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DORATASK: THE EFFECT OF RUNWAY OCCUPATION TIME ON OPTIMIZING RUNWAY CAPACITY AT NOP GOLIAT DEKAI AIRPORT

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Abstract

Nop Goliat Dekai Airport experienced an increase of 18.8 percent per year for passengers, 27.9 percent for cargo, and 19.4 percent of airport capacity both in terms of land and air. Due to the increasing number of aircraft movements, airport management is evaluating the value of runway capacity to improve service and comfort for airport customers. The aim of this research is to see how runway occupancy time and runway capacity influence the optimization of runway use. By using the DORATASK approach, this research aims to estimate the impact of runway occupancy time and runway capacity on air traffic services. The values for occupancy time and available runway capacity are still below the maximum values and have no effect on air traffic services, the study found. Runway 25 has an average Runway Occupancy Time (MROT) of 122.35 seconds, while runway 07 has a MROT of 115.23 seconds. Based on calculations, the Declared Runway Capacity (DCR) is 14 movements per hour, but currently the runway is only used 80% or 11 movements per hour at the busiest hours. This data shows that the runway capacity at Nop Goliat Dekai Airport is still in accordance with its performance.

Keywords: Runway Capacity, Runway Occupancy Time, Declared Runway Capacity, Doratask

Introduction

In the last five years, Yahukimo Regency has experienced extraordinary progress in the field of air transportation. The concept of air transport subsidies provided by the Ministry of Civil Aviation of the Republic of Indonesia for the 3T area, especially in Yahukimo Regency, is the cause of such great development (Ma et al., 2022; Yunus et al., 2021). Nop Goliat Dekai Airport is one of several airports that has received subsidized air transportation facilities and experienced a significant increase in the number of passengers and cargo.

The air side and land side of the airport are becoming increasingly congested as the number of passengers increases, even though these two locations have limited capacity to accommodate all passenger and goods activities (Puspita et al., 2020). Aircraft traffic irregularities will occur both on the ground and in the air as a result of an imbalance in the flow between current conditions and current capacity (Fernandes & Pacheco, 2002; Setyarini & Ahyudanari, 2017).

This imbalance and limitation is exacerbated by the fact that Nop Goliat Dekai Airport has not taken into account runway capacity or runway occupancy time. Until now, the airport flight navigation service administration (Airnav Indonesia) has not determined the maximum number of movements that can be accommodated (Stonkus, 2022; Tiara et al., 2019). There are several instances where aircraft that have landed cannot find a parking space to complete loading and unloading of passengers and baggage on the apron.

Restricting time allocation permits to flight operators is one of the mitigation steps taken by Airnav Indonesia in collaboration with the airport (Ongkowijoyo & Ruseno, 2021; Sampurno et al., 2018; Simarmata & Sari, 2019).

This research was conducted at Nop Goliat Dekai Airport to study and determine the influence of runway capacity values on runway optimization. The Doratask method is then used to analyze calculations and determine runway capacity. Because Airnav Indonesia uses this method to calculate runway capacity at all airports in Indonesia, this analysis method was chosen (Manual of Airnav Indonesia 2nd Edition). The aim of this research is to see how runway occupancy time and runway capacity influence the optimization of runway use.

Research Methods

This research was conducted at Nop Goliat Dekai Airport. The airport is located in Yahukimo Regency, Papua Province and is a quantitative study using data sampling techniques using a direct observation method for 7 days which is equipped with one year's data on aircraft movements with Doratask Method.

Method of collecting data

Primary and secondary data are required for this project. Primary data is information collected over seven days by direct observation. The duration of flight time between final approach and the threshold area on the runway is the main data collected, along with runway usage time (take-off/ROTT and landing/ROTL).

The ROTT calculation begins when the aircraft enters the runway holding position (t0) and continues until the imaginary runway threshold is crossed (t1).

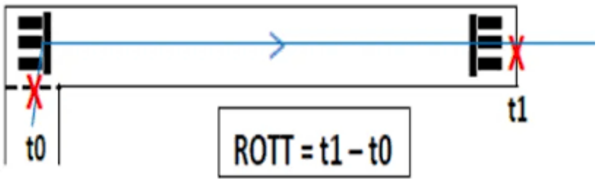

Figure 1. Runway Occupancy Time Take-Off

The ROTT calculation begins when the aircraft enters the runway holding position (t0) and continues until the imaginary runway threshold is crossed (t1).

