Lean Philosophy Application to a Company in the Furniture Industry

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Abstract: Globalization combined with the development of technology, pressures companies to increase the diversity of their products. In response to the need for "Mass Customization", companies must increase efficiency and flexibility in their production system, while reducing production costs.

It is based on these objectives that Lean Philosophy emerges. Focused on the absolute elimination of the different types of waste, this philosophy introduces a number of principles and tools to be applied together. This study focuses on the application of the Lean Philosophy to the case-study developed at a company in the Furniture Industry.

The production system diagnosis was performed, and through the VSM tool, its value chain and the various associated wastes were defined. The different critical aspects were separated into three areas to develop improvement solutions.

The analysis of the Setup activity was deepened and based on the SMED tool, a standard procedure was developed to reduce the duration and variation of the time spent in Setup. Several changes to the Layout were proposed, using the implementation of *5S*, FIFO Lane and *Andon*, with the objective of introducing continuous flow and drastically reducing the movement of forklift trucks. A solution focused on real-time monitoring of processes was also proposed, supported by digital Visual Management. In this way, production planning was facilitated, while introducing the concept of digitalization in Industry 4.0.

With these proposed improvements, it is predicted that the Production time and Inventory time in WIP reduce significantly. Thus, greater efficiency and flexibility of the Production system is achieved.

Keywords: Lean Philosophy, Furniture Industry, VSM, SMED, FIFO Lane, Digital Visual Management

1 Introduction

Currently, the consumers demand a high customization of products and low prices, alongside with a short delivery lead time. These personalization requirements created the concept of "Mass Customization", where the companies, in order to maintain their competitiveness, must have a flexible production system with low cycle times. This aspect is of greater importance in the Furniture Industry, which is the focus of this study, since it is characterized by an extensive product range with increasingly lower production batches. Because of that, it is needed to eliminate all sources of waste in the production processes, identifying and monitoring the value chain. Lean philosophy thus emerges, with a focus on the value given by the customer, eliminating or reducing, continuously, the activities that don´t add value to the products.

The objective of this work resides in the elimination of waste and in monitoring Production at a company in the Furniture Industry, by applying Lean principles and tools, in order to contribute to a greater efficiency and flexibility of its productive system.

2 Bibliographic Research

Lean Production was introduced by James P. Womack, co-author of the book "The Machine that Changed the World", (Womack, Jones, & Roos, 1990), published in 1990. It was used in order to contrast production system of the Japanese automobile company *Toyota* (*Toyota Motor Company*), with the Mass Production systems, widely adopted by the Western companies (Holweg, 2007). Therefore, Lean philosophy can be considered a western interpretation of the *Toyota* Production System (TPS), sharing its main focus on the absolute elimination of waste. Lean Philosophy has established a set of fundamental principles, similarly with TPS, to function as a guide for its success (Womack & Jones, 2003):

Value – The first crucial step for the transition into a Lean culture is the specification of value in the company's products. It is defined by the customer and for a specific product, meeting their needs for a specific price at a specific moment.

Value Chain – The value chain involves not only the activities of physical transformation of the products, but also the actions of information management and problem solving. All the activities can be separated into: **Value-Added Activities**, where the product is transformed towards a more complete state, and with more value for the client; **Non Value-Added Activities**, which don´t contribute to a more complete state of the product nor to an increase of value from the customer perspective; and, finally, **Required Non Value-Added Activities**, that do not add value to the product, but are necessary.

The customer is only willing to pay for the activities that fit the first category of activities. In order to eliminate or reduce the Non Value-Added Activities (required or not), it is necessary that everyone is capable of identifying the different types of waste. Taiichi Ohno, in (Ohno, 1988), classified waste in 7 different types:

1. **Transport**
2. **Inventory**
3. **Movement**
4. **Waiting**
5. **Overproduction**
6. **Overprocessing**
7. **Defects**

Flow –. After identifying the value of the products and its value chain, it is necessary to focus on the product itself and its physical path, from the beginning of its production to its delivery, in order to intervene over the flow of products (Womack & Jones, 2003). For this to be possible, one must ignore every barrier for a continuous flow in its analysis. Finally, improvement solutions must be implemented, through the application of Lean tools or simply by changing certain aspects, to reach an uninterrupted and continuous flow. These improvement solutions can be a layout restructuring, the elimination of non value-added steps or even a deeper change, regarding the productive process itself.

