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Analysis of Indonesian Air Transport Aviation Network Management (Case Study: Building Transportation Infrastructure for the National Capital)

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ABSTRACT

The air transportation network at Sepinggan Airport requires development to meet increasing transportation demands for the Indonesia National Capital (IKN) in East Kalimantan starting in 2024. With the planned relocation of the National Capital from Jakarta to Kalimantan, Sepinggan Airport is expected to see a significant rise in flight frequency over the next decade. The **research problem** was, the Indonesian government needs to enhance operational mobility to and from IKN Nusantara to improve airport supporting infrastructure. The **research objective** focuses on designing air transportation flight network management to optimize service and operational efficiency at Indonesian National Capital. The research used **mixed methods**, namely a methodology that combines qualitative and quantitative research. Firstly, it analyzed IKN's development plans for the next decade to understand air transportation needs and trends. Secondly, it evaluated existing airport infrastructure and facilities to identify deficiencies and areas needing improvement for enhanced operational efficiency. Thirdly, data collection, analysis, and modeling of the domestic and international flight network connected to IKN were conducted, exploring potential new routes and factors influencing their performance. **The objective** of the researach is to provide government stakeholders with insights for effectively managing the air transportation flight network to ensure optimal efficiency in the future. **The results** of these research are intended to assist governments and the aviation industry in preparing for forthcoming challenges and opportunities in the next decade. The study concludes with recommendations for managing the air transportation network in Indonesian National Capital over the next decade, encompassing infrastructure development, regulatory policies, and route expansion strategies.

Reccomended Citation:

APA Style

INTRODUCTION

As the largest archipelagic country in the world, Indonesia really needs optimal air transportation flight network management (Zhang et al., 2017;Supancana, 2022; Rochmawati et al., 2023). Indonesia consists of 17,531 islands spread among 37 provinces, 416 districts and 98 cities from Sabang to Merauke. So far, Soekarno-Hatta Airport in Jakarta, the capital of Indonesia, has been the main hub for the aviation network connecting all provinces, districts and cities, both for logistics distribution and commercial flights; domestic or international. Soekarno-Hatta Airport currently has three passenger terminals (Terminal 1, Terminal 2 and Terminal 3) with a total capacity of around 43

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million passengers/year, and a cargo terminal with a capacity of 600,000 tons/year. PT Angkasa Pura II as the manager of Soekarno-Hatta Airport projects passenger growth at Soekarno-Hatta Airport to reach around 80 million passengers in 2030 and continue to grow until 2035 reaches 100 million passengers. However, the plan to move the National Capital (IKN) from Jakarta to IKN Nusantara in Sepaku, North Penajam Paser Regency, East Kalimantan, means that this projection must be transferred to the airport around IKN Nusantara (Tukimun, 2021).

Unfortunately, there are still many challenges that must be overcome with the IKN transfer plan. The first challenge is the development of airport infrastructure. There are 13 airports in East Kalimantan which function as hubs and spokes which are connected to each other in the domestic and international flight network. East Kalimantan has contributed to the implementation of these principles by enhancing transportation infrastructure, particularly through the development of new representative airports (Tukimun, 2022) , but they are still unable to handle the increasing number of passengers and flights like Soekarno-Hatta Airport. The nearest airport is Sepinggan which is two hours by land from IKN Nusantara. Sultan Aji Muhammad Sulaiman Sepinggan Airport was built on an area of 300 hectares, with a capacity of up to 10 million passengers per year. Currently SAM Sepinggan Airport is still operating, serving around 5 million passengers a year with a runway of 2,500 meters. Thus, it is necessary to build airport facilities so that SAM Sepinggan increases passenger capacity by at least four times to match the current Soekarno Hatta Airport.

Another challenge is geographical factors. The geographical condition of Kalimantan is generally hinterland so it has areas that are difficult to reach. In addition, weather conditions that cannot always be predicted can affect flight performance and make it difficult to manage the flight network. Extreme weather conditions also cause limited flight routes. Currently, flight routes to Kalimantan do not cover all cities in Kalimantan. This could complicate connectivity between cities in Kalimantan and hinder economic and tourism development in the area. The transfer of flight routes from Jakarta to East Kalimantan also requires synergistic and clear coordination and regulations. The relocation of the nation's capital will involve various stakeholders, such as the government, business people, air transport operators, government employees and the general public. Good coordination between them will be the key to the success of the project to move the country's capital. Apart from that, currently aviation regulations in Indonesia still need to be perfected, especially those related to aviation safety and security aspects in new regions. Current regulations do not yet accommodate the surge in passengers, additional flight routes and flight operational arrangements. With the increase in the number of passengers and flights, the aviation market in Kalimantan is becoming wider and more competitive. Therefore, effective and efficient aviation network management is needed to ensure airline business success and customer satisfaction.

This research aims to provide suggestions and input for the government at the Ministry of Transportation regarding the management of the air transportation network in IKN. Apart from that, this research also aims to contribute to the world of knowledge, especially those related to air transportation management. It is hoped that this research can complement the recommendations for Air Transportation Aviation Network Management at IKN which will help the Government and the Aviation Industry and Industries that require Air Transportation in preparing to face the challenges and opportunities that will arise in the next decade. Based on the background, the author tries to identify the problems that arise, as follows, What are the projected development plans for airport infrastructure supporting IKN in the next ten years?, What aspects must be improved to accommodate the projected development of air transportation to and from IKN Nusantara in the next ten years? And What is the most effective and efficient management of the air transportation network in IKN Nusantara?

METHOD

This research will use mixed methods, namely a methodology that combines qualitative and quantitative research, to model the development of airport infrastructure facilities needed over the next 10 years. Mixed Methods Research is a research approach that combines qualitative and quantitative data collection and analysis in one study. This allows researchers to gain a more comprehensive understanding of the phenomenon under study, as well as test and develop theories in more depth. (Creswell, J. W., 2014). We will carry out an

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analysis of the trends and prospects of the aviation market in Kalimantan, to ensure that the aviation network management strategy taken is in line with market needs and is able to maintain competitiveness in an increasingly competitive market.

Data was collected through a questionnaire which previously involved interviews with decision makers at the Ministry of Transportation and aviation experts and practitioners from Airnav and Airlines. This data collection method is adapted to the objectives and procedures that will be used to analyze the data. Passenger preference data is collected through various steps. First, researchers will create a closed quantitative questionnaire that tracks passengers' preferences when choosing certain modes of air transportation and flights. Respondents were passengers at Soekarno-Hatta Airport and S.A.M.S. Airport. Sepinggan. Second, because ASN will move to IKN starting in 2024, researchers will create a survey. for this survey are central government ASNs from agencies on the list of moving to IKN. Questionnaires are distributed either directly or through online formulary media (Google Form). Then the researchers will ask for research data on developments related to Soekarno-Hatta Airport, S.A.M.S. Airport. Sepinggan, and A.P.T. Pranoto to the decision makers within the Ministry of Transportation, here addressed to the Directorate of Airports and the Directorate of Aviation Navigation, where the data will later be processed into a modeling which the researchers plan as advice to the government regarding the design of a capable and efficient infrastructure for flights in IKN Archipelago.

Quantitative analysis will be carried out on the collected questionnaire data. Previously, statements in the questionnaire were answered with a weight of 1 to 5 where 1: Strongly disagree and 5: Strongly agree. Researchers will use SPSS to process passenger preference data in these numbers. For qualitative analysis, we will use the Exploratory Research Design method and simple descriptive analysis, here are several indicators that are used as references for qualitative analysis, namely: Analysis Capacity Requirements: A study needs to be carried out to identify the ideal capacity for S.A.M.S Airport. Sepinggan, including additional facilities and infrastructure. In this study, it must also be taken into account the estimated growth of passengers and flights, both in the short and long term. Transportation Access Infrastructure Planning to the Airport: A study was carried out to identify the infrastructure needed to support the growth of the aviation industry in Kalimantan in the long term, including improving land transportation infrastructure to facilitate the movement of passengers in traffic activities in and out of access to the airport and Analysis of flight route availability: Reviewing the availability of flight routes to and from cities in Kalimantan, and assessing the possibility of adding new routes to increase connectivity between citiesa in Kalimantan and cities outside Kalimantan.

All the results obtained from the quantitative analysis and qualitative analysis will be processed into a model recommendation regarding aspects of improving service on flights at IKN Nusantara which will later be validated and discussed first through a Focus Group Discussion (FGD) session. The results validation process is carried out using the FGD method, which processes the results of analysis related to future airport development policies and projections. Experts will provide opinions and hold discussions in clusters of topics, namely: capacity requirements, route design, geographical factors, feasibility of airport infrastructure development, as well as related long-term infrastructure planning. Each FGD will invite 4 experts or practitioners in their field, both from Airnav, Airlines, and within ministries such as the Ministry of Transportation, Ministry of PUPR, and Ministry of Finance.