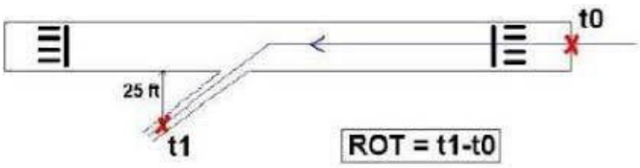

Figure 2. Runway Occupancy Time Landing

During peak hours, observations for primary data collection were carried out. During peak hours, the number of aircraft movements in a certain time period reaches a maximum. The peak hours chosen are the hours that have the most traffic in a row. Secondary data includes information from the Nop Goliat Dekai airport manager in the field of aviation navigation (Airnav Indonesia), such as aircraft movement data for a week, runway usage data for a year, airport specifications and local procedures (ATS SOP).

Data processing

A quantitative approach is used to process data. The primary data and secondary data obtained were then checked and calculated using the Doratask method formula. Search results for Runway Occupancy Time (ROT) data when aircraft take off (ROTT) and land (ROTL), which are then calculated and categorized to provide one number for each aircraft category for each runway direction.

Secondary data from aircraft movements during takeoff and landing for seven days can be used to calculate the percentage of runway use by aircraft type (MIX). Meanwhile, aircraft movement data for a year can be used to calculate the proportion of time that both sides of the runway are used.

Data analysis

The data in this research was analyzed to produce runway occupancy time and runway capacity values, as well as an analysis of their influence on runway optimization at Nop Goliat Dekai Airport. Doratask is an analytical method that uses logical calculations and offers understandable examples based on fast time simulations. Theoretical Base Capacity/TRC is the result of this procedure. Meanwhile, the theoretical value of runway capacity is the capacity that takes into account the ROT, flight time and separation/safe distance provided. The Runway Capacity Analysis Process Using the Doratask Method is as follows:

1) As aircraft take off and land, search and compile Runway Occupancy Time (ROTT) (ROTL) data.

2) Use the formula to get the arithmetic average ROT time per aircraft category (Arithmatical Mean Runway Occupancy Time/AMROT).

$$AMROTcatx = \frac{\mathrm{MROTLcatx + MROTcatx}}{2}$$

3) During takeoff and landing, use formulas to search and compile Runway Occupancy Time (ROTT) (ROTL) data.

$$MIX = \frac{\Sigma\%\mathrm{ACFTcatx}}{\mathrm{nDays}}$$

4) Determine the average ROT time (Mean Runway Occupancy Time/MROT).

$$MROT = \frac{\Sigma(\mathrm{AMROTcatx} \cdot \mathrm{MIXcatx})}{100}$$

5) Calculate the physical capacity of the runway (Physical Capacity Runway/PCR) for one hour, then convert it to seconds.

$$PCR = \frac{3600}{\mathrm{MROT}}$$

6) The aircraft movement data that has been obtained for one year will be used as a basis for calculating aerodrome physical capacity (Aerodrome Physical Capacity/APC).

$$APC = \frac{\sum(\text{PCRrwyx} \cdot \text{\%UPrwyx}}{100}$$

7) Collect flying time data between Final Approach Segment / Reference Point and threshold. Data is recorded when the aircraft passes the Final Approach Segment or Reference Point until it passes the threshold point. Nop Goliat Dekai Airport does not have an Outer Marker so data recording begins when the aircraft passes the Final Approach Segment.

8) Between FAS (Final Area Segment) and Threshold, calculates the aircraft approach speed (AV).

$$AVcatx = \frac{\text{DistanceFAS} \cdot \text{THR(nm)}}{\text{T FLIGHTcatx}}$$

9) Between FAS and THR (Average Final Approach Speed/MV), calculate the aircraft's average approach speed.

$$MV = \frac{(\text{MIXa} \,.\, \text{AVa}) + (\text{MIXb} \,.\, \text{AVb}) + ,,,, (\text{MIXg}.\,\text{AVg})}{2a100}$$

10) Establish safe separation (Safety Separation/SS). At Nop Goliat Dekai Airport, separation is determined using SOP data.

$$SS = MV \times MROT$$

11) Calculate the total safe distance (TS) between two consecutive landings. The Nop Goliat Dekai Airport SOP contains the Regulatory Separation Minima (RSM).

$$TS = SS + RSM$$

12) Calculate the total safe distance (TS) between two consecutive landings. The Nop Goliat Dekai Airport SOP contains the Regulatory Separation Minima (RSM).

$$MTTS = \frac{TS}{MV}$$

13) The number of aircraft that can land in one hour (Number of Landings in One Hour Interval / P) is determined.