Pull – The transition to a Pull Production means that every upstream process only starts when required downstream. For its implementation the most common tool is the *Kanban* system, which was adopted directly from TPS and inspired in the same logic used at the supermarkets in the fulfillment of its shelfs (Holweg, 2007). Other tool is the "FIFO Lanes", presented in (Rother & Shook, 1999), which is more suitable in systems with a high variety of products, since the *Kanban* system in this case would become too complex.

Perfection – This principle is based on the visualization capability, as the 4 principles described, but somewhat more abstract, aiming perfection. The effort to reach a state of perfection, the absolute inexistence of waste, will be what enables the development of solutions and the continuous improvement of a company.

2.1 Lean tools and methodologies

Within Lean Philosophy, in order to apply its principles, there are various tools and methodologies, that enable cost reduction through waste elimination. Most of these were adopted from TPS, improved as those who applied them faced difficulties in their implementation. All of them need the involvement of the workers, and their commitment in its success, therefore *Kaizen* Events are of extreme importance in a Lean enterprise. These events are essentially meetings with a reduced number of people from different departments, where discussion is promoted between everyone, to reach a consensus regarding the objective of the meeting.

In this work different Lean tools were used, with the constant reminder that every tool implemented cannot be viewed as an independent solution, but as a part of a whole. The Lean tools used were:

Visual Management – This tool shows superiority regarding the quickness of retaining the content of a message, when compared with its transmission in a written or oral form (Koskela, Tezel, & Tzortzopoulos, 2018). According to (Eaidgah, Maki, Kurczewski, & Abdekhodaee, 2016), Visual Management can be used as a solely Informative tool, or as an Informative and Directive tool. Three important tools, implemented in this work and strongly supported by Visual Management, are: Standard Procedures; FIFO Lanes and *Andon* Systems. The latter, through the digitalization of information, is elevated with the implementation of digital Visual Management dashboards, allowing the monitoring of the shopfloor in real time.

VSM – The Value Stream Mapping (VSM) tool is considered essential to a successful Lean implementation. With VSM one can fulfill the second Lean principle, while enabling the identification and localization of the different types of waste. It can be considered as an Informative Visual Management tool, as defined in (Eaidgah, Maki, Kurczewski, & Abdekhodaee, 2016). (Rother & Shook, 1999) establish a methodology to implement this tool, but more importantly, a standardized symbology is defined. This common language will allow that anyone familiarized with VSM will understand any value chain presented.

<u>5S</u> – This methodology is one of the most widely implemented by companies transitioning to a Lean philosophy (Abu, Gholami, Saman, Zakuan, & Streimikiene, 2019) and is directly adopted from TPS, having suffered none or little changes throughout time. Each *S* represents a different Japanese word, later translated to English: Sort, Set, Shine, Standardize and Sustain. It was presented by Hirano in (Hirano, 1995), who refers to this tool as the necessary foundation to TPS, and therefore to Lean philosophy. Hirano also advocates that *5S* must be applied not only to workstations but also to the entire shop floor.

<u>SMED</u> – As in (McIntosh, Owen, Culley, & Mileham, 2007), by adopting "Mass Customization", the main focus of modern Production is the capability of transitioning between production orders. This model introduces a high number of daily Setups, a Required Non Value-Added Activity. The Lean method to reduce the time of Setups was created by Shigeo Shingo, named "Single Minute Exchange of Dies" (SMED), (Shingo, 1985). It is based on the separation of tasks between Internal and External, conversion of Internal tasks into External and reducing the duration of both types of activities.

2.2 Lean in the Furniture Industry

Results were scarce in the scientific bibliography research, regarding models or techniques of Lean implementation in the Furniture Industry. In (Henao, Sarache, & Gómez, 2018), the authors show that from 679 Lean articles revised, only 3% were focused on the Furniture Industry. A characteristic of this industry is its small batch production with high volume and low repeatability, being this characteristic recognized as a limitation of Lean philosophy implementation in (Hines, Holweg, & Rich, 2004). Nonetheless, the authors advocate that the integration of other non-Lean tools to fight this limitation, as long as they do not harm Lean's principles, are recommended. In this sense, the integration of tools or elements from the emergent Industry 4.0 might be useful in this situation, since, as in (Wang, He, & Xu, 2017), they are focused on granting a higher flexibility to production systems.