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RESULTS AND DISCUSSION

a. Quantitative Analysis

In this research, researchers conducted a quantitative study to measure trends in customer satisfaction surveys of service users at Soekarno Hatta Airport and Sepinggan Airport. Researchers obtained a total of 51 respondents for Soekarno Hatta Airport and 33 respondents for Sepinggan Airport. Respondents were taken using a random sampling technique, namely a method of taking respondents without paying attention to or providing certain conditions, both age classification and education type classification.

Before distributing the questionnaire, the researcher validated the question instrument and found that 16 questions could be forwarded because they were relevant and valid to be distributed as a questionnaire. Furthermore, after the questions were declared valid and could be continued, the research team continued to distribute the results of the questionnaire, the researchers carried out data processing using the SPSS 27 application. The SPSS 27 application was used to simplify and increase the accuracy of calculating research results, especially to obtain descriptive statistical analysis of each statement items submitted to respondents. There are 16 statements and the following are the results of data processing using SPSS 27.

Table 1. Results of Soekarno-Hatta Airport satisfaction data processing in statements 1-16

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
STS	18	2.2	2.2	2.2
TS	21	2.5	2.5	4.7
N	113	13.8	13.8	18.5
S	298	36.6	36.6	55.1
SS	366	44.9	44.9	100
Total	816	100	100	

Table above shown the total data of statement 1 – 16 combined, with 16 different statements, below are the explaination about each 16 statements at Soekarno-Hatta Airport

Statement 1: ‘Airport services are provided in a timely manner’; Of the 51 respondents, 1 person strongly disagreed, 3 people disagreed, 6 people were neutral, 21 people agreed, 20 people strongly agreed. The highest percentage, namely 21 people, agreed that services at Soekarno-Hatta Airport were provided on time.

Statement 2: ‘Services at the airport are implemented as promised’; Of the 51 respondents, 1 person strongly disagreed, 1 person disagreed, 7 people were neutral, 22 people agreed, 20 people strongly agreed. The highest percentage, namely 22 people, agreed that services at Soekarno-Hatta Airport were implemented as promised.

Statement 3: 'There is a match between the price of the Passengger Service Charge and the services received'; Of the 51 respondents, 1 person strongly disagreed, 2 people disagreed, 6 people were neutral, 17 people agreed, 25 people strongly agreed. The highest percentage, namely 25 people, strongly agree that there is a match between the Passenger Service Charge price and the service received at Soekarno-Hatta Airport.

Statement 4: 'Accurate and error-free passenger and goods data recording system'; Of the 51 respondents, 2 people strongly disagree, 1 person disagrees, 7 people are neutral, 19 people agree, 22 people strongly agree. The highest percentage, namely 22 people, strongly agree that an accurate and error-free passenger and goods data recording system exists at Soekarno-Hatta Airport.

Statement 5: ‘Clarity of information conveyed from the airport information center’; Of the 51 respondents, 2 people strongly disagree, 1 person disagrees, 6 people are neutral, 19 people agree, 23 people strongly agree. The highest percentage, namely 23 people, agreed that there was clarity in the information conveyed from the Soekarno-Hatta Airport information center.

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Statement 6: 'Officers really try to help passengers who have problems at the airport'; Of the 51 respondents, 1 person strongly disagreed, 2 people disagreed, 5 people were neutral, 22 people agreed, 21 people strongly agreed. The highest percentage, namely 22 people, agreed that officers really try to help passengers who have problems at Soekarno-Hatta airport.

Statement 7: 'Airport staff assist passengers who appear confused at the airport'; Of the 51 respondents, 1 person strongly disagreed, 1 person disagreed, 7 people were neutral, 22 people agreed, 20 people strongly agreed. The highest percentage, namely 22 people, agreed that Soekarno-Hatta Airport officers helped passengers who looked confused at the airport.

Statement 8: 'The staff at the airport are not too busy so they respond quickly to passenger requests/needs'; Of the 51 respondents, 1 person strongly disagreed, 2 people disagreed, 10 people were neutral, 17 people agreed, 21 people strongly agreed. The highest percentage, namely 21 people, agreed that officers at Soekarno-Hatta Airport were not too busy so they responded quickly to passenger requests/needs.

Statement 9: 'Passengers feel comfortable interacting at the airport'; Of the 51 respondents, 1 person strongly disagreed, 1 person disagreed, 5 people were neutral, 16 people agreed, 28 people strongly agreed. The highest percentage, namely 28 people, strongly agreed that passengers felt comfortable interacting at Soekarno-Hatta Airport.

Statement 10: 'Airport staff are always friendly and polite to passengers'; Of the 51 respondents, 1 person strongly disagreed, 1 person disagreed, 7 people were neutral, 16 people agreed, 26 people strongly agreed. The highest percentage, namely 26 people, agreed that Soekarno-Hatta Airport officers were always friendly and polite to passengers.

Statement 11: 'Airport officials can be trusted to provide a sense of security for passengers'; Of the 51 respondents, 1 person strongly disagreed, 1 person disagreed, 8 people were neutral, 17 people agreed, 24 people strongly agreed. The highest percentage, namely 24 people, agreed that Soekarno-Hatta Airport officers could be trusted in providing a sense of security for passengers.

Statement 12: 'Airport officials put passengers' interests first'; Of the 51 respondents, 1 person strongly disagreed, 1 person disagreed, 11 people were neutral, 17 people agreed, 21 people strongly agreed. The highest percentage, namely 21 people, agreed that Soekarno-Hatta Airport officers prioritize the interests of passengers.

Statement 13: 'Airport officials put passengers' interests first'; Of the 51 respondents, 1 person strongly disagreed, 1 person disagreed, 6 people were neutral, 20 people agreed, 23 people strongly agreed. The highest percentage, namely 23 people, strongly agreed that Soekarno-Hatta Airport officers prioritize the interests of passengers.

Statement 14: 'Airport operating times that are suitable for passengers'; Of the 51 respondents, 1 person strongly disagreed, 1 person disagreed, 8 people were neutral, 17 people agreed, 24 people strongly agreed. The highest percentage, namely 24 people, strongly agree that airport operating times are suitable for Soekarno-Hatta Airport passengers.

Statement 15: 'Airport officers act fairly (do not discriminate between passengers) when providing services'; Of the 51 respondents, 1 person strongly disagreed, 2 people disagreed, 9 people were neutral, 15 people agreed, 24 people strongly agreed. The highest percentage, namely 24 people, agreed that Soekarno-Hatta Airport officers were fair (not discriminating between passengers) when providing services.

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Statement 16: ‘The appearance of airport staff is neat and ethical’; Of the 51 respondents, 1 person strongly disagreed, 5 people were neutral, 21 people agreed, 20 people strongly agreed. The highest percentage, namely 24 people, strongly agreed that the appearance of Soekarno-Hatta Airport officers was neat and ethical.

After carrying out the descriptive analysis test, the next step is calculating the calculated r value against the r table. The table r value must be greater than the calculated r for the statement to be declared valid. It was found that the results of the r table calculations all had a value greater than the calculated r, which means the data is valid.

Table 2. Results of data processing on Sepinggan Airport satisfaction in statement No. 1-16

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
STS	26	4.9	4.9	4.9
TS	53	10	10	14.9
N	98	18.6	18.6	33.5
S	185	35.1	35.1	68.6
SS	166	31.4	31.4	100
Total	528	100	100	

Table above shown the total data of statement 1 – 16 combined, with 16 different statements, below are the explaination about each 16 statements at Sepinggan Airport

Statement 1: ‘Airport services are provided in a timely manner’; Of the 33 respondents, 1 person strongly disagreed, 2 people disagreed, 4 people were neutral, 16 people agreed, 10 people strongly agreed. The highest percentage, namely 16 people, agreed that services at Sepinggan Airport were provided on time.

Statement 2: ‘Services at the airport are implemented as promised’; Of the 33 respondents, 1 person strongly disagreed, 1 person disagreed, 4 people were neutral, 16 people agreed, 11 people strongly agreed. The highest percentage, namely 16 people, agreed that the services at Sepinggan Airport were implemented as promised.

Statement 3: 'There is a match between the price of the Passengger Service Charge and the services received'; Of the 33 respondents, 4 people strongly disagree, 15 people disagree, 10 people are neutral, 1 person agrees, 3 people strongly agree. The highest percentage, namely 15 people, did not agree that there was a match between the Passenger Service Charge price and the service received at Sepinggan Airport.

Statement 4: 'Accurate and error-free passenger and goods data recording system'; Of the 33 respondents, 2 people strongly disagree, 1 person disagrees, 3 people are neutral, 14 people agree, 13 people strongly agree. The highest percentage, namely 14 people, agreed that an accurate and error-free passenger and goods data recording system exists at Sepinggan Airport.

