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THE EFFECT OF METEOROLOGICAL UNDERSTANDING OF AERODROME CONTROL TOWER PERSONNEL ON AIR TRAFFIC SERVICES AT MAKASSAR AIR TRAFFIC SERVICE CENTER

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Abstrak

Personel ATC memiliki peran penting dalam proses diseminasi informasi meteorologi dalam penerbangan. Tujuan dari penelitian ini adalah mengetahui seberapa besar pengaruh pemahaman meteorologi personel ATC terhadap pelayanan lalu lintas penerbangan di Makassar Air Traffic Services Center. Metode penelitian kuantitatif digunakan dengan pengumpulan data menggunakan kuesioner dan wawancara tidak terstruktur kepada personel ATC dan pilot di Bandar Udara Internasional Sultan Hasanuddin Makassar. Pengolahan data yang digunakan pada penelitian ini adalah uji korelasi, uji determinasi, dan regresi linier sederhana.Penelitian ini menghasilkan koefisien korelasi sebesar 0,79117 dan koefisien determinasi sebesar 62,6% yang menjelaskan bahwa pemahaman meteorologi dan pelayanan lalu lintas penerbangan memiliki hubungan yang kuat dan pemahaman meteorologi memberikan kontribusi sebesar 62,6% terhadap pelayanan lalu lintas penerbangan. Regresi linier sederhana menunjukkan bahwa setiap penambahan 1 nilai pemahaman meteorologi maka pelayanan lalu lintas penerbangan akan meningkat sebesar 1,79111, semakin baik pemahaman meteorologi personel ATC maka semakin baik juga pelayanan lalu lintas penerbangan di Makassar Air Traffic Services Center.
Kata Kunci : meteorologi penerbangan; pelayanan lalu lintas penerbangan

Abstract

ATC personnel have an important role in the process of disseminating meteorological information for every phase of flight. The purpose of this study is to find out how much influence the meteorological understanding of ATC personnel has on air traffic services at Makassar Air Traffic Services Center. The quantitative research method is used by collecting data using questionnaires for ATC personnel and unstructured interviews with pilots at Sultan Hasanuddin International Airport in Makassar. The data processing used in this study is a correlation test, determination test, and simple linear regression. This study found the correlation coefficient is 0.79117 and the coefficient of determination is 62.6% which explains that understanding meteorology and air traffic services has a strong relationship and personnel ATC's understanding of meteorology contributes 62.6% to air traffic services. Simple linear regression shows that for every additional 1 value of meteorological understanding, air traffic services will increase by 1.79111, the better the meteorological understanding of ATC personnel, the better the air traffic services at Makassar Air Traffic Services Center
Keywords: aviation meteorology; air traffic services

INTRODUCTION

Air transportation is highly dependent on weather conditions and its changes (Saputra et al. 2015). Meteorological information in Indonesia is provided by the

Indonesian Agency for Meteorological, Climatological and, Geophysics (BMKG) which the meteorological information is given to ATC personnel to be disseminated to pilots as information for take-off process, during the flight to landing at the destination airport.

The purpose of the meteorological service as stated in Annex 3 of the Meteorological Service for International Air Navigation is to support the safety, regularity and efficiency of international navigation. ATC personnel have an important role in providing assistance to pilots regarding the weather by providing timely and accurate information (Alshaqah et al., 2019). Therefore, meteorological knowledge of ATC personnel is important in order to assist pilots in avoiding dangerous weather conditions for flights (Pradana, 2015).

Runway excursion happened at Sultan Hasanuddin International Airport in Makassar on June 2, 2015 where ATC personnel did not know the level of cumulonimbus clouds and changes in wind speed were not well anticipated by pilots and ATC personnel causing the aircraft to veered off the runway shortly after landing (KNKT, 2020). In the same year in Wamena an aircraft with registration PK-BBY was not given information about the gusty wind by ATC personnel caused the plane skidded (KNKT, 2020).

Identification of problems in this study is:

1. The level of meteorological understanding by ATC personnel in the aerodrome control tower at Makassar Air Traffic Services Center remains unknown.
2. There is no meteorological understanding monitoring and provision to maintain and improve the meteorological understanding of ATC personnel.
3. The influence of ATC personnel's meteorological understanding on Air Traffic Services at the Makassar Air Traffic Services Center is not yet known.

