Payload Optimization Comparison Of Airbus 330 – 300 And Boeing 777 – 300ER Aircraft

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Abstract. Aircraft analysis is one of the strategy that are applied in the airline industry to be able to compete with other airlines by determining which aircraft is more effective, efficient, and economic. In fact, some airlines cannot apply this strategy. With this analysis, the airline is able to compete. By Seat Load Factor (70%) calculation, estimated weight of seat vacancy can substitute to Cargo Allowable. The result of calculation and comparison will produce the effectiveness aircraft on payload optimization. The result of comparison analysis is able to be concluded that A 330-300 aircraft is the aircraft that can better implement Payload Optimization. The lowest Total Operating Cost in the amount of US 14,042.94.- Dollar compared to the B 777-300ER aircraft that have Total Operating Cost in the amount of US 21,887.06.- Dollar. With a larger Total Operating Cost is owned by B 777-300ER, A 330-300 has a greater profit of US 13,742.62.- Dollar compared to B 777-300ER which has profit of US 13,433.94.- Dollar.

1. Introduction
Along with the improvement of science and technology, it also has an impact on the development of the aviation industry. The improvement of science and technology has an impact on competition in all aspects of life. Also a competition in the aviation industry, an airline needs a strategy to be able to excel in competing. Fleet planning is the strategy that should be applied by the airlines in order to compete with other industry by deciding the correct aircraft to make the operating costs more efficient and effective [1]. In addition, airlines need to achieve their goals by increasing profits and reducing the total operating cost as much as possible. For example, simply knowing that a competitor has a cost advantage is not enough. Strategically, one should find out how much flexibility the competitor has in further reducing its price [2]. One of the main goals of an airline is to match its capacity and demand under prevalent market conditions, which has a direct impact on the increase of an airline's profitability and on the reduction of an airline's costs [3]. Each aircraft has their specification and characteristic, especially if connected with the performance and flying ability. Aircraft performance can calculate how the aircraft can fly efficiently by determining the route.

Taking passenger - kilometers and ton - kilometers as examples, if all the seats in each flight cannot be sold, the passenger - kilometers and ton - kilometers cannot be kept for the next flight. As a result, elevating operating efficiency is an important issue for the airline transportation industry [4]. Aircraft efficiency can be performed with payload optimization, payload optimized on passenger and cargo. Optimization on passenger can be assumed with average Seat Load Factor 70%. Load Factor is the
amount stated density level of aircraft passenger on one trip. And cargo optimization, obtained from passenger seat vacancy which is assumed to substituted into cargo allowable. This analysis uses two types of wide-body aircraft that is A 330 – 300 and B 777 – 300ER assuming international route Jakarta – Haneda. A 330 – 300 can accommodate 440 passengers for economy class and B 777 – 300ER (Extended Rate) can accommodate 550 passengers for economy class. For both single point and multipoint optimization with the objective of maximizing the specific hourly productivity [5].

2. Literature Review

2.1 Fleet Planning
The process of determining the ideal fleet to operate is called fleet planning [6]. Fleet planning is carried out by airlines to determine the quantity and type of aircraft to be purchased or leased in order to provide a profitable service throughout the longterm planning horizon [7].

2.2 Payload Optimization
This is how airline companies can effectively combine types of air cargo to increase loading rates and revenues has become an important issue for operations management [8].

2.3 Cargo
Cargo can be transported both on dedicated full freighters and in the belly of passenger aircraft. In the latter case, available cargo capacity can even fluctuate over time, because passenger revenue has priority when assessing belly space utilization [9].