Statement 5: ‘Clarity of information conveyed from the airport information center’; Of the 33 respondents, 4 people strongly disagreed, 12 people disagreed, 15 people were neutral, 2 people agreed. The highest percentage, namely 15 neutral people, stated that there was clarity in the information conveyed from the Sepinggan Airport information center.

Statement 6: 'Officers really try to help passengers who have problems at the airport'; Of the 33 respondents, 1 person strongly disagreed, 2 people disagreed, 3 people were neutral, 16 people agreed, 11 people strongly agreed. The highest percentage, namely 16 people, agreed that officers really tried to help passengers who had problems at Sepinggan airport.

Statement 7: ‘Airport staff assist passengers who appear confused at the airport’; Of the 33 respondents, 1 person strongly disagreed, 1 person disagreed, 6 people were neutral, 14 people agreed,

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11 people strongly agreed. The highest percentage, namely 14 people, agreed that Sepinggan Airport officers helped passengers who looked confused at the airport.

Statement 8: 'The staff at the airport are not too busy so they respond quickly to passenger requests/needs'; Of the 33 respondents, 1 person strongly disagreed, 1 person disagreed, 7 people were neutral, 13 people agreed, 11 people strongly agreed. The highest percentage, namely 13 people, agreed that officers at Sepinggan Airport were not too busy so they responded quickly to passenger requests/needs.

Statement 9: 'Passengers feel comfortable interacting at the airport'; Of the 33 respondents, 1 person strongly disagreed, 1 person disagreed, 3 people were neutral, 12 people agreed, 16 people strongly agreed. The highest percentage, namely 16 people, strongly agreed that passengers felt comfortable interacting at Sepinggan Airport.

Statement 10: 'Airport staff are always friendly and polite to passengers'; Of the 33 respondents, 1 person strongly disagreed, 1 person disagreed, 5 people were neutral, 12 people agreed, 14 people strongly agreed. The highest percentage, namely 14 people, strongly agreed that Sepinggan Airport officers were always friendly and polite to passengers.

Statement 11: 'Airport officials can be trusted to provide a sense of security for passengers'; Of the 33 respondents, 1 person strongly disagreed, 1 person disagreed, 5 people were neutral, 12 people agreed, 14 people strongly agreed. The highest percentage, namely 14 people, strongly agreed that Sepinggan Airport officers could be trusted in providing a sense of security for passengers.

Statement 12: 'Airport officials put passengers' interests first'; Of the 33 respondents, 1 person strongly disagreed, 1 person disagreed, 7 people were neutral, 12 people agreed, 12 people strongly agreed. The highest percentage, namely 12 people, strongly agreed that Sepinggan Airport officers prioritize the interests of passengers.

Statement 13: 'Airport officials put passengers' interests first'; of the 33 respondents, 1 person strongly disagreed, 5 people were neutral, 14 people agreed, 13 people strongly agreed. The highest percentage, namely 14 people, agreed that Sepinggan Airport officers prioritize the interests of passengers.

Statement 14: 'Airport operating times that are suitable for passengers'; of the 33 respondents, 4 people strongly disagree, 12 people disagree, 10 people are neutral, 5 people agree, 2 people strongly agree. The highest percentage, namely 12 people, did not agree that the airport operating times were suitable for Sepinggan Airport passengers.

Statement 15: 'Airport officers act fairly (do not discriminate between passengers) when providing services'; Of the 33 respondents, 1 person strongly disagreed, 2 people disagreed, 7 people were neutral, 11 people agreed, 12 people strongly agreed. The highest percentage, namely 12 people, strongly agreed that Sepinggan Airport officers were fair (not discriminating between passengers) when providing services.

Statement 16: 'Airport officers act fairly (do not discriminate between passengers) when providing services'; of the 33 respondents, 1 person strongly disagreed, 2 people disagreed, 7 people were neutral, 11 people agreed, 12 people strongly agreed. The highest percentage, namely 12 people, strongly agreed that Sepinggan Airport officers were fair (not discriminating between passengers) when providing services.

From this quantitative processing, comparison results were obtained in statements number 3, 5 and 14 which are the points of emphasis for Sepinggan airport. Apart from comparing trends in public satisfaction with airport services, researchers also summarized data on the amount of traffic at Soekarno-Hatta Airport from 2017-2023 compared to traffic at Sepinggan Airport in the same time

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period. This was done to project traffic growth at Soekarno-Hatta Airport compared to Sepinggan Airport. The traffic comparison is attached in the graph below.

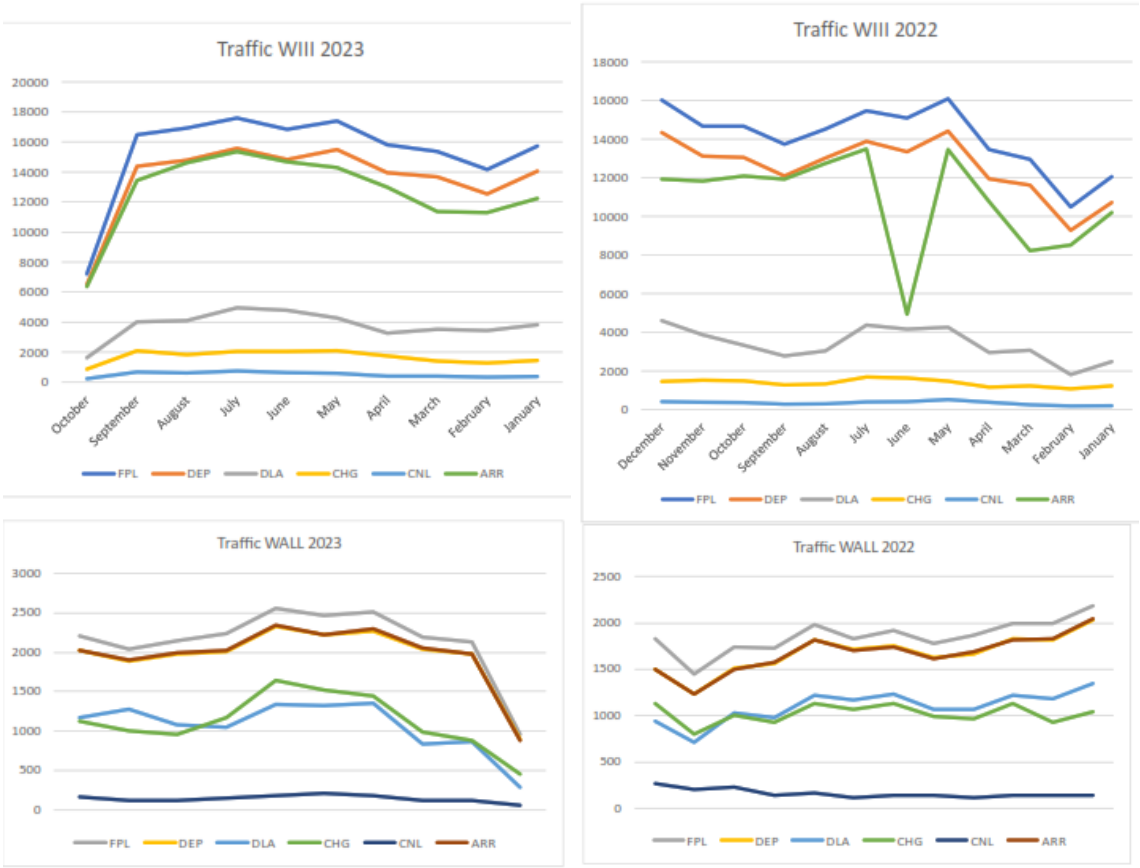

Figure 1. Comparison of traffic at Soekarno-Hatta Airport and Sepinggan Airport in 2022-2023

