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CONTROL AND INTEGRATION OF MILK-RUN OPERATION IN JAPANESE AUTOMOTIVE COMPANY IN INDONESIA

Humiras Hardi Purba[1], Adi Fitra[1], Aina Nindiani[2]

[1] *Master of Industrial Engineering Program, Mercu Buana University, Jakarta, Indonesia*
[2] *Industrial Engineering Program, Buana Perjuangan University, Karawang, Indonesia*

Corresponding author:
Adi Fitra
Mercu Buana University
Master of Industrial Engineering Program
Jl. Menteng Raya No. 29 Jakarta, Indonesia
phone: (+62) 02131935454
e-mail: adi.ftr@gmail.com

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Abstract
The implementation of milk-run in Indonesia has been started since 2005. As a developing country, there is a challenge to operate milk-run smoothly especially in urban area due to severe traffic congestion and unfavourable road condition in some areas. This research aimed to analyze the practice of milk-run operation in one of the biggest Japanese automotive companies in Indonesia. Transportation Value Stream Mapping (TVSM) is applied in order to perform just-in-time delivery in the supply chain before operating milk-run. It is discussed that this company still need to continue in improving milk-run operation. The operation system needs control and integration from manufacturer, supplier and logistics partner. The advantage of milk-run operation is cost reduction and also support green logistics in decreasing emission of carbondioxide (CO_2) by reducing the number of trucks used.

Keywords
milk-run, just-in-time, transportation value stream mapping, automotive, lean logistics, supply chain.

Introduction

The automotive industry in Indonesia is experiencing a good growth. Toyota Group is one of the big car manufacturers in Indonesia that always perform highest total sales every year. Toyota commited to carry out continuous improvement in all areas. As [1] mentioned that continuous improvement is seen as foundation in lean thinking. One of the area improvements is in lean logistics which include transportation fleet and warehousing. The implementation of lean logistic aims to achieve supply chain effectiveness and efficiency. Effective supply chain management has become a key strategy for the industry to stay competitive [2]. Thus the automotive industry should maintain synergy along the supply chain.

There are some research in the field of supply chain such as a study that creates framework for supply chain measurement [3]. Another study optimize supply chain from the perspective of a logistic provider [4]. This study focus on milk-run system in the supply chain of an automotive industry, mainly in controlling and integrating between manufacturer, logistic provider and suppliers.

As mention earlier, warehouses play an important role in supply chain. Based on [5], there are two kinds of warehousing, using stock and zero stock. Warehouse with minimum stock condition concept known as just-in-time or just in sequence. Moreover there are two kinds of transportation model in car factory, direct delivery model and consolidation model [6]. The car manufacturers in Indonesia applied direct system and milk-run system in delivering their stuff. In direct system, the supplier delivers the material directly to the manufacturing site by using supplier car unit or rental transporter. In milk-run system, a logistics carrier sends a vehicle on a pre-selected route, stopping at each of several vendors to pick-up material, and then delivers the total load to the manufacturing site [7].

There are two kinds of milk-run, in-plant milk-run and out-plant milk-run. The parts transported in the in-plant milk-run are raw materials, work in process and finished good. By syncronizing the moving parts and applying just-in-time in this condition make it possible to have zero stock in each process [8]. Out-plant milk-run takes part from supplier and sends the stuffs to the factory. It only includes local supplier and the selection process for milk-run supplier must consider high economic value and optimizing the delivery process of goods to the customer. Toyota Motor Manufacturing Indonesia (TMMIN) and Astra Daihatsu Motor (ADM) as the biggest car manufacturing companies in Indonesia work together in the automotive assembly process. Both companies developed system to synchronize parts flow from the supplier (where the parts taken from) until the parts arrive in the receiving section. The synchronization system called progress line. Progress line system is actually just-in-time system where there is no delay for parts supplied to the production line, hence the factory must have good document control and supporting information technology [9]. ADM has already been providing high quality, lower cost and short response times in achieving satisfactory and efficient logistics services.

This research aimed to discuss about milk-run system at ADM especially in control and integration with Sunter factory in North Jakarta. It is an approach of just-in-time in the supply chain. It also represents control undertaking by waste elimination caused by the transportation system associated with the problem of congestion in the city.

Methods of ordering and synchronizing system

Profile of Astra Daihatsu Motor

Toyota has reached best sales in Indonesia which always ranks first in total sales performance until 2017. Based on The Association of Indonesian Automotive Manufacturers (Gaikindo), from the total 1,079,534 units of cars sold in Indonesia, Toyota reached 371.332 units sales in one year with a total market share of 34.4%. As mentioned by [10] that automotive industry has become the most competitive sector. Most of Toyota's cars are assemblied by Astra Daihatsu Motor. Besides Astra Daihatsu Motor also perform car assembly for its Daihatsu brand. ADM production capacity reached 1700 units/day. ADM also expands its market by exporting cars to some ASEAN countries such as Malaysia, Thailand, Vietnam and Japan. With the high volume of production means the high number of trucks come to ADM. The ADM plant located in the capital city of Indonesia, in north Jakarta. Hence ADM need an efficient and integrated logistics system delivery. This system must be integrated with local suppliers in facing city congestion in Jakarta and the surrounding areas. Considering this condition, ADM chosed milk-run logistics system.

