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# *Optimization Of The East Terminal Control Area (TMA) Sector At PERUM LPPNPI Denpasar Branch*

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**Abstract – Since the COVID-19 pandemic which resulted in a decrease in traffic, Perum LPPNPI Denpasar Branch adjusted flight traffic services as needed, one of it is the East Terminal Control Area (TMA) was temporarily not operating so that traffic coming from the east was served by West Terminal Control Area (TMA). After traffic conditions begin to normalize, during peak hours the amount of traffic guided by the TMA unit reaches 30 traffic per hour where the TMA unit provides services at an altitude of 10,000 feet to a height of 24,500 feet. The return to normal traffic has led to an increase in the load of communication in the West Terminal Control Area (TMA) sector so optimization of the East Terminal Control Area (TMA) sector is needed. This research was conducted with the aim of providing suggestions to optimize the East Terminal Control Area (TMA) sector to improve flight traffic services at the Perum LPPNPI Denpasar Branch. The method used is qualitative descriptive.**

**From this study, it was found that the lack of personnel was a barrier to optimizing the East Terminal Control Area (TMA) sector. Therefore, the authors suggest a review of the needs of the number of personnel and the determination of Operating Hours (OH).**

**Keywords – Optimization, TMA, ATC**

## I. INTRODUCTION

Terminal Control Area (TMA) is a control area usually established at the confluence of ATS routes around one or more major airports [1]. In accordance with the Regulation of the Minister of Transportation of the Republic of Indonesia, Number PM 9 of 2022 concerning the National Flight Navigation Order, a Terminal Control Area (TMA) is an Airspace provided with approach control services or cruising flight services [2]. Air traffic control unit is a general term meaning diverse, area control center, approach control unit, or aerodrome control tower [3]. The appropriate ATS authority shall establish areas of responsibility for each air traffic control unit (ATC) and, where applicable, for individual control sectors within the ATC unit. If there is more than one ATC job position within a unit or sector, the duties and responsibilities of each job position should be defined. Meanwhile, according to the Operation Manual CASR 172 Perum LPPNPI Denpasar Branch in 2022, personnel are people who are directly related to the implementation of aviation traffic services and/or related officials [4]. Optimization comes from the word optimal meaning best or highest [5]. So optimization is the process of making something better or getting the best out of something.

The division of areas of responsibility and operating hours (OH) between units is stated in the Operation Manual CASR 172 Perum LPPNPI Denpasar Branch in 2022, especially the area of responsibility of East TMA, which is as follows

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| | | |
|---|---|---|
| **BALI TMA EAST**<br>091900S 1142800E to<br>"BLI" VOR/DME<br>Thence to 074706S<br>1165009E arc<br>clockwise with radius<br>of 115NM centered at<br>"BLI" VOR/DME to<br>103910S 1145147E<br>091900S 1142800E<br><br>**FL 245**<br>6 000 ft / 10 000 ft* | H-24 | *6 000 ft above<br>Lombok CTR<br><br>* 10 000 ft above<br>Bali CTR<br><br>11.30-15.30<br>service provided<br>by Bali APP on<br>Freq 119.3 MHz<br><br>15.30-23.30<br>service provided<br>by Bali APP on<br>Freq 119.7 MHz |

Figure 1. Bali TMA *East's* area of responsibility in MOS CASR 172 Perum LPPNPI Denpasar Year 2022

Meanwhile, since the Covid-19 pandemic which resulted in a decrease in traffic, Perum LPPNPI Denpasar adjusted flight traffic services as needed, one of which is the East Terminal Control Area (TMA) which is temporarily not operating so that traffic coming from East is served by the West Terminal Control Area (TMA).

