LEAN MANUFACTURING IMPLEMENTATION FOR LOW VOLUME CAR PRODUCTION

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ABSTRACT

The purpose of this project is to analyze the implementing of the lean methodology to low volume car production. There are many problem occurs at the production line such as breakdown of the machine. The project has started with identifying problem at the AMM plant focus at the Trim and Finale Department. Then, the data has been analyzed by using Total Quality Management Tools such as fishbone diagram and Pareto chart. From the analysis, the main problem is come from two type of the machine which is the mount lift and overhead pulley. The losses will affect the losses to the company. Some lean tools are suggested to overcome the problems which are Total Productive Maintenance (TPM), Standardized Work, Continuous Improvement, 5S and others. There are the advantages of applying lean methodology to the car production such as increase worker's discipline, eliminate the waste, and improve the quality of the product and others. There are some limitation of applying the lean methodology such as setup cost, cooperation within the administrator and operator and the company rules and policy. By applying the lean tools, the problem can be minimized and gain the high profit at the same time. The lean tools only can be suggested without implementation because of the rules and policy of the company.

ABSTRAK

Tujuan projek ini adalah untuk menganalisa pelaksanaan kaedah *'Lean'* bagi pembuatan kereta yang berkuantiti kecil. Banyak masalah berlaku dalam pembuatan kereta seperti kerosakan mesin. Projek dimulakan dengan mengenalpasti masalah di kilang AMM tertumpu hanya kepada bahagian pemasangan alat-alat aksesori kereta. Selepas itu, data dianalisis dengan menggunakan Teknik-teknik dalam Pengurusan Kualiti (TQM) seperti gambar rajah tulang ikan *(fishbone diagram)* dan carta pareto *(Pareto chart)*. Daripada analysis yang dibuat, masalah utama adalah berpunca daripada 2 jenis mesin iaitu lif pengangkat (*mount lift*) dan takal di atas (*overhead pulley*). Ia akan menyebabkan kerugian akibat kerosakan tadi. Sesetengah kaedah *'lean'* dicadangkan untuk mengatasi masalah yang berlaku iaitu pembaikan pembuatan (*Total Productive Maintenance*) dan Penyelarasan Kerja (*Standardized Work*), penambahbaikan secara berterusan (*Continuous Improvement*), Prinsip 5S dan sebagainya. Antara kelebihan pelaksanaan teknik-teknik *Lean* dalam pembuatan kereta ialah peningkatan disiplin pekerja, pembaziran dapat dielakkan dan meningkatkan kualiti produk. Selain itu, terdapat beberapa halangan dan cabaran dalam melaksanaan kaedah ini. Antaranya ialah penambahan kos operasi, kerjasama antara pihak pentadbiran dengan para pekerja serta polisi dan undang-undang syarikat. Dengan perlaksanaan kaedah *'lean'*, masalah dapat dikurangkan dan pada masa yang sama dapat meningkatkan keuntungan. Hasil keputusan cadangan kaedah *'lean'* dapat dilihat kejayaannya jika dapat diaplikasikan di dalam syarikat.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF PROJECT

Customers have numerous choices when it comes to buy their product. Combined with choices available to the consumer and expectation of shorter order fulfillment lead times, customers have become more fickle in their purchasing decisions and less loyal to their old long-standing business relationships. Products with similar features and price offered by multiple manufacturers begin to approach commodity status. Products can be produced in many ways. They can be manufactured by lean methodology or in batch quantities routed through traditional work centers. Its depend on many situation in order to choose lean or batch manufacturing such as the quantities, cost, manpower and others.

Batch manufacturing is similar with group the similar work together, creating department or work centers. These departments are usually located in separated areas of the facility, and work is moved from department to department until the product is completed. Batch manufacturing allows machines and people to appear more productive when large quantities of a product are built. The benefits of batch processing are offset by the problem created of manufacturing when responding to actual customer demand when trying to build a dynamic mix of products and volumes. This grouping work and machines usually provides little consideration for the equal distribution of capacity. This unequal distribution of capacity can create imbalances between manufacturing processes. These imbalances are often manifested in pools of excess inventory residing between imbalanced departments.

