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TOYOTA PRODUCTION SYSTEM IN THAILAND

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Abstract— **Meijo University Institute of Industrial Districts visited many foreign affiliates of Toyota in America, Europe and Asia to research how the Toyota Production System (TPS) was localized and implemented abroad. This research reveals that Toyota Motor Thailand (TMT) has the highly advantages of quality, productivity and flexibility over other countries. As the result, in the Toyota's new "International/ Innovative Multi-purpose Vehicle (IMV)" project, TMT is playing a significant role in the global market. This paper presents that TPS in Thailand is built on three distinctive and specific elements; the excellent supplier network for *Just in Time* (JIT), multi-functional and skilled workers for *Kaizen* (continuous improvement) and the experience of overcoming the currency crisis. Through the analysis, the author forecasts TMT and Thai automobile industry of the future beyond the global depression.**

Keyword— **Toyota Production System (TPS), ASEAN Free Trade Area (AFTA), International/Innovative Multi-purpose Vehicle (IMV), Just in Time (JIT), Kaizen**

I . INTRODUCTION

Toyota has the long history of 60 years in Thailand. Right after the GHQ lifted restrictions on the Japanese automobile industry, Toyota immediately exported to Thailand in 1949 and established the Bangkok branch in 1956 which was the first overseas base for Toyota. The Thai government started in response to this policy Toyota Motor Thailand (TMT) was established in the following year. TMT started to assemble light trucks by completely knocked-down (CKD) packages at the first Samrong Plant in December 1964, which was Toyota's second oldest foreign production facility next to Brazil.

As motorization proceeded with the economic growth in the 1990s, TMT built a new plant for passenger vehicles. This Gateway Plant started operation in February 1996 and from the end of that year manufacturing the Asian Car 'Soluna' at the pace of 6000 units per month in double shifts.

However, the Thai Baht crisis which occurred suddenly in July 1997 cornered TMT.

II . TOYOTA IMV PROJECT and AFTA

In the 21st century, as the Thai and ASEAN economies had recovered rapidly, Toyota launched the new global project called the "IMV". The IMV which stands for "International/Innovative Multi-purpose Vehicle" is the global car to meet with the local markets in the developing countries. It has three different upper-bodies (pick-up truck 'Hilux VIGO'; SUV 'Fortuner' and Mini-Van 'Innova') upon a common platform.

Toyota selected ten countries for the production locations of the IMV; Thailand, Indonesia, South-Africa, Argentina, India, Malaysia, the Philippines, Vietnam, Venezuela and Pakistan. Former five countries are the "core countries" which should export the CKD parts to the latter countries. Especially, Thailand was the center representing 41 percent of the total production of the IMV at the beginning stage of the project.

The background of the IMV project is linked to the changes of the ASEAN markets. In the 1960s, many Asian developing countries introduced industrial policies to encourage their domestic automobile industries. Corresponding to their needs, Toyota founded assembly plants in each country for its domestic market. As a result, the Asian automobile market was fragmented and Toyota was forced to diversify its investment and production until the end of the 1990s.

However, as the ASEAN Free Trade Area (AFTA) was formed among the ASEAN 6 countries in 2002, the tariffs on almost all the goods including vehicles and their parts were reduced to 5 percent or less. In addition, the Thai government repealed the local content requirement in 2000 because it was prohibited by the WTO-TRIM (Trade-related Investment Measures) agreement. By these measures, the ASEAN automobile industries were integrated into a single market.

With this new environment, Toyota decided to reorganize the production network of its vehicles and unit parts in ASEAN countries through the IMV project and concentrate its major production on Thailand, as shown in Figures 1 and 2. By this concentration, Toyota could gain the economies of scale and reduce the production costs.

In the IMV project, the Toyota group manufacturers cooperate with each other. Hino Motors Thailand manufactures the axles, frames and differential gears of the IMV for Toyota, while Astra Daihatsu Motor in Indonesia manufactures a compact SUV called the "Under-IMV (U-IMV)" and exports it to Thailand as "Toyota Avanza" by OEM.

