A Review of the Development of Lean Manufacturing and Related Lean Practices: The Case of Toyota Production System and Managerial Thinking

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[**Abstract]** This paper explores Lean manufacturing and related Lean practices, which were derived from the Toyota Production System (TPS). The TPS was the incubator in which the methods, techniques, and tools of Lean were pioneered and refined. This research paper examines what were the circumstances that gave rise to the development of Lean production and how Ohno and others have contributed to the development of the TPS and the Lean principles. For decades, the whole system of Lean principles and practices was known only to specialized manufacturers, certain academic researchers, and quality gurus. Its full potential was unknown to most organizations. All of that changed in the late 1980s, as the term Lean was coined to describe the fundamentals of the TPS to the rest of the world. As the understanding of Lean spread across the world, it became much easier to understand and implement. Lean is a proven long-term approach to aligning everything in a business to deliver increasing customer value. Lean engages people and aligns systems into processes that deliver a continuous stream of value to customers while continuously eliminating waste and deficiencies in the process. However, Lean is not just for specialists. Lean is an everyday practice performed by everyone at all levels to improve performance consistently.

[Keywords] lean, lean manufacturing, lean principles, Ohno, Toyota production system

Development of Lean Manufacturing and Related Lean Practices

Development of management theories depends on observation and mathematics to construct a model for business activities. In history, management practices often rely on case studies and the individual experiences when dealing with workplace situations. Because both schools of management theory and management practice have shortcomings and strengths, business leaders should study both styles of management to improve the efficiency and profitability of their organizations (Wren & Bedeian, 2008, pp. 9-12). Management can be described as a process that uses resources to accomplish organizational goals. It involves a set of operations, such as planning, decision-making, and evaluation of performance (Hitt, Black, & Porter, 2011, pp. 4-20). Management requires the assembly of varieties of resources: human, financial, material. and

information. Also, management involves activities that are carried out by employees in the organization with different functions to structure and coordinate with one another to achieve common organizational goals (Wren & Bedeian, 2008, pp. 5-8). The opening of global markets around the world, free trade agreements, and growing technological advances promote global competition. Management in the current economy cannot ignore the impact of technology and the way it affects the jobs, organizations, and the world. Historically, technology developments, such as mass production and Lean manufacturing, often force management to make changes.

What Is Lean?

Lean manufacturing (or Lean) is a systematic production method, which aims to aggressively eliminate waste within a manufacturing process. Lean is a broad concept that describes a holistic and sustainable approach to using less of everything to give organizations that practices Lean philosophy more. Lean concepts are not new. Organizations large and small around the world have practiced the techniques in various forms for decades. Lean also identifies waste through overburden and waste created through unevenness in workloads (Liker, 2004, pp. 20-26). Lean takes the position from the perspective of customers who uses a product or service, and any activities that do not add value for customers are considered as waste. Fundamentally, Lean manufacturing aims to make what adds value apparent by eliminating everything else. Lean principles resulted from the Japanese manufacturing industry.

Lean is a management philosophy derived chiefly from Taiichi Ohno's Toyota Production System (TPS) and recognized as Lean in the 1990s (Crainer, 2002, pp. 197-199; Womack, Jones, & Roos, 2007, p. 9). The TPS is known for its focus on reduction of the seven wastes to improve overall customer value. Toyota consistently outsells any other manufacturer, and its products top polls and surveys with regards to quality and reliability. Toyota and Japanese automobile companies' success are enough reason to investigate the actual benefits of Lean and how it was developed in management history. Lean is a holistic manufacturing process aimed at creating value and eliminating waste. Lean practices are not new; Lean has been proven to be successful as demonstrated by Toyota.

Historical Overview of Lean Manufacturing and Automobile Industries in the World

Lean principles are derived from the Japanese manufacturing industry. The term "lean manufacturing" was first created by John Krafcik in 1988 (Holweg, 2007). Krafick had been a quality control engineer with Toyota. Historical development of Lean principles is described by Womack, Hones, and Roos in *The Machine That Changed the World* (2007; pp. 47-69). This historical book is a classic on management and Lean manufacturing, and it is the third book in a historical sequence after Peter Drucker's *Concept Of The Corporation* in 1946, which summarized the mass production business model (Drucker, 1993), and Alfred Sloan's *My Years With General Motors* in 1965, which explained GM's organizational management system in detail (Sloan, 1990). According to Womack et al. (2007), Toyota was half of the size of General Motors (GM) and two-thirds of Ford in 1990.

However, in 2007, Toyota had become larger than Ford and GM and had become the largest and most consistently successful industrial enterprise in the world. Toyota's adoption of Lean allowed it to overtake the American powerhouses, Ford and GM. The two fundamentally different systems, one being mass production and the other being Lean manufacturing (or Lean production), created significant contributions in automobile and other industries. Mass production was used by businesses in almost every industry around the globe for nearly seventy-five years. The newer production system, Lean manufacturing, was pioneered by Toyota after World War II (WWII), and was rapidly implemented nearly everywhere in the world (Womack, Jones, & Roos, 2007; pp. 229-283). The lessons of the Lean production system have remarkably wide range of applications.

Development of the International Motor Vehicle Program (IMVP)

Automobile industries in the Western world have been relying on management practices developed by Henry Ford's mass production system, and those techniques were no longer competitive with innovations pioneered by the Japanese after WWII (Crainer, 2002, pp. 75-79). The business world did not have a name for this new Japanese business practices until Krafcik named it "Lean manufacturing" (Holweg, 2007, p.2). As the Japanese companies gained market share, they experienced more political resistance from the West. However, at the same time, Western businesses did not seem to be able to learn from their Japanese competition. Instead, the Western world was focusing on creating trade barriers, which resulted in a delay of dealing with the real issue at hand. After another economic downturn, North America and Europe feared that they would reject the opportunity to learn and use the Lean principles, which the Japanese had developed.