Lean manufacturing is a proven technique that allows work to be performed without bottlenecks or delays. In the lean environment, these activities do not add value to the product and considered a waste. The lean manufacturing methodologies eliminate the wasteful activities by linking and balancing equal amounts of work steps together, enabling products to be consume directly into the next step, one piece at a time until completed. The sum of the work time minus the added queue and wait time required to progress through the manufacturing processes is always shorter than the time required to route products through a batch manufacturing.

Physically, locating manufacturing processes close together allows the completes output of one process to be directly consumed into the next, reducing inventories and cycle time. This physical linkage allows the standard work tasks to be accomplished in a sequential and progressive manner at each workstation until the product completely processed. Wait and queue time normally associated with batches routed the different manufacturing departments is greatly reduced or eliminated.

1.2 PROBLEM STATEMENTS

In the manufacturing process, there are so many wastes that can affect the profit of the business. Waste is defined as anything that does not add value to the end product from the customer's perspective. The manufacturer must minimize the waste during producing the product so that the profit of the business can generate highly and the production cost can be minimized. The main task in this case is to implement lean methodology car production so that the waste can be eliminated.

1.3 OBJECTIVE OF PROJECT

I. The project is done at Automotive Manufacturer Malaysia (AMM), Pekan.
II. Analyze the problem that occurs at Trim and Final Department for the C Class Passenger Car production.
III. Suggest the suitable Lean Tools to solve the problem.

1.4 SCOPE OF PROJECT

I) Analysis is done in Automotive Manufacturer Malaysia (AMM), Pekan Pahang

II) Analysis in done to the Mercedes C Class passenger car production.

III) Analysis is done at the Trim and Final Department focus on trim line.

IV) The analysis is focus on the manpower and method element.

V) There lean methodology not be applied at the company because of the rule and the policy of the company.

CHAPTER 2

2.0 LITERATURE REVIEW

2.1 HISTORY OF LEAN MANUFACTURING

The goal of any manufacturing system is to produce the highest quality products in shortest lead time possible with the least amount of resources investment delivered to the customers and the lowest possible cost. Example for manufacturing process that are common use in the production industries are Lean Manufacturing and MRP/ERP batch manufacturing system. It has been argued that the goal of these two approaches for manufacturing even conflict with each another. Using elements of both methodologies provides a manufacturer a set of common – sense tools that can be used to optimize its manufacturing process as a competitive tool for the company (Dennis P. Hobbs, 2004).

After World War II Japanese manufacturers were faced with vast shortages of material, financial, and human resources. These conditions resulted in the birth of the "lean" manufacturing concept (Womack et al., 1990). Kiichiro Toyoda, the president of Toyota Motor Company at the time, recognized that American automakers of that era were out-producing their Japanese counterparts by a factor of about ten. Early Japanese industrial leaders such as Toyoda, Shigeo Shingo, and Taiichi Ohno responded by devising a new, disciplined, process-oriented system, which is known today as the "Toyota Production System," or "Lean Manufacturing." The system focused on pinpointing the major sources of waste, and then using tools such as JIT, production smoothing, setup reduction and others to eliminate the waste. (Fawaz A. Abdulmalek, Jayant Rajgopal).

The arrival of Japanese automotive companies in the UK in the 1980s and 1990s highlighted the uncompetitive nature of UK automotive components suppliers. Strategies were therefore developed to improve the product quality, cost and delivery (QCD) performance of UK companies. In 1996, the Society of Motor Manufacturers and Traders (SMMT), in collaboration with the Department of Trade and Industry, created the Industry Forum (IF). This was supported by Honda, Nissan, Toyota, General Motors and Volkswagen. They provided 'master engineers' who were world experts in manufacturing process improvement. The master engineers trained a cadre of UK engineers in the use of best practice manufacturing tools and techniques. The IF created a number of programs based around a 'common approach toolkit' which comprises: (i) 'The building blocks' (5C/5S, Seven Wastes, standardized work and visual management); and (ii) supporting tools (data analysis, problem solving, set-up improvement and line balance). IF engineers transferred their skills, knowledge and delivery techniques into the companies with whom they worked through master classes. Master classes are practical, shop floor-based process improvement activities implemented with a 'hands-on' approach. The objective of the training is to enable companies to make significant improvements in QCD and to encourage the development of partnerships with their customers and suppliers. The master engineers have now returned to their respective companies and the training is now provided by senior IF engineers who carry on the high standard of work (Colin Herron, Christian Hicks, 2007).