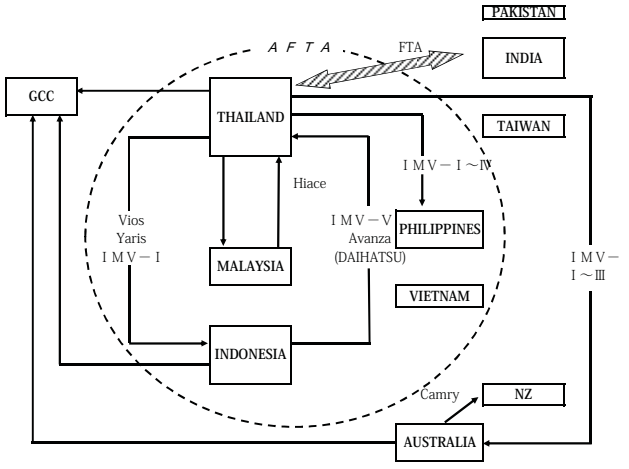

Fig.1 ASEAN Complementation by Toyota (vehicles)

Note: IMV-I/II/III = Hilux VIGO single/extra/double cabin model, IMV-IV = Fortuner, IMV-V = Innova, Source: Toyota Motor Corporation

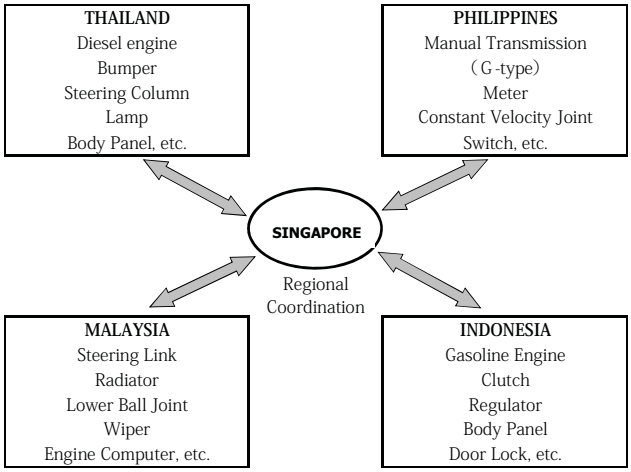

Fig.2 ASEAN Complementation by Toyota (parts)

Source: Toyota Motor Asia Pacific (Singapore)

III . TOYOTA PRODUCTION SYSTEM in THAILAND

Within the ASEAN single market, Thailand is the most favored location for Toyota. Many key performance indicators (KPI) there, e.g., gross stroke per hour in the press shop (GSPH), mean-term between failure of equipments (MTBF), shipping audit, defects per unit, direct run ratio and so on, prove that TMT is one of the best plants in the world. In other words, Thailand has some location-specific advantages and the Toyota Production System (TPS) successfully implemented there has led TMT to its present position.

The TPS in Thailand is built on the three major elements below.

A. Excellent Supplier Network for Just in Time

Taiichi Ohno, the guru of TPS, said that TPS was made of "*Just in Time*" and "*Jidoka*" [1]. First, *Just in Time* (JIT) was introduced and developed to shorten the lead time and save the inventory costs of receiving parts. However, JIT requires that sufficient and superior suppliers should be clustered close to the Toyota plants. From this point of view, Thailand with the excellent network of domestic suppliers for realizing JIT is similar to Toyota City.

The total number of Tier 1 suppliers shipping directly to TMT is about 150. 130 suppliers are in Thailand and about 90 percent of them are kept within a 90 km or 3 hours radius of TMT. TMT purchases about 85 percent of out-sourcing parts (value basis) from Japanese affiliates located in Thailand and these suppliers contribute to the strength of TMT. In 2006 the ratio of the receiving parts defects at TMT was less than 10ppm, which was equal or below the average in Japan.

However, many Japanese Tier 1 suppliers in Thailand still depend on large quantities of import parts from Japan and that lengthens the total lead time for TMT. As of the present, it is an urgent issue to bring up the local Tier 2 and Tier 3 suppliers.

TMT introduced the 'milk run' system and the 'progress lane' to adapt the JIT to Thailand. The Tier 1 suppliers in Thailand are grouped by geographical area and divided into 5 zones; Ayutthaya, Bangkok, Bangpakong, Chachoengsao and Chonburi, and the cross-dock was established in each area. Using the cross-dock and milk run system, TMT could reduce the inventory stock by 37 percent and the lead time for receiving parts by 50 percent [2].

