

The Need for Lean Training

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The recent economic downturn and the sustaining of lower economic conditions into the near future have caused manufacturers to reevaluate their operations. In many cases this has led to off-shoring, bankruptcies and plant closures. However, during these difficult times many companies have been able to succeed and some flourish. The difference between success and failure may in found in a single word, lean. This research investigates history related to the use of lean techniques, the market need for students trained in the use and application of lean tools and the development of a course dedicated to instructing lean methods.

BACKGROUND OF LEAN MANUFACTURING

Manufacturers have been forced, through competition and the increased competitive awareness of their customers, to continuously improve their operations. These improvements have taken different forms during the past twenty years. Manufacturing Resource Planning, Just-in-Time Manufacturing, Total Quality Management, Theory of Constraints, ISO 9000, Cellular Manufacturing, World Class Manufacturing and Six Sigma are some of the more popular implementation strategies companies have adopted. However, the end mission of each of these programs has been relatively the same: to improve the operation and in turn to enhance the manufacturer's profitability.

Lean manufacturing is a current manufacturing strategy that has gained prominence and has been shown to deliver results. Lean is a war against waste of both manufacturing inefficiencies and underutilization of people (Bodek, 2004).

Lean manufacturing, as it is generally understood today, was developed and implemented in Japan during the 1950s with the development of the Toyota Production System (Ohno, 1988). Although some aspects of lean had been reported by some authors such as Hall (1983) and Schonberger (1982), it was brought to light in the United States with the book *The Machine That Changed the World*, which popularized the terms "lean production" and "lean manufacturing" (Womack, Jones, & Roos, 1990). During the past two decades, many manufacturers have implemented lean manufacturing as their primary source of process improvement.

Lean manufacturing is an operational strategy oriented toward achieving the shortest possible cycle time by eliminating waste (Liker, 1997; Lee, & Allwood, 2003). Lean is focused on meeting customer requirements -- it starts and ends with customer service (Bodek, 2004). The objective is to increase the value-added work by eliminating waste and reducing unnecessary tasks.

DEFINITION OF LEAN MANUFACTURING

Womack et al. (1990) define lean in terms of a manufacturing operation to represent a system that utilizes fewer inputs to create the same or more outputs than those created by a traditional mass production system, while increasing the range and type of goods offered to customers. The benefits of lean manufacturing are generally lower costs, higher quality, and shorter lead times (Liker, 1997). Lean is a process, implementing change and continuous improvement to develop leaner operations. Hines, Holweg, & Rich (2004) indicate that lean is one of the most influential paradigms in manufacturing, providing improvement beyond the original focus, which was on heavy industrial shop floors, to improving the entire business operation.

The objective of lean is to improve manufacturing operations, increase productivity, reduce lead time to customers, and reduce costs and improve quality (Sanchez & Perez, 2001). These improvements are achieved by improving product flow, eliminating non-value-added activities, shortening manufacturing lead times, and establishing a process of continuous improvement (Labow, 1999). Simply put, lean manufacturing is about doing more, adding more value to products, improving customer satisfaction and generating additional income while utilizing fewer resources.

ORIGINS OF LEAN MANUFACTURING

Henry Ford, of the Ford Motor Company, and Alfred Sloan, with General Motors, moved manufacturing from a craft industry to a model of mass production in the early part of the twentieth century. In the mid-twentieth century, the Japanese manufacturer Toyota developed an improved production technique known as the Toyota Production System that has now come to be known as lean manufacturing (Womack & Jones, 1996). Henry Ford developed the auto industry during its infancy. His focus was on manufacturing excellence, which led to the development of mass production as a cost reduction strategy. The mass production model that was popularized in the automobile industry during the 1920s was quickly adapted in nearly every industrial sector in North America and Europe (Womack et al., 1990). Mass production was developed as a result of Henry Ford's effort to create true efficiency, developing and using the best methods possible, leading to the assembly line model of manufacturing (Ford, 1926).

