Pavement Technology and Airport Infrastructure Expansion Impact

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Abstract. This research aims for analyzing construction and infrastructure development activities potential contribution towards Airport Performance. This research is correlation study with variable research that includes Airport Performance as X variable and construction and infrastructure development activities as Y variable. The population in this research is 148 airports in Indonesia. The sampling technique uses total sampling, which means 148 airports that becomes the population unit then all of it become samples. The results of coefficient correlation (R) test showed that construction and infrastructure development activities variable have a relatively strong relationship with Airport Performance variable, but the value of Adjusted R Square shows that an increase in the construction and infrastructure development activities is influenced by factor other than Airport Performance.

1. Introduction

Developed countries such as Japan, USA, UK, Australia, New Zealand, and Singapore, have a high percentage of development, which attributed with services. Indonesia still lagging in supporting the service sector to produce more development. This situation confirms how developing countries such as Indonesia still exploit natural resources rather than focus on knowledge, innovation, or service. In addition to get more development, the growth of service industries also contributed to the number of people working in an area. Which means, the government needs to accommodate the labor force, both in terms of policy, political, social and education as became the capital of the nation [1]. The policy and political will of the government can create conducive environment for the growth of the service industry. The social aspect of the service industry is preventing the social gap between the rich and the poor. And the educational process needed to create a workforce, with competence, knowledge, and skills, then becomes an added value in business [2]

Indonesia as part of the Eastern Development Corridor is currently the best strategic location [3]. Industrial sector greatly affects the development of the region. The area that has Industrial area, contributes to a bigger industrial impact. Java Island which has 55 Industrial Areas (75.89 percent of total area of the Indonesian archipelago) is capable of being a driving force for the national
development by contributing 57.99 percent to the national development. In addition, the industrial sector on the island of Java was able to become the leading sector with a contribution of 29.87 percent. In a Middle-term of National Development Plan 2015-2019 (RPJMN), the government sets to build and facilitate the construction of 14 industrial estates. The fourteen regions are (1) Bintuni, West Papua for oil, gas and fertilizer industrial areas; (2) Buli of East Halmahera in North Maluku for industrial area of ferronickel smelter, stainless steel and downstream of stainless steel; (3) Bitung of North Sulawesi for agro and logistics industry; (4) Palu, Central Sulawesi for industrial area of rattan, rubber, cocoa, and smelter; (5) Morowali, Central Sulawesi; (6) Konawe, Southeast Sulawesi; and (7) Bantaeng, South Sulawesi is focused on ferronickel smelter, stainless steel and downstream struck steel smelter industries. (8) Batulicin, South Kalimantan for steel industry area; (9) Jorong, South Kalimantan for bauxite industrial zone; (10) Ketapang, West Kalimantan for industrial area of alumina; (11) Landak West Kalimantan for rubber industry area, CPO; (12) Kuala Tanjung, North Sumatra for industrial area of aluminum, CPO; (13) Sei Mangke, North Sumatra for CPO processing industry; and (14) Tanggamus, Lampung to regional maritime and logistics industry [4]

In terms of transportation, there are three types of road pavements that are used in Indonesia namely, flexible pavement, rigid pavement and composite pavement. The choice of pavement type depends on several considerations, in particular the cost factor of pavement construction. Pavements of bending roads that are most widely used in Indonesia are to use almost 95% of Asphalt Concrete road surface layers. Aggregate gradation can be distinguished by uniform gradations, dense gradations and gaps gradations. Uniform graded is an aggregate gradation that has roughly the same size or also called as open-graded for fine aggregate proportion only slightly so that the air spaces between the aggregates are large enough. Dense is graded aggregate having a grain size of course to fine continuously called graded well. The type of construction that uses this gradation is Asphalt Concrete (AC). The graded gap is an aggregate gradation that has grain size on a part of a fraction that does not exist or is small and is called Hot Rolled Sheet (HRS). Gradation aggregate will determine quality road. Damage to roads during the wet state through weight puts pressure on the road surface layer will cause the cracked street surfaces. Surface holding capacity of the street will reduced or weak (stripping). For this case, sticking aggregate level with asphalt can be raised by doing with anti-stripping addition [5] [6] [7]

