Lean Management: Wood Manufacturing Industry Case Study

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Abstract

In this work is made a characterization though the present VSM of the wood manufacturing process of Covelo e Pinto, Ltd, with the objective of improving his efficiency. A bibliographic review in the methodologies and applications in Lean Management to manufacturing is explored, identifying witch are the most adequate techniques to this case. The techniques applied are the product oriented *Layout*, *Pacemaker Process*, *Visual Management* and *5s*, In the end it is proposed a new VSM with the implementation of this techniques. The obtained results are a decrease of Lead time, of intermediary stock, waiting times, transport and handling of the product and an increase of the efficiency index.

Keywords: Process Improvement, *Lean Management*, Wood Manufacturing

1 – Introduction

The competitive environment lived in the wood manufacturing industry, where one of the arguments for the costumers decision is the final price, directs the companies to search for a better position in the market.

Companies that once lived high demand for their final products, who concern was based on rising productivity to satisfying that demand, are concern today in improving their process through decreasing of costs to a goal of more competitive final prices.

In Portugal this industry is composed essentially by small companies, with specialized productive systems. Due to this composition, the total productivity of the forestry roe was in 2009 11,6% less of the average of the manufacturing industry sector (Sarmento and Dores 2013).

With this scenario on background, the *Lean Management* principles can contribute to a rise in competiveness, providing through a business philosophy change and a process simplifying, better results in the various steps of the product manufacturing.

In the chapter 2 is presented the related literature about this theme.

2 – Related Literature

The management philosophy behind of these principles is in removing waste, though the discovery of the source of errors in the process that makes them. Each waste is based on inaccurate acts that are resulting of strategies, processes and methods. Therefore, any task that does not produce any value is inaccurate, then is a waste (Jie 2010).

Lean Management is a management that meets the product demand through the removal of any waste in the management process and ending any kind of inaccurate act (Jie 2010).

This concept has is focus in the process, making it the more efficient, with the minimum costs and with no wastes. It is an approach which requires that the companies make the best use of their resources – their technology, their equipment and above all the knowledge and skill of their people.

The Lean Management, due to is implementation in the business network and in the main activity of the companies, has established positive impacts in their competitive positions, taking it to the achievement of competitive advantages and sustainable competitive advantages (Lewis 2000).

Green, Lee et al. (2010) conducted a lean approach in the materials handling operations of an oil platform. Through the visual management, *5s* and pull system techniques they achieved a reduction in the inventory transportation time to the production line of 17 hours/week to 5,5 hours/week and a saving in the global operations set of approximately 14 hours/week.

Rahani AR. and al-Ashraf M. (2012) conducted a VSM analysis in one production line of the car company MAJAICO (Malaysia-Japan Automotive Industries Cooperation), with this analysis they check a reduction in the total hours of operators work in 16,9% and a reduction in the total hours of machine work in 14,17%.

Cumbo, Kline et al. (2006) compares the lead time of the wood manufacturing companies that has implemented lean techniques with others that do not have implemented, they check that the average lead time of the first ones is 18,9 days and the second ones 28 days, a difference of 32,5%. However, they identified multiple barriers to a complete lean implementation, including the communication between tasks.

Fricke and Buehlmann (2012) conducted an inquiry to the wood manufacturing industries that implemented lean techniques and they conclude that 70% of these companies decreased the lead time in 31% and 56% decreased their unit production cost in 23%.

The objective of this study is improving the wood manufacturing process, with the focus in two products, the Pallets and the Beams.

With the literature review, in the chapter 3 is presented the information about the company and the manufacturing process in study.

3 –The Company

The Covelo e Pinto, Ltd it is a limited company, funded in October of 1955. It has three distinct business units: sawmill, tools and construction store and forest and woods cleaning. This is indicated in figure 1.

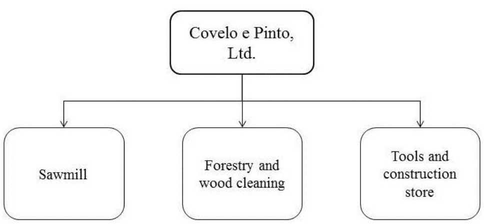

Figure 1 - CP business units

The need of a continuous improvement strategy and the adaptation of the wood manufacturing process is noticed by some facts of the present past of this SME. The electricity cost increase 21% in the last 3 years and a decrease in the last 5 years in 72% in the Pallets sales are some of the them (Covelo e Pinto).

