[1.]Mohamed Najeh LAKHOUA

METHODOLOGY OF ANALYSIS BASED ON A LEAN-MANAGEMENT

[1.] Research Unit Signals and Mechatronic Systems, National Engineering School of Carthage, ENICarthage, University of Carthage, TUNISIA

Abstract: In order to analysis the current state and to design a future state for the series of events that take a product or service from its beginning through to the customer with reduced lean wastes as compared to current map, we used a lean-management method. This project presents a work to eliminate waste in the production line in a pharmaceutical company. Then we used Value Stream Mapping (VSM) study followed by an analysis of causes and a plan of action carried out successfully enabled the company to optimize its production time.
Keywords: Value Stream Mapping, project management, improvement

INTRODUCTION

Pharmaceutical companies are facing competition. Indeed, the price differences between competing products can be such that it becomes difficult to compensate them by differences in value added. The conditions of competition are no longer homogeneous for the players involved. The price of a product is a given that puts a company and its customer face to face [1], [2].

However, price fixing obliges the company to consider internal factors relating to production costs and external factors such as customer attitudes, the existence of regulations and the structure of the market on which the firm evolved. In setting the selling price, the company must first take into account internal factors relating to its costs: costs of production fall into two categories, fixed costs and variable costs that depend on the quantities produced [3], [4].

The pharmaceutical company has decided to launch a new range "Brand Generics". One of the objectives of the launch of this range was the development of export and the presence of the pharmaceutical laboratory abroad. The problem inherent in this product range was the high cost of storage. This has led to an increase in delays and wastage of various resources such as working time and slower production rates. This provision increases handling costs and reduces labor productivity. These results in delayed orders that further disrupt the overall schedule. To overcome these limitations, it is necessary to identify bottlenecks at the workshop level (Figure1).

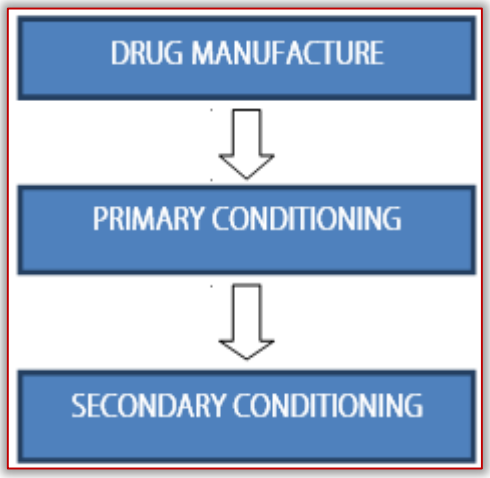

Figure 1- Flow diagram of the pharmaceutical company

The VSM tool is the ideal solution for this case of problem in order to locate the source of waste in the value stream by lean concepts and techniques to improve the performance of the current system. This paper presents the implementation of the Value Stream Mapping (VSM) project in a pharmaceutical company. It is structured as follows:

- determination of the family of products,
- drawing of the current state,
- drawing of the future state,
- action plan and implementation.

PRESENTITION OF THE VSM METHOD

Value Stream Mapping (VSM) is a lean-management method (Figure 2) for analyzing the current state and designing a future state for the series of events that take a product or service from its beginning through to the customer with reduced lean wastes as compared to current map. A value stream focuses on areas of a firm that add value to a product or service, whereas a value chain refers to all of the activities within a company [5].