Finally, the West thought that the constructive step to take to prevent failure of their industries would be to undertake a detailed study of the new Japanese technique, (e.g. Lean production) and compare it with the existing mass production that the West had developed. Then, the IMVP compared mass production and Lean production in cooperation with automobile manufacturers over the world. To accomplish this task, the International Motor Vehicle Program (IMVP) at the Massachusetts Institute of Technology (MIT) was created. In 1985, the IMVP took off at MIT following the formation of a new Center for Technology, Policy, and Industrial Development (Center). The Center went beyond conventional research to explore creative mechanisms between industry and government to understand the forces of international industrial change and to improve the policy development process in dealing with this change. The IMVP was the perfect platform for the new Center to show a creative role for academia to work with governmental bodies and industry (Womack, Jones, & Roos, 2007; pp. 15-70).

For MIT researchers to succeed, they would need extensive access to automobile industries across the world, from the factory plants to the executive boardrooms. Thus, the IMVP made it clear to its sponsors that their most valuable contribution would not be financial but the meetings with their employees to gather information to answer questions. In most cases, businesses were more open than the IMVP expected. Managers in the worst-performing facilities and weakest

companies shared their problems honestly, and managers in the best factories and strongest organizations were willing to explain their inner operations frankly.

To succeed in IMVP's objectives, the IMVP researchers developed feedback mechanisms that could explain their findings to industry, governments, and unions and to gain their perspectives to benefit every organization involved. To accomplish this, IMVP held annual meetings for the liaison people from each sponsor. At these meetings, research in previous years was reviewed in detail; criticisms were gathered, and the IMVP members discussed how to conduct future research efforts. The IMVP also held annual policy forums around the world to present their findings to executives and government officials of companies, governmental organizations, and the financial community. These meetings provided opportunities for leaders in the industry to discuss the challenges in transitioning from mass to Lean production without pressure from external publicity.

Also, the IMVP conducted numerous meetings with companies, governments, and unions to review global performance, assessed the performance of plants, and investigated the reasons why a factory might do poorly compared to the best-performing plants. At various meetings, corporate management boards, union executives, and government officials added their perspectives on the difference between mass and Lean production and provided comments on how to convert to Lean (Womack, Jones, & Roos, 2007, pp.15-25).

Lean Concepts Derived from the Toyota Production System (TPS)

In a broad sense, Lean is a set of tools that help identify and consistently eliminate waste. According to Monden, as waste is eliminated, quality improves while cost and production time are reduced. Some examples of such tools would be value-stream mapping, kanban (pull systems), poka-yoke (error-proofing), total productive maintenance, elimination of batching time, rank order clustering, redesigning working cells, multi-process handling, and control charts for checking mura (unevenness) (Monden, 1998, pp. 2-3). Also, Toyota promoted Lean manufacturing, and it is often called the Toyota way or the Toyota Production System (TPS), which focuses on improving the smoothness of work by eliminating mura (unevenness) through the system and not on waste reduction alone (Monden, 1998, pp. 2-3). Liker and Michael (2008) assert that Toyota's techniques to improve flow involve production leveling, the use of kanban by pull system, and heijyunka box (a visual scheduling tool to achieve a smoother production flow). Toyota's approach requires considerably more commitment and persistence than the basic application of Lean tools, and this might be the reason for its lack of attractiveness (Liker & Michael, 2008, p. 5).

The difference between the Lean manufacturing and TPS could be seen as a related principle whose goal is cost reduction by the elimination of waste (Ohno & Bodek, 1988, p.3). These principles include pull processing, perfect first-time quality, waste minimization, continuous improvement, flexibility, building and maintaining a long-term relationship with suppliers, autonomation, load leveling and production flow, and visual inspection (Liker & Michael, 2008, p. 29-31). The TPS has grown significantly since 1948 to respond to the problems it saw within its own Toyota production facilities.

Hence, what is considered Lean manufacturing is the result of a need-driven learning to improve where each step has built on previous ideas and is not based on a theoretical framework. The TPS views the general method of Lean manufacturing not as the tools but the reduction of three types of waste, such as muda (or non-value adding work), muri (overburden), and mura (unevenness), to expose problem areas systematically and to use tools where perfection cannot be accomplished (Ohno & Bodek, 1988, p.8).

Tsukamoto (2002) described four principles of the TPS. The first, all work should be highly specified as to content, sequence, timing, and result. The second, every customer and supplier connection needs to be direct, and there should be an unambiguous way to send orders and receive communication back and forth. The third, the pathway for every product and service needs to be clear and direct. The fourth, all improvements need to be made with the evidence-based method, under the guidance of a leader, at the lowest level in the organization (Tsukamoto, 2002, pp. 3-12). The TPS also is known as flexible mass production, and its two chief concepts are just-in-time (JIT) and autonomation (smart automation) (Monden, 1998, p.2-14).

Ohno preached that the smoothness of TPS delivery of value achieves other peripheral improvements as a result (Ohno, 2012, pp. 39-42). When production flows perfectly with the kanban pull system and with no interruptions there is no need for excess inventory. When customer-valued features are exclusively produced, then product design is simplified, and efforts are only expended on features that customers value (Ohno, 2012, pp. 47-50). Liker (2004) describes the other of the two major concepts of the TPS is the human resource aspect of autonomation, where automation is accomplished with a human touch. The human touch means to automate the systems so that the design aids people to efficiently complete the production process (Liker, 2004, pp.27-33).

Implementation of Lean

Ohno (2012) asserted that the Lean implementation focuses on getting the right things to the correct locations at the right time and in the right quantity to accomplish the perfect workflow while minimizing waste and being flexible to changes (Ohno, 2012, pp. 50-55). The idea of flexibility to change is needed to allow production leveling called heijyunka (Liker & Franz, 2011, p. 154). Liker and Franz (2011) explain that this flexibility to adapt to change is within bounds, not unlimited, and, thus, often realistic requirements.

