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Lean Manufacturing Analysis to Reduce Delays in the Inflight Entertainment Service before Departure Check-in Process

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ABSTRACT

The full service concept is a flight that prioritizes full service to passengers in terms of comfort to safety, quality consumption services, inflight entertainment, baggage capacity, and other services. GA airlines implement a full service service that prioritizes its customers fully. PT. Aero Indonesia is required and demanded to always be optimally effective and efficient in performing maintenance on GA airlines which have entrusted the maintenance of its aircraft fleet to PT. Aero Indonesia especially in inflight entertainment maintenance. In the inflight entertainment maintenance process at the time of the plane before departure, there is still a first departure delay caused by the inflight entertainment device that requires repair time, causing losses for the airline who must provide compensation. In this study, the Define-Mesure-Analyze-Improve-Control (DMAIC) and Failure Mode and Effects Analysis (FMEA) methods will be used to improve the before departure check process in the cabin maintenance services work unit at PT. The results of this study are expected to be able to provide suggestions regarding delay reduction so that the repair time will be more effective and efficient

Key Words: FMEA, Lean Manufacturing, Six Sigma.

1. INTRODUCTION

The growth of the aviation industry in Indonesia is increasing every year which can lead to business competition in order to get a bigger market share. Law No. 15 of 1992 concerning Aviation which was replaced by Law Number 1 of 2009 concerning Aviation is one of the milestones in the deregulation of the aviation business in Indonesia. These laws and regulations spur the growth and increase in the number of airline service companies that are members of the International Air Transport Association (IATA).

Currently, flight service providers in fulfilling customer satisfaction while on board the aircraft have 2 categories of services provided, namely full service and low service. Low cost carrier (LCC) is a concept flight with low cost and limited service. The full service concept is a flight that prioritizes full service to passengers both in terms of comfort to safety, quality consumption services, inflight entertainment, baggage capacity, and other services that are not available on airlines with low cost carrier (LCC) concepts. In other words, full service has many additional services which are added values from the main service offered [1-14].

Service quality is a very important priority for companies who want to see the difference in their services to their competitors in a competitive and tight environment [15-18]. Therefore, quality control is carried out from the concept of service to the process of activities in the service in accordance with predetermined standards. The consumer's desire in essence is to get satisfaction with the services they buy. If consumers are faced with several choices with relatively almost the same price, the product that has the same quality is chosen. Quality control that is carried out properly will make the company get a good quality impact within the company. However, even though service activities have been carried out properly, errors are still found in the service where the quality of service is not in accordance with the standards that have been set.

Lean six sigma is a management concept that combines the methods of lean and six sigma. With lean six sigma companies can get the speed that lean has and the quality that six sigma has [19-24]. In [25] states, improving company performance can be done with lean six sigma organization development (LSSOD), namely how organization development (OD) discusses the right culture and leadership style aimed at obtaining significant organizational improvements and changes by applying lean methods and using statistics. in six sigma with the DMAIC stage aims to improve and change the organization to be more successful. Meanwhile, Failure Mode and Effects Analysis (FMEA) is a technique used to locate, identify, and eliminate potential failures, errors, and known problems of systems, designs, processes, or services before they reach the consumer. The purpose of FMEA is to determine the level of risk of each type of failure so that a decision can be made whether an action needs to be taken or not [26].

GA airlines implement a full service service that prioritizes its customers in full. This airline company implements a service concept called GA Experience. GA equips the entire new fleet with state-of-the-art in-cab interiors featuring individual touch-screen LCDs across executive and economy classes. In addition, passengers are also pampered with audio and video on demand (AVOD), an entertainment system that offers a wide selection of movie or song menus, according to each passenger's choice.

Figure 1. Inflight Entertainment EFX Series B737-800NG

Currently, GA has a subsidiary to handle the maintenance and maintenance of its aircraft to PT Aero Indonesia. PT Aero Indonesia has been recognized as a world-class Maintenance Repair Overhaul (MRO) which has a certificate from the FAA and EASA which is able to maintain and maintain the condition of the aircraft. Along with the

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development of technology and to fulfill the airline program, GA became one of the best airlines and achieved the Sky Track program.

