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Milk-Run logistics by Japanese automobile manufacturers in Thailand

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Abstract

Recently, Japanese automobile manufacturers are trying to procure parts by the so-called Milk-Run logistics at most of their foreign factories. The case study on Japanese automobile manufactures in Thailand revealed that by introducing the Milk-Run logistics even under heavily congested traffic conditions, they can have full control of the procurement process, resulting in a reduction of the number of trucks dispatched and improvements in traffic conditions to some extent in urban areas.

Keywords: Automobile manufacture; Thailand; parts procurement; just in time; Milk-Run logistics; third party logistics; consolidation; real-time monitoring

1. Introduction

The global strategies of Japanese automobile manufacturers have evolved immensely especially in the ASEAN region which has become a significant market. However, ASEAN's automobile parts industry has not yet progressed to the same level of Japan, and its automobile industry cluster remains undeveloped. As a result, the original model of the Toyota Production System including parts procurement was modified in the ASEAN region using the Just-In-Time (JIT) concept as a basis. Its feature is that most parts are procured from local suppliers by the Milk-Run logistics, and the strategic parts (e.g. high-value added parts having scale economy in their production) are procured from neighbouring countries under the concept of the international division of labour system in the ASEAN region. In this paper, Toyota Motor Corporation, an automobile manufacturer typifying Japan, is taken up as a case study, and the synchronization of production and parts procurement used by Toyota assembly firms, suppliers and third party logistics (3PL) providers in Thailand is analyzed. The paper reveals that the Milk-Run logistics is achieved in Bangkok, even if road congestion is especially severe, through the use of ITS. In addition, it will explain how zero-

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waste production was achieved through the synchronization of the assembly process and parts procurement. Finally, the paper will try to clarify the features of Milk-Run logistics and its implications for city logistics.

2. Method of Production and Procurement System

2.1. Profile of Toyota Motor Corporation

Toyota Motor Corporation is one of the biggest automobile companies in the world with sales of about 26 trillion yen and with an operating profit of about 2 trillion yen (as of March 2008). The total number of vehicles sold worldwide has already reached 8.91 million, with about 2.19 million vehicles sold in Japan and 6.73 million vehicles sold in other countries. If we look at the breakdown of vehicle sales by region, North America has already surpassed the total vehicle sales of Japan with about 2.96 million, while Europe and Asia have total vehicle sales of 1.28 million and 0.96 million, respectively. However, the growth of vehicle sales in the Asian region has been increasing rapidly and growth rates are now relatively higher than that of Japan, the U.S. and Europe.

Toyota Motor Corporation is rapidly increasing its overseas production bases to cope with the expansion of the overseas market, and in fact, now maintains 52 production bases located in 27 countries. Since it is important to procure parts, in particular low-value added or bulky ones, from the surrounding areas of these production bases, they encourage potential local manufactures to provide the parts and develop efficient pickup network to connect the suppliers in different urban traffic conditions, which is called Milk-Run logistics.

2.2. Method of production and procurement

The Toyota Production System (TPS) is developed as a systematized production method employed in a manufacturing plant. In our view, however, TPS covers parts procurement and then parts pickup in urban areas as well.

An important concept in TPS is JIT production which eliminates, as much as possible, waste resulting from waiting, stock reserves, and defective parts (Monden, 2006). For example, if only necessary parts are produced in small lots and transported to the assembly lines, they could reduce the stock beside the assembly lines which also minimizes the number of defective parts produced. Another important concept is production levelling which involves minimizing the difference between the amount of production and the demand. If they produce different vehicle models one-by-one on the same assembly line in order to reflect the demand, the volume of necessary parts per hour is levelled and then each truck is expected to pickup the same amount of parts regularly in the Milk-Run.

This type of levelling has become a mechanism to synchronize the entire process with the “takt” time (production speed) determined from the number of vehicle units of each model as specified in the monthly production plan and the monthly operating time. The sequencing, work procedure, and planning of personnel according to vehicle model are drawn up to complete each work process within the calculated “takt” time. Stock items of parts necessary for the related process are put on a shelf (called a “store”) located at the side line of the assembling process.

