## Efficiency and Competition in the Asean Economic Community (AEC) Air Transport Market: changi Airport group singapore pte ltd versus PT ANGKASA PURA II (PERSERO)

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## Abstract

*Indonesia's economic and regulatory condition in the upcoming era as the effect of the ASEAN Single Aviation Market in 2015 will bring Indonesia both benefits and challenges to its air transport sector. This research aims to investigate the efficiency and competitiveness between Soekarno-Hatta Airport as a representation of Indonesia and Changi Airport as a representation of Singapore using Data Envelopment Analysis (DEA) and qualitative approach. The study focuses on aircraft, passenger, and cargo traffic, revenue and expenses, facilities, and assets. Efficiency, simply put, is the ratio between the outputs produced with the number of inputs used. This study will use DEA to measure the efficiency of service delivery units by comparing one unit to another. The data used for calculations represent resources common to all airports, including the operational and financial characteristics of Changi and Soekarno-Hatta International Airport during 2013-2017. There will be 80 observations of input and output in one panel. The airport operation data fall into several categories of numbers of operation, such as the number of parking stand and terminal. The airport financing data falls into the operating expense, while the value of assets owned by each airport falls into the input data. The output data also falls into two categories. The operational data outputs include the Air Traffic Movement and operating revenue generated by the airport. In this study, the data set consists of operational and financial data from Changi and Soekarno-Hatta International Airport. There has been many studies that compare airport efficiency using the DEA approach. Those studies mostly examinthe airports in Europe and America, while the efficiency studies for airports in Asia are hardly found. Furthermore, there remains a question on whether the competition increases efficiency. This study is one of the critical studies on airports, especially airports in Asia. This study can determine how ready PT Angkasa Pura II (Persero) is in becoming the leading airport to face global competition by measuring its operation and business efficiency. This study is beneficial for the management of PT Angkasa Pura II (Persero) because it depicts the existing condition and recommendations to improve future programs. Based on the efficiency analysis results using the DEA analysis tool, these two airports are found to be effective in using their resources to carry out their operational activities in seeking company profits. It is evidenced by the average efficiency value, which is SIN = 0.980 and CGK = 0.988. This value proves that the two airports are very effective and efficient in carrying out their business and operational activities, though having a relatively high-ranking distance.*

***Keywords****: Competition, Efficiency, CGK & SIN, Aiport Operation, DEA Analysis*

## Introduction

**From 2016 to 2036, air travel across Southeast Asia is expected to rise at an estimated compounded annual growth rate (CAGR) of 5.8%. The International Air Transport Association (IATA) announced that the expected number of passengers traveling in 2036 would amount to 7.8 billion people. The Asia Pacific area will be a crucial driver of this demand, accounting for almost 45% of travelers by 2036. Southeast Asia has been a desirable market according to economic and traffic growth perspective. Six members of ASEAN markets have now enjoyed at least three years of double-digit or near double-digit passenger growth. These include Cambodia, Laos, Myanmar, Thailand, Philippines, and Vietnam. (www.centreforaviation.com, 2019)**

**According to an inclusive estimation by Focus Economics, ASEAN grew 4.8% year-on-year in the fourth quarter of 2018, marking an accrual from Q3's revised 4.6% expansion (previously reported: +4.7% year-on-year). Looking forward, ASEAN should continue to increase at a strong leap. Private consumption should be maintained by wage gains and strong labor markets, whereas fixed investment had better expanded robustly thanks to the infrastructure development and FDI inflows. Export development is also likely to be abrupt, although considerably lower than the stellar rates observed in 2017 and 2018. An escalation of the trade war between the US and China and a faster-than-expected slowdown in Asia giant are the key downside risks to growth. GDP growth for the region is expected to reach 4.8% in 2019, unaffected from last month's forecast, and 4.8% again in 2020. (www.focus-economics.com, 2019)**

**ASEAN Economic Community (AEC) was established in 2015, and it consists of ten member states in the ASEAN region. Their respective airports are Singapore's Changi International Airport (SIN), Cambodia's Phnom Penh International Airport (PNH), Brunei's Brunei International Airport (BWN), Indonesia's Soekarno Hatta International Airport (CGK), Lao PDR's Wattay International Airport (VTE), Malaysia's Kuala Lumpur International Airport (KUL), Myanmar's Rangoon International Airport (RGN), the Philippines' Ninoy Aquino International Airport (MNL), Thailand's Suvarnabhumi International Airport (BKK), and Vietnam's Tan Son Nhat International Airport (SGN). AEC helps its member states to negotiate with their trade partners and enhance trade competition. AEC member states will benefit from tax exemption and increased free logistics among member states. The projected growth in tourism within AEC member states will result in increased competition between airlines. To gain the largest market share, all airlines need to reduce their costs (Jantachalobon et al., 2014)**

