TOYOTA PRODUCTION SYSTEM

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SUMMARY
Although the Toyota System has many problems, it has still managed to establish itself, using a strategy of shortening production time and, most importantly, being precise in terms of quantity and formulating a policy of prioritizing waste reduction. In the Toyota Production System, its development is supported by two pillars, which are indispensable in communication. Both systems are known and are called Just in Time and Automation or also known as*Jidoka*. The Toyota Production System developed a method for detecting seven types of waste that large industries face in the production system, namely, Waiting, Defects, Transportation, Movement, Excess Inventory, Excess Production, Over/Bad Processing.
Keywords: System, Toyota, Waste, Autonomation, Just in Time.

1 INTRODUCTION

The Toyota Production System adopts a seemingly simple strategy, but in fact it is not, and has been recognized worldwide as one of the most successful production systems in history. The system can be distinguished by the concept of waste reduction, often ignored by large industries. As certain wastes are reduced, profits and other factors can increase significantly, and these factors accumulate in the production process to produce significant results.

However, the system has two pillars, which are the basis of this project, which is the technology to achieve such a remarkable effect, they are Just in Time and Jidoka or Autonomation. Just-in-time is a waste search mechanism, because seven deadly wastes in any underproduction are found. These seven types of waste are listed by the Japanese who developed this concept (known as Ohno (1997) in academia). They are: waiting, defect, transportation, disposal, excess inventory, overproduction and overproduction / processing. It is believed that as these wastes are reduced, the production system will be more accurate in its development. The Jidoka system, also known as the automation system, is related to the implementation of the machine, and possible defects in the machine can be detected, preventing the shipment of defective parts. As the production process develops, it becomes more dynamic, with almost no interruptions and loss of work. This work is done to understand the production process. Because of this parameter, the Toyota Production System is one of the most famous and studied processes for research purposes, so that people can understand the structure

of this system by changing habits and disciplines, as they are successful production technologies. Employees changing the way of developing technology production methods.

This article aims to analyze the Toyota System. To do so, it is necessary to review scientific articles that contribute to its production, propose the pillars that support the production process and gather the seven types of waste that should be avoided in production. In this way, Toyota's production process works so that the companies that use it work sustainably, and unusable products are stored in suitable places.

2 TOYOTA PRODUCTION SYSTEM

The Toyota Production System is a form of production differentiation that focuses on reducing waste. However, to reach this stage, several strategies are necessary to benefit the companies that use the system. Therefore, it is not enough to eliminate waste. To achieve this goal, many changes must be made. The system developed by Toyota aims to provide customers around the world with the best quality expected from vehicles, and with this as a goal, the mass production of vehicles with the lowest cost and the shortest delivery time. In this way, the result is the mass production of products in the shortest possible time and by combating waste. The TPS can only be achieved using two strategies that are the backbone of the production system: These two methods are called Just-in-Time and Jidoka. In this way, the system is represented as a house, these strategies are the backbone of the house and represent the essence of these production technologies. Through the link between standardization and improvement work, followed by PDCA, the TPS is maintained and continuously improved. SITE (www.lean.org.br).

The system was created by the Japanese Taiichi Ohno, who led the Toyota Production System after World War II, starting with machining. He led the TPS between the 1950s and 1960s. Over the years, the TPS began to spread throughout the world, becoming a method created by large companies in different areas. Source (www.lean.org.br).

> Outside Japan, this spread began with the establishment of a Toyota-General Motors (NUMMI) joint venture in California in 1984. The concepts of JIT and Jidoka originated in the pre-war period. Sakichi Toyoda, founder of Toyota Motor Group, invented the concept of Jidoka in the early 20th century, which is to equip an automatic stop device on the loom, and if the thread breaks, the machine will stop working. This greatly improves quality and frees up employees to work not only supervising the equipment but also

> adding more value. Ultimately, this simple concept found its way into every Toyota machine, production line and operation.

In 1973, the world began a crisis called the oil crisis. This crisis left tens of thousands of people around the world unemployed, as did Japan. The country plunged into an economic recession, froze the country's growth, and also generated a crisis for several companies and societies around the world. However, Toyota managed to establish its position even with reduced profits. The company stands out from other large companies in the market, and its operations have lasted for many years longer than countless companies. Toyota survived with its production methods and differentiated technologies aimed at reducing waste. VIERA and COELHO (2017).

