OPTIMATION OF AIRCRAFT FLEET SIZE BASED ON FIXED SCHEDULE SYSTEM

Thesis
Submitted to International Program
Faculty of Industrial Technology in Partial Fulfillment of
The Requirements for the degree of
Sarjana Teknik Industri at
Universitas Islam Indonesia

Prepared by:

Name : Nahtadia

No. : 03 522 161

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By

Nahtadia

January 2008

Date : _____ Signature of Author: _____

Certified by:

Date: January 7, 2008

Ir. R. Chairul Saleh, M.Sc., Ph.D, Supervisor

Accepted by:

Date: January 7, 2008

Ir. R. Chairul Saleh, M.Sc., Ph.D

Director of International Program

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Submitted by : Nahtadia

Date: _____ Signature of Author : _____

Approved by Examination Committee:

Date: _____

Agus Mansur, ST., M.Eng.Sc, Chair

Date: _____

Ir. R. Chairul Saleh, M.Sc., Ph.D, Member

Date: _____

Indro Lukito, ST, Member

THIS THESIS IS DEDICATED TO:

My PARENTS, SISTER and BROTHER

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بِسْمِ اللهِ الرَّحْمٰنِ الرَّحِيْمِ

Assalamu'alaikum Wr.Wb.

Alhamdulillahirabbil'alamiin Praise be to Allah SWT, Most Gracious, Most Merciful, so that the author can finish this thesis with title "Optimation of Aircraft Fleet Size Based On Fixed Schedule System" as a Requirements for the degree of Sarjana Teknik Industri at Universitas Islam Indonesia Jogjakarta.

As a human's creation, this thesis is still far from the perfect form. Therefore, critics and suggestions from all point of views will be accepted as reference for the next research. During the arrangement of this thesis, the author helped and guided by some people. Therefore, in this chance the author wants to say a big thank to:

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Jogjakarta, January 2008

Nahtadia

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ABSTRACT

This research performed in an air transportation service company, PT. Merpati Nusantara Airlines. This research aims to find the best flight schedule arrangement and to determine the minimum total of aircraft fleet size required to fulfill the schedule planned. In this research we will find the optimum flight schedule for three airports, and finding how many aircrafts will be used to run the schedule. To solve such a fleet size problem, some mathematical models are needed. Here, the mathematical model used is an algorithm for the minimum number of transport units to maintain a fixed schedule which is developed by T.E. Bartlett. By processing the data such as arrival and departure schedule we will find the minimum number of aircraft needed and the optimum flight schedule.

KEYWORDS: *Fixed Schedule, Fleet Size Problem, Aircraft*

Thesis Supervisor: Ir. R. Chairul Saleh, M.Sc., Ph.D

CHAPTER I

INTRODUCTION

1.1 Background

Recently, as the population grow, more people need transportation, because in daily life transportation is very important as it helps most people in doing their daily activity, that is why a service company especially that move in transportation sector is much needed. And since many people need transportation, a transportation company must give the best service to their customer. Nowadays, many people are more interested in using air transportation service than any other kinds of transportation service, because by using aircraft it is the fastest transportation people can get.

Talking about aircraft, it is can not be separated from the flight trading company and also airport as a terminal where people arrive or depart to their next destination. We can imagine there are many planes from various flight trading companies that come and go in the airport, so there are some problems that delaying activities oftenly occured in airport such as the planes that arrive or depart late, delayed flight, or even technical problems are problems that often occured, where those things become important points in customers view to choose which flight they will take. And this is creating a competition among the flight trading companies to gain as many customer as possible. Like another companies, flight trading company is also aiming for as many profit and less cost as possible. As we know that nowadays in Indonesia air traveling is busy used by many people because now the price for flying is much more reachable than before, there are

many flight trading companies that provide flight with cheaper price which make more people interested in using air travelling and finally give lots of profit to the company.

Moreover, with the the up coming of Asia Pacific(APEC) 2010 with all the effects, some opportunity are predictable for airport service and certainly also for flight trading companies. Tourists 'Booming' which predicted will be happened in Asia Pasifik area, including Indonesia, will give very great benefit for Airport 1 (managed by PT. Angkasa Pura 1) and many flight trading companies due to the geographic locations which is very strategic near the first tourism destinations in Indonesia.

Flight trading company may get lots of profit, but there is problem in the operations management that may make company to expense more money. One of the factors that affects the total cost expensed in such flight trading company is maintenance cost. While, maintenance cost is also depends on the fleet size, the more fleet is the more cost expensed. This problem is called as fleet size problem, where this is caused by the fleet size available which is more than the minimum required, since the company is trying to meet the fixed flight schedule. Like we know, every flight trading companies has their own flight schedule. According to Krajewski, lee (2007) In the airline industry, the scheduling process can determine a company's long term competitive strength. Effective scheduling is essential to successful operations.

There are some researches about fleet size problem. Some of them are research done by Maxwell and Muckstadt (1982), Mahadevan and Narendran (1990) present a procedure for estimating the minimum fleet size requirements. This approach differs from most others, since it utilizes probabilistic routings and sequencing. The authors first develop an analytical model, which calculates the vehicle transportation time requirements based on a given trip matrix and then, the authors estimate the number of

vehicles required by dividing the vehicle time available into the total vehicle transportation time for transported loads.

In this thesis, the research is aim to find the best schedule arrangement and to determine the minimum total fleet size required to fulfill the schedule that later will improve work performance of the company. To solve such a fleet size problem, some mathematical models are needed. Here, the mathematical model used is the one developed by Bartlett (Morris, 1962), because this model is suitable for fleet size problem that relates with a fixed schedule.

1.2 Problem Formulation

Based on the background to the study, hence it can be defined the problem formulation as follows:

1) What is the minimum fleet size to maintain a fixed flight schedule of an Airline?
2) How is the best flight schedule arrangement?

1.3.1 Problem Limitation

To be focus on the research that will be done, some problem limitations are needed:

1) There are 3 terminals on the flight route, which areTunggul wulung Airport (Cilacap), Halim Perdana Kusuma Airport (Jakarta) and Ahmad Yani Airport (Semarang).
2) This research is only focus on one airline flight (Merpati Nusantara Airlines)

3) Factors such as weather or flight accident is not considered, the schedule and route can not be changed and must be met exactly.
4) No delays occurred.
5) The flight is done by using a single type and single series of aircraft (CN-235).
6) One type visual landing (the aircraft can not fly at night).
7) The departures at any terminal must use the vehicles which are regularly scheduled arrivals at that terminal.
8) Operating hour at each terminal assumed to be 10 hours (from 07.00 am – 17.00 pm).
9) The passenger embark and disembark times are included in the running times.
10) The flight time between Cilacap – Jakarta, Jakarta – Semarang, and Semarang – Cilacap are 40, 50, and 60 minutes respectively.

1.4 Research Objectives

The objectives of this research is determining the minimum fleet size by finding the minimum vehicle needed and also to fine the best schedule to improve work performance of the company based on the effectiveness of usage of existing facility.

1.5 Research Significance

1) Give more knowledge about the research object, so the student can apply the knowledge from class to the real world.
2) By doing this research hopefully can give some suggestion for the company to improve their work performance.

3) As a reference for further study especially those which concerning any fleet size problem.

1.6 Structure of Thesis

In order to get a well structured thesis report, hence the thesis outline is described as follow:

CHAPTER II LITERATURE REVIEW

This chapter contains of explanation about theories that used as basic of problem solving. Provides explanations of the method used by researcher to solve the problem.

CHAPTER III RESEARCH METHODOLOGY

This chapter contains a detailed series of steps of the research, research variable, research procedure, data collecting method, data processing method, and analysis method.

CHAPTER IV DATA COLLECTING AND PROCESSING

This chapter vary based on the research. It is contains of data collecting and processing the data to fins the final answer.

CHAPTER V DISCUSSION

In this chapter contains of the result from data processed, and also analysis and interpretation about the result.

CHAPTER VI CONCLUSION AND SUGGESTION

In this chapter contains of conclusion and suggestion from the problem solving analysis and also improvement suggestion for the company.

REFERENCES

APPENDIX

CHAPTER II

LITERATURE REVIEW

Literature review in this thesis contains of informations obtained from journals, workshops, seminar, and etc which are become the basic theory of this research, and also in this research, a deductive review has already done. A deductive review means a review which is usually done to gain informations wich are able to be used later as a basic thought of the research which is mainly sourced from books.

2.1 Introduction

Fleet size problem in a tranportation service company such airlines is very important, this problem is one of important factor that must be considered, since fleet are the main facility that support the operation of the company and since the cost of operation is affected also by the size of the fleet exist.

Fleet size problem is relates with schedule, with an optimum schedule it will affect the profitability of the company. An optimum schedule is schedule with good arrangement which with that schedule the vehicle needed to run the system is minimum. Optimum schedule is influenced by enough total fleet that can accommodate passenger demand, pertinent regulation which consist of operational aspects (aircraft performance, crew qualification, flight duty period) and technical aspects (technical performance). To make flight schedule is influenced by some factors such as the effectiveness of aircraft operational, there are some operational items which influence aircraft operational

effectiveness such as aircraft capability, airport condition, capability of aircraft crew, schedule optimization by tricking the costs appear at the airport, and passenger demand prospect.

Based on Merpati company operation manual, Aircraft capability is influenced by: 1) Engine effectiveness. Each aircraft has different kind of engine, for instance, for flight in tropical area needs aircraft with enghine which is effective in tropical weather condition that relatively hotter and bigger air pressure. And also the energy of anti icing system on the machine system that is relatively not necessary can be tranferred to air conditioning system. 2) Breaking wheel system, a diffrent kinds of braking system between aircrafts that operates in tropical area and subtropical area/pole. 3) Optimum flight time and distance, where each type of aircrafts has its own optimum value, it has optimum value if it is operated at a certain operation height and distance.

Take off performance of an aircraft is determined from air temperature, wind azimuth runway, engine anti icing, air pressure, and fields such as: runway slope, runway length, runway strength, runway obstacle.

To make an optimum flight schedule one must also consider about the airport capability/condition. The airport cability can be seen from the navigation aids available, navigation aids such as VOR (VHF Omny directional Range), NDB (Now Directional Beacon), ILS (Instrument Landing System), then airport operating hours, since each airport has different operating hour, and also embarked and disembarked passenger and services, airport weather phenomena, availability of fuel and starting equipment, and fire fighting equipment (must be qualified). Fire fighting cathegory are classified from aircraft length and width of wing span, Cathegory I: 81 m or more, Cathegory II: 56 – 80 m,

Cathegory III: 46 – 65 m, Cathegory IV: 26 – 45 m, Cathegory V: 26 – 45 m, Cathegory VI: 15 – 25 m, Cathegory VII: less than 15 m.

Another factor that influence flight schedule planning is the capability of aircraft crew, viewed from the qualification technique and competence consist of :

1) Rating aircraft qualification, the crew of an aircraft need certain qualification, since aircrafts are vary in types, for example Propeller I class aircraft and Narrow body class aircraft, each type of aircraft has its own crew qualification which is differ from other type of aircraft.

   a) Propeller I class aircraft, Pilot must have: an ATPL (Advance Transport Pilot Licence), a minimum 4000 hours of total flying experience on airlines including 1500 hours as PIC (Pilot In Command) on propeller liclass aircraft. Or, an ATPL, a minimum 3500 hours of total flying experience on airlines, minimum 5 years EWE (Effective Warning Experience) as a company pilot, and complete command training.

   b) Narrow body class aircraft, Pilot must have: an ATPL, a minimum 8 years EWE as company pilot, a minimum 5500 hours of total flying experience on airlines. Or, an ATPL, a minimum 6000 hours of total flying experience on airlines including 5000 hours jet experience, a minimum 8 years EWE as company pilot, and a complete command training.

2) Route qualification, crew capability is also viewed from route qualification, since flight routes or fields are not always smooth, there are also routes with some obstacles, in which capability of crew to operate the aircraft is needed. There are some area in which a route qualification must be done. For example Jogjakarta, Ruteng, Maumere, Timika, Jayapura, and etc.