**The Association of South-East Asian Nations (ASEAN) consists of ten states, incorporated under an Open Skies Policy (OSP) under the ASEAN Single Aviation Market (ASAM) from 2015. The ASEAN Economic Community (AEC), which aims to create a fully integrated region to face the global economy and, in turn, is reflective of an economic integration plan in the region, considers air transport as a critical and significant form of transportation in the region. The operation of ASAM will rely heavily upon the political and economic nature difference of the ASEAN member states. One of the key factors in this equation is the opposing priorities to air transport accorded by each state. In 2012, Indonesia had 29 international airports, the largest in the ASEAN region (Abeyratne, 2014).**

**The analysis and evaluation of airport operational efficiency have implications for airports' customers. Air transporters want to schedule and locate at more efficient airports. Metropolises want airports to be as efficient and as competitive as possible to attract business and passengers to show local governments that they provide good service. In funding airport improvement projects, the government could use airport efficiency evaluation to help determine the effectiveness of these programs and whether various airport improvement projects that focus on reengineering or capital improvements impact relative airport efficiency. Benchmarking their airports against similar airports is one way for airport operations managers to ensure competitiveness. Factors beyond operation decisions that may impact airport operational efficiency are investigated here (Sarkis, 2000).**

**PT Angkasa Pura II (Persero), one of the state-owned airport operators, has the vision to be 'the best smart-connected airport operators' in the region. 'The best smart-connected airport operators' envisions that airports managed by PT Angkasa Pura II (Persero) are airports connected to many routes or destinations, both local and international, encompassing their domestic/international airports. Both passengers and goods must be able to mobilize without a hassle during the connecting time and processes. Furthermore, AP II is also preparing its airports to become smart airports by utilizing modern technology. Asia is the targeted area referred to in the vision. The vision of PT Angkasa Pura II (Persero) is to build airports with high connectivity, to use modern technology that is integrated into airport operations, and to improve passenger services. This year, PT Angkasa Pura II (Persero) has a main program called Go Global; it is a company expansion program to manage airports abroad. In 2018, PT Angkasa Pura II (Persero) had tried bidding an offer to become the Philippines’ Philippines' Clark Airport operator. Unfortunately, the contract was won by North Luzon Airport Consortium, which is Changi Airport Group-led consortium.**

**PT Angkasa Pura II (Persero) has 13 airports under management. This paper will not explain all 13 airports; it will only discuss Soekarno-Hatta International Airport. Soekarno-Hatta International Airport (CGK) is the biggest airport in Indonesia, owned by PT Angkasa Pura II (Persero). In 2018, CGK served 72 million pax/year and recorded 80 aircraft movements/year by operating two runways and three terminals. Terminal 3 is the newest and the biggest built-in 2017 with a capacity of 25 million passengers. CGK airport will continue to develop to fulfill the capacity demand. In 2018, CGK Airport built another runway called Runway 3. By adding Runway 3, the movement will increase to 140 movements/hour. A new terminal (Terminal 4) is planned to be built in 2021.**

Soekarno-Hatta International Airport airport is not the only remarkable airport among the ASEAN countries; the biggest competitor in reaching global expansion is Changi International Airport (SIN). In 2018, Changi Airport served 63 million pax/year. It has three runways and 40 movements of aircraft/year. Changi has four terminals; Terminal 4 is the newest terminal with the LCCT concept, operated in 2018. Changi won the Best Airport in The World according to Skytrax seven times in a row.

From each profile that has been shown, we can see that Soekarno-Hatta International Airport is busier than Changi Airport. That the Soekarno-Hatta International Airport is busier but the World's Best Airport always goes to Changi Airport makes it interesting to analyze both airports' efficiency and competition.

## Literature review

Airports offer a wide range of services and facilities to passengers, shippers, airlines, and others. Those services include runway and taxiway services, apron services, baggage, cargo loading and unloading, passenger services, concessions, office rentals, car parking, etc. The airport industry is very diverse and varied with a high degree of difference in quality, ownership and regulatory structures, mixes of services and operating characteristics, as well as external constraints (such as location and environmental factors). Therefore, measuring and comparing both airports' performance is a bit tricky (Oum and Yu, 2014).

Inamete (1993) stated that airport operational efficiencies might be enhanced through internal and external measures. Government policies are strong external measures, while communication and close management of operational, technical, and managerial functions are internal measures. Few studies have focused on the productivity and efficiency of major US airports. Productivity can be defined as a general measure of output to input ratio. The focus on productivity measurement in the industry typically is on organizations that use the airports' services and on general transportation infrastructure (e.g., Schefczyk, 1993; Truitt and Haynes, 1994; Windle and Dresner, 1995).. An efficient unit is the frontier of other units.

Concerning the measurement of airport productivity changes, many studies have utilized the MPI to evaluate airport efﬁciency (e.g. Abott and Wu, 2002; Fung et al., 2008; Li and Liu, 2007; Murillo-Melchor, 1999; Yang, 2010). However, one critical problem of the basic DEA model and the MPI is that other key factors causing variations in airport efﬁciency may not be clearly understood. A clear explanation of what factors affect airport efﬁciency could help airport managers and policymakers to understand better ways of improving airport efﬁciency.

