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A Comprehensive Study of Lean Manufacturing Philosophy in Gear Manufacturing Company

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ABSTRACT

Lean Manufacturing is a systematic approach to identifying and eliminating waste through continuous improvement. Lean is about doing more with less: Less time, inventory, space, people, and money. Lean is about speed and getting it right the first time. From an operations perspective, Lean is helpful in cutting production cuts costs & inventories rapidly to free cash, which is critical in a slow economy. It also supports growth by improving productivity and quality, reducing lead times and freeing huge amounts of resources. Lean manufacturing is a technique, which, by focusing on the overall picture and waste reduction and removal programs creates higher stocks and increases the bottom line profits. It is among one of the few programs that cover its impact on such a vast group. Lean manufacturing has its effect on the employees and the customers alike.

Keywords: Lean, Manufacturing, Lean Tools, Discrete Event Simulation, Value Stream Mapping.

INTRODUCTION

Lean is a mindset, or way of thinking, with a commitment to achieve a totally waste-free operation that's focused on our customer's success. It is achieved by simplifying and continuously improving all processes and relationships in an environment of trust, respect and full employee involvement. It is about people, simplicity, flow, visibility, partnerships and true value as perceived by the customer. . But lean manufacturing questions the role of inventory and defines as a waste it self and also as the reflector of the imperfections a system has. This example, itself shows the conceptual deference between the traditional manufacturing system and lean manufacturing system.

When was the last time you purchased a customized computer just for you and found exactly what you wanted? Because of the large number of options available that a consumer can make, most customers end up compromising. You buy the shape you do not prefer or pay for a premium DVD drive you may not need. This problem is not just for the computer industry. Why do modern day factories manufacture an abundance of products that sit as excess inventory yet they still do not know what exactly the customer wants? In the past, the rule of traditional business in the manufacturing industry was dictated by a high volume of products at low costs. Today, Lean Manufacturing has been a great interest for manufacturers not only in the United States but the whole world. It is because this principle affects companies of all sizes. Numerous companies are applying Lean technologies and seeing dramatic improvements in quality, production, customer service, and profitability. What is "Lean Manufacturing"? Lean Manufacturing technology is not just a management style or a way of producing better products. It is a production philosophy. You can also understand as the way of mapping the overall production process from raw materials to finished products all the way to the customers. It is called "Lean" because this technology, or a process, helps manufacturers to produce more with less time, inventory, capitols and fewer resources.

In most production cycles, only a small amount of time is spent adding a value to a product, something that is meaningful in the eyes of customers. Most manufacturing efforts are spent on activities that do not add value to the product and are not

required by the process or by the customers. This is non-value added activity. Often cases, when manufacturers would like to improve or increase production output, it is common practice to simply plan more of everything. It is very common to hire more employees, buy more equipment, or a build more factory space. This actually would result in more value added activity with higher output but also higher non-value added activity. Lean Manufacturing takes a different approach. In Lean Manufacturing, the production output or non-value added activity is expanded into value added activity. The operation should be the same size as prior time, additional employees should not be higher than before unless it's really needed, new equipment should not be purchased unless it's really needed, and existing employees do not need to work harder or faster than before. The Lean Manufacturing approach is to redirect non-value added activity into value added activity.

LITERATURE REVIEW

Jones, Roos, and Womack (1991) found that "After World War II, Eiji Toyoda and Taiichi Ohno at the Toyota Motor Company in Japan pioneered the concept of Lean production" (p.11). Toyota Motor Company developed their original moving assembly line called "Toyota Production System (TPS)" to keep material flow continuously. Monden (1983) states that: The TPS was developed and promoted by Toyota Motor Corporation and is being adopted by many Japanese companies in the aftermath of the 1973 oil shock. Thought the main purpose of the system is to reduce costs, the system also helps increase the turnover ratio of capital (i.e., total sales/total assets) and improves the total productivity of a company as a whole" (p.1). The Toyoda family originally owned a big textile company in Japan. After World War II, the Toyoda family decided to start new venture from Toyota Automatic Loom Company to a Toyota Motor Company. Wren and Greenwood (1998) stated, "The Toyota Automatic Loom Works was the product of the inventive and entrepreneurial genius of Sakichi, who perfected Japan's first power-driven loom and held numerous patent for automatic looms and textile production" (p.218).

