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Chapter 1 : Fun â€œIntroduction to Lean Manufacturingâ€• Activity | Farnborough International Airshow

Lean provides tools and processes to eliminate waste from the manufacturing process resulting in improved efficiency, effectiveness, and profitability.

Author Archive In production plants across the globe, lean manufacturing techniques are being used to meet increasing demands placed on manufacturers. Originally developed as a methodology to make production processes highly efficient, lean techniques have been adopted by more than 72 percent of machine shops across the country. For many of these, the techniques have helped them to dramatically increase their competitive edge, while continuing to remove wasteful practices and contribute to the bottom line. What is lean manufacturing? These concepts, in addition to a multitude of others, have come together to formulate what we know today as lean manufacturing. The core idea behind lean manufacturing is maximizing customer value while minimizing waste, thereby achieving manufacturing excellence through the creation of more value with fewer resources. Waste is defined as an activity that does not add value to the product. Through the elimination of waste along the entire manufacturing process, rather than at isolated points, companies are able to create processes that need less human effort, less space, less capital, and less time to produce high-quality, lower-cost products compared with traditional business systems. Guiding principles of lean Given the shift toward a customer-centric environment while facing formidable competition, many manufacturers are implementing lean principles to help eliminate waste and increase efficiencies rather than relying on processes and procedures that have been used in the past figure 1. To help guide companies through a lean transformation, James Womack and Daniel Jones developed a five-step thought process detailed in their book, Lean Thinking Free Press, The five steps represent a continuous cycle of improvement, and act as the foundation for the successful implementation of lean in a facility: Value can only be defined by the ultimate customer, although it must be created by the producer. Identify the value stream. Identifying the entire value stream for each product will almost always reveal three types of actions along the value stream, including steps that create value, steps that create no value but are unavoidable with current technologies and production assets, and nonvalue-adding steps that can be eliminated. Once value has been precisely specified and the value stream for a specific product fully mapped, making work elements flow continuously with minimal queues and no rework or stoppages is the next step in a lean transformation. After wasteful steps have been removed, and flow has been established, the ability to deliver only what is wanted by your customer, and only when they want it, is the fourth principle of lean thinking: As organizations bring their processes through the initial four principlesâ€”accurately specifying value, identifying the value stream and removing wasteful steps, creating flow, and letting customers pull value from the enterpriseâ€”the fifth principle, perfection, becomes attainable. In the Toyota Production Systemâ€”developed by Taiichi Ohno, Shigeo Shingo, and Eiji Toyodaâ€”one of the major precursors to lean manufacturing, the elimination of waste, is also one of the main objectives. All finished goods and batched inspections include the seven deadly wastes. However, being cognizant of this fact can help companies eliminate the waste while achieving maximum efficiencies. Below are the seven deadly wastes and lean tools that can be implemented to counteract waste. Time spent waiting on something, or someone, to complete a task. Design processes so that flow is continuous, and there are minimal or no buffers between steps in production. Any unnecessary movement of people that does not add value to the product or service. Ensure that work areas are logically organized, e. Using more energy or activity than is needed to produce a product. Look for potential simplifications to the manufacturing process, e. Excess product waiting to be processed. Excess or just-in-case inventory can result in lost money and resources caused by storage. Aiming for just-in-time inventory reduces downtime associated with inventory problems. Unnecessary movement to get goods from one process to the next. The transportation of goods or material can be risky. Damages or delays incurred while goods are in transit uses up resources. Effective planning can ensure that excess wastes in terms of moving do not occur. Making more parts or information than is required. Pacing material flow through production to match customer demand can help to minimize overproduction, and is more cost-efficient in the long run. Fixing defects and mistakes. Time spent repairing or reworking material