Lin and Hong (2006) in their study used eight variables as inputs: the number of employees, the number of check-in desks, the number of runways, the number of parking spaces, the number of baggage belts, the number of gates, the number of aprons and surface area of the terminal. As for outputs, they used the number of passengers (PAX), the number of flight operations (ATM), and the number of cargo moved. Calculation contains data from 20 major world airports. DEA results were exposed to statistical testing to classify factors with high impact on efficiency. The effect of ownership structure turned out to be immaterial for efficiency. It was found that statistically significant determinants were the location, the level of economic development of the region, and the hub's status.

Barros and Sampaio (2004) did a DEA calculation of 10 Portuguese airports in 1990-2000. Capital and labor cost were chosen as inputs, while revenues, number of aircraft movements, passengers, and cargo were chosen as outputs. In the second stage of the analysis, the Tobit model was used to observe the impact of the following variables on efficiency: the market share, the share of regional authorities, the location, the region's population, and the cost structure. It was found that management style has a significant impact on the efficiency and the airport's size does not play a significant role.

Vogel (2004) analyzed 31 European airports in the period of 1990-1999. Airports were divided into groups according to the type of property: fully private, partially private, and fully state-owned. In addition to the DEA, the author calculated partial and total productivity ratios, then provided statistical tests. As a result, it was found that, on average, private airports are the most efficient. It was also noted that, despite obtaining higher operational efficiency, fully privatized airports generate lower dividend to its shareholders than its partially privatized counterparts.

Müller et al. (2009) investigated 6 German and 7 British airports in 1998-2005 using Partial Factor Productivity analysis and the DEA to study the impact of privatization on efficiency. The terminal's surface, the number of check-in desks, and the number of gates were used as inputs. As the only output variable, they used the number of passengers. The paper presented an unusual assumption that airports are focused on maximizing the effects with a constant level of inputs. Analysis of the results with the Tobit model protected the hypothesis of the higher efficiency of the fully privatized entities and airports with very high passenger volume. The worst outcome in the study received commodities with partial participation of private capital. There are several DEA applications to measure and assess airport efﬁciency and productivity changes. The DEA-CCR and BCC methodology was developed to measure an airport's efﬁciency relative to other airports using constant return to scale (CRS) or variable return to scale (VRS) respectively, incorporating multiple airport input versus output variables (e.g. Gillen and Lall, 1997; Martin and Roman, 2001; Pels et al., 2001, 2003; Sarkis, 2000). The main drawback of the traditional DEA models is that they neglect intermediate products of linking activities or fail to identify the sources that lead to airport inefﬁciency (Tone and Tsutsui, 2009). The SBM DEA model was recently developed to measure airport efﬁciency; this deals with the input excesses and the output shortfalls of the decision-making units (DMU) concerned (Tone, 2001, 2002).

Different airport performance measures and methodologies have been advanced and practized over time (Francis et al., 2002; Humphreys and Francis, 2002). For example, Martin and Roman (2001) used the DEA to evaluate 37 Spanish airports' performance. They included three outputs (aircraft movements, number of passengers, and tons of cargo) and three inputs (labor, capital and materials—all expressed in terms of expenditures). Martin-Cejas (2002) estimated a translog cost function to observe the productive efficiency of 40 Spanish airports. "Units of traffic transported" was used as the single output variable, whereas labor and capital are the only two inputs measured. It was not clear how input prices are determined. Parker (1999) examined the performance of BAA before and after privatization using DEA as well. Labor, capital stock, non-labor, and capital costs were used as inputs, while the number of passengers, cargo, and mail handled was used as outputs. Abbott and Wu (2002) investigated the efficiency and productivity of 12 Australian airports in 1990–2000 using the Malmquist total factor productivity (TFP) index and the DEA. The study considered two outputs and three inputs; the two outputs were the number of passengers and the amount of cargo in tones passing through an airport. The three inputs were the number of staff employed by the airport, the capital stock in constant dollar terms raised using the perpetual inventory method, and the airport's runway length.

Sarkis (2000) estimated the operational efficiency of US airports using the DEA. The input set included operational costs, number of airport employees, gates, and runways, while the outputs included operating revenue, number of passengers, aircraft movements and cargo. Hooper and Hensher (1997) studied six Australian airports' performance over four years period using the TFP method. A deflated revenue index was used as an output measure, and labor, capital, and others were used as input. Nyshadham and Rao (2000) used the TFP to assess 24 European airports' efficiency performance and examine the relationship between the computed TFP index and several partial measures of airport productivity. Like Hooper and Hensher, they used revenue and expenses as output and input variables to compute the TFP index. Gillen and Lall (1997) and Pels et al. (2001) separated airport operation into landside and airside and developed separate DEA models to evaluate landside and airside operations' productive efficiency, correspondingly.

Hakfoort et al. (1997) calculated how the aircraft movement of European airlines had changed after aviation deregulation by using the concentration ratio. Lijesen (2000) also considered the clumping of direct and indirect flights using the flight data of ten routes to Europe in February 2000. The method to measure such clumps is called the Herfindahl-Hirschman Index. Moreover, the market share was calculated to find out the cost of airlines. Danesi (2007) studied various forms to determine aviation centers by using each airline's flight time tables. The data of flight time tables were used to evaluate the concentration of flights by using the concentration ratio. Dennis (2006) used the data of connecting time to determine airline and airport hub in Europe. Any airport with the shortest connecting time would be a suitable hub. Burghouwta et al. (2003) studied the viability of Amsterdam-Schiphol Airport in becoming a regional hub by using the data of quality and frequency of connecting flights and applying NETSCAN connectivity.

