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IMPROVEMENTS OF WORKSITE CONTROL FOR PULL SYSTEM

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ABSTRACT

Pull system is one of lean manufacturing tools. This system is a method of regulating the flow of goods inside the factory and from outside suppliers or customer. The system is based on automatic replenishment through signal cards that indicate when the goods or parts are needed. Currently in Autokeen Sdn. Bhd., the manufacturing process is based on the daily requirement output schedule. The production line only produced goods according to the schedule. As a result, overproduction of the goods usually occurred. Many goods were stored for a long period in the inventory due to low demand from customer. Thus, some of the parts have started to corrode. The tarnished goods need to be reworked before shipping to the customer. This study is to improve the worksite controls for pull system by investigating the current condition and efficiency of pull system. Then improvement plans have been proposed which suitable for the pull system to be implemented. As a result, this system will avoid overproduction, minimize the inventory and reduce rework process. Thus, all of these improvements will definitely reduce waste. Furthermore, the manufacturing cost will be decreased and the manufacturing processes become more efficient.

Keywords: lean manufacturing, production line, pull system, Kanban system.

INTRODUCTION

Basically the pull or push system is a concept of material flow in the production line. If the production lines apply pull system, the following station will pull parts from the previous station. On the other hand, if the production lines apply push system, the parts will be pushed to the following station by the previous station. Pull system is one of lean manufacturing tools. This system is a method of regulating the flow of goods inside the factory and from outside suppliers or customer. The system is based on automatic replenishment through signal cards that indicate when the goods or parts are needed (Vorne Industries Inc, 2013). A successful pull system will produce only what is consumed and when it is consumed. The inventory level is only what is required for the demand of the customer, so the overproduction can be minimized. If the company applies the system smoothly, the production schedule can be totally removed (Krause II, 2007).

There are three rules of kanban that need to be followed. These rules are to ensure that all process produced parts at the correct volume and at the right time. These rules can control the movement of kanban in the factory. If the rules do not exists, the system cannot be control and mistake can be occur (Sugimori, Kusunoki, Cho, and Uchikawa, 2007). These rules are withdrawal by subsequent process, leveling of production and one piece production. Many companies are relying on computerized system.

The efficiency of the system inside the company can be measured by having the aim as the benchmark (Sugimori, Kusunoki, Cho, and Uchikawa, 2007). In additions, the Kanban system also will improve the process flow between suppliers, manufacturing warehouse and the assembly line. More control will be placed at the operational level. The risk of material shortage can be reduced. The cash flow will be improved by reducing the inventory of overproduction (Prasansub and Fumio, 2014). Currently in Autokeen Sdn. Bhd. (AKSB) the manufacturing process is based on the daily requirement output schedule. As a result, overproduction of the goods usually has been occurred. Many goods were stored for a long period in the inventory due to overproduction. Thus, some of the parts have started to show some corrosion. The tarnished goods need to be reworked before shipping to the customer. The communication between stations or departments also needs to be revamped. For example, the operator needs to walk to the previous stations to ask for parts due to shortage of parts to complete the order. On the other hand, some stations deal with overstock of parts. Because of this problem, the flow of the material from raw material to finished goods is not organized and efficient.

The goals of this study are to investigate the current condition of the production system due to the problems occurred at AKSB. Design, propose and implement the suitable kanban cards and kanban post that suitable for the pull system. Demonstrate the efficiency of the implemented new kanban system as the result. This system is implemented at the AKSB near Kampung Melayu Subang, Shah Alam. The company produced automotive parts mostly for Proton and Perodua.

The system only will focus on the reinforcement roof side rail inner with part number is 61248-BZ100 and the back number is AUK 015 in D87A model. This will be the pilot line for the implementation for being the most important and fastest moving production line in the company. If this project demonstrates positive performance efficiency, AKSB will implement this new design kanban system to the other model in stages.