From all those qualifications, training program is needed in order to fulfill personel capability limitation required. Those trainings are consist of:

a) Initial training: the training will be given to the crew member and flight operation officer who have not qualified and served in the same capacity on another aircraft on the same group.

b) Transition training: The training will be given to the crew member and flight operation officer who have qualified and served in the same capacity on another aircraft of the same group.

c) Upgrading training: The training will be given to the crew member who have qualified and served as second in command on a particular aircraft type, before they serve as pilot in command on that aircraft.

d) difference training: The training will be given to the crew member and flight operation officer who have qualified and served on a particular type aircraft. when the director find the differencies training is necessary before crew member and flight operation

officer serves in the same capacity on a particular variation of that aircraft.

3) Duty crew management, The effectivity of aircraft operations is also certained by crew scheduling which is limited by some regulation (CASR: Civil Aviation Safety Regulation). For example the regulation for maximum flight time and flight duty time. *Flight time* means total time from the moment the aircraft moves under its own power for the purpose of taking off until the moment it comes to rest at the end of the flight. While *flight duty time* means the elapsed time between reporting time and relieves time. There is also Flight deck duty time which means total time flight crew required to do all cockpit duties with respect to a flight or series of flights excluding the in-flight rest period, and etc.

Schedule optimization by tricking the costs appear at the airport must be done to avoid money waste, because there are some fees must be paid when an aircraft arrive at the airport. Those fees are landing fee, transit fee, and RON (Remain Over Night) fee. Airport with higher traffic will have higher fee so if possible must plan RON at the airport with lower RON cost.

After that company must also consider about the selection of alternate airport for landing, because of aircraft is different from any other transport vehicle, an alternate airport must be planned to anticipate all posibilities that might be happened, for example when there is a bad weather in the destination airport and it is not possible for landing at the airport, then an aircraft must landing at the alternate airport. Normally, one alternate airport shall be available, a second alternate airport is required when the weather condition forecast for the destination and first alternate airport are marginal.

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The following cosideration should be taken into account when selecting an alternate airport:

1) Operational requirement: weather condition and weather minima, runway condition and length, airport facilities, availability of fuel and starting equipment, aircraft handling facilities.

2) Commercial consideration: distance from destination, passenger handling facilities, final destination of disembarking passenger, ground connection and/or hotel accomodation, schedule regularity, political aspects.

Then, schedule planning is also influenced by passenger interest prospect, where the high interest passenger is appear with the reasons are the area condition that obliged the society to use aircraft only as the effective selection, increasing income rates, the existence of social and culture change, government regulation, and political condition.

All of the factors above must be taken as consideration to make such a flight schedule, but in this research, the focus will be to find the best schedule and the number of vehicle needed to operate the schedule based on time to time consideration only.

2.2 Transportation

One of important factors that affect the social and economic development in a country is transportation. A social and economic condition of a country can not be developed if there is lack of transportation facilities. With the basic funtion of transportation that is carry passengers and goods from one olace to another, transportations might be described as an effort to transport, to move, to handle, or to

remove an object one place to another place, where in this other place the object is more beneficial or useful for certain purposes (Miro, 2005).

Transportation is a process where, in the process a supporting tools are needed. Without this supporting tools a transportation process might not going well. This supporting tools in tranportation science is known as transportation system. Transportation system has definition that consist of definition of system and transportation it self. *System,* which is the form of connection and relation between one variable to another variable in a structured sequence, while ***transportation*** is activity to move passengers or goods from one place to another place (Munawar, 2005).

Entirely a transportation system means is a form of integral connection and relation between variables in a process of passengers or goods movement from one place to another place. Transportation system is consist of some subsystems such as:

1) Links: the roadways or tracks connecting two or more points. Ex: Sealanes and airways can also be considered as links.
2) Terminal: a place where travel begins or ends. Ex: Bus terminals, airports.
3) Vehicles: a handling tool of moving people and goods from one place to another place. Ex: Cars, buses, ships, airplanes.
4) Management and labor: the people who construct, operate, manage the links, vehicles, and terminals. (Jotin, 1990).

These subsystems must available together entirely, it must be integrated, because it can not operates by only one subsystem, and if there is no complete subsystems, the transportation systems might not be able to function. There are 2 aspects in transportation system which are aspects of facility and supporting facility. Facility is related with the

vehicle used in the movements of passengers and goods, for instance car, train, ship, and aircraft. Supporting facility is related with space or another tool that used to support the facility such as road, railway, harbour, terminal, airport, and train station. Generally, type of transport are classified into three types of transportation which are: land, water, and air transport. In this research we will discuss about problem that occur in air transportation.

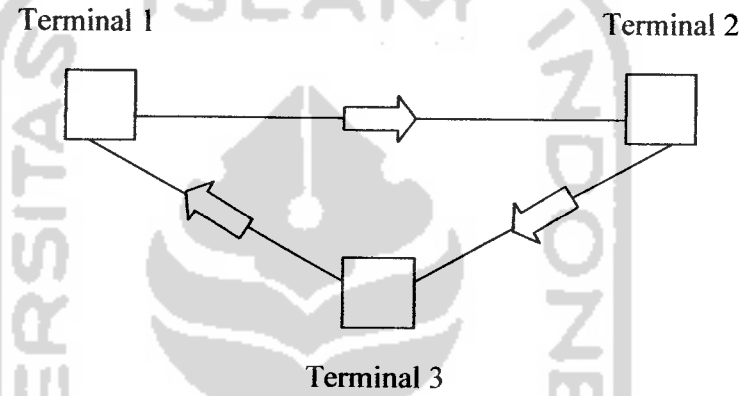


Figure 2.1 Three –Terminal Transportation Network

2.2.1 Air Transportation

Modes of air transportation usually using aircraft or helicopter, as we understand that air transportation is mostly use for long distance trip. Since people who wants to take a long journey needs a transportation that really support their needs, air transportation s become predominant because of its speciality which is more than any other tranportation. According to Sartono, Wardhani (1992) Air transportation has some advantages but also limitations as follow:

a. Advantages of air transportation:

1) *Rapidity*: Air tranportation maintains the highest speed. The majority of civil aircraft has speed a little less that sound speed.

2) *Continuous journey*: Air transport mode is continuous over land and water without loss of time.

3) *Accessibility*: Air transport has an unique ability to open up that is inaccessible by other means of transportation. These were applied in hinterlands located in Kalimantan and Papua by constructing airstrips.

b) Limitations of air transportation:

1) *Operating expenses*: The operating expenses are generally very high including the cost of air vehicles, landing and take off facilities, traffic control system etc. The air transport modes accomodates very few travellers and small cargo, so the freight charges are comparatively high.

2) *Capacity*: Weight carrying capacity of aircraft is the lowest compared to other carriers of transport, so the transport cost for unit weigth is very expensive.

3) *Weather conditions*: the weather conditions considerably affect the operation of air transport. Slush are absolutely not convenient for the landing and take off operations of aircraft.

4) *Flight rules*: The air transport is more beneficial for the international travel. ICAO (International Civil Aviation Organization) that is laws in respect to the international aviation should be observed.

2.2.2 Aviation Organizations

According to Putra, Pranoto Dirhan (1998) based on the managerial, aviation organizations are classified into some group which are organization managed by international government, national government, and regional and industry or trade government.

a) *International Civil Aviation Organization* (ICAO)is an international aviation organization under the United Nations, this organization relates with development of airport.

b) Aviation organization in America such as Civil Aviation Board (CAB, 1985), Federal Adviation Administration (FAA), and National Transportation Safety Board (NTSB). In Indonesia civil aviation organization is handled by Direktorat Jenderal Perhubungan Udara Departemen Perhubungan. Rules and types of aviation organization in the world are direct to United Nations aviation organization (IATA, ICAO) because of its advanced technology and the set of laws.

2.3 Fixed Schedule System

In an airline industry, an airline company must arrange good plan in order to be able to compete with other company. A fleet size problem is a problem that must be considered remembering that fleet is the main thing in a flight service company. A fleet size problem might be appeared in such a tranportation system that use a fixed schedule system or variable schedule system, but in this research will discuss only about the problem of fleet size in a fixed schedule system.

Fixed Schedule system arises when a service is delivered to many customers at once. The timetables or schedules are generally known in advance by customers as the information has been made publicly avilable. It is frequently used to solve a material handling problem in the business of railroad, bus, and shipping. It is usually used in the business where there are passengers on it, because it is involving the passenger service. Including airways industry, it is also uses a fixed schedule system because the movements that will occur in the system are highly predictable, since that is only need to examine the timetable/schedule (Morris, 1962).

The example of fixed schedule movement in a production system is the balanced assembly line which has a highly predictable operations. In many integrated and balanced sequence of production process, in the movement between operation also use a fixed time specifications. It is also found in jobshops, exemplified by a tractor trailer train that moves in a fixed route or path and schedule.

Fixed schedule system has advantage which is easy to manage and control, but it is also lack of flexibility and the difficulties in providing good service if it is applied on a non routine situation. If a production system is imagined as a set of terminals and there are links connecting it then, a specific arrival and departure time of each terminal and also routes are needed to make a fixed schedule system. It is called as the schedule of the system, for any schedule, people may examine such criteria as the number of vehicle needed to run the schedule , the service that provided in various terminal and also the vehicles utilization.

Hence, one must set the pattern of arrival, departure, and routing that will minimize the investment in vehicle or equipment, machine operating cost, and also cost of failing to provide perfect service at the terminal in order to get the very best fixed

schedule for a certain system. From the theory above, yield some problem formulation such as:

1) *The fleet size problem.* Given a fixed schedule for the movement in a production system, then, one will determine the minimum vehicle required to operate the schedule.

2) *The schedule design.* Given the requirement of certain number of departuresfrom the terminal in a system, then, one will design the best time for the vehicle to depart.

2.4 Algorithm For Minimum Number of Vehicle to Maintain a Fixed Schedule

According to Pollack, Maurice (1976) the fleet planning problem is generally concerned with howmany and what aircrfat to buy, to retain, and to release, and the timing of these decision. In this research will focus on the fleet size problem, with the purpose to determine how many vehicle (aircraft) needed. This problem will be solved by using Bartlett Algorithm to find minimum number of vehicle to maintain a fixed schedule, the data needed are such as the schedule of flight arrival and departure, and also travel time. Then, the fleet size can be found by calculating the running hour and idle hour.

This algorithm developed by Bartlett is usually use data found in a schedule, for example like departure and arrival time of vehicle in a various runs and also various terminals in typical time period (Bartlett, 1956). In order to determine the vehicle required, first that we have to determine is not simply the vehicles, but vehicle hours, where we can find the minimum vehicle hours required, then it can be immediately converted into required fleet size. For example in the case of three terminal network

shown above with the running times are assumed to be fixed which are 2 hours, 1 hours, and 2 hour from terminal 1 to 3 respectively, has a schedule as follow:

Table 2.1 Example of Schedule for three terminal network

Terminal 1	
Arrivals	Dapartures
1	2
3	5
6	8

Terminal 2	
Arrivals	Dapartures
2	1
4	3
7	7

Terminal 3	
Arrivals	Dapartures
2	1
4	4
8	7

According to T. Morris, William (1967) to find the minimium number transport units, this algorithm have some certain step, the steps are as follows:

1) Make some plans of the schedule for each terminal

example: for Terminal 1,

Table 2.2 Example of Schedule Plans for three terminal network

Plan 1

Arrival	Departure
1	2
3	5
6	8

Plan 2

Arrival	Departure
1	2
3	8
6	5

Plan 3

Arrival	Departure
1	5
3	2
6	8

Plan 4

Arrival	Departure
1	5
3	8
6	2

Plan 5

Arrival	Departure
1	8
3	5
6	2

Plan 6

Arrival	Departure
1	8
3	2
6	5

2) Calculate the idle time for each plan,

Idle time is the moment where vehicle is not runing and still waiting to depart, in the case of flight, idle time here means ground time, the time when aircraft is not flying but it is on the ground and waiting to the next depart. To calculate idle time, the formula is as follow,

if no vehicle kept over, $I_i = \sum_i d_{ij} - \sum_i a_{ij}$

where, I_i = Vehicles hours of idle time at terminal j (based on departing vehicles each period)

d_{ij} = Time of *ith* departure from terminal j

a_{ij} = Time of ith arrival at terminal j

if A vehicles are kept over, $I_j = \sum_i d_{ij} - \sum_i a_{ij} + AT$

(Kept over vehicles are the vehicles which are still on the run at the end of the scheduling period).