2.3 Lean and Industry 4.0

With the increase of digitalization and information accessibility, the manufacturing capability of customized products has become the key to companies' success. As in (Wang, He, & Xu, 2017), Industry 4.0 aims to transform the Manufacturing Industry into a smart one, with an improved flexibility in its production systems. The key elements in this new concept, by (Hermann, Penteck, & Otto, 2015), are: the Cyber-Physical Systems **(CPS)** which enable the incorporation of computers and devices at workstations and machines for monitoring in real time physical processes; the Internet of Things (**IoT**) and the Internet of Services (**IoS**) to create a network between smart devices with a common objective; and finally, the **Smart Factory** with background systems to help workers in tasks execution and Man to Machine communication. In (Mayr, et al., 2018) the commonalities between Lean and Industry 4.0 are established, and it is concluded that the foundation of the latter relies on Lean principles. The main component of Industry 4.0, that is of extreme relevance in Lean philosophy, is the massive potential improvement on monitoring and control capability, through **digital dashboards** updated in real time.

3 Case Study and Methodology

The factory where this study was carried out belongs to a Portuguese company founded in 1981, its main activity being the production and commercialization of contemporary furniture, through sustainable processes, exporting to more than 50 countries worldwide. This work focuses on a specific family of products in order to decrease its unitary cost and create a competitive edge in the market, through the elimination/reduction of waste in Production.

The methodology followed is presented in Figure 1. Firstly, it was necessary to identify 2 elements, that were representative of the family of products being studied. From that point, data was collected from the ERP software and the time spent in processes in each workstation was observed and measured through video, which enabled the construction of both VSM's. From the analysis it was possible to establish the critical aspects (wastes) and their respective root causes, leading to the definition of three different areas of action for the development of improvement solutions. These solutions were carried out through the implementation of various Lean tools and principles.

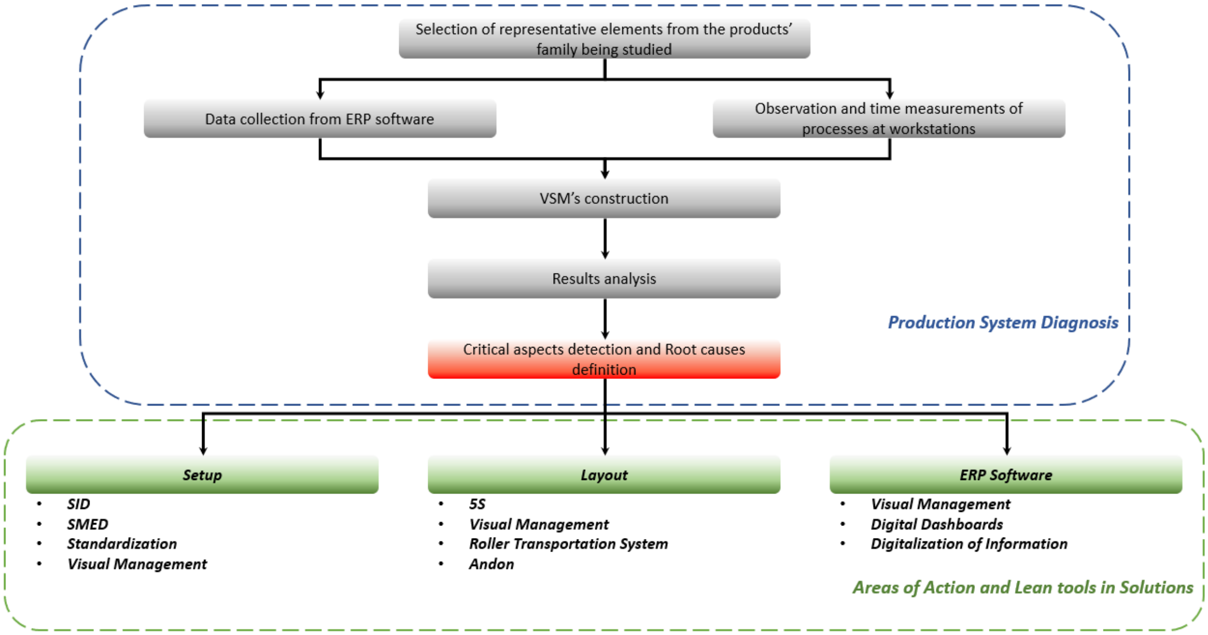

Figure 1 - Methodology followed for this work

4 Diagnosis

It was necessary to select 2 elements as representatives of the family of products being studied, based on the Production Volume, and the production steps. Elements X and Y were chosen, with the collaboration of the Production team and the Production Planning Department. These 2 elements represent 21% of the Annual Production Volume, from the 460 different elements in the family.