The replenishment of parts in the store is linked by instruction information through a “kanban”. The “kanban” has accomplished to move the process always in union with the items, completing each work process within the “takt” time, and making the entire lines synchronized. This mechanism is also similar between suppliers. The required parts must be supplied only at needed amounts coupled with necessary timing, and must neither cause any excessive parts inventory nor create any stock-out in each work process.

From the viewpoint of stock reduction, the ideal situation is to decrease the number of “kanban” cards and quickly replenish the previous process as soon as parts inventory in the assembly line becomes zero. In cases when suppliers are near the assembly base such as in Japan and the scale of production for each supplier is large enough, it becomes possible to perform frequent parts delivery (i.e. JIT delivery) with the required amount and necessary timing from each supplier.

2.3. Logistics concept

Toyota Motor Corporation is putting up three logistics concepts which cope with problems such as those stated above.

The first concept is 'flexible logistics' that can cope with demand fluctuation. As mentioned above, a mixed mass production system based on the TPS has been established, and it is necessary to pursue JIT transportation to maintain this. It is also necessary to have a safe logistics system (against transportation damages, wrong item delivery and stock-outs) that put importance not just on speed but also on transportation quality.

The second concept is logistics with a competitive edge as a result of 'minimum lead times (LT) and lower costs'. Ultimately, it includes reducing logistics costs by advancing localization of parts suppliers and re-assessing Milk-Run areas. After performing a re-assessment of such issues on production and procurement, shortening of lead times and reduction of distribution costs are pursued.

The third concept is logistics with 'minimum environmental impacts'. The response to the environmental problem is a major issue not only in Japan but also on a global level. In the logistics field, the ultimate objective is to reduce the amount of CO2 exhausts generated from the transportation activities and to decrease the amount of packaging and wrapping materials used.

As a method to actualize these concepts, consolidated fully-loaded distribution, through small-lot frequent pickup from each supplier and shortening of lead times, can be adopted after production levelling has been performed. It is designed to collect goods from two or more suppliers at the same time which increases the amount of cargo sufficient enough for fully-loaded distribution. Small-lot fully-loaded frequent distribution can be classified into three types. Milk-Run collection of goods is done when goods are procured from suppliers in the outskirts of the overseas plant. In Japan, it is common for the suppliers to perform JIT delivery by themselves as the amount of deliveries from each supplier is greater and delivery distance is not so long. In other countries, however, trucks are not fully-loaded. Furthermore in many cases, transactions (ownership transfer) are made at the supplier's plant, so Toyota Motor Corporation tailors the collection trucks and performs routing to collect goods from the suppliers.

Milk-Run logistics is a generic name of a logistics procurement method that uses routing to consolidate goods by the buyer. It is a method of goods collection in which the user (i.e. car assembly manufacturer) dispatches one truck at a specified time period to visit various suppliers (i.e. parts supplier) following a predefined route to collect parts or products, and deliver them to the factory. In general, the reasons why Milk-Run logistics has been widely employed are: 1) clarification of distribution cost included in the prices of parts previously in the traditional business practices, 2) reduction in transportation costs due to consolidated transportation offsetting even the use of small lot transport, 3) improvement of the assembly manufacturer's production line and greater accuracy of JIT goods delivery due to synchronization. Milk-Run logistics can provide consolidated collection of goods necessary to improve logistics procurement systems.

When there are two or more plants and the parts used in these plants are provided by a single supplier, consolidation at the supplier facility is performed. The parts are consolidated at the place of departure in such a way that they are fully loaded on the truck, transported, and unloaded at the various destinations. This method is used in the delivery of goods from suppliers in remote areas not only those located in the outskirts but also from other countries.

Consolidation using a transfer facility is a method of goods delivery in which parts are transported fully-loaded from suppliers in remote areas to the transfer facility, sorted according to the destination plant, and then transported. Transhipment can be performed without maintaining stocks. There are international cross-dock centres in the different regions of the United States, Europe, and Asia.