PERUM LEMBAGA PENYELENGGARA NAVIGASI PENERBANGAN INDONESIA
CABANG DENPASAR
**BALI APP DAILY REPORT**

**I. POSITION LOG** Day/Date WEDNESDAY 1 FEBRUARY 2023

A. BALI CTR ( 119.7 MHz )

| SHIFT 1 | | | SHIFT 2 | | | SHIFT 3 | | | SHIFT 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TIME | CONTRL | ASS.C | TIME | CONTRL | ASS.C | TIME | CONTRL | ASS.C | TIME | CONTRL | ASS.C |
| 23.30 | JONIARTA | SUARSA | 05.30 | CITTA | CHANDRA | 11.30 | SUCIPTO/OJT | DIPA | 16.00 | RHONA Y | |
| 01.00 | SUARSA | JONIARTA | 07.00 | CHANDRA | CITTA | 13.00 | DIPA | GEDE T.J | 18.30 | SULASTIAWAN | |
| 02.30 | AYU PUSPITA | DEVA | 08.30 | RAI DEWI | BARA | 14.30 | GEDE T.J | SUCIPTO/OJT | 21.00 | ROZI NST/OJT | |
| 04.00 | DEVA | AYU PUSPITA | 10.00 | BARA | RAI DEWI | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| SPV | SUARSA | | SPV | IBP WISMA A. | | SPV | SUCIPTO | | SPV | SULASTIAWAN | |
| MAN.OPS | IPG SUANDITHA | | MAN.OPS | MERDI T. URIKO | | MAN.OPS | NGURAH SUJI | | MAN.OPS | NGURAH SUJI | |

B. BALI WEST TMA ( 119.3 MHz )

| SHIFT 1 | | | SHIFT 2 | | | SHIFT 3 | | | SHIFT 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TIME | CONTRL | ASS.C | TIME | CONTRL | ASS.C | TIME | CONTRL | ASS.C | TIME | CONTRL | ASS.C |
| | | | 05.30 | ANGGA | WISMA/SURYA | | | | | | |
| 02.30 | PRASAMYA | INDRA | 07.00 | WISMA/SURYA | ANGGA | | | | | | |
| 04.00 | INDRA | PRASAMYA | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| SPV | SUARSA | | SPV | IBP WISMA A. | | SPV | | | SPV | | |
| MAN.OPS | IPG SUANDITHA | | MAN.OPS | MERDI T. URIKO | | MAN.OPS | | | MAN.OPS | | |

C. BALI EAST TMA ( 119.9 MHz )

| SHIFT 1 | | | SHIFT 2 | | | SHIFT 3 | | | SHIFT 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TIME | CONTRL | ASS.C | TIME | CONTRL | ASS.C | TIME | CONTRL | ASS.C | TIME | CONTRL | ASS.C |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| SPV | | | SPV | | | SPV | | | SPV | | |
| MAN.OPS | | | MAN.OPS | | | MAN.OPS | | | MAN.OPS | | |

Figure 2. Daily report Bali APP

After the COVID-19 pandemic decreased, traffic began to increase to reach 400 traffic per day, of course, this caused an increase in the load of communication, especially for ATC in the West TMA sector.

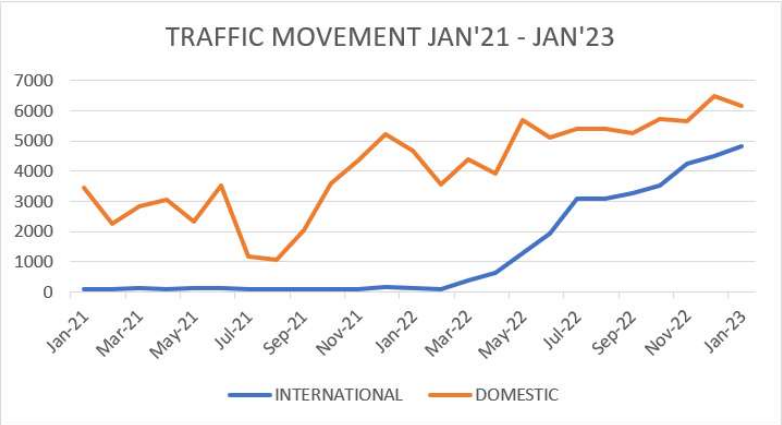


Figure 3. Traffic movement graph January 2021 to January 2023

The temporary takeover of responsibility for the East TMA sector is due to the lack of personnel if it is in accordance with the calculation of the number of personnel in the MOS CASR 172 Perum LPPNPI Denpasar Year 2022, namely:

In the 2022 Denpasar Branch Aviation Traffic Service Provider Operation Manual document, Chapter III Section 3.2 concerning Personnel Data, the method of calculating personnel needs in each work unit is attached, which is as follows:

In accordance with the Decree of the Director General of Civil Aviation Number: KP 166 of 2020, the calculation of the number of personnel needed at Perum LPPNPI Denpasar Branch is determined as follows:

$$\textbf{Number of Personnel} = \frac{\textbf{OH x 365 x number of set crew in a sector}}{\textbf{Effective working hours of personnel per year}}$$

Remarks:

- Effective working hours of ATC personnel per year = 1,128 hours (47 weeks x 24 hours)

When the average traffic is 1-16 per hour, it is not mandatory to assign dedicated personnel to function as supervisors, but the supervisor function still exists and personnel appointments are carried out by unit leaders. Operation Manual CASR 172 Flight Traffic Service Provider Perum LPPNPI Sub-Branch Denpasar III-12 When the average traffic is more than 17 per hour, it is mandatory to assign 1 (one) personnel to function as a dedicated supervisor. Then the calculation is:

a) Approach Control Unit – Bali CTR – Bali Radar

Average number = 19 movements/hour

Number of set crew = 3 set crew

$$\text{Number of Personnel} = \frac{\text{Operating Hours x 365 x Number of Set Crew}}{\text{Effective working hours of ATC personnel per year}}$$

$$= 24 \times 365 \times \frac{3}{1128}$$

$$= \frac{26280}{1128}$$

$$= 23{,}2878 = 24 \text{ personnel}$$

b) Approach Control Unit – Bali TMA West – Bali Radar

Average number = 19 movements/hour

Number of set crew = 3 set crew

$$\text{Number of Personnel} = \frac{\text{Operating Hours x 365 x Number of Set Crew}}{\text{Effective working hours of ATC personnel per year}}$$

$$= 16 \times 365 \times \frac{3}{1128}$$

$$= \frac{17520}{1128}$$

$$= 15{,}53 = 16 \text{ personnel}$$

c) Approach Control Unit – Bali TMA East – Bali Radar

Average number = 16 movements/hour

Number of set crew = 2 set crew

$$\text{Number of Personnel} = \frac{\text{Operating Hours x 365 x Number of Set Crew}}{\text{Effective working hours of ATC personnel per year}}$$

$$= 12 \times 365 \times \frac{2}{1128}$$

$$= \frac{8760}{1128}$$

$$= 7{,}76 = 8 \text{ personnel}$$

From these calculations, the number of personnel needed in the Approach Control Unit is 48 people while currently there are only 35 personnel that have an Approach Control Surveillance rating at Perum LPPNPI Denpasar Branch.

This lack of personnel delayed the resumption of the East TMA sector, causing an increase in the workload of ATCs in charge of the West TMA sector, especially an increase in a load of communication, according to [6] communication load refers to the actual effect of the message load on the processing capacity of the sender or receiver. According to [7] it is possible that the speed of speaking is increased to "squeeze" more information in a given period of time since the increased workload requires more communication in a given period of time. Time Task cycles and changes in air traffic control affect fatigue caused by workloads [8], this certainly increases the risk of breakdown of separation and breakdown of communication and can cause incidents or even accidents. [9] stated that assuming the operator detects a potential overload in the ATC sector, it can check whether changing routes or delaying some flights can reduce the workload in that sector, and see the impact on other sectors. Therefore, to reduce the workload of ATC so as to reduce the number of human errors, sector optimization is needed. The purpose of this study is to describe the actual conditions in the field and their impact so as to get solutions that can be suggestions for Perum LPPNPI Denpasar Branch to improve flight traffic services.

## II. METHODS

### *A. Data Collection Methods*

In this study, the author used qualitative descriptive data analysis techniques. The data analyzed are the traffic movement of I Gusti Ngurah Rai International Airport Bali, the ATC service schedule of the APP / TMA unit, the number of ATC personnel who have an Approach Control Surveillance rating, and the calculation of the ideal number of personnel according to the Operation Manual CASR 172 Perum LPPNPI Denpasar Branch.