Although the Toyota Production System has faced many problems, it has been able to position itself, using strategies to reduce production time and, above all, to be precise in terms of quantity, and to formulate a policy of priority waste reduction. But that's not all. The production system is quite effective, because in addition to the factors already mentioned, it is also implemented with mass production, that is, a production system is developed that does not have much leftover except for precise demand, accelerated production, no waste of materials. Therefore, using TPS is a somewhat complex strategy in its implementation. Source - VIERA and COELHO (2017).

> Therefore, to implement a system as broad as the Toyota System, it is necessary to understand all its ramifications in the organizational environment, in order to reveal its technology and continuously improve it, in order to promote it throughout the company, so that everyone involved. Everyone is motivated. Seeking efficiency and eliminating waste, VIERA and COELHO (p. 3, 2017).

Including the system in any business unit is not an easy task, as it is impossible to use the system in a separate department. The company must fully comply with the change in strategy, as it is a global operation process, rather than separating its isolated departments, as it is known that waste can exist in any part of the company. To the executive room on the factory floor. However, large companies around the world insist on the Toyota Production System to better establish production technology, benefit from it, improve production efficiency, expand market space and thus win more and more customers, generate profits and strengthen economic concepts. Every company develops an activity that benefits a certain part of society, some of these activities benefit the majority of people because the market for certain companies is very unequal. Of course, this inequality can be overcome to a certain extent and it is commendable. But the detail is that companies that are harmed by the commercial system should

build systems that are different from other systems to provide customers with quality assurance and precision in production forms.

> Currently, a large part of companies' production technologies are inspired by the Toyota Production System, due to the intensification of competition between companies, as well as the innovation, creation and implementation of more effective production technologies to gain market share, attract customers and increase the extreme demand for products. Retain existing customers of VIERA and COELHO (2017 page 5)

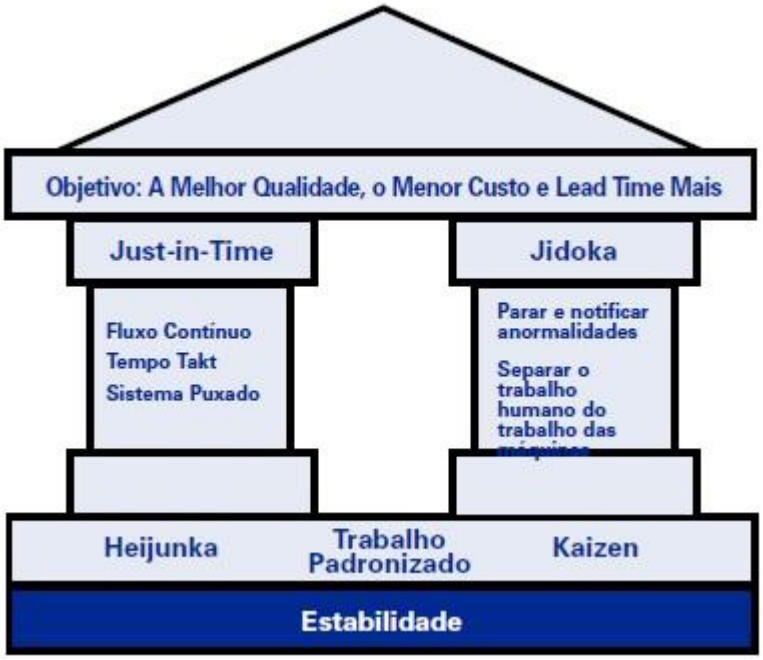
If a company can develop an efficient and complete production system, customers will naturally appreciate the company's commitment. It is worth noting that the Toyota Production System's thinking focuses on environmental sustainability, because when it focuses on combating waste, it is not about profit, but about reducing the emission of waste into the environment. This is a very important, environmentally responsible strategy.

