The regulator warehouse located in Moragas is only used in case of over stock in the warehouse of the factory. The more pallets are sent to the that warehouse the more the company must pay to APORTA for pallets transportation and space rental. All costs associated to APORTA's warehouse are called External Logistic Costs.

The stock reduction is a continuous challenge of the factory as it means a reduction in cost. The first way to optimize costs is to reduce stock in the factory warehouse in order to not need to use the regulator warehouse. The second way is the reduction of inventory in the Factory Warehouse to reduce the time that batches and lots are the plant.

The Delivery indicator calculated to measure the performance of the plant is DPD, Direct Product Delivery:

$$DPD = \frac{\text{number of pallets send directly to client}}{total\ number\ of\ pallets\ sold}\%$$

The pallets that are not directly sent to client are the ones that were sent to the Regulator Warehouse (inbound transport). This indicator reflects the first objective of reducing in stock explained in the paragraph above.

4.3.1. Inventory Level

There is a stock classification in order to make sure that all variable factors that have a repercussion in the production line are covered. In order to understand the importance of the inventory in production time there are explained the factors that should be taken into account:

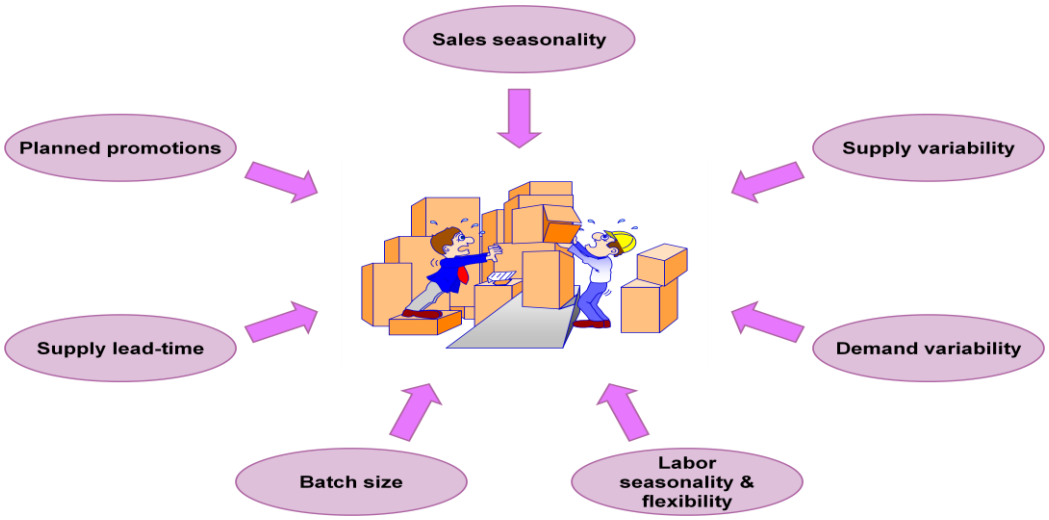


Figure 4.3.1.a. 7 Aspects needed to have in mind for the forecasting of the inventories

Sales Seasonality: Water bottle has a demand peak during the summer because of high temperatures that make people consume more water during the day. This variation in sales might be controlled by a preventive inventory in order to cover the demand during the whole year because the industrial capacity of the plant can not cover all the sales during this period.

Demand variability: Font Vella customers use to ask for the products they want 24 hours before the order delivery. Orders for the next day are informed to the plant at 16h of the day before. There is a forecast made up by the planning department in Barcelona for each of the 4 plants in order to have an estimation of the following week's demand which is important to ensure that stock pallets, raw materials, operators, etc. will be able to cover the demand of customers.

Production Flexibility: Speed of production lines, changeover time, reliability of lines (mechanic and quality problems), etc. are some of the key performance aspects to be optimized, reduced or improved in order to reduce inventories and make them more reliable.

Labor seasonality and flexibility: During vacation or public holidays for instance, the capacities of loading/transporting/delivering are limited. In order to cover the seasonal summer demand human resources appear as a key driver to design an effective adequacy.

For this reason motivation and commitment of operators, as one of the principles of DaMaWay, have a key contribution in their flexibility in developing multi skills, being open to possible schedule changes, etc.

Batch size: It is a fact that the variation of the batch size of orders has a lot of repercussion for determining the production of lots in the multiformat production lines. The amount that might be produced for each format needs to be determined taking into account this aspect.

Supply lean-time: Font Vella has clients in all the territory of Spain. The transport time to deliver the order is distributed between Font Vella Sacalm (with a 70% of the total distribution), Font Vella Sigüenza (with a 30% of the total distribution) Factories are as shown in the following figure. The plant of Lanjaron in Granada takes the territories of Andalucía for the distribution.

The time of delivery, the mean of transport, etc are factors that affect the total supply chain cost that should be considered for planning the inventories.

Figure 4.3.1.b. Factories and FONT VELLA influences in Spain

Planned promotions: Promotions for a specific period in the year can make changes in the planned inventory. It is very important the good coordination between the central office that manages the deadlines of the promotions and the industrial plant and supply chain in order to sell all products within the period indicated and not have over stock at the end of the period.