This study aims to determine the meteorological understanding of ATC personnel, to measure the air traffic services, and determine the effect of understanding meteorology for ATC personnel on air traffic services at the Makassar Air Traffic Services Center. The benefit of this research is to provide advice regarding

the importance of meteorological understanding of ATC personnel in the provision of air traffic services and to contribute for meteorological knowledge improvement.

Meteorology is a field of science that studies the atmosphere and all the phenomena inside (Suryanto and Luthfian, 2016). Aviation meteorology is the weather used for the operation of each phase of the flight (Saputra et al. 2015). The condition of the weather will determine the flight process whether to be continued, postponed, or canceled (Wulandari, 2021).

According to Annex 3 of the Meteorological Service for International Air Navigation, meteorological information is defined as meteorological reports, analyses, forecasts, and other statements relating to current or future meteorological conditions. Meteorological information is made by the Meteorological Unit which is then the information is given to ATC personnel every 30 minutes and if there is a significant change in weather that affects flight operations the pilot has to be informed as soon as possible.

Based on the Peraturan Menteri Perhubungan No. PM 95 Tahun 2018 tentang Peraturan Keselamatan Penerbangan Sipil Bagian-69 tentang Pelayanan Informasi Meteorologi Penerbangan, the form of meteorological reports are:

1. Routine observation report
2. Special observation report
3. Observation of volcanic activity report and reports of volcanic activity
4. Aircraft observation report

The contents of the meteorological observation report at the airport are as follows:

1. Type of report
2. Location indicator
3. Observation time
4. Identify if the report is automated
5. Surface wind direction and speed
6. Visibility
7. Runway visual range, if any
8. Present weather

9. Cloud amount, cloud type (for cumulonimbus and towering cumulus clouds) and cloud height or, vertical visibility
10. Air temperature and dew point temperature
11. QNH and if necessary QFE (QFE included only in local routine and special reports)
12. In addition, additional information

Air traffic services are divided into air traffic control service, flight information services, and alerting services. Air traffic control services based on Annex 11 Air Traffic Services are divided into aerodrome control service, approach control service, and area control service.

Document 4444 ATM/501 Procedures for Air Navigation Services states that the aerodrome control tower is an air traffic control service unit for all traffic in the maneuvering area and all aircraft that are, arriving, or leaving the traffic circuit. According to Document 9426-AN/924 Air Traffic Services Planning Manual, ATC personnel responsible for the flow of air traffic, assist pilots in an emergency and provide information needed for flights.

METHOD

The study was conducted at the Makassar Air Traffic Services Center with the population and sample of 30 ATC personnel who worked in the aerodrome control tower and had an aerodrome control rating. The meteorological understanding is the independent variable or an influencing variable in this study and air traffic services as a dependent variable or an affected variable. Data were collected using closed-ended questionnaires to ATC personnel at the Makassar Air Traffic Services Center. Open-ended questionnaires and unstructured interviews with pilots who have flown to and from Sultan Hasanuddin International Airport.

Table 1. Research Instrument for Meteorological Understanding

Dimension	Indicator
Atmosphere	The meaning of atmosphere
	Atmospheric layer structure

Temperature	Lapse rate
	Temperature effect to weather changes
	Temperature effect
Atmospheric Pressure	The variation of atmospheric pressure
	Atmospheric effect pressure
Humidity	Water vapor content
	Effect of humidity
Visibility	Results that affect visibility
Precipitation	Liquid precipitation
Movement of Air in the Atmosphere	Local wind system
	Wind effect
Cloud	Main form of cloud
	Cloud effect
Meteorology Codes	*METAR*
	TAFOR
	SIGMET
Turbulence/High Altitude Weather Flying	Turbulence
	Clear Air Turbulence

Table 2. Research Instrument for Air Traffic Services

Dimension	Indicator
Safety	Prevent accident/incident
	Prevent BOS and BOC
	Precise in giving clearance and instruction
	Precise in giving clearance and instruction
	Dissemination of appropriate information (precise, fast, and accurate)
	Understanding of tools used for work
	Predict and prevent potential

Efficiency	hazard
	Efficiency in the provision of separation and sequences in accordance with standard operating procedure
	Optimizing the use of airspace
	Accuracy and speed of ATC personnel in making decisions
	Reduce delay and holding on the ground and in the air
Regularity	Precise and skilled in determining the sequence
	Coordination

Data analysis used in this study are validity tests to ensure that the instruments used can measure variables (Sugiyono 2019), reliability tests to measure the reliability of measuring instruments, normality tests to assess the distribution of data, and linearity tests to determine whether the two variables have a linear relationship (Pradana 2019). Hypothesis testing in this study used a correlation test is used to find the relationship between the two variables, a determination test is used to measure the contribution of meteorological understanding to air traffic services, and simple linear regression is used to predict the value of the Air Traffic Services variable which is influenced by the meteorological understanding variable.