THE TWO PILLARS SUPPORTING THE TOYOTA PRODUCTION SYSTEM

The development of the Toyota Continuous Production System is based on two pillars, which are indispensable for its dissemination. People cannot imagine TPS without emphasizing these pillars, because that is how it was built. Both systems are called "just in time" and "automatic", also known as Jidoka. Basically, the system called "just-in-time production" focuses on eliminating losses in the production process, depending on the main factors, which include continuous production, cycle time and downtime.

The Jidoka system is more technical and can provide operators with updated machines and autonomy to stop any abnormal process. To this end, a poka-yoke system is used, which can detect possible defects in manufacturing activities, GHINATO (2000 apud RICCI, 2013, p. 17). These two pillars are represented in the house, and these pillars have contributed greatly to the success of the Toyota Production System. There are many solutions that represent the structure of Toyota's production system. Ghinato (2000) shows the structure of the Toyota Production System through Figure 1. It has two support points, namely opportunity and autonomy (Jidoka), in addition to other important components of the system.

Figure 1 - Structure of the Toyota Production System



Source - Ghinato (2000)

JUST IN TIME

According to Ohno (1997, apud Vieira and Coelho, 2017), "just-in-time production" has become a pillar of support for Japanese development through the Toyota Production System. This aspect attempts to reduce losses by focusing on precise production volume so that nothing or almost nothing is wasted. To ensure product quality, the Japanese change the "just-in-time" models for production to ensure product quality, a production strategy that has always yielded fruitful results.

> Failure at the end of the process. This will stop the production line or change the plan, regardless of the forecast, errors in filling out the form, defective products, equipment rework problems, absenteeism - there are countless problems. Problems at the beginning of the process will always lead you to choose a defective product at will. (OHNO, 1997, p.26, apud Vieira and Coelho, 2017).

Therefore, it is important to develop the system vision in all parts of the process to avoid abnormal situations, since stops and interruptions do not occur, as this can be a costly factor for the company. Therefore, errors in the production process must be avoided, as such interruptions can cause internal and external interference, which can lead to serious problems, such as the decline and discomfort of the company's image, and thus benefit the competitor's company. Therefore, just-in-time (JIT) is a policy that mainly aims to significantly reduce waste. It is associated with the production process. The production process is where waste begins. If the process is not designed correctly, it will become a waste problem. It comes from any market segment. The objective of

The development of this system is to produce the right quantity, at the right time, for the company and the recipient, without inertia. Therefore, this is a technology that allows the lowest cost and the cost of its production is also minimized, which reduces the value of producing high-quality parts.

> JIT depends on the balance between supplier flexibility and user flexibility. This is achieved through the application of elements that require full employee participation and teamwork. The main idea of JIT is to simplify. (SLACK; CHAMBER; JOHNSTON, 2009, p. 452).

Several industrial sectors manufacture different types of products and components, such as the automotive industry. Due to the large number of components, it is practically impossible to implement "just-in-time production" in all departments, as it depends on a series of factors that can lead to technological development and depends on a series of technical factors. The JIT concept has spread throughout the world and has managed to expand its technical scope. The concept aims not only to eliminate waste, but also to install all the right equipment in the right place and at the right time. In this way, the production process is developed in a broad and compatible way, combined with the company's space and low cost, in order to achieve productive efficiency and good performance in a long-standing industrial environment. These systems ensure high-quality products supplied to customers. Compared to traditional systems, JIT can reduce inventory, reduce costs and improve quality. (MARTINS and LAUGENI, 2005, p. 404).

JIDOKA

According to Ohno (1997 apud VIERA and COELHO, 2017, p.4), the JIDOKA system is an "intelligent automation" process dedicated to focusing its energy on machine intelligence. In this way, machines developed by this technology can operate independently once connected. However, as the machine may encounter technical problems, which delay the production system, the machine may stop working. These problems are related to small anomalies, they may be simple, but in any case, they will slow down the production of certain industries. These defects may be related to: loose or disconnected wires, dirt inside the machine, lack of lubrication, worn parts, etc.

Due to these abnormalities, the machine may produce parts that do not meet the company's quality standards. As a result, it may damage the downstream part of the process. Since the machine is automated, it is almost impossible to detect defects in these parts.

