AIR TRAFFIC FORECASTING OF AHMAD YANI AIRPORT, SEMARANG

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ABSTRACT

Trip demands in Ahmad Yani Airport - Semarang are increasing over time. This increase is enhanced by the fact that Semarang is one of the cities with high potential for economic activities as well as a business center in Central Java.

Forecasting is the core of planning and design process of an airport. Airport terminal, runway, freight accommodation facilities, parking area, and even road network from and into it are all to be based on air traffic demand forecasting.

The analysis result has suggested that the trip characteristics of air traffic users in Ahmad Yani Airport – Semarang are business trips makers. The reason for rendering air transport service is that such a trip takes shorter travel time and offers better level of comfort. Meanwhile, the growth of air traffic increases in every 5 years period with one plane addition in the peak hour.

INTRODUCTION

Recently, in the global era, the role of communication sector as the facilitating and stimulating element for other sectors has been increasing. This role reflects in the need for mobility of all sectors and regions in the framework of achieving the development goal. In the future, this need will continuously increase as the economy of people is improving.

Among the available transport modes, air transport has excellent prospect due to its competitive advantages which is better than those of the other modes; for instance the speed, the smoothness and comfort, all of which support the sifter of business activity and urban economy. Grasal improvement of this prospect is indicated from the increase of frequency of the passengers using air transport mode via airport. Such a picture calls for a need to formulate some development endeavors by considering the existing potentials and weaknesses in the location.

Ahmad Yani Airport, one of the airports located in Central Java, enjoys development which grows up in line with the level of air traffic user’s need. This airport operates to support Semarang City as the capital of Central Java Province, including the surroundings that have already developed into industrial areas.

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Concerning with the position of Semarang City as the development center for surrounding regions, transport mode will play very important roles as connector among regions. And viewed from its urban facilities, Semarang is one of the main gates for log and air transport stream within Central Java scope.

Forecasting is the core of planning and design process of an airport; airport terminal, runway, freight accommodation facility, parking area, and even road network from and into the airport are based on air traffic forecasting. A forecasting process can be an extremely critical factor in airport development (Heronjeff and Mc Kelvey, 1985). Mismatch in this phase process can be very expensive to compensate and able to influence the economy of a region. Underestimate on demand may contribute to traffic jams, delay, and waste of accommodation facility. On the other hands, overestimate may also cause big economic problems: causing high value investment with less optimum function.

Air traffic forecasting types can be classified into directional and non-directional forecasting. ICAO defines that directional type forecasting is an air traffic forecasting which occurs in a route-specific or between two regions specific, while non-directional type forecasting is a forecasting on the total traffic volume on a region, an area or a state, provided by a specific transportation mode.

The most important job in airport planning is the development of future air traffic form. The primary principle of air traffic which will be put into consideration for future needs includes:

- Annual passenger volume
- Annual plane volume
- Peak hour and peak day volume of passengers and planes
- Air mail and freight
- Ordinary flight.

Peak hour volumes of passenger, freight and mail are required for appropriate allocation of space in the terminal building and the decision of building size. Plane’s peak hour movement helps in the design of runway, taxiway, and parking load. It is also needed for air traffic control system (departure and arrival). The following is important factors which influence the characteristics of future air traffic service demand:

- Demographic and population growth characteristics
- Social-economic, tourism and cultural conditions,
- Degrees of competition among airline companies and among transport modes

THEORETICAL STUDIES

1. Forecasting

The type of forecasting to be conducted in this study is a theoretical forecasting based on historical data and is an empirical one. The applied forecasting base is quantitatively formal statistic forecasting using the operating statistic theoretical aid.

There are varieties of available forecasting techniques ranging from subjective consideration to sophisticated mathematic models. The choice of a particular method is in the functions of forecasting use, the availability of acquired data, the complexity and sophistication of the applied technique, the availability of fund, time, and degree of desired accuracy.

There are three main methods for air traffic forecasting, especially the civil flight, as in the following:

a. Trend Analysis

Trend analysis is a useful instrument when the development of air transport in the past took place in an environment with gradual changes while there was no expected big changes to occur in it during the forecasting period.