4.3.2. Stocks Types:

Inventories are made to hide or control these operational issues in order to have a **good quality of service.** In case of a high inventory level bad quality of forecast could be masked,

but because a lot of factors cannot be controlled 100% it is possible that the bad quality of forecast appear.

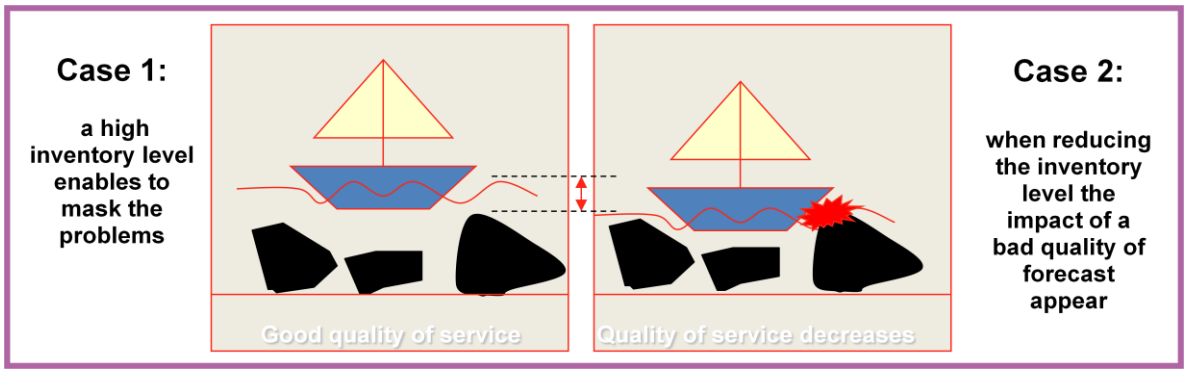


Figure 4.3.2.a. High inventory level enables to mask the problems

The best way to reduce the inventory is to decompose the stock in components and functions. Each stock component has the function of covering one or more operational issues in the plant distribution, demand variability, etc.

In the plant of Sant Hilary, for the distribution of water bottles we can find the following types of stock:

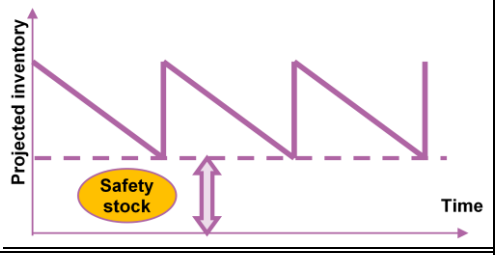
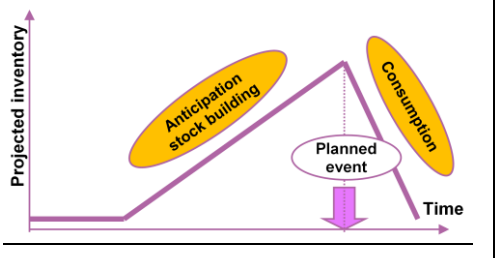
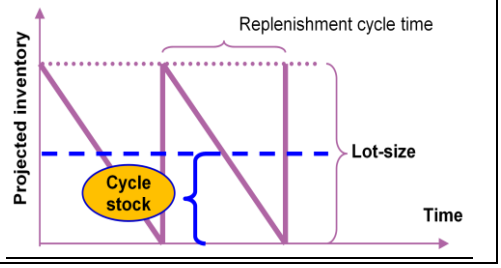
TYPE	WHY?	DRIVERS	PATTERN
SECURITY	Planned buffer inventory to protect against stock outs due to unexpected variation in demand and/or supply.	• Lead times • Supply uncertainty • Forecasting accuracy • Service levels	
ANTICIPATION	Stock to prevent possible issue if the is no enough finished product for a planned event in the time when it is needed.	• Availability of raw materials and production resources. • Sales seasonality • Promotions	
CYCLIC	Inventory that is procured produced and replenished in regular quantities to meet expected demand.	• Supplier economics • Production economics • Transportation economics	

Figure 4.3.2.b. Tables with the types of stocks and their properties

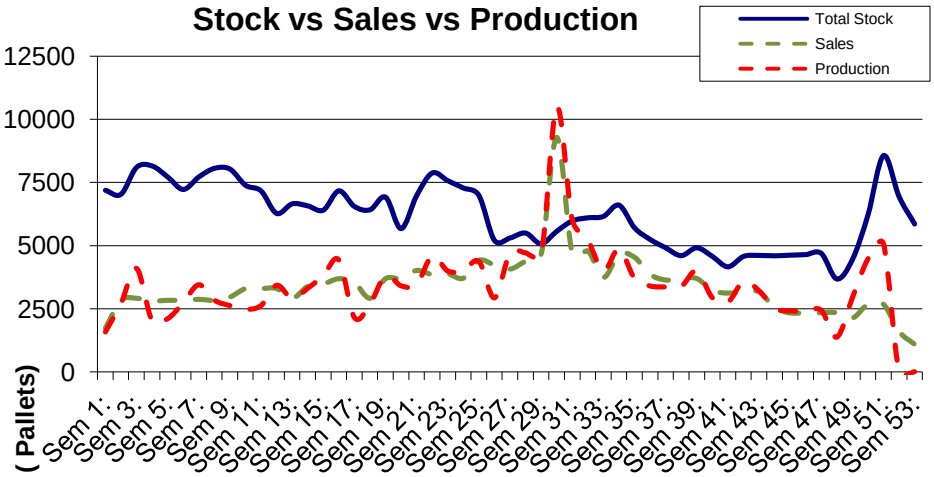
All the possible operational issues in the plant are covered by these three inventories. As we can see the security stock is stable and do not have variability during the year. Nevertheless every 3 and half months the security stock need to be sold as it cannot be sold after.