When a series of defective parts are produced, emissions cannot be avoided, because even with advanced technology, there is no system that can develop an automatic assembly to accommodate certain defective parts. Vieira and Coelho (2017, p. 7).

As a strategy, the Toyota Production System places special emphasis on autonomous systems, that is, machines that can independently avoid potential problems. This system is different from simple automation, which involves related systems and consists of machines that cannot correct errors. By using such machines, the TPS can save time without wasting many parts. This idea is an automatically activated loom (OHNO, 1997, p. 28) invented by Toyota Sakichi, the founder of Toyota Motor Corporation (Toyoda Sakichi, 1967-1930). According to Ohno (1997), this method was developed through automatic analysis of looms. When any type of abnormality is found in the machine, the system will stop production.

But the system could only be developed because these devices have technology capable of distinguishing abnormal conditions from normal conditions. In this way, no defective products are produced. Soon after Toyota developed these production technologies, several companies from different departments began investing in this automatic system to eliminate possible waste through equipment that detects possible defects in parts, so that they cannot be used in poor technical conditions. Officially recognized. The application can significantly reduce pedestrian losses.

However, to get to the point of precise analysis of the system, certain problems in the machine can cause certain situations to leave certain things in production, because when we think about it, there are defective parts. Waste is an incalculable loss. Therefore, the Jidoka system is not only a necessary measure to reduce losses, but also an attitude of sustainable development, because the factory leaves much less waste, which will be dumped on the vacant lot and run off into the river in the vegetation.

LEAN MANUFACTURING CONCEPT

The contextualized system related to lean manufacturing (more commonly referred to as lean manufacturing) addresses the division of labor, increasing production levels and developing departmental work, i.e., each department performs certain actions. In this way, the production system was upgraded to a higher level, and large companies adopted the system. The Toyota System was what created the concept of lean production. This industrial revolution was created in Japan after World War II. As

mentioned earlier, this system was adopted by large companies in industrial history and pursued the following objectives:

● Optimization and integration of manufacturing systems: depending on any process or activity, the accumulated value of products that do not generate waste from these processes or activities must be eliminated. Optimization and integration of manufacturing systems are continuous processes that aim to reduce the number of tasks required to complement specific processes.

● Quality: In lean production, the product must have a good finish, that is, it must have quality assurance. Every employee involved in the production process must have professional information in terms of responsibilities, knowledge, etc., in order to carry out the task of providing security with the desired result.

● Process flexibility: is the ability to obtain materials quickly and define processes in a short space of time and at minimum cost, that is, it is the ability to support changes in demand.

● Production on demand: production according to customer orders.

● Keeping commitments with customers and suppliers: Keeping commitments is the The end result is to unify all manufacturing companies into a continuous industrial process. The company must maintain contact with all customers and suppliers that manufacture new products, determine delivery times, and ensure product quality and profitability. Reduce production costs:

● For lean manufacturing, it’s about eliminating waste and reducing production costs. process, RESENDE, SILVA, MIRANDA and BARROS (2015, p.3).

According to the objectives outlined, it should be noted that the system values customer satisfaction. Therefore, we seek to deliver all scheduled products with the highest quality and within the expected timeframe. The system presented is a global reference and can be used to evaluate the customer's money. We are also responsible for the environment and prioritize waste reduction. In this way, a successful technology has been developed by using machines that do not cause continuous defects and disrupt the production process. Therefore, the Jidoka system allows the use of equipment on the machine and sends notifications immediately when new problems are discovered, controlling and avoiding the distribution of defective parts. The Toyota Production System has developed a detection technique to analyze seven types of waste that major industries produce in production systems. Certainly, by eliminating this waste, the production technology of

each company will be better utilized. The following figure mentions the seven wastes represented by OHNO (1997).

Figure 1: Seven wastes present in Lean Manufacturing

This image represents an illustration created by OHNO (1997). The Toyota Production System developed a method to detect seven types of waste that major industries face in production systems.

WAIT

Waiting time can be the time when employees wait for processing equipment to complete its work or perform previous activities, the production line stops waiting for parts, and the machine stops waiting for raw material changeover or maintenance. Kanban tool is one of the tools used to minimize waiting waste.

