Causative factor identification of N212-400 product project delay at PT. Dirgantara Indonesia

A S Pujiaradi* and S Widiyanesti
Universitas Telkom, Bandung, Indonesia

*agungsatriyo359@yahoo.com

Abstract. PT. Dirgantara Indonesia had a delay project for five aircrafts of N212-400 ordered by the Phillipines and Vietnam. This is a qualitative research using a case study approach in the identification of the causative factor of project delay, with the purpose of study using descriptive research and the process data validity and reliability using triangulation method. The data analysis in this research was the productivity of project, potential failure mode of the project using FMEA (Failure Mode and Effect Analysis) and fishbone diagram to determine the cause and effect of the project delay. The result of the productivity during N212-400 project was 40%, and in aerospace industry, this is below its average of 70% - 80%. Using fishbone and FMEA, the cause of delay and the potential failure of delay project N212-400 was identified and the main factor of project delay based on fishbone and FMEA was machine and material process. Both of the key factors had a high score of RPN (Risk Priority Number) at 810 and should be given priority for improvement.

1. Introduction
The aerospace industry in Indonesia has grown rapidly. PT. Dirgantara Indonesia is one of the aerospace industries that produces light aircrafts, remote aircrafts and helicopters. Cooperating with Airbus Group PT. Dirgantara Indonesia began producing multifunction aircrafts [1]. N212-400 is one with high technology. In the case of N212-400 aircraft order aircraft from the Phillipines and Vietnam with the total order of five [1]. During the project of N212-400, it was delayed due to several factors in the project activity [2]. The authors conducting the research at PT. Dirgantara Indonesia had a research purpose to describe the cause factor of delayed project and determine the potential failure of project activity.

Identification of the problem was conducted by the authors from observation and interview. The observation result showed that the delayed project was true, meanwhile the cause factor was a delay in material process delivery or supply chain material [3]. From problem identification, the research was started by analyzing the general problem of the research object on project delay that affected productivity of the firm to decrease [4]. The project of N212-400 was found to be delayed after one year with estimates of delivery target on February 2018 but in real time the delivery was in June 2018. PT. Dirgantara Indonesia as producer of N212-400 took the loss and punishment based on the payment contract [2].

This research used a qualitative one with case study approach to analyze and measure the delay of N212-400 project. The authors conducted the research in cross-sectional research time to make the analysis as fast as possible to give an improvement for the company. In this research, there were two dependent variables namely fishbone or cause-effect diagram and failure mode and effect analysis.
(FMEA) that influenced the independent variable that is productivity. The productivity in this research is a benchmark of the research, that was found before the productivity in PT. Dirgantara Indonesia was below of the average of aerospace industries in the world at 70% - 80%. PT. Dirgantara Indonesia would not be able to compete in the world if their productivity is below average. This research will help PT. Dirgantara Indonesia increase their productivity by using FMEA (Failure Mode and Effect Analysis) to determine the potential failure of project delay and Fishbone or cause-effect diagram for identifying the key factor and root cause of the N212-400 project delay.

2. Method
According to Widianti Total Quality Management or Quality Management is a combination of the company’s function that is incorporated in holistic philosophy that builds up based on a quality concept, productivity concept, and teamwork and customer’s satisfaction [4]. Suarez mentioned three experts of Quality Management. W Edwards Deming had a theory to reach the productivity of quality management by using process improvement “prevention” [5]. Prevention approach is achieved through process analysis, control, and improvement. A process is defined as any set of conditions, or set of causes, that work together to get the result, for product and service have a FMEA (Failure Mode and Effect Analysis) to determine the potential risk that causes the project to be delayed or is a problem. It is usually a blend of machines, methods, materials, and people.

The product or service process have several process evaluation and measurement. The evaluation and measurement of those processes is FMEA (Failure Mode and Effect Analysis) and Fishbone diagram. According to Widianti, fishbone can help in identifying or determining an action and step of improvement. It is easier to do if the problem and the root cause of the problem have been found [4]. The benefits of fishbone diagrams can help us to find the root cause of the problem in a user friendly manner, user tools or preferred by manufacturing industries where various manufacturing processes have variables which have the potential to cause a problem.