Qualitative research methods are methods for understanding a phenomenon from the point of view of the subject, described in words and sentences in a defined natural context. Qualitative research methods are suitable for problems that are (1) exploratory in nature; (2) descriptive and (3) explanatory [10]. This research uses an analytical descriptive method with a qualitative approach. However, descriptive research is more accurately called the "type or nature of research" compared to certain

research methods [11]. Data collection techniques use documentation studies. The documentation method is the collection of information by recording existing information. Data collection techniques with documentation are the collection of information obtained through documents [12].

*B. Data Processing Methods*

In this type of qualitative research, data processing does not have to be done after the data is collected or data processing is complete. In this case, temporary data is collected, existing data can be processed and data analysis is carried out simultaneously. At the time of data analysis, you can return to the field to find additional data that is considered necessary and process it again. [13]-data processing in qualitative research is carried out by classifying or categorizing data based on several themes according to the focus of the research. Data processing in this study consists of:

*I. Data Reduction*

Data reduction is a process of selection, focusing on simplifying, abstracting, and transforming rough data that emerges from field notes [14]. The steps taken are to sharpen the analysis, classify or categorize each problem through brief descriptions, direct, remove unnecessary ones, and organize the data so that it can be pulled and verified. The reduced data include all data on research problems.

The reduced data will provide a more specific picture and make it easier for researchers to collect further data and find additional data if needed. The longer researchers are in the field, the more data there will be, the more complex and complicated. Therefore, data reduction needs to be done so that the data is not stacked so as not to complicate subsequent analysis.

*II. Data Presentation*

After the data is reduced, the next step of analysis is the presentation of the data. The presentation of data is a set of structured information that provides the possibility of drawing conclusions and taking action [14]. The presentation of data is directed so that the reduced data is organized, and arranged in a relationship pattern so that it is easier to understand. The presentation of data can be done in the form of narrative descriptions, charts, relationships between categories, and flowcharts. The presentation of data in this form makes it easier for researchers to understand what is happening. In this step, researchers try to compile relevant data so that the information obtained is concluded and has a certain meaning to answer the research problem. Good data presentation is an important step toward achieving valid and reliable qualitative analysis. In presenting data, it is not merely described narratively, but accompanied by a continuous analysis process until the process of drawing conclusions. The next step in the qualitative data analysis process is to draw conclusions based on the findings and verify the data.

*III. Draw conclusions or verify*

This stage is the stage of drawing conclusions from all data that have been obtained as a result of research. Conclusion drawing or verification is an attempt to find or understand the meaning/meaning, order, patterns, explanations, the flow of cause and effect, or propositions. Before drawing conclusions, data reduction, data presentation, and conclusion drawing or verification of previous activities are carried out. In accordance with the opinion of Miles and Huberman, the analysis process is not a one-time event, but interactive, going back and forth between reduction, presentation, and conclusion drawing or verification activities during the research time. After verifying, conclusions can be drawn based on the results of research presented in the form of a narrative. Drawing conclusions is the final stage of data analysis activities. This conclusion is the final stage of data processing.

*C. Data Analysis Methods*

Data processing is carried out based on each data acquisition from field notes, reduced, described, analyzed, then interpreted. The procedure for analyzing data on problems is more focused on efforts to explore facts as they are (natural setting), with study deepening analysis techniques (Verstegen) To provide an overview of research data, the following procedures are carried out:

1) Data presentation stage: data is presented in the form of an integrated description.
2) Comparison stage: the process of comparing the results of data analysis that have been described with the interpretation of data to answer the problem under study. The data obtained from the description results will be compared and discussed based on the theoretical basis.

3) Stage of presentation of research results: this stage is carried out after the comparison stage, which is then summarized and directed to conclusions to answer the problems that have been raised by researchers.