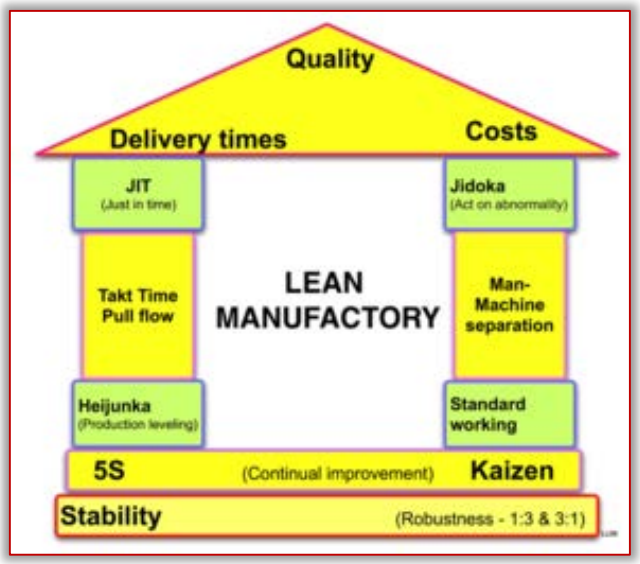

Figure 2- Modèle du système « Lean production » [6]

The purpose of value stream mapping is to identify and remove or reduce "waste" in value streams, thereby increasing the efficiency of a given value stream [6]. Waste removal is intended to increase productivity by creating leaner operations which in turn make waste and quality problems easier to identify.

Value Stream Maps are usually drawn using a set of standard symbols (Figure3) some of which can be seen here [7], [8].

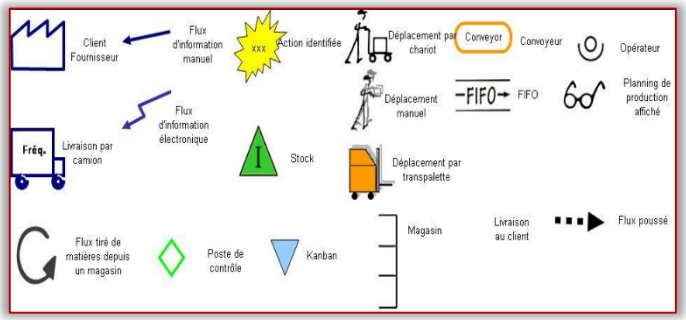

Figure 3- Symbols of the VSM method [6]

VSM has supporting methods that are often used in Lean environments to analyze and design flows at the system level (across multiple processes).

Although value-stream mapping is often associated with manufacturing, it is also used in logistics, supply chain, service related industries, healthcare, software development, product development, and administrative and office processes [9], [10]. VSM is a recognised method used as part of Six Sigma methodologies.

DETERMINATION OF THE PRODUCT FAMILY

For the case of this pharmaceutical company, the study will focus on a family of products that undergo the same treatments [11], [12], [13], [14], [15]. Then, we start this work in a one hand by a system analysis in order to describe the case study [16], [17], [18] and on the hand we develop any applications in this company [19], [20], [21].

— Application of ABC method

The ABC method proposes to distinguish three classes A, B and C which are distributed as follows:- (1) Class A: elements representing 80% of observed effect ; (2) Class B: items representing the following 15%; (3) Class C: the elements representing the remaining 5%.

In the case of researching the family of products to be studied, the observed effect will be sales and the items will be Products of the enterprise. Once the classification is established, the choice will be made among the products of Class A. If there are too many products in the A-Class, then a second selection may become necessary. To do this, it is advisable to draw up a table summarizing which equipment is used for the different products of class A. This amounts to creating a matrix products / equipments composed of "0" and "1".

This type of matrix sometimes reveals obviously the product families. It will be able to be reorganized thanks to a mathematical tool: the Analysis in Principal Components (PCA) in order to group the close products in terms of use of equipment.

— Application of PCA

The method Principal Component Analysis (PCA) is based on the calculation of the correlation coefficients between the series of values of two variables in order to determine whether they are dependent on each other. To do this, it is necessary to calculate the variance of each series (the value that characterizes the dispersion of a distribution) and the covariance between the two series (a value that characterizes the dispersion of one distribution over another).

— Drawing of the current state

In order to develop a reworked map of the value chain of a product or a family of products, one must first know the current situation. This part is devoted to the drawing of the VSM card in its current version.

First Phase of Design: The Customer

The VSM is part of a chain-of-value improvement approach. This implies a clear definition of the value of the product (s), in the eyes of the customer.