Moreover, Burghouwt and Veldhuis (2004) used the same method to evaluate the market competition of the Western European airport model. In Asia, Burghouwta et al. (2009) evaluated the Hub Connective Performance by using flight data from various airports in East and Southeast Asia. He used the NETSCAN model to identify flights' concentration to pinpoint where a hub should be industrialized in the future. Bowen (2003) studied airline hubs in Southeast Asia by using network analysis to analyze which airport hosts the most connecting flights and would be most suitable as a regional gateway. Kim and Park (2012) studied the connectivity of trans-shipments at Incheon International Airport, which is a hub. They used the data from Korean Air and Asiana Airlines and used the method of wave systems of the Bootsma model and the Netscan model. Schwieterman (1993) identified airlines using alternative methods: airport capacity, location advantage, market size, terminal service, and government policy. Park (2003) assessed airports in East Asia by determining five factors: service, demand, management, facilities and spatial qualities.

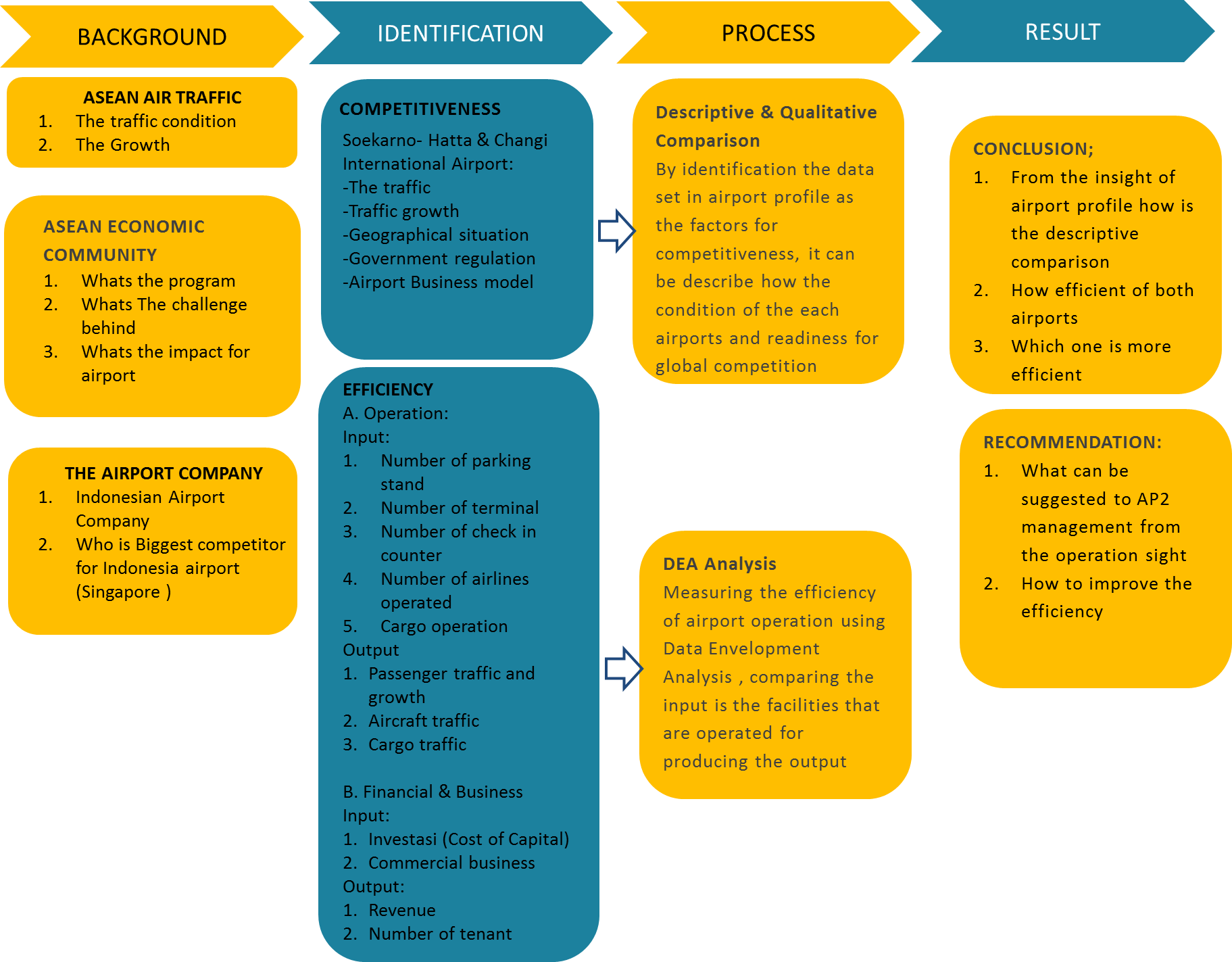
Gillen and Lall (1997) argued that the development of a strategic performance amount needs multiple outputs and objectives to be accommodated. It should also be possible to translate the performance indicator into effective management strategies. Methods of measuring efficiency can be approximately classified into non-parametric and parametric. Non-parametric methods include indexes of partial and total factor productivity and data envelopment analysis—a linear programming-based method. On the other hand, parametric methods involve estimating neoclassical and stochastic cost and production functions. The data requirements for the various methods vary, as do their ability to inform managerial decisions.

