

DESIGN OF ORDER RELEASE MONITORING SYSTEM USING AUTOMATIC DATA CAPTURE BARCODE BASED TO IMPROVE THE ACCURACY OF DATA AND THE RESPONSE OF PROBLEMS AT MACHINING MPM INDONESIAN AEROSPACE .LTD

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Abstrak

Indonesian Aerospace. Ltd is one of the manufacturing company in Indonesia which is engaged in the manufacture of aircraft design, development and manufacture of civil and military aircraft. The execution order process of aircraft components at MPM Machining Department Indonesian Aerospace. Ltd start after production planning activity. There are problems that occur at the shop floor that causes the delivery order delays. The response to the problems at the shop floor is often come late so that incidents delays of delivery order is frequently occur. During this time, data of status order in the company is not accurate because the data retrieval process is done manually. In this research is designed a improvement system with visual management approach that supported by an integrated system barcode based to improve the accuracy of the data and the response to the problems that occur in the shop floor. The improvement system is designed with AIDC infrastructure, data needed as input, and process improvement. The infrastructure needed consist of barcode as tools of AIDC technology, computer devices, integrated network connection, LCD monitor, and integrated database system. The data needed consist of JID, employee id, machine, completion status, and problem status. The process improvement to support this system are process of order execution and process of reporting problem.

Kata Kunci : Visual Management, Order release, AIDC, Monitoring, Barcode, Andon

Abstract

Indonesian Aerospace. Ltd is one of the manufacturing company in Indonesia which is engaged in the manufacture of aircraft design, development and manufacture of civil and military aircraft. The execution order process of aircraft components at MPM Machining Department Indonesian Aerospace. Ltd start after production planning activity. There are problems that occur at the shop floor that causes the delivery order delays. The response to the problems at the shop floor is often come late so that incidents delays of delivery order is frequently occur. During this time, data of status order in the company is not accurate because the data retrieval process is done manually. In this research is designed a improvement system with visual management approach that supported by an integrated system barcode based to improve the accuracy of the data and the response to the problems that occur in the shop floor. The improvement system is designed with AIDC infrastructure, data needed as input, and process improvement. The infrastructure needed consist of barcode as tools of AIDC technology, computer devices, integrated network connection, LCD monitor, and integrated database system. The data needed consist of JID, employee id, machine, completion status, and problem status. The process improvement to support this system are process of order execution and process of reporting problem.

Keywords : Visual Management, Order release, AIDC, Monitoring, Barcode, Andon

LIST OF TERMINOLOGY

- Order : Ordering product.
- Due-date : The date on which something falls due, especially the delivery of order
- Part : Part of a product.
- Tools : A device or implement used to carry out a particular function or for industrial production
- Raw material : The basic material from which a product is made.
- Machining : Process for industrial production by using machine.
- Pre operation : Tooling hole process for hanger part on fixture.
- Roughing : Cutting operation or shaping to achieve final dimension.
- Main Operation: Main operation of material cutting fit to form of part.
- Simulator : A device to perform simulation
- Sequencing Job : Sequencing production on machines accordance to the priority
- Rescheduling : Perform scheduling again.
- Monitoring : Activity to monitor and measure performance of the process.
- Barcode : A set of readable barcode by machine or device.
- Database : A structured set of data held in a computer, especially one that is accessible in various ways.
- Interface : A media or program enabling a user to interact and communicate with computer.
- Andon : Visualization.

Chapter I Introduction

I.1 Background

Indonesian Aerospace .Ltd (PT. DI) is one of the manufacturing company in Indonesia which is engaged in the manufacture of aircraft design, development and manufacturer of civil and military aircraft. Indonesian Aerospace .Ltd often called as PT. Dirgantara Indonesia has several production sections, such as logistics, machining, surface treatment and quality control. (Indonesian Aerospace, 2013)

Each part of the production process has a different activity. The production process starting from pre-cutting processes, pre-operation, operation until the final inspection as shown on Figure I.1. The machining process is the main process in the manufacturing process of raw materials into airplanes parts.