More importantly, the Lean concepts need to be understood and embraced by the actual workers who build the products and own the process that delivers what customers view as value (Liker & Franz 2011, p. 159). The cultural aspects of Lean could be more important than the actual tools of production itself because there are some examples of Lean implementation without long-term benefits, and these shortcomings are often blamed on a weak understanding of Lean application throughout the entire organization (Harvard Business School Press, 2009, pp. 202-220).

Lean principles aim to make the workflow simple enough to understand, execute, and manage. To achieve these three goals simultaneously, Toyota believes in a mentoring process of senior and junior (senpai and kohai) employees to foster Lean methods and culture to disseminate

throughout the organization (Liker & Franz, 2011, p. 23). Toyota's mentoring process is thought to be equivalent to the idea, Lean sensei, which encourages organizations and businesses to seek unbiased advice and coaching (Womack, Jones, & Roos, 2007, pp.302-309).

History of Lean Waste Reduction Thinking

The elimination of waste has an extensive history. Lean manufacturing principles are built on one's experiences and mistakes. Many of the Lean concepts have been discovered and used over the years by others in one's search to reduce excess waste. Most of the Lean manufacturing goals are intuitive and common sense, and there are documented examples that are seen as early as Benjamin Franklin (The Library Company of Philadelphia, n.d.). Franklin's *Poor Richard's Almanac* states that eliminating wasted time and unnecessary costs could be more profitable than increasing sales. Also, Franklin stated that carrying unnecessary inventory should be avoided. Later, according to O'Reilly (2008), Henry Ford referred to Franklin as a key influence on his automobile manufacturing business, which resembled just-in-time (JIT) production (Crainer, 2002, pp. 97-99; O'Reilly, 2008). The idea of waste reduction was observed by the motion efficiency expert, Frank Gilbreth, as well, who studied bricklayers' motions of lowering and raising one's entire body to pick up a brick; Gilbreth stated that this inefficiency was built into masons' job through their practice. The introduction of a non-stooping scaffold that delivered the bricks at waist level allowed workers to carry out their tasks about three times as fast with less effort (Crainer, 2002, pp. 107-108; Price, 1989).

During the Industrial Revolution in the West

In the latter half of the Industrial Revolution, as the complexity of products increased, labor cost content of products had increased, and labor cost began to overtake material cost (Wren & Bedeian, 2008, pp. 39-54). This change gave rise to the ideas of Fredrick Taylor, Frank Gilbreth, and the scientific management theories. Taylor, as the father of scientific management, introduced what is called standardization and best practice deployment. Taylor said in *Principles of Scientific Management* that whenever a worker suggests an improvement, the management should make a careful analysis of the new method and, if needed, conduct a series of investigations to determine the relative merit of the new idea. Whenever the new method is found to be noticeably better than the old method, it should be adopted as the standard for the entire organization (Crainer, 2002; Taylor, 1997). Frank Gilbreth established the basics for predetermined motion time system, used in systems equivalent to the methods-time measurement (Crainer, 2002, pp. 107-108). Shigeo Shingo, well known as the proponent of single minute exchange of die and error-proofing or poka-yoke, was inspired by Taylor's *Principles of Scientific Management* (Shingo & Dillon, 1989, pp. 3-5).

Henry Ford continued his focus on waste while developing his mass production system. Ford wrote in his *My Life and Work* (1922) and addressed his idea of waste. Ford stated that poor management of the workplace, which is the major focus of the modern concept of continuous improvement (kaizen) is the major type of waste. Ford stated that wasted motion and effort drives

costs to increase and profits to decline (Ford, 2013). Ford also examined how easy it was to overlook material waste in his factories and saw the rust and realized that the steel plant was to recover all of the iron. However, Womack et al. (2007) examined that Ford's early success was not sustainable. Though Ford did use waste reduction to accomplish his success, what Ford achieved was a specific case rather than an extensive use of Lean principles as the management tool of his business.

The major criticisms that Ford faced were that his methods were built for a steady state environment, rather than for the dynamic conditions firms increasingly experience now (Womack, Jones, & Roos, 2007, pp. 141-148). Design for manufacture (DFM) also was Ford's concept. Ford stated that the company reduces cost by cutting out useless parts and simplifying necessary ones but also to remember that all parts are designed so that they can be produced with ease (Ford, 2013). This standardization of parts was central to Ford's concept of mass production and the manufacturing tolerances or upper and lower dimensional limits that resulted in interchangeable parts. This standardization of parts became widely applied across manufacturing (Womack, Jones, & Roos, 2007, pp. 141-148).

Toyota Develops the Toyota Production System (TPS) in Japan

However, a few decades later, the Japanese quality expert, Genichi Taguchi, demonstrated that Ford's simplistic goal post method of measuring was not sufficient. Taguchi showed that loss in capabilities did not start only after exceeding these tolerances but increased as described by his statistical model at any condition exceeding the normal (Taguchi, Chowdhury, & Wu, 2004, pp. 52). This development became an important part of Deming's quality movement in the 1980s, later helping him to investigate key areas of focus such as cycle time variation in improving manufacturing quality and efficiency in many industries (Womack, Jones, & Roos, 2007, p. 301).

Though Ford is recognized for his mass production line, it is often overlooked how much he put his effort into removing the fitters' work to keep the production line moving. Until Ford, a car's components needed to be fitted or reshaped by engineers at the point of assembly so that the parts will connect properly. Ford was able to reduce manufacturing effort by roughly half by enforcing strict specification and quality measurements. Nevertheless, Ford's mass production system failed to incorporate the idea of Lean's pull production and, therefore, often suffered from overproduction (Womack, Jones, & Roos, 2007, pp. 22-26).