PROCESS FLOW

During the investigation of the current process in AKSB, observation activities or Genba Kanri (GK) has

ARPN Journal of Engineering and Applied Sciences

been done to collect as much as possible data [5]. This activity has been done for eight hours daily for two weeks at the initial phase of this study. Furthermore, GK activity has been done at least two hours daily until this study completed. The significant of this activity is to know how the problems can be happened in every angle. Some readings of the data recorded by the operator also have been read to collect data of the current status of the production process. The communication flow between the stations also can be observed during this process. A site visit to one of Malaysia's car manufacturer Perodua has been done to collect some valuable data for designing the new pull system in AKSB.

The D87A line was the fastest and busiest production line in the AKSB. This is because the processes involved were straight forward and high demand. The supplier was supplied blanked sheet metals which will be stored in the storage department. After the order has been received from the customer, the order will be transfer to the production department for production. Then, the blanked sheet metals will be requested by the production department from the storage department to be pressed and become the finished goods. After the sheet metals have been pressed according to the part dimensions, the parts were collected and transferred to another station by the operators before the parts become the finish goods. The station filed the edge of the parts, checked the quality of the parts and put it onto the pallet. The pallet quantity for this part was 30 pieces per pallet. Furthermore, the pallets were transferred to the warehouse before shipping. Another checking process had been done before they had been placed at each pallet during this process. The scenarios above are illustrated in the Figure-1.

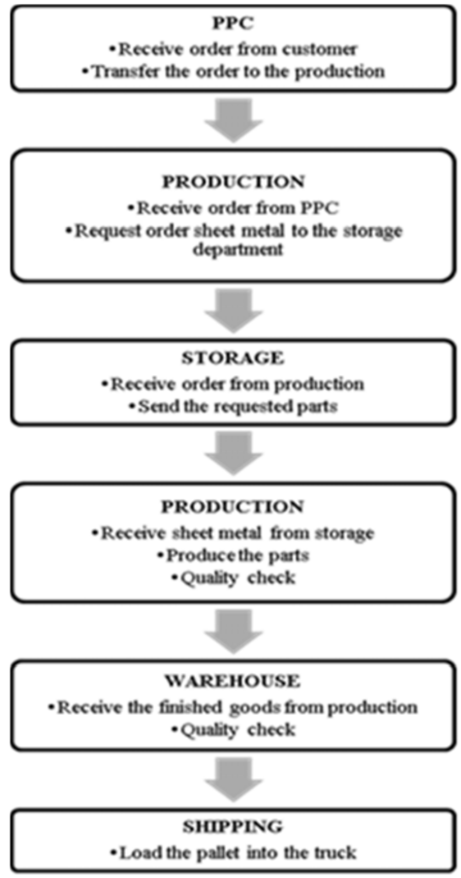

Figure-1. The current flow at AKS.

There are two types of kanban cards. The first card is withdrawal kanban that means by the quantity that the subsequent or following stations should withdraw from the previous station. The card will circulate between two stations only. The second type of the kanban cards is production kanban. The production kanban will indicate that the quantity of the parts that need to be manufacture in order to replace the parts that have been withdraw (Prasansub and Fumio, 2014). The withdrawal kanban cards are the needed here in AKSB. The sizes of the kanban have to be calculated in which to know the desired quantity of the parts per kanban and the number of kanban. There are many ways to calculate. One of the examples of kanban formula:

$$N = \left(T_{\max} \times Q_{cap} \times Q_{bom}\right) \div Q_{pack} \quad (1)$$

N = quantity of kanban needed
T_{max} = maximum production time from the raw material at the production shelves
Q_{cap} = quantity of finish product per hour
Q_{bom} = quantity of specific parts in one finish product
Q_{pack} = quantity of parts in the packaging or pallet or trolley

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ARPN Journal of Engineering and Applied Sciences

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If the minimum kanban card is needed for safety stock, use the same formula:

$$N_{\min} = \left(T_{\min} \times Q_{cap} \times Q_{bom}\right) \div Q_{pack} \qquad (2)$$