or information. The cost of fixing defects or mistakes is often cheaper the sooner they are found. However, understanding that lean is not only a set of tools but also a cultural concept that affects every level of an organization, will result in a successful implementation. From the production floor to C-level management, it is critical for teams to understand the concept and buy into the overall goal. Below are four common lean tools and practices implemented in the process of bringing on a lean transformation. Arranging production work stations and equipment in a sequence that supports a smooth flow of materials and components through the production process with minimal transport or delay. Shifting from traditional batch-and-queue mass production systems figure 2 to a single-piece flow-and-pull production system figure 3 , cellular manufacturing helps to eliminate overproduction and reduce defects. Allowing organizations to be flexible in terms of production setup and delivery, cellular manufacturing helps to facilitate faster turnaround and reduce work-in-process inventory, while optimizing the layout on the production floor. Typical batch-and-queue system Figure 3: Cellular manufacturing layout 5S workplace organization: A series of activities for eliminating wastes that contribute to errors, defects, and injuries. Clearly distinguishing what is necessary and disposing of the unnecessary Straighten. Organizing the necessary items so that they can be used and returned easily figure 4 Scrub. Cleaning floors, equipment, and furniture in all areas of the workplace. Achieving the discipline of properly maintaining the correct 5S procedures and continuously improving to making maintaining 5S easier Figure 4: These images illustrate 2S: Everything has a proper location and an organized method of location marking. Removing the need for separate testing and inspection labs figure 5 , in-line inspection allows workers to perform inspections directly on the line to ensure the accuracy of in-process work. Verifying measurements on the line, rather than having to bring a part to a separate temperature-controlled room, helps to create more efficient workflows and streamlines the inspection process figure 6. In a lean work cell, the goal is to eliminate scrap, while building quality into the process. One way to accomplish this is to implement portable coordinate measuring machines CMMs on the line, increasing production efficiencies and producing higher quality finished goods. Mounted directly on the machine, portable CMMs eliminate the need to bring a part to a quality lab, saving the company time and money. By utilizing portable metrology tools such as articulating arms designed to withstand harsh working environments, operators are able to quickly identify defects of parts in-process. Typical batch manufacturing and inspection Figure 6: Lean manufacturing and inspection Kaizen: Often considered to be the building block of all lean production methods, kaizen events are rapid and cost-effective projects that focus on identifying waste, improving productivity, and achieving sustained continual improvement in targeted activities and processes. Aiming to involve workers from multiple functions and levels in working together to address a problem or improve a process, the kaizen team uses analytical techniques such as value-stream mapping and the 5 Whys to identify opportunities quickly to eliminate waste in a targeted process or production area. After identifying an area for a rapid improvement event, such as a production area where significant bottlenecks or delays occur, the kaizen team must identify the root cause of the problem. This can be accomplished by utilizing the 5 Whys technique. An example would be: There was an overload, and the fuse blew. The bearing was not sufficiently lubricated. The lubrication pump was not pumping sufficiently. The shaft of the pump was worn and rattling. There was no strainer attached and metal scrap got in. Once the root cause of the problem has been identified, the team can then work to collect information on the targeted area, such as measurements of overall product quality, amount of work-in-progress, and scrap rate and source of scrap. Analyzing these data allows the team to identify areas for improvement, and test improvement options before implementation. A key portion of a kaizen event is the follow-up activity to ensure improvements are sustained and not just temporary. Following an event, the team routinely tracks key performance measures and document improvement gains to assess performance and identify modifications that may be necessary to sustain the improvements. Portable CMMs and lean manufacturing Ideal for a variety of applications, including 3-D modeling, reverse engineering, alignment, machine installations, and rapid prototyping, portable coordinate measuring machines CMMs such as articulating arms and laser trackers have become critical components in the implementation of lean principles. One of the major elements of lean manufacturing is the concept of creating flow. By making work elements flow continuously with minimal queues and no rework or stoppages,

a company is one step closer to reaching optimal levels of production. Creating flow through the implementation of portable CMMs on the line simultaneously eliminates two of the deadly wastes, waiting and transportation. For example, by mounting an articulating arm directly on a machine producing a part, operators are able to create flow between each station and eliminate the waiting periods commonly found in batch-and-queue manufacturing. Eliminating the machine outage time necessary for off-line inspection, operators are able to reduce inspection times without having to transport materials to inspection rooms while mitigating measurement variability between users. Fixing defects is another example of a deadly waste that can be helped through the implementation of portable CMMs. Many companies utilize portable CMMs for incoming and in-process inspection. For example, by implementing an articulating arm to inspect parts as they arrive, defects can be eliminated at the raw materials stage, preventing incorrect products from making it further into the production process. Additionally, laser trackers can be used for in-process inspections, ensuring that components are aligned correctly for work-in-process, eliminating rework at final inspection. Discovering any errors early in the production process saves companies valuable time and money. Summary Many companies have implemented lean manufacturing techniques to create more efficient workflows. Through the elimination of waste and the creation of flow through the various processes, companies are able to eliminate costly scrap and rework while contributing to their bottom line. Implementing portable CMMs into standard workflows has helped them achieve their lean manufacturing goals; in many cases, companies that have implemented portable CMMs directly on the line for in-process inspections have seen a reduction in inspection time of up to 60 percent. Used to ensure accurate alignment and precision measurements, portable CMMs have become a value-adding component helping companies to achieve various lean principles. To learn more about creating efficient workflows using portable CMMs, visit www. To learn more about lean principles, visit www.