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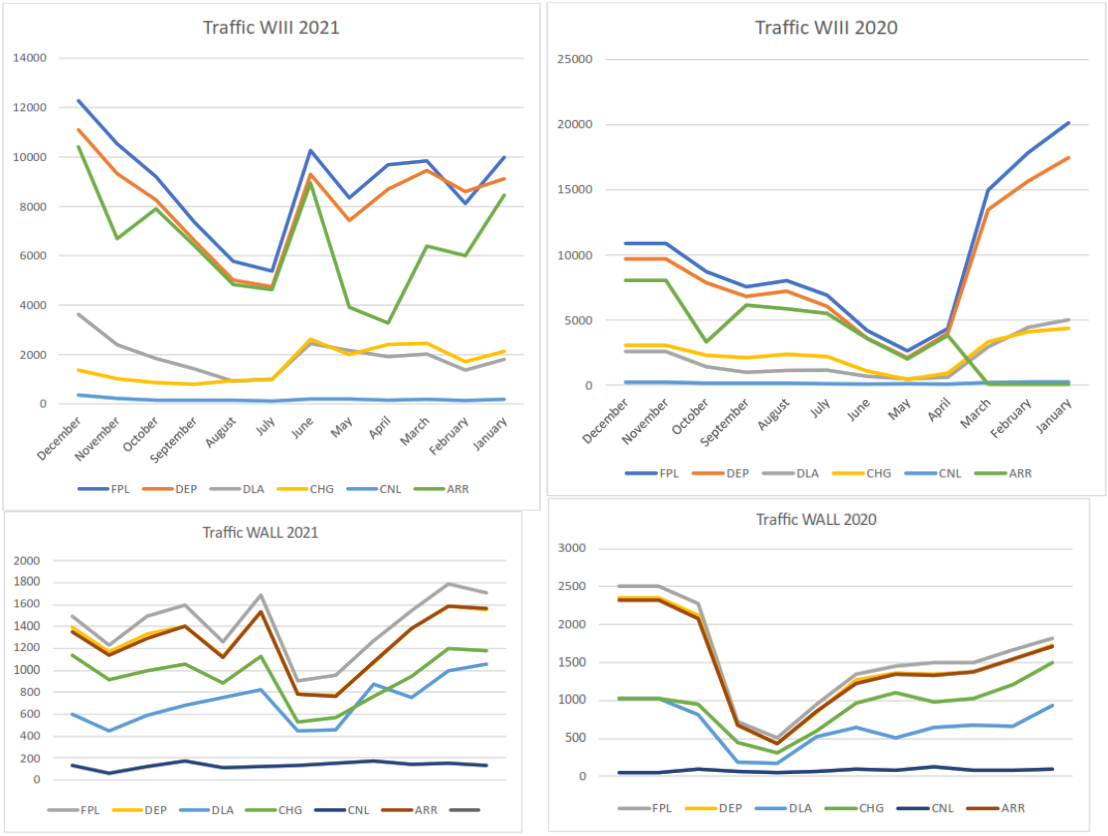

Figure 2. Comparison of Soekarno-Hatta Airport and Sepinggan Airport traffic in 2020-2021

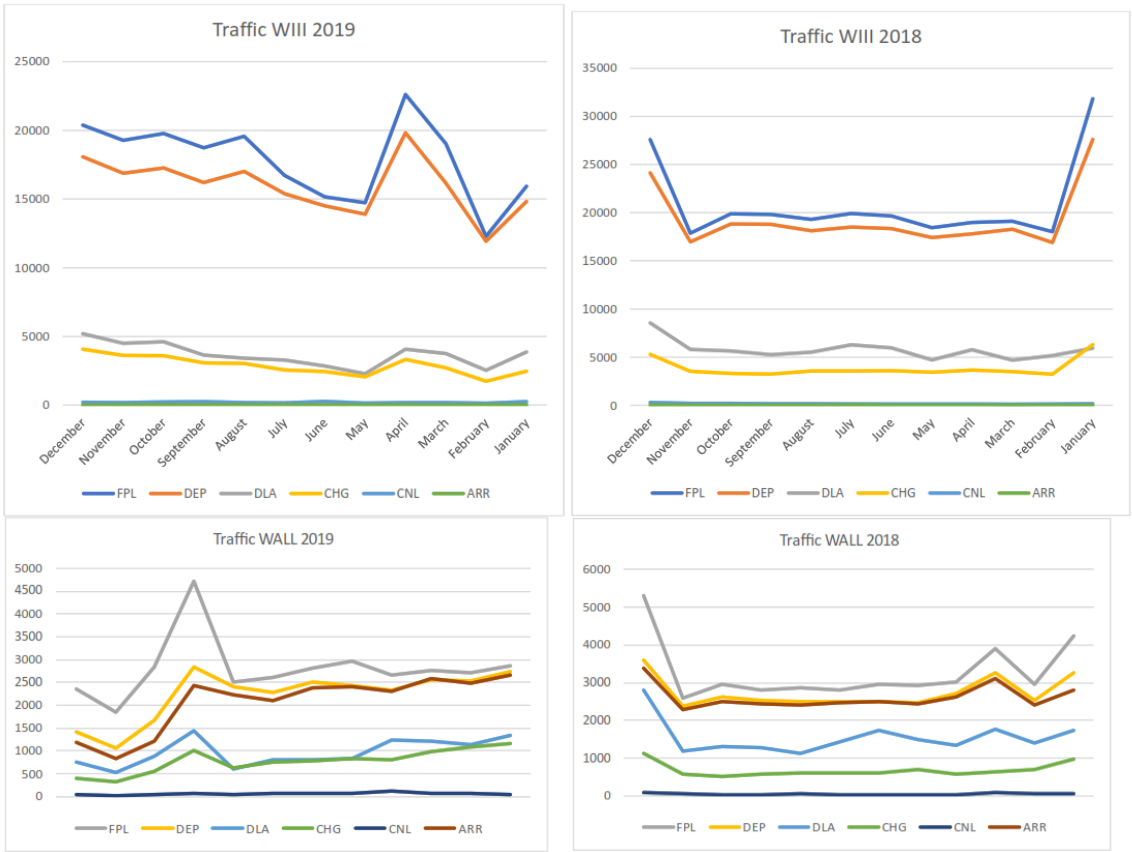

Figure 3. Comparison of Soekarno-Hatta Airport and Sepinggan Airport traffic in 2018-2019

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The conclusion from the traffic data comparison is; traffic shows an increasing trend every year. A significant decline occurred in the 2020-2021 period due to a major event, namely the Covid-19 outbreak and the implementation of health protocols. After that, traffic continued to show an increase at each airport. Next, to complete the three core components of a flight; airport and airline, it is necessary to design a route that can represent flights to Sepinggan Airport. Furthermore, the route design is expected to increase flight efficiency to the Indonesian capital. The following is a description of the routes listed in accordance with the Minister of Transportation Regulations.

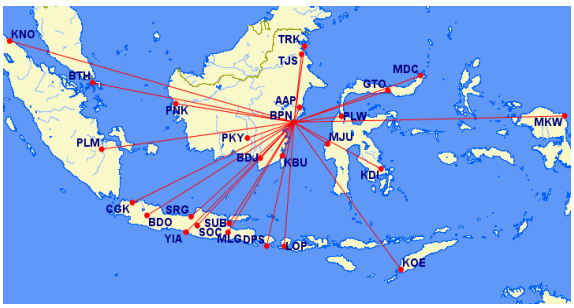

Figure 4. S.A.M.S. Airport Flight Route Sepinggan

b. Qualitative Analysis

This research is a qualitative study which aims to investigate Soekarno-Hatta Airport, S.A.M.S Airport. Sepinggan, and A.P.T. Pranoto. Researchers used field data obtained from decision makers at the Ministry of Transportation, especially from the Directorate of Airports and the Directorate of Air Navigation. Next, this data will be modeled for the purpose of providing recommendations to researchers on how to do it. For the research carried out, researchers will use the Exploratory Research Design method and simple descriptive analysis of the field data that has been collected.

1) Analysis of Airport Capacity Requirements

In terms of analyzing passenger capacity requirements at airports, various factors must be considered carefully to ensure that airports are able to respond to growth in flight demand and provide optimal service to passengers. One aspect analyzed is the number of passengers expected to use the airport in a certain time period. This involves the study of air traffic growth trends, potential increases in flight routes, and the influence of external factors such as economic development and tourism. Apart from that, it is also necessary to pay attention to supporting facilities, such as passenger terminals, aprons and transportation facilities to and from the airport. By conducting a comprehensive analysis of passenger capacity needs, authorities can identify areas that require capacity increases or infrastructure changes in order to accommodate expected growth and provide efficient and comfortable services for passengers.