Sakichi sold his automatic loom patents to finance a research of automobile manufacturing system with his son Kiichiro. In the mean time, General Motors (GM) and Ford assembly plants had located in Japan. Therefore, challenging the new automotive venture for the Toyoda Group was considered a risky business. According to Wren and Greenwood (1998), the eldest son of Sakichi, Kichiro Toyoda, was in charge of loom production. He had a great interest of the automotive engine as well. He had studied Western automotive industry to modify their management into Toyota's way of automobile assembly line. Even though conditions to make competitive automobile products against Western automobile products were extremely difficult, both the Toyoda family and Taiichi Ohno were trying to modify number of ideas and skills imported from the Western countries. Kiichiro was trying to modify higher production quantities into smaller production quantities in order to match with Japanese economy size at that time.

In addition to the smaller production quantities, Kiichiro was trying to establish Toyota cars as fuel-efficient vehicle that would match Japanese narrow streets and tight expenditure of Japanese people (Wren & Greenwood, 1998). Jordan and Michel (2001) stated, "Toyota and Japan needed a different manufacturing paradigm" (p.14). The Japanese have defined that anything prevents the flow of material is called "Muda" which means "Waste" in Japanese language. Jordan and Michel (2001) stated, "Toyoda and Ohno realized they had to get the most out of each worker, and that would happen only if the workers knew how to do many different tasks effectively" (p.14). After World War II when Japanese manufacturing industry was suffering from a poor quality production system, Toyoda Motor Company started to develop their own efficient production principal. According to Jordan and Michel (2001), "the Japanese government, with support from the United States occupation forces, provided a protective cover for struggling Japanese industries while the domestic manufactures tried to find the way"(p.14).

ASSEMBLY SEQUENCE OF THE PRESSURE VESSEL

The assembly sequence of the pressure vessel consists of fifteen different operations. The first operation is the plasma arc cutting where the sheet metal is being cut into the desired size. The next operation is the edge beveling operation where the edge surface marks and projections are being removed. It is followed by the rolling operation where the sheet metal is being

rolled and the rolled sheet metal is called as the shell. The next operation is the long seam welding followed by the disc-tac fit up assembly, where the dish and shell are welded together. The next operation is the circular seam welding where the initial spot welding in made into a continuous weld. The next station is the child parts assembly where some subassembled parts are being welded to the vessel. It is followed by the full welding operation in which all the spot welded areas are welded as a stitch weld or full weld. The next station is the hydro leak test where the tank is filled with pressurized water to check if there are any leakages in the tank. It is followed by the shot blasting process and followed by powder coating process. The final station is the packing dispatch and inspection.

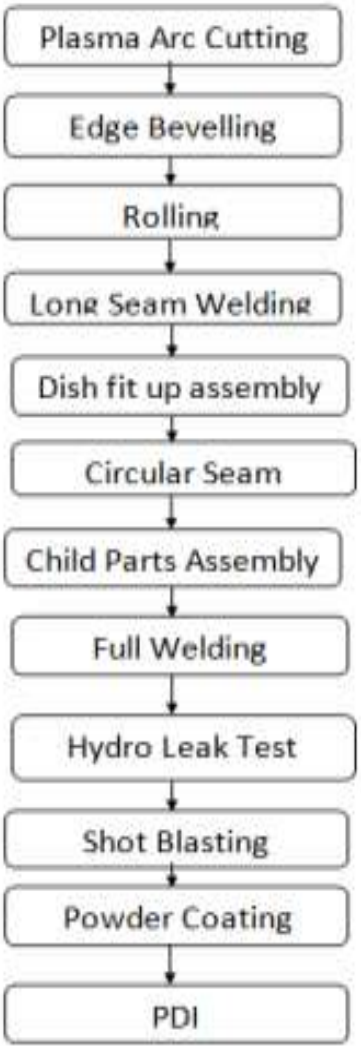

Fig. 1: Flow chart of pressure vessel assembly

OBSERVATION

Increased cycle time at different machines due to which the overall productivity of the tractor was decreased as assembly line coupling was badly affected due to shortage of various sub assemblies prepared in assembly shop.