$$P = \frac{3600}{MTTS}$$

14) Calculates the number of planes that can take off in one hour (Number of Take-offs in One Hour Interval / D).

$$D = P - 1$$

15) Determining capacity from runway theory (Theoretical Runway Capacity/TRC).

$$TRC = D + P$$

16) The overall capacity value that will be declared is based on the proportion of use of each runway that is considered operationally practical (Declared Capacity of the Runway/DCR).

$$MV = \frac{(\text{MIXa . AVa}) + (\text{MIXb . AVb}) + ,,,, (\text{MIXg. AVg})}{2a100}$$

The Declared Capacity of Runway/DRC, obtained in step 16, has a value of 100 percent. Meanwhile, based on management regulations and operational needs, the overall capacity value for data publication can range from 90 to 80 percent (Airnav Indonesia, Runway Capacity Calculation Manual, 2nd Edition).

Results and Discussion

Prior to carrying out this research, Nop Goliat Dekai Airport had not yet carried out measurements and determined the runway capacity value. However, in daily operational activities, this airport serves up to 11 movements per hour at peak hours (Airnav Indonesia Unit Dekai, December 2021).

ROT (Runway Occupancy Time) is determined by direct observation to collect aircraft movement data for seven consecutive days.

Table 1. ROTT Runway 25 Results

Categories	nAircraft	second	average @type
A	81	12119	149.617284
B	6	1559	259.8333333
C	5	1340	268

The Doratask method requires calculating runway capacity using both sides of the runway. The results of the ROTT calculation originating from aircraft taking off from runway 07 are in the following table:

Table 2. ROTT Runway 07 Results

Categories	nAircraft	second	average @type
A	15	1554	103.6
B	1	293	293
C	0	0	0

The ROTT data collected from each aircraft category is then added up and divided by the number of aircraft in each category to produce an average ROTT value for each category. Classification of aircraft by type is based on the aircraft's approach speed. The following table shows the categories of aircraft depending on their approach speed:

Table 3. Aircraft classified according to their approach speed

Category	Speed
A	< 90kt
B	91 - 120kt
C	121 - 140kt

Table 4. ROTL Runway 25 results

Categories	nAircraft	second	average @type
A	30	1500	50
B	0	0	0
C	0	0	0

The ROTL data from each category is then summarized and divided by the number of aircraft in each category to produce an average ROTT for each category.

Table 5. ROTL Runway 07 results

Categories	nAircraft	second	average @type
A	66	3456	52.36363636
B	6	526	87.66666667
C	5	444	88.8

Arithmetic calculation of runway usage time shows that the Mean Runway Occupancy Time/MROTT for runway 25 is 163.23 seconds and for runway 07 is 115.43 seconds. Runway 25 has an MROTT value of 47.80 seconds which is greater than runway 07, and this shows that runway 25 is the dominant runway for aircraft to take off.

Meanwhile, the average ROTL value for runway 25 was found to be 50 seconds and 57.48 seconds for runway 07, and this data shows that runway 07 has a dominant tendency for the aircraft landing process because it has a value that is 7.48 seconds greater than runway 25.

Aerodrome Percentage Utilization by Aircraft Category (MIX) will be calculated on both sides of the runway, namely runway 25 and 07. Below is the MIX data on runway 25 and it can be seen that the largest MIX data is in category A.

Table 6. Aircraft Percentage by Aircraft Category (MIX) Runway 25

Paint	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 7	TOTAL	MIX
A	35	22	13	25	13	6	120	92.307692
B	1	0	3	0	1	0	5	3.8461538
C	0	1	0	1	0	2	5	3.8461538
TOTAL	36	23	16	26	14	8	130	100

This data was obtained from the total number of aircraft movements for seven days. For each category, a percentage of the total movement of the aircraft in each runway direction is calculated.

Table 7. Aircraft Percentage by Aircraft Category (MIX) Runway 07

Paint	DAY 1	DAY 2	DAY 3	DAY 4	DAY 5	DAY 7	TOTAL	MIX
A	14	13	13	18	5	5	68	87.17948718
B	1	0	3	0	1	0	7	8.974358974
C	0	1	0	1	0	2	3	3.846153846
TOTAL	15	14	16	19	6	7	78	100

The result of multiplying AMROT by MIX is Mean Runway Occupancy Time (MROT).