In the annual passenger growth data listed in the Exposure held by the Airport Directorate, at S.A.M.S. Airport. More details are shown in the exposure data below:

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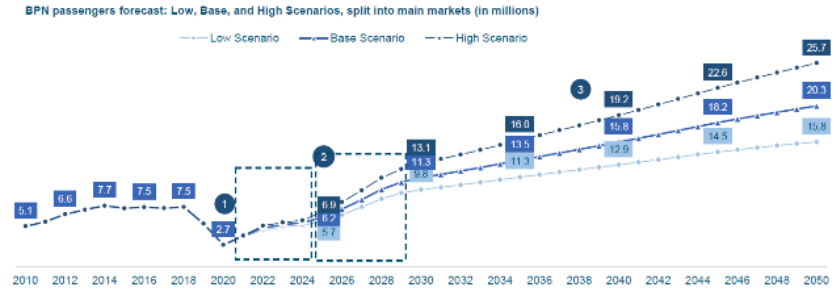

Scenario	Traffic segment	2010	2019	2025	2028	2030	2040	2050	2010-19	2019-25	2025-28	2028-50	2025-50	2019-50
Low Scenario	Domestic	5.0	5.4	5.5	8.1	9.2	12.1	14.6	0.7%	0.5%	13.7%	2.7%	4.0%	3.3%
	International	0.1	0.1	0.2	0.5	0.5	0.8	1.1	0.4%	22.0%	34.4%	4.0%	7.3%	10.0%
	Total	5.1	5.4	5.7	8.6	9.8	12.9	15.8	0.7%	0.9%	14.5%	2.8%	4.1%	3.5%
Base Scenario	Domestic	5.0	5.4	6.0	9.0	10.4	14.4	18.2	0.7%	1.8%	14.7%	3.3%	4.6%	4.0%
	International	0.1	0.1	0.2	0.8	0.8	1.4	2.1	0.4%	27.0%	45.8%	4.6%	8.9%	12.2%
	Total	5.1	5.4	6.2	9.8	11.3	15.8	20.3	0.7%	2.3%	16.3%	3.4%	4.9%	4.3%
High Scenario	Domestic	5.0	5.4	6.5	9.9	11.5	16.7	21.9	0.7%	3.1%	15.2%	3.7%	5.0%	4.6%
	International	0.1	0.1	0.4	1.4	1.5	2.5	3.8	0.4%	40.0%	45.8%	4.7%	9.0%	14.4%
	Total	5.1	5.4	6.9	11.2	13.1	19.2	25.7	0.7%	4.1%	17.7%	3.8%	5.4%	5.1%

*any discrepancies in values due to rounding

Figure 5. Forecast of Growth in Passenger and Aircraft Movements at S.A.M.S Airport. By the end of 2021-2050

It was explained that the estimated growth in the number of passengers and flights carried out at S.A.M.S. Airport. Sepinggan is estimated to reach 20,325,000 passengers and 147,000 flights by 2050, on a total of domestic and international routes. S.A.M.S Airport Sepinggan, which in this research is planned by researchers as an airport with a hub type which will later operate serving flights in IKN Nusantara, if it can be compared with the data on the growth in the number of passengers at Soekarno-Hatta Airport which is now operating serving flights to the Indonesian capital in DKI Jakarta which will be explained in the exposure data below:

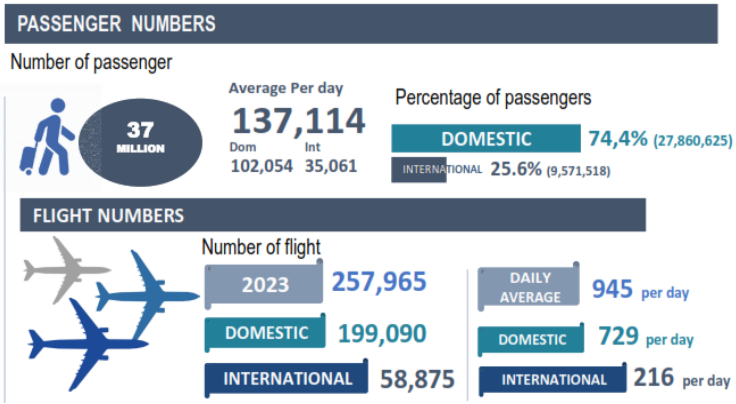

Figure 6. Existing Growth of Passenger and Aircraft Movements at Soekarno-Hatta Airport as of September 2023

It was explained that the forecast growth in the number of passengers and flights carried out at Soekarno-Hatta Airport reached 37,432,143 passengers and 257,965 flights in 2023, in total flights on domestic routes and international routes. With this comparison it shows that S.A.M.S Airport. Sepinggan still really needs to develop facilities both on the air side and on the land side, so that it can support the implementation of flights to be able to catch up with the number of passengers and flights per year at least reaching the figure of ± 37,432,143 passengers and ± 257,965 flights when it became a Hub Airport. which will support IKN Nusantara flights in the future.

2) Airport Access Transportation Support Facilities

Access to airports is a crucial element in transportation infrastructure, playing an important role in smooth air mobility. Analysis of the transportation system that connects passengers and cargo from various points to the airport does not only include physical aspects such as roads and railways, but also involves managerial elements, security and operational efficiency. In this context, a deep understanding of traffic dynamics, accessibility and connectivity is key to improving the travel

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experience, ensuring timely arrivals and departures and minimizing environmental impact. By focusing on analysis of inbound airport transportation, we can identify potential improvements in infrastructure and services that can increase sustainability and efficiency in the modern air transportation ecosystem.

At S.A.M.S. Airport already has land transportation routes for access to the airport, including via toll road access with four-wheeled motorized vehicles, as well as via train access with each route being connected to each other, between the Central Government Core Area (IKN Nusantara), Bandar Air S.A.M.S. Sepinggan, and A.P.T. Pranoto, as shown below:

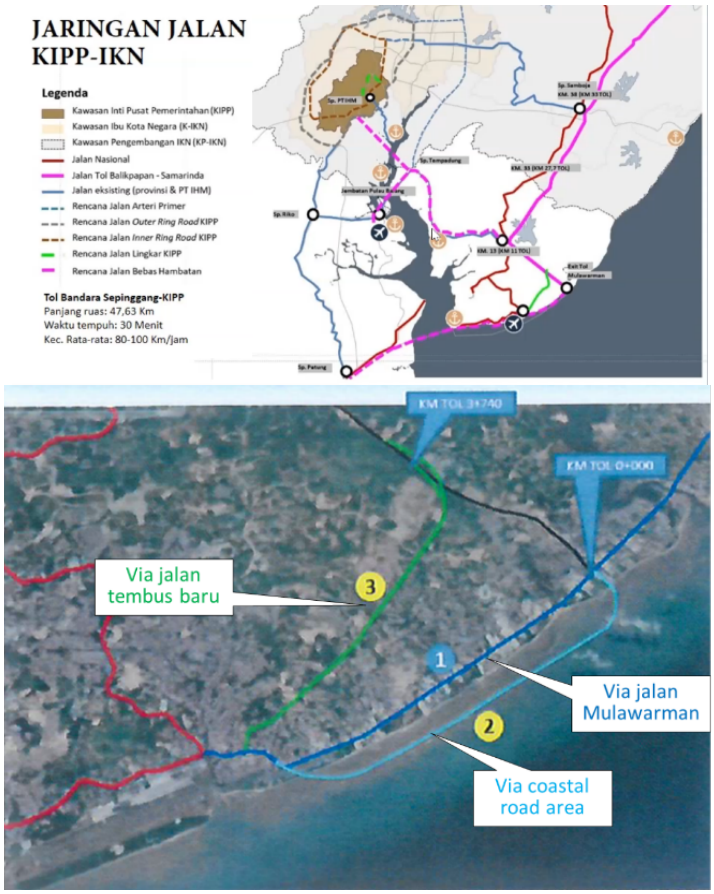

Figure 7. IKN - S.A.M.S. Airport Toll Road Route Network Sepinggan

Figure 8. KIPP-Airport S.A.M.S. Railway Route Network Sepinggan-A.P.T. Airport Pranoto

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By having access to these interconnected modes of transportation, it is possible to develop a more effective and efficient access development plan which of course will make it easier for passengers who will fly at S.A.M.S. Airport. Side by side of these three points with a direct route scheme to airport entry access, either via land transportation using four-wheeled motorized vehicles via toll road access, or the airport train route, as in the airport entrance access plan scheme below:

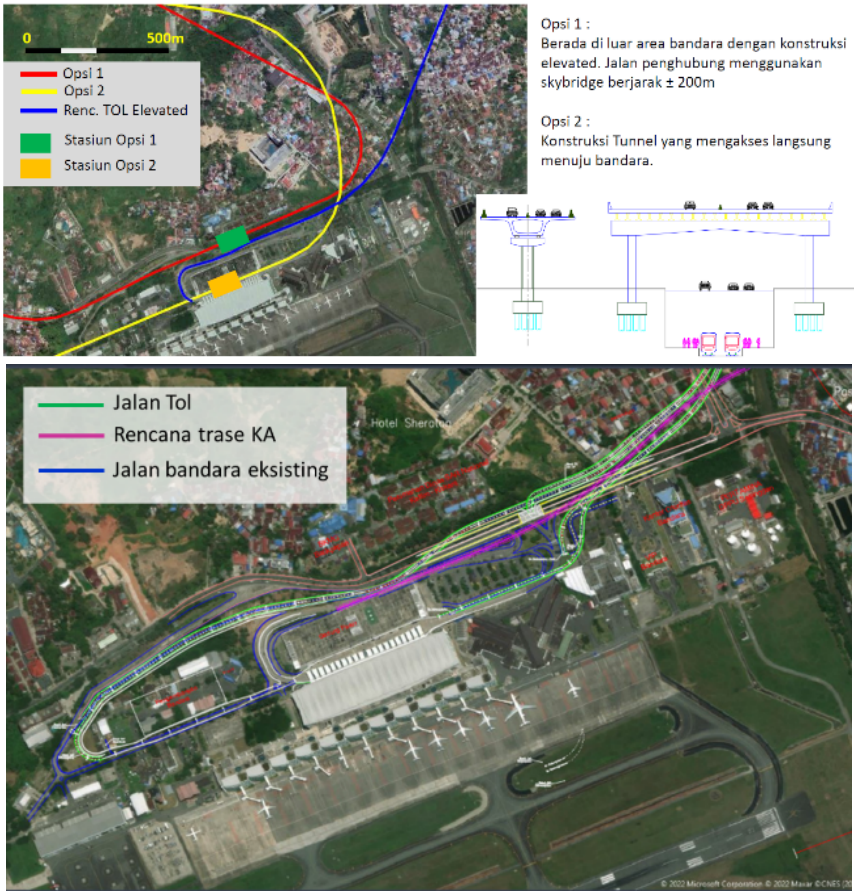

Figure 9. Scheme of Airport Entry Access Plan via Toll Road and Train at S.A.M.S Airport. Sepinggan

3) Flight Route Analysis

Figure 10. Flight Route Analysis Based on PM 88/2013

In terms of managing flight routes in Indonesia, there are three approach patterns, namely:

a. Plane follows the trade: Airplanes follow routes that have a commercial market

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b. Trade follows the plane: The market will develop if there are flight routes there (especially pioneer flights)
c. Combined: That is, the market and aviation work together and synergize with each other to develop

In terms of developing a new route, an airline at least emphasizes several things that need attention, namely market conditions (existing demand), aircraft utilization according to the company's business plan, flight safety as a cost. Meanwhile, at the same time, providing transportation connectivity is the government's responsibility as mandated by law.

Researchers also collected data in the form of the Airport Master Plan (RIB BU). This RIB BU is used as an analytical reference to provide estimates of airport capacity projections and improvements to flight navigation facilities which will later support the operations of Sepinggan Balikpapan airport as a hub.

The type of route proposed by researchers is Hub and Spoke modeling. In which case, the Hub route is the main route which will become the flight center from the feeder airport. The following is a route analysis carried out by researchers by making Sultan Aji Muhammad Sulaiman Sepinggan Balikpapan airport the hub of airports in Indonesia:

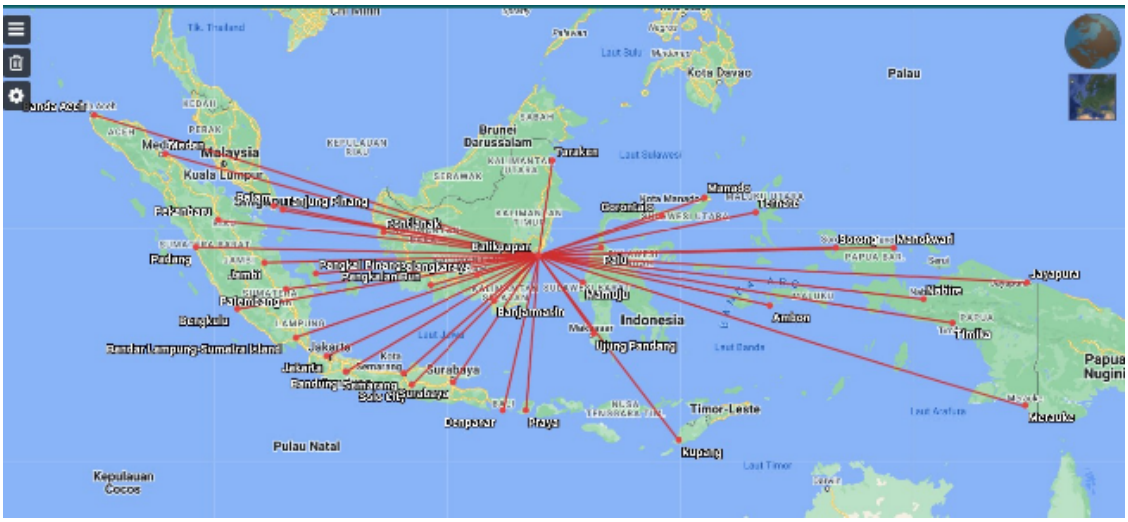

Figure 11. Sepinggan Flight Route Plan as Hub

After the quantitative survey and qualitative analysis are completed, the next step is Focus Group Discussion (FGD). FGD is a further part of research that is used to validate design results and talk with experts in the field. Researchers invited resource persons from the Air Transport Directorate, Airport Directorate, and Aviation Navigation Directorate to participate in a Focus Group Discussion (FGD) on this occasion.

From the FGD that was carried out, the resource person agreed with designing the Balikpapan route as a Hub airport in order to support air transportation connectivity to the National Capital (IKN) of the Archipelago. However, there are several points that need to be studied in further research, namely:

a. S.A.M.S Airport Design Sepinggan as a hub airport has of course been studied by stakeholders and the government. However, this research can be an additional reference regarding route design to support air transportation connectivity to and from IKN.
b. b. It is also necessary to study the possibility of surrounding airport options as a spoke airport or support for Sultan Aji Muhammad Sulaiman Sepinggan Airport. For example, Aji Pangeran Tumenggung Pranoto Airport, Sjamsuddin Noor Airport Banjarmasin, Juwata Airport Tarakan, and also pioneer airports such as Datah Dawai Airport/

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In this research S.A.M.S Airport. Sepinggan will be proposed as an airport that will serve commercial flights in the IKN Nusantara government area later. Currently, the development of IKN Nusantara is underway, where the IKN Nusantara research carries the principle of Multi Airport System (MAS) or multi airport, which is an airport operational concept that is carried out when there is more than one airport in the same area and serving the same area. MAS focuses on the operationalization of primary and secondary airports. At IKN, the primary airport is S.A.M.S Sepinggan Airport and the secondary airport is A.P.T. Airport. Pranoto. IKN Nusantara itself is located in the Sepaku area, North Penajam Paser Regency, East Kalimantan, where the geographical conditions of Kalimantan Island are generally hinterland so it has areas that are difficult to reach. In addition, weather conditions that cannot always be predicted can affect flight performance and make it difficult to manage flight networks, so with the MAS concept at S.A.M.S Sepinggan Airport and A.P.T. Pranoto is expected to be able to create new flight routes that have not existed before for flight services in the IKN Nusantara region in the future.

In implementing the MAS principles for aviation services in the IKN Nusantara region, existing data regarding existing facilities at 2 (two) reference airports from researchers is required, namely S.A.M.S Sepinggan Airport and A.P.T. Airport. Pranoto. Existing data related to facilities both land side and land side at S.A.M.S Sepinggan Airport are briefly shown in the image below.

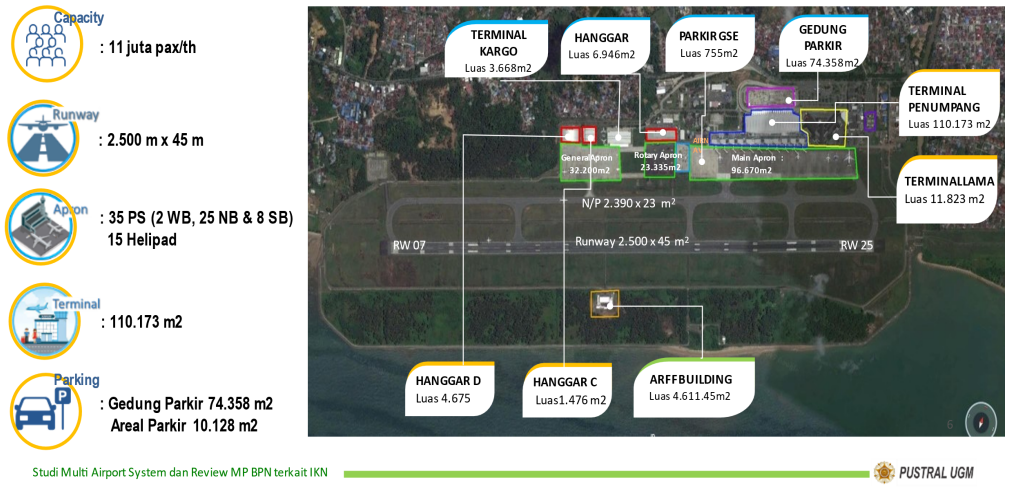

Figure 12. Existing Layout of S.A.M.S Airport Sepinggan

To support development in the IKN Nusantara area of S.A.M.S Sepinggan Airport in the future, of course there will be several stages of development that will be carried out in order to create qualified services, in order to support the transfer of the capital city of Jakarta to IKN Nusantara which will most likely have a big impact on community movement and potential. economy in the IKN Nusantara region, both before it was selected as the Capital Region and after. For explanation regarding development data from S.A.M.S Sepinggan Airport as contained in the RIB presentation from the Directorate of Airports, it is shown in the image below.