Airport pavement technologies that have high quality yet development in cost is needed in Airport infrastructure in Indonesia. The utilization of air transport access through airports in 2016, including 835.9 thousand domestic and international flight departures, 99.7 million domestic and international passengers transported, 75.6% load factor of domestic and international passengers, 715.8 thousand tons domestic and international goods transported [8]. Indonesia is currently still in 10th rank in the world in the highest amount of passengers. With the high potential number of passengers in the next 10 years (2027) Indonesia is predicted will rise to 6th world rank over Japan, Germany, Thailand and France. On the other hand, Indonesian flights frequency is currently still low in comparison to the high number of the population, so that the airport infrastructure investment would be beneficial for accelerating the regional development growth in the future [9]

The increase in investment indirectly impacts on comfort of Airport instruction. This study aims to analyze contribution potential of construction and infrastructure development towards Airport Performance.

2. Method
This research is correlation study with research variables includes Airport Performance as X Variable and construction and infrastructure development activities as Y Variable. The population in this research is 148 airports in Indonesia. The sampling technique uses total sampling, which means 148 airports are the population units then all of them become samples. Data analysis was done by using correlation coefficient (R) test. In addition, this study is also included a descriptive analysis of 30 airports with the highest construction and infrastructure development activities in Indonesia.
3. Result and Discussion

Thirty airports in Indonesia with the highest construction and infrastructure development activities are not supported with good performance of airport. There are some areas that come at top 30 of construction and infrastructure development activities, but it is not included in 30 major Airport Performance in Indonesia in relation to Aircraft and Passengers, namely Jember, Malang, Jambi, Banyuwangi, Palu, Cilacap, Bengkulu and Bone areas. Besides that airport with the highest construction and infrastructure development activities is not an airport with the best airport performance, namely Bandung, East Jakarta, Palembang, Batam, Pekanbaru areas. The comparison analysis of construction and infrastructure development activities with Airport Performance, among 30 of 151 airports in Indonesia, can be seen on Table 1.

Table 1 Comparison Sonstruction and Infrastructure Development Activities in area with Airport Performance