RESULT AND DISCUSSION

METEOROLOGICAL UNDERSTANDING

The closed question questionnaire used the Guttman scale as the measuring scale. Guttman scale is a measuring scale with only 2 choices of answers. The results of the closed question questionnaire given to the sample obtained are as follows:

Table 3. Meteorological Understanding Result

No.	Score	No.	Score
1.	19	16.	16
2.	19	17.	15
3.	19	18.	14
4.	19	19.	14
5.	18	20.	13
6.	18	21.	13
7.	18	22.	13
8.	18	23.	13
9.	18	24.	12
10.	18	25.	12
11.	18	26.	12
12.	18	27.	12
13.	17	28.	11
14.	17	29.	11
15.	17	30.	10
			462

Based on the results of the questionnaire, a total score of 462 was obtained from a maximum score of 600 so the percentage of meteorological understanding obtained was 77%. The level of meteorological understanding is good if it is above 75%. These results are supported by open-ended questions to the pilot and the results of unstructured interviews.

Table 4. Understanding Percentage

Percentage (%)	Explanation
85-100	Very Good
75-84	Good
60-74	Acceptable
50-59	Poor
0-49	Very Poor

AIR TRAFFIC SERVICES

Air Traffic Services data were obtained through closed-questionnaire data given to the research sample using a Likert scale. The questionnaire was distributed via google form and the following results were obtained:

Table 5. Air Traffic Services Result

No.	Score	No.	Score
1.	57	16.	48
2.	53	17.	50
3.	53	18.	49
4.	60	19.	48
5.	60	20.	49
6.	54	21.	50
7.	58	22.	50
8.	59	23.	48
9.	60	24.	45
10.	59	25.	47
11.	49	26.	49
12.	52	27.	46
13.	48	28.	44
14.	52	29.	42
15.	52	30	38
		Total	1529

The total score obtained for the Air Traffic Services variable is 1529 with the maximum score that can be obtained being 1600, so it is found that the Air Traffic Services in Makassar Air Traffic Services is good. This statement is supported by the results of open-ended questionnaires and unstructured interviews with pilots who have flown to Sultan Hasanuddin International Airport Makassar.

Data analysis begins by testing the validity of the research instrument using the biserial point correlation for the meteorological understanding

variable and the Pearson product moment correlation for the Air Traffic Services variable. The data is declared valid if rpbi>rtable, where in this study the value of rtable is 0.361, so that the following results are obtained:

Table 6. Meteorological Understanding Validity Test Result

No	r_{pbi}	r_{tabel}	Result
1.	0,457	0,361	Valid
2.	0,419	0,361	Valid
3.	0,389	0,361	Valid
4.	0,518	0,361	Valid
5.	0,449	0,361	Valid
6.	0,154	0,361	Invalid
7.	0,280	0,361	Invalid
8.	0,323	0,361	Invalid
9.	0,236	0,361	Invalid
10.	0,389	0,361	Valid
11.	0,509	0,361	Valid
12.	0,160	0,361	Invalid
13.	0,503	0,361	Valid
14.	0,533	0,361	Valid
15.	0,319	0,361	Invalid
16.	0,184	0,361	Invalid
17.	0,514	0,361	Valid
18.	0,539	0,361	Valid
19.	0,037	0,361	Invalid
20.	0,289	0,361	Invalid

Table 7. Air Traffic Services Validity Test Result

No	r_{pbi}	r_{tabel}	Keterangan
1.	0,603	0,361	Valid
2.	0,620	0,361	Valid

3.	0,606	0,361	Valid
4.	0,694	0,361	Valid
5.	0,371	0,361	Valid
6.	0,676	0,361	Valid
7.	0,783	0,361	Valid
8.	0,426	0,361	Valid
9.	0,681	0,361	Valid
10.	0,802	0,361	Valid
11.	0,701	0,361	Valid
12.	0,426	0,361	Valid

11 instruments of meteorological understanding variables were declared valid and 9 others were declared invalid, the instruments that were declared invalid were not used for further testing. All Air Traffic Services instruments were used for reliability testing because all instruments were declared valid. The reliability test was carried out using KR 21 for the meteorological understanding variable and alpha cronbach to test the Air Traffic Services variable. After being tested, it was stated that both data were declared reliable.

