Adoption of JMM practices – A key to performance improvement of a local automotive industry

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Abstract. It is imperative for a manufacturing company all over the world to constantly look for ways to increase productivity and at the same time to lower cost to secure a competitive position. It is recognized that practices associated with Japanese Manufacturing Management (JMM) can yield a superior competitive advantage in terms of productivity, quality and provide overall successful business performance. This paper discusses the transfer of the best practices of the JMM locally and analyses the impact of adoption and adaptation of the management system as an in-depth case study conducted in a Malaysian automotive company. This study is to identify what are the changes in terms of the philosophy and practices undertaken by the company and ascertain the impact of the JMM on its manufacturing and financial performances. The elements of business performance from the viewpoint of manufacturing are based on safety, Parts Per Million (PPM), in-line Defect per Unit (DPU), First Time Quality (FTQ), cycle time, productivity, efficiency and stock level. The results show a positive impact to the automotive plant manufacturing performance. For example, safety index has reduced to 0 major accident occurrences. The PPM and In-line DPU have improved by 98% and 91% respectively whereas the FTQ has improved by 167%. Cycle time has reduced from 20 to 6 minutes and productivity increased up to 43% whilst the efficiency reached at 99.9%. The stock level was reduced from half month to 3 days after the adoption of the JMM. The revenue has increased up to 92%, the percentage of expenses has reduced from 11.04% to 3.06% giving an improvement of 72% whilst the net profit has increased from 5.33% to 8.15%. The Return of Asset (RoA) and Return of Equity (RoE) also showed slight improvement despite the effects from the restructuring exercise, Tsunami calamity and fluctuation in Japanese exchange rate.

1. Introduction
Automotive companies all over the world are constantly looking for ways to increase productivity and at the same time to reduce cost to remain competitive. They are looking for ways and means to produce quality and competitive products and services to the market. Currently, Toyota Motors Corporation is the largest auto maker in the world. They exceeded the sales records of the giant automotive companies such as General Motors (GM) and Ford. The title of number one automotive manufacturer formerly held by GM since 1950s for more than seven decades and was claimed by Toyota in 2008. Toyota lost the title when sales declined in 2011 due to natural disasters of tsunami
and Thailand flood. But it managed to recover it in the following year [1]. In 2012, Toyota sold 9.75 million vehicles in the United States compared with 9.29 million for GM [2]. There remains a wide gap in profitability between the giant American automotive manufacturers and their Japanese automotive counterparts. Toyota continues to be the industry benchmark of automakers. But the American automakers have been facing with various problems including bankruptcy, reorganization, declining demand, high operational costs, and overproduction [3].

The success for Toyota does not happen overnight. The success for Toyota starts since post World War II (WWII). Toyota has developed its own principles in excellent manufacturing practices and philosophy. After WWII, with scarce materials and resources, Toyota has utilized different techniques of manufacturing rather than mass production introduced by Ford in the USA. Unlike mass production with high inventory level to cater for big production volume to take advantage of economy of scale, the manufacturing practices by Toyota emphasizes on Lean Production. Lean Production focuses on producing high quality finished goods satisfactory to customer demands by eliminating waste (muda). The Lean Production approach includes a wide variety of management practices, including just-in-time (JIT), continuous improvement (Kaizen), quality systems, quality circles, work teams, cellular manufacturing, supplier management, etc. in an integrated system [4,5]. These practices, which later referred to the best practices when applied to manufacturing scenarios, are continuously improved and tied to form a management system such as Toyota Production System (TPS). The effectiveness of this technique motivated most of the Japanese automotive companies in the 70s to implement this technique and later it was adapted and implemented in the USA, Europe and other parts of the world. Isuzu also practices Lean Production and the Japanese way of manufacturing with its philosophy and practice called Isuzu Manufacturing Management (IMM). IMM is implemented by its parent company in Japan and similar best practices are adopted and shared by its overseas plants throughout the world. The TPS, IMM and JIT have been adopted and adapted in various developed and developing countries to the extent they form what is known as “The Japanese Way” [6]. Until now, the Japanese has continuously perfected their manufacturing strategy in automotive industry [7]. Japanese Manufacturing Management (JMM) has evolved over the last thirty years and it continues to evolve. A lot of studies examined the transfer of Japanese production practice and its impact on the company performance in the US [6, 7, 8]. Also, in the UK, Japanese manufacturing practices and its relationship with performance have been studied extensively. Phan et al. [9] conducted two surveys with twenty seven Japanese manufacturing companies in the 1990s and 2000s to compare the degree of implementation of eleven quality management practices and their impact on different dimensions of competitive performance during the period. This paper provides an insight of the performance improvement of a local automotive plant by adoption and adaptation of JMM.