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Chapter 2 : An Introduction to Lean Manufacturing | Quality Digest

Introduction to Lean Manufacturing - Guest Lecture - Carnegie Mellon University Australia Guest Lecture The following is a partial transcript of a guest lecture given at Carnegie Mellon University Australia on the 18th of July

Free resources and fresh perspectives on lean. Improve production with lean tools. Get Started What is Lean? The core idea of lean manufacturing is actually quite simpleâ€¦relentlessly work on eliminating waste from the manufacturing process. So what is waste? The good news is that just about every company has a tremendous opportunity to improve, using lean manufacturing techniques and other manufacturing best practices. Techniques that enable you to deliver higher quality products at significantly lower costs. Now that is something to get excited about! It can be difficult to find reliable and well-written information about improvement techniques for manufacturing. So, our goal is to provide you with the absolute best source of easy-to-understand information for helping you improve the efficiency, effectiveness, and profitability of your manufacturing operations. With that in mind, we have designed each topic on this site to be self-contained and to stand on its own. If you want to learn about a topic, simply forge ahead and read about it. We have worked to make it particularly easy to explore the topics that are of most interest to your situation. Easy Our goal is to create learning materials that are easy to understand and easy to implement. We believe that even complex topics can be made easier and more accessible. Practical We are realistic about what is within the reach of most teams to accomplish â€" and the resource limitations that we all face. We want to help you achieve quick progress. Flexible We are not dogmatic about lean. We respect tradition and we honor heritage â€" but not at the expense of progress. We believe that lean should be living and adaptable. People-Focused We emphasize the critical role of people like you in creating sustainable long-term change.

Chapter 3 : Introduction to Lean Manufacturing

The Eight Types of Waste per the Toyota Production System (TPS) The most successful implementation of Lean Manufacturing to date is widely acknowledged to be when Toyota created the Toyota Production System (TPS), which focused on reducing the eight types of waste (or Muda, which is the Japanese word for waste).

The talk focuses on removing waste from business processes to improve productivity, quality and safety, and includes insights from the kaizen training and lean tours that Shinka Management runs in Japan. As part of the lecture a discussion was held on the relevance of lean to the role of the CIO. As the most senior executive in an enterprise responsible for the information technology and systems, the CIO often plays a central role in business transformation projects. An understanding of the fundamentals of lean is relevant in this role, as more and more we are seeing business transformation projects being labeled as lean or agile. These projects often miss the point that lean is a culture that is developed over years, not a one-off undertaking. In brief, lean management seeks to implement business processes that achieve high quality, safety and worker morale, whilst reducing cost and shortening lead times. This in itself is not unique to Japan. What sets lean management apart, and makes it particularly effective, is that it has at its core a laser-sharp focus on the elimination of all waste from all processes. The Seven Wastes So what do we mean by waste? In lean manufacturing there are generally considered to be seven types of waste. Over-production against plan Waiting time of operators and machines Unnecessary transportation Waste in the process itself Excess stock of material and components Non value-adding motion Defects in quality Whilst we discuss these in terms of their origins in the automotive manufacturing industry, this same thinking can apply to almost all industries. These wastes can all be applied, for example, to the preparation and serving of a hamburger, logistics operations or a call center â€" this thinking is not limited to manufacturing. Labour and Equipment Effectiveness We can typically look at the waste within a business process by considering the labour and equipment effectiveness. We can define this difference through a series of losses. This includes not meeting standard times and not following standard operating procedures. Method Loss is the responsibility of engineering and management across the organisation. Plan Loss results from scheduling equipment not to run Stop Loss results from a changeover or breakdown Speed Loss results from running equipment below the design speed of the machine Quality Loss results from producing defective parts and materials Analysis of equipment effectiveness is especially important to focus on when dealing with high-cost equipment, such as in drilling, mining or the airline industry. In these cases a business is only making money or providing value when its equipment is operating. This example is for an Australian power utility and focuses on the field asset inspection process. Utility companies, whether they be power, water, gas, or telecommunications have a responsibility to continually assess the condition of their assets, and this is especially true for utilities operating in a regulated environment. A power utility typically has dozens of asset inspectors operating in the field. The task of the asset inspector, in simple terms, is to carry out a series of visual inspections for a pole and its associated infrastructure wires, insulators, transformers, etc. This task involves differing levels of complexity depending on terrain, configuration at the top of the pole, and reporting requirements and can take anywhere from 5 to 40 minutes for a single pole. Time studies Time studies and work sampling can be used to analyse asset inspection process. Time studies involve analysing individual cycles of a process, in this case the inspection of a single pole. The motion of the inspector and movement of tools is recorded and each individual element step in the process is listed along with the time required to complete it. Definition of time study, from: Time studies can be carried out manually or with video-based time and motion study software to help us understand: We can then use the results of the time study, either manually or using time study software , to understand where improvements can be made to reduce the time required for the task and improve consistency. Improvements are found through analysing each element and then working through a process of eliminate, combine, rearrange and simplify. Eliminate â€" Question whether or not the work or operation can be omitted, and eliminate those which are unnecessary. It is necessary to consider elimination before any other improvements. Combine and Separate â€" For those operations which cannot be eliminated, study the manner

