



Factors Affecting Flight Delays of Aerodrome and Approach Control Services at Don Mueang International Airport

Amornateb Intasorn*, Thanyarat Khamproh, Sathaporn Srisomwong, and Attapol mungsawad

Master of Management Program in Aviation Management, Civil Aviation Training Center,
Bangkok, Thailand

*Corresponding author, E-mail: amornatebatc@gmail.com

Abstract

This quantitative research aimed to study 1) flight delays level and 2) factors affecting the flight delays of Aerodrome Control Service and Approach Control Service at Don Mueang International Airport. Six Thai and five International studies, international air transport association airport manual, and international civil aviation organization (ICAO) documents, ICAO Annex 11, ICAO DOC 4444 were reviewed and cited in the study. The sample group consists of 86 air traffic controllers who provide air traffic control services at the Aerodrome and Approach Control Services at Don Mueang International Airport. The research used a questionnaire as a tool for data collection and statistical tools such as mean, standard deviation, and multiple regression analysis for data analysis. The results of the study revealed that the factors affecting flight delays were at a high level with an overall mean of 3.89. Each of the five major factors affecting the flight delays was also at a high level. The air traffic volume was at the highest level ($\bar{x} = 4.18$), followed by the air traffic services ($\bar{x} = 4.05$), the weather ($\bar{x} = 4.00$), the airport ($\bar{x} = 3.71$), and the ground passenger management activities ($\bar{x} = 3.64$). The factors affecting the flight delays of the Aerodrome Control Service and Approach Control Service at Don Mueang International Airport were air traffic volume ($R = 0.43$) at 18.50% and the airport factor ($R = 0.47$) at 22.50%. The research further found that every independent factor had a high-level effect on the flight delays, and the factors that had directly affected flight delays were air traffic volume factor and airport factor out of five factors.

Keywords: Delays, Flights, Aerodrome Control Service, Approach Control Service

1. Introduction

Thailand has developed a main strategic plan and sustainable development goals (SDGs) as well as restructured Thailand to Thailand 4.0, which was considered one of the key strategies of the 12th National Development Plan. Thailand had the policy to prepare for future industrial development or New S Curve including the Robot industry, Aviation and Logistics industry, Biofuel and Biochemical industry, Digital industry, and Integrated Medical industry to drive the country's economy from the expansion of various industrial sectors, especially the aviation and logistics industry since Thailand had a geographical advantage over other countries in Southeast Asia (Middle of Southeast Asia) (Charoensook, 2017). The countries with good and efficient transportation systems would possess an advantage of developing the country's economic base as these developed transportation systems could improve the economy by bringing in large amounts of income to circulate domestic expenditure. Thailand is currently in a very high airline traffic situation. As statistics showed in 2019, Thailand had a very high air traffic volume among the 35 airports. It had grown by 10% on average of about 3,000 flights a day, or less than 1 million flights per year, and will increase by one-fold or not less than 2 million flights a year within the next 15 years (Naewna, 2019).

An increase in flight volume causes the amount of air traffic in the airspace to be denser than ever before, which resulted in higher workloads for the air traffic controllers to operate air traffic services in 3 main departments; 1) Aerodrome Control Service, 2) Approach Control Service, and 3) Area Control Service. Regardless of flight volume, the air traffic control services had 3 purposes to achieve: 1) Preventing collision between aircraft and aircraft, 2) Preventing collision on the maneuvering area between aircraft and obstructions, and 3) Expediting and maintaining an orderly flow of air traffic (International Civil Aviation Organization, 2001). Due to the geographical structure and various factors at Don Mueang International Airport, it is different from most general airports. It offers services to commercial aircraft operating both domestic and international flights, aircraft that are used in training and military missions, and aircraft that serve important persons both domestic and abroad. As a result, Don

[303]



Mueang International Airport provides much more diverse and different air traffic control services from other airports, especially in the area of responsibility in the airspace of Don Mueang International Airport for the Approach Control Service that overlaps with that of the Approach Control Service at Suvarnabhumi International Airport. Therefore, the air traffic controller needs to provide a separate control between aircraft, either in the air and on the ground, which can also cause flight delays at the Aerodrome and Approach Control Services at Don Mueang International Airport.

From the background and importance of the problems, the researchers were interested in studying the factors that affect the flight delays from air traffic management at Aerodrome and Approach Control Services at Don Mueang International Airport to have a guideline to reduce the impact of the air traffic management on flight delays and increase the efficiency and effectiveness of the air traffic controllers in managing and controlling the airspace.