2. Overview of automotive manufacturing in Malaysia
The manufacturing sector in Malaysia plays a significant role in the financial health of the nation. In 2011, the manufacturing sector contributed 27.9% of Malaysia Gross Domestic Product (GDP) compared to other sectors i.e. agriculture (7.4%), mining (7.1%), construction (3.2%) and services (57.3%). The percentage had also steadily increased from 26.6% to 27.6% for respective years of 2009 and 2010 [10]. The automotive industry is viewed as one of the most pertinent contributors for the economy since it is directly correlated with manufacturing and service sectors. The industry is also significant because more than half of the population in Malaysia owns a vehicle with the rate of car utilization stood at 67%. The number of new car registration has also increased every year [11].

The presence of Japanese influence in Malaysian automotive industry has existed for quite some time. The ‘Look East’ policy by the former Prime Minister Tun Mahathir Mohamad has resulted in the establishment of the first national car company Proton in Malaysia, in 1983 which jointly collaborated with Mitsubishi Motors Corporation and Mitsubishi Corporation. The second national car company of
Malaysia was established in 1992 under the name PERODUA. The company is a joint venture between a Malaysian company and Daihatsu Motor Corporation.

3. **Japanese manufacturing management (JMM) and Toyota production system (TPS)**

The objective of manufacturing management is to manage resources effectively and contribute significantly to the achievement of corporate objectives. The main target of manufacturing management is productivity, meaning manufacturing or production effectiveness. Manufacturing requires integration with other management functions to ensure that the manufacturing objectives can be accomplished. This includes the running of production processes, quality management, logistics, maintenance, industrial engineering, procurement as well as human resources.

For effective operation, top management must acknowledge that the organization as a whole needs to develop an integrated approach to the business and its activities. This involves recognizing and understanding the interactions between different functions that are necessary for the organization to be effective. Different management functions must be involved in setting the corporate strategy of the organization. Each function will then set its own functional objectives and develop a functional strategy to achieve those objectives.

JMM places a great emphasis on mission and vision of a company. In the Executive Summary of the 14 Toyota Way Principles extracted from the book ‘The Toyota Way’ written by Liker [12], it is stated that companies should base the management decisions on a long-term philosophy, even at the expense of short-term financial goals. Company should also have a philosophical sense of purpose that supersedes any short-term decision making. The company’s philosophical mission is the foundation for all the other principles [12]. Liker and other researchers believe that the basis of Toyota's success stems from the business philosophy that underlies its production system.

TPS is the most vital component for understanding Japanese production management. It can be seen as a technology-based, comprehensive production management system with the primary goals of increasing productivity and reducing costs. This is achieved by reducing cycle time, increasing flexibility, reducing stock levels and shortening machine changeover times [13]. The best word to describe TPS is Lean Production. The use of the term "Lean", in a business or manufacturing environment, describes a philosophy that incorporates a collection of tools and techniques into the business processes to optimize time, human resources, assets, and productivity, while improving the quality level of products and services to their customers.

Shingo (1989) in his book ‘The Study of the TPS from an Industrial Engineering Perspective’ [14] identified the basic features of TPS as follows:
1. It achieves cost reductions by eliminating waste, be it staff time, materials, or other resources.
2. It reduces the likelihood of overproduction by maintaining low inventories (“non-stock”) and keeps labor costs low by using minimal manpower.
3. It reduces production cycle time drastically with innovations like the Single-Minute Exchange of Die (SMED) system, which cuts downtime and enables small-lot production.