The cabin maintenance services service is one part of PT Aero Indonesia which is responsible for maintaining aircraft, especially the cabin area. Handling inflight entertainment contributes to the first departure delay which causes losses for consumers. GA airline has set an on-time performance target of 95% as the standard for punctuality performance in its flight operations for 2020. On time performance is also important in the world of aviation. The timing of the flight schedule must be in accordance with the realization of the departure time. Timeliness of flights will give passengers confidence and increase the competitiveness of airlines. The higher the level of timeliness or On Time Performance (OTP), the higher the level of professionalism and responsibility of the airline company [27-29]. The management of the cabin maintenance service wants zero delay for every before departure check that is carried out. Cabin handling delay data before the monthly departure check for the first departure GA aircraft at Soekarno-Hatta airport January 2021 - December 2021.

Table 1. Inflight Entertainment EFX Series B737-800NG delay data for the period January 2021 – December 2021

No	Month	Total Flights	Total Delay
1	January	1050	2
2	February	1055	2
3	March	1010	1
4	April	1060	2
5	May	1054	3
6	June	1055	3
7	July	1051	5
8	August	1045	3
9	September	1048	4
10	October	1055	3
11	November	1055	2
12	December	1050	2
Total		**12588**	**32**

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Table 2. Types of Causes of Delay and Total Causes of Delay for the period January 2021 – December 2021

No	Types of Causes of Delay	Total
1	Crew Panel Failure	7
2	System Controller Failure	20
3	File Server Failure	2
4	VSEB Failure	3

In table 1 is the total flight data and total delay in the period January 2021 to December 2021. In table 2 are the types of causes of delay in inflight entertainment at the time of departure check, namely Crew Panel Failure, System Controller Failure, File Server Failure, and VSEB Failure in the period March 2019 to February 2020. From the results of the study [30-32] with the title of the proposed application of the DMAIC methodology and service blueprint for improving service quality to PT MUTU customer satisfaction, it was found that the application of the Lean Six Sigma method resulted in the results obtained from the application of the DMAIC methodology in This research is to increase the level of sigma from before repairs and after repairs. The sigma level value for the analysis completion time before improvement is 3.94 and after improvement is 4.013. In addition, the results obtained from the company's business side are an increase in company income after the implementation of the DMAIC methodology, by eliminating losses of Rp. 1.000.000,- per month per 1 sample. And the results of the study [33-34] with the title The application of FMEA to reduce defective rate from broken filament defects in the Direct Spin Drawing process, it was found that the application of the FMEA method of defective filament defects decreased from 3.35% to 1.76% .

Therefore we need a way to minimize the delay in inflight entertainment EFX series. In this study, the Define-Measure-Analyze-Improve-Control (DMAIC) and Failure Mode and Effects Analysis (FMEA) methods will be used to improve the before departure check process in the cabin maintenance services work unit at PT. Aero Indonesia.

2. RESEARCH METHOD

Data processing and analysis methods are important stages after collecting data, here are ways to process data by analyzing so that it can produce information:

2.1. Field Observation

Knowing the company by looking at how the delays occurred from the beginning of the aircraft maintenance process until the plane was declared delayed.

2.2. Data Retrieval

The data taken include:

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• Data delay during handling inflight entertainment before departure check at the Cabin Maintenance Service unit at PT. Aero Indonesia March 2019 to February 2020.

• Supporting data such as historical inflight entertainment maintenance from the cabin maintenance log book..

2.3. DMAIC Method (Define, Measure, Analyze, Improve, Control)

a. Define

In the define stage, problem identification is carried out, starting with the definition of each type of delay that occurs in inflight entertainment, then continuing with the determination of CTQ (Critical to Quality) with the aim of knowing the factors that affect the handling of inflight entertainment treatment.

b. Measure

At this stage, the DPMO (Defect per Million Opportunities) value and the sigma value will be determined, and a Pareto diagram will be made to determine the type of cause of the dominating inflight entertainment delay. Furthermore, the DPMO value is converted to the Six Sigma conversion table to determine the sigma level.

c. Analyze

In the analyze stage, the tools used are fishbone diagrams with 4M+1E to find out the causes of delays in the inflight entertainment treatment process. After knowing the cause of the delay in inflight entertainment before departure check based on the fishbone diagram analysis, then proceed to distributing the FMEA (Failure Mode And Effect Analysis) questionnaire to evaluate the priority risks that cause delays in inflight entertainment.

d. Improvement

After the analysis has been carried out, the next stage is improvement using the tools used in the Improve stage, namely FMEA (Failure Mode And Effect Analysis) which functions to find out the problems that function to find out accurately what actions must be taken to overcome existing problems. The purpose of FMEA is to determine the level of risk of each type of failure so that a decision can be made whether an action needs to be taken or not (Hasbullah et al., 2017).