Second phase of the drawing: Manufacturing Processes

Then, the two icons used in the VSM are the manufacturing processes, also called Case Processes, and Stocks. Process boxes represent operations where the raw material is processed. In order to limit their number on the drawing, the connected steps or the workstations belonging to a single process are represented by a single icon. On the other hand, if an operation is cut off from the next (geographically or temporally) and intermediate stocks accumulate between the two or are moved in batches, then two process boxes are needed. This differentiation also depends on the purpose of the study, if the objective is to understand in detail an operation, then it will be necessary to use a process box for each of its steps. Placed end to end, the process boxes constitute the material flow, which is placed in the lower half of the design of the VSM, from left to right in the direction of the treatment of the materials and not according to the physical layout of the places.

Third phase of the drawing: Suppliers

After focusing on the customer and then on the manufacturing process, the third step concerns suppliers. The representation of the frequency and mode of delivery is the intermediary between the supplier (s) and the first step of the process, as well as between the last step and the customer(s). A wide arrow indicates a delivery between two factories, and a truck (or an aircraft, a boat...) which mode of delivery is used.

Fourth Drawing Phase: Information Flows

At this stage of construction of the VSM card, only material flows have been drawn. The fourth phase aims to represent information flows. To do this, we need to introduce new icons essential to the understanding of the drawing: a straight line represents a flow of physical information (on paper in general), while the lightning corresponds to an electronic information flow. A frame placed in the middle of an information flow is used to describe this flow (giving an exchange frequency for example). There is another type of connection that it is important to characterize: the movement of materials between the manufacturing processes.

MAPPING THE VALUE CHAIN

The mapping of the current state is now complete. This application, based on the example of a pharmaceutical company, has aroused a number of questions and observations concerning the areas of overproduction. The work carried out until now will have been in vain if the map of the current state is not analyzed and reworked, in order to construct the drawing of the future state.

The third part of the VSM approach is a transition stage: its purpose is to analyze the current state in order to reflect on the

future state. To do this, a new mode of operation of the production of products called production at the right.

This pharmaceutical company works with 2 teams that each work 8 hours a day (with 30 minutes of break). The customer request is 600 rings per day. The Takt Time of the production activity of this example is 90 seconds. This is tantamount to saying that if the company wants to respond to customer demand, hardware must exit its production line every 90 seconds.

This implies that the cycle times of each manufacturing process correspond to the Takt Time, or at least do not exceed it. This adaptation of production requires: 1) an effective response to functional problems leading to systematic delays; 2) the elimination of causes of unexpected stoppages (breakdowns, non-conformities, etc.); 3) redefining the manufacturing steps.

In the drawing of the future state, if a continuous flow is established between two processes, then their execution times will accumulate and the two process boxes will merge to form only one. But be careful, in accordance with Foundation # 1, the overall cycle time must be less than the Takt Time. The entire value chain must not necessarily be in continuous flow. When situations such as those described above arise, there are two alternatives: flow drawn with storage depots or the FIFO corridor. By definition, if a continuous flow is unthinkable, this implies that two discontinuous streams are kept at some point in the value chain. The link between these two processes can be managed through storage depots. In order to avoid recreating a situation of overproduction and product accumulation in stocks, it is preferable to control the process downstream rather than attempting to schedule production with estimates of customer needs.

The last part is devoted to the redesign of the VSM card. This phase of representing the future state of the value chain enters the Improve stage of the DMAIC process. The objective of Lean Manufacturing is to identify and eliminate sources of non-value added. Some waste is linked to the technology used, the plant layout in the plant, or the design of the products. These themes are not explored in the drawing of the future state, but they can be studied further by other tools than the VSM.

Staring from this analysis discussed in this paper, work is in progress to develop a novel strategy for system analysis for similar real cases [22], [23], [24], [25]

CONCLUSIONS

In this paper, we presented a work to eliminate waste in the production line in a pharmaceutical company. This work is based on a VSM study followed by an analysis of causes and a plan of action carried out successfully enabled the company to optimize its production time.

Thanks to the reorganizations carried out, Lead Time increased from 65.3 days to 12.2 days. The difference between the two comes from stocks that have been reduced or eliminated. The ratio of processing time on Lead Time was 1.5%, it was multiplied by more than five and is now 8.2%.