Table 8. MROT Runway 25

Categories	AMROT		MIX	MROT
A	124.8086	X	92.30769	115,208
B	129.9167	X	3.846154	4.996795
C	134	X	3.846154	5.153846
∑ Time (Sec)				125.3586

Table 9. MROT Runway 07

Categories	AMROT		MIX	MROT
A	104.1636	X	87.17949	90.80932
B	234.1667	X	8.974359	21.01496
C	88.8	X	3.846154	3.415385
∑ Time (Sec)				115.2397

The ROT value for each aircraft category (Tables 1, 2, 4, and 5) is then multiplied by the MIX Index for each aircraft category to obtain the MROT value (Tables 8 and 9). Next is to run PCR calculations for one hour on both sides of the runway, then convert the results to seconds.

Table 10. Calculating PCR (Physical Capacity of Runway)

Categories	PCR	
	Rwy 25	Rwy 07
PCR = 3600/MROT	28.71761	31.23924

Secondary data, such as aircraft movement data for a year, is used to calculate usage / UP on each side of the runway.

Table 11. Finding the Utilization (UP) value

RUNWAYS	Movement	% a year
Runway 25	4145	55.99081453
Runway 07	3258	44.00918547
TOTAL	7403	100

After the UP value is obtained, the percentage weighting is then carried out between the results of the PCR value (table 10) multiplied by the percentage value of the UP value (table 11).

Table 12. Aerodrome Physical Capacity (APC)

RWY	PCR	% Utilization (UP)	APC	
			E movement	Movement
25	28.71761	55.99081453	16.07922416	29.82736
07	31.23924	44.00918547	13.74813667	

After the APC data results are obtained, the next step is to find the average of the aircraft's approach speed between the Final Approach Segment/MV and the threshold. In this research, the Final Approach Segment/MV calculation with a threshold is used because this is the only facility available at Nop Goliat Dekai airport.

Table 13. Mean Speed in the Final Approach (MV)

RWY	MV
25	0.049 kt
07	0.102 kt

The Doratask approach allows ATC to position a takeoff aircraft between two landing aircraft while maintaining Regulatory Separation Minima/RSM compliance. The separation to include one aircraft taking off is calculated by estimating the flying distance between the two aircraft in the final approach segment after the first aircraft has landed, which is then added to the RSM applicable to Nop Goliat Dekai Airport, which is 8nm.

Table 14. Determination of Safety Separation/SS

RWY	MROT	X	MV	SS
RWY 25	125.3586	X	0.048937	6.134693
RWY 07	115.2397	X	0.101972	11.75121

The total safe distance between two consecutive landings/TS is obtained by adding up SS in step 10 and RSM. Nop Goliat Dekai Airport has an RSM of 8NM in accordance with the applicable SOP.

Table 15. Total Separation Between two consecutive Landings/TS

RWY	SS	RSM	T.S	MV
RWY 25	6.134693	8	14.13469	0.048937
RWY 07	11.75121	8	19.75121	0.101972

Table 16. Weighted between two consecutive landings/MTTS

RWY	T.S	:	MV	MTTS
RWY 25	14.13469	:	0.048937	288.8336
RWY 07	19.75121	:	0.101972	193.6926

Table 17 values will be used as a divider to calculate the maximum number of aircraft that can land in a certain time.

Table 17. Calculating the Number of Landings in One Hour Intervals (P)

RWY	Second in an hour	MTTS	P
RWY 25	3600	288.8336	12.46392
RWY 07	3600	193.6926	18.58615

After the value (P) is obtained, the next step is to determine the value (D) by reducing the value (P) by 1.

Table 18. Calculating the Number of Takeoffs in One Hour Intervals (D

RWY	P	D
RWY 25	12.46392	11.46392
RWY 07	18.58615	17.58615

It is proven that one plane can take off between two successively landed planes based on the total separation time obtained, and then the number of planes that can take off between the landed planes can be determined based on the number of landed planes.

Table 19. Determination of Theoretical Runway Capacity (TRC)

RWY	P	D	TRC
RWY 25	12.46392	11.46392	23.92785
RWY 07	18.58615	17.58615	36.1723

In theory, the concept of runway capacity is a value that considers ROT, Flying Time and the separation provided (De Leege et al., 2009; Knabe et al., 2022; Metz et al., 2021). The figures above are based on the total number of aircraft taking off and landing. Declared Runway Capacity (DCR) is then calculated using the procedure in step 16 and a value of 14 movements/hour is obtained (Republic of Indonesia Ministry of Transportation, 2017; Yadav & Nikraz, 2014).

Conclusion

Currently, the distance between the taxiway and the threshold on each side of the runway and the Runway Occupancy Time (ROT) value have not had a significant effect on optimizing runway use at Nop Goliat Dekai Airport. At its busiest hour, Nop Goliat Dekai Airport serves 11 movements per hour, which is 80% of the Runway Capacity calculation using the Doratask technique. The calculation results from this method are 14 movements per hour at 100% usage and 13 movements per hour at 90% usage.