Because Lean principles evolved from the study of the Toyota Production System (TPS), one might expect that the principles of Lean and TPS are similar. They are very similar, but they are nevertheless organized differently. To understand Lean, one needs to understand what TPS is. Toyota's development of TPS, which later became the Lean manufacturing may have started around the turn of the twentieth century with Sakichi Toyoda. The Toyoda was founded by Sakichi Toyoda in 1926, where he pioneered the practice of jidoka (automation with a human touch). Ten years later, the company changed its name to Toyota and Toyoda's son, Kiichiro, and an engineer nephew, Eiji, began producing automobiles with parts from General Motors. Japan's entry into

WWII in 1941 diverted its efforts to truck production; during postwar reconstruction, the company nearly went bankrupt (Liker, 2004, p. 228).

Unfortunately, after WWII, levels of demand for Japanese products in the world was low and application on mass production to lower the cost per product through the economies of scale had little promise. Around the same time, Taiichi Ohno, a Japanese industrial engineer and the father of the Toyota Production System (TPS), visited the United States (U.S.) after WWII and studied retail operations and recognized that scheduling of work should not be driven by production targets but by actual sales to eliminate overproduction (Ohno & Bodek, 1988, pp. 1-17). Given Japan's poor financial situation during this period, Ohno recognized that unnecessary overproduction needed to be avoided. Thus, the concept of kaizen or pull, to build to order than target-driven push was implemented in production scheduling. Originally, TPS was called just-in-time production; it builds on the approach created by the founder of Toyota, Sakichi Toyoda, his son, Kiichiro Toyoda, and Taiichi Ohno (Liker, 2004, pp.71-73). The principles underlying TPS are exemplified in Toyota's management philosophies and operations.

Taiichi Ohno and Eiji Toyoda, Toyota's Japanese industrial engineers, developed TPS between 1948 and 1975 (Liker, 2004, pp.71-73, p. 11). The TPS is an integrated socio-technical system, an approach to complex organizational work design that identifies the interaction between individuals and technology in workplaces developed by Toyota, which embraces its management philosophy and practices (Liker, 2004, p. 27). The TPS organizes manufacturing and logistics for the automobile manufacturers, including interaction with suppliers and customers. Ohno found the seven wastes or muda as part of this system, and the TPS is the major precursor of the more generic Lean manufacturing (Ohno & Bodek, 1988, p. 95).

Types of Waste

As an individual, if one ever tried to get back in shape, one knows that one has to change the way one eats, exercises, hydrates, and rests to have long-term success in building a healthy, fit body. When one starts on a Lean journey, one of the important ways to improve the health of the value stream is to eliminate waste. Like the empty calories of junk food, one will find that a lot of non-value-added activities have crept into the diet of one's value stream. Because the foundations of Lean originated from the TPS, the language of Lean contains quite a few Japanese words. Waste in Lean is described as the three broad types of waste: muda (waste), mura (unevenness), and muri (overburden). Muda is divided into seven forms of waste (Ohno & Bodek, 1988, p. 96-98).

Seven Forms of Muda (Waste)

Waste is everywhere, and one might waste time waiting in line or waiting in traffic. Taiichi Ohno categorized muda (waste) into seven forms (Ohno & Bodek, 1988, p. 95). These seven forms are transport, waiting time, overproduction, defects, inventory, motion, and excess processing (Ohno & Bodek, 1988, p. 71). The first type of waste is transportation. Any movement of product or materials that is not otherwise required to perform value-added processing is waste. The more one moves, the more opportunity one has for injury or damage (Liker, 2004, pp. 29-31). The second

type of waste is waiting. According to Ohno, waiting in all forms is waste. Any time a person's hands are idle is a waste of that resource, whether due to shortages, unbalanced workloads, need for instructions, or by design (Ohno & Bodek, 1988, p. 10).

The third type of waste is overproduction. Producing more than one's customer requires is waste. It causes other wastes like inventory costs, manpower, and conveyance to deal with excess product, consumption of raw materials, and installation of excess capacity (Liker, 2004, pp. 28-29).

The fourth type of waste is defects. Any process, product, or service that fails to meet specifications is waste. Any processing that does not transform the product or is not done right the first time is also waste (Liker, 2004, p. 30). The fifth type of waste is inventory. Inventory anywhere in the value stream is not adding value. One may need inventory to manage imbalance between demand and production, but it is still non-value-added. Inventory ties up financial resources. It is at risk to damage, obsolescence, spoilage, and quality issues. It takes up floor space and other resources to manage and track. Large inventories can cover up other signs in the process like imbalances, equipment issues, or poor work practices (Liker, 2004, p. 28). The sixth type of waste is motion. Any movement of a person's body that does not add value to the process is waste. This includes walking, bending, lifting, twisting, and reaching. It also includes any adjustments or alignments made before the product can be transformed (Liker, 2004, p. 88).

The seventh type of waste is over-processing. Any processing that does not add value to the product or is the result of inadequate technology, sensitive materials or quality prevention is waste. Examples include in-process protective packaging, alignment processing like basting in garment manufacturing or the removal of sprues in castings and molded parts (Liker, 2004, p. 30). Also, there are two types of muda. One includes actions that are non-value-added but are for some other reason deemed necessary. These forms of waste usually cannot be eliminated immediately. Another type of muda is those activities that are non-value-added and are also not necessary (Liker, 2004, pp. 28-29). These are the first targets for elimination.

Mura (Unevenness) and Muri (Overburden)

Beyond the general forms of muda are two other related waste family, mura and muri (Liker, 2004, pp. 28-29). As with the forms of muda, the goal is to eliminate these types of waste, as well. Mura is variation in an operation when activities do not go smoothly or consistently. This is waste caused by variation in quality, cost, or delivery. Liker (2004) illustrates that mura consists of all the resources that are wasted when quality cannot be predicted (Liker, 2004, p. 280). This is the cost for things, such as testing, inspection, containment, rework, return, overtime, unscheduled travel to the customer, and one can use statistical tools and methods, including Pareto charts and design of experiments (DOE) (Shingo & Dillon, 1989, pp. 80-102).