This method is based on time series concept, i.e. an examination of historical data pattern of activities, and regards that the factors which determine the variation of past traffic will continually indicate similar relationship in the future. The analysis is carried out by considering the existing data’s trend pattern. This analysis uses data of time series type and tries to analyze the growth rate which relates to flight activity.

The objectives of this type modeling is to forecast the future annual passenger volume without considering other factors that may affect a trip.

b. Econometric Model

Economic model bases on causal relationship which is analyzed by relating flight activities to social, economic and operational factors that influence air transport services. From there the basic relationship between aviation activities and the variables affecting its changes are revealed. The trip generating factors are, more or less, determined by social, economic, educational level, and habitual factors.

Internal factors of airline company which serves air transport are determined by the promotion, service and marketing strategies as well as the investment made by that concerned company. Competitor’s factors are also worth considering; modal split that occurs from year to year needs to be examined in order to identify the acceleration of people’s trip motivation for using a particular transportation mode.

Meanwhile, error factors are difficult to forecast, random in nature, and sometimes occur extremely extrinsically, such as war, political crisis and natural disaster.

An econometric model can be constructed with the aid of statistic facility of regression equation by relating one or more independent variables to a dependent variable being searched.

c. Market analysis

This method is applied to estimate flight demand in local level and its most general application is in the determination of the portion of total national traffic activities that will be accommodated in a certain area, in a center of traffic activity, or in an airport.

Historical data are studied to determine the ratio of local airport traffic to the total of national traffic, from which the tendency will be determined. The application of market ratio analysis is to find some tendency which may be related to the ratio in an
activity forecasting which splits from national level to regional level before other ratios are applied to divide the region equally into airports in that concerned region.

This model is specifically suitable for the developments of new market, or under-developed market, or individual route.

2. Trip Generation Factor

Trip generation factor is more or less, determined by social, economic, income level, and habitual indicators and by internal factors of airline company running air transport services. The commonly used types of explanatory variable are the growths of population, tourist, and economic income, gross national product, market factors (trip's tariff, service level, promotion cost, and number of hired employees), trip's obstruction factors, and competition among transport modes. The applications of these variables usually take many forms and are for different purposes (i.e. gross national product is for measuring business trip while income is for non-business trip).

3. Validity of Forecasting Model

R$^2$ is generally used as a measure of effectiveness to evaluate the forecasting quality of various models. R$^2$ (determination coefficient) is one of statistic values which is applicable to identify whether a relation of influence exists between two variables. This determination coefficient value indicates percentage of dependent variable's value variation which is explainable by the resulted model.

Even though other models with higher R$^2$ are available, none of them have effective forecasting ability.

In addition to examining potential validity and accuracy of a model, it is also of importance to identify effects of internal factors on demand, for example war, deregulation of transport industry, etc.

4. Plane Frequency

Frequency of plane in an airport is affected by:

a. number of transported passenger of each flight route.
b. type and composition of used plane
c. boarding seat capacity
d. capability and capacity of runway, navigation system being used and condition of airport environment and surrounding.

Number of transported passenger in each flight route can be obtained from historical data of passenger ratio per route to annual passenger.

One of the factors which exerts its biggest influence on plane frequency is load factor. Load factor is defined as the ratio of the number of transported passengers to the boarding seat capacity. It is natural for airline company to keep the load factor remain high since the higher the load factor the higher the profit that the company will enjoy. The load factor which is generally applied in the planning ranges from 0.6 to 0.7. Using this load factor, demand of plane frequency can be shown in the following equation:

\[ Y = 86372427.456 + 43668.203X \]

5. Air Traffic Analysis

Major considerations for future forecasting include:

a. volume characteristic of passenger, plane, vehicle, freight and mail during peak hour
b. number and type of plane required to serve air traffic
c. number of plane for ordinary flight and number of generated movements
d. operation and achievement characteristics of land-road entry sister.