The driving force behind the Japanese system of production is eliminating waste, thereby maximizing process efficiency and the returns on resources. A wide number of principles and practices can be employed to achieve this goal. While low inventory levels are a key outcome of the TPS, an important element of the philosophy behind its system is to work intelligently and eliminate waste so that inventory is no longer needed. The act of imitating without understanding the underlying concept or motivation may have led to the failure of those projects.

4. **Adoption of JMM**

The findings by Laosirihongthong et al. [6] on Japanese auto companies established in Thailand, Indonesia, Malaysia, Singapore, Philippines, Vietnam and Australia show that there are six pillars to support JMM implementation. These are the key enablers to success in adopting JMM. These six pillars are summarized as follows:
Cultural change: local employees are encouraged to adapt and be familiar with JMM by providing on job training and education.

Quality at the shop floor: Assembly line employees practice quality check point to ensure they do not receive defects, make any defects or transfer the defects to the next workstation. Defects are identified using root cause analysis through PDCA – problem solving cycle to detect defects in dimensions of Man (skill and training), Machine (preventive maintenance), Material (Suppliers development program) and Method (Standard Operating Procedure and Work Instruction). Morning briefing is held daily as part of quality circle to improve production process.

Consensus: Top Down and Bottom Up approaches present in JMM companies.

Incremental continuous improvement: Implementation of Kaizen at shop floor including open concept office layout with no partitions for easy communication and access. Gemba (Go see problem at source) are conducted every day by managers to better understand issues at workplace and to develop relations with subordinates. Visual Management System and Boards are effectively used in the companies under study. Also a large number of Kaizen program are implemented.

Benchmarking: All cases studied use benchmarking techniques for quality, delivery, cost, flexibility and innovation metrics.

Backward-forward integration: The relationship integration exists among the suppliers, the auto company itself and customers.

Laosirihongthong et al. [6] outlined that manufacturing practices should describe the contributions it makes to the cost, quality, flexibility, delivery and future objectives of the business. Manufacturing practice / strategy which is developed and implemented through a set of activities into output measurable in terms of the competitive priorities of cost, quality, delivery, flexibility and innovation, can be further elaborated as follows:

Quality: Manufacture of products with high quality or performance standards.

Delivery: Meet delivery schedules and respond quickly to customer orders.

Cost: Production and distribution of product at low cost.

Innovation: Number of new products and processes that are developed to fit customers’ requirement and differ from competitors.

5. Implementation of JMM

The local company, upon adopting the JMM, had taken massive improvement activities under JMM umbrella during its restructuring exercise in late 2007. In line with the implementation of JMM, the improvement activities can be listed as follows:

Plant Layout Improvement: the initial improvement in plant layout was conducted by rearranging the original layout to fit the lean requirement. All of the plant reengineering and relocation activities are performed under a project called J-Project.

Quality Improvement: Among the quality improvement activities conducted are workshop quality improvement, open space concept for the offices and supplier quality management. The workshop on quality improvement is dedicated to minimize wrong assembly and defects in production line and most detection are performed by production operators. This self-check activity has empowered operators to ensure the quality of the vehicle manufactured to be in-line with the standard required by JMM.

With the implementation of the J-Project and quality management adopted from JMM in 2008 onwards, all operations personnel including manufacturing supervisors, technical specialist, engineers, managers and in particular production operators were directly involved in the Quality Improvement Activities of the JMM. Their skill and energy are the sources of continuous improvement as well as standardization and has become the biggest asset in the organization today. Their competence and commitment are an invaluable capital to the organization.

In quality control for manufacturing, the JMM adopted by the local company emphasizes on quality management of not passing defect and being unable to make defects. For JMM, quality must be measured, controlled and charted at shop floor where the process and manufacturing strategy is
executed. The reason is because the “process owner” is a person who is responsible for providing the resources to a process to perform activities and tasks thereby intimately knowing where exact problems occur. Therefore, such operational personnel should be given the opportunity to suggest the options to solve any problems at source through Gemba and Kaizen activities.