2.2 WHAT IS LEAN?

Lean Thinking starts with the customer and the definition of value. Therefore, as a manufacturing process is a vehicle to deliver value (a product) to a customer, the principles of lean thinking should be applicable to the Process Industries and the specific manufacturing processes within that industry. We can remove waste from many steps of our manufacturing processes, from how we develop the initial product and process design, how we assure compliance, to how we design to operate a completed facility. However, to be truly lean we have to link all these elements within a robust supply chain—we need to ensure the flow of value. This leads to what many are calling a 'lean enterprise' (Melton, 2005).

Lean Manufacturing is a philosophy, based on the Toyota Production System, and other Japanese management practice that strives to shorten the time line between the customer order and the shipment of the final product, by consistent elimination of waste. In other words, producing more with less. All types of companies, manufacturing, process, distribution, software development or financial services can benefit from adopting lean philosophy. As long as a company can identify a value stream, from when customers order a product to when they receive it, lean principles can be applied and waste removed (Rajinder Singh, 1998).

2.3 TOOLS OF LEAN MANUFACTURING

2.3.1 Cellular Manufacturing

Cellular Manufacturing is one of the cornerstones when one wants to become lean. Cellular manufacturing is a concept that increases the mix of products with the minimum waste possible. A cell consists of equipment and workstations that are arranged in an order that maintains a smooth flow of materials and components through the process. It also has assigned operators who are qualified and trained at that cell.

Arranging people and equipment into cells has great advantages in terms of achieving lean goals. The advantages of cells is the one-pieces flow concept, which states that each product moves through the process one unit at a time without sudden interruption, at a pace determined by the customer's need. Besides that, the advantage of the cellular manufacturing is extending the product mix. When customers demand a high variety of products as well as faster delivery rates, it is important to have flexibility in the process to accommodate their needs. This flexibility can be achieved through grouping similar products into families that can be processed on the same equipment in the same sequence. This also shortens the time required for changeover between products, which will encourage production in smaller lots. Below are the benefits of the cellular manufacturing:

- Inventory reduction
- Reduced transport and material handling

- Better space utilization
- Lead time reduction
- Improved productivity
- Enhanced teamwork and communication
- Enhance flexibility and visibility

2.3.2 Continuous Improvement (KAIZEN)

Continuous improvement is another fundamental principle in a lean manufacturing. Kaizen, which is the Japanese word for a continuous effort for perfection, has become popular in the west as paramount concept behind good management. In manufacturing settings improvements can take place in many forms such as reduction of inventory and reduction of defective parts. One of the most effective tools of kaizen is 5S, which is the basis for an effective lean company. 5S consist of the Japanese words Seiri (Sort), Seiton (Straighten), Seiso (Sweep and Clean), Seiketsu (Systemize) and Shitsuke (Standardize). The underlying concept behind 5S is to look for waste and then try to eliminate it. Waste could be in the form of scrap, defects, excess raw material, unneeded items, old broken tools and obsolete jigs and fixtures. Taken together, 5S means good housekeeping and better workplace organization. Kaizen tools such as 5S are not only a means to increase profitability of affirm but also allow companies to reveal potential strengths and capabilities that were hidden before.

2.3.3 Just – In – Time (JIT)

Closely associated with the lean manufacturing is the principle of just-in-time, since it is a management idea that attempts to eliminate sources of manufacturing waste by producing the right part in the right place at the right time. Inventories and material flow systems are typically classified as either push (traditional) or pull (just-in-time) systems. Customers demand is the driving force for the both systems. However, the major difference is in how each system handles customer demand. JIT is tool that enables the internal process of company to adapt

to sudden changes in the demand pattern by producing the right product at the right time and the right quantities.