e. Control

The control phase is the phase of controlling process performance and ensuring that delay does not reappear during handling before departure check. This stage is only a proposal to be implemented by the company

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3. RESULT

Results of Analysis With DMAIC and FMEA Methods

The following is a proposed explanation for the delay in the in-flight entertainment process before the departure check at PT. Aero Indonesia using DMAIC (Define, Measure, analyze, Improve, Control) and FMEA (Failure Mode And Effect Analysis):

3.1 Definition (Identification) Stage

At the Define stage there are two tools used, namely CTQ (Critical To Quality). Analysis using CTQ (Critical To Quality) is a characteristic of a product or service that meets consumer needs. The CTQ (Critical To Quality) criteria were obtained based on the results of collecting information from observations based on the cabin maintenance log book and interviews with field engineers related to the causes of delays in the inflight entertainment process before departure check which is the person in charge when there are consumers seeing the in-flight maintenance process before the plane. they are sure to use in-flight entertainment devices on GA and PT airlines. Aero Indonesia as the maintenance party, so that field technicians can find out what consumers want. So that the CTQ criteria are obtained which include:

Table 3. Critical To Quality (CTQ) Inflight Entertainment Failure Check Before Departure

No	CTQ	Information
1	Crew Panel Failure	The Crew Panel device is blank and inoperable
2	System Controller Failure	Major system malfunctions on inflight entertainment devices
3	File Server Failure	Unable to access media content on each smart monitor
4	VSEB Failure	System failure on some smart monitors cannot listen to sound and display images.

3.2 Stage Measure (Measurement)

At the measurement stage in this study, the CTQ (Critical To Quality) criteria have been obtained then will be explained with a Pareto diagram to measure based on the highest level of damage and focus on repairing the most dominant problems. Then proceed with calculating DPMO (Defect Per Million Opportunities), calculating probability (Yield). The following is the result of calculating with Pareto and determining the sigma value:

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3.2.1 Pareto chart

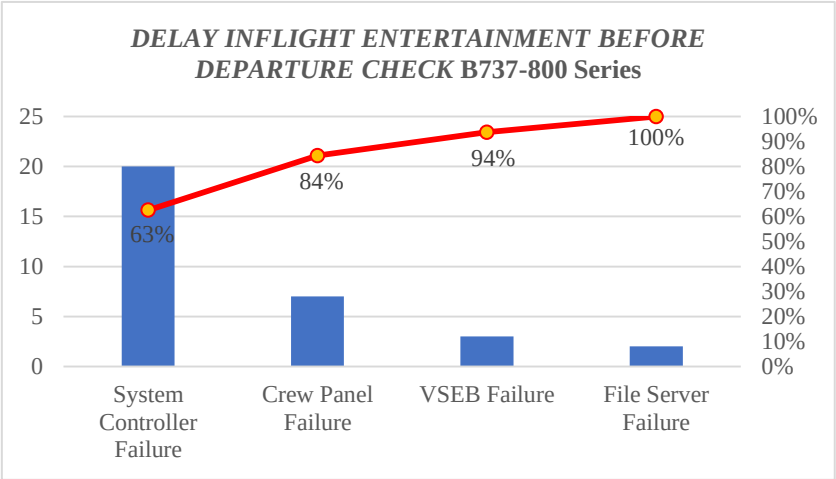

Figure 3. Pareto Chart

Based on the calculation results, it can be seen that the type of delay inflight entertainment before departure check has a percentage of 63% System Controller Failure, 22% Crew Panel Failure, 9% VSEB Failure and 6% File Server Failure. As we know, the philosophy of the Pareto chart is that 80% of problems can be solved by solving 20% of the biggest problems. So that by solving the Sytem Controller Failure problem, 80% of the problems or factors that can cause delays in inflight entertainment before departure check can be resolved.

3.2.2 Sigma Value

Based on the calculations in chapter IV in table 4.5, it can be seen that the average DPMO result or the possibility of the number of defects per one million opportunities in the inflight entertainment process before departure check is 635.526 of the number of flights with a yield value or probability without problems of 99.75%. With an average level of sigma inflight entertainment before departure check at PT. Aero Indonesia based on data before departure and delay inflight entertainment for the period March 2019 - February 2020 is 4.72. Based on the results obtained from the calculation of the sigma level, it can be concluded that the process of inflight entertainment before departure check needs to be continuously improved regarding inflight entertainment maintenance services because it has not reached the target of improving the quality of Six Sigma, namely reaching a Sigma Level of 6 Sigma (6σ).