The construction of both VSM's was possible for a typical batch of each element from the data gathered from the ERP software, regarding the time spent between processes (WIP), and from the observation of its production processes, aided by video recording, measuring the time spent in the different steps within the production process at each workstation. Besides the VSM's, the flow of materials on the factory layout was also mapped.

Different improvement opportunities were identified from the analysis of the VSM's. Regarding the information flow, it was shown that several steps were dependent of the physical transfer of information, from Production Managers to Workers or Workers to Forklift Drivers, responsible for the difficulty in monitoring the shop floor and for the waiting times. The communication to Forklift Drivers often creates waiting times of material supply at workstations, directly affecting the Productive Lead Time. The exchange of information through the ERP software at certain steps was characterized of regular mistakes from workers in the records of the production orders milestones. This led to sub utilization of the data, due to management mistrust.

The results obtained from the VSM's, shown in Table 1, surfaced different problems, being the most apparent one the time spent by the production batches as Work in Process (WIP). WIP represents 91% for element X and 88% for element Y, of the whole Productive Lead Time, and value added activities (*t.v.a*) only represent 4,6% for X and 7,3% for Y. If one removes WIP from calculations, the Setup activities take 38% of the time spent in actual Production in X and 23% in Y.

It was concluded that the Setup activity was higher at the processes identified as bottlenecks. The production bottleneck for element X was on the chamfer opening process, where the Setup activity took 52%. Still for element X, in the drilling process, the Setup activity took 50% of the whole time spent. Regarding element Y, its production bottleneck is located at the drilling process, in which the Setup activity took 35% of the time spent in the process.

Another relevant aspect to address, is the high movement of Forklifts in the shopfloor, in the production of both elements. The products, in a typical batch of element X, travel 410 meters from which 400 are by Forklift. Regarding the production of element Y, the distance covered by the products is of 1200 meters, where 1140 of these are covered by Forklift Drivers.

Table 1 - Time sum of the different types of activities in every Production process for a typical batch of both elements

		WIP	in Production				Productive Lead Time
			t.setup	t.exp	t.others	t.v.a	
X	min	1756	68	9	13	88	1934
	%	90,8%	3,5%	0,5%	0,7%	4,6%	100,0%
Y	min	3056	92	23	35	251	3457
	%	88,4%	2,7%	0,7%	1,0%	7,3%	100,0%

A root cause analysis was performed for the different critical aspects determined (the high value of the time spent in WIP, the waiting for supply at workstations and the high movement of Forklifts in the shopfloor), from which it was possible to establish three different areas of action to solve these aspects and its root causes. The areas of action established for the development of improvement solutions were:

- Setup
- Layout
- ERP Software

5 Solutions

5.1 Setup

The diagnosis of the productive system suggested that the time spent in Setup activities was high, which was then confirmed by the VSM analysis for both elements. Being a root cause to the high WIP time, it was necessary to deepen the analysis of this activity, namely the Setup of a Production bottleneck process. It was performed the analysis at the drilling process workstation of the element Y, a bottleneck to its production, and similar to the one at the workstation responsible for the drilling process for element X, at which the Setup activity also consumes much time.

Three observations were performed, and the several tasks were classified into seven categories of operations, being this methodology adopted from the SID tool developed in (Peças, Morgado, Jorge, & Henriques, 2012):

1. Cleaning
2. Transport
3. Operator movement
4. Positioning and Adjustments
5. Tools exchange
6. Programming
7. Final Verifications

In this approach the analysis is systemized, enabling it to be applied to different Setup activities, namely to the workstation where the production bottleneck of element X is located. The results obtained from the observations are presented in Figure 2, as an Yamazumi chart. The first two observations had the exact same conditions for the Setup realization and the only difference in the third one, was the absence of one worker, from the usual two in this workstation.