The cyclic and anticipation stock have a direct dependence with the production in lines.

4.3.3. 2013 STOCK VOLUME IN FONT VELLA Sacalm

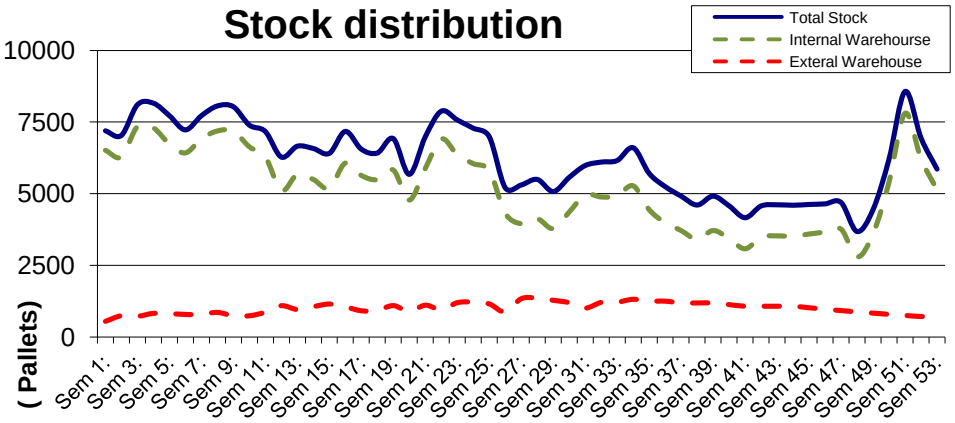
During the whole year 2013 the plant of FONT VELLA Sacalm has a prevision of sales of 351 milion of bottles, a decreasse of 40% compared to sales in 2008.

The following figure shows the total stock, sales and production in number of pallets estimated for each week of 2013. From the week 1 to the week 36 (first week of September) the estimation has been replaced by the real ones. The rest of the weeks of the year are estimated by the planning service according to forecast.



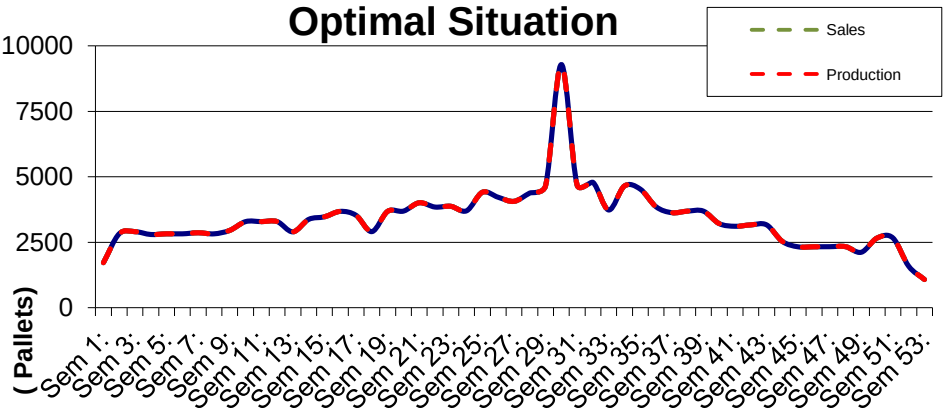
The amount to be produced covers the sales during all the year with small variability. Also we can see that sales are not regular during the year because of the seasonal demand variability.

The following graphic shows the distritubution of stocks in the plant. There is part of the stock in the external warehouse, most of it coming from the security stock of the plant.



The over stock in the plant causes the need for using the external warehouse as there is no more space in the internal warehouse. This stock represetns the 3% of the total logistic cost and a cost of production and material that is not remunerated by the client.

The optimal situation is represented in the following graphic where the production have the same level of the sales:



In this case the stock could be zero because every volume produced would directly be sent to the client, but there are lots of aspects that have an impact in the amount that is really sold to the client. There is a need for balancing production capacity and forecasting to reduce stock and production level.

4.4. Industrial Optimization:

In the following point of the study I will focus on the optimization of the performance efficiency of the lines in order to reduce the inventory level. The final objetive is to reduce total production costs making balance between the industrial and supply chain areas.

All operators and managers in the plant target their work in the production line. The production of bottles is the final mision of the plant and every action, they performe have a direct influence, and a meassure of added value to the production. The situation is very diferent from working in the siege in Barcelona where the production is not visual and their work have a long term positive effect on it.

