Optimization Of Fuel Tankering And Cargo Maximization At Garuda Indonesia Airline To Gain Profitability (Study Case Of Route Cgk-Sub)

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Abstract. Fuel is a considerably high cost component in aviation operations. One of the ways to cost savings of an aircraft expense is Fuel Tankering. Fuel Tankering is an additional fuel carrying procedure aimed at obtaining cost savings by resorting to the price gap between departure and arrival airport, as well as minimizing risk. In reality, Fuel Tankering strategy in some airlines is still not favorable. Thus, companies must be able to weigh up expenditures and revenues. Therefore, there is a need for the estimation of fuel tankering and cargo maximization in the aircraft, so that Flight Operation Officer has a reference in estimating the defined formulations. The purpose of this research is to optimize Fuel Tankering and cargo maximization of airline company. It is expected that upon the strategy application within Indonesian airlines, there will be a significant and profitable operations.

1. Introduction

Aviation services are enthusiastically desirable by the people of Indonesia, owning to its rapidity and efficiency among other modes of transportation, it challenge airline companies to compete in increasing number of passengers. The current enactment of additional fee for checked baggage from one of the airlines which aims to increase profit has raised pros and cons among the industry and also in cargo companies. In addition to that, the price of avtur is rising dramatically in some areas[1]. The rise due to the depreciation of rupiah currency rate over US dollar. The exchange rate of rupiah to USD in April 2019 dropped to Rp 14,240 and in May 2019 strengthened by Rp 14,426. In addition, most airline in Indonesia is referring their operation cost to foreign exchange (US dollar) while the income is in rupiah.[2][3][4][5][6]

According to Carter et al., (2006)[7] jet fuel is the biggest expense component in airline, due to the consumption represents 37%-39% of direct operation total cost (depending on the aircraft type). As fuel price increases, the common initiatives adopted by the airlines are the efficiency of jet fuel consumption. [4][8][9][10]

This makes the airline company must continue to make profit for its company. Because the characteristics of commercial aviation is in its competitive market dealing with lower profit to compare with other modes of transportation.[11][8] Therefore, airlines that manage fuel consumption efficiently and maximizing cargo capacity as well, will undoubtedly gain competitive advantages that can ensure the company's sustainability[12]. IATA also estimates that currently for every dollar spent on fuel, the airline must generate revenues of 15 to 20 dollars to earn the same profit margin. The
avtur price at Soekarno-Hatta Airport on July 2018 was US$57.36 (Rp 8,275) per-liter, and in June 2019 the price of the Avtur rose to US$64.09 (Rp 9,246) per-liter. The fluctuative price of avtur in Indonesia begets the airlines to hold initiative to contribute profit to the company. [9][13][14]

Therefore, we recommend the optimalization of Fuel Tankering and cargo maximization as the exit strategy to the existing barrier of aviation industry in Indonesia.

2. Literature Review
This section discusses the practices, studies, and related methods to demonstrate the benefits of fuel-generation and the optimisation of cargo revenue to the airline company. This part provides an understanding of when and why companies should perform such practices and how they use and optimize them. The following review contains of Fuel, Fuel Tankering, Cargo, the heavy parts of aircraft, Manufacturer Certified Weights.

2.1. Fuel
Based on Civil Aviation Safety Regulations (CASR) Part 91 AMDT. Four general operations and flight rules[13] regarding the fuel components that aircraft must load in flight are the fuel that allows the plane flies from the departure to the destination airport, from the destination airport to the alternative airport, and the fuel to last 45 minutes.

2.2. Fuel Tankering
Fuel Tankering is the loading of fuel needed than necessary to perform a mission, for instance a required range of load over the specified route. Typically, aircraft only load the fuel needed for the specific mission, including the regulatory fuel reserves. In this context, we discuss whether carrying extra fuel will lead to a beneficial differential cost.[15][16]

2.3. Cargo
Cargo is the goods freight forwarded accompanied with SMU incorporates general and specific cargos [7]. The cargo discussed in the research which is handled by Garuda Indonesia in its commercial flight.[5][17]