The local company has been practicing three main quality-check-point activities for operational personnel

1. Do not receive any defects;
2. Do not make any defects; and
3. Do not transfer any defects”.

The JMM adopted by the local company necessitates the changes in quality activities implemented in accordance to JMM requirement. The activities for workshop improvement consist of daily quality audit meeting; two (2) minutes parts check; two (2) minutes tips check; defect parts management; work stop rule; torque analyser usage; daily inspection of torque wrench and torque meter; daily checking of inspection tools; fallen bolt, torque wrench and meter; 4M change control point at QC inspection points; QC in-line inspection and process matrix; QC quality agreements; feedback rule among production lines and from QC to production; abnormalities guidelines; maintenance agreements; joint operation manual; purchase of new torque; colour code etc. [15].

6. Results and discussions

6.1. Manufacturing performance

The results of the implementation of the JMM in the local company, gauged in the process performance metrics based on safety, quality, cost and delivery (SQCD). The performance metrics are listed as follows:
a) Safety - Safety index
b) Quality – Parts Per Million (PPM), In-Line Defect Per Unit (DPU), First Time Quality (FTQ)
c) Cost – cycle time and productivity
d) Delivery - efficiency

6.1.1. Safety. Implementation of JMM shows a significant improvement of the safety index. In financial year 2007/2008, the local company registered 6 occurrences of recordable major accidents with medical leave and 8 minor accidents as shown in Figure 1. The accident rate dropped sharply in FY2011/2012 with no occurrences of recordable major accident and 6 occurrences of minor accident. This is the best accident record ever achieved for the major accident. Although in early implementation of JMM, the minor accidents were above the plant target of 8 occurrences per year, the rate dropped below the target of 8 occurrences in FY2008/2010 onwards.

![Figure 1. Plant accidents](image-url)
6.1.2. Parts per Million. PPM (Parts per Million) is a measurement used by the local company to measure quality performance of parts received from suppliers. One PPM means one defect in a million or 1/1,000,000. In the past a good supplier would have a defect rate of less than 1%, (10,000 PPM). However, production and quality control procedures have improved with an expected defect rate of as low as 300 PPM.

Since the adoption of the JMM, the defective parts shipment to the plant by suppliers had been reduced significantly over the last few years. The plant originally recorded 6,500 PPM in FY2007/2008 and then improved by 97.8% at 141 PPM and 98.1% at 121 PPM for FY2010/2011 and FY2011/2012 respectively. The downward trend for the PPM at the local company is depicted in Figure 2.

Even though PPM is only one part of the overall quality picture, it is still a very large part. At the local company, quality awards are hand out to suppliers based on a number of criteria, including low PPM. Supplier quality programs are geared to make PPM as low as possible.

![Figure 2. Quality trend of incoming parts measured in Parts per Million](image)

6.1.3. In-Line Defect Per Unit (DPU) and First Time Quality (FTQ). Defect per unit (DPU) is the average number of defects per unit. The ratio of defects to unit is the universal measure of quality simply defined by the following equation:

\[
\text{In-Line Quality Defect Per Unit (DPU)} = \frac{\text{Total number of defects}}{\text{Total number of units}}
\]

The In-line DPU is simply the number of defects found in assembly line divided by the number of units inspected. Since the implementation of the JMM, the In-line DPU had shown a consistent downward trend. From FY2007/2008 to FY2011/2012, the In-line DPU was reduced from 5.7 DPU to 0.49 DPU giving 91% improvement for the DPU.