3) Calculate the running time, and total running time of the whole system,

for example if the ith departure from terminal j becomes kth arrival at terminal m, and the whole trip are included in the scheduling period, then the running time become:

$$a_{km} - d_{ij}$$

if the run of the transportation system is starting in one time and arrive at the next time , then the mathematical model become:

$$a_{km} - d_{ij} + T$$

For the total running time of the whole system we use this formula below:

$$R = \sum_i \left\{ \sum_i a_{ij} - \sum_i d_{ij} \right\} + BT$$

where B = Vehicle kept over

4) Find the total vehicle hour,

to find total vehicle hour th following model is used:

$$t = I + R$$

where t = Total vehicles hours required

I = vehicles hours idle

R = vehicles hours running

5) Determine the minimum transport unit/fleet size required

the formula to find minimum fleet size,

$$\frac{I+R}{T}$$

where I = I = vehicles hours idle

R = vehicles hours running

T = Length of scheduling period

CHAPTER III

RESEARCH METHODOLOGY

3.1 Research Object

The research performed in PT. Merpati Nusantara Airlines. The object is the data of fleet and the flight schedule of the company where the research purpose is to determine the optimum fleet size and to get the best schedule.

3.2 Model

3.2.1 Variable Definitions

I_i = Vehicles hours of idle time at terminal j (based on departing vehicles each period)

d_{ij} = Time of *ith* departure from terminal j

a_{ij} = Time of *i*th arrival at terminal j

t = Total vehicles hours required

I = Total vehicles hours idle

R = vehicles hours running

T = Length of scheduling period

The model used in this research is:

1) If there is no vehicle kept over,

$$I_i = \sum_i d_{ij} - \sum_i a_{ij}$$

2) If there is vehicle kept over, $I_j = \sum_i d_{ij} - \sum_i a_{ij} + AT$

3) $R = \sum_i \left\{ \sum_i a_{ij} - \sum_i d_{ij} \right\} + BT$

4) $t = I + R$

5) $\frac{I+R}{T}$

3.3 Data collection

Data are divided into two groups; they are primary data and secondary data. Primary data is data that will be used directly as input of calculation in this research. Secondary data is additional data that taken on observation and data collecting but this data are not used directly as input calculation on this research.

3.3.1 Primary Data

The primary data collected are:

1) Data of flight schedule planned for Tunggul Wulung Airport
2) Data of flight schedule planned for Halim Perdana Kusuma Airport
3) Data of flight schedule planned for Ahmad Yani Airport

3.3.2 Secondary Data

Secondary data is only supporting or additional data toward research object. The secondary data are Company profile and all data related with company activities, There are attached on attachment.

3.4 Data Collecting Method

In this research, there are some method that used to collect the data required. The methods are shown below:

1) Interview. It is a method that having direct interview with resource person that know deeply about operational that performed by the company.
2) Secondary data, is data that obtained indirectly such as company profile, production system and production process.

3.5 Research Procedure

The research procedure is shown below:

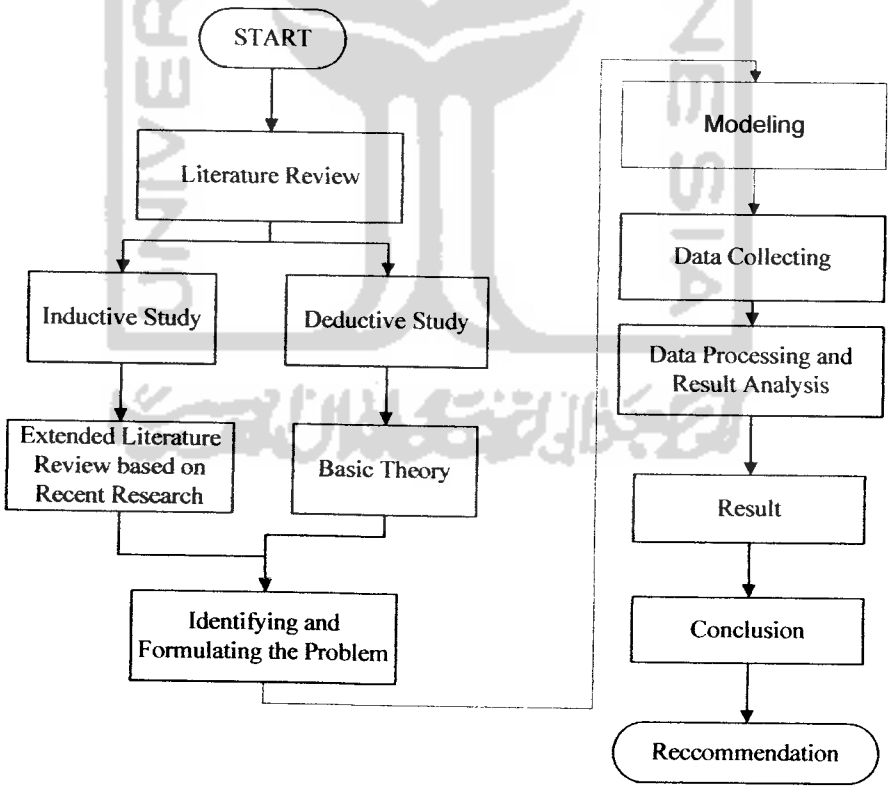


Figure 3.1 Flow diagrams of Research Procedure

3.6 Data Processing and Result Analysis

The data which has already collected, then processed by using the mathematical calculation according to the model which will be used and then the result is analyzed and concluded and to be a research conclusion.

3.7 Research Result

The result of the research obtained from the data processing and analysis then are discussed to know the possibility of drawback or speciality from the research result so that a recommendation of this research will be able to be made.

CHAPTER IV

COLLECTING AND CALCULATING DATA

4.1 Collecting Data

Technique of collecting data performed in this research is by doing interviews at PT. Merpati Nusantara Airlines.

4.1.1 Flight Schedule

Assumed that PT. Merpati Nusantara Airlines willing to open a new flight route among Cilacap-Jakarta-Semarang, and the schedule are as follows:

Table 4.1 Flight Schedule

Tunggul Wulung Airport		Halim Perdana Kusuma Airport		Ahmad Yani Airport	
Arrival	Departure	Arrival	Departure	Arrival	Departure
8.15	7.35	8.15	8.00	8.50	07.15
9.40	9.15	9.55	9.05	9.55	08.40
10.45	11.20	12.00	10. 30	11.20	09.45
13.50	12.10	12.50	13.30	14.20	12.50

4.1.2 Fleet/Aircraft Data

In this Research, the type of aircraft that will be used is a CN-235 type Propeller aircraft. The CN-235 is a twin engine, pressurized aircraft having a light

centilever wing monoplane and retractable tricycle landing landing gear. The aircraft has a loading access through a side and a large ventral door.

Dimension,

Overall length = 21.400 m (70 ft 2.4 in)

Wing Span = 25.810 m (84 ft 8.0 in)

Height = 8.177 m (26 ft 9.9 in)

Cabin Data,

Cabin Length = 9.646 m (31 ft 7.7 in)

Cabin Height = 1.900 m (6 ft 2.8 in)

Cabin Floor Level = 1.215 m (3 ft 11.8 in)

Cabin Floor Area = 22.822 m (245.59 sq ft)

Cabin Volume = 43.362 m (1531 cu ft)

Seat Pitch = 30 in

Number of Seat = 36

Design Criteria,

Maximum RAM Weight = 14.450 kg (31.855 lbs)

Maximum Take-Off Weight = 14.400 kg (31.746 lbs)

Maximum Landing Weight = 14.200 kg (31.305 lbs)

Maximum Zero Fuel Weight = 13.600 kg (29.982 lbs)

Maximum Operation Weight = 9.700 kg (21.384 lbs)

Cabin Dimensions,

Length = 393 in 9,98 m

Max Width = 106,3 in 2,70 m

Floor Width = 93,1 in 2,36 m

Height Aisle = 74,8 in 1,90 m

Power Plant = General Electric CT7-7A Turboprop.

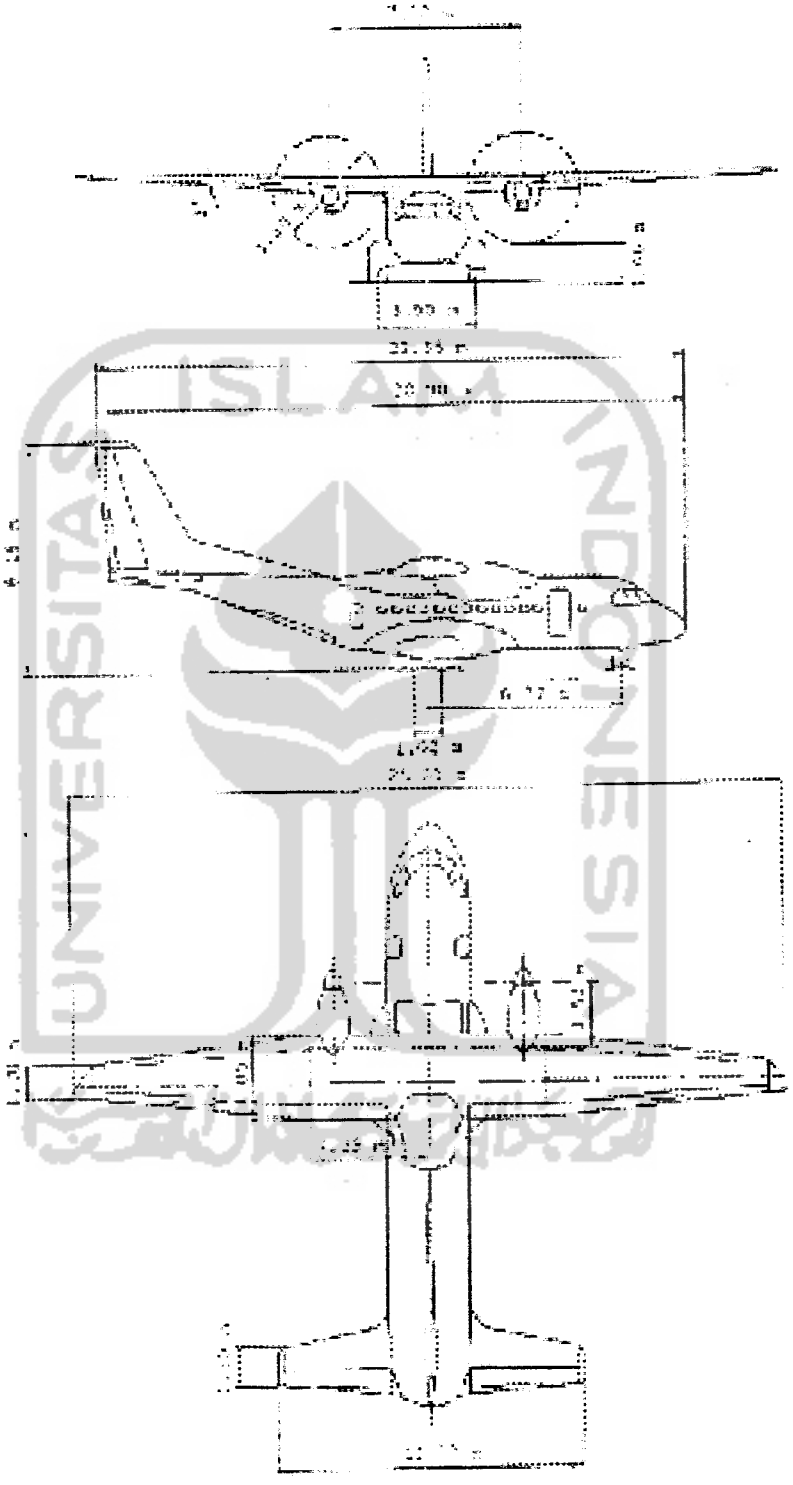


TABLE VIEW DRAWING

4.2 Data Processing

To process the data, there are some steps that we must follow:

4.2.1 Schedule Planning

To find the best schedule, first we must make some plans for the new schedule. There are three airports that will be discussed in this research which are Tunggul Wulung (Cilacap), Halim Perdana Kusuma (Jakarta), and Ahmad Yani (Semarang) Airport.