Pirraglia, Saloni et al. (2009) conducted an inquiry pointing that in the wood manufacturing industry, the feedstock represents more than 50% of the total production costs. In the USA and Canada, the numbers reveal that 55% of the companies has knowledge of lean methodologies and are applying them, 27% has knowledge but are not applying, 11% has knowledge and will applying and 7% don´t have knowledge of this methodologies.

3.1 – Description of the manufacturing process

There are two main sections in the CP manufacturing process, the section of the cutting lines and the section of assembly.

In the cutting lines section there is two main lines, one dedicated for the construction woods and the other for the pallet woods. This is indicated in figure 2.

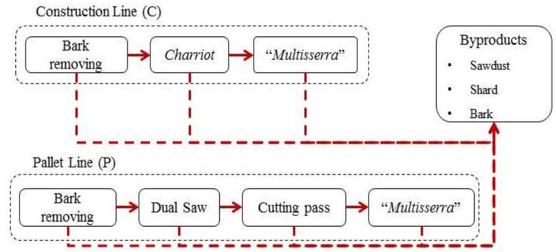

Figure 2 - Cutting Lines

Before the entry of feedstock in the *Charriot* and the Dual Saw for the cutting process, is removed the bark in the bark removing process. In this process is produced bark has byproduct which is availed for selling.

After the high cut in the wood pieces in the construction line, they move to the "*Multisserra"* for the width cut. The length cut is made in the assembly section.

In the Pallet line, after the high cut in the Dual Saw, the length cut is made in the Cutting Pass and the width cut is made in the "*Multisserra"*. In this line the wood pieces are already completed in their final form.

After the Cutting Lines section the wood pieces step into the Chemical Treatment with the aim to avoid the creation of mold in the wood.

After the Chemical Treatment, the wood goes to the assembly section. This is indicated in figure 3.

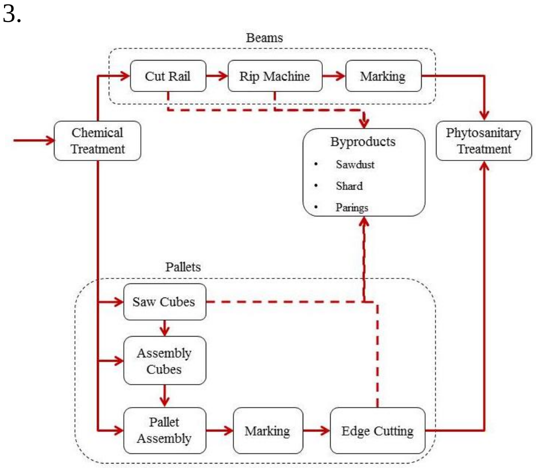

Figure 3 - Assembly Section

The boards are moved to the cube and pallet assembly and the Beams are moved to the saw cubes.

In the task of the saw cubes the Beams are cut to get the respective cubes, that go directly to the assembly cubes where are assembled with the boards from the chemical treatment. After this process is obtained the pallet foundations, these foundations are moved to the task of pallet assembly to the complete pallet construction.

After the pallet assembly the Pallets are marked with the stamp of the company in the marking task. In the next task, the edge cutting, the edges of the Pallets are cut off.

After the pallet assembly process, these ones are moved to the phytosanitary treatment, where is removed the possibility of spreading the diseases of pine wood.

For the Beams assembly, those that come from the chemical treatment are cut in length in the cut rail. After that, they pass through the rip machine and the marking task, finishing the process in the phytosanitary treatment.

With the process characterization and presentation of the company, in the chapter 4 is analyzed the data of the manufacturing process.

4 – Case Study Analysis

With the data collection, flow material analysis and time analysis it is possible to present the value add time in the process of Pallets and Beams.

To smooth the analysis of the process it will be present the assumption that in this study there are materials in the right place, in the right time and at the required quantity.

4.1 – Material Flow

The transport of products is analyzed in table 1, presenting the covered meters that are needed to obtain the final product.

Table 1 - Covered Meters

Product	**Transport**
Beams	355 m
Pallets	437 m

Due to the fact that the manufacturing equipment of the process are *Job-Shop* oriented, where are aggregated in a job section the tasks for one stage of the global manufacturing process of the product (http://www.lean-manufacturing-japan.com/factory/factories_of_different_kinds.html). It appears in table 1 that for the manufacturing of Beams it is covered 355 meters and 437 meters for Pallets.

4.2 - Waiting Times

In any manufacturing process it is considered waste the waiting time that the material flow faces when it is in inventory, as well as the transport where there is not any value added to the product.

