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Role of Lean Manufacturing on Organization Competitiveness

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ABSTRACT

This paper focuses on an empirical and theoretical understanding of lean manufacturing as a general solution to effective operations management in an organization through applications of its elements such as Just-in-time, higher efficiency manufacturing through the principle of 'continuous product flow', Continuous improvement of processes along the entire value chain and setting up of multi-functional and multi-skilled teams at all levels to achieve its goals. The redesign of the production floor such that a product is manufactured progressively from one workstation to another with minimal waiting time and handling operations between stations has been the main objective of many organizations today however lack of proper understanding of lean concept and its application has resulted to redundancy in many organization activities. This paper illustrates the role that lean manufacturing play today in our organizations in facilitating operations and hence production flow, maximizing profit, meeting customers' expectations and being competitive, with minimal or no waste.

Finally implementation of lean manufacturing practices should support the company business strategy and be in line with the corporate vision, mission, values and plans including communication and evaluation plans to build employee buy-in and communicate results. This will eventually improve overall organization performance and cultivate a closer customer relationship.

Key words: Lean manufacturing, Just in Time, Value, Continuous improvement, Total Quality Management

INTRODUCTION

1.1 Background

Lean manufacturing is a management philosophy focusing on reduction of many different types of waste in order to improve overall customer value. By eliminating waste, quality is enhanced and production time and costs are compressed Jordan etal (2001). To solve the problem of waste, lean manufacturing has several tools at its disposal. These include regular process analysis (kaizen blitz), pull production by means of kanban, total quality management, just in time approach and total productive maintenance.

In the 1950's Toyota Motor Corporation created Toyota Production System, then it formatted a new kind of Management concept 'Lean thinking'. The applications of lean thinking on manufacturing i.e. 'Lean production' reduce manufacturing cost, shorten development and manufacturing cycle time and enhance enterprise competitiveness. Besides auto industry, Lean production also extends to machinery manufacturing, electronics, consumer goods, aerospace and shipbuilding and becomes another milestone of modern production method after mass production method. In 21st century the application of lean thinking obtains advancements and has turned

into a new generation guidance thinking of management revolution. Lean manufacturing means eliminating wastes by identifying non value added activities thorough out the supply chain. The five fundamental Lean principles are to specify value from the point of view of customer, identify the value stream, make the identified value flow, set the pull system which means only make as needed and finally perfection in producing what the customer wants and by when it is required in the right quantity with minimum waste. It has become a universal production method and numerous plants around the world such as Toyota and other companies have successfully implemented it. Though Lean manufacturing started in the automotive industry, it has been applied successfully in other disciplines as well. Due to heightened challenges from global competitors, lean manufacturing has become a production method for many organisations to pursue.

1.3 CRITICAL ANALYSIS WITH REFERENCE TO OPERATION MANAGEMENT AND SUPPLY CHAIN MANAGEMENT

Toyota Production System (TPS) which is known as Lean manufacturing in their book “The Machine That Changed the World” has influenced the manufacturing practices around the world. The fundamental of TPS is to eliminate wastes and produce only the items needed at the required time and in the required quantities. Principles of lean are universal as they are broadly accepted by many manufacturing operations and have been applied successfully across many disciplines. It has become an integrated system composed of highly inter-related elements and a wide variety of management practices including Just-in-time, quality system, work teams, cellular manufacturing, etc. In addition, it requires keeping far less than half of the needed inventory on site, results in many fewer defects, and produces a greater and ever-growing variety of products. In short, it is called lean because it uses less, or the minimum, of everything required to produce a product or perform a service.

What is Lean Manufacturing

Lean Manufacturing can be defined as: Lean manufacturing or lean production, which is often known simply as "Lean", is the optimal way of producing goods through the removal of waste (Ohno 1988)**.** OR
“Lean manufacturing is the system which aims in elimination of the waste from the system with a systematic and continuous approach” OR
Lean Manufacturing is an operational strategy oriented toward achieving the shortest possible cycle time by eliminating waste. Lean manufacturing techniques are based on the application of five principles to guide management’s action toward success (Badurdeen 2007).

Value

In lean production, the value of a product is defined solely by the customer. Identifying the value in lean production means to understand all the activities required to produce a specific product, and then to optimise the whole process from the view of the customer.

Continuous improvement

The transition to a lean environment does not occur overnight. A continuous improvement mentality is necessary to reach your company's goals. The term "continuous improvement" means incremental improvement of products, processes, or services over time, with the goal of reducing waste to improve workplace functionality, customer service, or product performance.