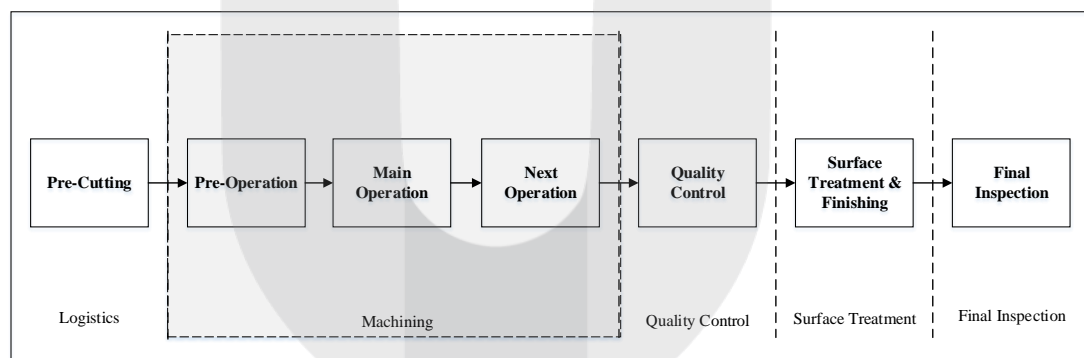


Figure I. 1 Production Process Flow
(Documentation of machining, Indonesian Aerospace .Ltd, 2013)

In this machining part, the production process is transforming raw material into parts due to the prescribed order. Machining process is done by using CNC machines (Computer Numerical Control). The machines are grouped into three divisions based on the dimensions of products and the processes on its path, there are Small Perismatic Machines (SPM), Medium Perismatic Machines (MPM) and Large Perismatic Machines (LPM).

There are problems in the production process at the Machining section, one of the problems is delaying of parts delivery. Figure I.2 shown the delivery parts in Machining section on February 3 to 17, 2014.

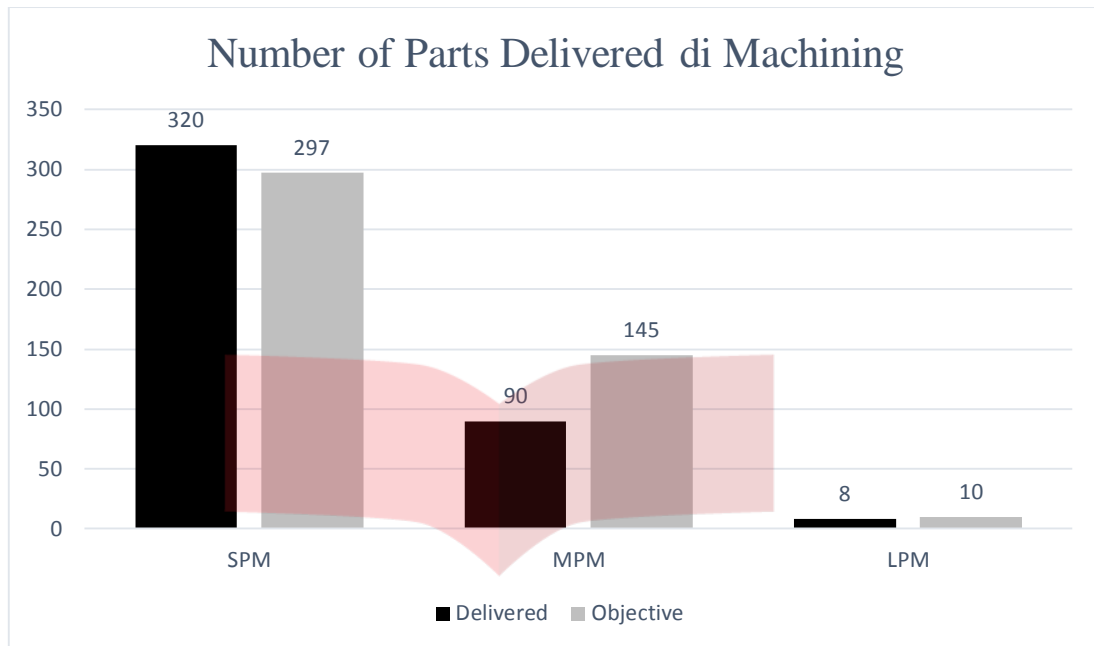


Figure I. 2 Delivered Parts in Machining Section
(Documentation of machining, Indonesian Aerospace .Ltd, February 2014)