The next process is FMEA (Failure Mode and Effect Analysis). According to Widianti, cited from McDermott et al FMEA, FMEA is “a systematic method of identifying and preventing product and process problems before they occur” [4]. Based on the definition given it can be understood that FMEA has the aim of looking at processes and products to determine the possibility of failure that occurs by identifying potential failures. It means the FMEA will determine the potential failure of the project. The measurement of FMEA calculates severity x occurrence x detection. The result of that will become a RPN (Risk Priority Number). A high score of RPN will give the benchmark of priority improvement. Based on Ambekar et al. “FMEA is a systematic process for identifying potential design and process failures before they occur, with the intent to eliminate them or minimize the risk associated with them” FMEA procedures are based on standards in the reliability engineering industry, both military and commercial [6].

Based on Ambekar et., al. Essentially the FMEA is to identify the equipment or subsystem, mode of operation and the equipment, identify potential failure modes and their causes, evaluate the effects on the system of each failure mode, identify measures for eliminating or reducing the risks associated with each failure mode, identify trials and testing necessary to prove the conclusions, provide information to the operators and maintainers so that they understand the capabilities and limitations of the system to achieve the best performance [6]. In this research, the FMEA process was conducted until the RPN (Risk priority Number) was determined. This research used snowball sampling based on the snowball sampling process mentioned by Neuman this research process sampling was taken by sixteen people [7]. The chosen persons were based on the criteria and the snow process that began and suggestion from first source or interview with a respondent code of R1 to R16 as samples. The process of taking snowballs in this study that shows R1 as the source of the interview process, then points to R2 and R3. In R2 and R3 the snowball process spreads to each respondent’s code until the snowball process mentions the project delay data is concrete.
3. Result and discussion
The productivity in PT. Dirgantara Indonesia during the production of N212-400 was found at 40% which was achieved from the calculation in the formula of productivity = Input/Output. Input in this productivity is labor cost, delay cost, material cost and for the output is 5 aircrafts of N212-400. The productivity measurement of project delay is shown below:

\[
Productivity = \frac{370000000000}{(664010300 + (175800000000 \times 5) + 37000000000)}
\]

\[
= 40.1019629 = 40\%
\]

The result of productivity showed that the productivity is 40% which mean that the productivity in PT. Dirgantara Indonesia was below the average of aerospace industry which is 70% - 80%, with delay assumption from force major. From the result of productivity, the authors analyzed causes that made productivity to be below the average by using fishbone and fmea (failure mode and effect analysis).

Improvement for the project at PT. Dirgantara Indonesia especially for N212-400 project would influence the productivity of the project. The authors conducted analysis of the cause factor of project delay in PT. Dirgantara Indonesia by using fishbone diagram with 5M category. The use of 5M category is appropriate with the manufacturing industry. 5M category of fishbone are 1. Machine, 2. Method 3. Manpower, 4. Material and 5. Money. Shown in figure 1 is the fishbone diagram that was analyzed and achieved from the interview to the eight persons in charge of the project at PT. Dirgantara Indonesia.

![Figure 1](image)

**Figure 1.** Diagram that was analyzed and achieved from the interview to the eight persons in charge of the project at PT. Dirgantara Indonesia.

The result of fishbone analysis showed that material and machine have a big factor that gave impact to the project delay in PT. Dirgantara Indonesia. And the result of fishbone will be raised by the authors to become a benchmark of project and evaluation for the future. The measurement and determination of potential failure of project used fmea (Failure mode and effect analysis). The result of fmea process is shown in table 1 that shows the process that has a high risk score for RPN (Risk Priority Number), and the rpn score will become a benchmark of project improvement.
Table 1. Material process.

| Process Step | Potential Failure Modal | Severity | Potential Cause | Occurrence | Current Control | Detection | Initial RPN |
|--------------|-------------------------|----------|-----------------|------------|----------------|-----------|------------|
| Material Process | Processing the Raw Material is Delay | 8 | Raw Material arrived delayed | 9 | Added the external time schedule for delivery material | 10 | 720 |
| | | | | | Re-build the supply chain process and business requirement project rules | 10 | 810 |

Table 2. Machine process.

| Process Step | Potential Failure Modal | Severity | Potential Cause | Occurrence | Current Control | Detection | Initial RPN |
|--------------|-------------------------|----------|-----------------|------------|----------------|-----------|------------|
| Machine Process | Processing the raw material is hampered and effect to installation component process | 9 | Limitation of machine capacity | 10 | Added another machine to help production and held the overtime | 9 | 810 |
| | | | | | Repair and Use again (None) | 8 | 448 |

The result of machine process above sees the limitation of machine making the processing of raw material to be hampered because the raw material and machine are important parts of production. The score of machine process is similar with the material process at 810 for the score of rpn.