The progress lane in the assembly shop is the temporary stock place for receiving parts up to a maximum of 6 hours. At first sight, the progress lane seems to be contrary to JIT eliminating the inventory. But it can improve the efficiency of truck utilization for reducing the logistics costs and absorb the fluctuation of receiving parts and the final assembly line. However, in the assembly shop so many workers engage in the progress lane for internal logistics, not assembly lines, and TMT needs to improve the efficiency of the total logistics as soon as possible.

One of the targets in the IMV project is the achievement of 100 percent localization of parts for drastic cost reduction. The local content ratio (the ratio of procurement in "ASEAN" countries) of the pick-up truck assembled by TMT rose from 65 percent at 'Hilux Tiger' (a former model of IMV) in 2000 to 90 percent on average and 96 percent at the highest model of 'Hilux VIGO' in 2004. About 90 percent of these ASEAN local parts are procured in Thailand and the rest called "Multi-Sourcing Parts (MSP)" are imported from other ASEAN countries on the AFTA scheme. Now, TMT imports only a few parts from Japan, e.g., an automatic transmission and a transfer for all-wheel drive. By this highly localized parts, the IMV helped Toyota cut procurement costs by over a third.

B. Multi-functional and highly skilled workers for Kaizen

The second pillar of TPS is "*Jidoka*". *Jidoka* means that both machines and people work right autonomously and *Jidoka* is the driving force for the "*Kaizen*" (continuous improvement).

Figures 3 and 4 show that the layouts of each shops and assembly lines in the Samrong and Gateway plant are conventional or orthodox compared with the latest plants in France and the Czech Republic which have the lean and compact layout as shown in figure 5. Therefore, at TMT human resources act for these equipments. In other words, everyone, not only managers and engineers but also team members (production operators), has the *Kaizen* mind and carries out *Kaizen* activities voluntarily and continuously. For example, the short meeting every morning ("*ASAKAI*") and QC circle activity visualize the problems and share information among all members.

Consequently, after the Samrong Plant started manufacturing the IMV in August 2004, it increased the production sharply with high productivity. The takt time was shortened from 1.7 minutes in August 2004 to just 1.0 minute in September 2005, which was almost equal to the highest level in Japan at that time. The shutdown time for the die change was also reduced from 12 minutes in 2005 to 8 minutes in 2006 ("*Single Dandori* [die change]").