Based on Figure I.2, there still order that has not reach delivery targets yet. Each division on the machining has different order completion target. The division that has not reach yet the target delivery yet are MPM and LPM divisions. MPM division has been successfully sent 90 parts while delivery target is equal to 145, thus the performance of the delivery orders in MPM division are late 55 parts or only achive 62% of the target. Furthermore, LPM division has work out at 8 parts of order while the delivery targets is 10, it means that the performance of orders delivery in LPM division is late 2 parts or just managed to achive 80% of the target. While delivery performance parts in SPM division exceeds the pre-determined targets, it means that in order completion, SPM division does not have a delaying problem. Therefore, there are some division in machining that still have delaying problem, they are MPM and LPM, while the SPM division does not have a delaying problem.

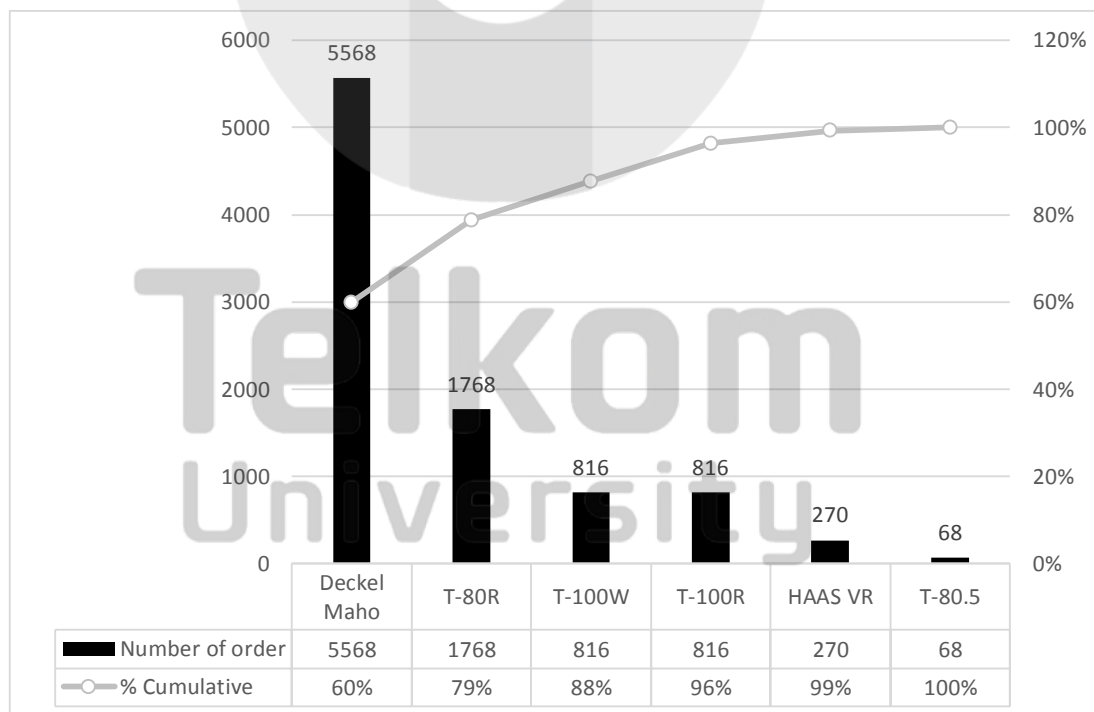
The delaying problem that occurs in one of the machining division is MPM division which had already occurred for almost along 2013.

