PRODUCTION IMPROVEMENT IN ACM MANUFACTURING COMPANY USING LEAN MANUFACTURING APPROACH

KAMSIDI @ ABD MALEK BIN SIDEK

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Faculty of Mechanical and Manufacturing Engineering
Universiti Tun Hussein Onn Malaysia

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ABSTRACT

ACM Sdn. Bhd. is a manufacturing company, in which to continuously commit on improvement process which based on the fundamental goal, to minimize or eliminate waste while maximizing production flow. The purpose of this study is to develop a value stream mapping for a ACM Sdn. Bhd. and it was begin with creating a current state map and understand the production flow and the current cycle times. This provides the information needed to produce a future state map. The goal is to identify and eliminate the waste, which is any activity that does not add value to the final product, in the production process. In order to collect the information needed, the study was conducted within the production facility to enable the researcher gained knowledge and familiarized with the production flow and the activities being performed at the shop floor. Parameters such as cycle times, down times, work in process (WIP) for inventory and material, and information flow paths were recorded. This information will enable the researcher to visualize the current state of the process activities by mapping the material and information flow and looking for opportunities to eliminate wastes. ARENA simulation software package was used to simulate and analyze the process flow and times. Result from the analysis shows that there are areas where the ACM Sdn. Bhd. can further improve their production system. Improvements in cycle times of 13-22% are possible by new arrangement of the layout. The results can be used as a guide to the ACM for improvement and implement the lean manufacturing concept in their manufacturing system.

ABSTRAK

ACM Sdn. Bhd adalah sebuah syarikat pembuatan, di mana secara berterusan melakukan penambahbaikan terhadap proses yang berasaskan kepada matlamat asas, untuk mengurangkan atau menghapuskan pembaziran sambil memaksimumkan aliran pengeluaran. Tujuan kajian ini adalah untuk membangunkan pemetaan aliran nilai untuk ACM Sdn. Bhd dan ia telah bermula dengan mewujudkan peta keadaan semasa dan memahami aliran pengeluaran dan masa kitaran semasa. Ini memberikan maklumat yang diperlukan untuk menghasilkan nilai pemetaan aliran pada masa depan. Matlamatnya adalah untuk mengenal pasti dan menghapuskan pembaziran, yang merupakan aktiviti yang tidak menambah nilai kepada produk akhir dalam proses pengeluaran. Dalam usaha untuk mengumpul maklumat yang diperlukan, kajian ini dijalankan dalam fasiliti pengeluaran bagi membolehkan penyelidik mendapat pengetahuan dan dibiasakan dengan aliran pengeluaran dan aktiviti-aktiviti yang dilakukan dalam keadaan pengeluaran sebenar. Parameter seperti masa kitaran, masa turun, kerja dalam proses (WIP) untuk inventori dan bahan-bahan, dan laluan aliran maklumat telah direkodkan. Maklumat ini akan membolehkan penyelidik menggambarkan keadaan semasa aktiviti-aktiviti proses pemetaan aliran bahan dan maklumat serta mencari kaedah yang sesuai untuk menghapuskan bahan buangan. Pakej perisian simulasi ARENA telah digunakan untuk mengsimulasi dan menganalisis aliran proses dan masa. Keputusan daripada analisis menunjukkan bahawa terdapat kawasan-kawasan di mana ACM Sdn. Bhd boleh terus memperbaiki sistem pengeluaran mereka. Penambahbaikan dalam masa kitaran 13-22% boleh dicapai dengan pengaturan baru susun atur. Keputusan boleh digunakan sebagai panduan kepada ACM untuk tujuan penambahbaikan dan melaksanakan konsep *Lean Manufacturing* dalam sistem pengeluaran mereka.

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CHAPTER 1

INTRODUCTION

1.1 Background

Lean Manufacturing is a comprehensive set of techniques which when combined allows you to reduce and eliminate the wastes. This will make the company leaner, more flexible and more responsive by reducing waste. Lean is the systematic approach to identifying and eliminating waste through continuous improvement by flowing the product or service at the pull of your customer in pursuit of perfection (Nash, Poling and Ward, 2006).

Many manufacturers included ACM manufacturing company are now critically evaluating their processes to determine their effectiveness in bringing maximum value of product manufacturing. Factory management techniques of yesterday are being replaced by more efficient methods that greatly minimize delays, reduce costs, and improve quality. Lean manufacturing is a whole systems approach that creates a culture in which everyone in the organization continuously improves processes and production. It is a system focused on and driven by customers, both internal and external.

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. Essentially, a "waste" is anything that the customer is not willing to pay for. Typically the types of waste considered in a lean manufacturing system are Overproduction, Waiting, Inventory or Work in Process (WIP), Processing waste, Transportation, Motion and Making defective products.