The use of partial productivity measures is pervasive. While these measures are easy to understand and compute, they can be quite deceptive because they neither reflect differences in factor prices nor take account of differences in the other factors used in production. Partial productivity measures are also unable to handle multiple outputs. One solution to some of these problems is to construct an index of total factor productivity (TFP). Even though this measure does not suffer from the inadequacies of partial productivity measure, it is not very informative for ranking management strategies when taken alone. Extracting more information from total factor productivity measures typically requires dependence on estimating parametric neo-classical cost or production functions. The data requirements are more demanding than partial measures. In addition to data on physical inputs and outputs, this measure also requires information on prices used to aggregate inputs and outputs. Data Envelopment Analysis (DEA) is another alternative and has found favor in applications where the outputs are not clearly defined. It is also useful in determining firms' efficiency that consume or produce inputs or outputs, which lack natural prices. DEA is a (linear) programming-based technique, and the basic model only requires information on inputs and outputs. Indeed, this is also a major disadvantage of DEA, as it does not integrate any information on factor prices or costs of production. DEA can incorporate multiple outputs and inputs; in fact, inputs and outputs can be defined reasonably without getting into problems of aggregation. If more of a measure is desirable, it can be modeled as output, and if less of a measure is better, it can be interpreted as input. It is an attractive feature in many service industries such as banking; it is difficult to determine whether something is an input or an output. DEA can also use proxy outputs, including output combinations that would not be used with other efficiency measures. DEA provides a scalar measure of relative efficiency by comparing the efficiency achieved by a decision-making unit (DMU) with the efficiency obtained by similar DMUs. The method allows us to obtain a well-defined relative between outputs and inputs. In the case of a single output, this relative corresponds to a production function in which the output is maximal for the indicated inputs. In the more general case of multiple outputs, this relation can be defined as an efficient production possibility surface or frontier. As this production possibility surface or frontier is derived from empirical observations, it measures the relative efficiency of DMUs that can be obtained with the existing technology or management strategy. Technological or managerial change can be evaluated by considering each set of values for different periods for the same DMU as separate entities. If there is a significant change in technology or management strategies, this will be reflected in a change in the production possibility surface.

Many studies analyzed the comparison of Airport efficiency by using DEA (Data Envelope Analysis); the studies mostly analyzed the airport in Europe and America. However, the efficiency studies for Asian airports are hardly found. This study is one of the critical studies on airports, especially airports in Asia. This study can determine how ready PT Angkasa Pura II (Persero) is in becoming the leading airport to face global competition by measuring its operation and business efficiency. This study is beneficial for the management of PT Angkasa Pura II (Persero) because it provides a depiction of the existing condition and recommendations to improve future programs

## DATA COLLECTION & METHODS

This study will be conducted as the framework below:



After explaining the condition that will be faced in the future and each airport's profile, data collection and analysis methods will be explained in this chapter. The data collected is comprehensive data, including traffics, facilities for operation, and financial statements from both airports.

The data used for calculations represent common resources of all airports, including operational and financial characteristics of Changi and Soekarno-Hatta International Airport. These data set will be used as input data. The airport operation data fall into several categories of the number of operations, such as parking stand and number of terminals. Meanwhile, airport financing falls into the operating expense and the value of assets owned by each airport. The output data fall into two categories. The operational data outputs consist of the airport's operating activities, which include:

1. Cargo traffic, the tonnage of inbound and outbound goods through the cargo terminal
2. Aircraft traffic, movements that represent commercial aircraft landings and take-offs at the airport
3. Passenger traffic, can be either a) passengers arriving or departing via commercial airplane; or b) transit passengers stopping temporarily at the airport and departing on an aircraft with the same flight number

Airport revenue is also used as a parameter in the output. Airport revenue comes from several sources, including concessions, parking fees, landing fees, user charges, and commercial development revenue.