Based on the work program of order, each division has different number of order it can be seen in Table I.1 below.

**Table I. 1 Number of order execution in LPM and MPM in 2013
(Documentation of Machining, PT.DI, 2013)**

Division	Program	Number of Order	Total
LPM	CN235	110	2037
	Airbus	1924	
	C212	3	
MPM	CN 235	827	9894
	Airbus	8976	
	CN212	50	
	MK-II	27	
	CN295	14	

Table I.1 shows that the number of orders completion in MPM division is much bigger than the LPM division. There are 9894 pieces of orders is done by MPM division along 2013, while LPM has done as many as 2,037 orders. Based on program, the order that has been done consists of CN235, Airbus, CN212, MK-II, and CN295 program. The highest orders is Airbus program. Thus, in MPM which is one of division in machining has huge and repetitive work load. The orders number of the Airbus program in MPM is equal to 8976 and these orders are charged into machines as shown on Figure I.4 below.



**Figure I. 3 Airbus Order Number in Main Operation Machine MPM in 2013
(Evaluation Data of MPM PT. DI, 2013)**

MPM division is like cells so the orders that entering MPM will be done by passing several processes and machines. In 2013, Indonesian Aerospace .Ltd MPM has 20 machines. The process' and machine's name can be seen on Table I.2

**Table I. 2 MPM Machines and Process
(Indonesian Aerospace, 2013)**

Process	Machines
Pre-operation	4VS, 5VS, 6VAT, Liecthy
Roughing	6VAT, YD800, YD1225, BMC 100 W
Main operation	BMC 63, BMC 80 R, BMC 100R, BMC 80.5, BMC 100.5, BMC 100.5E, Drop & Rhein, Deckel Maho

Those machines will be used in due to instructions from the orders made by planner in the process sheet. Process sheet is a document in a shape form that contains informations about production activities such as operation procedures of machining, machinery, tools, routing, and start and finish time schedule of each order. However, there are many problems occurred in shop floor when orders are being executed that led disrupted to the production activity so affect mess execution and delivery plan that have been made by the planner.

Problems that occur on the shop floor can be seen on Table I.3. Based on Table I.3 shows that despite the release order system planning is done properly, there is no guarantee that the execution of the order on the field is also running as it should.

Problems often occur on the shop floor, it can be caused by operator and not operator error such as incorrect routing and machine errors as shown on Table I.3. Errors may be caused by missed information received by the operator, such as the routing errors on T100-R engines are supposed to 100R, but actual instead to the 1005-E. One of errors on Table I.3 can also be caused by the actual information in the field is not delivered in real-time to the party that has the responsibility for handling those problems so that the problems will easily known as a problem in the engine 6VAT, DR-2, MPM , and DM-1 & 2.