"Regarless of the product or production type, all plants are integrated. Each of the functional groups , such as purchasing, maintenance, and production, depend on other functions. Without an integrated, coordinted effort of all functional groups, reasonable levels of performance cannot be achive." [6]

Along the day, production operators and middle managers are continually working to solve mechanical problems in production line. It is mandatory the total implication and well coordination among functional groups in order to achieve more efficiency.

4.4.1. Division of the calendar time:

Following the clasification of the inventory's types for the analysis of the factors that cause variations in the sales and production volumnes, the factors that affect the efficiency of bottle production is classificated according to its nature by the following division of the calendar annual time:

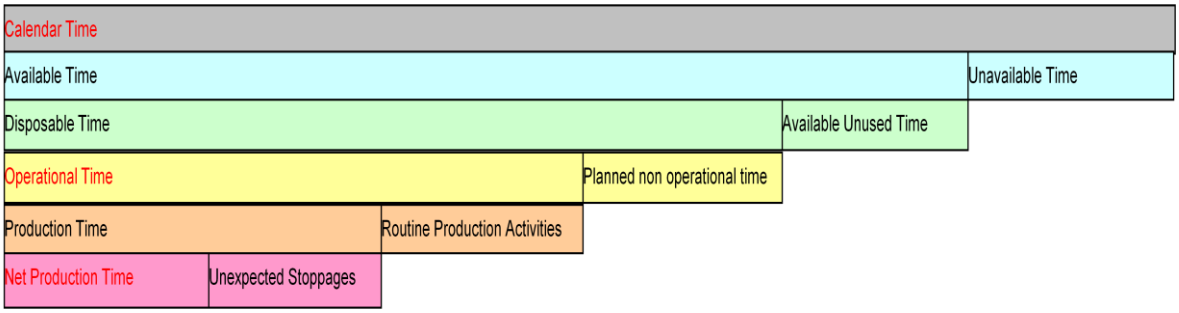


Figure 4.4.1.a. Division of the calendar time

The total **calendar time** of 24h 365 days of the whole year, is reduced to an available time by the holidays days (christmas day, first day of the year, local holidays, etc) giving to the company a total of 349 days of legally **available time** to run the line.

[6] R. Keith Mobley, "Total Plant Performance Management"

The **available time** is reduced to the called **disposable time**, time in which the equipment could be used, but production is not scheduled because there are no production orders planned. This time can be used for machine-up-grade or overhauls. The volumens decres had reduced the disposable time to week days working in Sant Hilari. Taking out the 104 week-end days the plant produced 245 days.

For the maintenance and cleaning of the machines and equipment, the plant needs to stop the production. This time is called **Planned non operational** time and in the plant needs:

- 6 days of trials non productive,
- 11 planned maintenance and
- 1 factory quality stop.

Finally the time expected where the equipments are planned to be operated for production purposes, called **operational time**, is 227 days, 5544 hours/year.

Division of the operational time:

In order to prepare the started of the production with an equipment changover, sanitation and rution cleaning within the week, etc. the lines are stoped, this time is called **rutin production activites** and depends on each of the lines.

The **production time** is the time in which the line is producing bottles, the line is running. There exist **unexpected stoppages**: time when the machine is unexpectedly stopped by identifiable and non-routin events. It is classified under the 4 categories:

1. Technical downtimes
2. Technological downtimes
3. Organizational downtimes
4. Time and waste adjustments

As mentioned above, the production lines have continuous mechanical problems that can make the machine stop for a certain time. Also problems in the quality results of the bottles is a factour that the operators controlled and stoped the line if necessary.

"Operators in the assembly cell can stop the production flow whenever they note anything suspicious. Mechanical and human autonomation prevent defective items from progressing into subsequent stages of production, prevent the waste that would result form production a series of defective items, and prevent overproduction." (lean p 320)

The **net production** time is then the time in which the line is producing at it's normal speed certain quantity of finish products. In the plant of FONT VELLA Sant Hilari this time is reduced to **188 days** provided from Agost for the 2013 year.

188 net production days → 50% total calendar time

The machines, the human resources, etc. of all the year amortization and cost need to be compensated by the production of the bottles during this production time. For this reason, the more the production line produced and solds the more balance will be between the total cost and the gain coming from the customers purchases.

At this point, I would like to show that the manufacturing and in our case, the production of bottle waters, requiers a lot of performance from managers and operators in order to produced at nominal speed the more time possible in order to exploit the inversion and resources of the plant. The measure of the profit of time and resources of the plant is meassured by some of the indicators that are shown in the following point.