In the table 2 is presenting the waiting times of the products between the tasks of the manufacturing process for Pallets. There is the assumption that one task ends when another is started.

Task	Waiting time
Bark Removing	0:03:23
Dual Saw	0:00:21
Cutting Pass	0:00:14
"*Multisserra*"	3:22:43
Chemical Treatment to Cube Saw	78:52:29
Chemical Treatment to Cube Assembly	4:23:18
Chemical Treatment to Pallet Assembly	6:40:26
Cube Saw	5:37:28
Cube Assembly	8:01:43
Pallet Assembly	0:44:04
Pallet Marking	0:21:42
Edge Cutting	26:52:09

Table 2 - Waiting time Pallets Process

The material flow for Pallets processing faces a bigger waiting time for the beginning of the cube saw task and for the beginning of the phytosanitary treatment.

In the table 3 is presenting the waiting times of the products between the tasks of the manufacturing process for Beams.

Table 3 - Waiting time Beams Process

Task	Waiting Time
Bark Removing	0:06:06
Charriot	0:00:35
"*Multisserra*"	3:18:21
Chemical Treatment	2:15:29
Cut Rail	17:45:22
Rip Machine	0:31:09
Beams Marking	26:51:05

In the material flow for Beams processing the bigger waiting time is in the beginning of the rip task and in the beginning of the phytosanitary treatment, which is common to the Pallets process.

After the analysis of the waiting times in the material flow, is continued with the value flow analysis of the process.

4.2 - Value Times

In this analysis is indicated the value added time that the manufacturing process add to the products, Pallets and Beams respectively. It is considered value everything that the costumer is willing to pay for the final product.

The value added that each task add to the Pallets manufacturing process is presented in table 4.

Table 4 - Value added Pallets Process

Task	Waiting Time
Bark Removing	0:00:20
Dual Saw	0:00:10
Cutting Pass	0:00:11
"*Multisserra*"	0:00:14
Cube Assembly	0:00:14
Cube Saw	0:00:02
Pallet Assembly	0:01:11
Edge Cutting	0:00:04
Phytosanitary Treatment	7:04:04
Chemical Treatment	0:00:56
Pallet Marking	0:00:08

The task that adds more value to the pallet process manufacturing is the phytosanitary treatment and the pallet assembly task.

The value added that each task add to the Beams manufacturing process is presented in table 5.

Table 5 - Value added Beams Process

Task	Waiting Time
Bark Removing	0:00:22
Charriot	0:00:03
"*Multisserra*"	0:00:10
Cut Rail	0:01:26
Rip Machine	0:00:03
Phytosanitary Treatment	7:04:04
Chemical Treatment	0:00:56
Beams Marking	0:00:08

The task that adds more value to the Beams process manufacturing is the phytosanitary treatment and the cut rail task.

With the value added and waiting time identification, in the section 4.3 it is characterized the actual VSM for Pallets and Beams

4.3 – Actual VSM

For the description of the actual VSM of Pallets and Beams it is necessary the efficiency index, presented in formula 1.

$$Efficiency\ Index = \frac{VAT}{Lead\ Time} \quad (1)$$

The VAT parameter is the value added time in the process. If the index is equal to 1, the process has 100% of efficiency and any activity is adding value to the product.

In the table 6 is presented the Pallets and Beams takt time and is efficiency index.

Table 6 – VSM Indicators

Product	*Takt time* (min)	Efficiency Index (%)
Pallets	0,54	5,2
Beams	0,24	11,2

The efficiency index of the process is 5,2% and 11,2% for Pallets and Beams, respectively. In consequence, for Pallets and Beams 94,8% and 88,8% of the time is considered waste, respectively.

The *Takt time* for the production of Pallets is 0,54 minutes and 0,24 minutes for the production of Beams. This means that in average the manufacturing process should produce one pallet in every 0,54 minutes and one beam in 0,24 minutes.

After the actual VSM analysis for the production of Pallets and Beams it is presenting in table 7 the analysis results.

Table 7 –VSM Results

Product	Lead Time (hours)	VAT (hours)	Operators
Pallets	137	7	19
Beams	63	7	9

In table 7 is indicated that the Pallet process have a lead time of 137 hours, a value added time of 7 hours and it requires 19 operators. For the

Beam process is required 9 operators, have a lead time of 63 hours and have a value added time of 7 hours.

In the chapter 5 are presenting the solutions for the limitations identified in this process.