N_{min} = minimum quantity of kanban needed
T_{min} = minimum production time from the raw material at the production shelves
Q_{cap} = quantity of finish product per hour
Q_{bom} = quantity of specific parts in one finish product
Q_{pack} quantity of parts in the packaging or pallet or trolley

These formulas are calculated to define the desire quantity of stock in the production shelves (Svirčević, Simić, and Ilin, 2013). Most of kanban system implementation failures were not because of using the wrong formula, but the lack of discipline and training of the operator or worker (Feld, 2000). The demand of this part is very stable for the past three months. Thus, now is the right time to implement the kanban system.

The daily requirement by Perodua Global is 16 pallets. The trips to Perodua are 16 times daily, so the part will be shipped one pallet per trip according to the customer order. Each pallet contains 30 pieces, means that the daily requirement for this part is 480 pieces. The management has decided to have another one-day stock as safety stock. Thus, 32 pallets need to be inside the warehouse that is equal to 960 pieces. According to the production schedule, the production rate of this part is 450 per day. Using these values above, the maximum production time can be calculated as requirement from customer is divided by daily production rate. Thus, the maximum production time calculated is 2.13 days. The value of requirement stock by management was two days and the maximum production time is nearly two days. This condition will ensure the stock will not stay inside the warehouse more than two days. As a result, the parts that enter the warehouse today will leave the warehouse as early as the next day. Thus, the area to place the finished goods will be at the minimum space which follows the concept of lean system. According to the Krajewski and Ritzman, lean systems use lot sizes that are small as possible (Krajewski and Ritzman, 2005). The kanban sizing is not required due to customer request. The customer has emphasized that they want 30 pieces in each pallet. After several meeting with the management, the kanban card will be hanged at each pallet to make it visible to the operator. The total number of kanban cards required for this case is 32 pieces.

According to Prasansub and Akagi, the detail of information that needs to be stated in the kanban cards are code and material descriptions, supplier, quantity and the kanban card number (Prasansub and Fumio, 2014). The management wants additional detail inside the kanban cards. The additional details are the line of production, back number, company's logo, customer's logo, part's picture, part number, part name, previous process and next process.

Figure-2 shows sample of kanban card that have been proposed to the management. The management wants the kanban cards serve as returnable card or two-ways card which can reduce the cost of making the card.

At initial stage, this system will be applied to the process between production and the warehouse department. The system will be applied to other departments too if the system running smoothly and efficiently. The reasons to implement this system stage by stage from the finished goods toward the manufacturing process and raw materials are to reduce the cost and to avoid major disturbance to current production. Pull system moves backward through the system from station to station and each station communicates its need for more work to the preceding station (Stevenson and Chuong, 2010). The operators also need to be trained to use the system and the operator need to be more discipline when using the system as stated by Feld (2000), most kanban system implementations fail because of lack of discipline or lack of training.

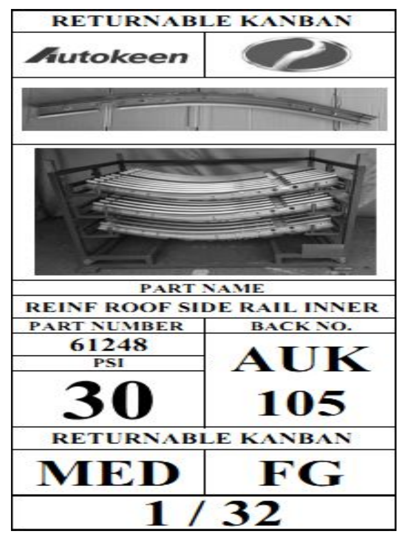

Figure-2. Design of kanban card.

CURRENT CONDITIONS

During the kanban calculation period, the method applied was the Hikitori Kanban. This method was a signal to move certain material from one storage place to another defined storage location at the shop floor. The signal was given by the leveling of the kanban card at the kanban post. This method was used at Perodua to pull parts from logistic into the production line. The kanban cycle needed to be known by following the schedule before calculating the Hikitori Kanban. The example of kanban cycle is visualized in Figure-3. Kanban cycle at AKSB was in one day has 16 trips with 16 interval.