Moreover, JIT is a critical tool to manage the external activities of a company such as purchasing and distribution. Each element of a JIT system provides some benefit for a manufacturer, but the application of each element potentially involves only certain areas in the organization, and unless a systems perspective is employed, the areas optimize locally, rather than at the organization level (Richard E. White, Victor Prybutok, 2000).

2.3.4 Production Smoothing (Heijunka)

In lean manufacturing system, it is important to move to a higher degree of process control in order to strive to reduce waste. Another tool to accomplish this is production smoothing. Heijunka is where the manufacturers try to keep the production level as constant as possible from day to day. Heijunka is a concept adapt from the TOYOTA Production System (TPS), where in order to decrease production cost, it was necessary to build no more cars and parts than the number that could be sold. To accomplish this, the production schedule should be smooth so as to effectively produce the right quantity of parts and efficiently utilize manpower. If the production level is not constant this leads to waste (such as work-in-process inventory) at the workplace.

2.3.5 Standardized of Work

A very important principle of waste elimination is the standardization of worker actions. Standardized work basically ensures that each job is organized and is carried out in the most effective manner. No matter who is doing the job the same level of quality should be achieved. At TOYOTA, every worker follows the same processing steps all the time. This includes the time needed to finish a job, the order of steps to follows for each job and the part of hand. By doing this one ensures that line balancing is achieved, unwarranted work-in-process inventory is minimized and non-value added activities are reduced. A tool that is used to standardize work is

what called “talk” time is. Takt time refers to how often a part should be produced in a product family based on the actual customer demand. The target is to produce at pace not higher than the takt time.

$$\text{TAKT TIME} = \frac{\text{Available work time per day}}{\text{Customer demand per day}}$$

2.3.6 Total of Productive Maintenance (TPM)

Machine breakdown is one of the most important issues that concern the people on the shop floor. The reliability of the equipment on the shop floor is very important since if one machine breaks down the entire production line could go down. An important tool that is necessary to account for sudden machine breakdowns is Total Productive Maintenance. In almost any lean environment setting a TPM program is very important.

There are three main component of TPM program which are, preventive maintenance, corrective maintenance and maintenance prevention. Preventive maintenance has to do with regular planned maintenance on all equipment rather than random check ups. Worker has to carry out regular equipment maintenance to detect any anomalies as they occur. By doing so sudden machines breakdown can be prevented, which leads to improvement in the throughput of each machine.

Corrective maintenance deals with decisions such as whether to fix or bur new equipment. If a machine is always down and its components are always breaking down then it is better to replace those parts with newer ones. As a result, the machine will last longer and its uptime will be higher. Maintenance prevention has to do with buying the right machine. Is a machine is hard to maintain (e.g. hard to lubricate or bolts are hard to tighten) the workers will be reluctant to maintain the machine on a regular basis, which will result in a huge amount of lost money invested for that machine.

2.4 THE BENEFITS OF LEAN MANUFACTURING

2.4.1 Improved Response Time to Customer Demand

Customers have numerous choices when it comes to buy their product. Combined with choices available to the consumer and expectation of shorter order fulfillment lead times, customers have become more fickle in their purchasing decisions and less loyal to their old long-standing business relationships. Products with similar features and price offered by multiple manufacturers begin to approach commodity status. Once designed or perceived by the customer as a commodity, product differentiation become more and more critical.

If the manufacturer cannot differentiate its products with improved technology, quality or prices, other criteria must be developed as way to attract and satisfy those customers. If a customer perceives no difference between products, but aspect rapid delivery of configured products, the manufacturer with the ability to respond to this demand faster than competitor will earn the business. For many manufacturers, this rapid-response delivery capability provides the differentiation needed to maintain and gain market share from its competitor.

