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Kanban System and Calculation of Kanban Production in Stamping Division of PT. XYZ

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***Abstract*— This far, the development of Japan industry has grown rapidly in the world. The automotive industry is one of the industry which play the important role in Indonesia, especially in transportation sector. Almost in automotive companies familiar with Toyota Production System method. The problem come up when the production planning use forecasting method, then the amount of the inventory will cause a lot of reject products and need a lot of storage spaces. One of the solution can solve this problem is the production planning department should control and monitor the number of kanban requirement to complete the task job. When the production planning fix the kanban number, then key performance index perform better. The purpose of this study is to calculate the amount of kanban for each line of production, then this calculation will reduce waste and increases the production capacity.**

Keywords*: *Toyota Production System, kanban, pattern, production, waste

I. INTRODUCTION

Japan always fights to renew creation and improve the quality of production. The method called Toyota Production System, also known as the Just-In-Time Production System, was born in an effort to catch up the automotive industry. It means just-in-time production system is a production system which was designed to get the best quality, cost, and time of delivery, by eliminating all types of waste contained in internal processes so this sistem is able to deliver the products according to the consumer's appropriately time By increasing productivity, reducing costs, and achiving this goal, the company reduces some unnecessary functions at the factory by approaching and investigating in each operation and designing new methods to find the solutions to all these constraints.

The solution is kanban. Kanban became the most important system of Japanese trade in the 17th century. If all of the component has been used in the production line, kanban is returned to kanban post, where it is needed as an order for the production of the goods.

The system that used at PT. XYZ is Just In time (JIT) and Jidoka which are carried out by standardizing the work, making equal distribution of work (heijunka) and making continuous improvements. To achieve Just In Time, the role of kanban is needed. Application of heijunka is making pattern production and calendar production. Kanban system is a new philosophy, which plays asignificant role in the JIT production system. Basically kanban is a plastic card containing all the information required for production at each stage and details of its path of completion. The kanban system is a multistage production scheduling and inventory control system. These cards are used to control flow process of production and inventory. This system facilitates high production volume and high capacity utilization with reduced production time and work-in- process.

II. LITERATURE REVIEW

A. Continuous Flow

The continuous flow process is an illustration of Just In Time, because production will be start when customer ordering the products and after the products are done then will be sent to the cusumers. The different between continuous flow and batch system is the batch system divides each one stage of production into one department. Material will enter the next department if all of the material has been produced in the previous

department. The ideal continuous flow has no inventory, but PT. XYZ requires safety stock if there has an abnormality. PT. XYZ uses a pull system with small supplies.

B. Jidoka

Autonomation (automation and autonomy), which is the automation of the engine to stop the process when there is a problem, but the operator also has the autonomy or authority to stop the engine when it encounters a problem. When a problem is found on machine or process, the previous process should be stopped. This aims to prevent more damage. It's better to stop the engine and improve the quality in the process compared to allowing damage to the process or the next consumer. Andon is a communication media in the form of lights to inform that a problem is occurring. Application of two TPS pillars in the Stamping Division of PT. XYZ is supported by Heijunka, a stable and standardizedprocess.

C. Heijunka

According to Magee, David (2007: 199) heijunka is equal distribution of production. Just in time, what is meant in the Toyota production system is not that PT. XYZ manufactures exactly when orders come from customers. If so, PT. XYZ will experience production imbalances. This mura (imbalance) results in a muri, which is an overload of people or equipment, so that when production is very high, people and machines will be overloaded. Mura will also cause muda (waste) to the health and safety risks of workers, as well as machine damage. Thus, PT. XYZ makes equal distribution of production schedules (number and types of products) based on accumulated customer orders within a certain period, so that PT. XYZ leveled the production schedule but still based on orders. There is inventory on the distribution of production schedules. This is in order to overcome the request suddenly or when there is an abnormality in the production system.

D. Safety Stock

According to in his book explaining that the concept of safety stock is an additional inventory that is held to protect or maintain the possibility of a material shortage or stock out. Whereas according to Heizer and Render in his book explains that the concept of safety inventory is an additional inventory that allows requests that are not the same and become an alternative. Safety stock is material stock, such as raw material, work-in-process goods, or finished goods which is preserved by the company to avoid risk cost and stock-out. Safety stock is needed to meet the demand at the right time sufficiently [1].