Following World War II, the Japanese industrial base needed to redevelop itself. It had been decimated by the war efforts and its productivity was far behind the United States. Toyota identified their mission to catch up with American productivity within three years. At that time, American manufacturers were nine times more productive than their Japanese counterparts (Ohno, 1988). Taiichi Ohno is credited with developing the Toyota Production System, which focused on waste reduction and was the genesis of lean manufacturing. Using waste reduction as the tool to lessen the productivity gap between Japan and the United States, Toyota developed many of the techniques that are now associated with lean manufacturing.

Toyota did not have the resources or market share that Ford enjoyed, so they needed to develop tools to provide them with a competitive advantage. The techniques and tools Toyota developed have become synonymous with lean manufacturing: kanban, methods for pull scheduling, mistake proofing, just-in-time inventory delivery, asking why five times for problem solving, and kaizen for process improvement. Each of these focuses on waste elimination and represents an alternative model to capital-intensive mass production (Hines et al., 2004). In the period between World War II and the 1970s, these new changes allowed Toyota and other Japanese manufacturers to make great strides in their manufacturing productivity. Soon, the United States was facing tough competition from Asian manufacturers (Hall, 1987). Productivity increased in Japan at a rate 400 percent higher than the United States over the postwar years (Ouchi, 1981).

In 1986, Toyota, working in conjunction with General Motors, re-opened an assembly plant in Fremont, California utilizing the Toyota lean principles. The Fremont plant immediately showed the auto industry the difference Toyota techniques could deliver, such as improved productivity, reduction of

defective production and reduced inventory (Womack et al., 1990). Ten years following the Japanese publication date, *Toyota Production System* was translated and republished in the United States, popularizing the Toyota management tools with United States manufacturers. Following this, *The Machine That Changed the World* was published in 1990, introducing the term “lean”:

Lean production (a term coined by IMVP researcher John Krafcik) is “lean” because it uses less of everything compared with mass production -- half the human effort in the factory and half the engineering hours to develop a new product in half the time. Also it requires keeping far less than half the needed inventory on site, results in many fewer defects and produces a greater and ever growing variety of products. (p. 13)

NEED FOR LEAN TRAINING

Lean manufacturing is implemented in an attempt to reduce unnecessary steps and simplify the movement of materials and information, expecting to reduce waste within the manufacturing system. This reduction of waste improves operational efficiency, which converts into increased opportunities for profitability and an enhanced position among the competition.

A survey conducted in July 2003 by DemandStream, a leading supplier of enterprise automation software, indicated American corporations are rapidly adopting lean manufacturing principles in order to insure global success. The study involved approximately 280 manufacturers and indicated that 40% of U.S. manufacturers described lean manufacturing as their primary business strategy. Additionally, the survey stated that 60% have adopted or have taken steps to adopt "continuous flow production" practices in their factories, where machines and operators handle uninterrupted flow of material at a given rate (Society of Manufacturing Engineering, n.d.).

Students graduating in business, engineering and technology disciplines will in most cases be employed by manufacturing companies that utilize lean techniques to improve their operations. Providing course work that is dedicated to exploring and practicing lean tools will provide students with a unique set of skills to offer future employers.

The graduates of University of Wisconsin Stout in programs of Business, Supply Chain Management, Engineering Technology and Technology Management were surveyed to identify their primary operational strategy of their present employer. This survey of students who graduated from the University of Wisconsin-Stout between 1995 and 2009 was conducted in 2010; they were asked questions related to the operational strategies applied by their employer. The results indicated that a significant number were employed by an entity that used lean as their principal strategy to improve their operations and thus reduce operational costs. The response to the question “Do you currently use lean as a strategy within your organization?” indicated that 48% of the employers use lean, further, 81% reported that using lean had provided a tangible financial return to their organizations (Harvey, 2010).

Employers are in a mode of cost management, hiring reduction and are experiencing increased competition. This has lead employers to be all the more selective in their hiring practices. Understanding which operational tools potential employers are using provides an opportunity for higher educational programs to tailor their curriculum to best meet employers’ needs. This will provide students with a competitive advantage as they enter the job market.