These three types of consolidation system can increase the loading rates of trucks, thus reducing their number on urban roads. Therefore, they have the same effect as the cooperative delivery system involving many shippers or consignees with a public consolidation centre, which is one of the most common city logistics policies. It means that if there is a large shipper like a car manufacturing company, the urban traffic condition could be improved to some extent by their own consolidation efforts.

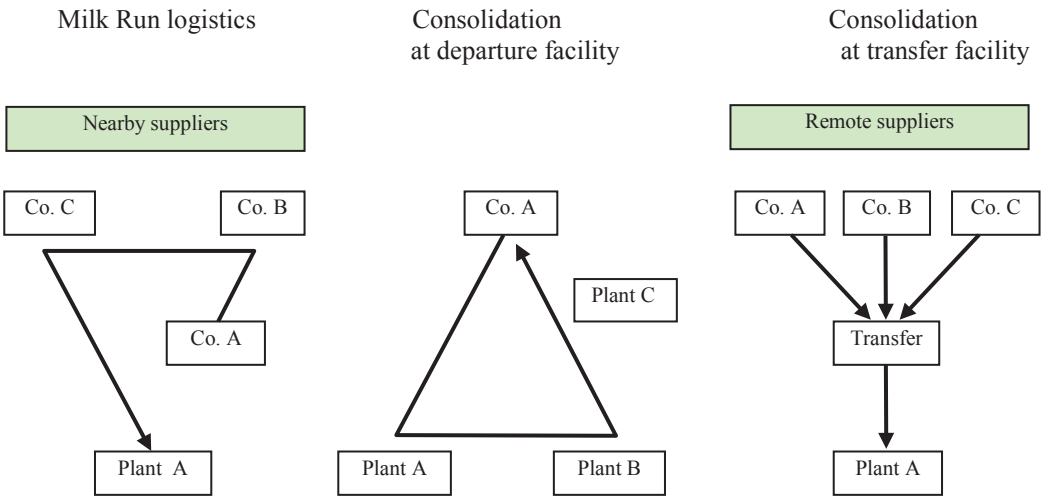

Figure 1 Types of consolidation system (Source: Toyota Motor Corporation documents)

3. Parts Procurement Logistics in Toyota Motor Thailand (TMT)

3.1. Milk-Run logistics in Thailand

Thailand is one of the centres of Toyota Motor Corporation's global bases that exert efforts to the production of automobiles employing global strategies. Although some strategic parts used to assemble the global car are imported from the ASEAN region in which a system of mutual supplementation is already established, parts that are procured in Thailand account for about 80% (monetary base).

In Thailand, some original parts procurement systems are being constructed and one of the systems in recent years is Milk-Run logistics. Milk-Run logistics is becoming one of the standard systems of an overseas version of JIT distribution. At overseas production bases, Milk-Run logistics in the local country and the above-mentioned international distribution system are combined, and a global procurement logistics system is formed. This section discusses the operations of Milk-Run logistics through an analysis of the interview surveys conducted at TMT (Toyota Motor Thailand) and the 3PL provider TTKL (TTK Logistics) (Thailand).

3.2. Overview of parts procurement

TMT maintains three assembly bases located in Samrong (including TAW), Gateway, and Ban Pho (Table 1), and produces 490,000 vehicles a year (of which about 200,000 are for export). This study investigated parts procurement logistics in the Samrong plant.

TMT's Samrong plant manufactures Innovative and International Multi-purpose Vehicles (IMV) having variations of minivans, SUVs, and trucks (two-seaters, four-seaters, and four-door types) adjusted for the market needs in each country while they share a common platform and the other major important parts are common. Moreover, the Samrong plant serves as a packaging/shipment base for export to bases outside Thailand.

At TMT, parts are procured from about 120 suppliers (Figure 2). These suppliers are allocated throughout Thailand following a division of five zones in which Milk-Run logistics is performed (one run made in a range of 4 hours). Two logistics service providers undertake Milk-Run logistics which is implemented using about 600 trucks. One of the larger companies undertaking Milk-Run logistics is TTK Logistics (Thailand) which is the focus of this survey.