First Time Quality (FTQ) is a lean metric that indicates to what extent parts are manufactured correctly the first time without need for inspection, rework, or replacement. FTQ is calculated by dividing the number of good units produced by the number of total units going into the process. FTQ is an important tool in any quality management system to deliver a high quality product: built right, the first time. This is a key element in the effort to exceed the expectations of both internal and external customers. A well-stratified FTQ system offers a multitude of benefits, among them includes the opportunity to identify opportunities for continuous improvement, reduce costs, and monitor process stability. It also provides added value to the customers by demonstrating and documenting measurable performance.
The FTQ in percentage also indicated an improvement trend beginning FY2009/2010. The upward trend for FTQ in FY2009/2010 was slightly dropped due to the effect of Tsunami and Thailand flood which contributed to disruption of operation and parts supply to the plant. In FY2011/2012, the FTQ improved at 84.97% as compared to 31.8% before the JMM implementation. This shows improvements of 167% for the FTQ as compared to those before the JMM adoption.

The trend for the DPU and FTQ shows that the quality has substantially improved due to the adoption of JMM. The In-line DPU and FTQ are depicted in Figure 3.

6.1.4. Cycle time. Understanding the concept of cycle time is a useful method in continuous improvement efforts. Cycle time describes how long it takes to complete a specific task from start to finish. Based on lean approach, cycle time should be considered a viable option when an organization is trying to improve efficiency, productivity, cost base, customer responsiveness and flexibility.

Cycle time reduction is identifying and implementing more efficient and effective ways to do things. Reducing cycle time requires elimination or reduction of non-value-added tasks and activities, which do not provide any real value to the customer. Reduction in cycle time has a significant impact on a company's profitability and ultimately customer satisfaction. The benefits of cycle time reduction include lower costs, elimination of waste and non-value activity, streamlined processes, improved communications, improved process consistency, schedule integrity and improved on-time delivery.

Over the years of JMM implementation, the cycle time for general assembly had been reduced significantly as shown in Table 1. Beginning with more than 20 minutes prior to the adoption of JMM, the cycle time was further improved to 6 minutes in financial year 2012/2013. The cycle time had improved by 70% as compared to the value prior to JMM Implementation.

| Financial Year | Prior to JMM | After JMM |
|---------------|-------------|-----------|
| Cycle time    | 20          | 16        |
|               | 12          | 10        |
|               | 8           | 6         |
The improvement was also due to the improved processes, skill upgrading, kaizen activities undertaken by all, not only the engineering personnel but also all process owners i.e. supervisors, foremen and operators, and improved manpower skill. It is also to be noted that the cycle time reduction is an ongoing process that takes strong management commitment.

6.1.5. Productivity. The standard measurement of productivity is output per worker-hour, or the ratio of output to inputs in production. The productivity is simply defined by the following equation:

\[
\text{Productivity} = \frac{\text{Output}}{\text{Manpower} \times \text{working hours}}
\]

During the early year of JMM in FY2008/2009, Body Shop and General Assembly employees collectively produced an average of 0.23 units per hour and 0.05 units per hour respectively which were below the plant target. In FY2011/12, over 3 years after JMM, Body Shop productivity improved by 43% at 0.33 units per hour. The General Assembly performance is quite stable at 0.07 units due to conveyorized system. Therefore, both shops had shown improvement in subsequent years after the introduction of JMM which exceeded or at par with the targets. The productivity for Body Shop and General Assembly is illustrated in Table 2.

Table 2. Productivity for body shop and general assembly

| FY/Shop       | Target | 2008/09 | 2009/10 | 2010/11 | 2011/12 |
|---------------|--------|---------|---------|---------|---------|
| Body Shop     | 0.28   | 0.23    | 0.32    | 0.31    | 0.33    |
| Gen. Assembly | 0.07   | 0.05    | 0.07    | 0.07    | 0.07    |

6.1.6. Efficiency. Manufacturing efficiency determines how well a factory operates in production. To avoid wasting money, all processes in manufacturing must be as efficient as possible. Calculating a numerical value for the efficiency helps to identify if improvements to the production process need to be made. The calculation of percentage efficiency used by the plant is as follows:

\[
\text{Efficiency} = \left(\frac{\text{Available working time} - \text{Downtime}}{\text{Available working time}}\right) \times 100
\]

The plant recorded an increase in efficiency for the past few years as compared to the first year of the JMM implementation in FY2008/2009. Although the efficiency performance at Body Shop recorded a mixed trend due to introduction of new models, new manpower and etc., the performance was above the target of 96% set by the plant. The highest achievement was efficiency at 99.9% accomplished in 2009/2010, an improvement of 4% against the target. The efficiency for the General Assembly had shown an increasing trend although a lot of improvement initiative are needed to reduce downtime in terms of machine breakdown, absenteeism, parts delays etc. in order to meet the target efficiency. The efficiency for Body Shop and General Assembly is presented in Table 3.