Manufacturing processes are driven by three controls cost, quality and delivery and the garment manufacturing industry is no exception to it. Any intervention that can add value to one or more of these can take some burden off from the management system. This boils down to optimization of turnaround cycle time, greater product variety and quality and the most economical output. If one can achieve the stated, the competition would be viewed as co-existence, profits would soar and the expansion plans would turn into a reality. They may have already tried a hand at various systems to ease out the flow and add the required dimension, but nothing other than the unnecessary administrative and financial burden would have been added. Lean touches the following aspects of an organization.

Lean manufacturing is an operations management philosophy focused on reducing waste in a manufacturing system. Lean identifies many different types of waste, among them the waste of overproduction making products and building inventories for which there is no current demand.

Installing pull production control policies is an important part of implementing Lean manufacturing in high volume, repetitive manufacturing systems. Production control policies, which ensure when manufacturing resources should work, affect important measures of manufacturing system performance, including cycle time and work in process inventory. Pull production control policies have been shown to improve manufacturing system performance by linking production control to customer demand. However, transforming a system governed by push to one controlled with pull has not been studied extensively.

The different ways to transform a system, the behavior of a system during transformation and the real world costs of Lean transition have never been measured. As a result, risk bad manufacturers have been slow to adopt Lean practices. Using simulation models of manufacturing systems, one can study the effects of different types of production control rules on performance metrics. One can also study the behavior of a system undergoing Lean transition. In doing so, this research aims to shed light on the transformation process, giving a would-be practitioner tools and techniques for Lean transition and realistic expectations of system performance during the transformation.

Lean manufacturing is a western adaptation of the Toyota Production System, developed by the Japanese carmaker and most famously studied (and the term "Lean" coined) in *The Machine That Changed the World* (Womack, 1996). Taiichi Ohno, the engineer commonly credited with development of the Toyota Production System, and therefore Lean, identified seven types of waste: defective products, unnecessary finished products, unnecessary work in process, unnecessary processing, unnecessary movement (of people), unnecessary transportation (of products) and unnecessary delays. Lean focuses on eliminating these wastes from a manufacturing system. In particular, this work is interested in the second and third types – unnecessary finished goods and work in process.

The entire offerings can be simply summed up as an optimized manufacturing system that is low on resources and high on deliveries. Lean manufacturing is about "delivering the extra-ordinary through ordinary resources by building extra-ordinary processes". The processes are built on the guidelines of reduction of waste and losses.

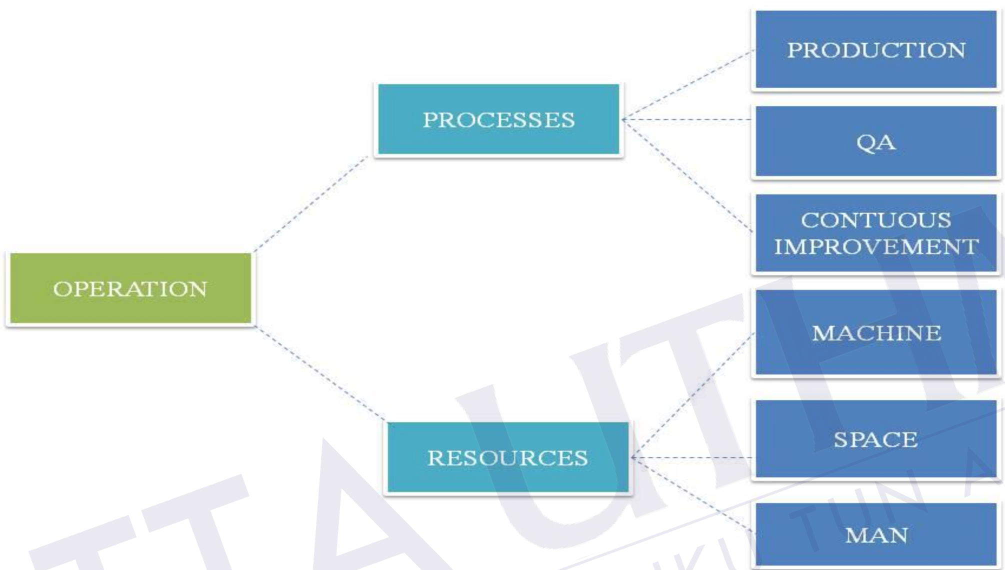


Figure 1.1: Aspects of an organization

Lean as a manufacturing philosophy aims at the following benefits:

i) It creates a robust inter-dependent support system for all components of operations
ii) Reduces the administrative costs entailed in other popular methods
iii) Focuses on waste reduction
iv) Specially emphasizes on unnecessary cost generating points
v) Imparts a better control over day to day activities
vi) Reduces the cycle time
vii) Implements socially answerable techniques
viii) Promotes environment friendly practices
ix) Potentially acts as a powerful tool for competitive coexistence

1.2 Statement of the Problem

The most common problem in ACM manufacturing company is to attain optimal inventory levels. Decisions about how many of which products are to be stored in the warehouse, when to place the next order, the quantities to be ordered are some of the problems encountered every day. High level of inventory locks up the capital of any company. Customers on the other hand, lose confidence in the company and look elsewhere if there is no availability. This can reduce the profitability of the company and eventually crumple the company. The science of balancing the right levels of inventory can be solved this problem by the inventory system and can be simulated and the result analyzed to reach the best practices in inventory management. Goods in transit, obsolete stock, dead stock, fast and slow moving stock, back orders are all problems associated with managing inventory systems.