Table 1 Toyota's manufacturing plants in Thailand (Source: TMT documents)

	Production Capacity (veh/year)	Takt time (min)	Lot Area (1000m2)	Building Area (1000m2)	No. of Employees	Main Production Function	Vehicle Types Produced
Samrong	218,000	1.0	430	157	4,221	P,W,T,A,R,U	Hi-Lux for local market (B,C,W)
Gateway	200,000	1.1	1,000	166	3,246	P,W,T,A,R,U	Sedan (Camry, Vitz, Corolla, Vios, Yaris)
Ban Pho (completed 2007)	100,000	2.25	2,500	188	1,176	P,W,T,A,R,U	Same car model as Samrong, but for export
TAW	54,000	4.0	400	230	1,248	W,T,A	SUV, Hi-Lux (W)

Notes: Functions P=Pressing, W=Welding, T=Painting, A=Assembling, R=Inspection, U=Knockdown models & Vehicle types: B=2 seater, C=4 seater, W=4 doors

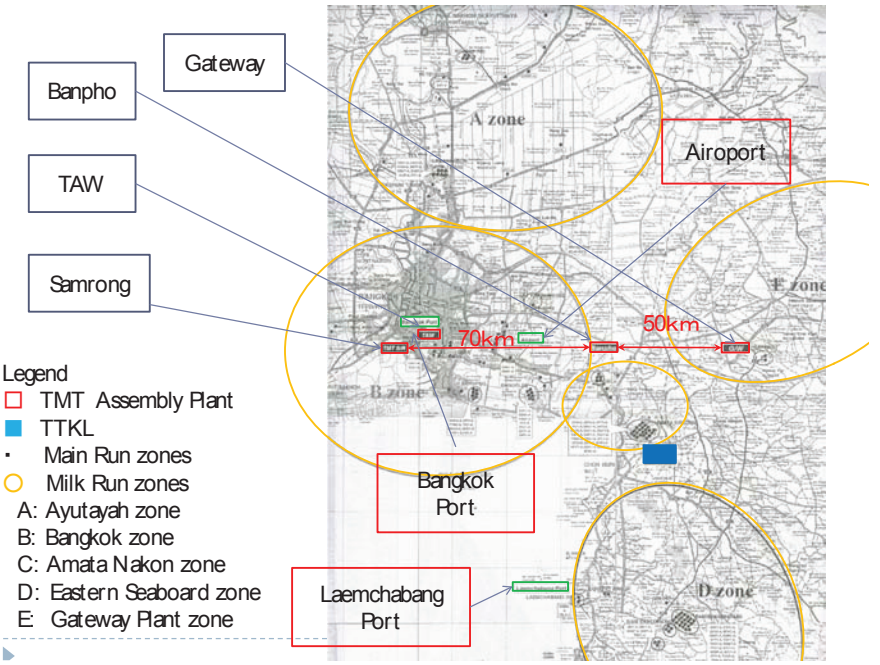

Figure 2 Milk-Run logistics in the Bangkok metropolitan area

3.3. Profile of TTKL

TTKL is a logistics company established in December 2002 to manage the Milk-Run logistics of TMT. Stockholder composition is 51% Toyota Tsusho Thailand, 26% Toyota Tsusho, and 23% Kimura Unity. Its activities are divided into transportation and logistics operations. The transportation operation is composed of the Milk-Run logistics of locally procuring automobile parts, which is the main activity, and other activities which include optimal route planning. The logistics operation, on the other hand, consists of Complete Knock Down (CKD) parts packaging (multi-sourced parts) for export, parts consolidation (vendor to vendor), and general

warehouse works. The truck centres which maintain a total of 616 trucks and 40 forklifts are located in Amata Nakorn, Samrong, Eastern Seaboard, and Gateway.

Milk-Run logistics for TMT was started by Toyota Tsusho Thailand in 2001, and succeeded by TTKL in 2003 and became full-scale with the beginning of IMV production. The number of trucks used for the Milk-Run logistics expanded to 565 trucks in May 2007 while the number of drivers expanded to 1,081. At present, Milk-Run logistics is being implemented for three factories of TMT. About 50 delivery routes are established to each plant, which could be changed in the case of traffic congestion. Six-wheel trucks (4.3 tons loading capacity) are usually utilized but at regions which can accommodate heavy trucks, ten-wheel trucks (12 tons loading capacity) are used.