BIBLIOGRAPHY

De Leege, A. M. P., In't Veld, A. C., Mulder, M., & Van Paassen, M. M. (2009). Three-degree decelerating approaches in high-density arrival streams. *Journal of Aircraft*, *46*(5). https://doi.org/10.2514/1.42420

Fernandes, E., & Pacheco, R. R. (2002). Efficient use of airport capacity. *Transportation Research Part A: Policy and Practice*, *36*(3). https://doi.org/10.1016/S0965-8564(00)00046-X

Knabe, F., Dreyzehner, T., & Korn, B. (2022). Super Close Runway Operations (SupeRO): A New Concept to Increase Runway Capacity. *Integrated Communications, Navigation and Surveillance Conference, ICNS*, *2022-April*. https://doi.org/10.1109/ICNS54818.2022.9771534

Ma, H. L., Sun, Y., Chung, S. H., & Chan, H. K. (2022). Tackling uncertainties in aircraft maintenance routing: A review of emerging technologies. *Transportation Research Part E: Logistics and Transportation Review*, *164*. https://doi.org/10.1016/j.tre.2022.102805

Metz, I. C., Ellerbroek, J., Mühlhausen, T., Kügler, D., & Hoekstra, J. M. (2021). Analysis of risk-based operational bird strike prevention. *Aerospace*, *8*(2). https://doi.org/10.3390/aerospace8020032

Ongkowijoyo, H. V., & Ruseno, N. (2021). Optimizing The Utilization of Third Runway in Soekarno Hatta International Airport Using Time Space Analysis. *Angkasa: Jurnal Ilmiah Bidang Teknologi*, *13*(1). https://doi.org/10.28989/angkasa.v13i1.783

Puspita, H., Ana, A., Wulandari, I. Y., & Andriana. (2020). The evaluation of the learning curriculum of the aircraft maintenance training organization 147 for avionic study program as a basis in meeting the need of the aviation industry. *Journal of Engineering Education Transformations*, *34*(Special Issue). https://doi.org/10.16920/JEET/2020/V34I0/157848

Republic of Indonesia Ministry of Transportation. (2017). Civil Aviation Safety Regulation (CASR) 141. *Certification and Operating Requirements for Pilot Schools*, *Amdt 12*.

Sampurno, R. A., Rinodistira, K., & Rizaldy, W. (2018). *Optimization Of Runway Capacity At Cgk AirporT*. https://doi.org/10.2991/grost-17.2018.63

Setyarini, C., & Ahyudanari, E. (2017). Analisis Pengaruh Pergeseran Runway Holding Position terhadap Runway Occupancy Time dan Runway Capacity (Studi Kasus: Bandar Udara Internasional Juanda). *WARTA ARDHIA*, *43*(2). https://doi.org/10.25104/wa.v43i2.311.105-116

Simarmata, I. G., & Sari, H. (2019). Identifikasi Faktor-Faktor Untuk Peningkatan Kualitas Layanan Navigasi Udara Dengan Menggunakan Metoda Kualitatif (Kasus: Bandara Sukarno Hatta). *Penelitian Dan Aplikasi Sistem Dan Teknik …*, *12*(3).

Stonkus, S. (2022). Harmonization of Aviation Safety and Security Legal Regulation in the European Union: Impact on the Global Convergence of Aviation Law. *Teisė*, *125*. https://doi.org/10.15388/teise.2022.125.8

Tiara, S., Liber, H. T., Nisa, S. A., & Marzuki, S. (2019). The Translation Of Civil Aviation Safety Regulation Part 170 Air Traffic Rules Into Indonesian. *Ideas: Journal on English Language Teaching and Learning, Linguistics and Literature*, *7*(1). https://doi.org/10.24256/ideas.v7i1.719

Yadav, D. K., & Nikraz, H. (2014). Implications of evolving civil aviation safety regulations on the safety outcomes of air transport industry and airports. *Aviation*, *18*(2). https://doi.org/10.3846/16487788.2014.926641

Yunus, M., Tuhepaly, R. S. S., & Fitriadhy, A. (2021). Feasibility Analysis of Runway, Taxiway and Apron Dimensions of Torea Airport in Fakfak Regency, West Papua Province. *EPI International Journal of Engineering*, *4*(2). https://doi.org/10.25042/10.25042/epi-ije.082021.09