DESIGNING ELECTRONIC KANBAN USING CONWIP METHOD TO REDUCE DELAYS ON PYLON ASSEMBLY LINE IN PT. DIRGANTARA INDONESIA

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Abstract— **PT. Dirgantara Indonesia is a company engaged in the manufacture of aircraft. Today, companies face problems to meet demand in a timely manner. The problem occurs because of the lack of parts needed to assemble the required components. This happens due to the delay in getting information about the parts needed and there is no warning about the availability of the parts needed, it makes some parts are not available in store. The lack of the parts and component from the required process causes the assembly line stop running. So that tail boom assembly process will also be delayed. The Incorrect item arrival schedule and unsuitable quantities are a major problem in the airbus tailboom assembly line. To obtain all the components and subassembly that are needed in the right amount and at the right time, this idea of this study is designing the electronic Kanban system which consists of calculating Kanban cards, design the mechanism for using the Kanban System, design the application of Electronic Kanban System and the number of buffer stock so that the required part is available in store. The results of this study are the number of Kanban card which have a number of buffer stocks to control the flow of item required and Electronic Kanban Systems to show the report of actual working status in the assembly line and classify the required information in a card.**

Keywords— *Kanban, E-Kanban, Constant Work In Process, Pull System.*

Abstrak— ***PT. Dirgantara Indonesia adalah perusahaan yang bergerak di bidang pembuatan pesawat terbang. Saat ini, perusahaan menghadapi permasalahan dalam memenuhi permintaan secara tepat waktu. Masalah ini terjadi karena kurangnya part yang diperlukan untuk merakit komponen Pylon. Hal ini terjadi karena keterlambatan dalam mendapatkan informasi part yang dibutuhkan dan tidak ada peringatan mengenai ketersediaan part yang diperlukan, masalah tersebut membuat beberapa part tidak tersedia di gudang. Kurangnya part dan komponen dari proses yang diperlukan menyebabkan jalur perakitan berhenti bekerja. Sehingga proses perakitan tailboom juga akan tertunda. Kesalahan jadwal kedatangan part dan jumlah yang tidak sesuai menjadi masalah utama pada lini perakitan tailboom. Untuk mendapatkan semua komponen dan sub perakitan yang diperlukan dalam jumlah yang tepat dan pada waktu yang tepat, penelitian ini memberikan gagasan untuk merancang sistem***

Kanban elektronik yang terdiri dari menghitung kartu Kanban, mekanisme untuk menggunakan Sistem Kanban, perancangan Sistem Kanban Elektonik dan perhitungan jumlah buffer stock agar part yang dibutuhkan selalu tersedia. Hasil dari penelitian ini adalah jumlah kartu Kanban yang memiliki sejumlah stok penyangga untuk mengontrol aliran barang yang diperlukan dan Sistem Kanban Elektronik untuk menampilkan laporan status kerja aktual di jalur perakitan dan mengklasifikasikan informasi yang diperlukan dalam kartu.

Kata kunci: Kanban, E-Kanban, CONWIP, Sistem Tarik.
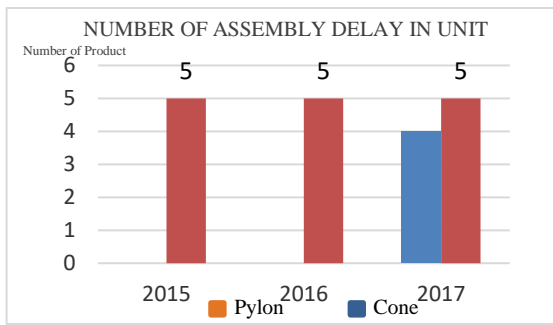
I. INTRODUCTION

PT. Indonesian Aerospace or well known as PTDI is a company that engaged in the manufacture of aircraft. The company competencies are included the design and development of aircraft, the manufacture of aircraft structures, aircraft assembly, and aircraft services. Currently PT Indonesian Aerospace is conducting a tailboom project for MK-II to meet the customer demand. To meet the customer demand, the company must produce different amounts of tail boom each year. However, the company only can meet 48.39% of the average demand.

