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Bachelor's Thesis

KAIZEN STRATEGIES FOR IMPROVING PLANNING AND PRODUCTION FLOW IN PHARMACEUTICAL ENVIRONMENTS

Double degree in Chemical Engineering and Industrial Electronics and Automation.

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Report and Annex

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5.1 The KAIZEN Philosofy

After World War II, Toyoda Kiichiro, then president of the Toyota Motor Company, saw the need to catch up with America to assure the survival of the automobile industry of Japan. Taiichi Ohno, Toyota's engineer, had a challenge: how to build a diversified line of products with the limited equipment Toyota possessed at the time. Instead of using batch production, he designed a system of integrated production that used one-piece flow, demonstrating that a trade-off between quality and productivity does not need to exist (Netland and Powell, 2016). Aligned with other practices, Toyota Production System (TPS) was born to defy the premise that bigger batches mean lower costs.

TPS, which ultimate goal is the absolute elimination of waste, is based in two pillars: just-in-time (JIT) and autonomation (automation with a human touch). The lack of the necessary capital resources to support high inventory levels was solved with the implementation of a just-in-time pull system. JIT means "to produce the necessary units at the necessary quantities at the necessary time". A company establishing this flow throughout can approach zero inventory. With autonomation, Toyota intended to create a built-in automatic checking system against small abnormalities. With this prevention mechanism, defective products were not produced. That was not the only advantage. While the machine is working properly, employees are liberated. Consequently, one worker could attend multiple machines, increasing production efficiency. Furthermore, autonoma- tion came as a facilitator of improvement. Stopping the machine creates awareness and, through the total comprehension of the problem, improvement measures can be taken. (Ohno, 1988) Lean, based on TPS, is a methodology that accentuates customer needs, to improve quality and reduce costs through continuous improvement and employee involvement (Graban, 2008). Kaizen, a Japanese word, refers to the concept of continuous improvement. It does not intend to be mistaken as innovation or disruption and elevated costs. On the other hand, Kaizen is about small and subtle improvements. It is a low-cost low-risk process that assures incremental progress and sustainable changes in the long term.

At the beginning of the 21st century, Toyota Motor Company surpassed General Motors and became the world leader in automobile production, expanding and elevating the Kaizen concept for its key role in the company's success. Kaizen's methodology is based on five fundamental principles described in Massaki and Sanchez's book [1] :

- Create customer value

  Value is what the customer is willing to pay for. Using a market-in approach to make informed decisions based on what the customers want and offer them that in the best way possible, improving customer experience.

- Create flow efficiency

  Flow efficiency can be obtained through the elimination of three Ms: Muda (waste), Mura (unevenness) and Muri(overburden). The concept of Muda primarily originated from Taiichi Ohno's production philosophy in the early 1950s. He defined, in the industrial context he was inserted, seven sources of Muda: overproduction, waiting, inventory, motion, transportation, over-processing and defects. All the activities that do not add value to the process are considered Muda. Fujio Cho, former President of Toyota, defined waste as "anything other than the minimum amount of equipment, materials, parts, space and worker's time, which are absolutely

essential to add value to the product". Eliminating waste is the most effective way to increase productivity and decrease costs. Although Muda has gained bigger awareness, comprehending all three concepts allows for a greater understanding of Lean (Netland and Powell, 2016). Mura is the variation in a process that is not caused by the final customer, for example highs and lows in the planned production due to the production system or the irregular work rhythm. Leveling production using JIT can eliminate this irregularities, avoiding work spikes and long waiting times for workers. Muri means to overburden equipment or workers, demanding a faster rhythm for a longer period than expected. While in equipment it can provoke defects and failures, in people it can result in safety issues.

- Be Gemba oriented

  Gemba is the place where value is added. Problems should be identified and solved there, at their root cause. Central to Kaizen is *genchi genbutsu* (go and see for yourself). Going to the Gemba means going to the place where the action really happens, to be able to thoroughly observe the reality of the processes.

- Empower people

  Respect for people is a fundamental principle of the Kaizen philosophy. Kaizen recognizes that people are not the problem, processes are. It intends to improve every day, everywhere, with everyone, training all employees and encouraging people to think and share their own improvement ideas, systematically. It is in management's biggest interest to create the best possible conditions for everyone to do the best possible work.

- Be scientific and transparent

  As important as identifying problems, is knowing how to explain and substantiate one's findings, supporting them with data. Visual Management is a basal tool of Kaizen, that highlights problems and allows for a quicker reaction to them.

6 The Problem at hand

6.1 Introducing the company

Now that we have introduce the base methodology of Kaizen we must understand the focus of this work. The project describe has been implemented in a Pharmacology Company located on the Catalonia area. It focuses primarily on providing Contract Manufacturing and Packaging Services for Medicines and Dietary Supplements, both for Human and Veterinary use.

The facilities are equipped with state-of-the-art machinery and have a total area of 7.200 m^2, distributed across two facilities, one dedicated to the manufacturing of pharmaceuticals and the other to nutraceuticals.

In total the company has over 400 employees and about 80% of the workforce is established on the shop floor.

There are several manufacturing areas and work lines:

- TMP (Raw materials handaling):

  This section is where the mixture of active components, either liquids or solids, and ingredients are composed.

- PI (Compression):

  In this section compression of solids into tablets occurs.

- PAC (Conditioning):

  In this section the formula is conditioned. There are 3 forms of presentation:

  Bottles: Only for liquids.

  Jars: Containers of tablets for solids.

7 References

[1] Imai Massaki and Cristina Sanchez. *Gemba Kaizen. Un enfoque hacia la mejora continua de la estrategia, 2ªEd.* Sept. 15, 2015. 580 pp.