4.4.2. Calculation of the indicators

There exists 3 indicators used tu define the distribution of the total calendar time in a plant and each one measures the diferences between two sections of time:

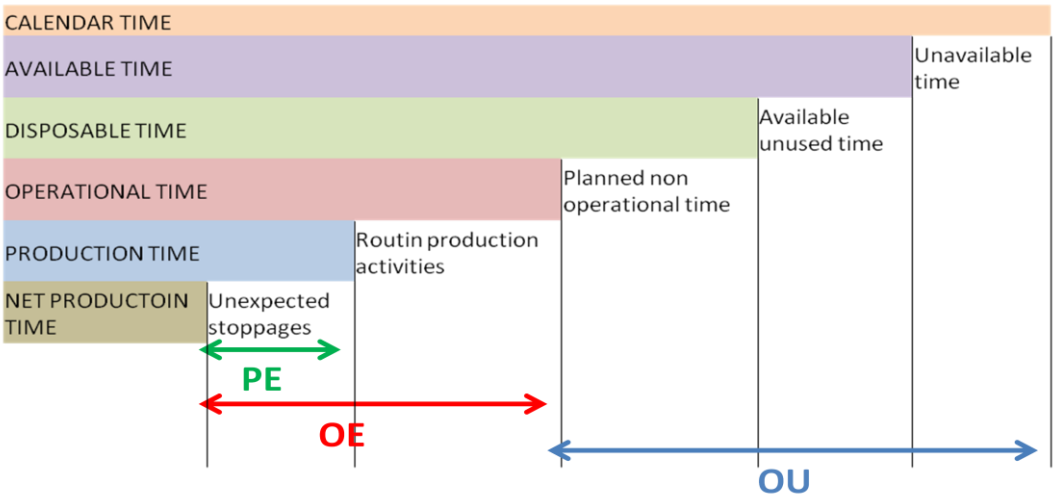


Figure 4.4.2. Division of the calendar time for the calculation of the indicators

The Operational Utilisation OU is calculated by the following formula:

$$OU = \frac{\text{Operational time}}{\text{Calendar time}} \ \%$$

The results of each line performance is measured by the indicator OE, Operatinal Efficiency. It is measure by the following formulle:

$$OE = \frac{\text{Number of bottles produced}}{\text{Total operational time} * \text{Nominal Speed}} = \frac{\text{Net production time}}{\text{Operational time}} \ \%$$

Nominal Speed → Speed expected of the line

Result for the 2013 (January to Agost): 80%

The production efficiency is the indicator that take into account all the unexpected stoppages during the operational time:

$$PE = \frac{\text{Number of bottles produced}}{\text{Production time} * \text{Nominal Speed}} = \frac{\text{Net production time}}{\text{Production time}}$$

Middle Time Between Failures, is an indicator that measures the middle time of the stops in the line production during a certain period of time

$$MTBF = \frac{\sum Times\ lost\ caused\ \ by\ the\ shutdowns}{Total\ shutdowns}$$

Indicators are the measure of operators, middle managers and managers of the plant for the continuous improvement in the delivery of the product. Each day the OE is calculated for each one of the lines and comented during the AIC meetings to find out the reasons why of the improvements or worsening of the results.

4.4. Practic case line I and H:

Formats 2,5 L and 6,25 L

The formats of 2,5 L and 6,25 L are produced in the plant of FONT VELLA as a big a middle format of bottles. The format of 2,5 L was introduced recently as a middle Family format, between the 1,5 L and 6,26 L.

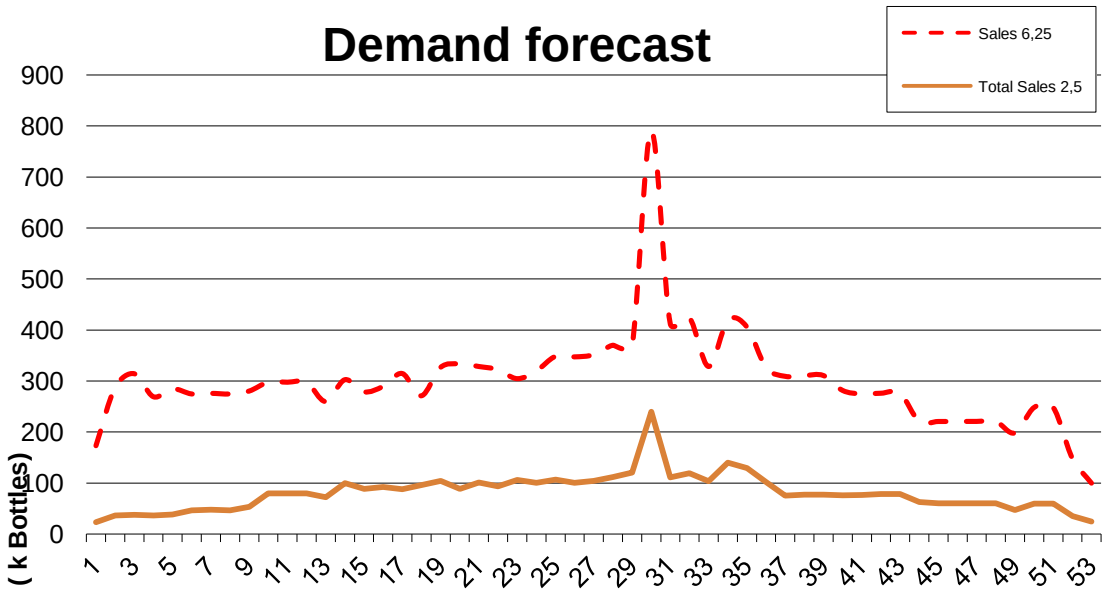
The line I produces bottles of 6,25 L and 2,5L, the high demand of the 6,25L requires another line production for this format having the line H that produced only 6,25L. The production planning of the line I, as the rest of the lines multi formats, is a critical factor in order to quantify the production of each volume bottles.