Customer focus

A lean manufacturing enterprise thinks more about its customers than it does about running machines fast to absorb labour and overhead. Ensuring customer input and feedback assures quality and customer satisfaction, all of which support sales.

Perfection

The concept of perfection in lean production means that there are endless opportunities for improving the utilisation of all types of assets. The systematic elimination of waste will reduce the costs of operating an enterprise and fulfil customer's desire for maximum value at the lowest price.

Focus on waste

The aim of Lean Manufacturing is the elimination of waste in every area of production including customer relations, product design, supplier networks and factory management. Its goal is to incorporate less human effort, less inventory, less time to develop products and less space to become highly responsive to customer demand while producing top quality products in the most efficient and economical manner possible.

1.4 APPLICATION IN KENYA AND GLOBALLY

John Covington (1996) tells "the story of the stick-mark." John worked as an engineer at a company that produced x-ray film. One of all engineers' early assignments was to try to solve the "stick mark problem." The company had been scrapping millions of dollars worth of film every year, due to what they called a "stick mark." A stick mark was a discoloration on the film that occurred during the production process. The first thing John did was to take samples of good film and scrapped film from the scrap bins. He then brought them to a local hospital, where he asked the x-ray technicians to look at the film and see if they could find anything wrong with it. "No," was their response. They compared it to good film, and could not detect any differences. They then took some x-rays with "stick mark" film and "good" film. The radiologists were unable to detect any deficiencies in the x-rays, and were unable to detect any difference between the x-rays shot with either of the films.

John went back to his company to try to understand why they were throwing away film that customers considered to be good. Way back when, in the early days of film production, the process included a step where the film needed to be dried. The way in which it was dried was by hanging it over a stick. Sometimes, this process resulted in a long mark where the stick was. This was unusable film, and had to be thrown away. The company then instituted an inspection process so that good film could be sorted from "stick mark" film. As time went on, the company made better and better use of technology. Not only did the manufacturing process improve, but also as the stick marks became harder to detect, the inspection technology "had to be" improved as well, so that stick marks that were invisible to the eye could be caught. The defect had been eliminated, but the wasteful inspection and sorting process didn't. Wasteful? Yes, absolutely! The company later embraced the five principles of lean production i.e emphasised on value, continuous improvement, customer focus, perfection and elimination of waste which resulted to transformation of production process. Lean manufacturing principles have not been fully adopted in Kenya. Sugar companies have only partially embraced the concept which has lead to price difference between sugar produced in Kenya and Brazil although the climate in the Kenya sugar belt is the same as that of Brazil

1.5 KNOWLEDGE GAP

There is lack of studies which are focused on consolidating the various key practices of lean manufacturing and investigating their level of adoption in real life. A set of areas is used to explore the adoption of lean manufacturing practices. Lean Manufacturing concept is not fully understood and adopted due to its business dynamic in nature; a frame work of Collaborative Lean Manufacturing is needed to investigate the gap between the practice and ideal system. Furthermore, people factors such as culture, openness, trust, willingness to change and commitment also play significant roles in the collaborative lean manufacturing management development.

2.0 THEORETICAL PERSPECTIVE

2.1 Total Quality Management Model (Philosophy)

Deming, Ishikawa, and Juran share the view that an organization's primary purpose is to stay in business, so that it can promote the stability of the community, generate products and services that are useful to customers, and provide a setting for the satisfaction and growth of organization members (Juran, 1969: 1-5); Ishikawa, 1985: 1; Deming, 1986:). The focus is on the preservation and health of the organization, but there also are explicitly stated values about the organization's context (the community and customers) and about the well-being of individual organization members: As Ishikawa (1985: 27) said, "An organization whose members are not happy and cannot be happy does not deserve to exist." The TQM strategy is dependent on four interlocked assumptions-about quality, people, organizations, and the role of senior management.