Lean factories that produces product in its actual work content time achieve a significantly shorter manufacturing lead time. The shorter the manufacturing lead time, the faster response to a customer order. Shorter manufacturing lead time usually allows a reduction in amount of finished goods and/or work-in-process inventories typically carried as an offset to quickly respond to customer demand. If the response to demand is shorter than the current Costumer-Quoted Lead Time (CQLT), there is little need to maintain forecasted product in a finished goods warehouse. This is the key market differentiator for Lean manufacturer. The ability to deliver product faster in a commodity-type market ultimately means an increase in market share from those customers to whom fastest response time is the primary purchase decision criterion.

2.4.2 Reduced Inventories

The manufacturer can eliminate the large amount of work in process because response time can be reduced on Lean line. The amount of reduction usually in direct proportion to the CQLT. CQLTs are established based on the minimum time required to route the product through the manufacturing process. Producing product in less than the CQLT becomes an anomaly requiring heroic effort on the part of the planners, production managers and purchasing personnel.

As lead time reductions are accomplished, matching inventory reductions are also accomplished. In addition, the balancing achieved throughout the factory also drives work-in-process requirements down. As work-in-process levels come down and confidence in line capabilities grows, subsequent reduction in finished goods inventory level also occurs.

2.4.3 Reduced Working Capital Requirements

The point in time from when purchased material enters the manufacturing process until it is converted into a completed product is call the manufacturing lead time. Customers aspect their orders to be shipped within lead time. When manufacturing lead time is greater than the customer's aspect lead time, customer satisfaction may suffer. To satisfy the order, manufacturers may purchase materials from suppliers well in advance of actual demand. Inventory level usually determined by forecasting the quantities of work in process of finished goods inventory to be maintained to assure the ideal customer response solution.

The lean manufacturing line can reduce the working capital investment required to operate a business just by reducing response time. In addition to the direction benefit of a shorter lead time response to customers, improving the time through manufacturing also yields a reduction in working capital requirement, as less money is committed to financing buffer inventory.

When significant improvement in response time through manufacturing occurs and manufacturing lead time is shortened, the reduction in inventories required to support manufacturing can begin. This inventory reduction liberates cash that can be put to use for a multitude of another purposes. The inventory reduction is not one-time improvement because inventories can be managed at significantly lower levels, the elimination of additional overhead and inventory carrying costs represents ± 20% of the value of inventory.

2.4.4 Simplicity and Visual Control

A key benefit for Lean manufacturer is the ability to perform Management by Walking around (MBWA). By walking through a Lean facility, it is very easy to see what is happening on the shop floor. The one-piece-at-a-time product flow indicates the status of products as they move through manufacturing. Everybody working on the Lean line knows what to do and when to do it. Supervision can often be decreased simply because of the Lean line layout.

Producing product on the Lean line does not require or advocate “chaining” an operator to a workstation or machine. To throttle the line up or down in response to daily customer requirements, people resources are intentionally added to or removed from the line. When the mixed-product Lean line does need to operate with less than a full complement of people, operators are required to move or “flex” from workstation to workstation to achieve the planned daily rate. Highly flexible and cross-trained operators are a key source of productivity in Lean manufacturing.

2.4.5 Productivity Improvement

The actual quantity of units produced by a team of people compared to the standard amount of time needed to produce those units is generally accepted as the measurement of a factory’s productivity. While productivity improvement itself is not typically a stated goal of Lean manufacturer, the methodologies of Lean Manufacturing inherently cause process improvement to occur. Formal strategies like Kaizen focus on the incremental reductions of wait time, queue time and other

nonvalue-adding activities. By eliminating wasteful time elements embedded in manufacturing processes, manufacturing operators are able to spend more of the working day producing products. Productivity improvement is an ancillary benefit of Lean Manufacturing.

2.4.6 Operational Benefits

Using linked processes and the IPK system, the need for subassembly production planning can be virtually eliminated. Over time, multilevel Bill of Material (BOM) can be dramatically compressed or flattened. Designed output variances can be managed by simply adding to or subtracting form the line's staffing level to match the require daily rate. The Lean manufacturer tends to drive production planning with a make-to-order production schedule. Actual customer orders drive the labor resources required in the production process each day.