Methods of ordering and synchronizing system

Toyota Production System is a system created to synchronize material flow from the beginning where raw material is ordered until the part received in the warehouse and supplied to the production line. Two pillars of Toyota Production System are just-in-time (JIT) and jidoka. The basic concept of just-in-time in production is to reach efficiency and effectiveness by reducing waste and cost reduction in stock and transportation [11]. In the logistics area, the problems usually arised in delivering parts. That's why the concept of JIT will be useful in reducing waste such as waiting time, overstock and defective parts [12]. Late arrivals caused by traffic jam can impact to production line. It can cause line stoppage and then stop production process. Another problem of long waiting time of truck in picking up part in one supplier can reduce the effective total time. In the JIT production system, it is important to trim good movement to synchronize processes. It is important to create improvement in transportation because if the transportation design is improved then it can reduce 20% of integrated logistics, 30% cost reduction and total resources utilization increase to 10% [13].

Toyota uses the term takt time where takt time is calculated by deviding customer demand rate into the available working time. Takt time plays an important role in manufacturing systems. Takt time is used to synchronize the production pace with the sales pace. Takt time show a number that gives a sense for the rate at which a process should be producing [14]. Takt time can synchronize movement between goods and processes. To see the movement between goods and the processes Toyota uses Part Information Flow Chart (PIFC). Toyota uses triggers in every process called kanban. To reduce lead time and excessive stocks and improve material flow within the manufacturing system, kanban-based production control and milk-run material handling system were implemented. It is realized that the design of kanban production control system is insufficient without implementing an appropriate material handling vehicle [15].

Kanban has two functions as a trigger for production of parts and the other as trigger for material handler to get and transfer parts [14]. At present kanban is no longer in paper form but is already in digital form called e-Kanban. Ordering system and planning of part pickup (Delivery Note) is now using Information Technology (IT) which already send 4 days before supplier send parts to ADM.

Logistics concept

ADM uses flexible logistics system. It can accomodate fluctuation in sales order, like added order when needed by the customer. This system based on TPS system or just-in-time. The system was integrated with ordering system and Warehouse Management System to synchronize the moving parts from supplier to warehouse. Synchronized system from ordering to part delivery is needed in order to avoid potential damage, wrong item delivery and stock-out. This is very important to keep the quality of delivery. Logistics partner and suppliers are confronted by another problem, they need to design truck routes and select suitable trucks with routes that satisfy their requirements [16]. 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 over the procurement process, resulting in the reduction of the number of dispatched trucks and improvements in traffic conditions to some extent in urban areas [15]. JIT milk-run applied in Toyota automobile assembly factories located in Thailand. It has been revealed by the case study that implementing the milk-run supply system even under dense traffic conditions, full control of the procurement process can be achieved by the supplier. It can reduce the number of vehicles in supplying network by optimizing the utilization of the vehicles and resolve the traffic problem to some extent level in urban areas and highways [17].

In general, the reasons why milk-run logistics has been widely employed are:

1. Reduction in transportation costs due to consolidated transportation offsetting even the use of small lot transport.
2. 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.
3. Improvement of the vehicle loading rate shortens the total distance traveled. It can achieve various suppliers and manufacturers for coordination, improve agility of supplies and flexibility, but also improve the ability of the manufacturer's response and system efficiency.
4. It reduces the risk of product quality in case of problems. Manufacturers can quickly discover and inform the corresponding suppliers, to minimize the impact on sales.
5. It changes logistics strategies, using third-party logistics so that significantly reduces in process inventory, increases capital flows, reduces investment risks. [11]

Reducing lead time and lowering cost are the main purposes to reduce stock in warehouse. In this system, lead time starts from part ordering until part is received in warehouse. ADM already use e-kanban that reduce lead time with 3 days interval before sending part to ADM. Low cost delivery system for logistics use milk-run system, the main purpose of milk-run model is to accomodate full utilization of vehicles' space and attempts to deliver the full loaded goods to designated place [18]. Milk-run can reduce number of trucks come to ADM that deliver part from supplier. By applying milk-run logistics with reduction in the number of trucks will give minimum environmental impacts. It means that milk-run system supports Green Logistics in reducing global CO_2. Most transportion in logistics operations involve huge numbers of trucks, with each truck consuming large quantities of fossil fuel and discharging a large quantity of carbon dioxide (CO_2) into the atmosphere. To reduce fossil-fuel consumption and CO_2 emissions from transportation, we need to enhance the efficiency of trucks. The milk-run approach, which is one of the most efficient and popular methods of improving truck-load ratios, refers to a mean of transportation in which a single truck cycle around multiple suppliers to collect or deliver freight [19].

Milk-run system was designed to collect goods from two or more suppliers and send to the customer. At the same time, truck must be optimized in the capacity to increase to the amount of sufficient cargo for fully-loaded distribution. The time and number of pickup schedule of milk-run determine the performance of JIT supply, while the route design and scheduling are the key factors that have an impact to the cost and also determine the smoothness of the continuous pickup. The core of milk-run operation is to minimize the inventory (holding) cost and transportation cost. The procurement cost of part is relevant to the total cost of a company in the automobile industry [20]. The truck sets off the parts collected from its suppliers and leave the empty containers for the next collection. It returns to the automaker to obey a time window, bringing a load corresponding

to 85% of its weight or cubic volume, to minimize transport costs [21].

ADM applied milk-run operation for their suppliers which is in max distance not more than 150 KM/trip. The traveling time needed to pick up parts is 8 hours for 1 trip. If it takes more than 8 hours per trip for the truck, then it will be charged overtime. That's why if the supplier located more than 150 KM or if the supplier area below 150 KM but in the condition of high traffic then ADM will prefer to apply direct delivery from the supplier. The main difference is that local milk-run can be driven within a day, while local-far ones take more time respecting legal rules for driving time and rest periods. Moreover, the more distant the suppliers are, the higher the transport risk is. The possible hesitations at the stops and traffic jams, the risk also rises with the number of participants in a milk run [22]. ADM will arrange time window for unloading to all type of delivery, direct delivery, milk-run delivery and sequence delivery. The time arrangement is important for loading-unloading of parts from supplier.