Assumptions

a) Quality is assumed to be less costly to an organization than is poor workmanship. A fundamental premise of TQM is that the costs of poor quality (such as inspection, rework, lost customers, and so on) are far greater than the costs of developing processes that produce high-quality products and services. The organizations that produce quality goods will eventually do better even on traditional measures such as profitability than will organizations that attempt to keep costs low by compromising quality (Juran, 1974: 5.1-5.15; Ishikawa, 1985: 104-105; Deming, 1986: 11-12). Producing quality products and services is not merely less costly but in fact is absolutely essential to long-term organizational survival (Deming, 1993

b) Employees naturally care about the quality of work they do and will take initiatives to improve it so long as they are provided with the tools and training that are needed for quality improvement and management pays attention to their ideas. As stated by Juran (1974: 4.54). "The human being exhibits an instinctive drive for precision, beauty and perfection. When unrestrained by economics, this drive has created the art treasures of the ages." Organization must remove all organizational systems that create fear, such as punishment for poor performance, appraisal systems that involve the comparative evaluation of employees and merit pay (Ishikawa. 1985: 26; Deming.1986: 101-109).

c) Organizations are systems of highly interdependent parts, and the central problems they face invariably cross traditional functional lines. To produce high-quality products efficiently, for example, product designers must address manufacturing challenges and trade-offs as part of the design process. Cross-functional problems must be addressed collectively by representatives of all relevant functions (Juran, 1969: 80-85; Deming. 1993: 50-93). Ishikawa, by contrast, is much less system-oriented: According to (Ishikawa, 1985: 116-117), he states that cross-functional teams should not set overall directions; rather, each line division should set its own goals using local objective-setting procedures

d) Quality is viewed as ultimately and inescapably the responsibility of top management. Since senior managers create the organizational systems that determine how products and services are designed and produced, the quality-improvement process must begin with management's own commitment to total quality. Employees' work effectiveness is viewed as a direct function of the quality of the systems that managers create (Juran, 1974: 21.1-21.4; Ishikawa, 1985: 122-128; Deming, 1986: 248-249).

2.2 Change Principles

TQM authorities specify four principles that should guide any organizational interventions intended to improve quality namely;

The quality of products and services depends mostly on the processes by which they are designed and produced. It is not sufficient to provide clear direction about hoped-for outcomes; in addition, management must train and coach employees to assess, analyze, and improve work processes (Juran, 1974: 2.11-2.17; Ishikawa, 1985: 60; Deming, 1986: 52).

Uncontrolled variance in processes or outcomes is the primary cause of quality problems and must be analyzed and controlled by those who perform an organization's front-line work. Only when the root causes of variability have been identified are employees in a position to take appropriate steps to improve work processes. According to Deming (1986: 20); "The central problem of management is to understand better the meaning of variation, and to extract the information.

TQM calls for the use of systematically collected data at every point in a problem-solving cycle-from determining high-priority problems, through analyzing their causes, to selecting and testing solutions (Juran, 1974: 22.1-28.1; Ishikawa, 1985: 104-105; Deming, 1986: Although Deming, Ishikawa, and Juran differ in their preferred analytical tools, each bases his quality-improvement program on collecting data, using statistics and testing solutions by experiment.(Management by fact)

The long-term health of an enterprise depends on treating quality improvement as a never-ending quest. Opportunities to develop better methods for carrying out work always exist, and a commitment to continuous improvement ensures that people will never stop learning about the work they do (learning and continuous improvement) (Juran, 1969: 2-3; Ishikawa, 1985: 55--56; Deming, 1986: 49-52).

TQM Interventions

Despite some differences in emphasis, the three TQM authorities have a common philosophical orientation and share a set of core values about people, organizations, and change processes. They prescribe five interventions to realize those values.

Explicit identification and measurement of customer requirements

To achieve quality, it is essential to know what customers want and to provide products or services that meet their requirements (Ishikawa, 1985: 43). It is necessary, therefore, for organization members to assess directly customer requirements such as durability, reliability, and speed of service (Juran, 1974: 2.2; Deming, 1986: 177-182). Some customers are external to the organization, others are internal, as when the output of some organization members is passed on to others. TQM defines the next process down the line as the "customer" for

each process. Within the organization, then, the assessment of customer requirements serves as a tool to foster cross-functional cooperation (Ishikawa, 1985: 107-108). With data about customer requirements in hand, quality improvement can focus specifically on those aspects of work processes that are most consequential for customer satisfaction. Some organizations actively manipulate customer preferences (for example, through advertising) to bring them into line with what the organization already is able to provide. And customers may define their own requirements in terms of existing products and services that may be low in quality.

Creation of supplier partnerships

TQM authorities suggest that organizations should choose vendors on the basis of quality, rather than solely on price. Moreover, they recommend that organizations work directly with raw material suppliers to ensure that their materials are of the highest quality possible (Juran, 1974: 10.1-10.35; Ishikawa, 1985, Deming, 1986: 31-43).

