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Toyota Production System – Maximizing Production Efficiency by Waste Elimination

Sarvesh A. Kulkarni[1], Rishi R. Nagare[2], Deep N. Nagare[3], Pushkar N. Aware[4]

Student, Mechanical Engineering, Guru Gobind Singh College of Engineering and Research Centre, Nashik, India[1,2,3,4]

Abstract: The Toyota motor corporation started in 1933 by Kiichiro Toyoda, the Toyota production system (TPS) was implemented after the CEO visited US companies like Ford, GM to gather the idea about how they improve the production system. for this purpose, they built a TPS house which is structured in 3 parts and shows elements of the system. It is focused on JIT, reduction of waste, cost reduction, Autonomation (Jidoka) and also the implementation of KANBAN and KAIZEN. This TPS foundation is built to always focus on resources which are reliable with minimum disorders and work as a repeatable manual process. My paper emphasizes the idea that Toyota production system is a set of general principles of organizing and managing an enterprise which can help any organization get on a path of positive learning and improvement.

Keywords: TPS, Toyota, Kanban, Kaizen, Standardization, JIT, Autonomation (Jidoka).

I. INTRODUCTION

Toyota Production system is an anomalous manufacturing approach developed by Eiji Toyoda and Taiichi Ohno between 1948 and 1975. The oil crises in autumn 1973 as well as the following global recession had a huge impact on the global economy and its companies. Even the economy of Japan broke down in 1974 and decreased to a zero growth[1],[3]. However, The Toyota production system was flourished out of demand after the World War II, the market was small for Toyota and they made different varieties of vehicles on the same assembly line. Thus, flexibility was a vital thing to their operations. This helped Toyota to discover a production system which focuses on eliminating waste of time and raw material from every step of production process to get higher quality, greater productivity, improved customer responsiveness and better utilization of equipment and space. Here in this paper, we will understand about the Elements involved in TPS house and how those factors can help in the waste elimination.

II. LITERATURE REVIEW

Dr Michael L. culig, and his team developed a new heart surgery program in a community hospital in Pennsylvania using methodology based on the Toyota production system (TPS) from March 1, 2008, and June 30, 2010 he studied about the effects of TPS, Where he observed that with the systematic use of a real time, highly formatted problem-solving methodology, processes of care improved daily. Using carefully disciplined teamwork, reliable implementation of evidence-based protocols was realized by empowering the front line to make improvements. Low rates of complications were observed, and a cost savings of $3,497 per each case of isolated coronary artery bypass graft was realized [2].Since then, a lot has been done in this field. Jeffrey K Liker & Eduardo Lander has argued in their paper that there is a fundamental misunderstanding of TPS, viewing it as a specific tool kit technically implemented in a formulaic way to achieve pre-specified results. Where they have explained TPS is a philosophy that can be better described as a set of general principles of organizing and managing an enterprise which can help any organization get on a path of positive learning and improvement. A case example of a low volume, highly customized artistic clay Tile Company illustrates the process by which the firm used TPS to learn how to understand its process, gain stability and control, empower its workforce, and become far more profitable[1].

III.OBJECTIVES OF TPS

- The main objectives of the TPS are to design out overburden (muri), inconsistency (mura) and to eliminate waste (muda).
- Process of production is as flexible as possible.
- Elimination of imperfection or problem so as to reduce inventory.

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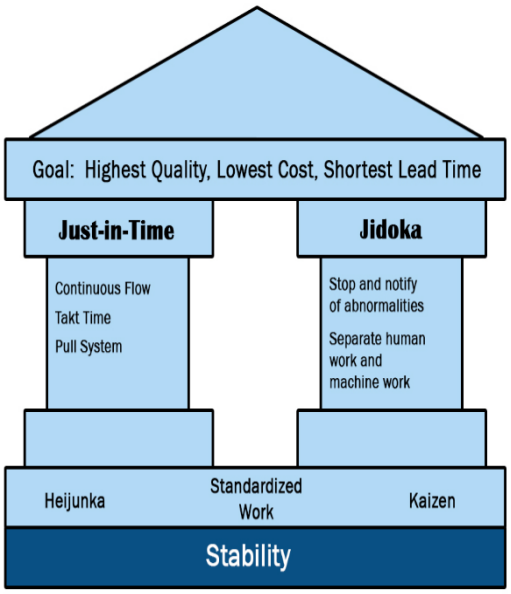

Fig 1. TPS House

IV. FOUNDATION OF TPS

a) Production Leveling (Heijunka)

It facilitates Just-in-time (JIT), is a Lean method for reducing the unevenness in a production process and minimizing the chance of overburden. What the heijunka leveling sequence provides is a pattern, or in other words, a target condition. It is something to strive for; something that helps us see what we need to work on, and to focus our improvement efforts where they are needed. Here is how it works:

1. Load the leveling device, the sorter, with kanban according tothe intended sequence and maximum lot size specification.
2. Ask, “Can we run this way today?”
3. If yes, do so. If no, ask, “What is preventing us?” Pursue oneproblem, and meanwhile temporarily go off the intended sequence. Strive to get back on the intended sequence as quickly as possible.