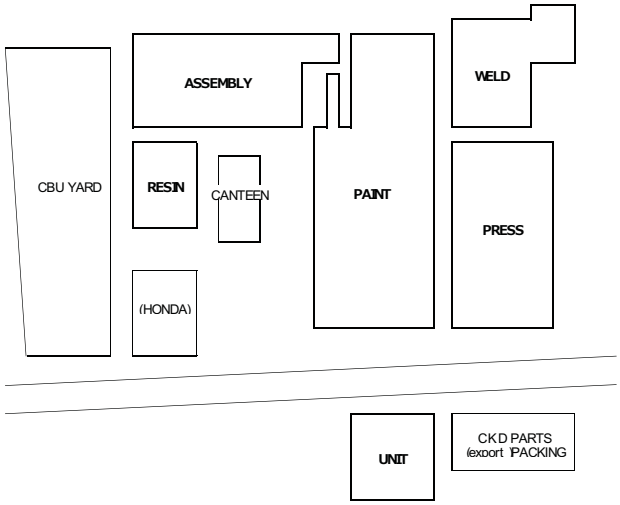

Fig.3 Layout of Samrong Plant

Source: [4] p.304

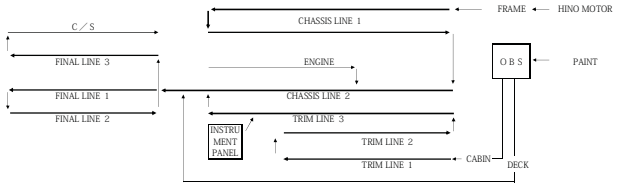

Fig.4 Layout of assembly lines in Samrong Plant

Source: [4] p.305

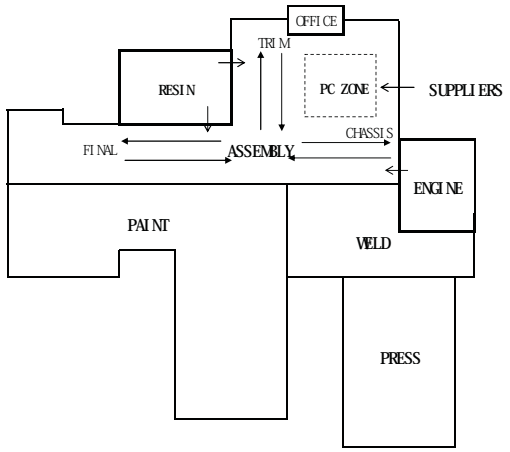

Fig.5 Layout of Toyota Motor Manufacturing France

Source: [4] p.134

With the IMV project, Toyota decided that TMT should assemble passenger cars centrally and export them to other countries in the AFTA. According to this complementation strategy, at the Gateway Plant 5 models from compact to large or mini-van with different platform ('Yaris', 'Vios', 'Corolla', 'Wish', 'Camry') are assembled using a single line and so very high flexibility in production is needed compared with other plants.

In the welding shop, at the plants in Japan many expensive automated welding robots work for a flexible production. On the other hand, at the Gateway Plant many skilled workers on the sub-assembly lines with a precise production control substitute for robots.

In the assembly shop, the set parts supply (SPS) was introduced entirely when the number of producing models increased to 5. The SPS started at the Tsutsumi Plant (Japan) in 2003 and thereafter has been diffused into other domestic and overseas plants. For example, at Toyota Motor Kyushu (Japan) producing 'Lexus' and hybrid cars or Guangzhou Toyota Motor (China) the SPS is introduced mainly for the sake of quality, while at the Gateway Plant it serves for supporting a complex and flexible mixed production.

Along with highly skilled workers on the lines, at the Gateway Plant, main managerial posts, e.g., general managers, managers, assistant managers and group leaders, are all appointed by local staffs. This high localization of human resources called "*Thainization*" is an important factor to take root the TPS successfully in TMT.

C. Experience of overcoming the Currency Crisis

When the currency crisis happened as previously mentioned, a lot of workers were dismissed in Thailand and some foreign companies disinvested away. However, no one was laid off by TMT, instead many workers were given training to prepare for the future. This invaluable experience helped TMT to establish TPS firmly and to launch the IMV project smoothly.

Toyota thinks of the IMV project as not just a cost reduction method, but an opportunity to develop TMT as a core plant in a global market. The export markets of TMT increased from only 8 countries in 2004 to 88 countries in 2005 by the IMV, mainly Asia, Oceania, and Middle Eastern countries.

The precious role of TMT attached other valuable functions to Thailand. In August 2005, the Asia Pacific Global Production Training Center (AP-GPC) was established inside the Samrong Plant. Toyota established the GPC inside the Motomachi Plant (Japan) in July 2003 first, and then the regional GPC in America (NA-GPC), UK (E-GPC) and Thailand (AP-GPC) two years later for adapting TPS to each regional situation. The AP-GPC is the training center of TPS in the Asia-pacific region from Pakistan to Australia, excluding China. At the AP-GPC, the Asian trainers ―not Japanese― teach a lot of practices to Asian trainees who come from other plants in Asia, for example, basic skill training and safety programs for newcomers, advanced programs for leaders and managers and the simulation of TPS. In the TPS simulation lessons, everyone can experience the effects of "*Kanban*, "*Heijunka*" (leveled production) and the one-piece flow. In the past, TMT had a "mother-child" relationship with the Motomachi Plant, and now many Toyota's Asian plants have the same relationship with TMT.

Toyota founded the Toyota Technical Center Asia Pacific Thailand (TTC-AP) for research and design in March 2005 and the Toyota Motor Asia Pacific (TMAP-

Thailand) to support the manufacturing activities in Indonesia, Malaysia, the Philippines, Vietnam, Taiwan and India in July 2006. In April 2007, TTC-AP and TMAP-Thailand consolidated into the Toyota Motor Asia Pacific Engineering and Manufacturing (TMAP-EM).

IV . CONCLUSIONS

Under the global depression caused by the Lehman shock in 2008, now the Thai economy and TMT face a difficulty. Although TMT could have developed rapidly by production and export of the IMV to a global market, the export-led growth brings a fragility to TMT.

Furthermore, political instability and soaring wages in recent years in Thailand is giving a severe burden on management.

However, in TPS, a problem can be an opportunity for visualizing and highlighting the true cause. The author of this paper assures that TMT which already has a matured ability to implement TPS will be able to overcome the difficulties and leap steps forward in the near future.

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