3. Research Method
The objective of this research is to choose the type of aircraft that can optimize the payload so that can be more effective, efficient, and economic between two types of wide-body aircraft. Researchers use two wide-body aircraft that is Airbus 330 – 300 and Boeing 777 – 300ER. The first step is to collect data of aircraft structures, limitations and characteristics from each wide-body aircraft for payload calculation. Then followed by Price List (Selling Price and Cargo Price), then the next step is calculating the revenue from passenger revenue, revenue cargo allowed (empty seat substituted to cargo) for each aircraft. Direct Operating Cost includes the costs that directly influence the aircraft operation. Indirect Operating Cost includes the costs that have indirect influence on the aircraft operation. Total Operating Cost includes the total aircraft operation costs for a route comprising both direct and indirect costs or the amount of direct operating cost plus indirect operating cost [10]. Then calculate the profit from revenue reduction with the total operating cost. The last step is analysis comparison between two wide-body aircraft which has larger amount of profit and lowest Total Operating Cost, then decide which aircraft is more optimal and suitable for route Jakarta – Haneda.

4. Result and Discussion
In this study, the dollar exchange rate into rupiah is very important. Because, in the industry dollar are used as a means of payment. So, we use the exchange rate in 2019 which is 1 USD = 14,341 Rupiah. Input prices together (including exchange rates) have been a more important factor than efficiency for determining a carrier's cost competitive position in the past [11].

| NO | DESCRIPTION | AIRCRAFT |
|----|-------------|----------|
|    |             | A 330 - 300 | B 777 - 300ER |
| 1  | DOW ( Kg )  | 126,100   | 168,700     |
| 2  | MZFW ( Kg ) | 175,000   | 237,680     |
| 3  | MTOW ( Kg ) | 242,000   | 351,800     |
| 4  | MLW ( Kg )  | 187,000   | 251,290     |
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5 FUEL CONSUMPTION ( Kg / Hour ) 6,150 8,100
6 SEAT CAPACITY ( Y CLASS ) 440 550
7 OPTIMUM SPEED (Mach Number) M.82 M.84

Source ( AIRBUS S.A.S. 2005[12] and Boeing Commercial Airplanes 2015[13]

Base on the aircraft characteristics Table 1, B 777 – 300ER has a Maximum Zero Fuel Weight (MZFW) that is 237,680 Kg than A 330 – 300 that is 175,000 Kg and can accommodate 110 more passengers than A 330 – 300. Even A 330 – 300 have the cheapest value that is US 264,200,000.- Dollar rather than B 777 – 300ER which is US 361,500,000.- Dollar. And also A 330 – 300 has a smaller fuel consumption around 1,950 Kg/Hour.

Table 2. Flight Time, Selling Price and Cargo Price with Jakarta – Haneda Route by Airbus 330 – 300 and Boeing 777 – 300ER

| NO | DESCRIPTION | AIRCRAFT |
|----|-------------|----------|
|    |             | A 330 - 300 | B 777 - 300ER |
| 1  | FLIGHT TIME | 06 Hour 34 Minutes | 06 Hour 24 Minutes |
| 2  | SELLING PRICE PER SEAT/HOUR | $61.07 | $62.60 |
| 3  | CARGO PRICE/HOUR | $0.68 | $0.68 |

Source (https://www.wego.co.id/tiket-pesawat/searches/cJKT-cTYO)

Selling price per seat/hour obtained through calculation of ticket price per seat divided flight time. This data Selling price per seat/hour obtained from the Wego website [14]. Each aircraft has different flight time, it is determined by a different Mach number. B 777 – 300ER flight is faster from Jakarta to Haneda. Cargo price is for regular cargo not for special cargo.

Table 3. Payload Allowable on Aircraft Airbus 330 - 300

| NO | DESCRIPTION | WEIGHT ( Kg ) |
|----|-------------|--------------|
| 1  | PAYLOAD ALLOWABLE | 44,000 |
| 2  | SEAT LOAD FACTOR 70% ( 308 PAX ) | 30,800 |
|    | CARGO ALLOWABLE | 13,200 |

Data Processed by the Author

Payload allowable on aircraft A 330 – 300 is 44,000 Kg. Assumption average Seat Load Factor (70%) from A 330 – 300 is 308 Passenger. Weight of 1 Passenger is calculated for 100 Kg, assumption Seat Load Factor (70%) is 30,800 Kg. Then seat vacancy substitution into cargo allowable for A 330 – 300 is 13,200 Kg.