The Kanban cycle can be understood easily by the help of the example Kanban cycle's illustration in Figure 3. The triangle shows the time of the delivery order received by the PPC and the circle shows the time to

ARPN Journal of Engineering and Applied Sciences

deliver the parts to the customer. The cycle 1 - 4 - 2 means that in 1 day have 4 trips with the interval by 2 trips. The delivery order received on the first trip of the day and the delivery time of the parts ordered on the third trip.

Several data for the information of the management such as circulation kanban monthly, circulation kanban daily, minimum pallet in the warehouse, minimum stock at production and the time of the parts inside the warehouse before it is delivered to the customer have been recorded. Furthermore, red mark has been placed at the kanban post to show the limit of the kanban cards that need to be rotated as in Figure-4. The flow of the kanban cards was illustrated in the Figure 5 to make it easier to be understood by the operators. If the flow is stated in words, it is hard to be understood by the operators. Figure-5 shows the flow of the kanban card.

The kanban card was transferred from the pallet at the standby area to the kanban post before the loading process. When the kanban cards reached the red mark, the kanban cards were transferred to the production cell according to the back number to pull the parts from the production. Then, the kanban card was hanged up at the pallet that has been filled up with the finish goods. The pallet and the kanban card then transferred to the warehouse waiting for delivery. After received the delivery order, the finish goods pallet was transferred from the warehouse to the standby area and inspection process occurred. The cycle was repeated according to the flows in Figure-5.

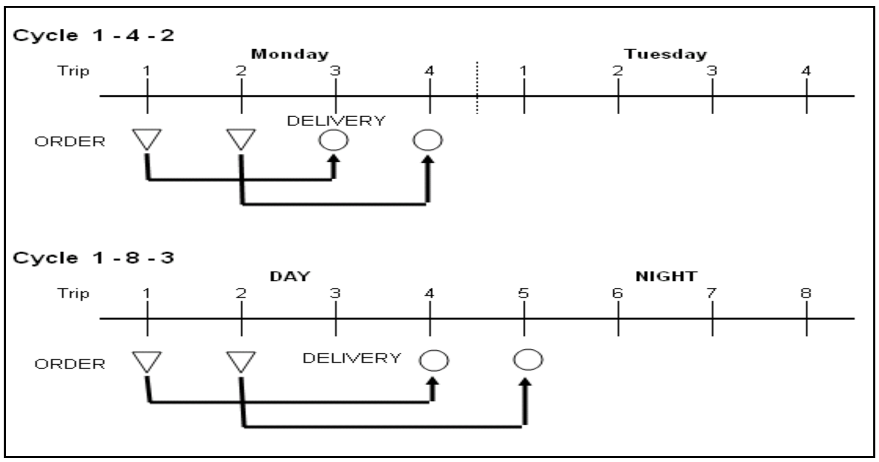

Figure-3. Example of Kanban cycle.

Figure-4. Kanban post.

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ARPN Journal of Engineering and Applied Sciences

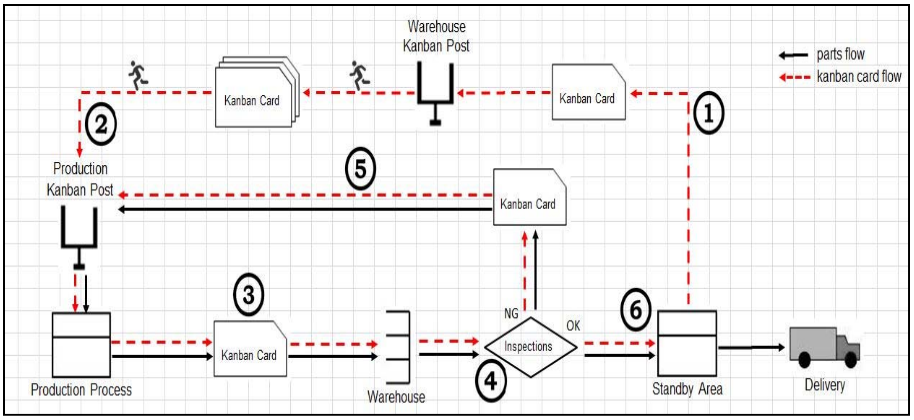

Figure-5. Kanban flow between warehouse and production in AKSB.