Milk-run logistics must be consolidated with the ordering system. This is very important to count the volume of parts delivered. For example when parts to be delivered has been calculated, then the number of trucks with the capacity required can be counted. The truck visits suppliers at a specified time period. The truck will pick up parts from suppliers and deliver them to the factory.

These are the reasons of milk-run operation in ADM:

1. Milk-run can clarify the distribution cost includes the price of part per delivery, which can not be seen in traditional business practices.
2. Milk-run can reduce the transportation costs due to the use of small lot transport.
3. Milk-run can improve the acuracy in the production line due to goods delivery synchronization using JIT. Milk-run logistics can provide consolidated collection of goods necessary to improve logistics procurement system.

Milk-run logistics in Indonesia

Indonesian automaker is one factory outside Japan that has high production capacity. Astra Daihatsu Motor (ADM) is a subsidiary of Toyota Motor Corporation (TMC). TMC give order to ADM to produce car. Due to the high production volume in ADM, it requires a high number of truck units to operate milk-run logistics. ADM cooperates with one of Toyota's subsidiaries in logistics field, Toyota Tsuho Logistic Center (TTLC). TTLC is responsible for transportation and warehouse management system. In carrying out its operations, ADM submit monthly volumes which will be calculated by TTLC to estimate the number of trucks used, delivery route and delivery cycle. TTLC also submit time window to ADM so that the pickup time window can be synchronized with the suppliers. If a good material handling and transport system design is accomplished, it is claimed that the cost will be reduced in between 10% and 30% [23].

ADM factory

ADM has two car assembly plants located in Sunter (North Jakarta) and Karawang industrial area. Sunter factory is responsible in producing MPV, SUV and commercial cars while Karawang factory geared up to produce small cars. Both plants also prepared cars for export purpose that send to Tanjung Priuk port when the cars are ready to deliver to other countries.

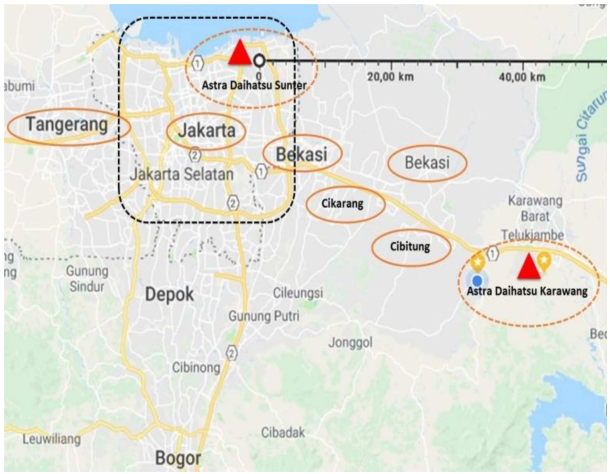


Fig. 1. Milk-run operation area of ADM.

The number of suppliers that support Sunter and Karawang factory reach 150 suppliers with total trips reach 400 trucks per day. The distribution area from suppliers spread out over Karawang, Cibitung, Cikarang, Tangerang, Bogor, Bekasi and Jakarta.

Suppliers ADM and TTLC work together to create milk-run route based on factory destination and suppliers' location spreading. TTLC and ADM usually create Transportation Value Stream Mapping (TVSM) and Total Overall Vehicle Effectiveness (TOVE). It is based on the location spreading of suppliers so that the route of the truck becomes more efficient and that the total loading time for one milk-run route becomes efficient.

Profile of Toyota Tsusho Logistic Center (TTLC)

TTLC is a company engaged in warehouse and transportation. In the field of warehouse, TTLC has a subsidiary, Toyota Tsusho Indonesia (TTI). TTLC's duty is to receive part ordered and then do unpacking and send to customer in need. Part that ordered by TTI is raw material order by ADM. Part raw material will be used by tier 1 ADM supplier for part production. Part that will be sent to Tier 1 will be sent by TTLC. Milk-run is a different division of operations with warehouse, this division is specialized only to serve the needs of milk-run transportation at Toyota Group. TTLC has nearly 650 trucks operated at all lines of the TTLC business and 40 Forklifts used in the main warehouse and supporting warehouse. Due to the increasing of production in ADM, the development of the route becomes more varied. In 2008 the milk-run route was only 50 trips per day while in 2017 the number of milk-run truck has reached 200 trips per day to accomodate two ADM plants. TTLC uses two types of milk-run trucks. They are10 ton truck with 2 axis and 12–20 ton truck with 3 axis.

Collaboration information between TTLC and ADM

Milk-run logistics is a round trip that facilitates either collection or distribution. It also ensures that the minimum distance is travelled and the maximum demand is carried into the truck to meet both the demand requirement and effective transportation with the least cost. The important advice is satisfying the customers demand in small volume and higher frequencies [24]. There must be a good connection and relationship between ADM and TTLC to operate milk-run system in order to create smooth production operation. ADM factory runs two production shifts. Every shift will determine the planning time of production, part information to supplier and number of orders. This information will be shared to TTLC to pick up the part at the suppliers.