1.3 Objectives

In recent years, Inventory Management has attracted a great deal of attention from people both in academic and industries. A lot of resources have been devoted in the inventory management practices of organizations. These companies pay more for faster production and logistics services only when the demand surges or goes up unexpectedly. On the other hand, companies with irregular demands and inferior forecasting abilities have to pay more for using fast production methods to respond to unexpected surges in demand.

The overall objective can supported by actual performance improvements and cost saving, improvements in production lead times, financial costs effective and efficient work processes and reductions in waste as the challenges that remained after its implementation at ACM manufacturing and will aim to determine the relationships between each of the following performance metrics:

i. Evaluate the production in the level of current value stream mapping to target for the practical mapping.
ii. Identify area for improvement in the core component and collect information related to process flow from raw material to finished goods.
iii. To meet demand on time to reduce the waste time.
iv. Propose improvement strategy to the ACM Company.

1.4 Importance of the Study

The result from this study could reduce costs, improve lead time, increase productivity, and improve amount of the core products produced in ACM Company. The impact of not doing the study could be inefficiency and working with an excess amount of work in process which will result in higher operating cost and loss of quality time.

1.5 Limitations of the Study

The limitations of the study were that:

i. The results of this study are limited to ACM manufacturing company only.
ii. The company defined the value stream to be targeted for improvements.
iii. The results will be based on data collected from the production activities performed along the value stream selected.
iv. The study includes only the development of the current for a value stream selected and recommends ways to improve the process.

1.6 Study Approach

To examine some most used lean manufacturing tools and techniques. This will be followed by the study of the existing production system of the case company for example the existing production layouts, work balancing methods and other different variables which needs to be improved for the betterment of the existing system.

To address the current issues of the industry, this result tries to find out the standard operation time for each operation by using time study techniques and will try to standardize all the operations. Once the standard operation time is obtained work will be done to find out the best suitable production layout and movement methods, which will help to get flexibility in style changeover, should reduce the production lead time.

1.7 Assumptions of the Study

It is assumed that this study with reference to the technical information required to be supplied by the ACM manufacturing company, will have the ability to develop in the future with an efficient way to implement lean manufacturing, in order to increase productivity and output, and for reduce costs, inventory, and time. It also assumes that all work centers involved in this study have been working only with selected value streams.

1.8 Definition of Terms

Available Production Time: Determined by taking the shift time and subtracting regular planned downtime events such as breaks.

Available Operating Time: Determined by taking the available production time and subtracting changeover time.

Batch Size: A technique used to run a determined quantity of parts at one operation prior to moving them to the next operations.

Changeover Time: The time that an operator spends at a work center switching the production tools in order to change from one product type to another.

Downtimes: Those are considered break times. Downtimes are regular planned times and usually involve unpaid lunch and paid breaks. During a downtime the production does not run.

Electronic Data Interchangeable: It is a tool that allows companies to process the purchasing order electronically.

Finished Goods: Refers to parts that already have been manufactured and are in the completed stage waiting to be shipped to the customer.

Kaizen: Continual improvement involving everyone within an organization (Ohno, 1998)

KANBAN: A tool to achieve just-in-time which consists of a card containing all the information required to be done on a product at each stage along its path to completion and which parts are needed at subsequent processes (Monden, 1993)

Lead Time: The time that parts take to be transformed from raw material to finished goods.

Lean Metrics: A list of measurements that will help for tracking progress toward the targets selected for improvements.

Material Requirement Planning: It is a tool that helps manage the production process. Basically, it is a plan for the production of the components and purchase of materials needed to make an item.

Operating cost: It is all the money that the company spends in order to turn inventory into finished goods.

Operators: Involves those individuals that provide the work hand to perform an operation.

Product Family: Refers to all the parts that are produced within the same value stream. All the parts for the product family group have common production processes and same pattern development.

Raw Material: Material that has been purchased but not changed in any way.

Value Stream: The set of processes, including value-added and non-value-added activities required to transform raw materials into finished goods that customers value (Womack & Jones, 1996).

Work-in-Process: Any product in the production process than began as raw material, but is not a finished good yet.

Takt time : Rate of Customer demand.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter reviews some of the research work that has been conducted so far in the field of system provide a comparative review of and lean manufacturing on determining the parameters, then discuss the studies on determining the evaluation for implementing lean manufacturing sequences to show the impact of operational issues on the parameters. The literature on lean consists of thousands of articles, which describe in different ways various models of lean systems and their systems. There are a few exceptional studies that use other methods such as statistical analysis. This chapter also to compiles and organizes information about lean manufacturing that will aid to understanding the specifics of the study.