2. Objectives

- 1) To study the flight delays level of Aerodrome and Approach Control Services at Don Mueang International Airport
- 2) To study the factors affecting the flight delays of Aerodrome and Approach Control Services at Don Mueang International Airport

3. Materials and Methods

3.1 Population and population samples

The population included in this study were 110 air traffic controllers who provide Aerodrome and Approach Control Services at Don Mueang International Airport, 86 of them were the sample group. The sample size was determined through purposive sampling using the Krejcie & Morgan table.

3.2 Reliability and Validity of Research Tools

The research tool used is a close-ended questionnaire about the factors that affect the flight delay with 5-point Likert rating scales and evaluation criteria such as 1.00-1.50 (very low), 1.51-2.50 (low), 2.51-3.50 (moderate), 3.51-4.50 (high), and 4.51-5.00 (very high). The errors were rectified and calculated to validate the reliability of questionnaires using the Index of Concurrence (IOC). The IOC of the rated questionnaires showed the results of 0.66-1.00, which is more than 0.5 (Rovinelli and Hambleton, 1977) and is considered reliable. With three experts in the aviation industry and the Cronbach alpha coefficient of the factors affecting flight delays of 0.864, which is more than 0.5, it indicates that the questionnaires had high reliability (Cronbach, 1990).

3.3 Data Collection

The researchers collected the data with the help of the Head of the Air Traffic Control Tower and the Head of Human Resources at Aeronautical Radio of Thailand Ltd. to distribute 86 questionnaires online. The researchers then followed up and collected the respondents' responses through online surveys. The questionnaires were completed and analyzed 86 copies of the data, representing 100 percent.

3.4 Data Analysis

The researchers used statistics to compare and classify personal characteristics factors in analyzing the mean (\bar{x}) and standard deviation (SD) to answer research question 1 and achieve the first objective. Linear Multiple Regression statistics was used to analyze the data collected specifically the Stepwise Model with the statistical significance level of 0.05 to answer the research question 2 and achieve the second objective.



4. Results and Discussion

1) Based on the online survey conducted using a questionnaire, the air traffic controllers rated the factors affecting the flight delays of Aerodrome and Approach control services at Don Mueang International Airport at a high level with an overall mean of 3.89 and standard deviation of 0.48. It was found that among the factors affecting the flight delays, the air traffic volume obtained the highest mean of 4.18 with a standard deviation of 0.58, the mean of the air traffic service was 4.05 with a standard deviation of 0.62, the mean of the weather was 4.00 with a standard deviation of 0.66, the mean of the airport was 3.71 with a standard deviation of 0.66, and the last factor, ground passenger management, had the mean of 3.64 with a standard deviation of 0.68.

The research results showed the overall mean of five operational-related factors; air traffic volume, air traffic service, weather, airport, and ground passenger management activities, as a high level with a mean of 3.89 and a standard deviation of 0.48. Further descriptions of the overall factors affecting flight delays are shown in Table 1.

Table 1 The flight delays level on factors affecting flight delays of aerodrome and approach control services at Don Mueang International Airport

Factors affecting flight delays	\bar{x}	S.D.	Level
1. Air Traffic Volume	4.18	0.58	High
2. Air traffic service	4.05	0.62	High
3. Weather	4.00	0.66	High
4. Airport	3.71	0.66	High
5. Ground passenger management activities	3.64	0.68	High
Include all averages	3.89	0.48	High

In summary, the air traffic controllers rated the factors affecting the flight delays at Don Mueang International Airport similar or not different from each other since every factor affected the flight delays. It depended on the difference of time, place, or situation to identify which among the factors had the most effect on the flight delays. The air traffic controllers had no control over the delays other than to prepare and plan when the flight delays occur.

2) The independent variables were related to the dependent variables with the coefficient of correlations between 0.31-0.70, which is not more than 0.905 as expected. The researchers then tested the multi-collinearity problem, and the result showed VIF of the independent variables between 1.32-2.53, which is less than 5.00 (Hair et al, 2010). It showed that the independent variables were related at a level that did not cause Multi-collinearity as shown in Table 2.