Table 3. Efficiency for body shop and general assembly

| FY/Shop Efficiency (%) | Target (%) | 2008/09 | 2009/10 | 2010/11 | 2011/12 |
|------------------------|------------|---------|---------|---------|---------|
| Body Shop              | 96         | 97.3    | 99.9    | 98.7    | 97.9    |
| Gen. Assembly          | 89         | 73.9    | 80.1    | 85.4    | 85.6    |

6.1.7. Stock level. The control of stock level is one of the important aspects of lean manufacturing. It was found that the CKD stock level for the local company was steadily controlled from 1.7 months prior to the JMM to 1.5 months after the JMM implementation. The stock level for the local parts also was reduced from 0.5 months to 7 days before delivery from the local suppliers. With the recent
implementation of distribution center and soon milk-run activities, the local parts stock level for the plant was further reduced to 3 days.

6.2. Financial performance

The financial results were taken in FY2007/2008, a year before the full implementation of the JMM in FY2007/2008 and assess throughout the adaptation period for the following 4 years. The local company began with RM 189.7 million business turnovers during the midst of the JMM implementation in FY2007/2008 but had significantly increased by 92% to RM364 million in a 4-year period by FY2011/2012. The financial statement of the local company is shown in Table 4.

**Table 4. Financial statement**

| JMM started | 2007/2008 | 2008/09 | 2009/10 | 2010/11 | 2011/12 |
|-------------|-----------|---------|---------|---------|---------|
| Revenue     | RM'000    | RM'000  | RM'000  | RM'000  | RM'000  |
| Gross profit| (163,275) | (254,041)| (207,097)| (269,323)| (324,796)|
| Operating expenses | 20,954 | 15,519 | 8,511 | 10,807 | 11,146 |
| Profit before taxation | 5,497 | 10,629 | 16,603 | 36,197 | 28,117 |
| Taxation | 4,614 | 11 | 546 | 2,256 | 1,553 |
| Profit after taxation | 10,111 | 10,640 | 17,149 | 38,453 | 29,670 |
| Percentage Revenue VS Expenses (%) | 11.04 | 5.54 | 3.67 | 3.42 | 3.06 |

Source: Audited report of the local company

Specifically, the revenue had increased by more than 47.6% from RM189.7 million in FY2007/2008 to RM 280,189 million in FY2008/2009. The revenue however had decreased to RM232.2 million in FY2009/2010 as a result of Tsunami calamity in Japan and Thailand flood which had disrupted the parts supply. Even so, the figure was still more than the revenue before the JMM implementation. The revenue continued to improve by 36% at RM316.3 million in the following financial year due to the increase in the volume of vehicles sold to the market, manufacturing efficiency and the acquisition of product ownership for the heavy-duty model. In FY2011/2012, the plant recorded an increase in revenue by 15% at RM 364 million compared to the previous financial year.

It is noted that for FY2007/2008, the expenses was high at RM20.9 million mainly due to company restructuring cost of RM2.40 million and Japanese technical assistance fee for the J-Project totaling RM1.86 million. The percentage expenses stood at 11.04% in FY2007/2008 prior to the JMM, however, after full implementation of the JMM in FY2008/2009, percentage expenses sharply fell by 50% at 5.54% as compared to the previous financial year and reduced further by 34% at 3.67% in FY2009/2010. The expenses had been steadily reducing for the following 2 years. For example, in FY2011/12, the percentage of expenses was at 3.06%, an improvement of 72% in comparison before JMM in FY2007/2008.