By doing the observation and scrutinizing the details of sub-assemblies that are manufactured in assembly shop, it was found that the major bottleneck was gear box assembly. Number of gear box manufactured per shift were not according to the target requirement as per the customer demand as shown in Fig. 2

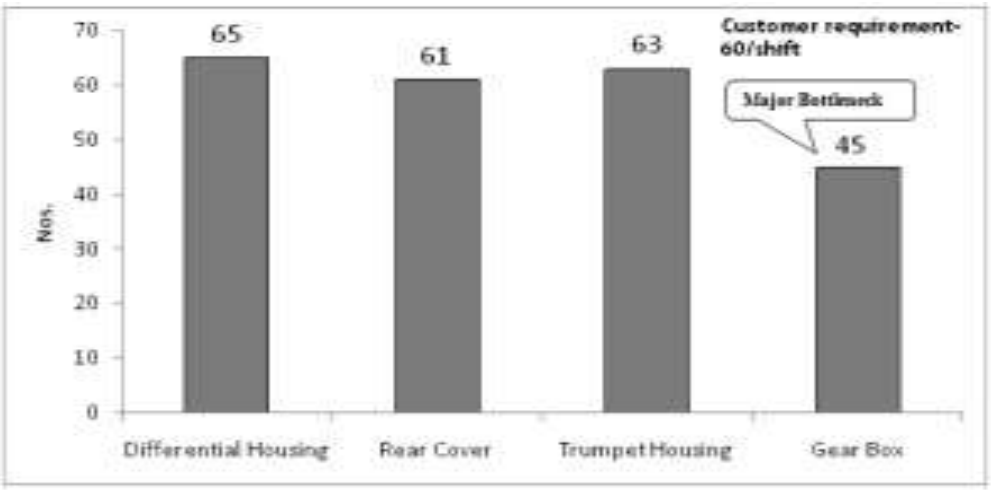

Fig. 2: Line capacity with the customer demand

KANBAN PUSH/PULL SYSTEM

The concept of pull in lean production means to respond to the pull, or demand, of the customer. Lean manufacturers design their operations to respond to the ever-changing requirements of customers. Those able to produce to the pull of customers do not need to manufacture goods that traditional batch-and-queue manufacturers must rely on. The planning for delivery of product to customers is less troublesome, and demand becomes more stable if customers have confidence in knowing that they can get what they want when they want it. Kanban is a Japanese word that means "instruction card". Kanbans are manual pull devices that allow an efficient means to transfer parts from one department to another and automatically reorder products using minimum/maximum inventory levels. A Kanban is a signal, such as an empty container returned to the start of the assembly line that signals the need for replenishment of materials to a user.