Use of cross-functional teams to identify and solve quality problems

Although cross-functional teams can be used in multiple ways in TQM programs, their main purpose is to identify and analyze the "vital few" problems of the organization (Ishikawa, 1985: 113-119; Deming, 1993: 85-89). Juran (1969) refers to such teams as the "steering arm" of a quality effort. Other teams, also cross-functional are created to diagnose the causes of problems that have been identified by the steering arm and to develop and test possible solutions to them. Diagnostic teams can be either temporary task forces or continuing organizational entities. In both cases, department heads are included as team members to ensure that stakeholder departments will cooperate when the time comes to implement the team's recommendations. Choose people who can provide access to the data necessary for testing potential solutions and who are critical to implementing the solutions developed (Juran, 1969: 78-89).

Use of scientific methods to monitor performance and to identify points of high leverage for performance improvement; Three of the most commonly used tools are control charts, Pareto analysis, and cost-of-quality analysis.

A control chart provides a pictorial representation of the outputs of an ongoing process. Control charts are used to monitor the performance of a process and to determine whether that process is "in control"-whether the variance produced by the process is random or attributable to specific causes. It is assumed that all processes produce variance, but a stable process fluctuates randomly. Therefore, data from a stable process will tend to fall within predictable bounds. Scrutiny of a control chart allows the user to;

(1) Determine whether a given process is in need of improvement.

(2) identify points outside the control range so that the causes of uncontrolled variance can be sought

(3) Reassess the process after experimental attempts to improve it are completed (Deming, 1986: 323-346).

Pareto analysis is used to identify the major factors that contribute to a problem and to distinguish the "vital few" from the "trivial many" causes. Pareto charts are used when each separate contributor to a problem can be quantified. For example, a group attempting to identify the vital few causes of high inventory costs would list each inventory item in order of total shilling value of materials kept in stock. Those materials that turn out to be major contributors to inventory costs are then addressed first (Juran, 1969: 43-54). Cost-at-quality analysis is used to highlight the cost savings that can be achieved by doing the work right the first time. The analysis involves quantifying all costs associated with maintaining acceptable quality levels, such as the costs of preventing errors, and then comparing these with the costs incurred by failures to achieve acceptable quality, such as the cost of rework. Cost-of-quality analysis thus helps to identify those opportunities for improvement that offer the largest cost savings (Juran, 1974; Ishikawa, 1985: 54-55).

Use of process-management heuristics to enhance team effectiveness; The TQM authorities suggest several techniques to help quality teams use their collective knowledge effectively in identifying and analyzing opportunities to improve quality. Three of the most commonly used devices are flowcharts, brainstorming, and cause-and-effect diagrams. **A flowchart** is a pictorial representation of the steps in a work process. Flowcharts, which use standardized symbols to represent types of activities in a process, help members identify activities that are repetitive, that add no value, or that excessively delay completion of the work (Deming, 1993: 58-61). **Brainstorming** is used by groups to generate lists of ideas about matters such as the potential causes of a problem, possible solutions, and issues likely to be encountered in implementing those solutions. Its purpose is to tap the creativity of group members by explicitly ruling out the evaluation of member contributions to the list and actively encouraging building on others' ideas. Brainstorming often is followed by the Nominal Group Technique or multi-voting to reduce and prioritize the list that has been generated (Ishikawa, 1985: 64-65). **A cause-and-effect diagram** or "fishbone" was developed by Ishikawa to graphically represent the relationship between a problem and its potential causes. Fishbone diagrams can help a group examine thoroughly all possible causes of a quality problem and discern the relationships among them. Group members place the problem at the right-hand side of the page (the head of the fish). The "bones" of the fish are lines on which members list the

potential causes by category; the generic categories are causes related to people, tools, materials, and methods. Members then collect data to assess the potency of each of these potential causes (Ishikawa, 1985: 63-65).

According to the founders of TQM, the five interventions summarized above define the core of total quality management. Knowledge of customer requirements provides a test for considering and evaluating process changes. Supplier partnerships ensure that materials entering the organization are of acceptable quality. Cross-functional teams bring the full spectrum of relevant information and expertise to bear on decisions about system wide problems. Scientific methods and statistical analyses provide teams with trustworthy data to use in their decision making. And process management heuristics can improve the quality of the decision-making process itself.