3.3 Analyze Stage (Analyze)

After the most dominant causes of delay in inflight entertainment before departure check can be identified based on the cumulative percentage level on the Pareto diagram, then the tools used are Fishbone Diagrams to be able to find the causes of delays in inflight entertainment before departure check. Based on the data processing on the fishbone diagram, it can be seen the factors based on 4M+1E (Man, Method, Machine, Material and Environment) which are the cause of the delay in inflight entertainment before departure check at PT. Aero Indonesia, including the following:

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1) Human Factor (Man)

In the human factor, there are factors that cause delays in inflight entertainment after departure check, namely during aircraft checks, there are often delays in arriving to the plane due to unprepared technicians. Technicians who arrive late to the plane result in reduced time to activate the inflight entertainment device so that when the cabin crew arrives, the inflight entertainment device is not ready for use and is at risk of system malfunction during booting which results in system controller faillure, due to the process of checking other devices such as interphone before the boarding time carried out by the cabin crew.

2) Method Factor (Method)

In the method factor, it was found that the distribution of handling time and man power scheduled for inflight entertainment before departure check was less efficient. The schedule is made by the scheduler which is then approved by the supervisor, but the schedule that has been shared with the technician can change the time and location of the aircraft parked according to the GA airline operation decision. This causes the technician to go wrong to the plane that will be handled and risks causing delays in in-flight entertainment before departure check.

3) Factor Machine (Machine)

On the machine factor, it was found that the software on the system controller was corrupt. which causes system controller failure. The malfunction of the system controller on the inflight entertainment device makes the boarding music and video announcement features unable to be displayed and all inflight entertainment devices cannot be used.

4) Material Factor (Material)

On the material factor, it was found that the new system controller component experienced a system malfunction when uploading media as a backup component. Due to the large media size, it is stuck when uploading media.

5) Environmental Factors (Environment)

On environmental factors, it was found that the fan in the system controller component had a malfunction caused by dust in the electronic compartment area so that it could be seen in the system status which resulted in slow damage due to dust in the system controller component so that it was easy to overheat.

Stage Control (Control)

At this stage, namely controlling the control of the proposed improvements or improvements that have been given previously in the improve stage through elaboration using 5W + 1H analysis, namely:

1. Making Standard Operating Procedures (SOP) in the implementation of inflight entertainment before departure check. Standard Operating Procedures (SOPs) are made with the aim of implementing inflight entertainment before departure checks on time and the malfunction of the inflight entertainment device system can be resolved because it has a preparation time that is in accordance with repairs.

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2. Implement preventive maintenance by implementing preventive maintenance on inflight entertainment devices in the form of clean up software level 1 according to the software engineer's recommendation and cleaning the electronic compartment from dust.

3. Perform media updates on the new system controller for inventory. System controller components that have been filled with new media content can be used immediately when the system controller fails, thereby reducing repair time.

4. CONCLUSION

Based on the results of research that has been carried out on the process of inflight entertainment before departure check in the Cabin Maintenance Services unit which is processed and analyzed using DMAIC and FMEA methods. The conclusions obtained from this research are as follows:

1. Based on the results of calculations that have been carried out using Pareto diagrams, it can be seen the types of causes of delay that affect the quality of service at the before departure check unit Cabin Maintenance Services at PT. Aero Indonesia is a System Controller Failure with the largest percentage of 63%, Crew Panel Failure 22%, VSEB Failure 9% and File Server Failure 6%.

2. Based on the analysis conducted using fishbone diagram tools or fishbone diagram, it can be seen the root causes of the delay in the inflight entertainment process before departure check, including: (1) Lack of preparation, (2) Lack of monitoring of the live schedule of operations (3) Software Corrupt, (4) Media content file size is too large, (5) Electronic compartment is dusty.

3. After analyzing using the DMAIC and FMEA methods, the proposed improvements can be given to the Cabin Maintenance Services unit of PT. Aero Indonesia to overcome the system controller faillure problem that occurs is by making Standard Operating Procedures (SOP) in the implementation of inflight entertainment before departure check and implementing preventive maintenance on inflight entertainment devices to reduce software corruption so that inflight entertainment delays before departure check due to system controller failure.

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