4.2.1.1 Tunggul Wulung Airport Schedule

The initial flight schedule at Tunggul Wulung Airport are as follow:

Table 4.2 Tunggul Wulung Initial Flight Schedule

Tunggul Wulung Airport	
Arrival	Departure
8.15	07.35
9.40	09.15
10.45	11.20
13.50	12.10

The following are schedule plans to find the best schedule to be used:

Table 4.3 Tunggul Wulung Flight Schedule Plans

Plan 1	
Arrival	Departure
8.15	07.35
9.40	09.15
10.45	11.20
13.50	12.10

Plan 2	
Arrival	Departure
8.15	09.15
9.40	11.20
10.45	12.10
13.50	07.35

Plan 3	
Arrival	Departure
8.15	11.20
9.40	12.10
10.45	07.35
13.50	09.15

Plan 4	
Arrival	Departure
8.15	12.10
9.40	07.35
10.45	09.15
13.50	11.20

Plan 5	
Arrival	Departure
8.15	07.35
9.40	11.20
10.45	12.08
13.50	09.12

Plan 6	
Arrival	Departure
8.15	11.20
9.40	12.10
10.45	09.12
13.50	07.35

Plan 7	
Arrival	Departure
8.15	12.10
9.40	09.15
10.45	07.35
13.50	11.20

Plan 8	
Arrival	Departure
8.15	09.15
9.40	07.35
10.45	11.20
13.50	12.10

Plan 9	
Arrival	Departure
8.15	07.35
9.40	12.10
10.45	11.20
13.50	09.15

Plan 10	
Arrival	Departure
8.15	12.10
9.40	11.20
10.45	09.15
13.50	07.35

Plan 11	
Arrival	Departure
8.15	11.20
9.40	09.15
10.45	07.35
13.50	12.10

Plan 12	
Arrival	Departure
8.15	09.15
9.40	07.35
10.45	12.10
13.50	11.20

Plan 13	
Arrival	Departure
8.15	07.35
9.40	09.15
10.45	12.10
13.50	11.20

Plan 14	
Arrival	Departure
8.15	09.15
9.40	12.10
10.45	11.20
13.50	07.35

Plan 15	
Arrival	Departure
8.15	12.10
9.40	11.20
10.45	07.35
13.50	09.15

Plan 16	
Arrival	Departure
8.15	11.20
9.40	07.35
10.45	09.15
13.50	12.10

Plan 17	
Arrival	Departure
8.15	07.35
9.40	12.10
10.45	09.15
13.50	11.20

Plan 18	
Arrival	Departure
8.15	12.10
9.40	09.15
10.45	11.20
13.50	07.35

Plan 19	
Arrival	Departure
8.15	09.15
9.40	11.20
10.45	07.35
13.50	12.10

Plan 20	
Arrival	Departure
8.15	11.20
9.40	07.35
10.45	12.10
13.50	09.15

Plan 21	
Arrival	Departure
8.15	07.35
9.40	11.20
10.45	09.15
13.50	12.10

Plan 22	
Arrival	Departure
8.15	11.20
9.40	09.15
10.45	12.10
13.50	07.35

Plan 23	
Arrival	Departure
8.15	09.15
9.40	12.10
10.45	07.35
13.50	11.20

Plan 24	
Arrival	Departure
8.15	12.10
9.40	07.35
10.45	11.20
13.50	09.15

4.2.1.2 Halim Perdana Kusuma Airport Schedule

The initial flight schedule at Halim Perdana Kusuma Airport are as follow:

Table 4.4 Halim .P.K. Initial Flight Schedule

Halim Perdana Kusuma Airport	
Arrival	Departure
8.15	08.00
9.55	09.05
12.00	10.30
12.50	13.30

The following are schedule plans to find the best schedule to be used:

Table 4.5 Halim .P.K. Flight Schedule Plans

Plan 1	
Arrival	Departure
8.15	08.00
9.55	09.05
12.00	10.30
12.50	13.30

Plan 2	
Arrival	Departure
8.15	09.05
9.55	10.30
12.00	13.30
12.50	08.00

Plan 3	
Arrival	Departure
8.15	10.30
9.55	13.30
12.00	08.00
12.50	09.05

Plan 4	
Arrival	Departure
8.15	13.30
9.55	08.00
12.00	09.05
12.50	10.30

Plan 5	
Arrival	Departure
8.15	08.00
9.55	09.05
12.00	13.30
12.50	10.30

Plan 6	
Arrival	Departure
8.15	09.05
9.55	13.30
12.00	10.30
12.50	08.00

Plan 7	
Arrival	Departure
8.15	13.30
9.55	10.30
12.00	08.00
12.50	09.05

Plan 8	
Arrival	Departure
8.15	10.30
9.55	08.00
12.00	09.05
12.50	13.30

Plan 9	
Arrival	Departure
8.15	08.00
9.55	10.30
12.00	09.05
12.50	13.30

Plan 10	
Arrival	Departure
8.15	10.30
9.55	09.05
12.00	13.30
12.50	08.00

Plan 11	
Arrival	Departure
8.15	09.05
9.55	13.30
12.00	08.00
12.50	10.30

Plan 12	
Arrival	Departure
8.15	13.30
9.55	08.00
12.00	10.30
12.50	09.05

Plan 13	
Arrival	Departure
8.15	08.00
9.55	10.30
12.00	13.30
12.50	09.05

Plan 14	
Arrival	Departure
8.15	10.30
9.55	13.30
12.00	09.05
12.50	08.00

Plan 15	
Arrival	Departure
8.15	13.30
9.55	09.05
12.00	08.00
12.50	10.30

Plan 16	
Arrival	Departure
8.15	09.05
9.55	08.00
12.00	10.30
12.50	13.30

Plan 17	
Arrival	Departure
8.15	08.00
9.55	13.30
12.00	10.30
12.50	09.05

Plan 18	
Arrival	Departure
8.15	13.30
9.55	10.30
12.00	09.05
12.50	08.00

Plan 19	
Arrival	Departure
8.15	10.30
9.55	09.05
12.00	08.00
12.50	13.30

Plan 20	
Arrival	Departure
8.15	09.05
9.55	08.00
12.00	13.30
12.50	10.30

Plan 21	
Arrival	Departure
8.15	08.00
9.55	13.30
12.00	09.05
12.50	10.30

Plan 22	
Arrival	Departure
8.15	13.30
9.55	09.05
12.00	10.30
12.50	08.00

Plan 23	
Arrival	Departure
8.15	09.05
9.55	10.30
12.00	08.00
12.50	13.30

Plan 24	
Arrival	Departure
8.15	10.30
9.55	08.00
12.00	13.30
12.50	09.05

4.2.1.3 Ahmad Yani Airport Schedule

The initial flight schedule at Ahmad Yani Airport are as follow:

Table 4.6 Ahmad Yani Initial Flight Schedule

Ahmad Yani Airport	
Arrival	Departure
8.50	07.15
9.55	08.40
11.20	09.45
14.20	12.50

The following are schedule plans to find the best schedule to be used:

Table 4.7 Ahmad Yani Flight Schedule Plans

Plan 1	
Arrival	Departure
8.50	07.15
9.55	08.40
11.20	09.45
14.20	12.50

Plan 2	
Arrival	Departure
8.50	08.40
9.55	09.45
11.20	12.50
14.20	07.15

Plan 3	
Arrival	Departure
8.50	09.45
9.55	12.50
11.20	07.15
14.20	08.40

Plan 4	
Arrival	Departure
8.50	12.50
9.55	07.15
11.20	08.40
14.20	09.45

Plan 5	
Arrival	Departure
8.50	07.15
9.55	09.45
11.20	12.50
14.20	08.40

Plan 6	
Arrival	Departure
8.50	09.45
9.55	12.50
11.20	08.40
14.20	07.15

Plan 7	
Arrival	Departure
8.50	12.50
9.55	08.40
11.20	07.15
14.20	09.45

Plan 8	
Arrival	Departure
8.50	08.40
9.55	07.15
11.20	09.45
14.20	12.50

Plan 9	
Arrival	Departure
8.50	07.15
9.55	12.50
11.20	08.40
14.20	09.45

Plan 10	
Arrival	Departure
8.50	12.50
9.55	08.40
11.20	09.45
14.20	07.15

Plan 11	
Arrival	Departure
8.50	08.40
9.55	09.45
11.20	07.15
14.20	12.50

Plan 12	
Arrival	Departure
8.50	09.45
9.55	07.15
11.20	12.50
14.20	08.40

Plan 13	
Arrival	Departure
8.50	07.15
9.55	08.40
11.20	12.50
14.20	09.45

Plan 14	
Arrival	Departure
8.50	08.40
9.55	12.50
11.20	09.45
14.20	07.15

Plan 15	
Arrival	Departure
8.50	12.50
9.55	09.45
11.20	07.15
14.20	08.40

Plan 16	
Arrival	Departure
8.50	09.45
9.55	07.15
11.20	08.40
14.20	12.50

Plan 17	
Arrival	Departure
8.50	07.15
9.55	09.45
11.20	08.40
14.20	12.50

Plan 18	
Arrival	Departure
8.50	09.45
9.55	08.40
11.20	12.50
14.20	07.15

Plan 19	
Arrival	Departure
8.50	08.40
9.55	12.50
11.20	07.15
14.20	09.45

Plan 20	
Arrival	Departure
8.50	12.50
9.55	07.15
11.20	09.45
14.20	08.40

Plan 21	
Arrival	Departure
8.50	07.15
9.55	12.50
11.20	09.45
14.20	08.40

Plan 22	
Arrival	Departure
8.50	12.50
9.55	09.45
11.20	08.40
14.20	07.15

Plan 23	
Arrival	Departure
8.50	09.45
9.55	08.40
11.20	07.15
14.20	12.50

Plan 24	
Arrival	Departure
8.50	08.40
9.55	07.15
11.20	12.50
14.20	09.45

4.2.2 Kept Over Vehicle Determination

Since operating hour of the three airport are begin at 07.00 am until 05.00 pm or 07.00 until 17.00, the value of vehicles kept over "KO" can be determined by looking at the time between arrival and departure, if the time from the arrival time to the departure time have passed the operating hour or 17.00 o'clock then there is vehicle kept over.

4.2.3 The Calculation of Vehicle Kept Over and Idle Time (Ground Time)

4.2.3.1 Tunggul Wulung Airport (Cilacap)

Plan 1

Arrival					Departure								
Hours	minutes	hours	mnt / 60 mnt	total minute	hours	minutes	hours	mnt / 60 mnt	total minutes		Ground time(mnt)		Kept Over
8	15	8	0.25	495	7	35	7	0.583333333	455		-40	560	1
9	40	9	0.667	580	9	15	9	0.25	555		-25	575	1
10	45	10	0.75	645	11	20	11	0.333	680		35	35	0
13	50	13	0.833	830	12	10	12	0.167	730		-100	500	1
										TOTAL	-130	1670	3

Plan 2

Arrival					Departure								
Hours	minutes	Hours	mnt / 60 mnt	total minute	hours	minutes	hours	mnt / 60 mnt	total minutes		Ground time(mnt)		Kept Over
8	15	8	0.25	495	9	15	9	0.25	555		60	60	0
9	40	9	0.667	580	11	20	11	0.333	680		100	100	0
10	45	10	0.75	645	12	10	12	0.167	730		85	85	0
13	50	13	0.833	830	7	35	7	0.583333333	455		-375	225	1
										TOTAL	-130	470	1

Plan 3

Arrival					Departure								
Hours	minutes	Hours	mnt / 60 mnt	total minute	hours	minutes	hours	mnt / 60 mnt	total minutes		Ground time(mnt)		Kept Over
8	15	8	0.25	495	11	20	11	0.333	680		185	185	0
9	40	9	0.667	580	12	10	12	0.167	730		150	150	0
10	45	10	0.75	645	7	35	7	0.583333333	455		-190	410	1
13	50	13	0.833	830	9	15	9	0.25	555		-275	325	1
										TOTAL	-130	1070	2

Plan 4

Arrival					Departure							
Hours	minutes	Hours	mnt / 60 mnt	total minute	hours	minutes	hours	mnt / 60 mnt	total minutes		Ground time(mnt)	Kept Over
8	15	8	0.25	495	12	10	12	0.167	730		235	235	0
9	40	9	0.667	580	7	35	7	0.583	455		-125	475	1
10	45	10	0.75	645	9	15	9	0.25	555		-90	510	1
13	50	13	0.833	830	11	20	11	0.333333333	680		-150	450	1
										TOTAL	-130	1670	3