At the beginning, the answer to the question, “Can we run this way?” will be no more than yes. But if you do this over and over and tackle the obstacles one by one, the yeses will increase. What you are doing is improving the associated processes step by step in a systematic way—by leading people in a direction.
Now we can see that while the scheduling software at the German factory does ensure a feasible schedule every day, in doing so it works around problems and leaves the factory standing still rather than improving its processes.

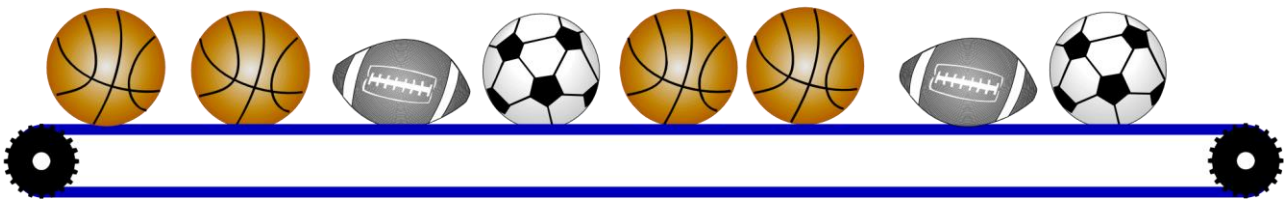

Fig 2. The production quantity ratio for basketballs, footballs and soccer balls is 2:1:1 respectively.

b) Standardized Work

The Toyota Production System organizes all jobs around human motion and creates an efficient production sequence without muda. Work organized in such a way is called standardized work.

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c) Kaizen

Kaizen means improvement, continuous improvement involving everyone in the organization from top management, to managers then to supervisors, and to workers. In Japan, the concept of Kaizen is so deeply engrained in the minds of both managers and workers that they often do not even realize they are thinking Kaizen as a customer-driven strategy for improvement. This philosophy assumes according Imai that ‘’our way of life – be it our working life, our social life or our home life – deserves to be constantly improved’’.

There is a lot of controversy in the literature as well as the industry as to what Kaizen signifies. Kaizen is a Japanese philosophy for process improvement that can be traced to the meaning of the Japanese words ‘Kai’ and ‘Zen’, which translate roughly into ‘to break apart and investigate’ and ‘to improve upon the existing situation’(4). The Kaizen Institute defines Kaizen as the Japanese term for continuous improvement. It is using common sense and is both a rigorous, scientific method using statistical quality control and an adaptive framework of organizational values and beliefs that keeps workers and management focused on zero defects. It is a philosophy of never being satisfied with what was accomplished last week or last year**.** Improvement begins with the admission that every organization has problems, which provide opportunities for change. It evolves around continuous improvement involving everyone in the organization and largely depends on cross-functional teams that can be empowered to challenge the status quo.

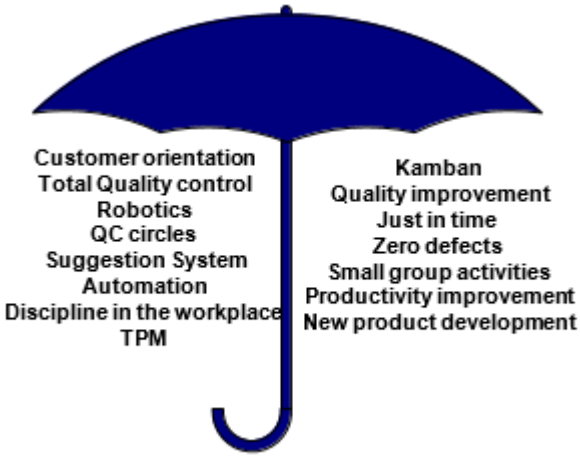

Fig 3. Kaizen Umbrella Concept

V. PILLARS OF TPS

a) Just-in-Time

JIT is a manufacturing management process which involves Making only "what is needed, when it is needed, and in the amount needed“.

Another essential component of JIT concept is Kanban, The word Kan=card, ban=signals Coloured cards may be used in kanban to indicate specific demands. The operations planning and control system is an information system running throughout the manufacturing environment. Although there is a common system framework as discussed in Chapter one, systems run in different ways in different environments. For example, dedicated special facilities are used in make-to-stock environments; general purpose machines are used in make-to-order environments. Dedicated production lines can be designed in a balanced way with minimal setups in order to maximize the flow rate of the materials, while a general-purpose machine must be set up before producing a specific item.