Some might mistakenly think that statistics and data analysis are not part of Lean, but this assumption is inaccurate. Shingo and Dillon (1989) stresses that to reduce mura and muda, one need to study data because by measuring one's process before and after, one verifies that one has improved or not (Shingo & Dillon, 1989, pp. 140-151).

Ohno described muri as the unnecessary or unreasonable overburdening of people, equipment, or systems with demands that exceed capacity (Ohno & Bodek, 1988, pp. 45-61). Muri is the Japanese word for unreasonable, impossible, or overdoing. From a Lean perspective, muri applies to how work and tasks are designed (Cusumano & Kentaro, 1998, p. 26). Cusumano, and entaro (1998) show that one of the core tenets of Lean is respect for people. When a company is asking its people to repeatedly perform movements that are harmful, wasteful, or unnecessary, it means the company is not respecting its people and, thus, is not respecting the foundation of Lean (Cusumano & Kentaro, 1998, pp. 56-86). In addition to physical overburdening, requiring people to work excessive hours is a form of muri, as well (Ohno & Bodek, 1988, pp. 45-48).

Ohno demonstrated that excessive demands of the business environment all contribute to muri. Muri manifests itself in employee turnover, medical leaves, system outages and downtime, and poor decision-making. The clear identification of non-value-added work, as distinct from wasted work, is critical to identifying the assumptions behind the current work process and to challenging them in due course (Ohno & Bodek, 1988, pp. 70-82).

Relevance of Lean

In Lean, one relies heavily on teams of people working together to improve the effectiveness of the business (Cusumano & Kentaro, 1998, pp. 10-16). Cusumano and Kentaro (1998) explained that Lean environments have many types of teams (p. 26-32). There are natural work teams, cross-functional teams, teams that come together for kaizen, teams that include members from the upstream or downstream of the organization. The type of team formed and length of time the team stays together is dependent on the reasons for the team's existence and the performance objectives. The team environment takes advantage of collaboration between individual members to identify a better solution, eliminate waste, accomplish an objective faster, and produce larger benefits (Cusumano & Kentaro, 1998, pp. 10-23).

Lean in the Organization: Lean Leadership

Highly performing teams in Lean culture have certain characteristics. They look a certain way, and they behave a certain way. High-performing teams know where they need to go and why they need to go there. They understand how they contribute to the success of the whole and how it serves the customer. They have short-term goals that move them in the direction of the long-term goals. Also, a winning team has clearly defined roles, and the team members develop and maintain healthy relationships. They rely on the diverse talents of each team member (Cusumano & Kentaro, 1998, pp. 110-115). They show mutual trust and support and resolve conflicts productively. Performing teams also have multi-directional, effective communication (Harada, 2015, pp. 23-30).

Communication flows effectively within the team and beyond. It is productive, solution-focused, and proactive. Performing Lean teams have clear processes, decision-making, and continuous improvement orientations. They are empowered to make decisions and do so promptly. They have a problem-solving and continuous improvement mentality (Harada, 2015, pp. 65-71).

Successful Lean teams demonstrate creativity, innovation, and adaptability (Cusumano & Kentaro, 1998, pp. 111-118).

They use all of the talents of the team to create new product and process innovations. They learn to adapt to changing markets and customer situations while maintaining a commitment to their core Lean principles (Harada, 2015, pp. 68-70). They solve problems in a systematic and effective way. The Lean leadership is from within, and it is congruent in words and actions (Harada, 2015, pp. 72-74). Managers in successful Lean cultures eliminate barriers, provide direction and mentoring, and develop capabilities and development opportunities. They trust the team to perform, and they empower team members to solve problems and make decisions quickly. Last, performing Lean teams recognize the value of celebration and acknowledgment (Harada, 2015, p. 58).

Lean advocates the development of multifunctional workers, especially in natural work teams (Liker & Convis, 2011, p. 15). They train each member of the area in the activities of the others. They track training progress and develop a level of competency before an employee performs a task unsupervised (Liker & Convis, 2011, pp. 16-18). This is easy to envision in a manufacturing environment, but Lean advocates apply the same philosophy in non-manufacturing environments like accountancies, industrial kitchens, retail outlets, or hospitals (Liker & Convis, 2011, pp. 25-28). By having a well-trained workforce, an organization is insulated against the effects of absenteeism, vacations, and variations in demand. Managers directly influence the adaptation of Lean through their behaviors, decisions, and communications. As the face of Lean leadership, they have the challenging role of leading an organization to success in spite of their personal reactions to the change (Liker & Convis, 2011, p. 30). Liker and Convis (2011) state that declaring an organization will become Lean is easy, but making the change is harder (p.6).

Managers should start by creating a clear vision for the organization, such as a straightforward image of what it means for the organization to move toward Lean. In successful Lean organizations, Lean is not an initiative. It becomes the way one does business (Liker & Convis, 2011, pp. 25-30). Working in a Lean organization is not like working in a traditional organization. It requires one to develop a different mindset and an updated leadership style from a traditional leadership.

Essential Characteristics of a Successful Lean Management

Liker and Convis (2011) state that the essential characteristics of a successful Lean management are to be relevant and effective (pp. 90-119). The Lean management members need to stay true to the long-term focus, even in a short-term crisis. The top of the organization sets the long-term vision and strategy for the enterprise. Whatever action one decides must be consistent with the long-term vision and investment in the organization. An effective Lean manager needs to maintain an unrelenting commitment to delivering customer value through the elimination of waste in all aspects of the business (Liker & Convis, 2011, pp. 26-32).