Table 8. Reliability Test Result

Meteorological Understanding	Air Traffic Services
r_{11} : 0,871938 0,871938 > 0,6	r_{11} : 0,854717 0,854717 > 0,6

The normality test was carried out to see the distribution of the data. The test used the Kolmogorov Smirnov technique to determine whether the data is normally distributed or not. The data is declared to be normally distributed if the value of difference (D) was smaller than that specified in the table of critical test values, 0.242. Based on the tests conducted, it is stated that the two variables are normally distributed.

Table 9. Normality Test Result

Meteorological Understanding	Air Traffic Services
D : 0,120355 0,120355 < 0,242	D : 0,135284 0,135284 < 0,242
Conclusion: Data Normally Distributed	Conclusion: Data Normally Distributed

After conducting the normality test, a linearity test was conducted to determine whether the data of the two variables had a linear relationship. The data have a linear relationship if Fcount is greater than Ftable, where in this study the value of Ftable is 4.18. Based on the tests conducted, the two data have a linear relationship.

Table 10. Linierity Test Result

F (F_{count})	F_{table}
46,8577	4,18
46,8577 > 4,18	

Further testing of the hypothesis is done by doing a correlation test, a test of determination, and simple linear regression. The correlation test was carried out using the product moment correlation test and obtained a correlation coefficient of 0.79117 which means that the two variables have a strong relationship.

Table 11. Correlation Interpretation

Coefficient Interval	Correlation
0,00 - 0,199	Very Low
0,20 - 0,399	Low
0,40 - 0,599	Moderate
0,60 - 0,799	Strong
0,80 - 1,00	Very Strong

The contribution of the meteorological understanding variable to the aviation traffic service is calculated using a determination test. After the

calculation is carried out, it was found that the coefficient of determination is 62.6%, which means that meteorological understanding contributes 62.6% to the Air Traffic Services.

Table 12. Determination Test Result

CD = r2 x 100%
CD = 0,791172 x 100%
CD = 62,59568391%

The prediction of the value of the Air Traffic Services variable which influenced by meteorological understanding is obtained using simple linear regression with the help of data analysis on the Microsoft Excel 2016 application and the equation is obtained:

$$Y' = 36{,}6975 + 1{,}79111X \quad (1)$$

Based on the above equation, it can be concluded that:

a. The constanta value is 36.6975, which means the value of air traffic services is 36.6975 if the value of meteorological understanding is equal to zero.
b. The regression coefficient for the meteorological understanding variable is 1.7911, which means that for every 1 additional meteorological understanding value, the flight traffic service value increases by 1.7911.

CLOSING

Conclusion

Meteorological understanding of ATC personnel at Makassar Air Traffic Services Center is good with an understanding percentage of 77% from 100% based on the results of questionnaires given to ATC personnel and pilot statements. The results of the Air Traffic Services questionnaire show that the flight traffic service at Makassar Air Traffic Services is good with a total score of 1529 with a maximum score of 1600. Statements from pilots who have flown to Sultan Hasanuddin Airport Makassar are that the Air Traffic Services in Makassar Air Traffic Services is good. so this statement supports the results of the questionnaire to ATC personnel.

The meteorological and air traffic services have a strong relationship with a correlation coefficient is 0.79117 and meteorological understanding influenced 62.6% of the air traffic services. For every additional 1 value of meteorological understanding, the value of air traffic services increases by 1.79111.

So it is necessary to increase the understanding about aviation meteorology of ATC personnel by providing regular theoretical classes to refresh and improve the understanding on meteorology of the ATC personnel, conducting briefings with the Meteorological Unit before carrying out service, increasing the active role of personnel in providing meteorological information, and increasing the contribution of ATC personnel to ensure that all available information is in accordance with conditions that occur on the field. In addition, all equipment must be ensured in good condition and ATC personnel have to be aware of any changes in the weather that occur when conducting services.

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