RESULTS AND DISCUSSIONS

After two weeks implementing the kanban system in the AKSB, a problem occurs on the kanban system. The problem was missing 14 kanban cards of AUK009. The Kanban Man realized the problem when he audited the kanban system. The challenge was the cycle times to produce parts become less compared to the normal cycle time. When the number of kanban card reduces, production would receive kanban card from the warehouse later than normal but the warehouse need to be filled much faster. The problem was detected when the production's operator came to the kanban post to collect kanban card because there were no kanban card at the cell. If there were no kanban cards, the production line needed to be stopped Searching process was conducted to find the lost kanban card around the AKSB buildings. The process was not successful, the kanban cards were lost. Lack of training to the operators about the kanban system was the main factor to this problem. Thus, several meeting with the operators was conducted to train them with the kanban system. During these meeting, the operators were briefed about the consequent of their actions toward the kanban system. As a result, the kanban was running without any problems after the kanban cards were replaced.

Before introducing kanban system into the AKSB, the inspection and preparing for delivery process needed to have five operators. After kanban system was applied to the AKSB, the number of operators was reduced to two people as shows in Figure-6. The reduction of operators resulted in reducing the cost.

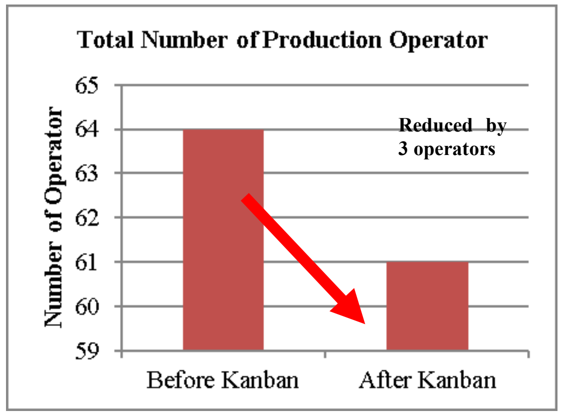

Figure-6. Total number of production operator.

The reduction of operators was due to less rework were needed before the delivery. Less rework resulted fewer parts were rusty in the warehouse due to the reduction of time the parts inside the warehouse from two days to one and half days as illustrated in Figure-7. As a result, reducing the operator was the right action by AKSB because there are no problems after the action has been taken.

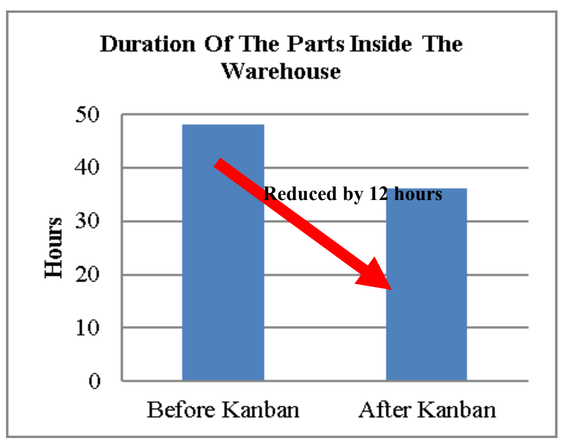

Figure-7. Reduction of the duration of the parts inside the warehouse.