| No | Airport                                         | Construction and Infrastructure Development Activities | Aircraft rank | Aircraft | Passenger | Passenger (Person) |
|----|-------------------------------------------------|-------------------------------------------------------|---------------|----------|-----------|-------------------|
|    |                                                 |                                                       |               |          | Arrival   | Departure Rank    | Departure | Arrival | Transit |
| 1  | Husein Sastranegara (Bandung)                   | 11,166.02                                             | 19            | 10,258   | 10,305    | 16                | 1,250,087 | 1,240,116 | 3,558    |
| 2  | Hasanuddin (Makassar)                           | 6,834.53                                              | 3             | 43,807   | 43,811    | 4                 | 3,306,534 | 3,793,351 | 2,090,777 |
| 3  | Achmad Yani (Semarang)                          | 5,950.78                                              | 11            | 17,598   | 17,649    | 9                 | 1,754,468 | 1,782,455 | 9,039    |
| 4  | Halim Perdanakusuma (Jakarta Timur)             | 5,521.89                                              | 13            | 13,683   | 14,064    | 12                | 1,482,125 | 1,473,207 | -        |
| 5  | Sultan Mahmud Badaruddin II (Palembang)         | 5,486.29                                              | 15            | 12,773   | 12,803    | 11                | 1,632,277 | 1,643,238 | 77       |
| 6  | Temindung (Samarinda)                           | 4,219.96                                              |               |          |           |                   |           |          |         |
| 7  | Hang Nadim (Batam)                              | 4,192.43                                              | 10            | 19,212   | 19,210    | 8                 | 2,313,360 | 2,489,168 | 161,301  |
| 8  | Soekarno Hatta (Tangerang)                      | 3,101.29                                              | 1             | 152,91   | 148,78    | 1                 | 19,151,202 | 20,802,860 | 1,935,806 |
| 9  | Sepinggan (Balikpapan)                          | 3,003.56                                              | 5             | 33,405   | 33,405    | 5                 | 3,242,802 | 3,301,423 | 757,063  |
| 10 | Sultan Syarif/Kasim (Pekanbaru)                 | 2,971.44                                              | 23            | 8,629    | 8,612     | 15                | 1,260,344 | 1,242,567 | 1,755    |
| 11 | Supadio (Pontianak)                             | 2,420.46                                              | 16            | 11,949   | 11,972    | 14                | 1,316,686 | 1,311,463 | 11,414   |
| 12 | Kualanamu (Medan)                               | 2,209.62                                              | 7             | 23,804   | 25,554    | 6                 | 3,226,695 | 3,024,679 | 123,523  |
| 13 | Sam Ratulangi (Manado)                          | 1,941.76                                              | 20            | 10,162   | 10,138    | 18                | 1,014,885 | 1,017,956 | 27,480   |
| 14 | Juanda (Sidoarjo)                               | 1,844.31                                              | 2             | 61,412   | 61,499    | 2                 | 6,821,775 | 7,731,353 | 903,730  |
| 15 | Adi Sumarmo (Surakarta)                         | 1,326.07                                              | 28            | 6,858    | 6,908     | 22                | 738,990  | 720,087  | -        |
| 16 | Noto Hadinegoro (Jember)                        | 1,314.94                                              |               |          |           |                   |           |          |         |
| 17 | Bandara Internasional Lombok (Mataran)          | 1,304.84                                              | 17            | 11,531   | 11,527    | 17                | 1,112,940 | 1,141,037 | 50,320   |
| 18 | Abdul Rachman Saleh (Malang)                    | 1,267.03                                              |               |          |           |                   |           |          | -        |
| 19 | Sultan Thaha Syarifuddin (Jambi)                | 1,251.24                                              |               |          |           |                   |           |          | -        |
| 20 | Eltari (Kupang)                                 | 1,217.97                                              | 22            | 10,048   | 10,044    | 21                | 752,753  | 752,017  | 18,556   |
Table 1 shows the highest construction and infrastructure development activities is in Bandung, but Airport in Bandung, only ranked 19th in Aircraft Arrival, and only ranked 16th in Passengers’ Departure. Thus also with airports in Makassar, Semarang, East Jakarta, Palembang, Batam, Pekan Baru, Pontianak, Manado, Surakarta and Kupang areas, the airports in those cities have better construction and infrastructure development activities compared with the arrival and departure of aircraft passengers. The different things happen in airports in Jakarta, Batam, Balikpapan, Medan, Sidoarjo, Sleman, Badung, Palangkaraya and Ambon, where the aircraft arrival and departure have better ranks than construction and infrastructure development activities. For example, Jakarta successfully becomes the first rank in the aircraft arrival performance and departure passengers, but only gets the 8th rank in construction and infrastructure development activities. The thing that is quite unique is on the airports in Mataram city, where the airport in the city got the 17th rank both in GR construction and infrastructure development, aircraft arrival and departure passengers. Thus, the high construction and infrastructure development activities in the area are still not yet supported by airport performance. To give a positive impact on the construction and infrastructure development activities, airport performance should be increased, in particular by improving the quality of Airport infrastructure.

Multiple linear regression analysis is used to determine the amount of effect of the construction and infrastructure development activities towards Airport Performance using multiple linear regression formula. The data used are 148 airports in Indonesia, where each city and district are taken 1 (one) Airport. Variables include:

\[ Y_2 = \text{construction and infrastructure development} \]

\[ X_{2.1} = \text{Aircraft Arrival} \]
\[ X_{2.2} = \text{Aircraft Departure} \]
\[ X_{2.3} = \text{Passenger Departure} \]
\[ X_{2.4} = \text{Passenger Arrival} \]
\[ X_{2.5} = \text{Baggage Unloaded} \]
\[ X_{2.6} = \text{Baggage Loaded} \]
\[ X_{2.7} = \text{Cargo Unloaded} \]
\[ X_{2.8} = \text{Cargo Loaded} \]

The results of the analysis using SPSS version 20, as follows:

**Table 2. Correlations (Y \_2 = construction and infrastructure development activities)**

| Pearson Correlation | Y \_2 |
|---------------------|------|
| X\_2.1              | 0.393|
| X\_2.2              | 0.398|
| X\_2.3              | 0.373|
The table above shows the Pearson correlation coefficient, with the lowest correlation is $X_{2.8}$ (Cargo Loaded) of 0.189 and the highest is $X_{2.2}$ (Aircraft Departure) which means that the construction and infrastructure development activities Activities have relatively strong correlation with variable Airport Performance, unless the variable $X_{2.7}$ (Cargo Unloaded) and $X_{2.8}$ (Cargo Loaded) which has a correlation value below of 0.2

### Table 3. Model Summary ($Y =$ construction and infrastructure development activities)

| Model | R   | R Square | Adjusted R Square | Std. Error of the Estimate |
|-------|-----|----------|-------------------|---------------------------|
| 1     | .603$^a$ | 0.363 | 0.326 | 1191.89855 |

*a. Predictors: (Constant), X28, X27, X25, X22, X24, X26, X23, X21

The above table shows that the magnitude of the coefficient correlation (R) of 0.603 means that the construction and infrastructure development activities Activities variable has relatively strong correlation with Airport Performance variable. While the value of Adjusted R Square is 0.326, meaning that 32.6% of the effect of Airport Performance variable towards the increase of construction and infrastructure development activities, while the remaining 67.4% increase in the construction and infrastructure development activities are influenced by factors other than the Airport Performance.

### Table 4. Multiple Linear Regression Equation

($Y =$ construction and infrastructure development activities)

| Model | Unstandardized Coefficients | Standardized Coefficients | t | Sig. | Correlations |
|-------|-----------------------------|---------------------------|---|-----|--------------|
|       | B                           | Std. Error | Beta |    | Zero-order   |
| 1     | (Constant)                 | 118.934   | 121.639 | 0.978 | 0.330 |
|       | X21                        | -0.336    | 0.467   | -3.457 | -0.720 | 0.473 | 0.393 |
|       | X22                        | 0.514     | 0.447   | 5.194  | 1.150  | 0.252 | 0.398 |
|       | X23                        | 0.005     | 0.002   | 5.768  | 2.497  | 0.014 | 0.373 |
|       | X24                        | -0.003    | 0.002   | -3.641 | -1.593 | 0.113 | 0.366 |
|       | X25                        | 0.000     | 0.000   | 1.602  | 1.790  | 0.076 | 0.384 |
|       | X26                        | 0.000     | 0.000   | 4.590  | -3.576 | 0.000 | 0.358 |
|       | X27                        | -2.885E-005 | 0.000 | -2.045 | -2.238 | 0.027 | 0.256 |
|       | X28                        | -2.568E-005 | 0.000 | -0.391 | -2.886 | 0.005 | 0.189 |

Multiple regression formula:

$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5$

From the results of the above regression obtained multiple linear regression equation as follows:

$Y_2 = 118.934 - 0.336X_{21} + 0.514X_{22} + 0.005X_{23} - 0.003X_{24}$

Based on the multiple linear regression equation of the above, it appears that $X_{22}$ dan $X_{23}$ (aircraft depart and passenger depart) have a positive impact on the increase in the construction and
infrastructure development activities, while the $X_{31}$ dan $X_{34}$ variables (aircraft arrival and passenger arrival) have an negative impact in the decline of the construction and infrastructure development activities.

4. Conclusion

The high of construction and infrastructure development activities in the area, have not been connected with Airport performances which covers aircraft performance and passengers performance. Thirty airports in Indonesia with the highest construction and infrastructure development activities, are not supported by good airport performance. There are some areas that come in the top 30 construction and infrastructure development activities, but it does not come as the 30 major Airport Performance in Indonesia in relation to Aircraft Performance and Passengers, namely Jember, Malang, Jambi, Banyuwangi, Palu, Cilacap Bengkulu and Bone area. Besides that airport with the highest construction and infrastructure development activities is not airport with the best airport performance, namely Bandung, East Jakarta, Palembang, Batam, Pakanbaru area. The result of the coefficient correlation ($R$) test showed that construction and infrastructure development activities variable has a relatively strong relationship with Airport Performance variable, but the value of Adjusted R Square showed that increase in the construction and infrastructure development activities is influenced by factor other than Airport Performance.

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