In this study, the data set consists of operational and financial data from Changi and Soekarno-Hatta International Airport during 2013-2017. It has 80 observations of input and output in one panel. The data set observed in this paper is as follows:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **DMU** | INPUT DATA | | | | OUTPUT DATA | | | |
| **PARKING STAND** | **OPERATING EXPENSES** | **ASSET** | **TERMINAL** | **CARGO TRAFFIC** | **PAX TRAFFIC** | **AIRCRAFT TRAFFIC** | **REVENUE** |
| SIN 13 | 134 | Rp12.368.947 | Rp69.767.124 | 3 | 1.837.580 | 53.874.049 | 339.191 | Rp21.982.281 |
| SIN 14 | 134 | Rp13.099.602 | Rp78.952.503 | 3 | 1.847.423 | 53.969.875 | 347.458 | Rp22.441.550 |
| SIN 15 | 134 | Rp13.402.302 | Rp90.183.715 | 3 | 1.867.784 | 56.737.315 | 351.059 | Rp22.587.681 |
| SIN 16 | 134 | Rp14.623.540 | Rp96.655.232 | 3 | 1.998.479 | 59.371.696 | 362.246 | Rp24.059.429 |
| SIN 17 | 159 | Rp17.212.147 | Rp155.462.529 | 4 | 2.143.119 | 62.972.068 | 377.429 | Rp27.159.494 |
| CGK 13 | 118 | Rp663.687 | Rp322.848 | 2 | 645.298 | 60.137.347 | 399.430 | Rp3.267.301 |
| CGK 14 | 118 | Rp729.727 | Rp109.572 | 2 | 626.046 | 57.221.169 | 390.984 | Rp3.585.391 |
| CGK 15 | 118 | Rp897.802 | Rp2.828.821 | 2 | 614.822 | 54.291.366 | 386.615 | Rp4.019.180 |
| CGK 16 | 118 | Rp947.971 | Rp10.910.264 | 2 | 586.117 | 58.123.781 | 413.659 | Rp4.290.685 |
| CGK 17 | 172 | Rp1.642.140 | Rp12.204.173 | 3 | 617.657 | 63.015.620 | 447.390 | Rp5.873.680 |

This study's limitation is that the input dan output data have the same position as the other units for the same type; the input and output variables are independent with each other.

After gathering the data, an analysis was conducted. The analysis is used to define the competitiveness and efficiency of each airport. We used descriptive and qualitative methods to analyze competition readiness. We also used Data Envelopment Analysis (DEA Models) for measuring the efficiency. These two methods will be explained below:

1. Competitiveness

It compares the air traffic movement data of each airport and the business methods used by each airport. The comparison can be analyzed as a qualitative result to describe the airport readiness for global competition. The parameters of comparison are air traffic, facilities, financial data, geographical review, government support, and airport business model. After making a descriptive explanation, we continued by scoring each parameter to measure global competition readiness. The scoring follows the specification below:

\* : Local oriented, pax movement <5 million pax/year, one linear terminal

\*\* : Regional oriented, pax movement 5-30 million pax/year, single/multiple linear terminals

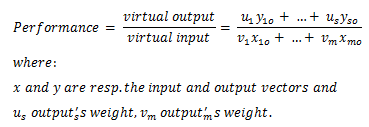
\*\*\* : Global oriented, pax movement >30 million pax/year, multiple linear terminals, piers, etc.

1. Data Envelopment Analysis (DEA)

Broad-based measures usually conducted by most companies, such as financial performance profitability or return on investment measures, are highly relevant as overall performance measures. However, they are not sufficient to describe the operating efficiency of a service unit. For instance, one could not conclude that a profitable company is necessarily efficient in its use of personnel and other inputs.

DEA was used as an empirical method of measuring service delivery units' efficiency by comparing one unit against others. If viewed from an engineering perspective, the measure of an organization’s productivity is similar to the measure of a system's efficiency. We can see that this comparative analysis of unit performance provides an opportunity to promote continuous improvement through shared learning. The data for DEA models includes both input and output factors from the relative technical and scale. DEA model uses that kind of data as input data, and the efficiency is calculated from the input and output data ratio.

As we have explained before, efficiency, simply put, is the ratio between the outputs produced with the number of inputs used. The DEA model used here is Output Oriented, where DEA measures the efficiency of a unit called Decision Making Units (DMU). The weighted ratio model uses the formula as illustrated below:



Source: <http://opensourcedea.org/dea/>

This study used software that can identify the DEA model. The software uses DEA-CCR, which is the original method of DEA. This model is also called CRS (Constant Return to Scale); the model assumes that each DMU has been optimally operated. The formula is illustrated below:

Constrains:

|  |  |
| --- | --- |
| *Zo : additional rate total output DMU in-o*  *O : DMU under analysis*  *θo : additional rate total output DMU in-o*  *λj : weight DMU in j*  *i : input in i*  *r : input in r*  *j : DMU in j* | *Si- : slack input i*  *Sr+: slack input r*  *xij : input value unit i to unit j*  *yrj : output value unit r to unit j* |

## RESULT EXPECTATION, LIMITATION AND ORIGINALITY

From the data procession, as mentioned before, there are two results. The first one is the competitiveness result; it will be explained as a descriptive and qualitative result. The second one is the efficiency calculation result obtained from the Data Envelopment Analysis.

1. Competitiveness

The data for competitiveness is obtained by comparing each year of each parameter directly from each airport. Here are the results of the comparison:

1. Traffic Movement

* Passenger Traffic: The average passenger movement of CGK in five years is 58.557.857 pax/year, while in SIN is 57.385.001 pax/year. The SIN's passenger traffic is 1.172.856(2,003%) lower than Indonesia, meaning SIN and CGK has a similar scale.
* Aircraft movement: The average aircraft movement of CGK in five years is 407.616 movements/year, while SIN is 355.477 movements/year. It has a 13% difference, meaning CGK is indeed busier than SIN.
* Cargo Movement: cargo productivity of CGK is 617.988 tones/year, while SIN is 1.938.877 tones/year. Indonesia is 60% behind Changi. The geographical condition of Singapore supports Changi as a cargo hub. CGK has a potential market, especially for domestic cargo, because of the far distance among cities. However, CGK has not taken advantage this condition.