It was expected that the latter observation would take longer to execute due to the absence referred, but that was not the case, as observed in Figure 2. This aspect and the discrepancy at the distribution of the time spent in each category of operations strongly

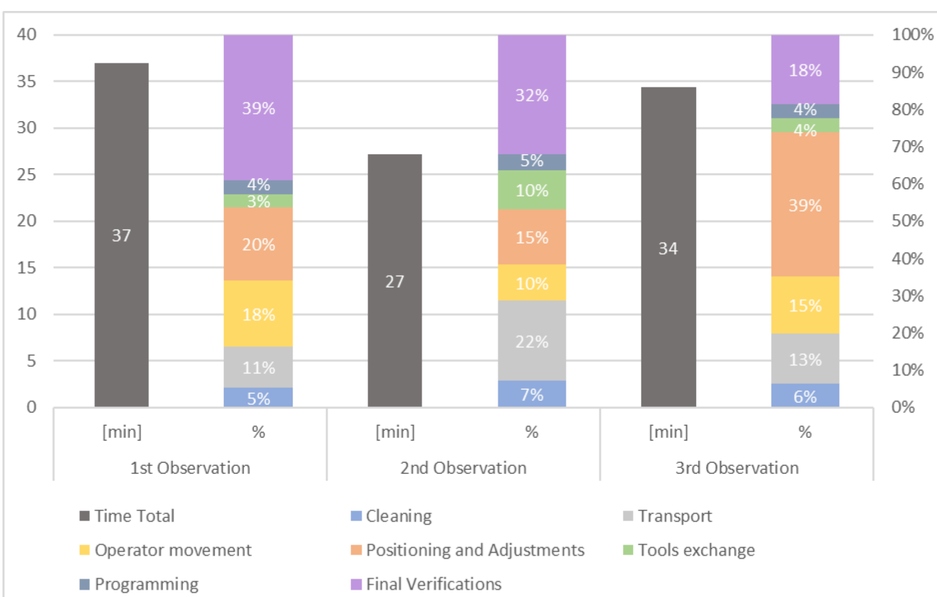

Figure 2 – Time distribution of the different categories of operations for the observations of the same Setup activity

suggests the need of a standard procedure. The definition of a standard procedure must eliminate the following causes for the high variation and time consumption of the Setup activity:

- High variation in the duration of the different categories of operations
- Uneven task distribution between Operators
- Difficulty on getting the parameters right at first try
- Most tasks are performed as Internal Activities

Applying the SMED tool, the different categories of operations were classified as Internal Activities or External Activities. It was estimated the impact in the time consumed when the activities classified as External are really performed externally, shown in Table 2. This separation corresponds to the initiation of phase 1 at a SMED implementation.

Table 2 - Results to achieve with phase 1 of SMED

	Initially [min]	Phase 1 SMED [min]	Difference [%]
1st Obs.	37	12	**68%**
2nd Obs.	27	10	**63%**
3rd Obs.	34	18	**47%**

Additionally, when looking to the first two observations, the simple separation of tasks, the variability between both would also decrease, from an initial **26%** to **16%**.

A Standard Procedure, as represented in Figure 3, was created collaborating with the workstation Operators and Production Managers, in order to achieve these results. In this document, the External tasks to perform before stopping the machine at the workstation, as well as the ones to perform after finishing the Internal operations, are clearly separated, being the External in green and the Internal in red.

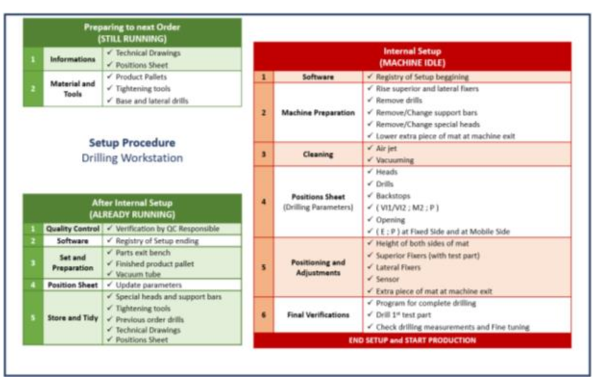

Figure 3 - Standard Procedure for the drilling workstation

This procedure was defined in order to be applicable to the various different Setups performed in the workstation, besides the one related to element Y. In that way, the already used Positions Sheet created by the Operators is integrated. This is where the different parameters are registered and updated every time, as indicated in the new Standard Procedure. Also, it is defined in the document created the moments to register the milestones of the activity, meaning its starting time and completion time, so that its data becomes more reliable for management.