in which they should be performed. The study should be done without bias from accepted ideas or prejudice. Attempt to reorganize work in as simple a way as possible. This is combination and separation. Rearrange and Substitute â€" Consider questions such as when to do, in what order, how can work be done easily, etc. Simplify â€" Consider improvements to make each operation simple and easy, to shorten distances, to lessen weight etc. An example of each in the context of the asset inspection example is given here: Eliminate â€" Remove the need for the inspector to walk around the car to fetch tools, by storing tools on the same side of the car as the inspector. Combine and Separate â€" Merge the tasks of wire inspection by binoculars and photographing top of pole by providing inspector with binoculars that include a camera function. Rearrange and Substitute â€" This can refer to changing the order of the elements or changing the layout of the work area. An example of the later would be to attach lighter tools required for the inspection to the inspector and attach other tools to a board which can be easily attached and detached to the pole e. Simplify â€" Reduce the time required to upload photos during each inspection by using wireless upload to laptop rather than wired upload. Standard Work Time studies play a role in the development of standard work, often defined as standard operating procedures SOPs. Standard work plays a critical role in achieving the following: A record of activities is taken at a set interval, for example every minute, and a day is summarised according to time spent performing main tasks, performing auxiliary tasks and idle. The purpose of work sampling is to help identify how more time can be allowed for performing main value-adding tasks as opposed to auxiliary tasks such as setup and shutdown, and tasks that are not work-related. Although not the main role of work sampling, the mere act of carrying out a work sampling activity can help in identifying a wide range of improvement topics relevant to the task be studied. This example is based on the Dealership Process Improvement offering that has been implemented in quite a number of countries with the purpose of improving customer experience and dealership productivity. During the lecture we looked at an analysis that focuses on movement and tasks performed as part of a standard service. The changes include the move to using two mechanics working in unison, and other improvements that are simple and not capital intensive. The ordering and assignment of tasks allows each mechanic to reduce the amount of walking they do, and the design of the express service trolleys allows for more convenience and less movement away from the work area. The result is that the service can be carried out with two mechanics in under a third of the time it originally took with one mechanic. Benefits associated with these improvements include - Customer convenience associated with maximum one hour wait time - Standardised process has positive impacts on quality - Better utilisation of space â€" a greater number of cars can be serviced without having to increase the number of service bays - The planned approach has many benefits that extend beyond just the service itself The example relates only to the service component, but there are many other aspects to the Dealer Process Improvement offering.

Chapter 4 : Introduction to Lean Manufacturing | Intelitek

In production plants across the globe, lean manufacturing techniques are being used to meet increasing demands placed on manufacturers. Originally developed as a methodology to make production processes highly efficient, lean techniques have been adopted by more than 72 percent of machine shops across the country.

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Introduction to Lean is the perfect introductory course. It helps Students understand the foundational concepts of lean along with sharing key principles, tools and techniques.