1. Facilities

* Terminal: Both CGK and SIN have the same pattern in developing the terminal. They do not develop terminal for three years, and additional new terminals were built in 2017. In 2017, CGK had three terminals with a capacity of 25 million pax/year. Meanwhile, in 2017, SIN built the fourth terminal, and it operated with the concept of LCCT (Low-Cost Carrier Terminal).
* Apron Parking Stand: Both CGK and Changi have a similar amount of parking stand; CGK has 644 parking stand and SIN has 695 parking stand. Both are utilized for narrow and wide-body

1. Financial data

* Airport Operation Cost: SIN has an operating expense that is four times bigger than CGK. SIN's average operating expense for five years is Rp.14.141.308, while CGK's is Rp.976.265.
* Asset: The assets calculated are the assets owned by each airport written in the financial report. SIN's average asset value is Rp.98.204.221; it is 18 times bigger than CGK's, which is Rp.5.275.135.
* Revenue: SIN's revenue has reached double-digit in 5 years. SIN's average revenue for five years is Rp.23.646.087; it is five times bigger than CGK's, which is Rp.4.207.247, -

1. Geographical Review

The location of Singapore gives an advantage to Changi International airport. From a geographical basis, Singapore is located at the crossroads of international trade routes, and it is placed in the heart of Asia. Singapore is a top location for investments and is ranked the fourth most competitive country by the Swiss-based World Economic Forum in its Global Competitiveness Report 2001.

Therefore, SIN values this condition by setting many air-links to connect to Asia- Pacific Region. Furthermore, with this kind of geographical value, SIN sees the chance by building a transshipment hub.

The geographical condition of Indonesia also has a role in air traffic. Being an archipelago country and having far distances among the cities necessitates air transportation to reduce the time spent on transport. This condition also gives an advantage for the cargo movement; it can reduce transfer time and saving money. Soekarno-Hatta notices that and plans to be the regional hub of air transport.

1. Government Support

The Singaporean government is a pro-business government with a reputation of being responsive to changes and anticipating global trends by creating policies that can adapt to them. Civil Aviation Authority (CAAS) of Singapore manages the airport in three frameworks:

* Economic and service regulation

The aim is to ensure competitive pricing and high service standard in airports. It consists of three components; pricing regulation, aeronautical charges and incentive for initiative and efficient effort in operation; service regulation, maintaining the high service standard; competition regulation, and reaching a fair and efficient market.

* Airport Development Planning

To prepare as a global hub, airport infrastructure development is necessary to anticipate future air traffic demands. The CAAS will safeguard the land as the commitment of the government to keep the improvement sustainability

* Air Service Policy

Singapore adopts a liberal aviation policy for its flexibility in market opportunities. It also signed the Open Skies Agreements where it allows carriers to operate in any flights beyond the signatory states, resulting in global flights to improve the commercial viability of scheduled flights

Airports in Indonesia are managed under the Directorate General of Civil Aviation (DGCA). DGCA created a government policy about Indonesian aviation, which is Law No. 1 on Aviation. Mostly they concern technical issues as listed below:

1. An airport development plan should be stated in the Airport Master Plan and approved by the minister. It should also be updated every five years.
2. To avoid privatization, the government regulates that anyone who wants to create and operate an airport must possess a license issued by the Ministry of Transportation.
3. The airport authority calculates aeronautical pricing. However, it must be approved by the ministry of transportation.

The Indonesian government does not regulate global expansion and services by airports; the airport fully manages it.

1. Airport Business Model

|  |  |
| --- | --- |
| **Singapore International Airport** | **Soekarno-Hatta International Airport** |
| * Stepping into The Future with Digital Airport * Strengthening Our Position as a Leading Air Hub * Growing Our Non-Aeronautical Business * Enhancing Infrastructure, Operation, Safety and Security * Passenger Service Innovation * Sustaining financial growth * Expanding Internationally * Building people of Changi | * **Financial leverage improvements** * Bonds & Loan * Transformation: Culture activation * **Service level excellence** * Triple double-digit growth * Airport facility improvement * **Growth Acceleration** * 30% international pax proportion * Double digit growth on non-aero & cargo revenue * **Global Partnerships & Innovation** * Cargo business global partnership * Global airlines partnership * **The best smart connected airport in region** * World-class people & High-performance culture * CGK Regional Hub * Smart airport fully integrated |

Below is the comparison of CGK and SIN airport business focus:

**The scoring analysis:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **No** | **Parameters** | **SIN** | **CGK** | **Description** |
| 1 | Traffic Movement | \*\*\* | \*\*\* | Both airports have the same position to serve big scaled air traffic movement |
| 2 | Facilities | \*\*\* | \*\*\* | Both airports focus on developing the airport infrastructure to meet the traffic demand and prepare for increased traffic in the future |
| 3 | Financial data | \*\*\* | \* | CGK is still left behind in the financial management |
| 4 | Geographical Review | \*\*\* | \*\* | Both airports are located in strategic countries which have a potential market for the airport |
| 5 | Government Support | \*\*\* | \*\* | Singaporean government fully supports and gives detailed policies. However, they are sometimes too strict and inflexible, though it keeps the airport development stay on track. Meanwhile, the Indonesian government has provided regulations, but it lacks directions |
| 6 | Airport Business Model | \*\*\* | \*\*\* | Both airport business model are global-oriented |

1. DEA Models

**CRS Model (Input and Output)**



Based on the efficiency analysis results using the DEA analysis tool and the WINDEAP software (DEAP 2.1 For OS Windows), the efficiency values ​​of each DMU study are obtained. It is shown in the table below:

**Results of CSR (Model CSR Output 13 - CSR Output 17)**

The meaning of each color is:

Green indicates the business operation is safe and on the right track

Amber indicates the business operation may be at risk if the management does not notice and handle the issue quickly

Red indicates the business operation is at high risk and out of track; management must take action to solve it immediately

In 2014, SIN was at risk of operational inefficiency, as was CGK in 2015. In 2017, both SIN and CGK had the same risk of operational inefficiency. It might be due to the slow condition in the aviation industry or other macro factors. Looking at the big picture, these two airports' operational efficiency trends tend to be the same, even though these two airports have fairly far-reaching world ranks. The number of resources and financial conditions of the two airports also tend to have a long gap. However, CGK has operational efficiency that is not inferior to SIN. The annual operational efficiency trends of the two airports are presented in the following graph:

**CGK and SIN operational efficiency trend charts**



In the graph above, we can see that the two airports have a fairly stable efficiency value in the first four years. Both dropped in 2017. It indicates that these two airports tend to be effective in using their resources in carrying out their business and operational activities to seek company profits. It is evidenced by the very close average efficiency value, where SIN = 0.980 and CGK = 0.988. This value proves that the two airports are very effective and efficient in carrying out their business and operational activities, though having a fairly high ranking distance.

## CONCLUSION & RECOMMENDATION

This study shows that, in terms of aircraft and passenger movement, Soekarno-Hatta Airport (CGK) has a higher number than Changi Airport (SIN). However, in terms of cargo movement, SIN is considered more productive than CGK, with a 60% difference. In terms of revenue and expense, SIN has a higher number than CGK. In terms of assets, SIN has 18 times bigger assets compared to CGK. Both of CGK and SIN have a similar pattern of terminal development. They also have a similar number of parking stands. Geographically, SIN is located at the crossroads of international trade routes, advantageous for SIN in becoming a hub in the ASEAN region.

From the scoring analysis, it can be concluded that both airports are in the same stage and condition of traffic and facilities, meaning that both airports have the same focus on maintaining the facilities to fulfill the traffic demand. However, CGK is still behind SIN when it comes to maintaining their financial condition; it is probably due to CGK's small cost and revenue. SIN and CGK have the same advantages on the geographical condition but a different scale. SIN uses that advantage to build an international reputation, while CGK builds a national reputation.

In terms of passenger traffic, it is found that the number of passenger traffic at CGK is higher than SNI. However, SIN's revenue is nearly always much greater than CGK's. We first assumed that CGK's operational business processes are efficient due to this large gap. Nevertheless, the results of this study can refute these assumptions. It is found that the operational efficiency value of the two airports tends to be similar, with SIN = 0.980 and CGK = 0.988. Their efficiency value also has the same trend and decrease at the same rate. Thus, it can be concluded that the two airports have carried out operational and business processes effectively and efficiently.

After obtaining the conclusions, here are some recommendations for the management of Soekarno-Hatta International Airport to continue improving its operational and financial performance:

1. Soekarno-Hatta International Airport should utilize and empower the Indonesian geographical condition's advantages to improve its operational performance and efficiency. We recommend that Soekarno-Hatta International Airport shift its focus not only on the passengers but also on cargo business.
2. Soekarno-Hatta International Airport needs to be more aware of its financial performance; there should be financial strategies to improve its revenue growth. We recommend further studies on the comparison of managing financial strategies between Soekarno-Hatta International Airport and other similar airports to gain an in-depth understanding of airport financial strategies.
3. Soekarno-Hatta International Airport must have a contingency plan, so it can better maintain airport efficiency when the aviation macro condition poorly impacts the airport.
4. We recommend further studies to add more calculation methods by adding more input and output variables. Further studies should compare these airports with other airports in the top 10 best airports to make the study more objective.
5. There are several methods to measure an airport's efficiency. Airports have their own international regulation issued by ICAO (International Civil Aviation Organization). Therefore, it is recommended to conduct another efficiency comparison study using the DEA and the ICAO Regulation method.

Soekarno-Hatta International Airport has great potential to enter the ASEAN and global aviation market. With all the resources being developed and utilized accordingly, the time has come for Soekarno Hatta airport to compete globally. This study requires further research.

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**DEA model**

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**Airport business model**

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