Plan 5

Arrival					Departure							
Hours	minutes	Hours	mnt / 60 mnt	total minute	hours	minutes	hours	mnt / 60 mnt	total minutes		Ground time(mnt)	Kept Over
8	15	8	0.25	495	7	35	7	0.583333333	455		-40	560	1
9	40	9	0.667	580	11	20	11	0.333333333	680		100	100	0
10	45	10	0.75	645	12	10	12	0.167	730		85	85	0
13	50	13	0.833	830	9	15	9	0.250	555		-275	325	1
										TOTAL	-130	1070	2

Plan 6

Arrival					Departure							
Hours	minutes	Hours	mnt / 60 mnt	total minute	hours	minutes	hours	mnt / 60 mnt	total minutes		Ground time(mnt)	Kept Over
8	15	8	0.25	495	11	20	11	0.333333333	680		185	185	0
9	40	9	0.667	580	12	10	12	0.167	730		150	150	0
10	45	10	0.75	645	9	15	9	0.250	555		-90	510	1
13	50	13	0.833	830	7	35	7	0.583333333	455		-375	225	1
										TOTAL	-130	1070	2

Plan 7

Arrival						Departure								
Hours	minutes	Hours	mnt / 60 mnt	total minute		hours	minutes	hours	mnt / 60 mnt	total minutes		Ground time(mnt)		Kept Over
8	15	8	0.25	495		12	10	12	0.167	730		235	235	0
9	40	9	0.667	580		9	15	9	0.250	555		-25	575	1
10	45	10	0.75	645		7	35	7	0.583333333	455		-190	410	1
13	50	13	0.833	830		11	20	11	0.333333333	680		-150	450	1
											TOTAL	-130	1670	3

Plan 8

Arrival						Departure								
Hours	minutes	Hours	mnt / 60 mnt	total minute		hours	minutes	hours	mnt / 60 mnt	total minutes		Ground time(mnt)		Kept Over
8	15	8	0.25	495		9	15	9	0.250	555		60	60	0
9	40	9	0.667	580		7	35	7	0.583	455		-125	475	1
10	45	10	0.75	645		11	20	11	0.333333333	680		35	35	0
13	50	13	0.833	830		12	10	12	0.166666667	730		-100	500	1
											TOTAL	-130	1070	2

Plan 9

Arrival						Departure								
Hours	minutes	Hours	mnt / 60 mnt	total minute		hours	minutes	hours	mnt / 60 mnt	total minutes		Ground time(mnt)		Kept Over
8	15	8	0.25	495		7	35	7	0.583333333	455		-40	560	1
9	40	9	0.667	580		12	10	12	0.166666667	730		150	150	0
10	45	10	0.75	645		11	20	11	0.333	680		35	35	0
13	50	13	0.833	830		9	15	9	0.250	555		-275	325	1
											TOTAL	-130	1070	2

Plan 10

Arrival					Departure								
Hours	minutes	Hours	mnt / 60 mnt	total minute	hours	minutes	hours	mnt / 60 mnt	total minutes		Ground time(mnt)		Kept Over
8	15	8	0.25	495	12	10	12	0.166666667	730		235	235	0
9	40	9	0.667	580	11	20	11	0.333	680		100	100	0
10	45	10	0.75	645	9	15	9	0.250	555		-90	510	1
13	50	13	0.833	830	7	35	7	0.583333333	455		-375	225	1
										TOTAL	-130	1070	2

Plan 11

Arrival					Departure								
Hours	minutes	Hours	mnt / 60 mnt	total minute	hours	minutes	hours	mnt / 60 mnt	total minutes		Ground time(mnt)		Kept Over
8	15	8	0.25	495	11	20	11	0.333	680		185	185	0
9	40	9	0.667	580	9	15	9	0.250	555		-25	575	1
10	45	10	0.75	645	7	35	7	0.583333333	455		-190	410	1
13	50	13	0.833	830	12	10	12	0.166666667	730		-100	500	1
										TOTAL	-130	1670	3

Plan 12

Arrival					Departure								
Hours	minutes	Hours	mnt / 60 mnt	total minute	hours	minutes	hours	mnt / 60 mnt	total minutes		Ground time(mnt)		Kept Over
8	15	8	0.25	495	9	15	9	0.250	555		60	60	0
9	40	9	0.667	580	7	35	7	0.583	455		-125	475	1
10	45	10	0.75	645	12	10	12	0.166666667	730		85	85	0
13	50	13	0.833	830	11	20	11	0.333333333	680		-150	450	1
										TOTAL	-130	1070	2

Plan 13

Arrival						Departure								
Hour	Minute	Hour	mnt / 60 mnt	total minute		Hour	Minute	Hour	mnt / 60 mnt	total minute		Ground time(mnt)		Kept Over
8	15	8	0.25	495		7	35	7	0.583333333	455		-40	560	1
9	40	9	0.667	580		9	15	9	0.25	555		-25	575	1
10	45	10	0.75	645		12	10	12	0.167	730		85	85	0
13	50	13	0.833	830		11	20	11	0.333	680		-150	450	1
											TOTAL	-130	1670	3

Plan 14

Arrival						Departure								
Hour	Minute	Hour	mnt / 60 mnt	total minute		Hour	Minute	Hour	mnt / 60 mnt	total minute		Ground time(mnt)		Kept Over
8	15	8	0.25	495		9	15	9	0.25	555		60	60	0
9	40	9	0.667	580		12	10	12	0.167	730		150	150	0
10	45	10	0.75	645		11	20	11	0.333	680		35	35	0
13	50	13	0.833	830		7	35	7	0.583333333	455		-375	225	1
											TOTAL	-130	470	1

Plan 15

Arrival						Departure								
Hour	Minute	Hour	mnt / 60 mnt	total minute		Hour	Minute	Hour	mnt / 60 mnt	total minute		Ground time(mnt)		Kept Over
8	15	8	0.25	495		12	10	12	0.167	730		235	235	0
9	40	9	0.667	580		11	20	11	0.333	680		100	100	0
10	45	10	0.75	645		7	35	7	0.583333333	455		-190	410	1
13	50	13	0.833	830		9	15	9	0.25	555		-275	325	1
											TOTAL	-130	1070	2

Plan16

Arrival						Departure								
Hour	Minute	Hour	mnt / 60 mnt	total minute		Hour	Minute	Hour	mnt / 60 mnt	total minute		Ground time(mnt)		Kept Over
8	15	8	0.25	495		11	20	11	0.333	680		185	185	0
9	40	9	0.667	580		7	35	7	0.583	455		-125	475	1
10	45	10	0.75	645		9	15	9	0.25	555		-90	510	1
13	50	13	0.833	830		12	10	12	0.166666667	730		-100	500	1
											TOTAL	-130	1670	3

Plan 17

Arrival						Departure								
Hour	Minute	Hour	mnt / 60 mnt	total minute		Hour	Minute	Hour	mnt / 60 mnt	total minute		Ground time(mnt)		Kept Over
8	15	8	0.25	495		7	35	7	0.583333333	455		-40	560	1
9	40	9	0.667	580		12	10	12	0.166666667	730		150	150	0
10	45	10	0.75	645		9	15	9	0.250	555		-90	510	1
13	50	13	0.833	830		11	20	11	0.333	680		-150	450	1
											TOTAL	-130	1670	3

Plan 18

Arrival						Departure								
Hour	Minute	Hour	mnt / 60 mnt	total minute		Hour	Minute	Hour	mnt / 60 mnt	total minute		Ground time(mnt)		Kept Over
8	15	8	0.25	495		12	10	12	0.166666667	730		235	235	0
9	40	9	0.667	580		9	15	9	0.250	555		-25	575	1
10	45	10	0.75	645		11	20	11	0.333	680		35	35	0
13	50	13	0.833	830		7	35	7	0.583333333	455		-375	225	1
											TOTAL	-130	1070	2

Plan 19

Arrival						Departure								
Hour	Minute	Hour	mnt / 60 mnt	total minute		Hour	Minute	Hour	mnt / 60 mnt	total minute		Ground time(mnt)		Kept Over
8	15	8	0.25	495		9	15	9	0.250	555		60	60	0
9	40	9	0.667	580		11	20	11	0.333	680		100	100	0
10	45	10	0.75	645		7	35	7	0.583333333	455		-190	410	1
13	50	13	0.833	830		12	10	12	0.166666667	730		-100	500	1
											TOTAL	-130	1070	2

Plan 20

Arrival						Departure								
Hour	Minute	Hour	mnt / 60 mnt	total minute		Hour	Minute	Hour	mnt / 60 mnt	total minute		Ground time(mnt)		Kept Over
8	15	8	0.25	495		11	20	11	0.333	680		185	185	0
9	40	9	0.667	580		7	35	7	0.583	455		-125	475	1
10	45	10	0.75	645		12	10	12	0.166666667	730		85	85	0
13	50	13	0.833	830		9	15	9	0.25	555		-275	325	1
											TOTAL	-130	1070	2

Plan 21

Arrival						Departure								
Hour	Minute	Hour	mnt / 60 mnt	total minute		Hour	Minute	Hour	mnt / 60 mnt	total minute		Ground time(mnt)		Kept Over
8	15	8	0.25	495		7	35	7	0.583333333	455		-40	560	1
9	40	9	0.667	580		11	20	11	0.333333333	680		100	100	0
10	45	10	0.75	645		9	15	9	0.250	555		-90	510	1
13	50	13	0.833	830		12	10	12	0.167	730		-100	500	1
											TOTAL	-130	1670	3

Plan 22

Arrival						Departure								
Hour	Minute	Hour	mnt / 60 mnt	total minute		Hour	Minute	Hour	mnt / 60 mnt	total minute		Ground time(mnt)		Kept Over
8	15	8	0.25	495		11	20	11	0.333333333	680		185	185	0
9	40	9	0.667	580		9	15	9	0.250	555		-25	575	1
10	45	10	0.75	645		12	10	12	0.167	730		85	85	0
13	50	13	0.833	830		7	35	7	0.583333333	455		-375	225	1
											TOTAL	-130	1070	2

Plan 23

Arrival						Departure								
Hour	Minute	Hour	mnt / 60 mnt	total minute		Hour	Minute	Hour	mnt / 60 mnt	total minute		Ground time (mnt)		Kept Over
8	15	8	0.25	495		9	15	9	0.250	555		60	60	0
9	40	9	0.667	580		12	10	12	0.167	730		150	150	0
10	45	10	0.75	645		7	35	7	0.583333333	455		-190	410	1
13	50	13	0.833	830		11	20	11	0.333333333	680		-150	450	1
											TOTAL	-130	1070	2

Plan 24

Arrival						Departure								
Hour	Minute	Hour	mnt / 60 mnt	total minute		Hour	Minute	Hour	mnt / 60 mnt	total minute		Ground time(mnt)		Kept Over
8	15	8	0.25	495		12	10	12	0.167	730		235	235	0
9	40	9	0.667	580		7	35	7	0.583	455		-125	475	1
10	45	10	0.75	645		11	20	11	0.333333333	680		35	35	0
13	50	13	0.833	830		9	15	9	0.25	555		-275	325	1
											TOTAL	-130	1070	2

4.2.3.2 Halim Perdana Kusuma Airport (Jakarta)

Plan 1

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time		Kept Over
8	15	8	0.25	495		8	0	8	0	480		-15	585	1
9	55	9	0.917	595		9	5	9	0.083333333	545		-50	550	1
12	0	12	0	720		10	30	10	0.500	630		-90	510	1
12	50	12	0.833	770		13	30	13	0.500	810		40	40	0
											TOTAL	-115	1685	3

Plan 2

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time		Kept Over
8	15	8	0.25	495		9	5	9	0.083333333	545		50	50	0
9	55	9	0.917	595		10	30	10	0.500	630		35	35	0
12	0	12	0	720		13	30	13	0.500	810		90	90	0
12	50	12	0.833	770		8	0	8	0	480		-290	310	1
											TOTAL	-115	485	1

Plan 3

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time		Kept Over
8	15	8	0.25	495		10	30	10	0.500	630		135	135	0
9	55	9	0.917	595		13	30	13	0.500	810		215	215	0
12	0	12	0	720		8	0	8	0	480		-240	360	1
12	50	12	0.833	770		9	5	9	0.083333333	545		-225	375	1
											TOTAL	-115	1085	2