The first article on the implementation in manufacturing appeared in the 1970s (Sugimori et al. 1977). Since then, a lot of research articles have been published in various journals. This review was based on previous literature surveys by Golhar and Stamm (1991), and Huang et al.(1985). The review here is not an exhaustive one, but encompasses most of the major work done in lean.

As the study being proposed deals mainly, the first section in this review is devoted to the study that has been conducted in the related area.

For Lean Manufacturing, the popular definition consists of the following (Wilson, 2009).

i. It is a comprehensive set of techniques which when combined allows you to reduce and eliminate the wastes. This will make the company leaner, more flexible and more responsive by reducing waste.
ii. Lean is the systematic approach to identifying and eliminating waste through continuous improvement by flowing the product or service at the pull of your customer in pursuit of perfection (Nash, Poling and Ward, 2006).

2.2 Related literature

As mentioned in, many articles are devoted to the study of lean. Typically, most papers deal with the determination of the number of lean either through optimization models or through simulation models. Some of these articles that deal with lean manufacturing are listed below according to the category they fall under. Liberators, (1979) considered a more realistic situation for his model and developed an equation for the order size based on stochastic lead times and backlogged demand. The traditional equations of inventory theory with deterministic lead times and no backlogging were special cases of this model.

Kimura and Terada (1981) were among the first to model a lean manufacturing system. They describe the system by means of three relations. They did not directly create an optimization model of the behavior of the system described but they used simulation to study the amplification at workstation fluctuations of demand at the final workstation.

Bitran and Chang (1987) extended the work of Kimura and Terada and offered a mathematical programming model for a multi-stage production setting. Their deterministic model is designed to assist in the choice of the number to use at each stage and thus control the level of inventory. The model was solved as an ILP and the solutions were aimed at giving managers in a JIT environment an idea of the operational control.

Philipoom, Rees, Taylor and Huang (1990) used an integer programming approach in solving a different problem. They considered the case where it is not possible to reduce all machine setup times to the level required for smooth operation of the method. In the case that they considered, a bottleneck workstation contains more than one machine and produces more than one type of part during a production cycle. Setup times are long with respect to production times. This situation may arise in a smaller shop that uses general purpose machine tools or in a larger plant where cost does not always allow the purchase of dedicated machines. They present evidence showing that in a shop where a limited number of workstations retain long setup times, the use of the unmodified kanban method will, in general, lead to bottlenecks resulting from too frequent and too long setups. The suggested solution is to use signal interfaces with the workstations in question.

Bard and Golany (1991) examined the problem of determining the number of multi-product, multistage manufacturing system. They describe the example of a printed circuit board assembly plant where five workstations produce three end products. A workstation is, in principle, able to undertake more than one operation and so to produce more than one in-process item. The objective of the model is to determine the number of KANBANS to use at each workstation so as to minimize the total cost, including setup costs, holding costs, and shortage costs, over a known time horizon.

Li and Co (1991) used dynamic programming to determine the number to use at each stage of a production process in order to minimize the inventory holding cost. Their formulation allows the treatment of both serial and tree-structured production processes. They assume that capacity will always allow requirements to be satisfied without backorders. Quantity discounts are price reductions that are offered to the retailer when they place an order that is beyond a certain specific level. It is an incentive to the retailer to buy larger quantities. When quantity discounts are offered the retailer is forces to consider the possible benefit of ordering larger number of items with a lower price per item over the increase in the inventory costs that would be incurred by the retailer (Kim et al. 2003). Including the purchasing cost in the total cost equation does not change the point but changes the total cost for the retailer since the unit costs for certain ranges are different. There are two cases of this model:

i. Carrying costs are constant: When carrying costs are constant, the same for all the curves.
ii. Carrying costs are a percentage of the purchasing cost: When the carrying costs are a percentage of purchasing cost per unit, the starting with the lowest price range is found.

This procedure is continued until a feasible solution is reached. Inventory management is defined as the direction and control of activities with the purpose of getting the right inventory in the right place at the right time in the right quantity in the right form and at the right cost.

Hopp and Spearman (2000) provide a good introduction to these topics. Analyze a generalized production authorization system that includes a variety of traditional schemes as special cases. Dynamic scheduling is closely related to real-time control, since decisions are made based on the current state of the manufacturing system. Controlling a manufacturing system so that it maintains a desired inventory position (in work in process or finished goods) is a common strategy when there is steady demand for each product. There may be multiple process flows (routes), but they are known, and each one has a steady throughput of jobs following that flow.

This consistency makes other pull-based mechanisms, hedging points, and base stock policies feasible. The system works to maintain a low level of work-in-process, but the consistent demand insures that this inventory turns over regularly.