In setup operations, the material flow is interrupted. Manufacturing environments can be changed to make planning and control systems simpler and more effective. For example, products are designed to have high similarity in processing and are mixed in a dedicated production line with negligible setups. Since lead-times are shortened, this turns a make-to-stock product into a make-to-order product. Just-in-time is not only a control technique, but also a way

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to improve the manufacturing environment. JIT control systems are only effective in JIT environments. Introducing kanban systems into a non-JIT environment means nothing to a company.

Any activity that does not add value to the product or service in the eyes of the customer is a waste. Poor product design such as the inclusion of fancy functions not required by the customer is a waste. A product design causing difficulty in manufacturing is a waste. Standardization reduces the planning and control efforts, the number of parts, and the inventory required. A poor product design without enough standardization leads to waste. In addition to waste resulting from poor design, Toyota identifies seven examples of waste resulting from poor manufacturing methods.

- Waste of overproduction

  Overproduction is the production of goods more than what are immediately needed. Overproduction causes extra material handling, quality problems, and unnecessary inventories. Consuming materials for unnecessary products may cause a shortage of material for other products that are needed. Never overproduce products to keep men and machines busy. If the required loading is less than the capacity, leave it alone.

- Waste of waiting

  A material waiting in queue is a waste. An operator waiting for material or instruction and having no productive work to do is a waste.

- Waste of movement

  Poor plant layout results in materials having to be moved extra distances and cause unnecessary material handling costs. Work centers should be close to each other in order to reduce the move distance. Someone may say that close work centers provide no room for WIP inventories. That is fine! No room for WIP inventory forces the WIP to decrease.

b) Jidoka

The Toyota Production System is frequently modeled as a house with two pillars. One pillar represents just-in-time (JIT), and the other pillar the concept of jidoka. The house will not stand without both pillars. Yet many of us focus on the mechanisms of implementation--one piece flow, pull production, takt time, standard work, kanban--without linking those mechanisms back to the pillars that hold up the entire system. JIT is fairly well understood, but I believe jidoka is key to making the entire system stick. A lot of failed implementations can be traced back to not building this second pillar. What does jidoka mean? A common answer to this question is "autonomation" or "automation with a human touch." This is usually illustrated by example of a machine that will detect a problem and stop production automatically rather than continue to run and produce bad output. The principle's origin goes back to 1902 when Sakichi Toyoda invented a simple but ingenious mechanism that detected a broken thread and shut off an automatic loom. That invention allowed one operator to oversee the operation of up to a dozen looms while maintaining perfect quality. But the system goes much further.

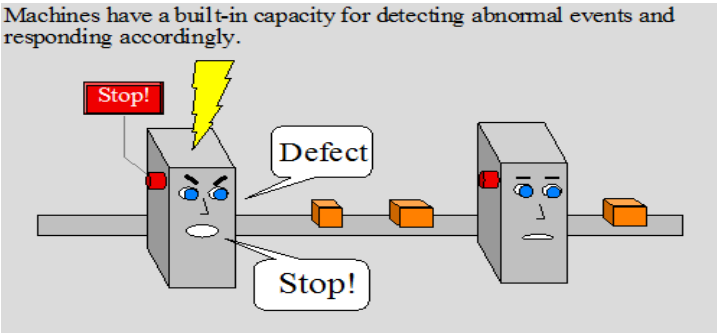

Fig 4. Jidoka

VI. EQUIPMENT RELIABILITY

Up-time. If every process can obtain the necessary parts at the required time--just in time -- and in the proper quantities, there will be no need to maintain stocks of extra materials or parts. However, what are the appropriate

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counter measures if equipment breaks down and the operational rate is lowered, with an accompanying decline in production, or if defects in quality occur frequently?

Changeover. The changeover capability of equipment is important for continued flexibility, production smoothing and capital savings. The ability to changeover and set-up equipment quickly and accurately will go a long way in eliminating the wastes of waiting, overproduction and inventory. By maximizing the time equipment can be utilized making quality parts, we minimize the need for additional equipment. (World class injection moulding change-overs take less than 180 seconds.)

Quality. Moulding machines, robots and other equipment requiring set-up need to have standard settings that can be executed by the operator and documented. Standardize all settings so that the equipment can produce a good part the first time. We must stop "adjusting" things. Improvement efforts can determine that a new setting is in order. This new standard must then be documented and implemented. These standards are critical for consistent quality production from our manufacturing equipment.

VII. CONCLUSION

Implementation of the Toyota Production System into a dynamic lean manufacturing philosophy, supported by systems and tools, requires consistent effort and education. In order to continue to compete in the global automotive component market and provide for the needs of customers, employees and investors, it is essential that all employees become experts in the principles of the Toyota Production System. The success of the system requires everyone's participation. Managing ongoing change and improvement is essential.

If, through the participation of all employees and work teams, we maintain reliable equipment, level all production requirements, provide outstanding internal and external quality through In Station Process Control and operate Just-in-Time, we will provide ourselves a safe and rewarding place to work and outstanding quality and cost for our customers. The result will be an equitable return for our investors and secure employment with equitable wages and bonus for all employees.

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