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NO	URAIAN	TAHAPAN PENGEMBANGAN				KETERANGAN
		EKSISTING 2021	TAHAP I	TAHAP II	TAHAP III	
I	FASILITAS SISI UDARA					
1	Aerodome Reference Code	4D	4E	4E	4E	
2	Klasifikasi Landas Pacu	Instrument Presisi	Instrumen Presisi	Instrument Presisi	Instrument Presisi	
3	Pesawat Terbesar	B737-900ER	B777-300	B777-300	B777-300	Pesawat
4	Rute Terjauh	Singapura	Jeddah	Jeddah	Jeddah	
5	Orientasi Landas Pacu (Runwa	07 - 25	07 - 25	07 - 25	07 - 25	
6	Landas Pacu (Runway)	2.500 x 45	3.250 x 45	3.250 x 45	3.250 x 45	m2
7	Kekuatan Landas Pacu	74/F/C/X/T	92/F/C/X/T	92/F/C/X/T	92/F/C/X/T	
8	Declared Distances					
	TORARW 07	2.500	3.250	3.250	3.250	m
	TORARW 25	2.500	3.250	3.250	3.250	m
	TODARW 07	2.695	3.310	3.310	3.310	m
	TODA RW 25	2.811	3.310	3.310	3.310	m
	LDARW 07	2.500	3.250	3.250	3.250	m
	LDA RW 25	2.500	3.250	3.250	3.250	m
	ASDARW 07	2.500	3.250	3.250	3.250	m
	ASDA RW 25	2.500	3.250	3.250	3.250	m
9	Strip Landas Pacu (Runwaystri	2.620 x 300	3.370 x 300	3.370 x 300	3.370 x 300	m2
10	- Clearway RW 07	196 x 300	196 x 300	196 x 300	196 x 300	
	Clearway RW 25	311 x 300	280 x 300	280 x 300	280 x 300	m2
11	- RESA RW 07	90 x 90	90 x 90	90 x 90	90 x 90	m2
	RESA RW 25	90 x 90	90 x 90	90 x 90	90 x 90	m2

NO	URAIAN	EKSISTING 2021	TAHAPAN PENGEMBANGAN TAHAP I	TAHAP II	TAHAP III	KETERANGAN
12	Landas Hubung (Taxiway)					
a	Exit Taxiway					
	- Taxiway A	268 X 23	268 X 23	268 X 23	268 X 23	m2
	- Taxiway B	221 X 23	221 X 23	221 X 23	221 X 23	m2
	- Taxiway C	153 X 23	153 X 23	153 X 23	153 X 23	m2
	- Taxiway D	153 X 23	153 X 23	153 X 23	153 X 23	m2
	- Taxiway E	200 X 23	200 X 23	200 X 23	200 X 23	m2
	- Taxiway F	68 X 23	68 X 23	68 X 23	68 X 23	m2
	- Taxiway G	83 X 23	83 X 23	83 X 23	83 X 23	m2
	- Taxiway H	-	200 X 23	200 X 23	200 X 23	m2
	- Taxiway I	-	55 x 23	55 x 23	55 x 23	m2
	- Taxiway J	-	55 x 23	55 x 23	55 x 23	m2
b	Parallel Taxiway					
	- Paralel taxiway	2390 x 23	3120 x 23	3120 x 23	3120 x 23	M2
c	Rapid Exit Taxiway					
	- Taxiway K	-	-	-	312 x 23	m2
	- Taxiway L	-	312 x 23	312 x 23	312 x 23	m2
d	Landas Parkir (Apron) - Total					
a	Luas					
	'- Apron pesawat	127,490	170,992	181,252	189,583	m2
	'- Apron Heli	23,335	23,335	23,335	23,335	m2
	'- Apron VIP		34,020	34,020	34,020	m2
	- Total	150,825	228,347	238,607	246,938	m2
b	Kapasitas Parkir Pesawat					
	- Wide Body (B747 -400, B777-200/300, A330-200/300)	2	3	3	4	pesawat
	- Narrow Body (B73 8/739/MAX, A320Neo, CRJ, Propeler (ATR 42/72), C212/DHC-6	33	38	42	44	pesawat
	- Pesawat Cargo (freighter)	0	2	2	2	pesawat
	Total	35	43	47	50	pesawat
	- Helipad	15	15	15	15	pesawat

NO	URAIAN	EKSISTING 2021	TAHAPAN PENGEMBANGAN TAHAP I	TAHAP II	TAHAP III	KETERANGAN
II	FASILITAS SISI DARAT					
1	Terminal Penumpang	110.173	110.173	146.151	189.446	m2
2	Terminal Penumpang Lama	11.823,73	11.823,73	11.823,73	11.823,73	m2
3	Gedung Parkir Publik	74.358	74.358	74.358	74.358	m2
4	Areal Parkir Publik	10.128	10.128	10.128	10.128	m2
5	Terminal VIP	563	600	600	600	m2
6	Fasilitas Ibadah	819	819	819	819	m2
7	Gedung Crisis Center	175	175	175	175	m2
8	Gedung Boat Shelter	140	140	140	140	m2
9	Kantor Administrasi	1.026	1.026	1.026	1.026	m2
10	Gedung Teknik	504	504	504	750	m2
11	Kantor Operasi	215,5	215,5	215,5	215,5	m2
12	Kantor AirNav Lama	1.414,51	1.414,51	1.414,51	1.414,51	m2
13	Menara Pengawas (Tower Control)	121,91	121,91	121,91	121,91	m2
14	Area perkantoran Airnav baru termasuk area Tower ATC	-	37.000	37.000	37.000	m2
15	Gedung Serba Guna	731	731	731	731	m2
16	PKP-PK	1.295	1.295	1.295	1.295	m2
17	Power House	972	972	1.500	1.500	m2
18	Apron Services Building	746	746	746	746	m2
19	Bangunan AZB	322	322	322	322	m2
20	GSE Maintenance Building	-	250	250	250	m2
21	Kantor Badan Meteorologi dan Geofisika	980	980	980	980	m2
22	Taman Pengamatan Badan Meteorologi dan Geofisika	464	400	400	400	m2
23	Bangunan operasional BMKG	-	200	200	200	m2
24	Kantor Keamanan	-	100	100	100	m2
25	Poliklinik	-	100	100	100	m2
26	Bangunan Sumber Air	263	263	263	263	m2
27	Bangunan Glide Path	9	9	9	9	m2
28	Bangunan Localizer	9	9	9	9	m2
29	Bangunan VOR/DME	42	42	42	42	m2
30	Terminal Kargo	5.064	5.806	9.290	12.452	m2

NO	URAIAN	EKSISTING 2021	TAHAPAN PENGEMBANGAN TAHAP I	TAHAP II	TAHAP III	KETERANGAN
31	Perkantoran Kargo	494	494	600	600	m2
32	DPPU	20.225	20.225	20.225	20.225	m2
33	Jasa Boga/Katering	-	2.500	2.500	2.500	m2
34	Hanggar B	6.946	6.946	6.946	6.946	m2
35	Hanggar C	4.801	4.801	4.801	4.801	m2
36	Hanggar D	4.675	4.675	4.675	4.675	m2
37	Tempat Penyimpanan Sampah Sementara	78	78	200	200	m2
38	Tempat Penyimpanan Limbah B3	60	60	60	60	m2
39	Bangunan Incenerator (Pembakaran Sampah)	102	102	102	102	m2
40	Fasilitas SPBK (Stasiun Pengisian Bahan Bakar Khusus)	250	250	250	250	m2
41	Instalasi Pengolahan Air Limbah (IPAL/STP)	-	200	200	200	m2
42	Hotel	8.278,58	8.278,58	8.278,58	8.278,58	m2
43	Stasiun Kereta Api		1.250	1.250	1.250	m2
44	Gudang		500	500	500	m2
45	Bangunan EMPU	470,4	470,4	470,4	470,4	m2
46	Area Pengembangan Komersial (area eks terminal lama)	-	19.300	19.300	19.300	m2
47	Kantor Otoritas Bandara	10.800	10.800	10.800	10.800	m2
48	Area Penyimpanan Logistik Perawatan Sisi Udara	400	400	400	400	m2
49	Tolgate Bandara		150	150	150	m2
50	Fasilitas TNI AU (area)	3.800	3.800	3.800	3.800	m2
51	Isolated Parking Area		4.750	4.750	4.750	m2
52	Gedung Sub AMC	35	50	50	50	m2
53	Approach Lighting System	1	2	2	2	Unit
54	Antena NDB	1	1	1	1	Unit
55	Bangunan Panel Approach Lamp	112,36	112,36	112,36	112,36	m2
56	Ruang Panel	495	495	495	495	m2
57	Gardu Penghubung PLN	790	790	790	790	m2
58	Gedung Airport Equipment Readiness	612	612	612	612	m2
59	Group Tank	130	130	130	130	m2
60	GSE Park	5.912	8.990	10.546	12.804	m2
61	Solar Park	-	Sesuai perhitungan studi	Sesuai perhitungan studi	Sesuai perhitungan studi	m2