Markowitz and Wein (2001) present these references demonstrate the utility of simulation to analyze the steady-state performance of production control policies. Simulation in general is focused on steady state performance of models. Modern simulation methodologies and software tools are specifically designed to limit transient effects on measurements. This work is concerned exclusively with transient behavior of systems undergoing a change from one production control policy to another. To study such systems using simulation models, this dissertation introduces new techniques to set up and conduct experiments and to collect performance data during transient behavior.

(Cudjoe, 2010) Inventory is an important current asset with far reaching financial ramifications which deserves very organizations serious attention to ensure cost savings and optimum utilization of scare resources. Cudjoe, (2010) explained that the terminology-Inventory was of American origin which was synonymous with stock associated with British authors. Assets in the form of goods, property or services held for sale in the ordinary course of business, in the process of production for sale or to be consumed in the production of goods for sale or in the rendering of services.

Muckstadt et al., (2010) discussed that model was determined by minimizing the total annual cost incurred by the company by virtue of its ordering cost and carrying cost. They said that this model was based on the basic assumption that there was a single item, with deterministic demand and lead time, no shortages, and inventory was replenished in batches rather than continuously over a period of time. Muckstadt et al., (2010) also said that the first component of this equation represented the inventory management costs and the second component represents the ordering cost. The literature in the area of inventory management included different types of inventory models dealing with different real-world constraints.

Many of these models are variations of the basic model where the alterations include the conditions that are encountered in the situation being studied. Despite these new conditions these models still try to determine the optimal order quantity, which is one area where the model developed in this research is different from other models.

The traditional model also assumed that if the inventory is zero when the order was received then that particular order was lost. This was not the scenario in real life as orders may be backordered and fulfilled when the inventory was available.

The term lean manufacturing was first used to describe the implementation of what is now considered to be part of lean manufacturing such as just-in-time (JIT). It began as a description of procedures used by the Toyota Motor Corporation from 1950 through the 1980s (Ohno, 1988). Now lean means much more. The Toyota production system started as part of a strategy to survive developed by Taiichi Ohno, presently vice president of the Toyota, in an effort to conserve capital, eliminate waste, reduce inventory, and reduce production times and operating expenses while increasing quality and production flexibility at the same time. The Toyota production system was proved to be successful and implemented throughout the entire company.

According to Womack, Jones, and Roos (1990), the term “lean” represents a system that utilizes fewer inputs in order to create the same outputs than those created by a traditional mass production system, while increasing the range of different finished goods for the end customer. The term lean manufacturing is synonymous with different names, such as agile manufacturing, just-in-time manufacturing, synchronous manufacturing, world class manufacturing, and continuous flow.

Lean manufacturing is an operational strategy oriented toward achieving the shortest possible cycle time by eliminating waste (Liker, 1997). It is derived from the Toyota production system and its objective is to increase the value-added work by eliminating wastes and reducing unnecessary work. The technique often decreases the time between a customer order and shipment, and it is designed to improve profitability, customer satisfaction, throughput time, and employee motivation. The benefits of lean manufacturing generally are lower costs, higher quality, and shorter lead times (Liker, 1997). The term lean manufacturing is created to represent less human effort in the company, less manufacturing space, less investment in tools, less inventory in progress, and less engineering hours to develop a new product in less time.

According to David Magee, (Magee, 2007) different kinds of wastes in a process can be categorized in following categories. These wastes reduce production efficiency, quality of work as well as increase production lead time.

i. Overproduction – Producing items more than required at given point of time i.e. producing items without actual orders creating the excess of inventories which needs excess staffs, storage area as well as transportation etc.

ii. Waiting – Workers waiting for raw material, the machine or information etc. is known as waiting and is the waste of productive time. The waiting can occur in various ways for example; due to unmatched worker/machine performance, machine breakdowns, lack of work knowledge, stock outs etc.

iii. Unnecessary Transport – Carrying of work in process (WIP) a long distance, insufficient transport, moving material from one place to another place is known as the unnecessary transport.

iv. Over processing – Working on a product more than the actual requirements is termed as over processing. The over processing may be due to improper tools or improper procedures etc. The over processing is the waste of time and machines which does not add any value to the final product.

v. Excess Raw Material - This includes excess raw material, WIP, or finished goods causing longer lead times, obsolescence, damaged goods, transportation and storage costs, and delay. Also, the extra inventory hides problems such as production imbalances, late deliveries from suppliers, defects, equipment downtime, and long setup times.

vi. Unnecessary Movement – Any wasted motion that the workers have to perform during their work is termed as unnecessary movement. For example movement during searching for tools and shifting WIP.

vii. Defects – Defects in the processed parts is termed as waste. Repairing defective parts or producing defective parts or replacing the parts due to poor quality etc. is the waste of time and effort.

viii. Unused Employee Creativity – Loosing of getting better ideas, improvement, skills and learning opportunities by avoiding the presence of employee is termed as unused employee creativity (Liker, 2003).