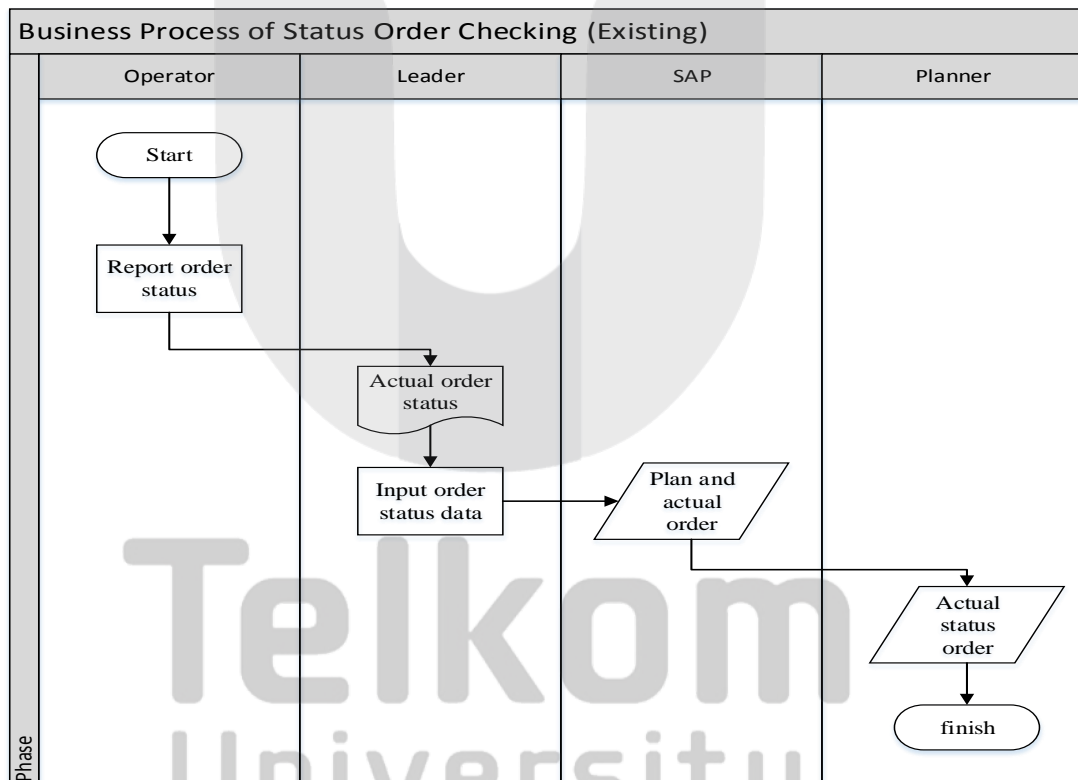
Currently, Indonesian Aerospace .Ltd is not having a monitoring system that can giving an early warning or notice automatically if there is abnormal condition or a discrepancy with the actual operation that was planned by the planner. Thus, the events

like incorrect routing that happened on machine T100-R on Table I.3 is not easy to handle and avoided. Beside that, information delivery systems is lack of delivered in real time and it done manually. It is very important to handle the delaying problem that caused many problems. One of the problems is overload, for example if the overload information or actual delivery time information is too late to be delivered to the planner, then, it can be handled quickly because the planner can do some actions to handle such as splitting or reschedule.

Table I. 3 Production Process Incompatibility Problems in the Shop Floor
(Indonesian Aerospace Document, 2010 – 2011)

No	Machines	Part Number	Problem
1	T100-R	L574-51445-20001	Routing supposed to 100R, but the actual to the 1005-E
2	6VAT	35-62204-0101	Process orders delayed due to the location physical part was not found
4	T100-W	D5744368220401/501	T63 is damaged, moved to T100-W, overload. HF NCOD.
5	DR-2	D5744368220401/501	Overload T100-W moved to DR-2. HF NCPR.
6	T100-5E	L5745162220101	Overload T80-T100-5 moved to 5E. HF NCP.
7		L5745162320001	
8		L5745162320101	
9		L5745162420001	
10		L5745162620001	
11		L5745162620101	
12		L5745162820101	
13		L5745162920001	
14		L5745162920101	
15	MPM	WIP	WIP parts that has entered the garage and has not been scheduled in the load plan was transferred to another place.
16	DM-1 & 2	332A21107373/74	DM over-load, transfer to another machine.

Up to now, the order status reporting at the Indonesian Aerospace .Ltd MPM which to monitor the performance of the work order is still not real time. Checking the actual order status still passed a long process. Based on Figure I.5 shows that in the order status checking process, first of all, the operator report the actual order status to the leader, in case there is delivery or processing orders which is delay. After the leader receives reports of delay, then the leader needs to input order status actual data into SAP (system). After updating the actual order status data, the planner can determine the actual status condition from SAP. Thus, current status information in the field will easily come late to the planner. In addition, up to now the reporting was done traditionally (manually) through periodic SQCDP evaluation meeting every work day. The results of these evaluations are reported on a SQCDP panel. SQCDP evaluation meeting schedule can be seen on Table I.4.