Table 2 The correlation coefficient analysis of the factors affecting flight delays and effects of flight delays at Don Mueang International Airport

variables	Effects of flight delays	Air traffic volume	Air traffic service	Weather	Airport	Ground passenger management activities	VIF
\bar{x}	3.92	4.05	4.0	4.18	3.64	3.71	
S.D.	0.74	0.62	0.66	0.58	0.68	0.66	
Effects of flight delays		0.32	0.35	0.43	0.32	0.33	1.32
Air traffic volume			0.39	0.70	0.49	0.47	2.53
Air traffic service				0.52	0.31	50	1.64
Weather					0.32	0.35	1.54
Airport						0.48	1.38
Ground passenger management activities							1.60

The overall results of the analysis showed the relationship between various factors affecting the flight delays of the Aerodrome control service and Approach control service at Don Mueang International Airport. The research found that the independent variables, namely air traffic volume, air traffic service, weather, airport, and ground passenger management activities, were positively correlated with the dependent variables, which had an impact on the flight delays at Don Mueang International Airport with multiple correlation coefficients as follows.

Model 1 showed the simple regression analysis of one initial variable, air traffic volume. The multiple correlation coefficient equal to 0.43 means that it is able to predict the flight delays at Aerodrome and Approach control services at Don Mueang International Airport at 18.50% with a 0.67 standard error of the estimate.

Model 2 showed the simple regression analysis of two initial variables; air traffic volume and airport. The multiple correlation coefficient equal to 0.47 means that it is able to predict the flight delays at Aerodrome and Approach control services at Don Mueang International Airport at 22.50% with a 0.66 standard error of estimate as shown in Table 3.

Table 3 Summary of the overall test results of various factors affecting the flight delays of Aerodrome and Approach Control Services at Don Mueang International Airport

Factors affecting flight delays	R	R Square	Adjusted R Square	Std. Error of the Estimate
Model 1) Air Traffic Volume	0.43 ^a	0.185	0.17	0.67
Model 2) Air Traffic Volume and Airport	0.47 ^b	0.225	0.20	0.66

a. Predictors: (Constant) Air traffic volume

b. Predictors: (Constant) Air traffic volume and Airport

[306]



The overall results of the analysis showed that various factors affect the flight delays of aerodrome and approach control services at Don Mueang International Airport. The two factors that affected the flight delays were the air traffic volume factor and the airport as shown in Models 1 and 2 since both had a significant level of less than 0.05. Model 1 showed that the air traffic volume variable increases to 1 for the flight delays at the Aerodrome and Approach control services at Don Mueang International Airport, which was equal to 0.43. Model 2 showed that the air traffic volume variable increases to 1 for the flight delays at the Aerodrome and Approach control services at Don Mueang International Airport, which was equal to 0.35, and the Airport variable increases to 1 for the flight delays at Aerodrome and Approach control services at Don Mueang International Airport, which was equal to 0.21. Accordingly, the results could be described as follows.

Model 1) The air traffic volume had a significance equal to 0.00*

Model 2) The air traffic volume and airport had a significance equal to 0.01* and 0.04* as shown in Table 4.

Table 4 Summary of the overall coefficients of linear multiples correlation of factors of Aerodrome and Approach Control Services at Don Mueang International Airport

Model	Constant	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
Model 1	Air traffic volume	0.55	0.12	0.43	4.37	0.00*
Model 2	Air traffic volume	0.45	0.13	0.35	3.45	0.01*
	Airport	0.23	0.11	0.21	2.05	0.04*

* A statistically significant level of 0.05

5. Conclusion

The research on factors affecting flight delays of Aerodrome and Approach Control Services at Don Mueang International Airport is concluded as follows.

Objective 1; To study the flight delays level of Aerodrome and Approach Control Services at Don Mueang International Airport.

The overall research results showed that the factors affecting the flight delays of Aerodrome and Approach Control Service were at a high level. Considering the mean of each factor, it was found that there were not many differences or could be stated as similar responses because each factor affected the flight delays. It depended on the difference of time, place, or situation at that time to identify which one among the factors could result in the flight delays and which was a random phenomenon (Martinz, 2012). It could further show which among of these factors from the air traffic controllers' perspectives is responsible for the overall flight delays. When considered individually, it was found that most air traffic controllers agree that the factor of air traffic volume was the first-factor affecting the flight delays, and the second was the factor of air traffic service, weather factors, airport factors, and ground passenger management activities, respectively.



Objective 2; To study the factors affecting the flight delays of Aerodrome and Approach Control Services at Don Mueang International Airport.