Plan 4

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time		Kept Over
8	15	8	0.25	495		13	30	13	0.500	810		315	315	0
9	55	9	0.917	595		8	0	8	0.000	480		-115	485	1
12	0	12	0	720		9	5	9	0.083333333	545		-175	425	1
12	50	12	0.833	770		10	30	10	0.5	630		-140	460	1
											TOTAL	-115	1685	3

Plan 5

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time		Kept Over
8	15	8	0.25	495		8	0	8	0	480		-15	585	1
9	55	9	0.917	595		9	5	9	0.083333333	545		-50	550	1
12	0	12	0	720		13	30	13	0.500	810		90	90	0
12	50	12	0.833	770		10	30	10	0.500	630		-140	460	1
											TOTAL	-115	1685	3

Plan 6

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time		Kept Over
8	15	8	0.25	495		9	5	9	0.083333333	545		50	50	0
9	55	9	0.917	595		13	30	13	0.500	810		215	215	0
12	0	12	0	720		10	30	10	0.500	630		-90	510	1
12	50	12	0.833	770		8	0	8	0	480		-290	310	1
											TOTAL	-115	1085	2

Plan 7

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time		Kept Over
8	15	8	0.25	495		13	30	13	0.500	810		315	315	0
9	55	9	0.917	595		10	30	10	0.500	630		35	35	0
12	0	12	0	720		8	0	8	0	480		-240	360	1
12	50	12	0.833	770		9	5	9	0.083333333	545		-225	375	1
											TOTAL	-115	1085	2

Plan 8

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time		Kept Over
8	15	8	0.25	495		10	30	10	0.500	630		135	135	0
9	55	9	0.917	595		8	0	8	0.000	480		-115	485	1
12	0	12	0	720		9	5	9	0.083333333	545		-175	425	1
12	50	12	0.833	770		13	30	13	0.5	810		40	40	0
											TOTAL	-115	1085	2

Plan 9

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time		Kept Over
8	15	8	0.25	495		8	0	8	0	480		-15	585	1
9	55	9	0.917	595		10	30	10	0.5	630		35	35	0
12	0	12	0	720		9	5	9	0.083	545		-175	425	1
12	50	12	0.833	770		13	30	13	0.500	810		40	40	0
											TOTAL	-115	1085	2

Plan 10

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time		Kept Over
8	15	8	0.25	495		10	30	10	0.5	630		135	135	0
9	55	9	0.917	595		9	5	9	0.083	545		-50	550	1
12	0	12	0	720		13	30	13	0.500	810		90	90	0
12	50	12	0.833	770		8	0	8	0	480		-290	310	1
											TOTAL	-115	1085	2

Plan 11

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time		Kept Over
8	15	8	0.25	495		9	5	9	0.083	545		50	50	0
9	55	9	0.917	595		13	30	13	0.500	810		215	215	0
12	0	12	0	720		8	0	8	0	480		-240	360	1
12	50	12	0.833	770		10	30	10	0.5	630		-140	460	1
											TOTAL	-115	1085	2

Plan 12

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time		Kept Over
8	15	8	0.25	495		13	30	13	0.500	810		315	315	0
9	55	9	0.917	595		8	0	8	0.000	480		-115	485	1
12	0	12	0	720		10	30	10	0.5	630		-90	510	1
12	50	12	0.833	770		9	5	9	0.083333333	545		-225	375	1
											TOTAL	-115	1685	3

Plan 13

Arrival						Departure						ground time		Kept Over
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes				
8	15	8	0.25	495		8	0	8	0	480		-15	585	1
9	55	9	0.917	595		10	30	10	0.5	630		35	35	0
12	0	12	0	720		13	30	13	0.500	810		90	90	0
12	50	12	0.833	770		9	5	9	0.083	545		-225	375	1
											TOTAL	-115	1085	2

Plan 14

Arrival						Departure						ground time		Kept Over
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes				
8	15	8	0.25	495		10	30	10	0.5	630		135	135	0
9	55	9	0.917	595		13	30	13	0.500	810		215	215	0
12	0	12	0	720		9	5	9	0.083	545		-175	425	1
12	50	12	0.833	770		8	0	8	0	480		-290	310	1
											TOTAL	-115	1085	2

Plan 15

Arrival						Departure						ground time		Kept Over
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes				
8	15	8	0.25	495		13	30	13	0.500	810		315	315	0
9	55	9	0.917	595		9	5	9	0.083	545		-50	550	1
12	0	12	0	720		8	0	8	0	480		-240	360	1
12	50	12	0.833	770		10	30	10	0.5	630		-140	460	1
											TOTAL	-115	1685	3

Plan 16

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time		Kept Over
8	15	8	0.25	495		9	5	9	0.083	545		50	50	0
9	55	9	0.917	595		8	0	8	0.000	480		-115	485	1
12	0	12	0	720		10	30	10	0.5	630		-90	510	1
12	50	12	0.833	770		13	30	13	0.5	810		40	40	0
											TOTAL	-115	1085	2

Plan 17

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time		Kept Over
8	15	8	0.25	495		8	0	8	0	480		-15	585	1
9	55	9	0.917	595		13	30	13	0.5	810		215	215	0
12	0	12	0	720		10	30	10	0.500	630		-90	510	1
12	50	12	0.833	770		9	5	9	0.083	545		-225	375	1
											TOTAL	-115	1685	3

Plan 18

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time		Kept Over
8	15	8	0.25	495		13	30	13	0.5	810		315	315	0
9	55	9	0.917	595		10	30	10	0.500	630		35	35	0
12	0	12	0	720		9	5	9	0.083	545		-175	425	1
12	50	12	0.833	770		8	0	8	0	480		-290	310	1
											TOTAL	-115	1085	2

Plan 19

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time		Kept Over
8	15	8	0.25	495		10	30	10	0.500	630		135	135	0
9	55	9	0.917	595		9	5	9	0.083	545		-50	550	1
12	0	12	0	720		8	0	8	0	480		-240	360	1
12	50	12	0.833	770		13	30	13	0.5	810		40	40	0
											TOTAL	-115	1085	2

Plan 20

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time		Kept Over
8	15	8	0.25	495		9	5	9	0.083	545		50	50	0
9	55	9	0.917	595		8	0	8	0.000	480		-115	485	1
12	0	12	0	720		13	30	13	0.5	810		90	90	0
12	50	12	0.833	770		10	30	10	0.5	630		-140	460	1
											TOTAL	-115	1085	2

Plan 21

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time		Kept Over
8	15	8	0.25	495		8	0	8	0	480		-15	585	1
9	55	9	0.917	595		13	30	13	0.5	810		215	215	0
12	0	12	0	720		9	5	9	0.083	545		-175	425	1
12	50	12	0.833	770		10	30	10	0.500	630		-140	460	1
											TOTAL	-115	1685	3

Plan 22

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time		Kept Over
8	15	8	0.25	495		13	30	13	0.5	810		315	315	0
9	55	9	0.917	595		9	5	9	0.083	545		-50	550	1
12	0	12	0	720		10	30	10	0.500	630		-90	510	1
12	50	12	0.833	770		8	0	8	0	480		-290	310	1
											TOTAL	-115	1685	3

Plan 23

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time		Kept Over
8	15	8	0.25	495		9	5	9	0.083	545		50	50	0
9	55	9	0.917	595		10	30	10	0.500	630		35	35	0
12	0	12	0	720		8	0	8	0	480		-240	360	1
12	50	12	0.833	770		13	30	13	0.5	810		40	40	0
											TOTAL	-115	485	1

Plan 24

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time		Kept Over
8	15	8	0.25	495		10	30	10	0.500	630		135	135	0
9	55	9	0.917	595		8	0	8	0.000	480		-115	485	1
12	0	12	0	720		13	30	13	0.5	810		90	90	0
12	50	12	0.833	770		9	5	9	0.083333333	545		-225	375	1
											TOTAL	-115	1085	2

Plan 22

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time		Kept Over
8	15	8	0.25	495		13	30	13	0.5	810		315	315	0
9	55	9	0.917	595		9	5	9	0.083	545		-50	550	1
12	0	12	0	720		10	30	10	0.500	630		-90	510	1
12	50	12	0.833	770		8	0	8	0	480		-290	310	1
											TOTAL	-115	1685	3

Plan 23

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time		Kept Over
8	15	8	0.25	495		9	5	9	0.083	545		50	50	0
9	55	9	0.917	595		10	30	10	0.500	630		35	35	0
12	0	12	0	720		8	0	8	0	480		-240	360	1
12	50	12	0.833	770		13	30	13	0.5	810		40	40	0
											TOTAL	-115	485	1

Plan 24

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time		Kept Over
8	15	8	0.25	495		10	30	10	0.500	630		135	135	0
9	55	9	0.917	595		8	0	8	0.000	480		-115	485	1
12	0	12	0	720		13	30	13	0.5	810		90	90	0
12	50	12	0.833	770		9	5	9	0.083333333	545		-225	375	1
											TOTAL	-115	1085	2

4.2.3.3 Ahmad Yani (Semarang)

Plan 1

Arrival					Departure							
hours	minutes	hours	mnt / 60 mnt	total minutes	hours	minutes	hours	mnt / 60 mnt	total minutes		Ground time (mnt)	Kept over
8	50	8	0.833333333	530	7	15	7	0.25	435		-95	505	1
9	55	9	0.917	595	8	40	8	0.666666667	520		-75	525	1
11	20	11	0.333333333	680	9	45	9	0.750	585		-95	505	1
14	20	14	0.333	860	12	50	12	0.833	770		-90	510	1
										TOTAL	-355	2045	4

Plan 2

Arrival					Departure							
hours	minutes	hours	mnt / 60 mnt	total minutes	hours	minutes	hours	mnt / 60 mnt	total minutes		Ground time (mnt)	Kept over
8	50	8	0.833333333	530	8	40	8	0.666666667	520		-10	590	1
9	55	9	0.917	595	9	45	9	0.750	585		-10	590	1
11	20	11	0.333333333	680	12	50	12	0.833	770		90	90	0
14	20	14	0.333	860	7	15	7	0.25	435		-425	175	1
										TOTAL	-355	1445	3

Plan 3

Arrival					Departure							
hours	minutes	hours	mnt / 60 mnt	total minutes	hours	minutes	hours	mnt / 60 mnt	total minutes		Ground time (mnt)	Kept over
8	50	8	0.833333333	530	9	45	9	0.750	585		55	55	0
9	55	9	0.917	595	12	50	12	0.833	770		175	175	0
11	20	11	0.333333333	680	7	15	7	0.25	435		-245	355	1
14	20	14	0.333	860	8	40	8	0.666666667	520		-340	260	1
										TOTAL	-355	845	2

Plan 4

Arrival					Departure							
hours	minutes	hours	mnt / 60 mnt	total minutes	hours	minutes	hours	mnt / 60 mnt	total minutes		Ground time (mnt)	Kept over
8	50	8	0.833333333	530	12	50	12	0.833	770		240	240	0
9	55	9	0.917	595	7	15	7	0.250	435		-160	440	1
11	20	11	0.333333333	680	8	40	8	0.666666667	520		-160	440	1
14	20	14	0.333	860	9	45	9	0.75	585		-275	325	1
										TOTAL	-355	1445	3

Plan 5

Arrival					Departure							
hours	minutes	hours	mnt / 60 mnt	total minutes	hours	minutes	hours	mnt / 60 mnt	total minutes		Ground time (mnt)	Kept over
8	50	8	0.833333333	530	7	15	7	0.25	435		-95	505	1
9	55	9	0.917	595	9	45	9	0.75	585		-10	590	1
11	20	11	0.333333333	680	12	50	12	0.833	770		90	90	0
14	20	14	0.333	860	8	40	8	0.667	520		-340	260	1
										TOTAL	-355	1445	3

Plan 6

Arrival					Departure							
hours	minutes	hours	mnt / 60 mnt	total minutes	hours	minutes	hours	mnt / 60 mnt	total minutes		Ground time (mnt)	Kept over
8	50	8	0.833333333	530	9	45	9	0.75	585		55	55	0
9	55	9	0.917	595	12	50	12	0.833	770		175	175	0
11	20	11	0.333333333	680	8	40	8	0.667	520		-160	440	1
14	20	14	0.333	860	7	15	7	0.25	435		-425	175	1
										TOTAL	-355	845	2