Figure 2 describes the information flow from ADM to suppliers and TTLC. The information from ADM to supplier include delivery order and label for pollybox. This label provide information about pickup delivery cycle of truck and information of sequence to supply line. Delivery note that sent from ADM will be used by supplier to proof of transaction and delivered parts. TTLC collects data and calculate the distance, travel time and cost estimation. The logistics carrier section of TTLC receives information from logistics teams of the ADM plant and then sets a transportation plan. It makes contact with suppliers, collects and manages transport, until the arrival at the assembly point on the time scheduled. It delivers the empty packaging to the suppliers in advance, benefiting the next scheduled collection [25]. The logistics carrier needs this information to plan the demand and manage the program of parts collection, in order to reach the lowest operating cost of transportation at milk-run system and give better leveraging to the capacity of the transport vehicle [26]. Observation will be checked by ADM to synchronize with order system and receiving time at ADM. ADM will make unloading time window in ADM and TTLC will make time window in suppliers. This time window contains information for logistics partner driver to do the loading and unloading parts.

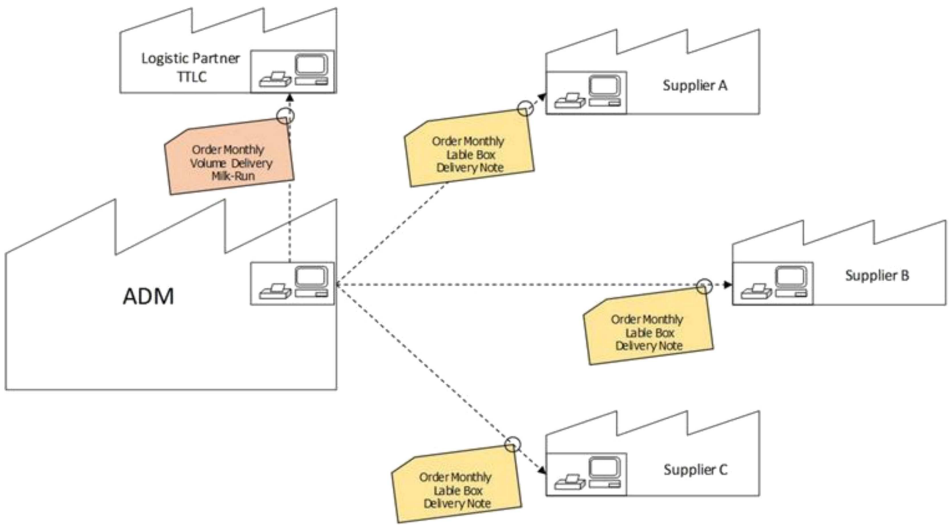
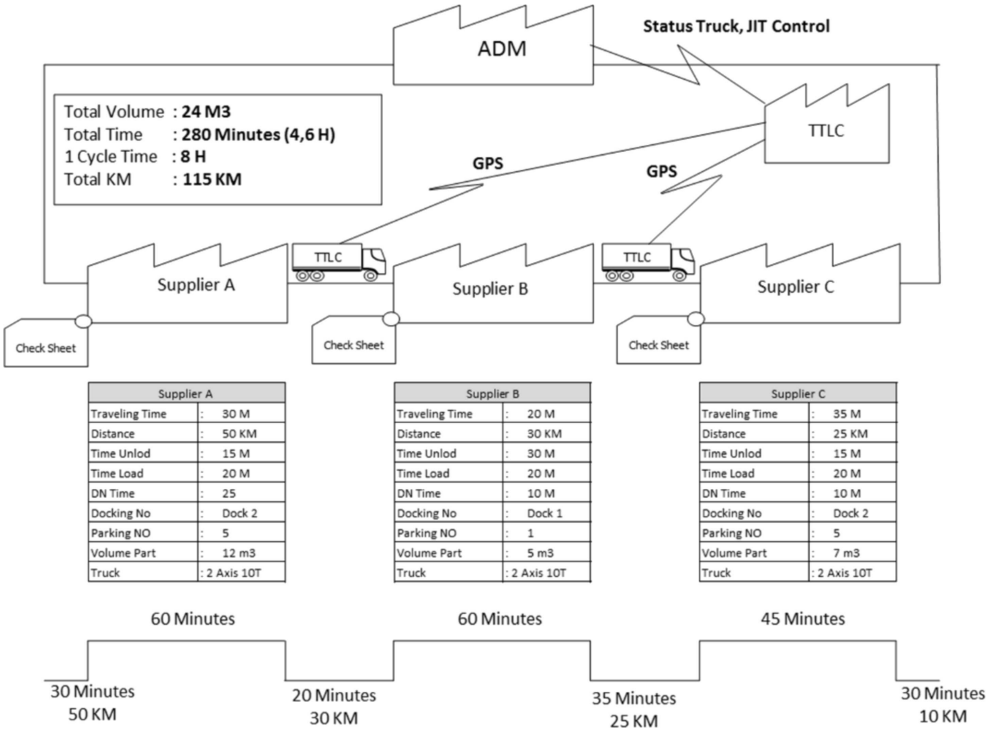


Fig. 2. Information flow to supplier and TTLC.