Lean manufacturing is not a magical solution (Feld, 2000). It involves a change in leadership that requires considerable communication, coordination, and organization which results in a change in the company's culture. Just implementing one lean technique will not result in lean implementation. Positive employee reaction to lean manufacturing is essential to success, but does not always occur since becoming lean improves productivity and can reduce the number of workers needed. Laying people off and asking the remaining employees to become more involved may not work.

According Feld (2000), the organization needs to be aware of where it is at that point. They must know why they need to change and why change is important. It is necessary to provide the answers to these questions to employees so they become more engaged in the process. "Motivation, tenacity, leadership, and direction all play roles in the successful deployment of a lean program". Feld also stated that roles within the team and the way in which team members interact with one another are important. All members must understand their roles and why they were selected for their assignment.

2.3 Related Tools and Techniques

Once the companies find the main sources of wastes, tools such as just-in-time, KANBAN systems, production smoothing method, work cells, autorotation, Kaizen, and others will help companies to take corrective actions to eliminate or reduce these wastes (Monden, 1993). Following is a compilation of information regarding to those tools.

2.3.1 Just-in-Time

Just-in-time means that each process receives the right parts needed at the time they are needed and in the amount they are needed to produce an order from a customer with the highest quality (Ohno, 1988). Just-in-time is an important concept in the Toyota production system. Just-in-time allows companies to eliminate wastes such as work-in-process inventory, defects, and poor delivery of parts (Nahmias, 1997). It is a critical tool to manage activities such as distribution and purchasing, and can be classified into three categories: just-in-time production, just-in-time distribution and just-in-time purchasing. Henry Ford (1922) found that it was only worthwhile to buy materials for immediate use, taking into account the state of transportation at the time. If there were never any problems with transportation and an even flow of materials could be depended upon, it would not be necessary to carry any stock because raw materials could go immediately into production, decreasing the amount of money tied up in materials. When transportation cannot be depended upon, a larger stock is necessary.

The basic ideas behind the JIT production system, which have been practiced for many years in Japan, are waste elimination, cost reduction, and employee empowerment. The Japanese philosophy of doing business is totally different than the philosophy that has been long prevalent in the other country. The traditional belief in the west had been that the only way to make profit is to add it to the manufacturing cost in order to come up with a desired selling price (Ohno, 1997) on the contrary; Japanese approach believes that customers are the generator of the selling price. The more quality one builds into the product and more service one offers, the more the price that customers will pay. The difference between the costs of this price is what determines the profit. The JIT manufacturing discipline is to work in every facet of the value stream by eliminating waste in order to reduce cost, generate capital, bring in more sales, and remain competitive in a growing global market. The value stream is defined as "the specific activities within a supply chain required to design, order and provide a specific product or value.

The term "JIT" as Womack and his colloquies define, it denotes a system that utilizes less, in terms of all inputs, to create the same outputs as those created by a traditional mass production system, while contributing increased varieties for the end customer.

2.3.2 Kaizen

Kaizen involves continual improvement involving everyone within an organization (Ohno, 1988). Kaizen is a Japanese word meaning gradual and orderly continuous improvement. The Kaizen business strategy involves everyone in an organization working together to make improvements without large capital investments. Kaizen is a culture of sustained continuous improvement focusing on eliminating waste in all systems and processes of an organization. This strategy begins and ends with people, and involves leadership that guides people to continuously improve their ability to meet expectations of high quality, low cost, and on-time delivery, therefore transforming companies into superior global forces. The most important tool for continuous improvement is the 5S Housekeeping, also known as 5S, which is a process that includes a set of techniques utilized for cleaning and organizing the workplace (Levinson & Rerick, 2002). 5S reduces wastes by eliminating the searching for tools because everything is in the right place. Preventive maintenance assures that the tools are ready to use, reducing setup time, and the equipments and machines will be running effectively, avoiding unplanned downtime or breakdowns. 5S comes from the Japanese words Seiri (Clearing up), Seiton (Arranging), Seiso (Neatness), Shitsuke (Discipline), and Seitketsu (Ongoing improvement).

Seiri refers to sorting the workplace and eliminating needless items (Feld, 2000). It means "throw away" and separates the messes from those items that are needed to work easily resulting in a better flow of materials, utilization of space, and organization for operators to move.

Seiton refers to arranging everything within a specific area (Feld, 2000). All items and equipment must be identified with a label and organized in a specific place resulting in an easier way to recognize and find the proper tooling, resources, and materials quickly.

Seiso refers to cleaning everything and doing periodic maintenance (Feld, 2000). Everything should be cleaned, organized, and well maintained at the end of every shift, including the production area, tools, and materials.

Seitketsu deals with the management strategies for institutionalizing the standard activities (Feld, 2000). Managers must establish policies and procedures to keep the area organized, ordered, and clean.

Shitsuke refers to the leadership strategy to implement housekeeping involving training, communications, and motivation as fundamentals leadership practices in order to ensure that everyone follows the 5S standards (Feld, 2000).