3.4. Information linkages between TMT and TTKL

Since Milk-Run logistics is closely related to the automobile's production plan, a close cooperative relationship between TMT, TTKL, and the suppliers has been established. The Samrong factory operates two shifts, and parts are ordered through e-kanban by regularly dividing the daily amount into 36 orders per day. The production and the operational plans determined from the working plan, parts information, and information on goods delivered are transmitted by the TMT to the TTKL.

TTKL collects basic information on running times and transport distances necessary for determining the routes and provides them to TMT. TMT then calculates the transport volume everyday based on parts information, the production plan, and container sizes, and determines the routing and scheduling plan using an optimization system on operations management. Based on these results, TTKL prepares the stowage plan, truck diagram, and the schedule of the host terminal.

At present, this planning is the most time consuming process. There are cases when the calculated schedule might not be followed due to non-standard container sizes of parts suppliers and inconvenient unloading time at the host terminal. Therefore, the operation is re-checked manually to determine if the operation is actually possible.

4. Milk-Run Logistics Operation

4.1. Operational plan and management

In actual operation, a guide containing the driver check sheet, route code card, terminal card, and basket label is prepared by the TTKL's operations manager for easily understanding of the operational plan. The operation manager assigns a driver for each route, and registers the route information in a geographic information system (Figure 3).

The driver fills-in the check sheet at each stage of operation. During the operation, monitoring is performed every minute and the operations manager acquires GPS information and manages the movement of the truck. In cases of non-conformities with the schedule, such as delay or over-speed, or if there are differences in the route, the information are displayed in the computer terminal of the operation centre and the operation manager rectifies the situation by calling the driver on his cellular phone. In cases of traffic congestion, a detour is selected from the alternative routes set beforehand. Furthermore, in cases of accidents, an emergency truck is dispatched to the site and goods are transhipped and delivered to the destination in accordance with the scheduled delivery time.

At TTKL, it was evaluated that the investment in GPS was appropriate taking account of fuel efficiency, accident reductions, and insurance rate discounts. Trucks do not require on-board computers, and management is simple by just filling-in the check sheet. It is possible to sufficiently manage the operations by comparing the GPS data and the check sheets. It is also possible for the driver to be guided accordingly. The benefits produced by such improvement are therefore shared between TTKL and TMT.

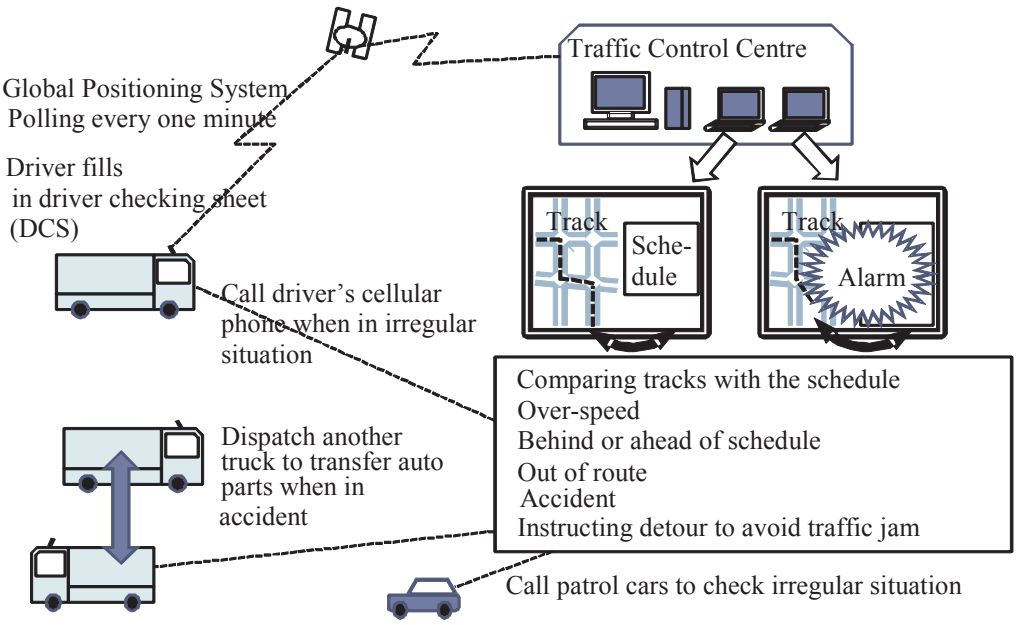

Figure 3 Fleet management using GPS (Source: TTKL)