Table-1 Historical Demand

Year	Demand (Unit)	Fulfill Demand (unit)
2015	4	3
2016	4	3
2017	8	7
2018	15	5

Tail boom is the back side of a plane. It divided into two main parts there are Cone and Pylon. Based on production time data from 2015 to 2018 the company problems are some delay in pylon assembly.

Table-2 Delay Comparison

The delay occurs for several reasons, one of the reason is the incorrect time in order fulfillment so that it causes the lack of part needed on pylon assembly. Pylon assembly consist of skin assy right and left, floor assy lower and floor assy upper. Every subassembly should be ready for final assembly at the right time but in real condition some of components are not ready to be assembled because of the part that is not available to assemble the component. Because there is a delay in getting information about the parts needed and there is no warning about the availability of the parts needed, it makes some parts are not available in store. The lack of the parts and conponent from the required above causes the assembly line stop running. So that tail boom assembly process will also be delayed. Incorrect item arrival schedule and unsuitable quantities are a major problem in the airbus tail boom assembly line.

To obtain all the components and sub assembly that are needed in the right amount and at the right time, the appropriate control system that can be used is Kanban. Kanban is card that contain the product information required for production or assembly at each stage and details of the completion path. By using Kanban, the minimum inventory can be achieved at one time [2].

However, there are some weaknesses while using Kanban card. Information on Kanban card will be recorded manually by operator, this will take operator's time while assembling the product and it takes up a lot of paper to use. Besides that, the results of manual record must be inputed into the system, the delay of inputting the data will hold over the update of the latest information which is integrated by all departments.

From these problems, the electronic Kanban system is designed to tackle the problem. Electronic Kanban (E-Kanban) is a variation of conventional Kanban by converting physical signals into electronics, so it has more accuracy in transmitting information [3]. The Information supplied by electronic Kanban is more efficient and effective compared to conventional systems caused by lead time reduction [4]. For this problem, in this research the Electronic Kanban System will be used to reduce delays in pylon assembly.

II. LITERATURE REVIEW

As explained before, to solve this problem, this research is solved by using Electronic Kanban. Kanban is one of Just In Time (JIT) tools to control assembly line. Kanban is a philosophy to produce goods in accordance with the required amount, as needed, and in the appropriate amount of needs so that it will have a healty flow of goods.[5].

In designing kanban system, there are some rules for implement Kanban System[6]. The rules describe in the following point:

1. Downstream Processes Withdraw Items from Upstream Processes Rule.
2. Upstream Processes Produce Only What Was Withdrawn
3. Send Only 100 Percent Defect-Free Products
4. Establish Level Production
5. Workshop Indicator
6. Use Kanban to Discover Needs for Improvement

While designing kanban card, there are some parameter such

1. safety inventory
   safety inventory or safety unit will be replaced by buffer stock, it is denoted by S.

$$ss = 0.1 \times Numb\ of\ part\ during\ leadtime$$

2. Number of Kanban Card
   According to Optimal Method for Changing the Number of Kanban In E-Kanban System and It's Applications (Kotani, 2007), the calculation of Kanban cards is denoted by N symbol

$$N = \frac{D \times a \times \left(\frac{c+1}{b}\right) + S}{M}$$

In order to calculate the number of kanban, several notations are used:

N = Number of Kanban

D = Demand

M = Capacity box or MHE

S = Safety stock

a = product must be sent every a days.

b = product must be sent in b times

c = must be delivered ib c delivery times

III. METHODOLOGY

The study is started by designing kanban system. The design starts with calculating the safety stock of each component, then calculating the number of kanban based on the safety stock in each component. In designing electronic kanban, there are

several steps that must be done such as designing the kanban system, calculating the number of kanban and designing application using zend framework. While calculate the number of kanban card, the appropriate method that is used is CONWIP. It can solve many cases because the backlog allows explicit control over which parts are produced and in which sequence [5].