2.3.3 KANBAN Systems

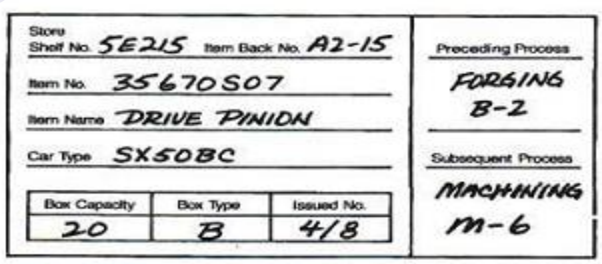
A KANBAN is a tool to achieve just-in-time (Monden, 1993). It consists of a card containing all the information that is required to be done on a product at each stage along its path to completion and which parts are needed at subsequent processes. This card is usually put in a rectangular vinyl envelope and is used to control work-in-process, production, and inventory flow. A KANBAN system consists of a set of these cards, with one being allocated for each part being manufactured and the travel between preceding and subsequent processes.

To make KANBAN system work, manufacturing processes are designated as preceding process and subsequent process. The withdrawal KANBAN details the quantity that the subsequent process should withdraw, while the production ordering KANBAN shows the quantity preceding process should produce. By drawing the Value Stream Map as a tool, a number of wastes were listed out in the current manufacturing line out of which Unnecessary inventory is very important as it affects more, the cost of production. KANBAN system is an information system to harmoniously control the production quantities in every process.

The KANBAN system is based on the use of cards called "KANBANS". The card is put in a rectangular. The following are the three kinds of cards normally used:

i. Withdrawal KANBAN
ii. Production Ordering KANBAN
iii. Signal KANBAN

Withdrawal KANBAN. The main function of a withdrawal KANBAN is to pass the authorization for the movement of parts from one stage to another (Monden, 1993). The KANBAN in Figure 2.1 shows that the subsequent process (machining) requests the parts from the preceding process (forging). The part, which is a drive pinion, must be made at the forging process and picked up for the subsequent process at the position B-2 of the forging department. The box has shape type B and each of them contain 20 units of the part needed. This KANBAN is the fourth of eight sheets issued.


Store Shelf No. 5E215 Item Back No. A2-15
Item No. 35670S07
Item Name DRIVE PINION
Car Type SX50BC

Box Capacity	Box Type	Issued No.
20	B	4/8

Preceding Process
FORGING B-2
Subsequent Process
MACHINING m-6

Figure 2.1: Withdrawal Kanban.

Production ordering KANBAN. The primary function of the production KANBAN or in-progress KANBAN is to specify the kind and quantity of product that the preceding process must produce (Monden, 1993).

The KANBAN in Figure 2.2 shows that the preceding machining process SB-8 must produce an item called craft shaft for a core type SX50BC-150 and the part must be placed at store F26-18.

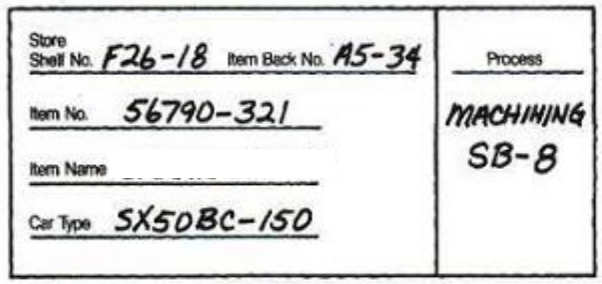


Figure 2.2: Production ordering KANBAN

Signal KANBAN. A signal KANBAN is tagged into a box within the production lot (or batch) and is used to specify lot production in the stamping processes. Two types of signal KANBANs are used:

1. Triangular KANBAN: The triangular shaped KANBAN in Figure 2.3 shows that an order from punch press process # 10 is required when the lot size is down to 200. It is placed on pallet 2 of 5.

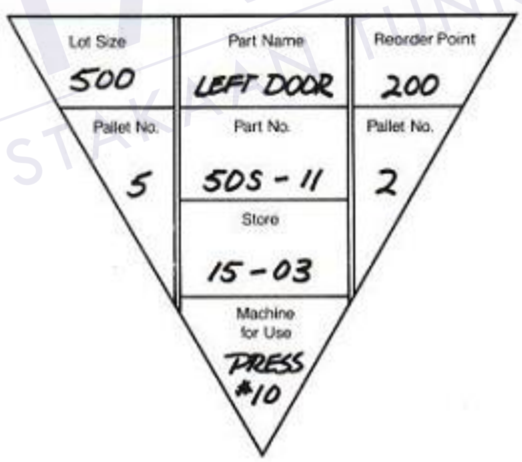


Figure 2.3: Triangular KANBAN

2. Material requisition KANBAN: The rectangular shaped KANBAN in Figure 2.4 shows that the press process # 10 must go to the store 25 to withdraw 500 units of steel board, when the left doors are withdrawn down by two boxes.