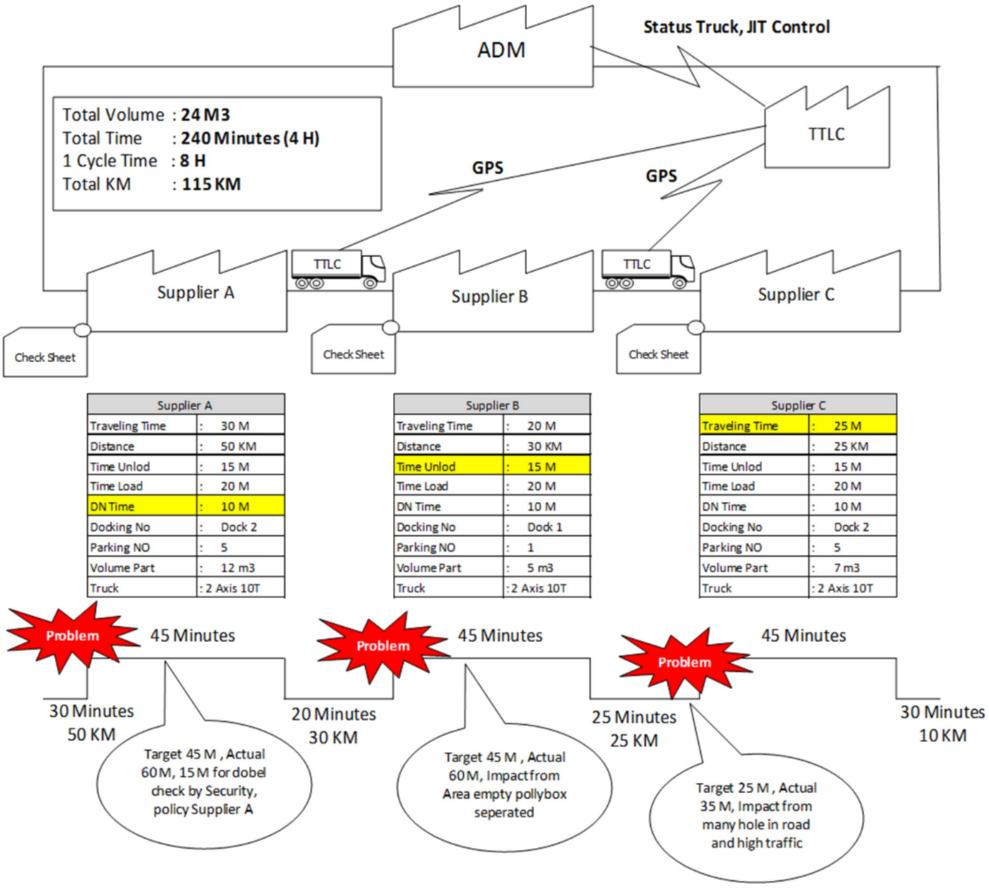


Supplier A		
Traveling Time	:	30 M
Distance	:	50 KM
Time Unlod	:	15 M
Time Load	:	20 M
DN Time	:	25
Docking No	:	Dock 2
Parking NO	:	5
Volume Part	:	12 m3
Truck	:	2 Axis 10T

Supplier B		
Traveling Time	:	20 M
Distance	:	30 KM
Time Unlod	:	30 M
Time Load	:	20 M
DN Time	:	10 M
Docking No	:	Dock 1
Parking NO	:	1
Volume Part	:	5 m3
Truck	:	2 Axis 10T

Supplier C		
Traveling Time	:	35 M
Distance	:	25 KM
Time Unlod	:	15 M
Time Load	:	20 M
DN Time	:	10 M
Docking No	:	Dock 2
Parking NO	:	5
Volume Part	:	7 m3
Truck	:	2 Axis 10T

Fig. 3. Actual transportation value stream mapping.



Supplier A		
Traveling Time	:	30 M
Distance	:	50 KM
Time Unlod	:	15 M
Time Load	:	20 M
DN Time	:	10 M
Docking No	:	Dock 2
Parking NO	:	5
Volume Part	:	12 m3
Truck	:	2 Axis 10T

Supplier B		
Traveling Time	:	20 M
Distance	:	30 KM
Time Unlod	:	15 M
Time Load	:	20 M
DN Time	:	10 M
Docking No	:	Dock 1
Parking NO	:	1
Volume Part	:	5 m3
Truck	:	2 Axis 10T

Supplier C		
Traveling Time	:	25 M
Distance	:	25 KM
Time Unlod	:	15 M
Time Load	:	20 M
DN Time	:	10 M
Docking No	:	Dock 2
Parking NO	:	5
Volume Part	:	7 m3
Truck	:	2 Axis 10T

Fig. 4. Ideal transportation value stream mapping.

The supplier's time window will be made by logistic partner based on the reference of ADM time window. Before determining the time window, it is necessary to classify waste that relevant to transport operations. The identification is conducted through a transportation value stream mapping study, and the use of the Transportation Value Stream Mapping (TVSM) index for the measure of the overall performance of the transport operation [27].

Figure 3 describes the actual Transportation Value Stream Mapping (TVSM) between ADM, suppliers and TTLC. When the logistics partner runs milk-run operation, the waste have to be identified and eliminated to be more efficient. In this figure, the total time needed is 280 minutes. It is because of double checking by security at supplier A, separated empty polly box area at supplier B and many holes on the road and moreover high traffic congestion from supplier B to supplier C.

TTLC identified and eliminated waste and found potential problem in next step by analyzing the gap. The gap means the difference between planning or ideal TVSM condition vs actual TVSM as described in Fig. 4. The gap found will be counter measured to create improvement and become Ideal TVSM. The common problem arrised is related to time. If there is a traffic jam in the short distance route, there will be additional time if it still uses this route. In this time TTLC will search other routes based on time available. It can change route even if the route is further but it takes less time than the first one. It is a strategy to eliminate such kind of waste [20]. VSM can identify waste on facilities and installations along the supply chain. TTLC performs calculations based on the standard types of truck used. The common type of truck used is a truck with capacity of 12 tons with 12 meters length.