Table 4. Revenue on Aircraft Airbus 330 - 300

| NO | DESCRIPTION | USD |
|----|-------------|-----|
| 1  | SELLING PRICE/SEAT SLF 70% (308 PAX) | $18,809.56 |
| 2  | CARGO ALLOWABLE (13,200 Kg) | $8,976.00 |
|    | TOTAL REVENUE | $27,785.56 |

Data Processed by the Author

From the table of A 330 – 300 revenue above following selling price and cargo price on table 2. Then, Seat Load Factor (70%) is 308 passenger produce US 18,809.56.- Dollar and cargo allowable is 13,200 Kg produce US 8,976.00.- Dollar. Total revenue for A 330 – 300 is US 27,785.56.- Dollar.
Payload available on B 777 – 300ER is 55,000 Kg. Assumption Seat Load Factor (70%) from B 777 – 300ER is 385 passenger. Weight of 1 passenger is calculated for 100 Kg, assumption for Seat Load Factor (70%) is 38,500 Kg. Than seat vacancy substitution into cargo freight for B 777 – 300ER is 16,500 Kg.

To decide which aircraft is suitable for this route, we compare a Total Operating Cost from each aircraft. Comparing the total operating cost from each aircraft is the best way to decide which aircraft is more effective and efficient for the airlines [1]. Thus, an accurate evaluation of the DOC is one of the most significant considerations for airlines when adopting new aircraft [15]. The Aircraft with a lot of seat capacity as B 777 – 300ER uncertainly has the lowest Total Operating Cost. As we know, the total operating cost (TOC) for each aircraft type varies as it is influenced by several things, such as aircraft price, maintenance cost, crew cost, fuel cost, aircraft insurance, route navigation charges, handling cost and others [16]. Accordingly, airlines are forced to also reduce their operating cost for ground handling and fuel wherever possible to stay in business [17].

Certainly, B 777 – 300ER has a bigger Total Operating Cost because its known Fuel Consumption per Hour B 777 – 300ER is 8,100 Kg more than A 330 – 300 which has Fuel Consumption per Hour 6,150 Kg. Fuel consumption constitutes a large portion of airline operating costs and forecasting fuel consumption is a continual topic of interest [18]. So, Fuel Consumption is has an impact on Total Operating Cost. However cost in the aviation industry using US Dollar, therefore US Dollar fluctuation is very influential to Total Operating Cost.

Table 7. Profit from Total Revenue and Total Operating Cost by Airbus 330 - 300 and Boeing 777 - 300ER

| NO | DESCRIPTION | AIRCRAFT |
|----|-------------|----------|
|    |             | A 330 - 300 | B 777 - 300ER |
| 1  | TOTAL REVENUE | $ 27,785.56 | $ 35,321.00 |
| 2  | TOTAL OPERATING COST | $ 14,042.94 | $ 21,887.06 |
|    | PROFIT       | $ 13,742.62 | $ 13,433.94 |

Data Processed by the Author
330 – 300 is better. The lowest Total Operating Cost make A 330 – 300 has bigger Total Profit. The Lowest Total Operating Cost is by lowest Aircraft Value, Fuel Consumption, and Maintenance Fee factors.

5. Conclusion
Payload optimization is done by calculating SLF (70%) assumption and seat vacancy 30% assumed to cargo allowable. Payload optimization is for aircraft efficiency so that an airline can be the best airline in the aviation industry. A 330 – 300 have a Total revenue from Payload Optimization is US 27,785.56-Dollar with Total Operating Cost is US 14,042.94-Dollar. While B 77 – 300ER have a Total Revenue from Payload Optimization is US 35,321.00 Dollar. In this analysis, the more effective aircraft in payload optimization is A 330 – 300. A 330 – 300 produces a bigger Total Revenue for Payload Optimization and lowest Total Operating Cost, then produces more Profitability.

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