*D. Place and Date of Research*

1) Place: Approach Control Unit of Perum LPPNPI Denpasar Branch, Bali, Indonesia

2) Date : January 2023

## III. Results And Discussion

As a solution to the problem that the author already experienced, here are things that are possible to do at Perum LPPNPI Denpasar Branch Office to optimize the East Terminal Control Area (TMA) sector as follows:

1) Determining Operating Hours (OH) in the West and East TMA sectors by adjusting peak hours, so it does not need 12 and 16 hours as stated in the Operation Manual CASR 172 Perum LPPNPI Denpasar Branch in 2022 because this has an impact on calculating the needs of the number of personnel. As stated in Table I, it can be concluded that peak hours are at 04.00 UTC – 09.00 UTC (5 hours).

Table I. Traffic movement on January 2023

| TIME (UTC) | AVERAGE TRAFFIC MOVEMENTS |
|---|---|
| 00.00-00.59 | 13,9 |
| 01.00-01.59 | 16,9 |
| 02.00-02.59 | 15,8 |
| 03.00-03.59 | 21,3 |
| 04.00-04.59 | 26,0 |
| 05.00-05.59 | 26,1 |
| 06.00-06.59 | 27,1 |
| 07.00-07.59 | 27,1 |
| 08.00-08.59 | 26,7 |
| 09.00-09.59 | 16,5 |
| 10.00-10.59 | 16,3 |
| 11.00-11.59 | 20,5 |
| 12.00-12.59 | 21,1 |
| 13.00-13.59 | 18,7 |
| 14.00-14.59 | 14,8 |
| 15.00-15.59 | 10,5 |
| 16.00-16.59 | 6,8 |

| | |
|---|---|
| 17.00-17.59 | 5,0 |
| 18.00-18.59 | 0,4 |
| 19.00-19.59 | 0,1 |
| 20.00-20.59 | 0,1 |
| 21.00-21.59 | 0,1 |
| 22.00-22.59 | 2,0 |
| 23.00-23.59 | 20,4 |

2) After determining the Operating Hours (OH) in the West and East TMA sectors, it is better to recalculate the number of personnel needs. The results of the author's calculations are as follows:

a) Approach Control Unit – Bali CTR – Bali Radar

Average number = 19 movements/hour

Number of set crew = 3 set crew

$$\text{Number of Personnel} = \frac{\text{Operating Hours x 365 x Number of Set Crew}}{\text{Effective working hours of ATC personnel per year}}$$

$$= 24 \times 365 \times \frac{3}{1128}$$

$$= \frac{26280}{1128}$$

$$= 23{,}2878 = 24 \text{ personnel}$$

b) Approach Control Unit – Bali West TMA – Bali Radar

Average number = 19 movements/hour

Number of set crew = 3 set crew

$$\text{Number of Personnel} = \frac{\text{Operating Hours x 365 x Number of Set Crew}}{\text{Effective working hours of ATC personnel per year}}$$

$$= 5 \times 365 \times \frac{3}{1128}$$

$$= \frac{5475}{1128}$$

$$= 4{,}8 = 5 \text{ personnel}$$

c) Approach Control Unit – Bali East TMA – Bali Radar

Average number = 16 movements/hour

Number of set crew = 2 set crew

$$\text{Number of Personnel} = \frac{\text{Operating Hours x 365 x Number of Set Crew}}{\text{Effective working hours of ATC personnel per year}}$$

$$= 5 \times 365 \times \frac{2}{1128}$$

$$= \frac{3650}{1128}$$

= 3,2 = 4 personnel

By changing the Operating Hours (OH) in the West and East TMA sectors, the total personnel needed is 33 personnel which is sufficient with the current number of personnel (35 personnel).

3) Set the official schedule in accordance with the fatigue risk management system so that the East Terminal Control Area (TMA) can operate normally again. While fatigue risk management system according to [15] is a data-driven means to continuously monitor and manage fatigue-related safety risks, based on scientific principles and knowledge and operational experience aimed at ensuring relevant personnel work at an adequate level of vigilance.

## IV. CONCLUSION

The conclusion that can be drawn from the problems described is that the optimization of the East Terminal Control Area (TMA) sector is carried out by reviewing the determination of the West and East TMA Operating Hours (OH) and calculating the number of personnel so that the East Terminal Control Area (TMA) sector can operate normally again as the number of traffic increases.

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