The ideal TVSM is presented in Fig. 4. The processing time at supplier A is targetted to 45 minutes by reducing DN time become 10 minutes. The targetted time at supplier B is 45 minutes by reducing unloading time to 15 minutes. While the targetted travelling time from supplier B to supplier C is 25 minutes.

The new process metrics are suggested that could give an impact to cost, service and quality in the transportation value stream mapping. They are time components (process, lead or value-added), changeover time, batch sizes or practices, demand rate, percent complete or accurate, reliability, number of people, inventory, information technology utilized, available time, faster-than-necessary pace, waiting, conveyance, processing, excess stock, unnecessary motion, and correction of mistakes.

Milk-run logistics in ADM

Operational plan and management

TTLC management prepares loading-unloading check sheet for truck driver to guide driver operation in ADM and supplier. This check sheet includes milk-run route map, time line and time window that has to be filled manually by the driver. It is unable to ask for replacing the check sheet by GPS. Check sheet is evidence of receiving or delivery note to take new spare part and replace the empty polly box. Computer and tab phone are not available inside the truck. It is a challenge for TTLC and ADM to apply improvement in the future where signature and submission of the data can be performed in the real time. TTLC controller will monitor the movement and speed of the truck. Besides, the new GPS technology can see the truck so the safety is able to be monitored. It means that the controller record the information of the truck movement to ensure that the driver doesn't drive the truck at high speed that can endanger himself and also the goods carried. Moreover in some road conditions there are holes that can give effect in goods shifting. Figure 5 shows the TTLC's tracking control flow.

Cargo selection

Before time window is determined, TTLC will create stacking simulation in the truck first. This simulation aimed to achieve efficiency of stacking inside the truck. The standardization of packaging among automaker, suppliers and logistics carrier is essential. If the automaker changes its packaging, it notifies the logistics carrier in advance to determine the best vehicle for programmed collection of parts. Changes in packaging can affect the capacity of a vehicle, decreasing efficiency and thus the process would not contribute to minimize transport costs in the integrated logistics chain. The supplier may also be informed in advance if the package is changed [25]. There are two kinds of goods, goods that use polly box and goods that use iron pallet. The polly box cannot be stacked either above the pallet or under the pallet, so TTLC will use the belt to ensure the goods are not shifting or falling apart during the delivery process. Preparation of stacking will consider time window and the sequence of suppliers. Loading-unloading process will take 45 minutes. Time for loading-unloading will be deferent in each supplier depend on the quantity and time available in supplier. TTLC truck must be ready within 15 minutes before entering ADM for unloading part. This just-in-time process in supplier and ADM factory will be recorded as key performance of TTLC

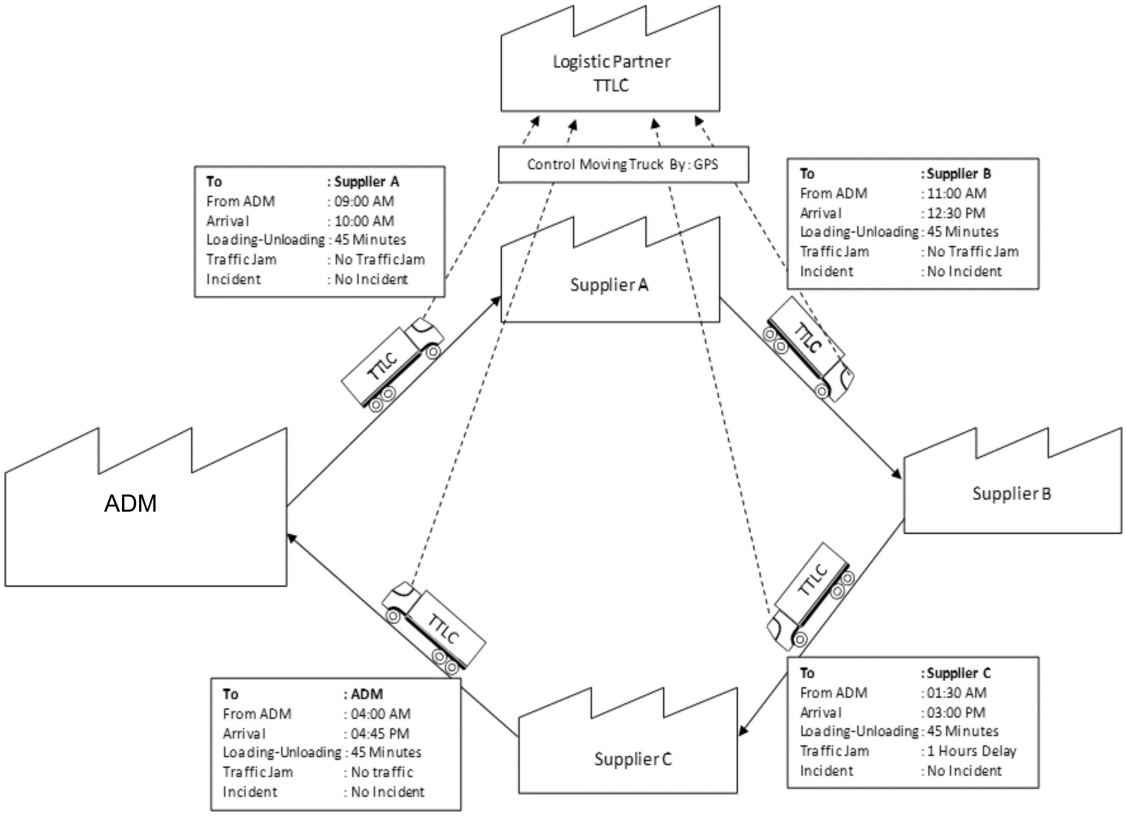


Fig. 5. TTLC's tracking control flow.