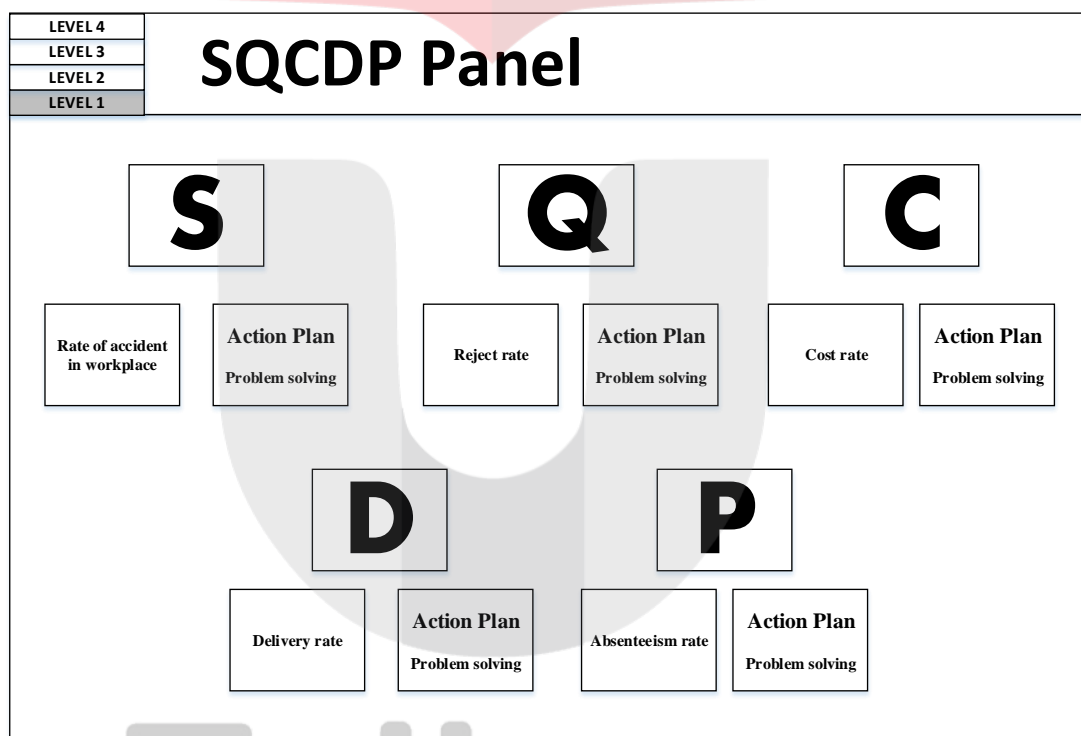
**Figure I. 4 Business Process of Status Order Existing MPM
(Documentation of Machining, Indonesian Aerospace .Ltd, 2013)**

SQCDP panels which can be seen on Figure I.5 is a KPI that shows the performance of the Safety, Quality, Cost, Delivery, and People. Safety panel shows the incidence rate of accidents at work. Quality panel shows the reject rate of the product. Cost panel shows the level of the actual cost and the objectives that have been set.

**Table I. 4 SQCDP Evaluation Conducted Periodically In Every Work Day
(Documentation of PT.Dirgantara Indonesia, 2013)**

SQCDP Level	Scope	Meeting guide	Schedule
1	Work Center	Leader	07.45 - 07.55
2	MPM Group	Supervisor	08.00 - 08.15
3	Machining Group	Manager	08.30 - 08.45

Delivery panel shows the performance of successful delivery of parts shipped. And the People panel shows the employee absenteeism level. The evaluation is done by conducting regular meetings every work day.



**Figure I. 5 SQCDP Panel as KPI in Machining
(Documentation of Machining PT.DI, 2014)**

Collecting data manually has many weaknesses, such as: low efficiency and the error probability is very high (Wang, 2012). Inaccuracies order status on the system caused by the way of data capture is not going well. Entry-data is manually done based on recapitulation data of the work order form that has been done. So it feared that order status information in the system does not describe the actual status on the shop floor.