DEFECT

It occurs due to failures in process operations, process and raw material. So if you have two options, it is scrap or rework which will increase your production costs. The technique that can be used is the quality control method.

TRANSPORT

They cause the material to move more than necessary. The work crew and support staff should be close together. This way, unnecessary trips are avoided, time is wasted and transportation costs increase.

MOVEMENT

It is the excessive movement required to perform the operation, usually due to poorly designed layouts and obstacles that cause the operator to deviate from the target. Research on timing and method of use helps eliminate unnecessary actions and improve operational procedures.

EXCESS INVENTORY

This waste is related to excess raw materials, which directly affects the company's capital, resulting in a high level of inventory, i.e., “still cash”. This usually occurs because the supplier cannot deliver on time or the company's inventory system does not match the actual stock stored in the company.

OVERPRODUCTION

It is the largest waste product of a company and is also seen as the source of all other waste. As the name suggests, the products you manufacture exceed the demand at the time, which leads to unnecessary use of raw materials, labor, and transportation, resulting in excess inventory. This is usually due to a lack of coordination between demand and production, and the process description is not clear.

BAD PROCESSING

This is a treatment carried out within the factory, but is not necessary due to its good performance. Improper use of machinery and equipment in operation. The extra effort does not increase the value of the product or service.

All this waste will cause companies in various fields to stop making profits without paying due attention to this waste and will actually start seeing huge losses. This waste is completely predictable and therefore easy to solve, requiring the use of technology to eliminate the seven wastes. However, in a company, this process is not easy, as it is necessary to have the technical capacity to develop such a process in the company. After all, the investment can be high. However, the possible benefits must be considered.

METHODOLOGY

The research method used in this article is through research of articles and, thanks to the author's contribution, they approach the Toyota Production System in a conceptual way. As a result, despite its great contribution, it has been applied in various industrial fields, so it has a very dynamic and content-rich point of view, and although it is theoretical, it can also be linked to the information collected, therefore, it has a broad ranking impact. Learn about the subject.

CONCLUSION

Taking into account all the factors presented in this article, it can be concluded that companies in all sectors must keep in mind that it is important to eliminate waste from an economic and environmental point of view. Therefore, it makes sense that the production system is effective due to the high cost of implementation, but the fact is that the rewards are great and rewarding. The more companies that implement this system, the more the environment will become more valuable, since the disposal of defective products will destroy the entire environment and minimize the cost of the process. Therefore, since this production system has been successful for many years, this work has contributed greatly to the lives of people interested in the subject. Therefore, such a developed philosophy and ideas that go beyond other thinking only contribute to any learning method because it increases the importance of planning. Every business manager must plan ahead to ensure that problems may arise. The role of the Toyota Production System is fulfilling for any professional, because by correcting errors, you can reduce costs and satisfy customers, it is the center of the work of every company. The company's production system has contributed to society, in addition to technical contributions, there are also moral contributions, because when the company focuses on delivering products with greater precision, it is acting against the recipient. An example is when a consumer buys a car and needs to deliver it within the time required by law, with the quality announced at the time of signing the contract.

REFERENCES

GHINATO, P. **System Toyota of production** Available in http://prod.org.br/files/v5n2/v5n2a04.pdf Accessed on May 26, 2019.

REZENDE, Daiane Maciel, SILVA, Jessica Freitas, MIRANDA, Sheila Marcela, BARROS, Anderson**lean manufacturing:**waste reduction and process standardization Available at https://www.aedb.br/wp-content/uploads/2015/05/104157.pdf Accessed on May 29, 2019

RICCI, MR**toyota production system:**a study on the production line in a suit industryAvailable in http://repositorio.roca.utfpr.edu.br/jspui/bitstream/1/1697/1/MD_COENP_%202013_1_17.PD F Accessed on May 31, 2019.

SHIMOKAWA, K., FUJIMOTO, T.**birth of lean**available at https://www.lean.org.br/ comunidade/downloads/capitulo_2.pdf Accessed on May 23, 2019.

COELHO, PF**The Toyota production system and its supporting pillars within the organizational scope:**a theoretical approach. Available at https://even3.azureedge.net/anais/43613.pdf Accessed on May 20, 2019.