5.2 Layout

A big part of the root causes identified from the critical aspects are related with the way the factory Layout was defined. The various solutions proposed aim to solve the following:

- Shop floor area occupation inefficient
- Cutting workstation permanently stopped taking up space
- Roller transport system not implemented in various connections between workstations
- No warning system for Forklift Drivers on the need of the workstations

At a *Kaizen* Event performed virtually with several members of different departments, where improvement ideas were exchanged, it was concluded that the elimination of the need of Forklift Drivers at the workstations was necessary. This would allow the compliance of the objectives defined and enable the introduction of a more continuous flow. Firstly, it was necessary to remove the non-working workstation, since it was only occupying precious space at the shop floor. This new available area, due to its strategical location, was defined to be the area for Quality Control check before the Painting process, in which must be implemented a roller transport system so the transportation and management of pallets is facilitated, but also to establish a connection with the painting workstations and with a new area defined as WIP for the products to be painted. This new area was proposed by the members of the company at the *Kaizen* Event, due to the change of locations of Quality Control desks, previously in this area. These changes are presented in Figure 4.

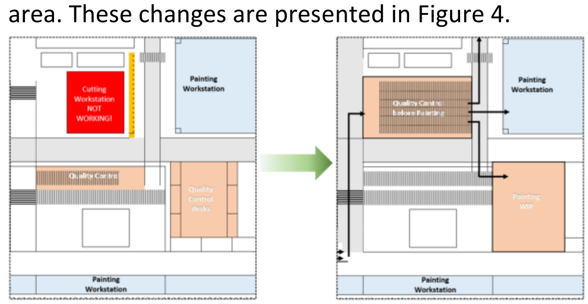

Figure 4 - New Quality Control and Painting WIP zones created

Next, to enable the elimination of Forklifts to carry the products between workstations and WIP areas, it was necessary to act on the current organization of the WIP areas. These zones did not have an actual organization neither any Visual cues to guide the storage of products, and were also mainly concentrated in one main area, including the Painting WIP products. It was then proposed to separate all the different WIP zones by clearly identifying the destination of the products in these areas, through Visual Management. The WIP areas must be near the workstations where the products will be subjected to, and following the FIFO Lanes concept, which enables a continuous flow and the introduction of a Pull system. The FIFO Lanes must have a roller transport system implemented and when visibly full, the production upstream must stop so that there is no Overproduction.

Another solution established at the *Kaizen* Event was the definition of a new location of one of two the major cutting workstations. This one was set to be placed closer to the Stock of Raw Material, so that the distance travelled by Forklift Drivers can be greatly reduced, since they are necessary for the supply of Raw Material at both major cutting workstations. It was agreed upon that the moved workstation should now be dedicated to the cutting process of other families of products, instead of the family studied, switching with the other cutting workstation. Since these workstations have the need to be supplied by Forklifts Drivers, it was proposed the implementation of a simple *Andon* system, where through the pressing of a button a light is turned on, signaling the Forklift Drivers the need of supply.

With these changes the flow of products became more continuous, due to the connection of the several workstations responsible for the Production process of the family studied, simultaneously benefiting the flow of the other families' products, and with less waiting times for supply at workstations.

The last improvement solution suggested regarding the shop floor layout, was the restructuring of the drilling workstations, with the integration of a new one. It was followed the solution of implementing FIFO Lanes at every workstation, as explained previously, and it was proposed the rotation of machines, so the flow of materials becomes more straightforward. In these workstations, as shown in Figure 5, the pallets of material are always over a roller system, and it must be the Quality Control Operator to transport these pallets to the new area destined for that operation.

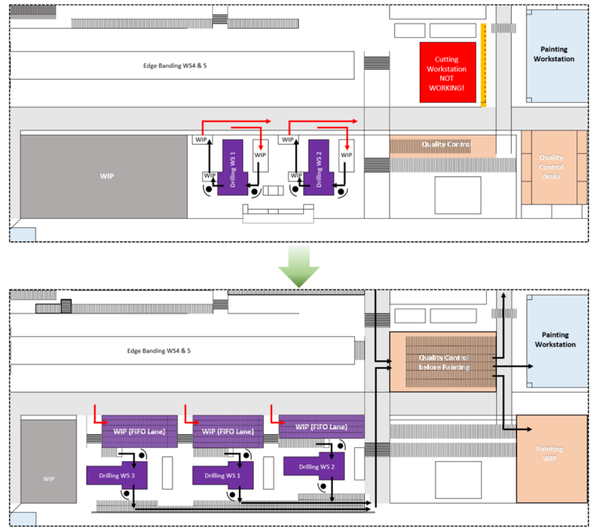

Figure 5 - Drilling workstations layout restructuring

All of the proposed solutions were accepted, with its implementation to be performed gradually to not disrupt abruptly the Production. With these, it was visible on the materials flow mapped for each element, the important reduction of movement of Forklift Drivers at the shop floor, being the results presented in Table 3. The reduction was enabled by the elimination of the need of supply by Forklift at several workstations. With that, also the problem of waiting time for supply is eliminated, becoming the responsibility of the Operators. Thus, it is important that WIP areas are clearly defined, through Visual Management, alongside with the proximity of these areas to the workstations functioning as FIFO Lanes.