After that, electronic system engineering began. The electronic system is an application that is inputted by the assembly line. The application will be a status report on the assembly line.
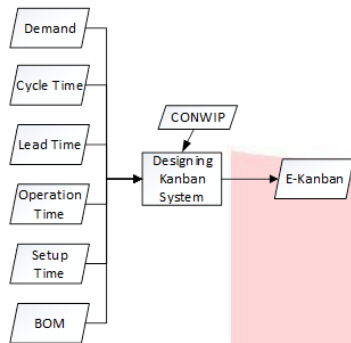

Figure-1 Delay Comparison

The method used in designing this kanban system is CONWIP or Constant Work in Process. CONWIP is a method that is described as the cards which is traverse entire production line [5]. It assumes that parts are moved in standard containers which have the same amount of work that makes the total process time for each container is approximately the same.

IV. RESULT AND DISCUSSION

A. Number of Kanban

In Kanban system that have been designed, the card is placed on the sub assembly store and assembly line. At sub assembly store area, the card is used to set the flow of part processes to be sorted according to work package per component, then it sent to assembly line area. When the part has been sent, sub assembly store send information to the fabrication so that the fabrication can immediately send parts according to the required components. In assembly line, the card flows in each sub assembly and main assembly that will be assembled to pylon assembly process. If the withdrawal card on the pylon is already hung then main sub assembly have to immediately send to pylon assembly. The impact of this system makes assembly flow will be more stable because the material is arranged according to the lead time of each component so the delay will also reduce.

Table -3 The number of Kanban Card

No	Component No	Buffer Stock	Number of Kanban
1	332A2407460002	1	2
2	332A2407470002	1	7
3	332A2406292001	1	3
4	332A2405710002	1	2
5	332A2407400001	1	2
6	332A2407420001	1	2
7	332A2407450002	1	6
8	332A2400311203	2	16
9	332A2406192201	1	3
10	332A2407440002	1	6
11	332A2405410202	1	3
12	332A240540AP01	1	2
13	332A2407430002	1	2
14	332A2407460002	1	2
15	332A2405610101	1	2
16	332A2405620101	1	2
17	332A2405630202	1	2
18	332A2405240002	1	2
19	332A2405752002	1	2
20	332A2407410001	1	3
21	332A2405752202	1	3

B. *Kanban System Mechanism*

The information flow is obtained from assembly line area that must assemble the product according to consumer demand. In Assembly line area, the card is used to control pylon assembly from the work package sent by the sub assembly store until it is processed into final product. The card in tailboom station will be used to collect main. When the red card has been hung in pylon, it must send the pylon immediately to WS where tailboom is assembled. If the process has completed and the card is hung on the post Kanban, then the sub assembly store must send a work package immediately to assembly line.
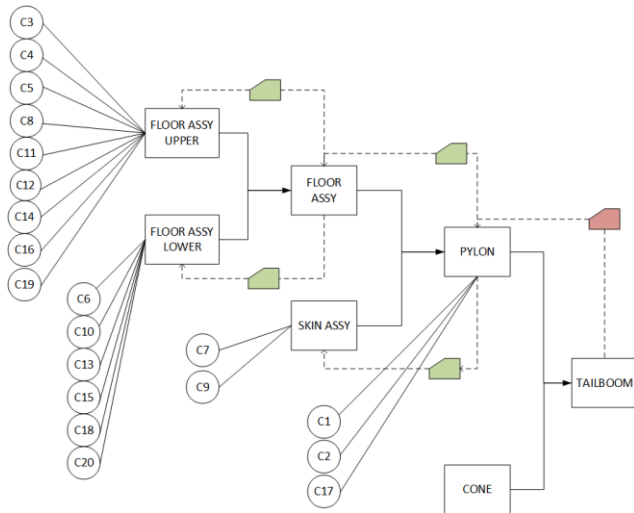

Figure-2 Kanban System Mechanism

When sub assembly store receives information to send theproduct to assembly line, the card will be used as a command to change the part into work package so that work package can be sent to the assembly line areaKanban System Mechanism