Indonesian Aerospace .Ltd needs to design an improvement to the existing monitoring system. Improvement can be done by changing the data capture procedures (data collection) in the monitoring system and also equip this system with a visualization of

data so that information on the system will be easily to be processed and delivered in real time.

The generated output from this research is a simulator design for application monitoring system. Systems are designed using the data capture process automatically along with data visualization order status. Thus, the order status become more a real time and accurately, so that the information can be processed by Production Planning and Production Control in order to the problems that cause delays in order completion delays is not happened again.

I.2 Problems Formulation

Problem formulation in this research such as follows:

1. How to design a data capture system of release order to improve the accuracy of data on the machining order MPM at Indonesian Aerospace. Ltd?
2. What kind of display and warning system that appropriate to monitoring and providing order status performance information to the planner so the planner always know the actual information in real time on the machining MPM at Indonesian Aerospace. Ltd?

I.3 Research Objectives

Based on the above problem formulation, can be seen the purpose of this study are as follows:

1. Designing an appropriate monitoring system model to improve the accuracy of the order at the MPM Indonesian Aerospace. Ltd.
2. Designing a problem notification system which come up in shop floor related to the production process in Indonesian Aerospace's MPM in order to press down the delaying of problem handling.

I.4 Problems Boundaries

The boundary problems in this study are as follows:

1. The study was conducted in the aerostructure area of machining at Indonesian Aerospace's MPM.
2. The used order data is the order release data of Airbus program which done on February 3 - February 14, 2014 on the shop floor machining at MPM Indonesian Aerospace.
3. The used machine on the main operation as a research object is the Deckel Maho machine.
4. Routing activity is started from pre-cutting processes to quality control.
5. Problem handling that concerned in this research are machine, tools, and program.
6. Cost analysis is not discussed.
7. The output of this research is a simulator system.

I.5 Research Benefits

The expected benefits of this research are as follows:

1. As proposed for machining MPM Indonesian Aerospace. Ltd in order to improve the level of data accuracy.
2. As proposed for Production Planning and Control at Indonesian Aerospace. Ltd to improve emergency response system in dealing problems that often occurs on the shop floor.

I.6 Writting Systematics

Stages for this study described the systematic writing as follows:

Chapter I Introduction

This chapter described about the research background, problem formulation, research objectives, research limitations, the benefits of research, and writting systematics.

Chapter II Literature Review

This chapter contains the literature relevant to the study and also discussed the results of previous studies. The study of theory is a method of execution used in this study consist of the Production Activity Control (PAC), Computer Integrated Manufacturing (CIM), monitor, jidoka, andon, BPI, and barcode.

Chapter III Research Methodology

In Chapter III described the steps in detail the research include: stages of formulating research problems, data collection, data processing and an application to be a simulator for monitoring system and andon.

Chapter IV System Design

Chapter IV contains the data collection and processing from the company. This chapter describes the design of the monitoring system, the andon proposed as an improvement of the existing system, and design of improvement process.

Chapter V Analysis

This chapter described the analysis of the proposed system in Chapter IV. The analysis includes the analysis of existing systems, activity and streamlining analysis, the advantages and weaknesses of the proposed system analysis.

Chapter VI Conclusions and Recommendations

This chapter explained the conclusions as a result of research. Moreover, it also explain the continuation and improvement suggestions from the system.