Table 3 - Estimated reduction of the distance travelled by Forklift Drivers

	Element X	Element Y
Before [m]	400	1140
After [m]	44	309
Estimated Reduction	**89%**	**73%**

5.3 ERP Software

When performing the diagnosis, it was noticed an underutilization of the data registered on the ERP software at workstations, due to a lack of confidence in its reliability. A sentiment among Operators of "no need to make correct registries at the right moment, since it won't be used" was identified and a difficulty regarding the processing and presentation of the data, which also contributed for the currently underutilization. These aspects are considered to be some of the main causes for the high WIP time of products since it harms the monitoring and control of the shop floor capability. The proposed solution aims to enhance this capability as well as optimize the information flow, through the digitalization of information. It was proposed that, besides the data already registered by the Operators, regarding the milestones of the Production Orders, the transmission of these Orders should be computerized, as shown in Figure 6. In this manner, the Production Managers do not need to physically address the workstations and the Operators are more quickly informed of the following Order, being able to perform the External activities of the next Setup sooner.

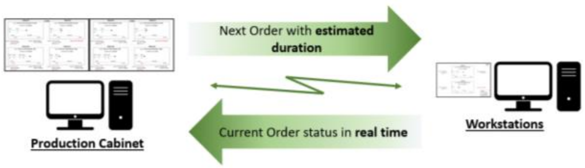

Figure 6 - Information flow between Production Managers and Operators

This solution will involve the installment of monitors in the Production Cabinet to enable the desired monitoring through digital Visual Management. It is also important the presence of monitors at workstations, showing with the digital dashboards that the data, which they must register, is being used in a useful manner. Alongside with the Production Managers, it was defined that the most useful indicator for the monitoring process of the shop floor was the Total Estimated Time for Production of each Production Order at every workstation. This would enable a better Daily Production Planning and would add more flexibility to the entire system. It was then proposed the appearance of a dashboard, as in Figure 7, knowing that several dashboards could be showed simultaneously in one monitor. In Figure 7, it is also identified and explained the different elements on the proposed dashboard.

The several recordings made by the Operators will be used to constantly estimate and update the Total Estimated Time for Production of the different Production Orders, separating by Setup Estimated Time and Actual Production Estimated Time. For this purpose, it was proposed the creation of a data base for the registries and its processing as a link between the ERP software data base and the software for the information presentation on the dashboards.

Similarly with the work developed in (Jorge & Peças, 2018), this solution aims for the availability of information in an intuitive manner, so that it is easily understood by every user. It allows the Production Managers to make decisions based on accurate information, updated in real time. With a more effective monitoring and control of Production, it is predictable a reduction on delays and rescheduling of the Production Planning, while increasing the flexibility in the productive system. This solution introduces the concepts of Industry 4.0 regarding the monitoring and control of the shop floor in real time. The author took advantage of the records already being performed, so that, in a structured way and with a defined utility, the information is processed and presented and does not become chaotic when there is a higher level of information. This initiative should be interpreted as a preliminary and low investment phase in the adoption of Industry 4.0.