Table-1 Advantages and Weakness of Kanban System Mechanism

		Advantages	Weakness
Kanban Card	1	Kanban card provides the information needed about the component that will be produced	The card has the possibility to be damaged so that it must be checked before the process runs
	2	Every card has a barcode that will make the entry data processs easier	
	3	The scanned barcode will show the working status on monitor	

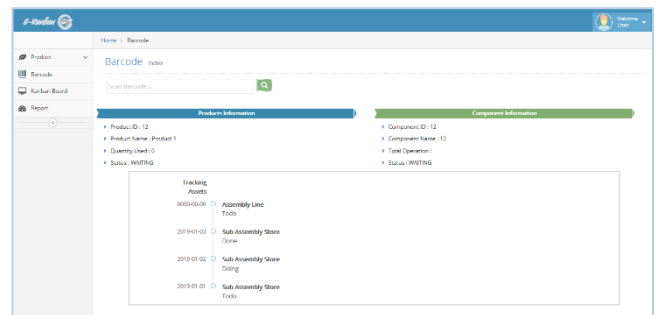| Amount of Kanban Card	1	The amount of cards has been adjusted on pylon assembly line	
	2	The number of cards is an input to set the replenishment schedule so there will be no shortage of parts to be assembled	
Mechanism for using kanban	1	Display status of work on monitor so that the problem can easily detected	The operator must understand the mechanism for using Kanban system and get to use as a habit so that the data will be recorded well and display the appropriate data
	2	Reports are recorded directly in the application	
	3	Give a trigger of goods withdrawal and availability	

C. *Interface*

Figure-3 Scan Barcode Interface

Barcode Menu is a location to detect barcode ID. The output of the barcode scanner will be read on the barcode form. Click the search button on this page then the barcode will show the status about the product details. In the same time, when search button is clicked then the information will be processed to the Kanban board tab.
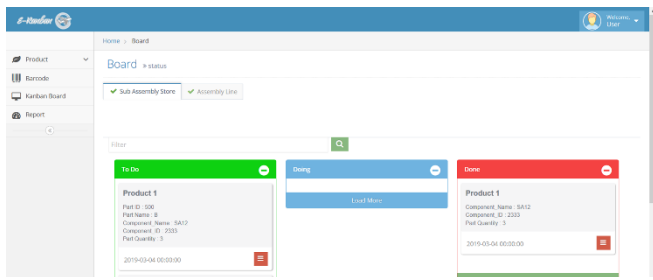
Figure 4 Kanban Board Interface

The Kanban board tab is one of User Interface that will show the working status of the current process. There are three status on Kanban board, To Do, Doing and Done. To Do is a list of items that will be processed, Doing is an ongoing process and Done is a status for the product that has been completed. Kanban Board status can be seen based on the area where the Kanban card is placed, the area is located in the Sub Assembly Store and Assembly Line.

V. CONCLUSION

The result of this research is an electronic Kanban system that is able to control production flow with a buffer so that there is no line stop in assembly line. This is caused by a reduction in delay. The expected delays can be reduced up to 17%. The reduction of leadtime occurs due to card information that indicates the availability of goods needed. If the card is already in post Kanban, then the required components must be sent immediately. Furthermore, there is also information on the system where the system will trigger the supplier to sends the needed items immediately. When deliver the parts, safety stock is also delivered to maintain assembly needs, so that after the stock reaches the minimum point, the part or component needed must be delivered to replenish the stock. It will have an impact in terms of part delivery in the right amount at the right time.

In addition, the design of the electronic Kanban system will improve the accuration compared to the use of manual systems. The accuracy is includes of a process tracking display, status of the amount of items available and items needed, and the status of goods and the report of the entire component. While designing Electronic Kanban system, there are several things that must be present such as Kanban Card, and E-Kanban application. However, to implement this system, the facilies needed are Barcode Scanner, Monitor, and Personal Computer.

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