Due to restructuring exercise, the net profit went slightly down from 5.33% to 3.8% giving a reduction of 29% in FY2008/2009, however, the net profit increased tremendously by 94% at 7.39% net profit in FY2009/2010, the second year after the JMM adoption. The net profit increased further by 65% at 12.16% net profit in FY2010/2011 whereas for FY2011/2012 it showed a reduction of 33%
at 8.15%. Although the figure is lower than previous year, the net profit had improved by 52% as compared to those before JMM. The reduction of net profit although with higher revenue was due to higher Japanese yen exchange rate for the CKD purchase from Japan. The percentage however, is still higher than the net profit before the JMM adoption. The financial performance of the local company is indicated in Table 5.

Table 5. Financial performance

|                | 2007/08 | 2008/09 | 2009/10 | 2010/11 | 2011/12 |
|----------------|---------|---------|---------|---------|---------|
| Revenue        | RM'000  | RM'000  | RM'000  | RM'000  | RM'000  |
| Profit after taxation | 189,726 | 280,189 | 232,211 | 316,327 | 364,059 |
| Total assets   | RM'000  | RM'000  | RM'000  | RM'000  | RM'000  |
| Total s/equity | 72,974  | 142,228 | 137,059 | 206,042 | 248,822 |
| Net profit margin (%) | 5.33    | 3.80    | 7.39    | 12.16   | 8.15    |
| Return on asset ROA (%) | 13.86   | 7.48    | 12.51   | 18.66   | 11.92   |
| Return on equity ROE (%) | 20.52   | 17.76   | 22.25   | 33.92   | 20.74   |
| Inventory Turnover Ratio | 6.91    | 7.67    | 10.55   | 10.51   | 4.70    |

Source: Audited report of the local company

The RoA (Return on Assets) reduced by 46% at 7.48% in FY 2008/2009 as compared to earlier financial year following to the restructuring exercise. The RoA increased by 67% at 12.51% in FY2009/2010 as compared to the previous financial year and then continued to increase by 49% at 18.66% in FY2010/2011. The RoA however, went down by 36% at 11.92% in FY2011/2012 as compared to earlier financial year due to the fluctuation in Japanese exchange rate.

The Return on Equity (RoE) which was at 20.52% in FY 2007/2008 reduced by 13% at 17.76% in FY2008/2009 after the restructuring of the plant. The RoE went up by 25% at 22.25% in the year FY2009/2010 and continuously increased by 52% at the percentage of 33.92 in FY2010/2011 before it went down by 39% at 20.74% for FY2011/2012 again due the fluctuation in exchange rate although the percentage RoE was still above the RoE prior to JMM implementation.

Following to the restructuring exercise and early stages of growth of the plant, the calculation of return on assets (RoA), return on equity (RoE) and net profit margin of the local company showed some reduction at the beginning of JMM introduction in FY2008/2009. The net profit margin, RoA and RoE however, had been steadily on the rise for the following three consecutive financial years before the performance was slightly declined due to the higher Japanese exchanged rate in FY2011/2012. The increasing financial performance for FY2008/2009 to FY2010/2011 after the JMM implementation had indicated that the profitability of the plant was improving.

The upward trend for the Inventory Turnover Ratio (ITR), which measures the rate at which the company manufactures and sells products to customers, indicates the company was enjoying strong sales and practicing JIT inventory methods throughout the 3-year period of JMM implementation. In FY2012, however, the inventory turnover ratio dropped to 4.70 as compared to 10.51 in the previous year mainly due to the company was carrying too much inventory in preparation for special promotions and new model introductions.

When compared the revenue and expenses during the financial years under review, the revenue increased significantly while the expenses had downward trend. This means that since the adoption of the JMM, the local company was able to run production efficiently as the revenues increased and expenses decreased or were steadily under control. The revenue versus expenses trend is illustrated in Figure 4. From this it can be concluded that the financial performance of the local company has improved after the JMM adoption.
When viewed over time since the adoption of the JMM, the revenue and the profit for the local company had shown an increasing trend. This indicates that the local company had effective control over cost in converting revenue into profit. The trend is shown in Figure 5.