Plan 7

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		Ground time (mnt)		Kept over
8	50	8	0.833333333	530		12	50	12	0.833	770		240	240	0
9	55	9	0.917	595		8	40	8	0.667	520		-75	525	1
11	20	11	0.333333333	680		7	15	7	0.25	435		-245	355	1
14	20	14	0.333	860		9	45	9	0.75	585		-275	325	1
											TOTAL	-355	1445	3

Plan 8

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		Ground time (mnt)		Kept over
8	50	8	0.833333333	530		8	40	8	0.667	520		-10	590	1
9	55	9	0.917	595		7	15	7	0.250	435		-160	440	1
11	20	11	0.333333333	680		9	45	9	0.75	585		-95	505	1
14	20	14	0.333	860		12	50	12	0.833333333	770		-90	510	1
											TOTAL	-355	2045	4

Plan 9

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		Ground time (mnt)		Kept over
8	50	8	0.833333333	530		7	15	7	0.25	435		-95	505	1
9	55	9	0.917	595		12	50	12	0.833333333	770		175	175	0
11	20	11	0.333333333	680		8	40	8	0.667	520		-160	440	1
14	20	14	0.333	860		9	45	9	0.750	585		-275	325	1
											TOTAL	-355	1445	3

Plan 10

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		Ground time (mnt)		Kept over
8	50	8	0.833333333	530		12	50	12	0.833333333	770		240	240	0
9	55	9	0.917	595		8	40	8	0.667	520		-75	525	1
11	20	11	0.333333333	680		9	45	9	0.750	585		-95	505	1
14	20	14	0.333	860		7	15	7	0.25	435		-425	175	1
											TOTAL	-355	1445	3

Plan 11

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		Ground time (mnt)		Kept over
8	50	8	0.833333333	530		8	40	8	0.667	520		-10	590	1
9	55	9	0.917	595		9	45	9	0.750	585		-10	590	1
11	20	11	0.333333333	680		7	15	7	0.25	435		-245	355	1
14	20	14	0.333	860		12	50	12	0.833333333	770		-90	510	1
											TOTAL	-355	2045	4

Plan 12

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		Ground time		Kept over
8	50	8	0.833333333	530		9	45	9	0.750	585		55	55	0
9	55	9	0.917	595		7	15	7	0.250	435		-160	440	1
11	20	11	0.333333333	680		12	50	12	0.833333333	770		90	90	0
14	20	14	0.333	860		8	40	8	0.666666667	520		-340	260	1
											TOTAL	-355	845	2

Plan 13

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time (mnt)		Kept Over
8	50	8	0.833333333	530		7	15	7	0.25	435		-95	505	1
9	55	9	0.917	595		8	40	8	0.666666667	520		-75	525	1
11	20	11	0.333333333	680		12	50	12	0.833	770		90	90	0
14	20	14	0.333	860		9	45	9	0.750	585		-275	325	1
											TOTAL	-355	1445	3

Plan 14

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time (mnt)		Kept Over
8	50	8	0.833333333	530		8	40	8	0.666666667	520		-10	590	1
9	55	9	0.917	595		12	50	12	0.833	770		175	175	0
11	20	11	0.333333333	680		9	45	9	0.750	585		-95	505	1
14	20	14	0.333	860		7	15	7	0.25	435		-425	175	1
											TOTAL	-355	1445	3

Plan 15

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time (mnt)		Kept Over
8	50	8	0.833333333	530		12	50	12	0.833	770		240	240	0
9	55	9	0.917	595		9	45	9	0.750	585		-10	590	1
11	20	11	0.333333333	680		7	15	7	0.25	435		-245	355	1
14	20	14	0.333	860		8	40	8	0.666666667	520		-340	260	1
											TOTAL	-355	1445	3

Plan 16

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time (mnt)		Kept Over
8	50	8	0.833333333	530		9	45	9	0.750	585		55	55	0
9	55	9	0.917	595		7	15	7	0.250	435		-160	440	1
11	20	11	0.333333333	680		8	40	8	0.666666667	520		-160	440	1
14	20	14	0.333	860		12	50	12	0.833333333	770		-90	510	1
											TOTAL	-355	1445	3

Plan 17

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time (mnt)		Kept Over
8	50	8	0.833333333	530		7	15	7	0.25	435		-95	505	1
9	55	9	0.917	595		9	45	9	0.75	585		-10	590	1
11	20	11	0.333333333	680		8	40	8	0.667	520		-160	440	1
14	20	14	0.333	860		12	50	12	0.833	770		-90	510	1
											TOTAL	-355	2045	4

Plan 18

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time (mnt)		Kept Over
8	50	8	0.833333333	530		9	45	9	0.75	585		55	55	0
9	55	9	0.917	595		8	40	8	0.667	520		-75	525	1
11	20	11	0.333333333	680		12	50	12	0.833	770		90	90	0
14	20	14	0.333	860		7	15	7	0.25	435		-425	175	1
											TOTAL	-355	845	2

Plan 19

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time (mnt)		Kept Over
8	50	8	0.833333333	530		8	40	8	0.667	520		-10	590	1
9	55	9	0.917	595		12	50	12	0.833	770		175	175	0
11	20	11	0.333333333	680		7	15	7	0.25	435		-245	355	1
14	20	14	0.333	860		9	45	9	0.75	585		-275	325	1
											TOTAL	-355	1445	3

Plan 20

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time (mnt)		Kept Over
8	50	8	0.833333333	530		12	50	12	0.833	770		240	240	0
9	55	9	0.917	595		7	15	7	0.250	435		-160	440	1
11	20	11	0.333333333	680		9	45	9	0.75	585		-95	505	1
14	20	14	0.333	860		8	40	8	0.666666667	520		-340	260	1
											TOTAL	-355	1445	3

Plan 21

Arrival						Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes		hours	minutes	hours	mnt / 60 mnt	total minutes		ground time (mnt)		Kept Over
8	50	8	0.833333333	530		7	15	7	0.25	435		-95	505	1
9	55	9	0.917	595		12	50	12	0.833333333	770		175	175	0
11	20	11	0.333333333	680		9	45	9	0.750	585		-95	505	1
14	20	14	0.333	860		8	40	8	0.667	520		-340	260	1
											TOTAL	-355	1445	3

Plan 22

Arrival					Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes	hours	minutes	hours	mnt / 60 mnt	total minutes		ground time (mnt)		Kept Over
8	50	8	0.833333333	530	12	50	12	0.833333333	770		240	240	0
9	55	9	0.917	595	9	45	9	0.750	585		-10	590	1
11	20	11	0.333333333	680	8	40	8	0.667	520		-160	440	1
14	20	14	0.333	860	7	15	7	0.25	435		-425	175	1
										TOTAL	-355	1445	3

Plan 23

Arrival					Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes	hours	minutes	hours	mnt / 60 mnt	total minutes		ground time (mnt)		Kept Over
8	50	8	0.833333333	530	9	45	9	0.750	585		55	55	0
9	55	9	0.917	595	8	40	8	0.667	520		-75	525	1
11	20	11	0.333333333	680	7	15	7	0.25	435		-245	355	1
14	20	14	0.333	860	12	50	12	0.833333333	770		-90	510	1
										TOTAL	-355	1445	3

Plan 24

Arrival					Departure								
hours	minutes	hours	mnt / 60 mnt	total minutes	hours	minutes	hours	mnt / 60 mnt	total minutes		ground time (mnt)		Kept Over
8	50	8	0.833333333	530	8	40	8	0.667	520		-10	590	1
9	55	9	0.917	595	7	15	7	0.250	435		-160	440	1
11	20	11	0.333333333	680	12	50	12	0.833333333	770		90	90	0
14	20	14	0.333	860	9	45	9	0.75	585		-275	325	1
										TOTAL	-355	1445	3

4.2.4 The Determination of Best Schedule

The schedule with smallest value of vehicle kept over is also have the smallest value of idle time. The best arrangement of flight schedule is indicated with the smallest value of vehicle kept over. Schedule with the smallest value of vehicle kept over must be chosen as the best schedule. In this research we found that the best schedule are as follow:

Table 4.10 The Best Schedule

Tunggul Wulung Airport	
Arrival	Departure
8,15	09,15
9,40	11,20
10,45	12,10
13,50	07,35

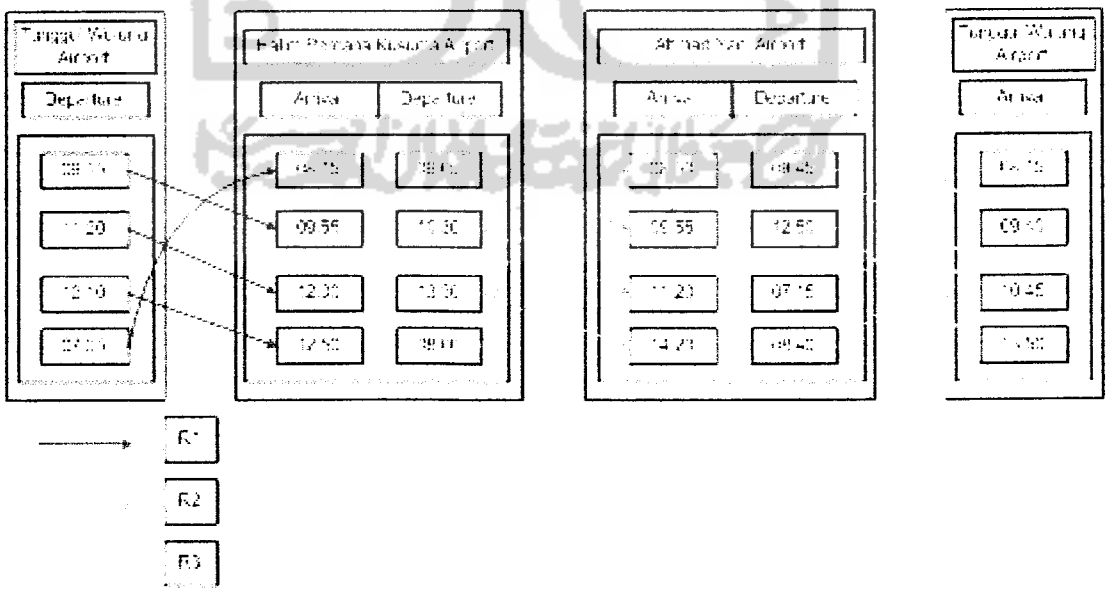
Halim Perdana Kusuma Airport	
Arrival	Departure
8,15	09,05
9,55	10,30
12,00	13,30
12,50	08,00

Ahmad Yani Airport	
Arrival	Departure
8,50	09,45
9,55	12,50
11,20	07,15
14,20	08,40

4.2.5 Determination of Running Time

From the new schedule arrangement we will determine the running time as follow:

Table 4.11 Aircraft Routes



Departure					Arrival								
hours	minutes	hours	mnt / 60 mnt	total minutes	hours	minutes	hours	mnt / 60 mnt	total minutes		Running time(mnt)		Kept Over
9	15	9	0.25	555	9	55	9	0.917	595		40	40	0
11	20	11	0.333	680	12	0	12	0.000	720		40	40	0
12	10	12	0.1666667	730	12	50	12	0.8333333	770		40	40	0
7	35	7	0.583	455	8	15	8	0.25	495		40	40	0
										TOTAL	160	160	0

R1 = Running time from Tunggul Wulung to Halim Perdana Kusuma = 160 minutes

Departure					Arrival								
hours	minutes	hours	mnt / 60 mnt	total minutes	hours	minutes	hours	mnt / 60 mnt	total minutes		Running time(mnt)		Kept Over
9	5	9	0.0833333	545	9	55	9	0.917	595		50	50	0
10	30	10	0.500	630	11	20	11	0.333	680		50	50	0
13	30	13	0.5	810	14	20	14	0.3333333	860		50	50	0
8	0	8	0.000	480	8	50	8	0.8333333	530		50	50	0
										TOTAL	200	200	0

R2 = Running time from Halim Perdana Kusuma to Ahmad Yani = 200 minutes

Departure					Arrival								
hours	minutes	hours	mnt / 60 mnt	total minutes	hours	minutes	hours	mnt / 60 mnt	total minutes		Running time(mnt)		Kept Over
9	45	9	0.75	585	10	45	10	0.750	645		60	60	0
12	50	12	0.833	770	13	50	13	0.833	830		60	60	0
7	15	7	0.25	435	8	15	8	0.25	495		60	60	0
8	40	8	0.667	520	9	40	9	0.6666667	580		60	60	0
										TOTAL	240	240	0

R3 = Running time from Ahmad Yani to Tunggul Wulung = 240 minutes

4.2.6 Determination of Vehicle Hour and Vehicle Needed

With the formula , $\mathbf{T} = \sum \mathbf{I} + \sum_t \left\{ \sum_i a_{ij} - \sum_i d_{ij} \right\} + BT$ we determined that the t (vehicle hour) is 2400 minutes (40 hours/day).