2.3 Just In Time (JIT) Philosophy (Model)

JIT is not a cure-all for every manufacturing problem. But, if implemented properly, JIT is a no-cost or low-cost method for improving manufacturing process. The basis of Just-In-Time (JIT) is the concept of ideal production. It centres on the elimination of waste in the whole manufacturing environment, from raw materials through shipping. Just-In-Time is defined as "the production of the minimum number of different units, in the smallest possible quantities, at the latest possible time, thereby eliminating the need for inventory. JIT does not mean to produce on time, but to produce just in time.

JIT was invented by Taiichi Ohno of Toyota shortly after World War II. Ohno's system was designed to handle large or small volumes of a variety of parts, Ohno and his associates came to America to study the manufacturing processes. They determined that the system was much like the system that Japanese companies were using, but Japanese companies could not afford waste in their systems due to the devastation to their economy caused by World War II. While in America, Ohno learned much about America's culture. One of his discoveries has transformed the world's perspective on manufacturing.

Ohno learned the kanban (pull) system from the supermarket system in which customers pulled items from the shelves to fill their shopping carts, thereby creating an empty space on the shelf. The empty space is a signal for the stocker to replace that item. If an item was not bought that day, there was no need to replace it. When item quantities become low, that is the signal for the stockers to order more goods from their suppliers. Customers are content to take just what they need, because they know that the goods will be there the next time they need them. To apply this concept to manufacturing, Ohno devised a system whereby the usage of parts is determined by production rates. Materials are pulled through the plant by usage or consumption of the parts in final assembly. To obtain maximum results, Ohno decided to move the machines closer together and form manufacturing cells (AIDT - Just-In-Time Manufacturing - September 11, 2006). JIT is an operational philosophy which incorporates an improved inventory control system in conjunction with other systems, such as: set-up time improvement system, maintenance improvement system, quality improvement system, productivity improvement system, Properly implemented JIT system should; produce products customers want, produce products only at the rate that customers want them, produce with perfect quality, produce instantly with zero unnecessary lead time, produce with no waste of labour, material, or equipment and every move has a purpose and there is no idle inventory.

JIT steps or elements of the implementation process generally (though not always) include; reductions in set-up time, utilization of a formal preventive maintenance program, utilization of quality circles, utilization of cellular manufacturing techniques, quality certification of suppliers, reductions in vendor lead time, reductions in lot sizes, role sourcing, presence of one who "championed the cause of JIT within the firm.

Benefits touted as results of JIT implementation include:

Reductions in down time, reductions in inventory, reductions in scrap and re-work reductions in workspace, increased inventory turns, increased labour utilization, increased equipment utilization and improved service to customers.

2.4 **Total Productive Maintenance Model**

Total Productive Maintenance (TPM) is maintenance activities that are productive and implemented by all employees. TPM involves everyone in the organization from operators to senior management in equipment improvement. It encompasses all departments including: Maintenance, Operations, Facilities, Design Engineering, Project Engineering, Construction Engineering, Inventory and Stores, Purchasing, Accounting and Finance, Plant and Site Management

Goals of Total Productive Maintenance

TPM has goals, that is, improving equipment effectiveness, improving maintenance efficiency and effectiveness, early equipment management and maintenance prevention, training to improve the skills of all people involved and involving operators (occupants) in routine maintenance

Improving Equipment Effectiveness

This goal, which insures that the equipment performs to design specifications, is the true focus of TPM. All remaining goals for TPM are valueless unless they support improving equipment effectiveness. The focus must

be that nowhere in the world can another company have the same asset and make it produce more than your company can produce. If it does, then it is better at managing its assets than your company and will always be the lower cost producer or provider. The equipment must operate at its design speed, produce at the design rate, and produce a quality product at these speeds and rates. A major problem occurs because many companies do not know the design speed or rate of production for their equipment. In the absence of knowing the design criteria, management will set arbitrary production quotas. A second major problem develops over time when small problems cause operators to change the rate at which they run equipment. As these problems continue to build, the equipment output may only be half of that for which it was designed. This inefficiency then leads to the investment of additional capital in equipment, trying to meet the required production output.