7. Conclusion
The research shows that through the adoption of JMM, the manufacturing performance improved in terms of the following aspects:
   a) Safety index reduction from 6 major accidents to 0 accident,
   b) PPM reduction of 98%,
   c) In-line DPU improvement of 91%,
   d) FTQ up from 31.8% to 84.97% giving an improvement of 167%
   e) Cycle time improvement from 20 minutes to 6 minutes.
   f) Productivity improvement up to 43% at Body Shop and at par for General Assembly
g) Efficiency improvement up to 4% against the target for Body Shop.

h) Stock level of local parts from half month to 3 days and CKD from 1.7 months to 1.5 months.

The results of this study also show that the implementation of JMM increases the firm’s profitability and revenue besides maintaining the stability of expenses. The revenue has increased from 22% to 92% after the JMM adoption and the net profit has increased from 5.33% to 8.15%.

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References
[1] Krisher T 2012 Toyota Now Top Selling Automaker, Claims Title From GM. Huff Post Business, Retrieved March 2013. http://www.huffingtonpost.com/2013/01/14/toyota-top-selling-automakern_2471068.html.
[2] Dawson C 2013 Toyota Takes Top Car-Maker Title back from GM. Wall Street Journal, Retrieved March 2013, http://blogs.wsj.com/drivers-seat/2013/01/28/toyota-takes-top-car-maker-title-back-from-gm.
[3] Bergenwall A L, Chen C and White R E 2012 TPS’s process design in American Automotive Plants and its Effects on the Triple Bottom Line and Sustainability, Int. Journal of Production Economics, 140(1) 374-384.
[4] Shah R and Ward P T 2003 Lean Manufacturing: Context, Practice Bundles, and performance, Journal of Operation Management, 21 pp 129-149.
[5] Fullerton R R, McWatters C S and Fawson C 2003 An Examination of the Relationship Between JIT and Financial Performance, Journal of Operations Management, 21(4) 383-404.
[6] Laosirihongthong T, McLean M W, Leabsuetrakool P, Chongjaroenjai T and Leedhirakul S 2007 Technology Strategy: Findings from Adoption and Adaptation of Japanese Manufacturing Management (JMM) to ASEAN and Australasian Automotive Manufacturers, 4th IEEE International Conference on Management of Innovation and Technology, (2008) 1325-1330.
[7] Schonberger R J 2007 Japanese Production Management: An Evolution-With Mixed Success, Journal of Operations Management, 25(2) 403-419.
[8] Pil F K 2000 Thrive: Managing the Transfer of “Best Practice” at Japanese Auto Plants in North America, Journal of World Business, 34(4) 372-390.
[9] Phan A C, Abdallah A B and Matsui Y 2011 Quality Management Practices and Competitive Performance: Empirical Evidence from Japanese Manufacturing Companies, International Journal of Production Economics, 133(2) 518-529.
[10] Economic Report 2010/2011. (2010). Official Website of Ministry of Finance Malaysia. Retrieved March, 2013. http://www.treasury.gov.my.
[11] Haji Alias M, Harris A and Ramli M A 2009 Penglibatan Bumiputera Dalam Industri Otomotif Sokongan: Satu Penilaian Kritis, 2 pp 199–207.
[12] Liker J K 2004 The Toyota Way: 14 Management Principles from the world’s greatest manufacturer, McGraw- Hill, USA.
[13] Monden Y 1983 Toyota Production System: A Practical Approach to Production Management. Industrial Engineers and Management Press, Norcross, GA.
[14] Shingo S 1989. A Study of the Toyota Production System, revised ed. Productivity Press, Cambridge, MA.
[15] Mohiuddin A K M, Rahman M A and Julia Bt Haji A Jabar 2015 Adoption and Adaptation of Japanese Manufacturing Management in an Automotive company of Malaysia, Advanced Materials Research 1115 pp 589-595.