Then this work showed how the VSM tool is the ideal solution for this case of problem in order to locate the source of waste in the value stream by lean concepts and techniques to improve the performance of the current system.

References

[1] Kumar A. and Gureja L., Transformation of an Organisation into a Lean Organisation through Value Streem Mapping A case study, 2016.
[2] Hohmann C., Value Stream Mapping, Cartographie de la valeur, 1998.
[3] Rother M. and Shook J., Learning to See, value stream mapping to add value and eliminate muda, The Lean Enterprise Institute, 1998.
[4] Husson F., Lê S. and Pagès J., Analyse des données avec R, Presses Universitaires de Rennes, 2009.
[5] Drew J., McCallum B. and Roggenhofer S., Objectif Lean : réussir l'entreprise au plus juste, Eyrolles - Éditions d'Organisation, Paris, 2004.
[6] Benson B. and Hoshin K., The fundamental starting point for lean success. Cost Management, 2016.
[7] Mitchell A. and Millstein S., Takt Time Grouping: implementing kanban-flow manufacturing in an unbalanced, high variation cycle-time process with moving constraints, 2014.
[8] Bernier V. and Frein Y., Local scheduling problems submitted to global FIFO processing constraints, 2007.
[9] Zhen He, Xu-Tao Z. and Min Z., Reducing the voluntary turnover rate of dispatched employees by the DMAIC process, 2014.
[10] Hohmann C., Value Stream Mapping, Cartographie de la valeur, 1998
[11] Rother M. and Shook J., Learning to See, value stream mapping to add value and eliminate muda, The Lean Enterprise Institute, 1998.
[12] Holweg, M., The genealogy of lean production. Journal of Operations Management, 1990.
[13] Krafcik J. F., Triumph of the lean production system. Sloan Management Review. 1988.
[14] Ruffa S. A., Going Lean: How the Best Companies Apply Lean Manufacturing Principles to Shatter Uncertainty, Drive Innovation, and Maximize Profits, 2008.
[15] Lakhoua M.N., Systemic analysis of an industrial system: case study of a grain silo, Arabian Journal for Science and Engineering, Springer Publishing, 2013, Vol.38, pp.1243–1254.
[16] Lakhoua M.N., Investigation on the application of systemic analysis of the cereals stock mobility process, International Journal of Applied Systemic Studies, Inderscience, Vol.4, N°4, 2012, pp. 227-238.
[17] Lakhoua M.N., Systemic Analysis of a Wind Power Station in Tunisia, Journal of Electrical and Electronics Engineering, University of Oradea Publisher, vol.4, N°1, 2011.
[18] Beyaa R. and Majri H., Automatisation d'une ligne de production: étude de la situation existante, situation projetée, Master, ENICarthage, 2016.
[19] Meddeb D. and Achour M., Optimisation des temps d'occupation machine, Licence Appliquée, ENICarthage, 2014.
[20] Mokni A. and Matheli M., Amélioration de la capacité de d'une ligne de production, Licence Appliquée, ENICarthage, 2014.
[21] Lakhoua M.N. and Khanchel F., Overview of the methods of modeling and analyzing for the medical framework, Scientific Research and Essays, Academic Journals, ISSN: 1992-2248, Vol.

6(19), pp. 3942-3948, 2011.
[22] Lakhoua M.N, The need for systemic analysis and design methodology of the medical equipments, International Journal of Applied Systemic Studies, Inderscience, Vol.8, N°1, 2018.
[23] Lakhoua M.N., Jabri I, Battikh T, Maalej L and Mlouhi Y, Study on the use of Systemic Analysis and Image Processing Techniques in a Sports Meeting, European Journal of Scientific Research, 2015, Vol.132, N°1, 2015.
[24] Lakhoua M.N., Systemic analysis of a supervisory control and data acquisition system", Journal of Electrical Engineering, Politechnica Publishing House, vol.11, N°1, 2011.

ISSN: 2067-3809