5 - Results and Discussion

To overcome the limitations analyzed it is proposed some lean management techniques, these techniques are work area organization and *5s*, product oriented layout and pacemaker process categorization.

5.1 – Work area organization and *5s*

For the improvement of the tasks cycle time it will be applied work area organization techniques such as *5s* and visual management. With this concepts it will be possible the diagnosis of possible improvements to make in the tasks and a creation of an healthy work environment.

The steps of *5s* that are applied in the process are:

1. **Separate** – Separate what is need from what is not need, by cut out everything that is not need;
2. **Sort** – Define and put a way of sort what is need in accessible places;
3. **Shine** – Clean the area, determine the reason of dirty and cut it out;
4. **Standardize** – Establish the rules of work and standardize it;
5. **Sustain** – Make habit the application of *5s*, respect the rules and improving continuously.

In the company locksmitting, with the application of the visual management technique through the installation of an maintenance board for the assortment of work in progress and the work that it will be initiate, it is possible a better organization and planning of the one that must be done in the short, middle and long term time.

To reduce the waiting time, transport of materials and overload wastes of equipment it will be applied an *Kanban* label technique with the basis in a product oriented layout and a *Pacemaker Process*.

5.2 – Product oriented layout

The product oriented layout means that the process tasks should be disposed in the follow of the manufacturing task order.

In table 8 are present the total transportation meters of intermediary stock between the current layout and the proposed layout.

Table 8 – Transportation meters

Product	Current	Proposal
Beams	355	240
Pallets	437	327

The transportation meters of materials for the achievement of the final product are presented in table 8. From the current layout to the proposal layout is a decrease in 32,4% and in 25,2% in the manufacturing of Beams and Pallets, respectively.

5.3 – Pacemaker Process

The Pacemaker Process for the manufacturing of Pallets is proposed to be the Pallet Assembly task. In this task it will be send the information through a Kanban ticket system for the whole process of the intermediary products that are needed to assembly the pallet.

To the Beam process manufacturing the Pacemaker Process is the Balk Removing task, and then send downstream to the process the information relative to the final product.

In figure 4 is presented the information flow where the pacemaker process is marked.

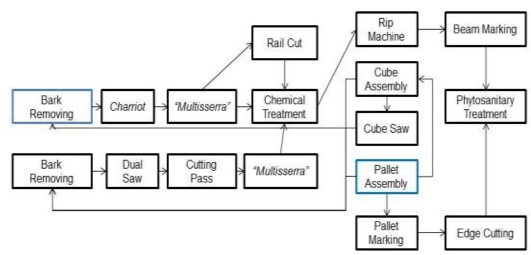

Figure 4 - Pacemaker Process

Through the categorization of the tasks Bark Removing for the Beam manufacturing and Pallet assembly for the pallet manufacturing, it is possible to improve the information flow through the whole manufacturing process, mitigating the overproduction of product.

After the implementation of these lean management techniques is obtained:

- A decrease in both manufacturing process lead time;
- An increase in the efficiency index in both manufacturing process;
- A decrease in the intermediary stock;
- A decrease in the waiting time;
- A decrease in the transport and handling of the product.

For the implementation of the identified improvements has well the respective VSM it will be applied a PDCA (Plan, Do, Check, Act) strategy. This strategy has the following plan (Rother 2010):

- **Plan** – Establish where the company want to go. In this step are defined and quantified the objectives for measure the results of the improvements.
- **Do** – Implementing the action plan. In here all the changes are made and gathered all the data concerning to them.
- **Check** – Analyzing the data of the previous step. In this analysis are discovery the new opportunities of improvement, this may can take to another PDCA strategy;
- **Act** – Applied corrective measures to the new improvements. If something in the new task is not going has planned, it should be adjusted in this step. In case of the problem keep going it should be started a new PDCA strategy.

6 - Conclusions

The Lean Management methodology applied in the wood manufacturing industry is based on the VSM analysis on the manufacturing process of Pallets and Beams.

With this analysis were identified wastes and improvement opportunities in the processes.

After the proposal VSM analysis, the results for Pallets and Beams, respectively, were the followed:

- Decrease in the lead time in 71% and 31%;
- Increase in the efficiency index in 12% and 6%;
- Decrease in the intermediary stock in 66% and 50%;
- Decrease in the transportation material in 25% and 32%;
- Decrease of the waiting time in 70% and 30%.

The implementation of Lean Management methodology in the wood manufacturing process shows good results of improving, going to meeting of results described in the bibliographic review.

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