Improve Maintenance Efficiency and Effectiveness

This goal focuses on insuring that maintenance activities that are carried out on the equipment are performed in a way that is cost effective. Studies have shown that nearly one-third of all maintenance activities are wasted. Therefore, this goal of TPM is important to lowering the cost of maintenance. It is important for all to understand that basic maintenance planning and scheduling are crucial to achieving low-cost maintenance. The goal is to insure lean maintenance, with no waste in the maintenance process. A secondary goal is to ensure that the maintenance activities are carried out in such a way that they have minimal impact on the up time or unavailability of the equipment. Planning, scheduling, and backlog control are again all important if unnecessary maintenance downtime is to be avoided. At this stage, maintenance and operations must have excellent communication in order to avoid downtime due to misunderstandings. Developing an accurate database for each piece of equipment's maintenance history is also the responsibility of the maintenance department. This history will allow the maintenance department to provide accurate data for decisions related to the plant or facility equipment. For example, the maintenance department can provide input to equipment design and purchase decisions, assuring that equipment standardization is considered. This aspect alone can contribute significant financial savings to the company. Standardization reduces inventory levels, training requirements, and start-up times. An accurate equipment history also helps stores and purchasing not only reduce downtime, but also avoid carrying too much inventory.

Early Equipment Management and Maintenance Prevention

The purpose of this goal is to reduce the amount of maintenance required by the equipment. The analogy that can be used here is the difference in the maintenance requirements for a car built in 1970 compared to a car built in 2000. The 1970 car was tuned up every 3040,000 miles. The 2000 car is guaranteed for the first 100,000 miles. This change was not brought about by accident. The design engineers carefully studied the maintenance and engineering data, allowing changes to be made in the automobile that reduce the amount of maintenance. The same can be true of equipment in a plant or facility. Unfortunately, most companies do not keep the data necessary to make these changes, either internally or through the equipment vendor. As a result, unnecessary maintenance is performed on the equipment, raising the overall maintenance cost.

Training to Improve the Skills of All People Involved

Employees must have the skills and knowledge necessary to contribute in a TPM environment. This requirement involves not only the maintenance department personnel, but also the operations personnel. Providing the proper level of training insures that the overall equipment effectiveness is not negatively impacted by any employee who did not have the knowledge or skill necessary to perform job duties. Once employees have the appropriate skills and knowledge, their input on equipment improvement needs to be solicited by senior management. In most companies, this step only takes the form of a suggestion program. However, it needs to go well beyond that; it should also include a management with an open doors policy. Such a policy indicates that managers from the front line to the top are open and available to listen to and give consideration to employee suggestions. A step further is the response that should be given to each discussion." In order to keep communication flowing freely, reasons must be given. Therefore, managers must develop and utilize good communication and management skills. Otherwise, employee input will be destroyed and the ability to capitalize on the greatest savings generator in the company will be lost.

Involving Operators (Occupants) in Routine Maintenance

This goal finds maintenance tasks related to the equipment that the operators can take ownership of and perform. These tasks may amount to anywhere from 10-40% of the routine maintenance tasks performed on the equipment. Maintenance resources that were formerly engaged in these activities can then be redeployed in more advanced maintenance activities such as predictive maintenance or reliability focused maintenance activities. It must be noted: the focus for the operations involvement is not to downsize the maintenance organization. Instead, the focus is to free up maintenance resources for the more technical aspect of TPM.

3.0 EMPIRICAL PERSPECTIVE

3.1 Lean Manufacturing

Lean Manufacturing, It is basically the fusion of various management philosophies designed to make operations as efficient as possible. Lean manufacturing operates on three principles: waste, is bad, manufacturing processes must be closely tied to the market's requirements, and company should be seen as a continuous and uniform whole that includes its customers and suppliers, a concept known as 'value stream'. The basic elements of lean manufacturing are: Just-in-time, higher efficiency manufacturing through the principle of 'continuous product flow' (also known as 'single piece workflow'), Continuous improvement of processes along the entire value chain, primarily in terms of quality and cost and setting up of multi-functional and multi-skilled teams at all levels to achieve its goals. Among these elements, the most eye-catching is perhaps the 'continuous product flow', which entails the redesign of the production floor such that a product is manufactured progressively from one workstation to another with minimal waiting time and handling operations between stations. This may mean the dedication of an entire process line to a group of similar products, or a group of products that undergo similar processing. The equipment and worktables are arranged in a 'streamlined' lay-out that keeps production continuous and efficient. Such a manufacturing set-up is also known as 'cellular manufacturing'. Attention to machine maintenance, up-time, and utilization is also a 'must.' According to lean manufacturing, the following are forms of 'waste' and should be eliminated, Waiting, Staging of inventories, Transport of inventories, Overproduction, over processing, unnecessary motion, Defective units.