4.2. Cargo collection

The parts supplier loads the parts based on a stowage plan. In order to prevent the collapse of goods during transportation, TTKL protects the goods with protective boards and safety belts. Goods are collected from several parts suppliers according to a collection schedule, and delivered to a specified truck bay in the TMT plant. Allowed arrival times are within plus or minus ten minutes of the scheduled time. For example, if the arrival time is about 15 minutes over the scheduled time, the event is recognized as compliance deviation concerning schedule. The rate of compliance deviation concerning schedule, which is one of the Key Performance Indicators (KPI), is around 5% in TTKL.

4.3. Unloading operations at the TMT plant

The driver unloads the goods to the receiving and checking area using a forklift, and loads empty containers instead. A standard time of 36 seconds is given for each loading and unloading activity above. Once the processing of the documents is completed, the driver exchanges the forklift keys with the truck keys, and returns to the TTKL terminal. The returning driver then confirms the contents of the check sheet with the operation manager. If there is no irregularity, the operation is succeeded to the next driver.

4.4. Transport responsibility

Since TMT takes care of the trucks utilized in Milk-Run logistics, it is natural to think that the responsibility belongs to the parts supplier before loading the goods onto the truck, and the responsibility shifts to TMT once they are loaded onto the truck (FOT: Free on Truck). In reality, accidents during transport and concealed damages are covered by the transport insurance of TTKL, and insurance is paid to TMT. However, because TMT cannot receive and check the goods at the parts manufacturer's place, TMT insists that property rights shift after receiving and checking are completed at the TMT arrival plant. Hence, Milk-Run logistics is vague in the issue of responsibility turnover.

Freight accident rates as perceived according to the number of transported pieces is 12 PPM (12 pieces per million). When a freight accident occurs, it is not just a problem of settling compensation for damages, because the production line might stop if parts do not reach the plants, emergency transport is performed. Five employees out of those who manage the drivers usually form a patrol team, and response to the emergent situation.

4.5. Flow of parts in the plant and synchronization mechanism

Parts collected by Milk-Run logistics are carried into the host terminal. As for small parts delivered in returnable boxes or containers, several e-kanban orders are delivered collectively based on loading efficiency and operational schedule. These orders are divided and placed according to P (progress) lanes (Figure 4). The P-lane serves two functions: lot division and progress adjustment for synchronization. For example, one order is composed of parts for 20 vehicles with ordering frequency of 36 times a day, while 9 e-kanban orders (180 parts) are delivered in the same Milk-Run (4 times to the supplier a day). The functions are accomplished by dividing the orders into e-kanban orders, putting them into the 36 lines, and bringing them to the assembly line in order to synchronize the production schedule.

Large-sized parts are composed of those that are put into the direct line, those that are divided into lots via the P-lane and put into the production line, and those that are put into the sequential area. In the sequential area, large-sized parts and parts in case units are set in the vehicles based on an instruction sheet at the assembly line, and put into the mixed flow production line after undergoing ordering and synchronization.