4. Conclusion

Based on the research result, the occurrence of delayed project of PT. Dirgantara Indonesia aerospace industry which leads to fines is true. For this research, interview was conducted to collect data with a (PIC) Person in Charge on PT. Dirgantara Indonesia projects especially for N212-400 project, with a purpose to fix and improve the productivity and analyze the causative factor of N212-400 project delay. Based on the research result, the conclusion was obtained below.

The productivity of PT. Dirgantara Indonesia during the project of N212-400 until the project was declared delayed was 40%. This is far from the average percentage of aerospace industries in the world. An aerospace industry must have a productivity of 70%-80%, with delayed assumption of force major.
The decreasing of company productivity caused delayed N212-400 project. By using fishbone diagram the cause-effect of project delay of N212-400 could be seen. The result of fishbone diagram generated the key factor of delayed N212-400 project that was 5M category of fishbone. The problem that was found from fishbone diagram was from the material process which was hampered due to delay in delivery of raw material. Machine process gave the effect into material because the limitation of machine, while the method on fishbone diagram which mentioned the planning and scheduling could not predict unexpected conditions. Man power factor of zero hour labor experience made the delay in processing, and the money caused the purchase of raw material to be hampered because of currency. The result of fishbone diagram will be a benchmark of evaluation process and analysis of N212-400 project by making improvement and can be given priority for improvement in FMEA (Failure Mode and Effect Analysis) process. The result of FMEA shown in material process has potential failure that hampered the raw material process caused by the potential cause, which is delayed delivery of raw material due to road traffic condition, with a calculation to determine RPN (Risk Priority Number) from severity, occurrence and detection of 810. The process of supply chain of raw material is the main problem in delay. One of the causes of supply chain problem is that the raw material has to be imported from other countries. Score of RPN (Risk Priority Number) will become a benchmark that the activity has a big problem and PT. Dirgantara Indonesia must give priority improvement to manage and control the delivery process. The author concluded that in the supply chain process, project planning process should be able to predict the unexpected delay. From the prediction and forecasting of scheduling expected, the supply chain process of raw material can be handled and able to reduce the delay problem in production, giving the result of fishbone and FMEA that has been evaluated by the company and conduct improvement research by analyzing the result of improvement using pareto chart as a measurement of production level and developing the research to become a mass production analysis on N212-400 project series.

References
[1] Dirgantara Indonesia 2016 Growth to Attach Customers and Sky Beyond [Online] Retrieved from: http://www.indonesian-aerospace.co.id/en/annualreport.
[2] Iwan S 2017 Telat kirim pesanan pesawat, PTDI kena denda Rp 222.56 Miliar [Online] Retrieved from: https://bisniskeuangan.kompas.com/read/2017/03/09/130000126/telat.kirim.pesanan.pesawat .ptdi.kena.denda.jp.222.56.miliar.
[3] Saha P K 2016 Aerospace Manufacturing Process (1st ed.). Florida (United States of America: CRC Press.)
[4] Widianti T 2015 Failure Mode and Effect Analysis (FMEA) Sebagai Tindakan Pencegahan Pada Kegagalan Pengujian130-147
[5] Suarez J G 1992 Three Experts on Quality Management: Philip B. Crosby, W. Edwards Deming, Joseph M. Juran (No. TQLO-PUB-92-02) Total Quality Leadership Office Arlington VA.
[6] Ambekar S B, Edlabarkar A and Shroutu V 2008 A review: Implementation of Failure Mode and Effect Analysis Journal of Engineering and Innovative Technology 2(8) 37-41
[7] Neuman W L 2003 The meanings of methodology. Social research methods: Qualitative and quantitative approaches 68-94