The overall analysis of the relationship between various factors affecting the flight delays of Aerodrome and Approach Control Services at Don Mueang International Airport showed that the independent variables including air traffic services, weather factors, air traffic volume, ground passenger management activities factors, and the airport factors showed a positive correlation between the dependent variable, which was the impact of flight delays at Don Mueang International Airport. The research was according to (Sawangarom, & Inchonnabod, 2016) that the overall research result showed that the efficiency of the air traffic control service of Approach control service at Don Mueang International Airport and Approach control service at Suvarnabhumi International Airport had a medium impact. The research results of the linear multiple correlation coefficients were 0.43, which was able to predict the flight delays at Aerodrome and Approach control services at Don Mueang International Airport at 18.50% and 0.47. It is further able to predict 22.50% flight delays at Aerodrome and Approach control services at Don Mueang International Airport with statistically significant levels of 0.00*, 0.01*, and 0.04*, respectively, which is less than 0.05. Accordingly, the air traffic volume and the airport had effects on the flight delays at the Aerodrome and Approach Control Service at Don Mueang International Airport. According to the Airline Delay Management Problem (ADMP), which can be described as the task of dealing with daily airline operational delays and deciding whether to delay subsequent flights at a hub airport or to have them departing on time, an innovative integer linear programming approach has presented to the capacitated case of the ADMP, and airport limitations in terms of bay availability, taxiway capacity, and runway separation are incorporated to represent capacity constraints. (Santos, 2017). However, due to the geographical location of Don Mueang International Airport, it is unable to expand despite the increase of both passengers and flights to deal with the delays. The increase of air traffic volume brought by a rapid increase of the consumer market was the reason for the flight delays of flight at Aerodrome and Approach Control Services at Don Mueang International Airport as shown in the research results.

6. Suggestions for further research

1) Research should be conducted on the factors affecting the flight delays at other airports such as Chiang Mai International Airport, Chiang Rai International Airport, Hat Yai International Airport, and Phuket International Airport to compare the factors affecting the flight delays with Don Mueang International Airport.

2) Research should be conducted on the factors affecting the flight delays at regional air traffic control centers to compare the factors affecting flight delays with other agencies that provide air traffic control services in the Aerodrome and Approach Control Services as well. However, further research should be conducted on different job characteristics than Aerodrome and Approach Control Services at Don Mueang International Airport.

3) Research should be conducted on human error factors that affect the efficiency of air traffic control services to understand the operational factors that cause air traffic controllers to commit errors during operations and affect the efficiency of air traffic control services.

7. Acknowledgements

I would like to thank Dr. Piyada Watthanasan, the President of St. Theresa International College for her support and give a scholarship. As well as Wing Commander Surath Sridech, Head of Air Traffic Control at St. Theresa International College for his expert advice and encouragement throughout this thesis.

8. References

- Charoensook, C., Chomchum, K., Manon, W., Chittaputta, P., & Sridech, S. (2017). *Factors Influencing Work Efficiency of the Royal Thai Air Force Air Traffic Controllers. Humanistic Management Association, Research Paper Series*, (17-18).
- Cronbach, L. J. (1990). *Essentials of psychological testing*. Harper & Row, New York, USA.



- Hair, J. F., Kennesaw State University, Black, B., Babin, B. J., Anderson, R. E., Drexel University. 2010. *Multivariate Data Analysis: Global Edition, 7th Edition*. UK: Pearson Education.
- International Civil Aviation Organization. (2001). *Annex 11- Air Traffic Services (13rd ed)*. Canada: International Civil Aviation Organization.
- Naewna, (2019). Future trends of the world's aviation industry. Retrieved February 27, 2020, from <https://www.naewna.com/business/467341> [in Thai]
- Rovinelli, R. J., & Hambleton, R. K. (1977). On the use of content specialists in the assessment of criterion referenced test item validity, *Tijdschrift voor Onderwijsresearch* (Dutch Journal of Educational Research), 2(2), 49-60.
- Santos, B. F., Wormer, M. M., Achola, T. A., & Curran, R. (2017). Airline delay management problem with airport capacity constraints and priority decisions. *Journal of Air Transport Management*, 63, 34-44. <https://doi.org/10.1016/j.jairtraman.2017.05.003>
- Sawangarom, S., & Inchonnabod, P. (2016). Efficiency in Controlling the Air Traffic Complexity between Suvarnabhumi and Donmuang Airports. *Journal of Logistics and Supply Chain College*. 2(2). 65-76. [in Thai]
- Matinez, V. (2012). *Flight Delay Prediction*. A thesis for the degree of Master of Systems Group of Computer Science, ETH Zurich. Eidgenössische Technische Hochschule Zürich (Swiss Federal Institute of Technology in Zurich). Switzerland