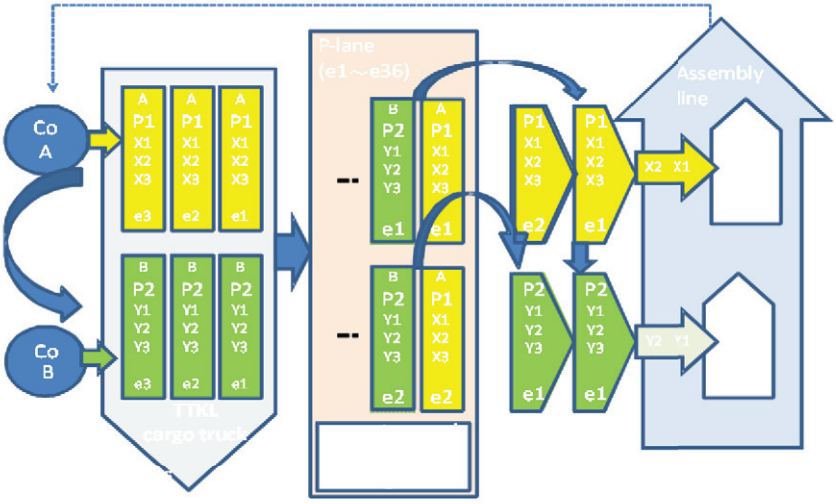

Figure 4 Milk-Run logistics and the progress-lane system

5. Conclusion

The paper discussed the current state of logistics procurement of TMT in Thailand which focused on Milk-Run logistics. It was revealed that TMT has established an advanced procurement system that synchronizes the production process based on the JIT concept. This was accomplished even when faced with conditions that are totally different from that of Japan, especially the more serious problem of road congestion. The features of Milk-Run logistics are enumerated below.

First, they established a system which synchronized production processes owing to close coordination with logistics companies. In Milk-Run logistics, high reception frequency of goods (4 times a day) is performed to maintain small-lot frequent delivery to the assembly lines as much as possible (36 times a day). In addition, a P-lane has been installed in order to reduce the gap between transport frequency and production levelling. Rather than saying that this permits buffer stocks between procurement and production, this works as a mechanism to make stocks visible and to conduct manage the production processes.

Second, in order to synchronize the parts procurement process and the production line operations, the actual operations and the progress of Milk-Run logistics are monitored real-time through the use of a GPS installed in the vehicle. In addition, the synchronized procurement results in eliminating waste and maintaining speed as much as possible. A transport system related to modularization which considers container size and truck's space dimensions is also being developed to increase transport efficiency and transport quality.

The automobile industry has been leading globalization efforts for a long time now and the TMT case explained a state-of-the-art logistics in which the JIT concept was tailored to suite the conditions of foreign countries. In foreign countries where the density of parts suppliers is low, Milk-Run logistics has expanded, spreading also in Europe, the United States, and even China. Moreover, Milk-Run logistics has spread not only in the automobile industry but also in the consumer electronic and electro-mechanical industries.

Milk-Run, which puts the assembly plant at its core, is a frequent parts procurement system implemented in a comparatively small urban region, or a virtual expanded factory yard. Its implications for city logistics are:

First, Milk-Run logistics has been planned to improve loading rates at possible levels and reduce the number of trucks and travel distances. As a result, it is an excellent transport method in which exhaust gases from trucks can be controlled. Therefore, the promotion of Milk-Run logistics can be highly evaluated from the viewpoint of environmental policy.

Second, because the Milk-Run logistics requires accurate management based on the operational plan, we could introduce an urban logistics policy to increase transportation reliability. For developing countries, a road infrastructure that can make scheduled operations possible and a road quality that does not cause damage to the transported goods are required. For developed countries, policies such as road-use control systems could be introduced to prioritize vehicles with high load factors which are being implemented in Amsterdam for example.

Third, consolidation using standardized returnable boxes and containers are implemented to increase transport efficiency in Milk-Run logistics. TMT provides standardized containers adjusted to truck dimensions in Thailand, while the sizes are not standardized even among the automotive companies in Bangkok.

Fourth, the paper clarified that the Milk-Run logistics plan is an offshoot of the production plan. Hence, when performing urban logistics analysis and establishing city logistics policies, it is important that factors that affect production plans of the company are adequately considered.

Finally, Milk-Run logistics is performed through close coordination and linkages between the automobile manufacturer, parts supplier, and logistics service provider, and its influence on regional transport becomes more significant if the scale of the Milk-Run logistics becomes larger. In other words, Milk-Run logistics is purely private efforts with financial motivation, but it has positive external effects for society as well. In this case, public involvement may be required for planning Milk-Run logistics which include the cooperation of related local governments and affected residents.

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