This practice case has the objective of planning one week production of the line I during the high period summer demand, last week of August.

Figure 4.4. FONT VELLA bottles of 6,25 L and 2,5 L

Demand of the two formats:

The planning of the two bottles formats depend on the demand of each one of the formats. The following graph shows the demand prediction for the two bottles formats during the year 2013.



The week that is going to be represented is the 35 of the year, from the 26th to the 30th of August.

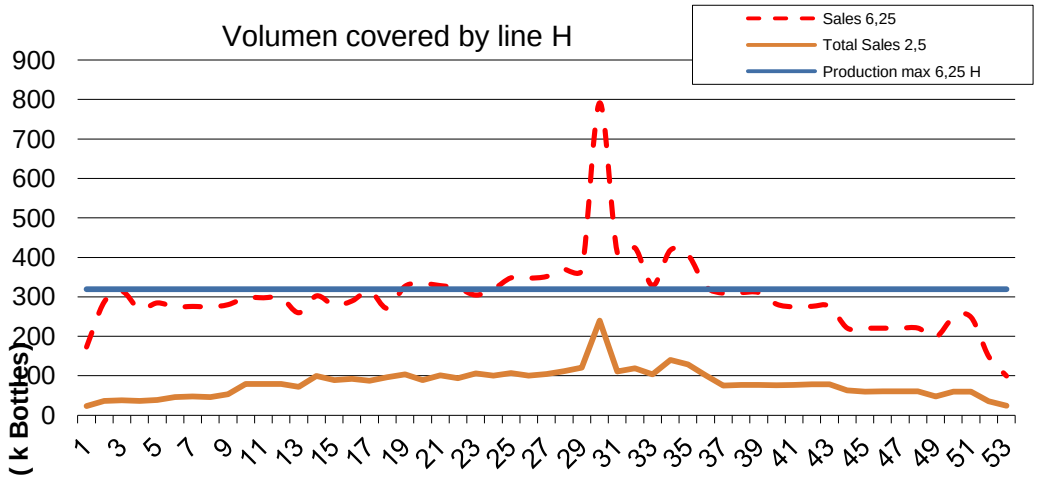
As we can see the prediction of the demand for the 6,25 liters is 250 kilo bottles higher during the first half of the year with a peak in the 30th week for each of the volumes. From the week 30th to the

end of the year, we can see that there is a slow reduction of the volumes demanded for each one of the volumes.

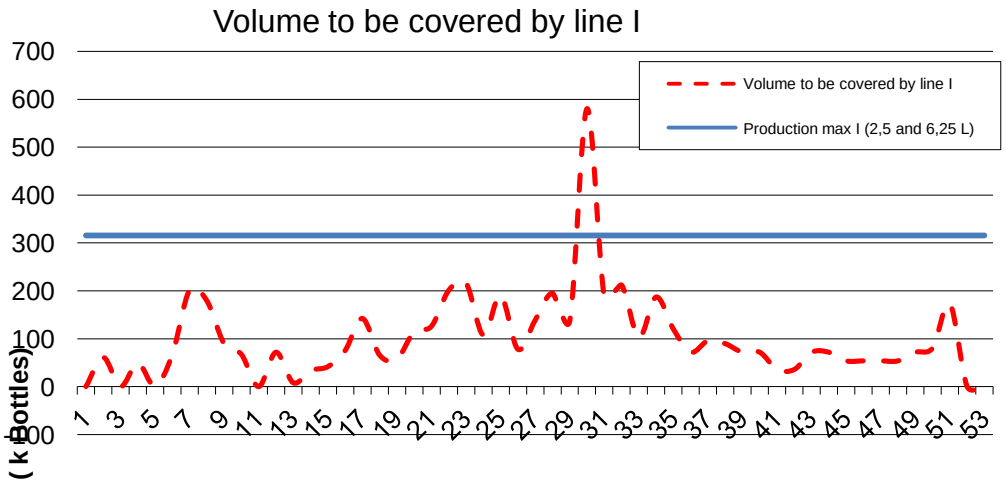
Capacity of lines production:

For each one of the lines, it has been calculated the performance of the lines measured in speed production of bottles in each week with the productioin results of August. This is a simple way to represent the production capacity for the observation of the demand.

Line H → Speed of production 319 kilo bottles/week



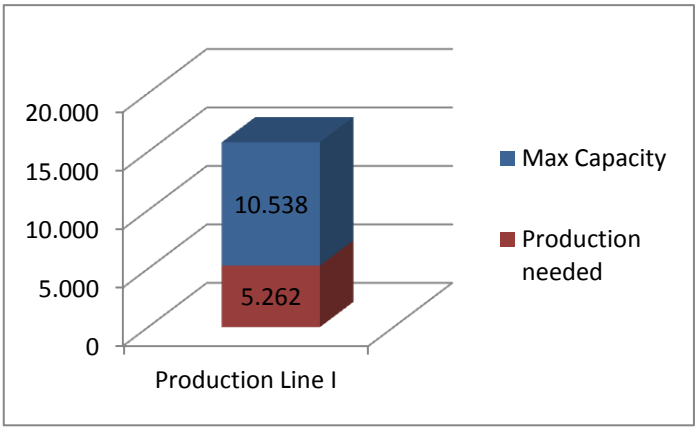
The production of the line I needs to cover the production of the



264 kbotles aren't possible to be covered by the production in the 30th week of the year. As seen, the lines are not over charged a cause of the reduction of the demand. The capacity of production of the lines is higher than the demand.