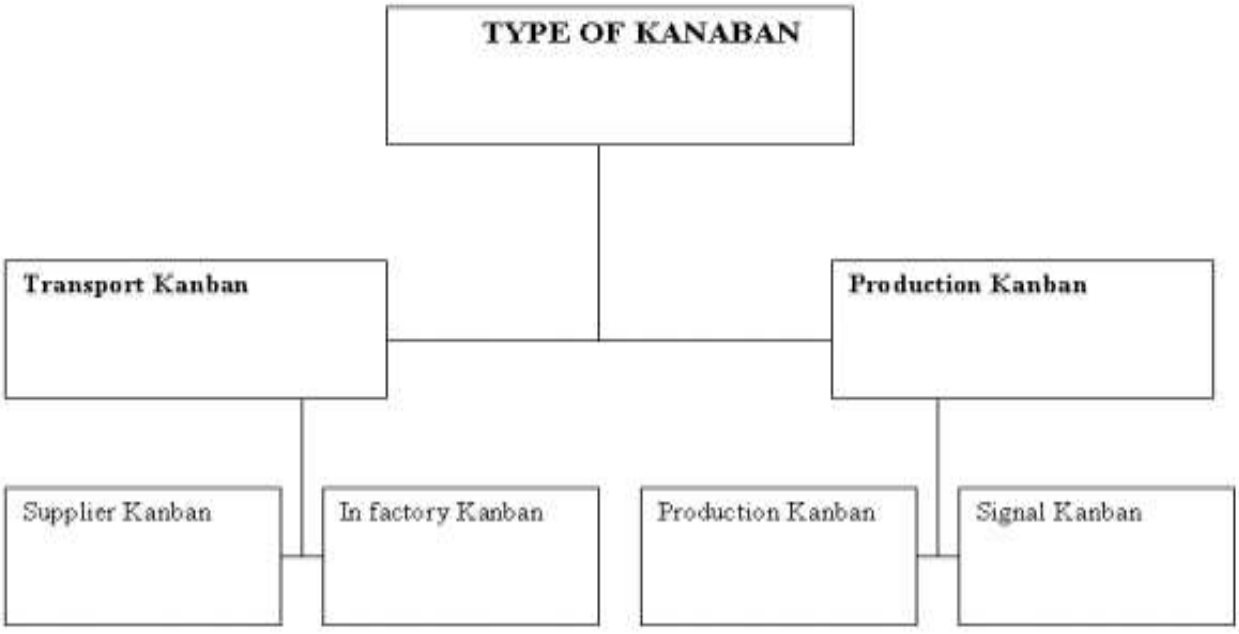

Figure 3: Types of Kanban

RESEARCH METHODOLOGY

Research Methodology applies to ways the researcher comes close to problems and seeks answers. This chapter describes the subject of the study and how he was selected for inclusion in this study and the methods used to gather information. The main objective of this research project was to eliminate non-value-added activities and increase company's profitability while increasing production and reducing costs at the same time. The purpose of this study was to determine how the consultant of Stout Advanced Manufacturing Assistance (SAMA) is implementing Lean Manufacturing process based on the company actually located in Minneapolis. The UW-Stout Technology Transfer Institute (STTI) was established to promote technology transfer between UW-Stout and industry. The institute, part of UW-Stout's College of Technology, Engineering, and Management (CTEM), draws on Stout's impressive technical resources, including the expertise of its faculty, stuff, and students and its well-equipped and diversified laboratories. Stout Advanced Manufacturing Assistance (SAMA) is the one of many centers located within STTI. SAMA offers a broad array of affordable services to make companies successful. They offer educational seminars and on-site, hands-on technical assistance. SAMA can provide advanced manufacturing services such as, Computerized Process Simulation, Mold fill Analysis and Finite Element Analysis to optimize process and product designs. SAMA uses proven technologies and best practices to help solve complex business problems as well as new and innovative solutions (UW-Stout website, 2003).

SAMPLE SELECTION

To accomplish the objectives of this study, an interview session was conducted to a full-time senior consultant within the Stout Advanced Manufacturing Assistance (SAMA) at the University of Wisconsin-Stout. The researcher was referred to the interviewee by the program director of the Management Technology major since the interviewee has tremendous amount of experience in implementing the Lean Manufacturing process into many organizations. The interviewee from SAMA was identified as a qualified data source for this research project, as his professional opinions and viewpoints could best address the research questions.

RESEARCH PROCEDURES

The interview was conducted on August 21, 2003 at the office of the SAMA consultant. During the interviewing session the interviewee was given directions and questionnaires. The interviewee was only asked the questions which the researcher had prepared in advance. Prior to the date of interview session, the interviewee was informed that the participation in the study was voluntary, and there were no consequences for choosing not to participate. Their answers were recorded by digital recorder for quotation and analysis purposes. The fundamental background of Lean Manufacturing process and consultant's work execution procedure will be learned by information gathering from academic books, the Internet, and various academic journals.

DATA ANALYSIS

The data collected during the interview session was analyzed to determine the scale that raising potential profit through increased production size or reduced operational costs at the same time. Data analysis for this study consisted of compiling responses to open ended questions. All open-ended responses were listed by the researcher and summarized into appropriate headings. The data is clearly displayed through appropriate headings that could potentially be improved. Qualitative data was analyzed by identifying and organizing the qualitative responses that introduced distinctive concepts. The data from the interview will be compiled to determine what characteristics are. It will then be decided if consultant should be utilized for lean manufacturing implementation, or having no trainers would succeed in lean training environment. The following chapter displays a complete review of the data gathered by interview session.

CONCLUSION

Lean manufacturing" is a leading manufacturing paradigm being applied in many sectors of the economy, reducing unnecessary cost during production, improving product quality, reducing production costs by reducing cost of poor quality, and being "first to market" and quick to respond to customer needs are critical to competitiveness and success. Lean Manufacturing is a collection of philosophies and techniques that reduce waste and add value.It is becoming more accepted and implemented in industry. Implementation of Lean Manufacturing is very important in current scenario in Indian Manufacturing industries. Lot of wastages are happened in industries can be removed with the help of Lean Manufacturing.

Manufacturing industries gain Number of benefits by applying Lean Manufacturing. It become essential for a company to remain competitive in the long term, which has focused on continuous improvement, has to focusing on systems approach, implementation of new and emerging techniques, automation and up gradation of technology. It is a systematic approach to identifying and eliminating waste

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