One needs to understand that a Lean organization exists to deliver value to its customers. Liker and Convis (2011) state that a true Lean organization offers servant leadership at all levels (pp. 147-185). One needs to serve one's team, help others break down barriors to eliminate waste

and better deliver customer value. One needs to challenge, ask questions, show respect, lead from knowing and understanding, and never be satisfied with the status quo (Liker & Convis, 2011, pp.132-137).

Harada (2015) states that a Lean manager needs to focus on both process and results (pp. 13-20). How a Lean manager and the organization achieve results is as important as the results themselves. The leader needs to put his/her efforts into developing sound processes, ensuring people meet the standards, relentlessly improving the business's processes, and leading the business to the results required (Liker & Convis, 2011, pp.150-160). A Lean organization should maintain integrity and congruency in words, actions, and vision. Lean leaders need to create long-term and short-term visions independent of the circumstances and lead consistently. One must be the same person, whether people are watching or not. Through leadership, Lean leaders need to create an environment of trust (Harada, 2015, pp.20-30).

Also, exemplary Lean leaders need to engage in deep reflection, understand why and accept mistakes, and commit to improvement (Liker & Convis, 2011, pp.111-113). The Japanese call reflection, hansei (Ohno & Bodek, 1988, p. 25). Whether things are going well or not, leaders should reflect on and understand why a situation is as it is. By understanding the cause of a situation, a leader can direct even more improvement efforts. In the current, fast-paced global business climate, this reflection is vital to success. When a leader does not understand what worked or did not work and why, that Lean leader cannot repeat success or learn from the business' efforts (Ohno & Bodek, 1988, pp. 22-30).

Lean in Human Resources

A successful Lean organization needs to attract and retain talented and willing people (Liker & Convis, 2011, pp.90-91). Leaders must focus hiring processes to find the right people for an organization. After a leader has hired employees, he/she must treat them as a long-term asset, not just bodies filling organizational roles. A Lean leader should lead by going and seeing, which is called genchi genbutsu in Japanese (Ohno & Bodek, 1988, pp. 97-99). A Lean leader should not delegate understanding, but go where the action is or to gemba to understand the true nature of problems and solutions. From this knowledge, a Lean leader can direct and guide problem solving (Ohno & Bodek, 1988, pp. 101-104). A successful Lean manager is also nonjudgmental and blame-free. He/she does not expect perfection, but how he/she responds when people make mistakes or when solutions do not work determines how well he/she respects and engages employees (Ohno & Bodek, 1988, pp. 20-28). Lean leaders must create a blame-free culture and not make failure personal. Instead, they should focus on what can be learned and what is the next thing needed to deliver value or achieve a goal.

Successful Lean organizations build capability in their people by mentoring them through problem solving (Ohno & Bodek, 1988, pp. 15-19). Because Lean leaders go and learn, they have a better understanding of the situation. This does not mean they have all the answers or solutions, but they will have the foundation for directing problem solving (Ohno & Bodek, 1988, pp. 97-99). Lean managers can point people where to look but not tell people how to solve their problems;

they should use Socratic methods to guide people to find solutions. Leaders should insist on rapid, simple, and systematic solutions first and change one thing at a time (Liker & Convis, 2011, pp.106-111).

Lean organizations recognize that their people are part of a greater community and that one operates in a relational ecosystem (Shingo & Dillon, 1989, pp. 12-20). Effective Lean leaders build long-term partnerships with customers, people, suppliers, and community (Liker & Convis, 2011, pp.50-64). By creating long-term productive, supportive, and challenging relationships, leaders can create broader change (Shingo & Dillon, 1989, pp. 24-30). Lean principles consider the long-term consequences of organizational decisions and legacies that will last into the future. Lean organizations guide their supply partners to improve and be successful in the long-term. Also, Lean leaders are never satisfied with the status quo (Liker & Convis, 2011, p.132).

Even when one has the best cultures and processes, one will decline when no one invests in them. Lean leaders should adopt the mindset that there is always a better way to move their organization toward its long-term vision (Liker & Convis, 2011, pp.130-141). Treating the long-term vision as attainable is important in Lean management. Lean organizations need to eliminate the barriers that block progress to attaining the vision. Lean leaders view a safe and Lean workplace as an obligation (Liker & Convis, 2011, pp.110-124). A clean, safe workplace is non-negotiable. Leaders' respect for people obligates them to ensure their safety. In Lean, leaders need to ensure people follow standards and eliminate barriers. They need to accept that they are responsible for ensuring that people follow standards (Ohno & Bodek, 1988, pp. 145-161).

Without standard conditions, leaders do not have a platform for consistency or improvement. Understanding the nature of the nonconformance, leaders should not assume there is a training issue (Liker & Convis, 2011, p.138). Instead, Lean leaders need to investigate to learn the true cause of problems and the singular countermeasure that will create a standard condition (Ohno, 2012, pp. 65-76). Committing to Lean practices is worth investing time in people for the long-term payoff. The success of Lean implementation in dynamic global environment is worth noting.

Lean Enterprise Management

Lean is an enterprise methodology. Some organizations may have mistakenly believed that it is only for the production part of their business, but it applies to all of the business (Womack & Jones, 2003, pp. 102-120). In the supply chain, for example, when it takes ten times longer to get materials from suppliers than it should, an organization will not be able to supply customers faster. By applying Lean across the enterprise, the multidisciplinary views and experiences will help the core business better serve the customer. Because Lean principles apply to processes in general, any process in any area of an organization can be improved using Lean (Womack & Jones, 2003, pp. 275-298).

Practicing Lean anywhere benefits the practice of Lean everywhere. Lean is not something done only by Lean experts or workers off in a corner (Cusumano & Kentaro, 1998, pp. 12-26). The more widely Lean is practiced across an enterprise and the greater understanding, acceptance,

and support it achieves in each area, the better one will serve one's customer and improve one's business. Lean practices reduce waste, time, and mistakes and improve overall customer satisfaction, and enterprise performance from the support areas to the operational floor (Womack & Jones, 2003, pp. 37-45).