E. Types of Kanban

Kanban is a tool to reach the production target level and a card that puts in the envelope [2]. Kanban production consists of two types, namely internal kanban and external kanban. Internal Kanban as a command card for the production of press parts in the production line and only circulating in the Stamping Division area. Internal kanban can be seen in Figure 1 below.

Figure 1. Internal Kanban

1. Line that produces parts.
2. Kanban serial number.
3. Model parts.
4. Part number.
5. Name of part.
6. Type of die (mold) used.
7. Type of steel material used.
8. Types of pallets used to place parts and quantities per pallet.
9. Location of parts in the store.
10. Barcodes for kanban scans in the production line and delivery section.

External kanban as a command card to take orders and circulate in the consumer area. External kanban is divided into e-kanban, namely kanban which is sent via e-mail and printed on delivery (logistics / shipping center and kanban center) and cyclic kanban, namely kanban which is carried directly by consumers.

External kanban (e-kanban and cyclic kanban) are taken from delivery and taken to the store and Quality Gate as part of the instructions to be sent to the consumer. After the part is taken according to the external kanban, the part is prepared in the transit area and the internal kanban located on the part pallet is exchanged with an external kanban. Then the internal kanban is scanned from "full" status to "empty" which means that the kanban which was originally used as a work order to produce parts, becomes ready to be used again as a work order to produce the next part. Then the parts are transported into the truck and sent to the next consumer.

When it is time for production, the internal kanban that has been scanned from "full" status to "empty" is brought to each production line by the kanban boy according to the schedule that has been made. After material from the control material is available in the production line, internal kanban is used by the production line as an order to produce parts. After the production line has finished producing parts and parts placed in the pallet, the internal kanban is scanned back from "empty" to "full". It's meaning the kanban which had not been used as a work order to produce press parts, has been used as a work order to produce press parts. Then the internal kanban is placed on the pallet.

After that the parts that already have good quality can be directly taken to the store using a forklift to wait for delivery. But parts that have a lot of disability, to be exported, or at the customer's request, are brought to Quality Gate to be checked and repaired before being sent to consumers.

External kanban can be seen in Figure 2

Figure 2. External Kanban Information:

1. Supplier part
2. Arrival time of trucks at consumers
3. Barcodes for scanning kanban in customers.
4. Consumers
5. Part number
6. Unique number is the same as the code for each part
7. Quantity per kanban
8. Order sequence number
9. Location of parts in the store
10. Dock code (shelter) for trucks at consumers
11. Progress line shows store shelves at consumers
12. Number conveyance (place to put the pallet)
13. Barcode to scan kanban at the customer.

F. The Function of Kanban

Kanban has several function, which are as follow:

a) Visibility function, information and material flow occur simultaneously when the Kanban is moved.
b) Production function, Kanban order production process, thus functioning as a production controller.
c) Inventory function, the number indicates the amount of inventory that Kanban controls.

III. RESEARCH METHODOLOGY

The methodology of this research can be seen in Figure 3 below.

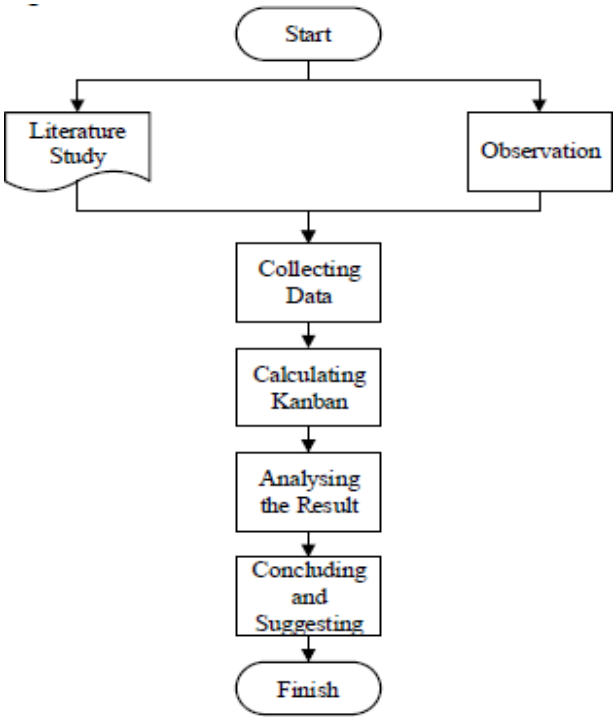

Figure 3. Research Methodology

IV. RESULTS AND DISCUSSION

Planning the number of kanban in a production process is needed. The number of kanban can be calculated based on the lot process. To calculate the number of kanban per part in a production process, data is needed on the number of production needs per shift, the long of work time in one shift, and the number of parts in a kanban. From these data can be calculated next process pull/hour with the formula as follows:

$$\text{Next Process Pull/Hour} = \frac{\text{Need Qty/Shift}}{\frac{7{,}6}{\text{Qty/Kanban}}}$$