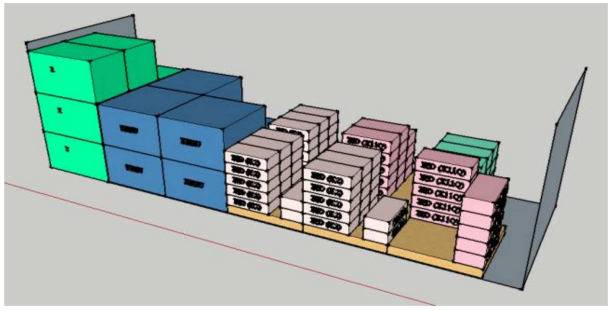


Fig. 6. Simulation of stacking in truck.

that will be reported in monthly review and logistics partner performance.

Unloading process at ADM

The forklift is prepared for loading-unloading part both in suppliers and ADM. The process of loading-unloading will be done by the logistics partner driver. The driver who is responsible for the process of loading-unloading part must obtain a license in operating forklift either from the government of Indonesia or from other licensing companies. The unloading process in ADM takes place within 45 minutes. During the process of unloading the goods, the receiver will check the goods in parallel. The driver will inform the receiver team about the part delivered along with the document. If it is not found a problem then driver can continue to next cycle or replaced with other driver. The process of driver replacement can be done at TTLC pool, ADM or supplier depend on TTLC management. The aim of driver replacement is to make sure that the driver's working hours not more than 8 hours. In the next cycle, TTLC truck will bring empty pallet to the supplier along with the process of taking new items.

Transport responsibility

When parts are still in the area of the supplier then they are still in the responsibility of the supplier and the assets of supplier. When the parts are loaded into the truck, they will change in the responsibility of TTLC with the assets still addressed to the supplier. The assets are moved to ADM if the parts has been included into the receiving system of ADM. As long as the goods have not entered ADM, the parts are still in the ownership of the supplier. ADM will accept all parts and move to ADM assets. Damaged goods will be travelled back to suppliers and suppliers will check how many NG parts there are. ADM will open additional orders and the price of this additional order will be charged to TTLC by adjusting the invoice.

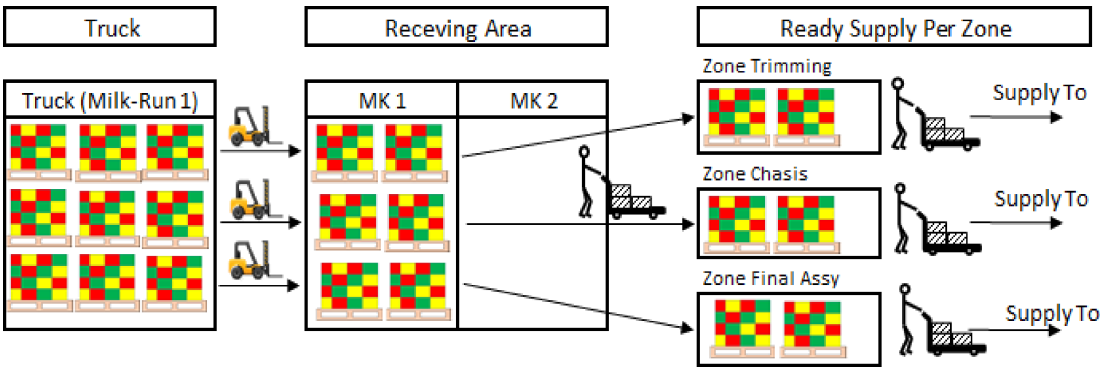


Fig. 7. Flow of part in the plant and synchronization mechanism.

Flow of part in the plant and synchronization mechanism

Parts are taken from the suppliers and delivered to the ADM in accordance with the milk-run or direct delivery docking. The process will syncronize the starting order of spare part, delivery cycle, loading-unloading time, docking at supplier and ADM, including in ADM factory for supply zone and frequency of supply parts to the production line. Parts will be separated based on supply zone (Fig. 7). The direct supply or progress line area for delivery process of goods happen 36 times in 1 day by using e-kanban trigger. Progress line will serve in synchronizing parts that will be sent to the line. Part that has been separated will be sent by using towing equipment. The large dimensions of parts will usually be resetted or sub assembled before the goods are sent to the production line. Parts to be sent to the assembly line has to be delivered in accordance with the order number of cars produced in the production line. Those activities show the implementation of JIT in the system.

Conclusions

To build milk-run system, it is necessary to synchronize the manufacturer, logistic provider and supplier. Synchronization begin from ordering system which connected to lot order system, type of packaging, and volume order. Based on the ordering system, it will be connected with how many trucks that will be operated based on the type of truck used. In developing milk-run system in Indonesia should consider abnormality point of congestion and also unfavourable road condition like damaged road or narrow road. If those conditions are not accomodated in determining time window, it can cause inaccurate time in milk-run operation. Transportation Value Stream Mapping (TVSM) is very important to be prepared before operating milk-run. TVSM can be used as a tool to visualize the whole picture of transportation in the system in order to reduce waste and to increase efficiency of trip.