DEVELOPMENT OF THE LEAN ENTERPRISE COURSE

The Manufacturing Extension Partnership (MEP) is a nationwide network of not- for-profit centers whose purpose is to provide small and medium sized manufacturers with access to technology for improved productivity. The National Institute of Standards and Technology (NIST) created MEP to serve as regional centers for technology transfer of manufacturing knowledge, with the objective of enhancing manufacturing productivity and technological performance in the United States (Manufacturing Extension Partnership, n.d.).

The Manufacturing Extension Partnership offers a variety of services to manufacturers that allow them to evaluate and implement manufacturing improvement processes. The primary services offered are: environmental friendly manufacturing, growth planning, lean manufacturing, measurement systems, nanotechnology, radio frequency identification, strategic management and quality systems management. The lean manufacturing services offered through MEP focus on producing more with existing resources by elimination of non-value-added activities and creating flow throughout the entire company (Manufacturing Extension Partnership, n.d.).

The Northwest Wisconsin Manufacturing Outreach Center (NWMOC), which is the MEP office serving northwestern Wisconsin, has recently developed a successful lean program to provide the training and consultation required for companies to begin their lean transformation. This training program and the associated lean-flow certification program NWMOC offers is the genesis for the lean enterprise course developed for students at UW-Stout. The outline of the NMMOC program is as follows:

1. Established a lean manufacturing implementation team
2. Trained the team members in the principles of lean manufacturing
3. Defined product families for process grouping and work center development
4. Chose a project within the manufacturing process to begin the lean implementation
5. Established goals and benchmarked present metrics

Furthermore, the course development has made use of the five primary elements of lean manufacturing: specifying value, identifying the value stream, flow, pull, and perfection (Womack & Jones, 1996). Specifying value refers to knowing what the customer values in the products they purchase. Value is a product related measure. Value is defined as the activities the customer pays for willingly, because it is truly necessary to solve the problem or required to produce the product (Womack & Jones, 2005). How the product performs, what the product costs, how the product is delivered and how the product is serviced are a few points that may define the value of a product. The value stream is defined by Womack and Jones (1996) as the set of actions required to bring a product through the physical transformations from materials into a salable product. In other words, the value stream is the series of activities or processes supporting the daily production needs of the organization.

The crucial element of lean manufacturing is value. Value is defined by the customer. It is expressed in terms of a product that meets the customer's needs at a specific price and a specific time (Womack & Jones, 1996). Manufacturing has two types of operations, those that add value and those that do not. In the past, using traditional thinking, manufacturers have focused on improving the value-added operations, while allowing the non-value-added operations to continue to exist (Conner, 2001). Lean manufacturing turns this traditional thinking around and focuses on the elimination of wasteful non-value-added operations, resulting in improved value for customers (Sahin, 2000). Non-value-added operations are waste. Waste can be found in excess motion or transportation, excess production, production of defective parts, and underutilization of abilities. Waste includes items the customer neither wants nor expects to pay for (Bodek, 2002).

LEAN ENTERPRISE COURSE OBJECTIVES

The objective of this new course is to provide students the ability to function as a leader with in a lean environment through the understanding and practice of the philosophy, process, people and problem solving systems utilized within a lean enterprise. Upon completion students will be able to:

- investigate the systematic differences between mass production and lean techniques
- develop a value stream
- analyze 5s systems for work place organization
- develop quick changeover and set-up reduction techniques
- determine lean strategy and justify specific projects
- organize project teams

- apply leadership and communication skills to lean management
- develop Kaizen activities
- identify and calculate Takt time
- analyze the benefits of flow processes
- develop pull systems for replenishment

SUMMARY

Due to the need to support operations objectives to reduce costs and improve value to customer's experience companies are implementing lean tools at an increasing rate. To provide relevant and timely education related to the principles and use of these lean tools undergraduate as well as graduate students need to be exposed to lean training prior to leaving campus. This training will likely provide these students with a competitive advantage as they enter the increasingly competitive job market.

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