2.4. Aircraft Weight
In the Company’s Operational Manual (COM) of PT. Sriwijaya Air [13], there is a heavy understanding of airplanes such as:
Dry Operating Index (DOI) is an index that shows the position of center of gravity in the Dry Operating Weight (DOW).
Dry Operating Weight (DOW) is the total weight of the aircraft with no fuel or cargo such as passengers, baggage and cargo. Operational Empty Weight to add with certain items for flight types such as catering, newspapers, kitchen utensils, etc..
Zero Fuel Weight (ZFW) is a Traffic Load added with a Dry Operating Weight.
Landing Weight (LW) is the weight of the aircraft on landing or Zero Fuel Weight added with the Fuel Reserve.
The Takeoff Weight (TOW) is the weight of the aircraft in which of took off at the departure airport. It is similar to Landing Weight added with Trip Fuel or Zero Fuel Weight plus Takeoff Fuel.
Takeoff Fuel is the fuel at the state of take off.
Trip Fuel is the fuel needed for travel in the air from the departure to the destination airport.
Traffic Load is the total weight of passengers, baggage and cargo, including non-revenue loads.

2.5. Manufacturer Certified Weights
Manufactured certified operating weights are developed during the aircraft design and certification phase and are laid down in the aircraft type certificate and manufacturer’s specification documents such as the Aircraft Flight Manual (AFM) and Aircraft Weight & Balance Manual (AWBM)[18]. Manufacturer certified operating weights can be broken down into the following weight categories: Maximum Takeoff Weight (MTOW) (also referred to as Brake Release Gross Weight) means the maximum weight for takeoff as limited and/or authorized by airplane strength and airworthiness requirements. This is the maximum weight at the start of the takeoff.

Maximum Landing Weights (MLW) means the maximum weight for landing as limited and/or authorized by airplane strength and airworthiness requirements.

Maximum Zero-fuel Weight (MZFW) means the maximum weight permitted before usable fuel and other specified usable fluids are loaded. The MZFW is limited and/or authorized by strength and airworthiness requirements.

Block Fuel is the total of all fuel loaded on board.

Taxi Fuel is the amount of fuel used when traveling from the Arpon to the runway (run way)

3. Research Method

To calculate Fuel Tankering and the cargo maximizing, we refer to the above calculation formula as well as analyzing the preceding data. From the results of the estimation, we discovered the amount of costs that can be saved from Avtur fuel and revenue generated from the cargo maximizing aircraft B737-800NG for the CGK-SUB route. [3][4][1]

This research aims to provide solution of saving fuel cost and maximize cargo capacity for airline in Indonesia. We observed the CGK-SUB route in which using the B 737-800 NG Garuda Indonesia aircraft. We conduct research with data analysis techniques and collect data which has been processed in the theories and the previous researchs. We analyzed the latest Avtur data from Pertamina Aviation Fuel Price and conducted direct observation at Prtamina Aviation Company. To support this research, we applied the following formula:

**TANKERING FUEL**

1. **FIXED WING ( CASR 135.637 )**

   Formula :
   a. \[ MFR = T.F \text{ Destination} + \text{Cont. 5\%} + T.F \text{ Alternate} + \text{30 Minutes Holding ( at 1500 ft )} + \text{Taxi Fuel} \]
   b. \[ \text{Cont 5\%} : \text{Contigency 5\%} \]
   c. \[ \text{Taxi Fuel} : 15 \text{ minutes} \]

2. **BLOCK FUEL CALCULATION**

   Formula :
   a. \[ B.F = MFR + \text{Extra Fuel} \]
   b. \[ \text{MFR} : \text{Minimum Fuel Requirement} \]

3. **PAYLOAD ALLOWABLE CALCULATION**

   Formula :
   a. \[ \text{MZFW Payload} = \text{MZFW} - \text{DOW} \]
   b. \[ \text{MTOW Payload} = \text{MTOW} - (\text{DOW} + B.F) \]
   c. \[ \text{MLW Payload} = ((\text{MLW} + T.F) - (DOW + B.F)) \]

4. **CARGO ALLOWABLE CALCULATION**
Formula :

a. MZFW
   \[ \text{Cargo} = \text{MZFW} - ((\text{DOW} + (\text{Pax} + \text{Bag}))) \]

b. MTOW
   \[ \text{Cargo} = \text{MTOW} - ((\text{DOW} + (\text{Pax} + \text{Bag} + \text{B.F}))) \]

c. MLW
   \[ \text{Cargo} = ((\text{MLW} + \text{T.F}) - (\text{DOW} + (\text{Pax} + \text{Bag} + \text{B.F}))) \]