By adopting a production floor that conforms to continuous product flow, these wastes can be reduced. Another technique is through the practice of 'customer pull', which means that only products that are immediately needed by the customer (or the next station) must be produced. Thus, a station needing inventories to process should be the one to 'pull in' these inventories from the previous station. Kaizen, or the Japanese concept of 'continuous improvement', is a major influence on lean manufacturing. This is why lean manufacturing promotes teamwork among multi-skilled, multifunctional individuals at all levels to effect the continuous achievement of process improvements toward zero non-moving inventories, zero downtimes, zero paper, zero defects, and zero delays all throughout the organization. Benefits of lean manufacturing, Waste reduction, and therefore, production cost reduction, Shorter manufacturing cycle times, Lower manpower requirements, Minimal inventories, Higher equipment utilization and manufacturing capacity, Improved cash flow, Higher product quality and reliability and Better customer service.

3.2 Lean Fundamentals

The Lean enterprise is focused on the elimination of waste. Based on a customer-focused systems view, this process provides the foundation of any lean enterprise as follows;

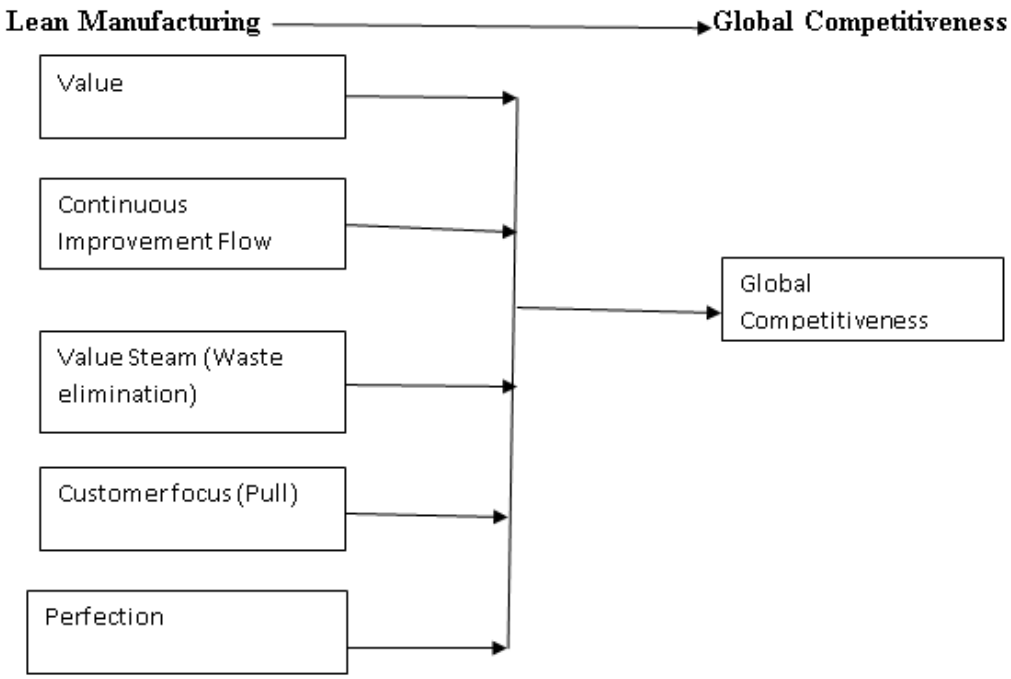

Fig. 1: Conceptualization

1. Specify Value

A waste-free process is a process that is working correctly. It takes time and effort to get the waste out of a process, so it is important to work on processes that create value. A firm's customers are the final judges as to whether or not the firm has created value. Therefore, one category of (waste) is having the "right" process for a product or service that the customer doesn't want. Lean companies therefore work to precisely define value in terms of specific products with specific capabilities offered at specific prices through a dialogue with specific customers. In other words, they work to understand and deliver what the customer wants to buy. Lean companies often restructure on the basis of product line, organizing managers and employees into product teams.