Forecasting can be made, by applying forecasting techniques, from those parameters, and so can the determination of passengers and plane movements volume during peak hour. Further, this forecasting enables the concepts of map and size of terminal, runway, taxiway, apron, and land-road entry facilities to be tested.

DATA COLLECTION

1. Air Traffic Movement

Air traffic movement is the movements of plane, passenger and freight, which use an airport as the place for executing operation, trip, and loading activities.

Data on annual air traffic movement are collected from the authority of Ahmad Yani airport – PT. Angkasa Pura, the Statistic Bureau, and Central Java Regional Office IX of Communication, from 1985 to August 1997 as the basis of analysis in this study.

2. Passenger and Freight

Passenger and freight movements from 1985 to 1987 are presented in Table 1 and 2 in the appendices. In addition data on the plane movement can be seen from the year 1985-1997 as well.

Moreover, trip generation factors can be detected by the buying power using the GRDP (Gross Regional Domestic Product) indication based on a constant price, while the passenger potential is by indicators of number of population and tourist-both the domestic and foreign. The growth of each component is presented in tables in the appendices.

FORECASTING

1. Passengers

a. Trend Analysis Model

Trend Analysis Model needs data only from one variable called output system. Afterward the forecasting is made based on past value of that variable. This trend forecasting approach does not consider factors which determine passenger number in the future. In this model, time is an independent variable while passenger is a dependent variable. From the result of statistic analysis for trend analysis model are derived the following equation:

\[ Y_t = 86372427.456 + 43668.203X_t \]
1. Econometric Model

Several independent variables which are used to identify their influence on air traffic in Ahmad Yani Airport-Semarang are:

a. Population of Central Java
b. Gross Regional Domestic Product
c. Number of Domestic and Foreign Tourists visiting Central Java
d. Per-capita income of Central Java

Other independent variables which are also suspected to exert significant influence on air traffic at Ahmad Yani Airport such as ticket price, time value, service level, etc., are not involved due to the difficulties to provide and to quantify them. Meanwhile, the dependent variables used in econometric model forecasting are data on annual passenger traffic recorded from 1985 to August 1997.

From the result of statistical analysis for econometric model forecasting is derived the following equation:

\[ Y_t = -85509.999 + 0.037 \times X_1 + 0.026 \times X_2 + 1.293 \times X_3 \]

Where:

- \( Y_t \) = passenger number of the year \( t \)
- \( X_1 \) = population of the year \( t \)
- \( X_2 \) = per-capita income of the year \( t \)
- \( X_3 \) = Tourist of the year \( t \)

2) Projection of Independent Variable

The following independent variables are used as the econometric analysis for the forecasting of domestic passenger in Ahmad Yani Airport-Semarang:

a) population of Central Java
b) per-capita income
c) number of domestic and foreign tourists visiting Central Java.

c. Prediction of Total of Passenger

By using constructed trend analysis and econometric models are obtained the projection of independent variables up to the reviewed period. The final result of passenger forecasting using the two models is presented in the Figure 1.

2. Freight

It has been an awareness that freight (mail and package) weight forecasting excluding the freight transported in Ahmad Yani Airport-Semarang is not an easy problem to solve. Uncertainty of data pattern and freight types causes the traffic forecasting to encounter obstacles.
3. Plane Frequency

a. Assumption and Consideration

Plane frequency is a plane's movement of once landing or once take off, or a plane's arrival/departure movement. Plane frequency prediction is made based on the prediction of passenger number with an assumption that the plane type remains the same as from the data of plane type recorded in August 1997. The prediction of plane type change for a particular flight route is difficult to make because it relates to the aspects of policy, operation, political and regulation.