A. Lot Process

Process Lots (or corner lots) are special-modified-wafers that help verifying chip design robustness to accommodate process variations that statistically occur in wafer production over the years. One of the products that semiconductor foundries offer is process lots (also called: corner lots, split lots or skewed lots). Corner lots wafers are a group of wafers which have been skewed by the fab to different corners.

The purpose of process lots is to help you find out whether your design will be immune to process variations in the future. A successful corner lot exercise includes production of process lots in all different corners.Lot process time is standard work time based on the number of cycle times. Lot process quantity is the number of lot size divided by the quantity per kanban.

This lot of process quantity has a unit, namely kanban. The number of kanban is determined by the number of lots. Lot size is the number of parts to be produced. The following is the formula used in determining the number of kanban based on the lot process.

Lot Process Time (H) = Lot Cycle x 7,6 (2)

Lot Process Qty = H x Next Process Pull/H (3)

B. Safety Stock

The persentage of safety stock is 10% from need quantity in one shift. Safety stock production in PT. XYZ is influenced by the distance between stamping (manufacturing) and assembling (assembly), and is influenced by problems that often occur in making parts, if often have problems, the number of safety stock must be more than making parts that rarely experience problems. Calculation of Quantity Kanban can be seen in Table 1.

Table 1. The Number of Kanban Calculation

No	Part No	Need Qty/Shift	Qty/ Kanban	Next process Pull/H**	Lot		Lot Process Time	Qty	Safety Stock	The Number of Kanban
					Cycle	Size				
1	61736-KK010	309	60	0,68	2	619	15,2	10,31	0,5	11
2	51252-KK020	295	80	0,48	2	589	15	7,3669	0,5	8
3	53717-KK010	284	50	0,75	2	569	15,2	11,377	1	13
	53718-KK010	284	50	0,75	2	569	15,2	11,377	1	13
4	57411-KK010	284	100	0,37	2	569	15,2	5,6885	0,5	6
5	57412-KK010	284	100	0,37	2	569	15,2	5,6885	0,5	6
6	57417-0K010	284	20	0,94	2	569	30,4	28,443	2	31
7	57418-0K010	284	20	0,94	2	569	30,4	28,443	2	31
8	58353-0K020	253	30	0,55	2	506	30,4	16,862	2	19
9	58316-0K021	242	20	0,80	2	485	30,4	24,243	2	26
10	58317-0K011	242	20	0,80	2	485	30,4	24,243	2	26
11	51211-KK010	168	100	0,22	2	336	15,2	3,36	0,5	4
12	51212-KK010	168	40	0,55	2	336	15,2	8,4	0,5	9
13	61735-0K040	168	30	0,74	2	336	15,2	11,2	1	12
	61736-0K040	168	30	0,74	2	336	15,2	11,2	1	12
14	12121-0C011	163	50	0,21	2	325	30,4	6,504	0,5	7
15	51211-KK020	127	50	0,33	2	253	15,2	5,067	0,5	6
16	51212-KK020	127	40	0,42	2	253	15,2	6,3338	0,5	7
17	51221-KK010	127	60	0,28	2	253	15,2	4,2225	0,5	5
18	51222-KK010	127	40	0,42	2	253	15,2	6,3338	0,5	7
19	51211-0D140	65	20	0,43	2	131	15,2	6,545	0,5	7
20	61736-0D140	13	100	0,02	23,12	300	175,7	3	0,5	4
	61735-0D130	13	100	0,02	23,17	300	176,1	3	0,5	4
21	61623-0D010	13	50	0,03	23,21	300	176,4	6	0,5	7
	61624-0D010	13	50	0,03	23,21	300	176,4	6	0,5	7
22	61635-0D100	13	100	0,02	23,21	300	176,4	3	0,5	4
23	61636-0D100	13	100	0,02	23,21	300	176,4	3	0,5	4

Example of calculation can be seen below: Part 61736-KK010

Need Qty/Shift = 309

Qty/Kanban = 60

Next process pull/hour = 309 pcs/shift 7,6 hour/shift 60 pcs/kanban
= 0,68 kanban/hour

Lot process time = 2 x 7,6 hours
= 15,2 hours

Lot process quantity =15,2 hours x 0,68 kanban/hour
= 10,31 kanban

Safety Stock = 309 x 10%
= 30,9
= 0,5 kanban

So, in one production each shift requires 11 kanban.