5. BLOCK FUEL ALLOWABLE
Formula :

a. MZFW
   \[ \text{Block Fuel} = (\text{MZFW} + \text{Block Fuel}) - (\text{DOW} + \text{Payload \ Actual}) \]

b. MTOW
   \[ \text{Block Fuel} = \text{MTOW} - (\text{DOW} + \text{Payload}) \]

c. MLW
   \[ \text{Block Fuel} = ((\text{MLW} + \text{Trip Fuel}) - (\text{DOW} + \text{Payload Actual})) \]

6. TANKERING FUEL CALCULATION
Formula :

Available Tankering Fuel = B.F allowable – B.F (MFR)

7. SAVING FUEL PRICE CALCULATION
Formula :

Saving Fuel Price = Fuel Price Destination – B.E.PFuel Price Origin

8. TOTAL SAVING COST CALCULATION
Formula :

Total Saving Cost = Tankering Fuel x Saving Fuel Price

LOAD CAPACITY

1. PAYLOAD
Formula :
   \[ \text{Payload} = \text{Total Pax} + \text{Bagasi} + \text{Cargo} + \text{Mail} \]

2. ZERO FUEL WEIGHT
Formula :
   \[ \text{ZFW} = \text{DOW} + \text{Payload} \]

3. TAKEOFF WEIGHT
Formula :
   \[ \text{TOW} = \text{ZFW} + \text{Tkoff Fuel} \]

4. LANDING WEIGHT
Formula :
   \[ \text{LW} = \text{TOW} - \text{Trip Fuel} \]

4. Result and Discussion
Depreciation of rupiah toward US Dollar, significantly affects the development of air transportation services. As of June 2019, the value of 1 USD amounted to Rp 14,426, this value fell to compare with the value in April and May.[19]

The influence of rupiah exchange rate can not be underestimated, according to Wenjen (2009) the increase in interest rate impacted the depreciation of rupiah, especially when Indonesia lowers its interest rate, which plays an important role to the market.

Almost all operation costs in the aviation industry refer to US Dollar and its revenue under Rupiah. Hence the airline should manage to reduce operation costs and design a good savings strategy that produce profits for the company, especially the fuel and the cargo maximizing.
In table I, we used the latest Avtur price data, June 2019[20]. Applicable at Soekarno-Hatta International Airport (CGK) and Juanda International Airport (SUB). Our data is valid until June 2019, so that the research discussion can develop and sustain.

**Table 1.** Valid Data of Pertamina Flight at 1-15 dan 16-30 every month

| Airport                  | Month | Price    | US Cent/liter |
|--------------------------|-------|----------|---------------|
| Soekarno-Hatta International Airport (CGK) | June  | Rp 9.246 | 60.09         |
| Juanda International Airport (SUB)          | June  | Rp 10.172 | 70.51         |

Source: www.Pertamina.Aviation

The table informed the price distinction between avtur at Soekarno-Hatta International Airport and Juanda International Airport, which differed at Rp 926,- or 6.42 US$. With the distinction in prices between the two airports, we can execute the Tankering Fuel strategy as well as cargo maximization of the aircraft in order to achieve a substantial profit.

**Table 2.** Aircraft Structure

| Description                  | Weight in Kg |
|------------------------------|--------------|
| Dry Operating Weight         | 41.413       |
| Max. Zero Fuel Weight        | 61.689       |
| Max. Take Off Weight         | 70.534       |
| Max. Landing Weight          | 65.317       |
| Max. Structural Payload      | 20.276       |
| Tank Capacity                | 20.894       |
| Fuel Consumption             | 2,435/hour   |
| Optimum Speed                | LRC/M.79     |
| Maximum Speed                | TAS=486 kts/ M.82 |
| Flight Level Optimum         | FL 350/360   |
| Max. Ceiling Altitude        | FL 290       |
| Seat Capacity                | 184 Y        |

Source: Manual Book Boeing[21]