Capacity of the line→15800 kilo bottles in the whole year. Taking into account the OU (Operational Utilization) and the performance of the line, in final the PE (Performance Efficiency) of the line.

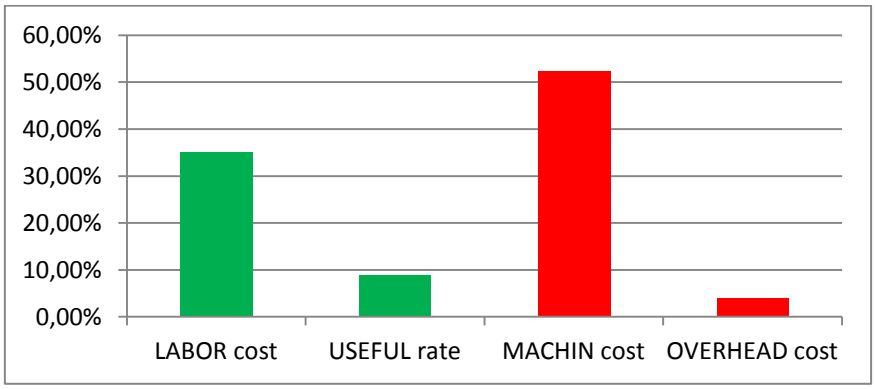
Production needed → 5262 kilo bottles, only the **30 %** of the total capacity of the line.



The ressources provided for the production of the bottles of 2,5 L and 6,25 L need to be reduced in a 70% as the same time of the volumen in order to decreasse the cost of production of one bottle.

Industrial cost:

The industrial cost that are associated to the production of one bottles water the following ones:



- **Labor cost:** cost of the operators and the technicians.
- **Useful cost:** Energy in electricity and combustible
- **Machine cost:** amortization, spare parts and project investment.
- **Overhead cost:** labor indirect, not directly working into the line production.

The labor cost and utility cost are the ones that are variable. This costs can be reduced or increased depending on the production volumen, and therefore influence the performance of the plant. Instead, the machine and overhead cost are fixed, they can not be reduced acording to the performance or volume of the plant.

It is important to point that this calculation is not 100% real. It is rather an aproximation of the reality in order to compare values.

Variable costs are the ones that can be atributable to the Operational Efficiency of the production line: **How much the variable cost is reduced by an improvement of the OE?**

An increase of the OE means an improvement of the performance and speed of the production lines, produciong more bottles during the total operatinal time. These improvement suppose a reduction of the total operatinal time and therefore the labor hours of the operators:

$$\text{Total labor hours} = \frac{\text{Sales volumes kb}}{\mathbf{OE} \ * \ \text{Production speed kb/h}}$$

$$Variable\ Industrial\ Cost = \frac{0{,}35 * \text{Total Industrial Cost} * \text{Sales volumes kb}}{\text{Total labor hours} * \mathbf{OE} * \text{Production speed kb /h}}$$

*To make more simple the calcul the "Total labour hours" has been considered constant

A decrease of the OE have an indirect relation with the total labor hours and the labor cost. As mencioned, the increase of change overs produce can reduce the OE result and therefore an increase in the industrial cost.

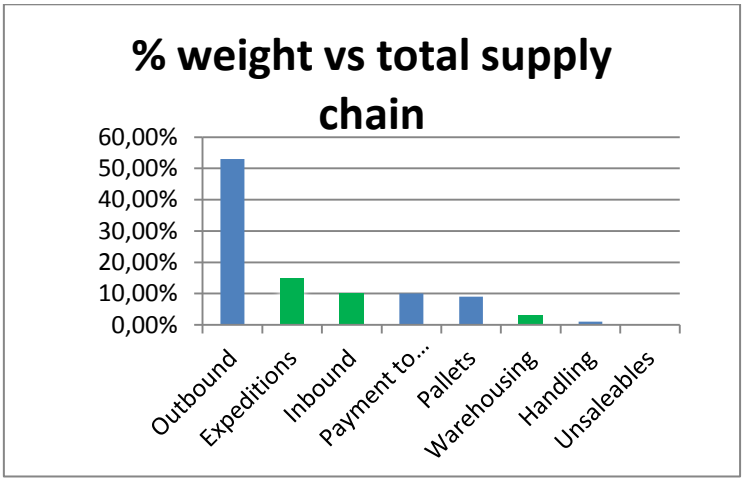
The results of the 36th week of the year in the line I has been the following ones:

	26	27	28	29	30
T. NET	20,86	21,28	14,37	13,48	13,48
T. OPER.	23,00	23,00	24,00	16,00	16,00
OE	90,70%	92,52%	59,88%	84,25%	84,25%

The only day that there was a change of format was the Thursday 28th. The time of change over was 3,5 hours stoped mor 1,5 hours in which the line runned with continues stoppes and need of ajustments.