In the Lean enterprise, Lean practitioners look at the whole business system (Cusumano & Kentaro, 1998, pp. 1-18). They conduct improvement activities at all levels with a complete view, seeing not only their value stream and their customers, but everyone's customers, the organization's customers, and the end consumers. Everyone examines the processes that influence results and performance (causes and effects) and sees the organization through the lenses of kaizen, or continuous improvement. Kaizen maintenance aims to maintain performance levels by following standardized work, and kaizen improvement targets continuous improvement to existing standards and processes or creating new processes (Ohno & Bodek, 1988, pp. 60-72). Across the Lean enterprise, people apply all their training and knowledge, using their resources and skills to provide support and supervision to both the improvement and the maintenance of standards. This business philosophy calls for never-ending efforts that involve everyone: executives, managers, and workers (Liker & Convis, 2011, pp. 30-45).

Satisfying the Customer through Lean

Lean principles lead to organizational behavior changes in many ways. At the epicenter of this change is the customer (Harada, 2015, pp. 16-20). In Lean, the customer is the primary focus; it is not that the customer is always right, but it is that what the customer values is everything. The customer defines value, and the customer stimulates the demand for a product or service; the customer defines the requirements and evaluates the results (Liker & Convis, 2011, pp. 68-85). Lean organizations optimize all processes and activities within the enterprise to deliver customer value.

Lean organizations manage the customer following the same rules, protocols, and philosophies as other Lean enterprise activities (Womack & Jones, 2003, pp. 161-180). Lean takes the waste out of customer relationship activities, optimizes the value stream of customer-facing functions, shortens the cycle time of customer response, takes a holistic system view of the customer, and understands the customer's customer (Liker, 2004, pp. 73-74). Lean optimizes the customer interface functions just as one would for any function across the enterprise using kaizen. Lean organizations strive to create customers for life (Liker, 2004, pp. 177-178). The customer relationship is where their expectations meet one's abilities, where leaders address their goals and desires by the results of their enterprise and the capacity of an enterprise's systems of development, production, and support. Lean solutions will deliver high levels of satisfaction for both the customer and the enterprise (Womack & Jones, 2003, pp. 43-45).

Lean Requires Thinking Differently

Lean is different from traditional Western-style thinking, organizational structures, and management styles, so keeping one's bearing can be difficult. Traditional ways of working still

have force and momentum. Many people, some well-meaning and some not, can quietly conspire either accidentally or purposefully derail Lean initiatives. Monden (1998) reports that many large companies have failed to implement Lean and fallen prey to pitfalls, such as complacency, senior managers not willing to embrace Lean, and assuming that Lean is a quick fix and suffered (pp. 23-28). There are common causes of problems with Lean initiatives, but conscious group effort in an organization will allow the organization to successfully implement Lean for the long-term.

Criticisms of Lean: Why Lean Might Not Work for an Organization

Taguchi et al. (2004) point out that there are multiple approaches to improvement, and for example, Six Sigma, the statistical tools most associated with this approach can be useful in the reduction of variation or mura, elimination of defects, but the infrastructure of a Six Sigma initiative differs greatly from that of Lean (pp. 12-20). One can include Six Sigma tools within Lean, but because Lean is a fundamental methodology, it cannot be wholly subjugated into other frameworks. Lean is a holistic and complete system. One needs to be thoughtful of how one adapts other methods and tools with Lean (Womack, Jones, & Roos, 2007, pp. 51-56). Womack et al. (2007) state that one of the most common mistakes of Lean implementations is the piecemeal application of individual tools (pp. 40-45). An organization that believes that a couple of tools will solve their world hunger problems is grossly mistaken.

One may find people who have a preconceived idea that Lean is not for them. These people may have other ideas or are used to thinking another way and do not want to change. Others may mistakenly think that Lean is strictly for manufacturing companies like Toyota. However, authorities in management agree that it is now proven that Lean principles are applicable everywhere (Balle, Morgan, & Sobek II, 2016). Complacency can be another killer of Lean initiatives. It is sometimes hard for people to change their behaviors and stay the course. Even when things are not going well, it is often difficult for people to change and take on a new initiative and carry it forward. Unfortunately, some people cannot see the compelling reason to change if there is no crisis in front of them.

Also, because Lean is a continuous, incremental change process, it is sometimes difficult for some people or organizations to perceive the significance or the value of the small, continuous kaizen changes. When they cannot see it, and when it does not appear significant enough, they are going to wonder why they need to change. Womack and Jones (2003) explain that resistance to change is natural to any change initiative, and it is no different in Lean initiatives (pp. 26-29). However, Lean can intensify this resistance through its incremental baby-steps approach. Like with any program or initiative, when the senior managers do not fully embrace Lean, one has a very difficult road ahead (Cusumano & Kentaro, 1998, pp. 12-24).

John Kotter, an authority in change management, and many in the industry would share that an organiztion's chances of a successful Lean implementation are null without senior management's full commitment and action because the initiative is so all-encompassing and life-changing; without management's active participation, it cannot happen (Harvard Business Review, 2010, pp. 137-152). Also, Lean is not a quick fix. Ohno demonstrated that the true power of the

Lean principle is through continuous, incremental improvement over the long-term (Ohno & Bodek, 1988, pp. 45-49).

Lean Everywhere

The future of Lean across all industries is limitless. Womack and Jones assert that the principles, methods, tools, and techniques apply in any situation (2003, pp. 14-36). Looking at a business, organization, or industry through the lens of Lean will open up new ways for improvement opportunities. Cusumano and Kentaro (1998) affirm that Lean fuels a passionate emphasis on waste reduction and value creation anywhere and everywhere across the enterprise (p. 98). It is in the excitement of enablement, the exuberance that comes from recognizing one has both the power and the ability to conquer frustrating obstacles.