As the Line matures, even cost accounting methods have an opportunity to be simplified as a result of the implementation of the Lean Manufacturing methods. Because lead time through a Lean facility is consistent, repeatable and not sensitive to volume changes, simpler activity-based costing methodologies can be implemented. Labor cost become elements included in overhead and also be created to account for extraordinary conversion costs driven by the use of special machines or resources.

2.5 THE CHALLENGE IMPLEMENTING LEAN METHODOLOGY IN AUTOMOTIVE INDUSTRY

The Lean manufacturing methodologies are not difficult to understand. Frequently, manufacturers comment on their simplicity and innate common sense. The methodologies have been around for 100 years and have gained and lost popularity during that time. There is a popular resurgence now and more manufacturer look for ways to become more flexible in order to satisfy their customers' increasing demand for more product variety, lower prices and faster deliveries with faster response and smaller working capital investment.

Implementation of Lean methodologies leaves mush room for compromise. This is a blessing and a curse for the Lean champion. During implementation, the methodologies present a series of trade-offs. There will always be some people who find reasons why elements of the Lean methodology cannot be implemented. It is up to steering committee, the Lean/steering committee coordinator and the implementation teams to avoid compromises to the Lean methodologies. Compromise reduces the benefits of Lean manufacturing.

To sufficiently battle resistance to change from all levels in the organization, implementation of the Lean manufacturing methodologies must be sponsored by higher levels of management in the company. Grass-roots sponsorship is frustrating and cannot be expected to persuade higher management levels if they do not want to participate in the change.

CHAPTER 3

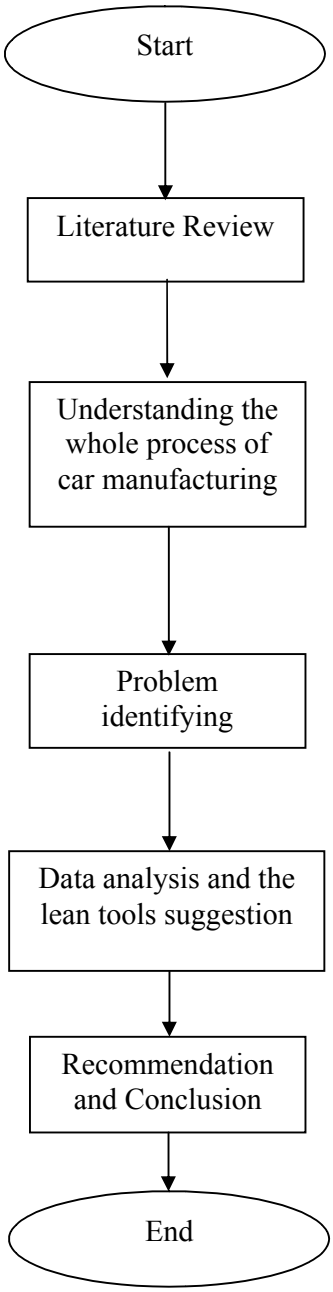
METHODOLOGY

3.1 PURPOSE OF METHODOLOGY

The purpose of the methodology is to achieve the objective of the study. Its start from understanding the title of the study and will be end with the appropriate report. The methodology is a guideline of the study to make sure that all process follows the plan. The study will be done on the C Class Mercedes passenger car production that operated at AMM. The study will cover up the only the Trim and Finale and Department. The problem occurs cannot be solved by applying lean tools because of the rules and policy of the company. So that, the lean tools are only be suggested for that particular problem.

3.2 PROJECT METHODOLOGY

3.2.1 Flow Chart



- Conformation the title and identify the objective, problem statements and scopes of this study.
- Getting information and benefit of the Lean Manufacturing implementation.
- Visititng the AMM plant to get the clear visual of the car manufacturing from Logistic Department to Quality Control
- Find problem that occur in the department based on 4M element
- Analysis the problem occurred and suggesting the suitable lean tools
- Make a conclussion and the recommendation for the next reseacher.
- End of the study by sent the report.

Figure 3.0: Flow chart of the project