**Table 3.** Fuel tankering analysis and Operating Saving Cost

| Description     | Result          |
|-----------------|-----------------|
| Route           | CGK- SUB        |
Distance 456 NM
Flight Time 59 Menit
Block Time 74 Menit
Trip fuel 3.508 Kg
Block Fuel 10.048 Kg
Block Fuel Allowable 16.404 Kg
( Limit by MLW )
Payload Allowable ( Limit by MLW ) 17.364 Kg
Cargo Allowable (Limit by MLW) 6.024 Kg
Average Seat Load Factor 68%
Actual Passanger 8.820 Kg
Actual Cargo 2.992 Kg
Underload 3.032 Kg
Assumption For Tankering 2.000 Kg
BEP Fuel Price Rp 9.681
Saving Fuel Price Rp 614/Kg
Total Saving Cost/ Flight Rp 1.228.000
Total Saving Cost/ Day (14 flight) Rp 17.192.000
Total Saving Cost/ Weeks Rp 120.344.000
Total Saving Cost/ Months Rp 481.376.000
Total Saving Cost/ Year Rp 5.776.512.000

Data processed by authors

Table 3 is the calculation result of the data that we processed by using the attached formula. The average seat load factor of the CGK-SUB route is at 68%, we found an underload of 3,032 Kg. From the underload, we did the tankering of 2,000 Kg at Soekarno-Hatta International Airport with lower price compared to Juanda International Airport with a difference of Rp 926.

Upon finishing the calculation above, after Fuel Tankering we revealed that Garuda Indonesia for CGK-SUB route can save operational cost of Rp 1.228.000/flight. In fact, Garuda Indonesia operates 14 (fourteen) flights/day for the CGK-SUB route, which means that if Garuda Indonesia consistently
Table 4. Cargo Analysis and Profitability

| Description                          | Result          |
|--------------------------------------|-----------------|
| Assumption For Cargo                 | 1.032 Kg        |
| Cargo Price                          | Rp 6,300        |
| Flight Time CGK-SUB                   | 59 Menit        |
| Total Income For Cargo/Flight Hour    | Rp 6,501,600    |
| Total Income For Cargo/Day (14 Flight)| Rp 91,022,400   |
| Total Income For Cargo/Weeks          | Rp 637,156,800  |
| Total Income For Cargo/Month          | Rp 2,548,627,200|
| Total Income For Cargo /Year          | Rp 30,583,526,400|
| Total Income For Cargo and Saving Cost| Rp 36,360,038,400|

Data processed by authors

Table 4 displays the total revenue of the airline company assuming that it did full sale of underload cargo remaining from the tankering, as much as 1,032 Kg. The price of cargo for each kilogram is Rp 6,300, and for one trip Garuda Indonesia earns Rp 6,501,600 from the sale of remaining underload cargo (excluding the total of other components). If Garuda Indonesia consistently performs underload cargo in one year, cargo underload of Garuda Indonesia can accumulate benefit to Rp 30,583,526,400. Then, from total saving cost and revenue on underload cargo, Garuda Indonesia gains profit of Rp 36,360,038,400 in one year.

In the current position, every airline should design the strategy to resolve a profit from the rise of Avtur price and the weakening of rupiah exchange rate over the US dollar that resulted in the extra charge of checked-baggage. In this case, fuel optimization and cargo maximizing strategy is very important in order to survive in the aviation industry. As we have done, Fuel Tankering and maximizing cargo for Garuda Indonesia on the CGK-SUB route in one year can save operational costs for Rp 5,776,512,000 and gain revenue on underload cargo of Rp 30,583,526,400. Regarding it, reducing operation costs and selling the remaining underload of the tankering cargo is the right strategy to get a lot of profit and survive the competition in the aviation industry.

5. Conclusion

Fuel is the highest operational cost compared to other operation costs. Moreover, fuel prices continue to rise with the depreciation of rupiah exchange rate to the US dollar and the charge for checked baggage incite the airline to raise the price of the ticket so that the company may survive. This will impact on the passenger of air transportation. The strategy that can be done to reduce the operational cost is by performing Fuel Tankering In this case, especially Garuda Indonesia must be able to design the strategic plan as to compete and survive in the aviation industry.
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