T (vehicle hour) = 1800 minutes + 600 minutes = 2400 minutes = 40 hours/day

And since the operating hour of each airport is 10 hours then,

$$\frac{I+R}{T} = \frac{40}{10} = 4$$

we determined that the minimum vehicle needed is 4 aircrafts.

The following table is a flight description to show the movement of each aircraft:

Table 4.12 Flight Description

Tunggul Wulung		Halim P.K		Ahmad Yani		Tunggul Wulung	
Departure		Arrival	Departure	arrival	Departure	Arrival	
09,15				08,60	09,45	08,15	
		09,55	10,30				
12,10				11,20	07,15	10,45	
		12,50	08,00				

> aircraft 1

> aircraft 2

> aircraft 3

> aircraft 4

CHAPTER V

DISCUSSION

5.1 Analysis

In this chapter, we will discuss and analyze the result of data processing to find the final result of this thesis. The analysis related to the objective of the research which is to determine the minimum fleet size required and also to fine the best schedule to improve work performance of the company.

From the research done, found that there are 24 possible plans for a better flight schedule arrangement for each airport, but there is only one plan which is chosen to be the best. This schedule plan is selected based on the smallest value of kept over vehicle and ground time, the smaller the value is the better plan. The best schedule determined can be seen in chapter IV.

For Tunggul Wulung airport, schedule plan no. 2 is chosen because it has the smallest value of kept over vehicle and ground time which are 1 and 60, 100, 85, 225 minutes, with total ground time is 470 minutes. For Halim Perdana Kusuma airport, schedule plan no.2 is chosen because it has the smallest value of kept over vehicle and ground time which are 1 and 50, 35, 90, 310 minutes, with total ground time is 485 minutes. For Ahmad Yani airport, schedule plan no. 3 is chosen because it has the smallest value of kept over vehicle and ground time which are 2 and 55, 175, 355, 260 minutes, with total ground time is 845 minutes.

Based on the new schedule arrangement, determined from the data processing that the total running time from Tunggul wulung to Halim Perdana Kusuma is 160 minutes, the total running time from Halim Perdana Kusuma to Ahmad Yani 200 minutes, the total running time from Ahmad Yani to Tunggul wulung is 240 minutes. And since the operating hour for each airport is 10 hours then found that the minimum total of vehicle needed to run the schedule is 4 aircrafts, with flight description table which show the movement of aircraft is stated in chapter IV.

The first aircraft will fly from Ahmad Yani Airport (Semarang) at time 07.15 and will end the flight back to Ahmad Yani at time 11.20, the second aircraft will start the flight from Tunggul Wulung Airport (Cilacap) at time 07.35 and will end the flight back at Tunggul Wulung at time 13.50, for the third aircraft will start the flight at time 08.00 from Halim Perdana Kusuma Airport (Jakarta), end will end the flight at Halim Perdana Kusuma Airport at the time 12.50, and then for the forth aircraft will start the flight at time 08.40 from Ahmad Yani Airport and it will end the flight at Ahmad Yani Airport at the time 14.20.

CHAPTER VI

CONCLUSION & SUGGESTION

6.1 Conclusion

From the analysis, we can conclude that the initial flight schedule provide by PT. Merpati Nusantara Airlines is not optimum yet as it is seen from the total idle time. After the research is done, we found the best schedule as follow, For Tuggul Wulung airport, aircraft that arrive at 08.15 will depart again at 09.15, aircraft that arrive at 09.40 will depart again at 11.20, aircraft that arrive at 10.45 will depart again at 12.10, and aircraft that arrive at 13.50 will depart again at 07.35 in the next morning. For Halim Perdana Kusuma airport, aircraft that arrive at 08.15 will depart again at 09.05, aircraft that arrive at 09.55 will depart again at 10.30, aircraft that arrive at 12.00 will depart again at 13.30, and aircraft that arrive at 12.50 will depart again at 08.00 in the next morning, for Ahmad Yani airport, aircraft that arrive at 08.50 will depart again at 09.45, aircraft that arrive at 09.55 will depart again at 12.50, aircraft that arrive at 11.20 will depart again at 07.15 in the next morning, and aircraft that arrive at 14.20 will depart again at 08.40 also in the next morning.

And from the best schedule after we have done some calculation we found that PT. Merpati Nusantara Airlines must provide minimum 4 aircrafts type CN-235 to run the flight schedule with route Tunggul Wulung (Cilacap)-Halim Perdana Kusuma (Jakarta)-Ahmad Yani (Semarang)-Tunggul Wulung (Cilacap).

6.2 Suggestion

Some Suggestions that could be given are as follow:

1) PT. Merpati Nusantara Airlines must perform the best flight schedule and provide the minimum number of aircrafts needed to increase service performance.

2) To get a better work performance and more optimum flight schedule then some other factor must be considered such as fire fighting cathegory, runway length, pavement runway, navigation aid, and also operating hour of the airport that must be extended.

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ENCLOSURES

At A Glance

Merpati Nusantara Airlines was born by the motherland and has grown up among the difference of cultures and language atmospheres which Merpati has been challenged to obtain its maturity. It has improved from year to year. Merpati always sends its best service through nations as the good image building for national aviation. A national leading airlines company is the commitment of achievement.

The pole has been planted and the flag has been displayed. Merpati continues to take off through global era to share the value of nation. This, however, requires efforts and strategies. The restriction program is the answer.These programs cover the increase of profits, efficiencies and effectiveness, human resources development and sustainable sense of competitiveness. This is a dedication of the people to go around their beloved country.

History

PN Merpati Nusantara was established pursuant to the governmental regulation of Republic of Indonesia No.19, 1962 and was milestone of the national air transportation development. In November 1958, the prime minister of Indonesian Ir. H. Djuanda officially launched "Air bridge of Kalimantan ". The fact proved the air bridge has been well developed. This was a starting point of decision to establish a state company of regional air transportation that was followed by the official establishment of P.N Merpati Nusatara in 6 September 1962. The core business of P.N Merpati Nusantara was regional air transportation, multifunction transportation, and developing wider aspects of air transportation. The first investments of the company were four De Havilland Otter DHC-3, and two Dakota DC-3 owned by the Indonesian air force. Using these capitals PN. Merpati Nusantara worked hard to participate in developing national economic for the benefit of the people.

In the early 1963, when Irian Jaya was handed over by Netherlands to Indonesian, NV De Kroonduif - a Dutch airlines company in Irian Jaya - was also handed over to Garuda Indonesian Airways, including six plane units, those are three DC-3, two twin pioneers and beaver. Since Garuda emphasized more developing its business as flag carrier, all local aviation concessions and technical facilities were handed over to Merpati. During the year, Merpati expended its networking by organizing air transportation Jakarta-Semarang, Jakarta-Tanjung karang, and Palangkaraya-balikpapan beside new routes in Irian jaya.

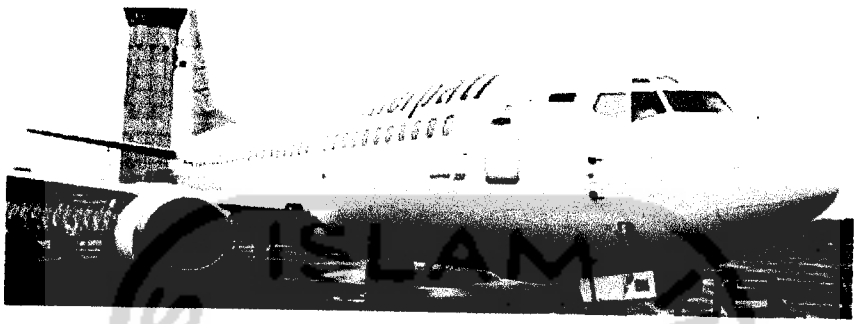
In 1969 Merpati was divided into two operational areas, MIB (merpati Irian Barat) and MOB (Merpati Operasi Barat) including Java, Kalimantan, Sulawesi and Nusa Tenggara, through this way, Merpati took a new step a head by changing its name into Merpati Nusantara Airlines (MNA). As a good fortune, since that time MNA has been well known. In 1970, Merpati did not only develop feeder line operation, but also trunk and semi trunk lines. These have been well operated. The regional flights were initiated for routes of Pontianak - Kuching and Palembang - Singapore, as well Kupang-Darwin right now. In 1974, governmental subsidized pioneer

flight was officially handed over to merpati. A series of success and achievement of Merpati resulted in trust. The valuable role of Merpati as a means of air transportation that is supported by excellent management and finance has brought the government to encourage Merpati becomes a limited company. In 6 September 1975, pursuant to the governmental Regulation of the Republic of Indonesia No. 70, 1971, Merpati changed into PT. Merparti Nusantara Airlines.

During the period of 1975 - 1978, Merpati initiated to gain the bigger scale of operation by participating in haji and transmigration programs. It also supported tourist by providing international charted flight, such as Manila - Denpasar using BAC-111 aircraft and Los Angeles-Denpasar with Boeing 707. Based on the governmental regulation of the republic of Indonesia No.30, 1978, the governmental decided to remove the share authority of the government in PT Merpati Nusantara Airlines to PT Garuda Indonesia Airways. In sequence Merpati has been the sister company of PT. Garuda Indonesian Airways with core business to operate pioneer, regional, transmigration flights as well International and domestic charter flight. This assignment was supported by sufficient facilities, such as workshop in Hassanudin Airport, Ujung Pandang, which was launched in 8 October 1979. In its development, the maintenance facilities in Ujung Pandang were removed to Surabaya. In 1991 Merpati launched its maintenance facilities in Juanda Airport, Surabaya, as one of the biggest maintenance facility in south East Asia for propeller class.

The International aviation era urged to a great demand. In August 1996 Merpati initiated International route Jakarta - Melbourne. Considering this development, the government decided PT Merpati Nusantara Airlines to be independently detached from the holding company, Garuda Indonesia, and built an independent limited company under the Transportation Ministry. This happened in 29 April 1997 pursuant to the government Regulation No.10, 1997. As a state company, today Merpati is optimising its core business as "commercial air transportation". In purpose, the company realizes to change several fields to achieve the goals to come the most preferred airlines in Indonesia.

& Mission



COMPANY'S VISION
To Become The Most Preferred Airlines In Indonesia

COMPANY'S MISSION
1. Providing air transportation service which is emphasize on safety, exact time, and best service with hospitality touch.

2. Maximizing Company value growth, efficient, and give prosperity to the employees according to airline standard.

3. Make the Company as centre of execellence and a trust worthy partner.

4. Maximizing Company value by implementing principle of Good Corporate Governance, which are: TARIF (Tranparancy, Accountabillity, Responsibility, Independent, dan Fairness)

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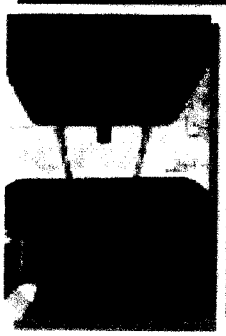

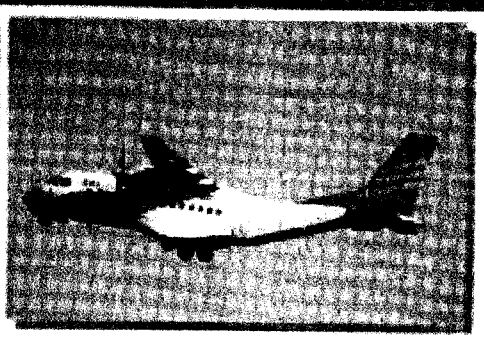

The Archipelago of Indonesia

Merpati

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