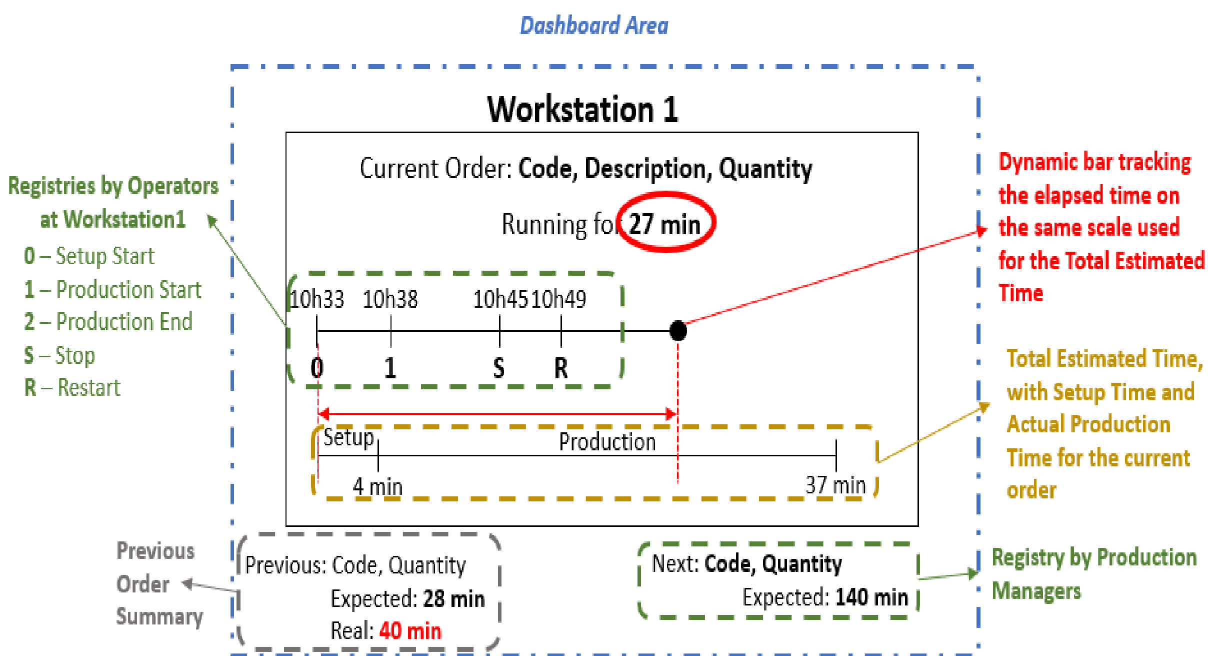

Figure 7 - Proposed dashboard for monitoring and control

5.4 Solutions estimated results

This section has the objective to summarize the impacts estimation of the different improvement solutions proposed. On the first area of action, a Standard Procedure was defined, alongside with the workstation Operators and Production Managers, for performing the Setup activity at a Production bottleneck. It was observed a high level of time consumption on External Activities as Internal and a high variability in its duration. It is estimated that with the Standard Procedure, as the 1st phase of SMED implementation, will decrease by up 68% the time consumed in the Internal Setup and reduce the discrepancy in their duration by at least 10%.

The different propositions of the Layout restructuring have apparently separate impacts, but all will contribute to a more continuous production flow. The restructuring of WIP zones into FIFO Lanes at each workstation with roller transport systems for the handling of pallets will enable the elimination, at these workstations, the waiting times of supply. At those where it is still necessary the supply of material by Forklift transportation, the simple *Andon* system will allow signaling the Forklift Drivers, reducing the waiting time of supply. These solutions, alongside with the restructuring of the drilling workstations, the movement of Forklifts on the shop floor is reduced I by 89% in the production of element X and by 73% for element Y.

The last improvement area was focused on the better utilization of the existing records on the ERP software, aiming the optimization of the current information flow and an increase in efficiency and effectiveness of the daily Production Planning. The implementation of digital dashboards showing the same information at several sites on the shop floor, will eliminate the need of physical exchange of information and will also reinforce the decrease of waiting times of supply, since the Forklift Drivers will have access to the next Production Orders at different workstations. The computerized exchange of information will also allow that the Operators can start the initial External Activities, indicated on the Setup Standard Procedure, more quickly. The real time monitoring proposed will allow a better decision making by the Production Managers relatively to the Production Planning, while attributing an improved flexibility to the productive system. This improvement in flexibility, alongside with mainly the FIFO Lanes established, will create a gradual decrease on the WIP time of the products.

6 Conclusions

This work was based on the application of the Lean principles and tools, aiming the identification of the different types of waste, through a diagnosis to the productive system of a products family on a Furniture company. By developing improvement solutions for the mitigation of the wastes identified, it was aimed to improve the system efficiency and flexibility, which results on the improvement of the company's competitiveness.

It was also aimed the demonstration, through the applied methodology and estimated impacts of the proposed solutions, the existing benefits on adopting Lean philosophy for the Furniture Industry, allied or not to the emergent Industry 4.0.

7 Limitations and Future Work

It is important to point out that this work was limited by the difficulty of staying at the company, by external reasons, for the development of the proposed solutions and the validation of the estimated results, due to the current global situation in which this work was developed.

It is recommended that the improvement solutions are implemented and the followed methodology applied to every workstation and Factory sector, based on the tools used or other Lean tools, since that the value of Lean is found when the entire enterprise is transformed into a Lean one, in which every process is free of waste.

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