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Rapid and precise information from the production line was one of the aims of kanban system. The first evident was the lost kanban card problem. The operator at the production line came to ask for kanban card. The operator could not start the process if there were no kanban cards at the cell. The possibilities were the full warehouse or late kanban cards sent to the production line. As a result, the processing information became rapid and precise without any calculation or analysis by the planner. Another aim of kanban system is to limit the production. This situation also could be seen during the lost kanban cards problem. The production could not produce parts without the kanban card. No overproduction could occur. This condition was the evident of limiting the production Furthermore, cost of processing information could be further reduce was another aim of the kanban system. After one month kanban system implementation between warehouse and production in AKSB, the production schedule was eliminated. This action made by the management was due the flow of the kanban system was very efficient. The production efficiency has increased after kanban system has been implemented. The production efficiency in February was 85.2 percent while 89.2 percent in March after implemented the kanban system. The production efficiency has increased by four percent. These values are illustrated in Figure-8.

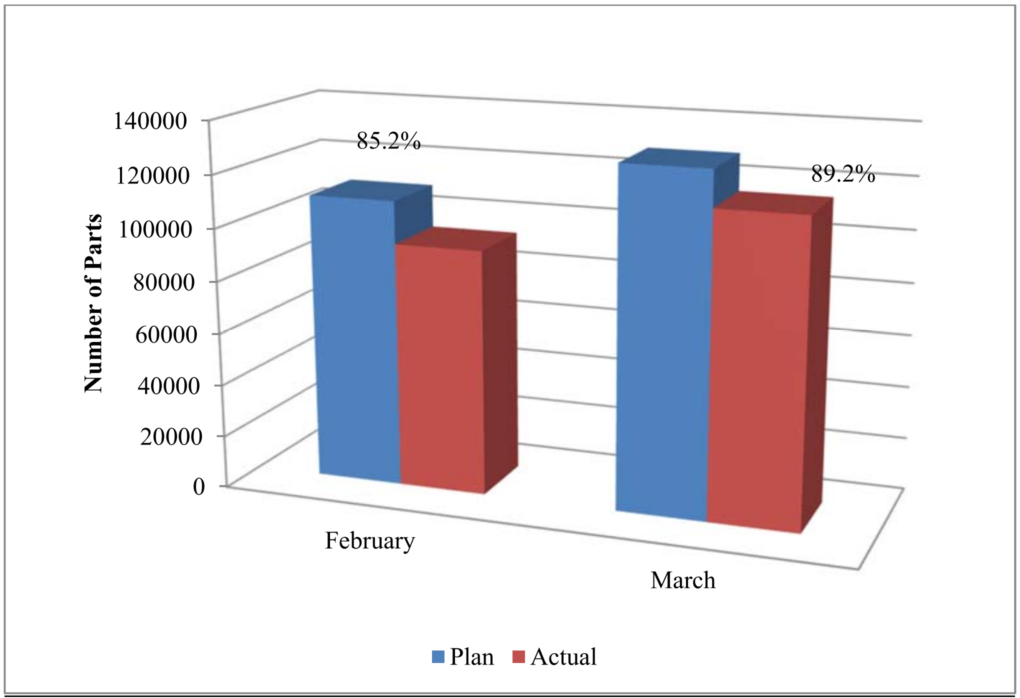

Figure-8. Production efficiency between February and March.

CONCLUSIONS

This study has achieved the objectives which are implementing pull system to the current production system by creating a kanban system between the departments and demonstrate the efficiency of the pull system. Kanban system consists of kanban cards and kanban posts. This system was used as a signal to replenish the parts inside the warehouse automatically. The communication flow was also improved after implemented this system. Furthermore, the inventory level inside the warehouse has been reduced from two days to one and half days stock which means the production only produced what is consumed and when it is consumed. This action was minimized the overproduction. Due to the reduction of the duration of the parts in the warehouse, fewer parts were rusty in the warehouse and the operator that operates the rework process has been reduced to two persons. The production schedule also has been removed after this system was stable which means the main target of the kanban system has been achieved. In conclusion, this study has achieved the targets and the production efficiency has increased by four percent.

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