C. Key Performance Index

The Key Performance Index is a measurement of the performance of a product. The Key Performance Index or abbreviated as KPI contains a comparison of the plan for the number of kanban to be produced with the number of actual kanban produced. Percentage kanban completion is the number of actual kanban having the same amount or not with the number of planned kanban. Data of kanban production on February 2019 can be seen in Table 2 and Table 3 below.

Table 2. Data of Kanban Production White Shift

White Shift	Date (February 2019)	1	3	4	6	7	8	11	12	13	14	15	18	19	20	21	22	25	26	27	28
	Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Total Kanban Planning/Shift	90	76	72	138	135	127	167	83	163	140	62	95	87	99	130	76	109	107	97	177
	Total Kanban Actual/Shift	90	76	72	94	135	127	160	79	161	138	59	79	77	86	111	73	109	106	97	159
	% Kanban Completion W Shift	100	100	100	68	100	100	96	95	99	99	95	83	89	87	85	96	100	99	100	90

Table 3. Data of Kanban Production Red Shift

Red Shift	Date (February 2019)	1	4	6	7	8	9	11	12	13	14	15	18	19	20	21	22	25	26	27	28
	Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Total Kanban Planning/Shift	78	80	40	120	96	61	77	160	80	100	140	87	62	96	75	120	90	99	89	97
	Total Kanban Actual/Shift	78	80	40	110	88	58	75	145	80	81	138	87	59	96	73	106	79	83	88	97
	% Kanban Completion R Shift	100	100	100	92	92	95	97	91	100	81	99	100	95	100	97	88	88	84	99	100

The graphic of the percentage of kanban completion on white and red shift can be seen in Figure 4 below.

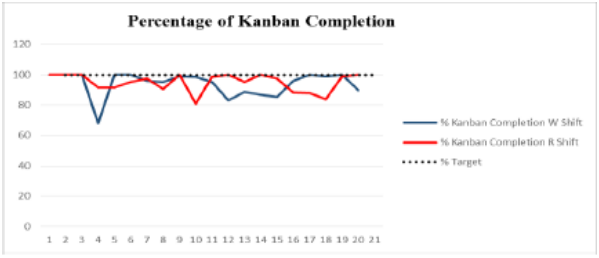

Figure 4. Percentage of Kanban Completion

In this production, the number of kanban production in each shift does not reach the target. The factors that can be happen is the line stop so when the production in one shift is complete but there has the kanban card left so the line operator will lack the number of parts and the free kanban is used to replace the kanban production that has not produced. Free kanban card is disposable, and cannot be used continuously, when the free kanban card is used it will not be valid anymore. To fulfill daily needs, safety stock which is available in the store will be used.

V. CONLUSION AND SUGGESTIONS

A. Conclusions

The JIT kanban system in a manufacturing companies activities, the production planning department should concern more and managed properly about the products delivery time to meet the customer order. Material requirement planning pay more attention in number of material quantity in the production line. The target of the number of kanban cards that will be rocessed for all parts is 2230 kanban cards for the white shift and 1847 kanban cards for the red shift. The actual of the number of kanban cards which have been produced is 2088 kanban cards for the white shift and 1741 kanban cards for the red shift. There are 42 kanban cards difference between the target and the actual that have been produced in the white shift, also 106 kanban cards difference between the target and the actual in the red shift.

As the conclusion, the kanban system in this manufacturing company is well integrated because this sistem can minimize cost such as the operational costs, wastes, scraps and losses, and the over production stocks can be controlled with flexible work stations. Key prefomance index will help the operator monitors the result of the production in one month period.

B. Suggestions

In kanban orders for each line can be applied with e-kanban system, so that it need not require to order the production activity manually sometime causing the kanban card was left in the kanban post. E- kanban system can be printed automatically by period of time for each line printing production when the kanban card come into the production line.

Discipline in delivering kanban card for production process which operators should record line stop process which happpend. This situation should solved quickly so the operator can handle precisely, and then kanban card should not be left behind in the production.

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