Chapter VI Conclusion and Suggestion

VI.1 Conclusion

Based on the research results of the monitoring system design and analysis, there are some conclusions such as follows:

1. The problem of data accuracy that caused by manual data capture process can be solved by using the technology of automatic identification and data capture infrastructure equipped by input data needed. Based on efficiency, effectiveness, and performance aspects of AIDC technology, it is concluded that barcode technology is the right solution to replace manual data capture process to fulfil the company's current needs. The infrastructure consists of
 - a. Barcode as tools of AIDC technology
 - b. Computer devices
 - c. Integrated network connection
 - d. LCD monitors
 - e. Integrated database system

The input data to perform this system consists of:

- a. Data of JID (work order)
 - b. Data of employee id
 - c. Data of machine
 - d. Data of completion status
 - e. Data of problem status
2. The problem of warning and display system that caused information comes late to the production control can be solved by using an integrated monitoring system that supported with andon system and improvement of business process. The monitoring system is able to detect delaying and problems that occur on the production floor in real time so that the planner able to find out the actual information quickly and handle immediately. The monitoring system design and andon need to be integrated with:
 - a. Production control (to handle rescheduling)
 - b. Maintenance (to handle machine problems)
 - c. Tooling (to handle tools problem)
 - d. NC Programming (to handle programs problem)

Features of monitoring system needed consists of:

- a. Delaying and time completion detection
- b. Problem or abnormality detection that supported by color indicator
- c. Audio warning signal to deliver handling problem

Process improvement to support this system is operator should be permitted to input order completion and problem status directly to the system. Meanwhile, supervisory control done by monitoring and manually checking by the leader using genichi genbutsu principle. Business process improvement to support this system are:

- a. process of order execution
- b. process of reporting problem

VI.2 Suggestion

VI.2.1 Suggestion For Indonesian Aerospace .Ltd

1. Required feasibility study comprehensively if the proposed system is implemented in the company to handle a larger scope.
2. The suggestion system should be supported by well-trained human resources and high awareness level of discipline. All production team member have to understand well the standard condition so they able to detect abnormality and deviation.
3. Required the work culture that appreciate problem detection as a part of learning process to learning organization so that the operators are motivated to report the problem. Because according to Liker (2008) that the system will not goes better if staff who perform the job fail to report the problem. By that way, the implementation of this system can be performed ideally.

VI.2.2 Suggestion For Further Research(es)

1. The programming design should use the latest standard programming technology to keep pace with the current era and the demands of the industry today and the future.
2. The system should be supported by the decision makers to assist the planner automatically perform rescheduling if there are problems that cause delays in delivery.
3. The system should be integrated with all stakeholders in the shop floor, especially with all the parties who are responsible for handling problems of production so as to suppress the occurrence of late response to handling problem.
4. The Problems warning system that occur in the shop floor should be developed using visual and audio signals which are more dynamic and more easily understood by all relevant parties so the problem can be handled by the right

- party immediately. Each problem has different audio warning signal to make more easily knew by responsible parties.
5. Do analysis of user acceptance and user acceptance testing more comprehensively to make the system of application more ready and easily used by the end user (operator in shop floor). Security and validity aspect of the application is also need to be considered comprehensively, one of validity aspect to be added in this application is need confirmation process(es) to verify the input data which will be submitted by user. That thing has purpose to avoid error submit or incorrect data input to the system.
 6. Considered the suggestion from Ir.Yustiono D.A. MT. concerned about the existing work culture in the company, the system should force the problem handler to solve the problem(s) immediately. The application system of hold menu (to alert problems) especially to nc programmer, maintenance, and tooling division should be activated by operator in shop floor. The alert noise should be located in the whole workplace so every stakeholder will force the problems to be solved immediately.
 7. The application system need add help tool feature. That feature purposed to educate the user since early before they use the application system. The feature consist of brief description of menu(s) and the procedure(s) to use the application system.
 8. Develop andon system which use wireless button (like a remote control) for the team leader(s) that will alert work place if there is any abnormal condition. Wireless button andon has advantage in security aspect because of it's mobility makes the team leader can use it anywhere (in certain scope and distance) with a remote control to trigger the andon (followed by visual and audio warning signal) in workplace. This suggestion purposed to support genchi genbutsu activity in finding out the problem(s) by team leader.
 9. Do cost analysis related to the implementation of the system in order to obtain the results of the study more comprehensively.

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