In addition to those aspects, more assumptions are used such as in the following:
1) Load factor design is 70% for all airlines companies
2) No new route addition or old route abandonment
3) No new airline company serving for scheduled air transport in a certain route.
4) No sudden changes in economical growth.

b. Passenger Ratio per-route

Under the consideration that passenger forecasting is not at all a directional movement forecasting, it is necessary to divide passenger portion for each flight during the forecasting period. This division is made by dividing the available flight routes according to the existing data during the last eight months. The scenario of trip division will be as in the following:

- Semarang – Jakarta = 76%
- Semarang – Surabaya = 18%
- Semarang – Banjarmasin = 2.8%
- Semarang – Pangkalan Bun = 3.0%
- Semarang – Ketapang Sowa = 0.2%

4. Plane Plane

Plane plane is plane type which utilizes Ahmad Yani Airport in accordance with the capacity of runway and apron. The type of plane that usually operates in Indonesia can be classified according to plane category and number of available seat.

a. Total of Plane Frequency

Plane frequency and plane type is determined based on plane daily passenger of each flight route, from which the need of seat capacity will be determined. In accordance with the existing assumptions and the above considerations, the prediction of frequency plane in Ahmad Yani Airport – Semarang appears as in the following table:

<table>
<thead>
<tr>
<th>Year</th>
<th>Destinations</th>
<th>Annual passenger per route</th>
<th>Plan daily passenger</th>
<th>Seat capacity needed</th>
<th>Plane type</th>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>My25</td>
<td>B-737</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>M-1125</td>
<td>F-28</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Gp-85</td>
<td>C-114</td>
</tr>
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<td></td>
<td></td>
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<td>STOL-20</td>
<td>C-212</td>
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<td>2000</td>
<td>Jakarta</td>
<td>789,901</td>
<td>2,705</td>
<td>3,864</td>
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<td>Surabaya</td>
<td>187,082</td>
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<td>7</td>
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<tr>
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<td></td>
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<td>3,569</td>
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<td>3,590</td>
<td>5,129</td>
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<td>142</td>
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<td>4,364</td>
<td>6,479</td>
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<td>2010</td>
<td>Jakarta</td>
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<td>4,688</td>
<td>6,697</td>
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<td>181</td>
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<td>12</td>
<td>18</td>
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<td>Total</td>
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<td>6,668</td>
<td>8,811</td>
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<tr>
<td>2015</td>
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<td>1,767,725</td>
<td>6,054</td>
<td>8,648</td>
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<tr>
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<td></td>
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<td>7,966</td>
<td>11,279</td>
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</tr>
<tr>
<td>2020</td>
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<td>7,761</td>
<td>11,087</td>
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DISCUSSION

1. Passenger Forecasting

The cost and characteristic of transportation means are the main considerations for anyone to decide on a transportation mode he/she is going to take. In Indonesia, especially, the social condition in each region and in different situation shows specific character in deciding on transportation mode to reach their destination.
Air transport service users in Ahmad Yani airport Semarang have unique characteristics: in general the trips are business trips. One of the factors that influences their decision to take air transportation mode is the short time this mode takes and its high comfort it offers.

From the actual recorded data it is indicated that the busiest routes are Semarang-Jakarta and Semarang-Surabaya as they are business centers in Indonesia. From the same data it is also noted that during 1990 and 1991 there was a decrease of air transport users of both passenger and freight. This happens because of economic recession in those years that resulted in the definition of industrial activities and brought further consequences to business activities to restrain their trips. In 1992 the economic condition was getting better and was followed by the deregulation in air transport industry; in the previous years, airline companies could operate only small propeller type plane but after that they were allowed to operate jet plane. Tight competition among airline companies that forces them to lower the airfare and the promotion of Visit Asian Years 1992 program accelerates passenger increase up to 24.92%.

Another dramatic increase occurs in 1994, that is 30% passenger increase due to a better economic condition in Indonesia.

Thus, the conclusion is that air transport users are mainly those who make business trips in addition to picnic trips with the reasoning that it takes shorter time (time saving) and offers better comfort than the other transport mode such as train and private car.

The primary indicators of domestic passengers in Ahmad Yani Airport – Semarang are per-capita income, population and tourist number. The used per-capita income is the one that is based on a constant price. The used tourist data are the number of foreign and domestic tourist staying at 3 stars hotel only. Meanwhile, the population is the recorded population in Central Java without differentiating levels of economic, age, and education.