2. Identify the Value Stream

Covington (1996) defines the value stream as "The set of all the specific actions required to bring a specific product through the three critical management tasks of any business: problem solving, information management, physical transformation." Indentifying value stream in order to become lean involves creating detailed process flow diagrams for each product, highlighting all of the steps that are considered to be waste. This is usually done in the context of radical improvement. It requires re-examining of every aspect of a process. Any steps that can be eliminated immediately are stopped. Any activities that are identified as "non-value but currently necessary" become targets for improvement. This is also the point at which "target costing" is implemented. Target costing is a methodology in which the cost of a product is established based on its "waste-free" process. As it gets closer to the target cost, the lean philosophy suggests that the company will then be able to enjoy increased profits, or to reduce its selling prices to its customers, thereby increasing value in the customers' eyes.

3. Flow

In order to document the process, Lean teams will physically walk the process, noting the distance the product must travel in order to go through its entire process. Some very small operations report that their process is over a hundred miles long, and it is estimated that the process of producing aircraft is tens of thousands of miles long! With the process-specific waste identified and on its way to elimination, the purpose of this step is to encourage organizations to focus on rapid product flow, unencumbered by the walls and the physical distance that exist between typical functional departments. "Lean enterprises" are created for each product. The physical layout of the people and equipment involved in the process is changed. Factory floors are laid out in cells rather than in functional groupings, thereby reducing the distance parts must travel.

Lean enterprises implement what (Monden, 1996, p. 199.) collectively translate to a cleanup activity at the work place. The intention is to remove the waste associated with clutter and disorganization. The clean-up process involves;

a) Separate the necessary things from the unnecessary and discard the unnecessary

b) Neatly arrange and identify things for ease of use (a place for everything, and everything in its place)

c) To always clean up; to maintain tidiness and cleanliness—to clear your workplace thoroughly

d) To constantly maintain the 3 steps mentioned above ensures a clean workplace without rubbish or oil leakage.

e) To have workers make a habit of always conforming to rules.

4. Pull

In the lean enterprise, inventory is considered to be waste. Therefore, producing anything that is not sold is waste as well, for if it's produced but not sold, it remains as finished goods inventory. Thus, it is important that real customer demand pull product through the system. This is in stark contrast with the traditional push approach to manufacturing where the system encourages each resource to produce as much as possible, thus, pushing products through its system. Once the first three steps are implemented, this concept is especially important because the process is shortened when wasteful steps, wasteful activity within steps and distance parts must travel is removed, lean organizations usually find themselves with the capability to produce more than before. In a push environment, such capability would translate into increased inventory. In a pull environment, this tendency to overproduce is controlled. Activities may then be directed toward either removing excess capacity or increasing the rate of pull.

5. Perfection

The initial successes that are achieved as a result of implementing the first four steps highlight new opportunities for improvement in reducing effort, time, space, cost, and mistakes while offering products and services that more closely reflect what the customer really wants. This step shows that continuous improvement is possible, and is the desired state of any change in any environment.

4.0 Conclusion

Lean is all about streamlining the flow of value through an organization. If it does not create value in the customer's eyes, it is a waste. What are the effects of eliminating waste and focusing on value? Improved bottom line performance, greater productivity, increased quality, cost reduction, customer satisfaction, and greater market share are some of the results. But most importantly, all of these tie into an increase in shareholder wealth in the companies. Lean production method is an effective way to improve management, enhance the international competitiveness of manufacturing enterprises.

5.0 Recommendation

It is worth noting that the business world has become very competitive and the trends in operation management indicate that unless an organization manages her operations in the supply chain effectively; it may soon lose her market share. There are many dimensions to successful operation management, but the key ingredients which I do recommend operation managers to pay attention to in order to actualize lean manufacturing as a catalyst to global competitiveness of an organization include: creating value to a product or service through continuous improvement of processes, management cultural change through training that will ease adoption of new production and manufacturing techniques, elimination of waste (time, unnecessary inventory, space e.t.c), perfection (effectiveness and efficiency) and focussing on the customer satisfaction through (customization, adopting relevant technology and technique)

Implementation of lean manufacturing practices should support the company business strategy. The implementation should be in line with the corporate vision, mission, values and plans including communication and evaluation plans to build employee buy-in and communicate results. This will ensure that performance is measured to track actual performance against expectations, new initiatives, budgets including resources needed for new initiatives and current operations for lean projects.

Outcomes for lean practices need to be determined and should be business driven. Questions need to be asked whether implementation of lean projects supports core beliefs, market opportunities, competition, financial position, short and long term goals and an understanding of what satisfies the customer. Effectiveness of lean practices needs to be evaluated. Effectiveness should be measured through performance measurements such as inventory, cycle time, product quality and delivery time

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