Lean Across Industries, Not Just Manufacturing

According to The Lean Marketer (2013), marketing is the area in which the Lean organization and the customer develop mutual interest and excitement. This is the place and time in which dreams of future value are created. Lean in marketing is the process of conceiving and refining the basis for exchange (The Lean Marketer, 2013). Lean marketing asks what the customer might want and what the enterprise might deliver. Tools such as quality function development (QFD) and kano modeling are part of the transition between marketing and design. Akao developed QFD in 1966. QFD is a method to help translate customer needs into engineering characteristics and appropriate statistical test methods for a product or service. It prioritizes each product or service characteristic while setting development targets for the product or service (Akao, 1994, p. 339).

The Kano model is a product development tool created in the 1980s by Kano; it classifies customer requirements into five categories (Malcolm, 2016). The Lean Marketer describes that when implementing Lean in marketing, the value stream is a flow of concepts and ideas; the products are emotions. Customer value is measured as demand. Waste is anything that does not stimulate this value stream. Further, integrating Lean helps the enterprise through systems and processes of capability, capacity, and profitability (The Lean Marketer, 2013).

According to Sales Process Excellence, Inc. (2012), sales processes are often transactional and systems-based, and they tend to be focused on the transaction process and revenue. Applying Lean to the sales process enables one to focus on customer value and ensure the right customers receive the right offer (Sales Process Excellence, Inc., 2012). According to Kotler and Armstrong (2013), in online and the global Internet world, tools like product configurators and guided selling tools enable customers to move quickly and easily through the buying process. These tools match supply and production capacity with customer buying preferences (Kotler & Armstrong, 2013). Computer companies exemplify this process. For example, when production of laptop hard drives was temporarily halted due to a natural typhoon in Asia, a Lean enterprise's online tool quickly enticed consumers to select similar hard drives through special pricing and incentives. This way, customers are receiving a deal while the company turns a production problem into a marketing opportunity.

According to Kotler and Armstrong (2013), service after the sale is one of the make-or- break functions of the long-term customer relationship. This is likely the longest period of direct customer interaction; it is longer than the spikes of marketing or sales activity. It brings the customer back for more or it drives the customer away, and some may never return. Because good service keeps customers coming and poor service kills the customer relationship rapidly and permanently, one must apply significant energy and attention to optimizing the customer service function (Kotler, & Armstrong, 2013).

The Lean Marketer (2013) recommends an organization should design its customer service process as part of the whole value stream and apply Lean techniques to ensure that it is designed to best serve direct customers and that it is well-integrated with marketing and sales processes. The service process can provide valuable customer information because it is the gemba. How the lessons learned in gemba are fed back to the organization will impact an organization's ability to satisfy the customer and continue to improve its processes with the latest customer information (The Lean Marketer, 2013).

Lean organizations use Lean tools to closely connect their development processes with customers. Cusumano and Kentaro (1998) illustrate that the customer's voice not only tells the developers what to design, but that the customer's notion of value reveals much about the design process and thereby helps the developers eliminate non-value-added steps and activities. Lean organizations listen closely for details and any nuance that can further elucidate a requirement or specification that they can translate into the functional design of products and services (Cusumano & Kentaro, 1998, pp.102-106). The Lean process hears the customer's voice first, foremost, and louder than any other voice.

According to Parkinson, Yorwerth, and Silvester (2009), Lean IT is the extension of Lean manufacturing and Lean services principles to the development and management of information technology (IT) services. New programming tools and frameworks are enabling IT to be Lean itself and better fulfill its responsibility to provide the right technology and information systems that enable information flow within the value stream and the delivery of customer value (Parkinson, Yorwerth, & Silvester, 2009). IT's role in the enterprise continues to evolve rapidly as technology evolves. Technology is now supporting nearly every business function, enabling new business opportunities and facilitating closer interfaces with both the customer and consumer. The IT industry has developed platforms, tools, and capabilities that better enable Lean practices and is now better able to play a central role in the development and ongoing maturity of the Lean enterprise.

Conclusion

The Lean movement began in the production arena on the operational floor in Japanese automotive manufacturing and assembly plants. This is where the Lean philosophy, Lean principles, and techniques were first developed and later refined. Lean production techniques are much different from those used for twentieth-century style industrial mass manufacturing. Lean in the production area has always been about doing more with less, improving quality and effectiveness while

consuming less time, fewer resources, less energy, inventory, labor, and capital. The classic term, Lean manufacturing, has been applied to the greater movement that eliminated waste (muda, mura, and muri), streamlined processes, and sped up overall production while enabling and respecting employees and making customers happy.

More than ever, the pressure is on businesses of all types and sizes to rapidly develop and bring innovative, high-quality products and services to market. New product development efforts are now characterized by ever-shortening product-development cycles, lower-budgeted development costs, and required increases in product quality. More demanding customer requirements are constantly pushing the envelopes of features, customization, energy efficiency, environmental compatibility, reliability, maintainability, and life-cycle cost of ownership.

Lean development processes enable an enterprise to produce products and services faster with fewer resources and at higher levels of quality while using less capital and making satisfied customers. Lean development practices help managers address a myriad of challenges that conspire against them, including uncertain requirements, chaotic work environments, non-reusable designs, increasing product complexity, prohibitively expensive prototyping and test regimes, and rushed design changes. It is now proven that Lean applies almost everywhere for enterprises in any industry and all functions and processes (Balle, Morgan, & Sobek II, 2016). One must remember that how an organization applies Lean is unique to circumstances. Lean is not formulaic, so it needs to be tailored to how it best works for the enterprise. However, organizations must not let anyone say that Lean is not for them because Lean can be applied to everything anywhere. Lean organizations just need to help others understand why it is the right thing to do and how everyone benefits from Lean principles.

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