In the case of air transport passengers in Ahmad Yani Airport, there exists an elasticity which is elastic against each variable. It means that any increase in each independent variable will also result in increase of trip demand. It is not sufficient, however, to draw a conclusion to decide which variable exerts its biggest influence on air transport passengers because of different units of measure the variables apply. For example, per-capita income variable is measured in rupiah, while population and tourist variables are in person.

The percentage of all independent variables' influence on dependent variable value is indicated by the determination coefficient of $R^2$. From the analysis results is obtained $R^2 = 0.947$; this implies that 97.7% of passenger variable's change is caused simultaneously by the change of income, population and tourist variables, while the rest of 2.30% of change is influenced by other variables outside the used independent variables.

2. Freight Forecasting.

The analysis applies econometric method using GRDP as its independent variable. This GRDP is based on a constant price with the base year 1983, and is defined as the values of production, or income, or expenditure which are valued based on a constant price (the price in the base year) used for one year.

The conclusion from the applied model test is that the GRDP variable can only account 70% for the change of freight movement, while the rest of 30% is influenced by other unidentified variables. Another conclusion, from the t-test, is that GRDP is very convincing in influencing freight movement.

Freight movement is a compound of cargo and mail movements in two ways (loading and unloading). The slow rate of freight growth in Ahmad Yani Airport – Semarang can be reasoned out by the availability of Tanjung Mas seaport which is specially designed to manage cargo delivery.

The result of freight movement forecasting is useful in the planning of supporting facilities development (warehouse and area for loading activities), type and capacity of the airport.

3. Plane Frequency

In average, the growth of plane frequency at the peak hour occurs once every 5 years. Passengers do increase every year but plane frequency increases after several years. This happens because it can still be overcome by planned load factor. During the early years of plane frequency increase the value of load factor decreases (over supply) but in later years this load factor continually increases as demand are also increasing although the supply is not.

In average, every airline company decides its plan load factor between 0.6 – 0.7 for all flight routes, based on the availability and capital investment return to cover the operational cost.

The present apron capacity of Ahmad Yani Airport–Semarang can only accommodate 7 planes during peak hour; the result analysis indicates that in 2001 the number of plane will exceed the maximum capacity and there will be 12 planes at the end of the forecasting year (2020) so that prompt endeavors for optimization and extension must be considered.

CONCLUSION

The followings are the conclusions drawn from the analysis results:
1. Forecasting techniques using regression analysis are basically very different from those using trend forecasting analysis in terms of the underlying theories and concepts. Regression technique generally discusses causal approach, or one that is explanatory, for forecasting. Regression method, in general, is used in long term planning and in a situation where accuracy improvement requires additional expenditure.
2. In the econometric model every factors will influence other factors, for example economic disturbance will influence the level of demand for air transport service.
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BETON ASPAL DENGAN BAHAN PENGISI EKSTRAK ABUTON
Swapojo 7m³

ABSTRACT

There is possibility of exploitation of buton rock asphalt as a highway material, by processing of solvent extractor. This process will produce bitumen and filler. From buton rock asphalt, filler of Ca CO₃ will be found. The exploitation of buton rock asphalt will be optimal, if both extract bitumen and filler can be employed.

In an asphalt concrete mixture, a filler is needed with requirement that it has the same kind and source of the main aggregate. On the other hand, buton rock asphalt does not meet the requirements. Due to the filler function, there is a possibility to employ it as substitution filler.

From this research, the extract filler can be used as substitution filler of an asphalt concrete mixture. And extract filler content of 11 - 12% equivalents of dine stone can fulfill its requirements.

PENDAHULUAN


Dalam usaha penawaran aspal buton (abuton), telah dilakukan ekstraksi aspal-asphalt. Hasil ekstraksi bertepa aspal ekstrak dan bahan pengisi ekstrak. Mengingat buton aspal memenuhi bahan pengisi, dengan karakteristik yang ada pada bahan pengisi ekstrak abuton perlu dilakukan penelitian menyeluruhnya tentang bahan pengisi penggaris.

Dalam menyiapkan campuran beton aspal, termasuk benda uji beton aspal di laboratorium, dikenal luas terdapat perbandingan berat. Perbandingan tersebut dibertolak