Logistic cost:

The variable cost of the logistic area is going to be reduced to the Expedictions, Inbound, Warehousing and Handling cost: total 29 % of the total Supply Chain cost.



The cost has been simplified in order to give a realtion between them and the performance indicators.

The relation between this cost and the indicator DPD, Direct Product Delivery, is the following one:

Number of pallets inbound = Total number of transports – Number of pallets outbound

$$\boldsymbol{DPD} = \frac{\text{Number of pallets outbound}}{\text{Total number of pallets}}\ \%$$

Results of DPD of the 36th week of the year with the quantities of stocks expressed in pallets:

TOTAL	26		27		28		29		30	
	W	Ext. W	W	Ext. W	W	Ext. W	W	Ext. W	W	Ext. W
Initial	5731	13087	5753	13586	5619	14508	6750	15075	6750	15103
In	1564	598	1424	985	2643	665	1095	92	1208	80
Out	1542	99	1558	63	1512	98	1095	64	1095	76
End	5753	13586	5619	14508	6750	15075	6750	15103	6863	15107
DPD	72,06%		61,27%		69,45%		92,25%		93,19%	

Relation between both areas and conclusion:

It has been calcuted that increasing the number of changer over during the week from 1 to 3 the OE of would decrease to 60 % aprox (see calcul in annexe). This decrease can increase the industrial cost in a 0,01% of the total labour cost.

Nevertheless the level of the cicle stock would decrease during the days 27, 28, 29 and 30 consideratly for this two volumens bottles. This disminution can decrease the supply chain in a 0,1% aproximatly because the number of pallets needs to be send to the Regulator can be reudced in 100 pallets.

This example show that the disiminution of the level demand can be also seen like an oporntunity to decrease the level of the cicle stock by increasing the number of change overs. The sum of the variable cost of both industrial and loggistic area are reduced.

Finally, the procedure of DaMaWay called SMED is also a way to win in flexibility as it suppose a reducion of the OE and therefore a balance between the industrial and supply that suppose a reduction of stock and cost more considerable.

5. CONCLUSION:

In the every day more competitive market it is necessary to integrate a culture of continues improvement in the production plant. Lean Manfacturing System aims to follow this idea with a methodology or work base in the elimation of every acction or ressource that doesn't added value to the final product. DaMaWay, Danone Management Way, integrate this methodology with a culture based in the devellopement at all levels of the organization.

AIC, ZONNING and SMED are three DaMaWay tools used by all employers in the fabric. The first one have the main objective of sincronizing the action of all funtions and the second put in practice the ergonomi in the work and facilite the authonomy of the operator in his post of work. Finally, when both the AIC and ZONNING are integrated in the plant, the procedure SMED can be applied in order to reduce the time in change overs.

The sincronization of all departments that are involved in the order to delivery process of the bottles production is the first step to get to the flexibility. The second step could be breaking the barriers to continues improvement and finally the "sacrification" of the performance in an area to reduce cost might be necessary.

The reduction of the volume demand in FONT VELLA has been seen like an oportunity to focus into a reduction of the actions and ressources that not give value to the product and therefore grow in performance.

6. ANEXES

ANEXE 1: Calculation of the stock in a week of 3 changes over, Line I.

	Production day : Expected Demand		No COV		COV		Stock end of day	OE
	Monday : Tuesday	Stock	Shifts number	Production	Shifts number	Prod.		
2,5 L I	32.250,00	50.250,00					18.000,00	
6,25 L I	101.500,00	14.296,28	3	62208			38.844,28	0,89
6,25 L H	-		3	63.840,00				0,89
	Tuesday : Wensday	Stock	Shifts number	Production	Shifts number	Prod.		
2,5 L I	32.250,00	18.000,00	1	20684,49985	1	15740	22.174,22	0,79
6,25 L I	101.500,00	38.844,28	1	20736			21.920,28	0,89
6,25 L H			3	63.840,00				0,89
	Wensday : Thursday	Stock	Shifts number	Production	Shifts number	Prod.		
2,5 L I	32.250,00	22.174,22	2	43024			32.948,22	0,93
6,25 L I	101.500,00	21.920,28			1	15739, 7246	-	0,68
6,25 L H			3	63.840,00				0,89
	Thursday : Friday	Stock	Shifts number	Production	Shifts number	Prod.		
2,5 L I	32.250,00	32.948,22					698,22	
6,25 L I	101.500,00	-	3	62208			24.548,00	0,89
6,25 L H			3	63840				0,89
	Friday : Monday	Stock	Shifts number	Production	Shifts number	Prod.		
2,5 L I	32.250,00	698,22	1	21512	1	20684, 4999	10.644,72	0,61
6,25 L I	101.500,00	24.548,00	1	20736			7.624,00	
6,25 L H			3	63840				0,89

ANEX 2: Proprieties of the line I

		Cap prod bottle/shift	
Nominal Speed	Middle Speed	No COV	COV
2900	2689	21512	20684
2900	2592	20736	15740
3000	2660	21280	21280