To increase the precision of just-in-time milk-run, every milk-run route must be paired with GPS to control the positions and problems faced by the milk-run truck. GPS can improve just-in-time milk-run control and also improve safety of the operating truck. Besides, milk-run operation gives some advantages. It has good effects in reducing the traffic congestion by decreasing the number of trucks used and also reducing the emission of CO_2 in the environment.

Further study is suggested to discuss about collaboration and integration of out plant milk-run, cross-dock system (warehouse management) and in plant milk-run. This method could analyze the benefit and cost estimation that generate best modeling system in Indonesian automotive industry. This system could possibility creating real zero stock in manufacturing plant.

References

[1] Holtskog, H., *Continuous Improvement beyond the Lean understanding*, Procedia CIRP 7, 575–579, 2013.

[2] Satayapaisal A., Takala J., Wiriyacosol S., Chansangavej C., *Critical performance attributes of Thai automotive supply chains*, Management and Production Engineering Review, 3, 2, 36–48, 2012.

[3] Sillanpää I., Kess P., *The literature review of supply chain performance measurement in the manufacturing industry*, Management and Production Engineering Review, 3, 2, 79–88, 2012.

[4] Sitek P., Wikarek J., *Mathematical programming model of cost optimization for supply chain from perspective of logistics provider*, Management and Production Engineering Review, 3, 2, 49–61, 2012.

[5] Prabhu N.S., Rajenthirakumar D.,*Development of lean assembly line using 5S and RFID technique*, International Journal of Engineering, 15, 2, 185–188, 2017.

[6] Aksoy A., Ozturk N., *A two-stage method to optimize the milk-run system*, European Journal of Engineering Research and Science, 1, 3, 7–11, 2016.

[7] de Moura D.A., Botter R.C., *Delivery and pick-up problem transportation – milk run or conventional system*, Independent Journal of Management & Production, 7, 3, 746–770, 2016.

[8] Baudin M., *Lean logistics: the nuts and bolts of delivering materials and goods*, Belgium: Productivity Press, 2005.

[9] Jiang Z., Huang Y., Wang J., *Routing for the milk-run pickup system in automobile part supply*, Preceedings AISC, 66, 1267–1275, 2010, Springerlink.com.

[10] Caridade R., Pereira T., Ferreira L.P., Silva F.J.G., *Analysis and optimisation of a logistic warehouse in the automotive industry*, Procedia Manufacturing, 13, 1096–1103, 2017.

[11] Bagheri O., Mansouri A., Rostami M., *Implementation of milk run logistic vehicle cooling system pride KIA parts*, Journal of Fundamental and Applied Sciences, 8, 3S, 2307–2325, 2016.

[12] Monden Y., *Toyota production system*, Diamond Publishing, 2006.

[13] Xu Q.H., *Milk run practice and application about cycle pick up model in Shangahi GM*, (J) Automotive Accessories, 2003.

[14] Rother M., Shook J., *Learning to see: value stream mapping to add value and eliminate muda*, Cambridge: The Lean Enterprise Institute, Inc., Brookline, 2003.

[15] Nemoto T., Hayashi K., Hashimoto M., *Milk-run logistics by Japanese automobile manufacturers in Thailand*, Procedia Social Behavioral Sciences, 2, 5980–5989, 2010.

[16] Satoh I., *A specification framework for earth-friendly logistics*, International Conference on Formal Techniques for Networked and Distributed Systems, Berlin, 251–266, 2008.

[17] White A.S., Censlive M., *An alternative state-space representation for APVIOBPCS inventory systems*, Journal of Manufacturing Technology Management, 24, 4, 588–614, 2013.

[18] You Z., Jiao Y., *Development and application of milk-run distribution systems in the express industry based on saving algorithm*, Mathematical Problems in Engineering, Volume 2014, 1–6, 2014.

[19] Hernandez J.E., Poler R., Mula J., Lario F.C., *The reverse logistic process of an automobile supply chain network supported by a collaborative decision-making model*, Group Decision and Negotiation, 20, 79–114, 2011.

[20] Gorman M.F.,Clarke, J.P., Gharehgozli A.H., Hewitt M., Koster R., Roy D., *State of the practice: a review of the application of OR/MS in freight transportation*, Interfaces, 44, 6, 535–554, 2014.

[21] Drira A., Pierreval H., Hajri-Gabouj S., *Facility layout problems: a survey*, Annual Reviews in Control, 31, 255–267, 2007.

[22] Conze M., Sailer T., Gunthner W.A, *Combined call-off and transport control for milk run based on order pearl chain in the vehicle sector*, International Journal of Engineering, 11, 1, 137–142, 2013.

[23] Zotteri G., *An empirical investigation on causes and effects of the bullwhip effect: evidence from the personal care sector*, International Journal of Production Economics, 143, 489–498, 2013.

[24] Villarreal B., *A lean thinking and simulation-based approach for the improvement of routing operations*, Industrial Management & Data Systems, 116, 5, 903–925, 2016.

[25] Bennet D., Klug F., *Logistics supplier integration in the automotive industry*, International Journal of Operations & Production Management, 32, 11, 1281–1305, 2012.

[26] Fuentes J.M., Diaz M.S., Jurado P. J.M., *Cooperation in the supplychain and lean production adoption evidence from the Spanish automotive industry*, International Journal of Operations & Production Management, 32, 9, 1075–1096, 2012.

[27] Villarreal B., *The transportation value stream map (TVSM)*, European J. Industrial Engineering, 6, 2, 216–233, 2012.