Preceding Process	STORE 25 ⟹	PRESS #10	Subsequent Process
Back No.	MA 36	Item Name	STEEL BOARD
Material Size	40 x 3' x 5'	Container Capacity	100
Lot Size	500	No. of Container	5

Figure 2.4: Material requisition KANBAN

To make KANBAN system work, manufacturing processes are designated as preceding process and subsequent process. The Withdrawal KANBAN details the quantity that the subsequent process should withdraw, while the Production Ordering KANBAN shows the quantity which the preceding process should produce. These cards circulate within the factory.

2.3.4 Value Stream Mapping

Value stream mapping is a visual representation of all the specific activities, including the flow of material and information, which occurs along the value stream selected for a product or family (Tapping, 2002). The value stream mapping process will likely reveal that a significant amount of non-value-added activities are present in your current processes. These activities consume financial and human resources and make longer lead-time without adding value. However, some of these activities are really necessary in the process; therefore the idea is to minimize their impact. Figure2.5 below shows the value stream symbols used to describe each process of manufacturing or assembly.

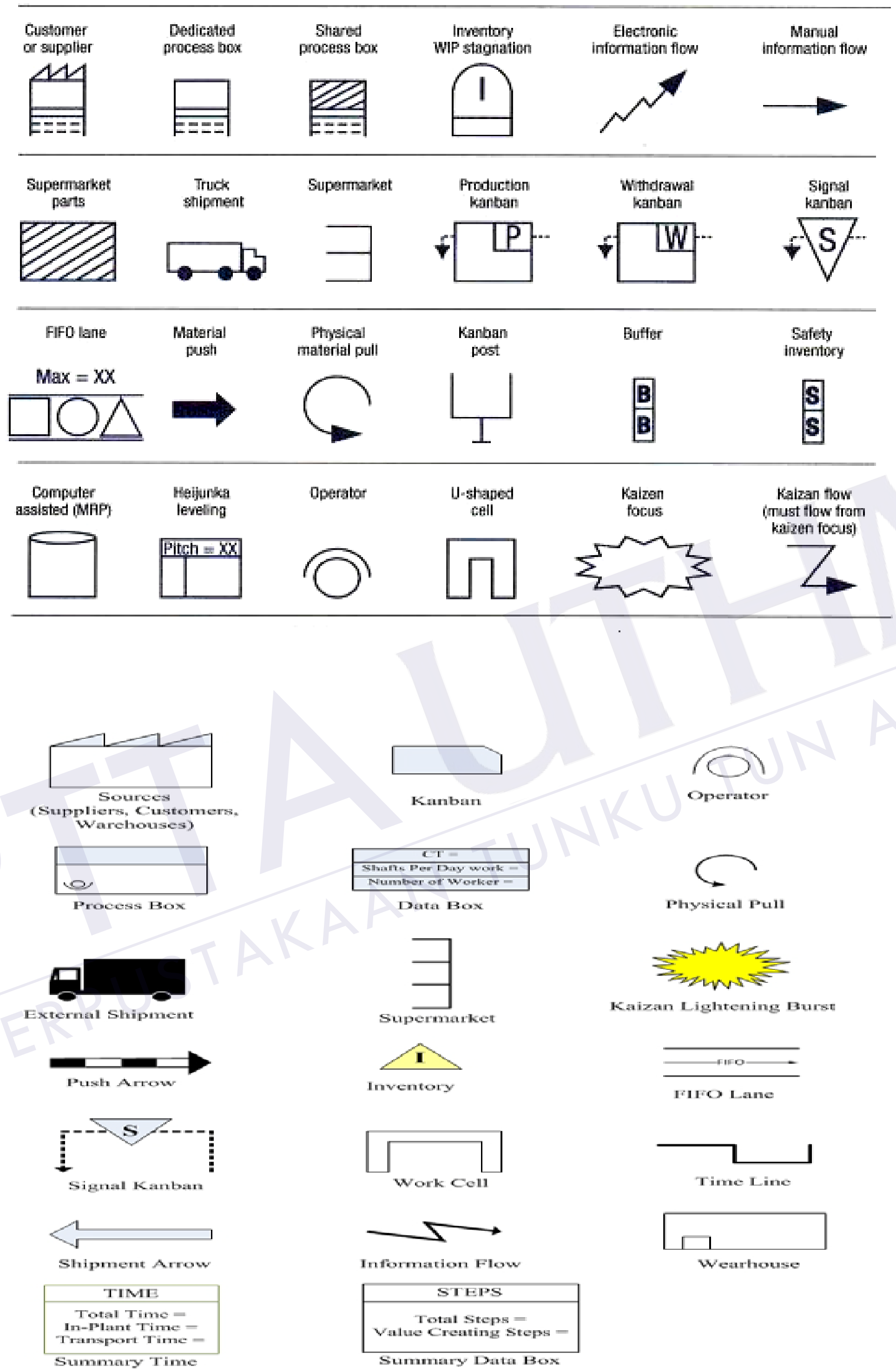


Figure 2.5: Value stream mapping symbols

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