NO	URAIAN	EKSISTING 2021	TAHAPAN PENGEMBANGAN TAHAP I	TAHAP II	TAHAP III	KETERANGAN
III	FASILITAS NAVIGASI PENERBANGAN	VOR/DME	VOR/DME	VOR/DME	VOR/DME	
		NDB	NDB	NDB	NDB	
		ILS	ILS	ILS	ILS	
		RADAR	RADAR	RADAR	RADAR	
		GNSS Procedure	GNSS Procedure	GNSS Procedure	GNSS Procedure	
IV	ALAT BANTU PENDARATAN VISUAL	PAPI	PAPI	PAPI	PAPI	
		Windsock	Windsock	Windsock	Windsock	
		Runway Edge Lights	Runway Lights	Runway Lights	Runway Lights	
		Marka	Marka	Marka	Marka	
		PALS (RW 25)	PALS (RW 25)	PALS (RW 25)	PALS (RW 25)	
		ILS	MALS (RW 07)	MALS (RW 07)	MALS (RW 07)	
		Glide Path	ILS	ILS	ILS	
		Localizer	Glide Path	Glide Path	Glide Path	
		Threshold Light	Localizer	Localizer	Localizer	
		Runway End Light, Taxiway Edge Light	Light: Threshold Light, Runway End, Runway Centerline, Stopway, Taxiway Edge, Taxiway Centerline			
V	FASILITAS KOMUNIKASI PENERBANGAN	Tower Set	Tower Set	Tower Set	Tower Set	
		AFTN	AFTN	AFTN	AFTN	
		VHF A/P	VHF ADC	VHF ADC	VHF ADC	
		HF SSB	HF SSB	HF SSB	HF SSB	
		FSS	UHF Radio Link	UHF Radio Link	UHF Radio Link	
		-	AMSC, VCSS	AMSC, VCSS	AMSC, VCSS	
		-	ATIS	ATIS	ATIS	
		-	VHF APP, VHF TRANCEIVER	VHF APP, VHF TRANCEIVER	VHF APP, VHF TRANCEIVER	
		-	Direct Speech	Direct Speech	Direct Speech	
		-	VSAT	VSAT	VSAT	
		-	AMHS	AMHS	AMHS	
		-	VSCS	VSCS	VSCS	
VI	PELAYANAN LALU LINTAS UDARA	APP	APP	APP	APP	
VII	FASILITAS KEAMANAN PENERBANGAN	X-Ray Cabin, X-Ray Baggage, Walk Trough Metal Detector, Handheld Metal Detector, Explosive Detector, X -Ray Cargo				
		Pagar Kelilling dan Pembatas	Pagar Kelilling dan Pembatas	Pagar Kelilling dan Pembatas	Pagar Kelilling dan Pembatas	
		CCTV	CCTV	CCTV	CCTV	
		Kendaraan Patroli	Kendaraan Patroli	Kendaraan Patroli	Kendaraan Patroli	
		Avsec Radio Comunication	Avsec Radio Comunication	Avsec Radio Comunication	Avsec Radio Comunication	
VIII	PKP-PK					
	- Tipe PKP -PK	Tipe A	Tipe A	Tipe A	Tipe A	
	- Kategori PKP-PK	Kategori 7	Kategori 9	Kategori 9	Kategori 9	

Figure 13. Data on Stages of Development of S.A.M.S Airport Facilities. Sepinggan

For existing data related to facilities both land side and land side at A.P.T. Airport. Pranoto is briefly shown in the image below.

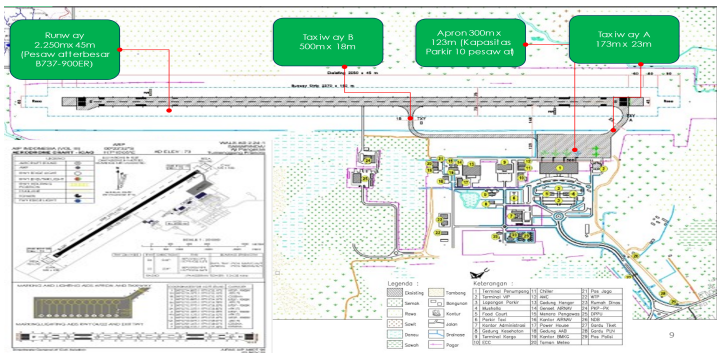

Figure 14. Existing Layout of A.P.T. Airport Pranoto

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To support development in the IKN Nusantara region, A.P.T. Airport. In the future Pranoto will also of course carry out several development stages that will be carried out, related to development data from A.P.T Airport. Pranoto as stated in the RIB presentation from the Airport Directorate is shown in the image below.

This comparison shows that facilitating and serving flights in the IKN Nusantara region still really needs development related to facilities both on the air side and land side, on the implementation of MAS principles or methods at S.A.M.S Airport. Sepinggan and A.P.T. Pranoto to support the implementation of flights in the IKN Nusantara region to be able to catch up with the number of passengers and flights per year reaching at least ± 37,432,143 passengers and ± 257,965 flights when it becomes a Hub Airport that supports IKN Nusantara flights in the future.

In future flight operations as a hub airport, S.A.M.S. Sepinggan must be able to create several additional routes on domestic and international routes. With the addition of flight routes, it is hoped that the airport that will be the focus of researchers, namely S.A.M.S. Sepinggan can support flight services in the new capital, previously the capital Jakarta became IKN Nusantara. For existing route data at S.A.M.S. Airport. Sepinggan can be seen in the table below.

Table 3. Existing S.A.M.S. Airport Route Sepinggan

Domestic	International
Jakarta	Kuching
Makassar	Kuala Lumpur
NYIA	Singapore
Banjarmasin	
Palangkaraya	
Palu	
Mamuju	
Bandung	
Samarinda	
Surabaya	
Denpasar	
Semarang	
Tarakan	
Berau	
Tanjung Selor	
Malinau	
Toraja	

As an airport that will later serve flights in the IKN Nusantara region, S.A.M.S Airport. Sepinggan is an airport that is planned to become a hub airport, so there must be additional new routes that previously did not exist, because moving the capital city of Jakarta to IKN Nusantara will increase transportation movements with various new routes, just as moving the new capital to Kalimantan will certainly add a lot. needs that are massive, both in terms of government scope and the needs of the people who are heading towards IKN Nusantara. By considering the above, the researchers provide recommendations for additional routes which can later be adapted to S.A.M.S Sepinggan Airport as a Hub Airport, for the routes as follows:

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Table 4 Recommended Additional Flight Routes for S.A.M.S Sepinggan Airport

Recommendation	Distance (km)
BPN → CGK	1258
BPN → BDJ	338
BPN → PKN	602
BPN → PKY	345
BPN → TRK	514
BPN → PNK	843
BPN → BTJ	2503
BPN → KNO	2076
BPN → PKU	1730
BPN → PDG	1842
BPN → BTH	1446
BPN → TNJ	1397
BPN → PGK	1201
BPN → PLM	1368
BPN → DJB	1475
BPN → BKS	1644
BPN → TKG	1374
BPN → BDO	1207
BPN → SRG	960
BPN → SOC	970
BPN → SUB	815
BPN → DPS	849
BPN → LOP	831
BPN → KOE	1238
BPN → MDC	947
BPN → PLW	338
BPN → GTO	696
BPN → MJU	279
BPN → UPG	513
BPN → TTE	1190
BPN → SOQ	1602
BPN → MKW	1910
BPN → NBX	2082
BPN → TIM	2251
BPN → DJJ	2632
BPN → MKQ	2728

CONCLUSION

The research that has been carried out produces the following conclusions is generated 37 Routes that made the Airport S.A.M.S. Sepangan as a Hub airport. S.A.M.S Airport Design Sepinggan as a hub airport has of course been studied by stakeholders and the government. However, this research can be an additional reference regarding route design to support air transportation connectivity to and from IKN. It is also necessary to study the possibility of options for surrounding airports as spoke or support airports for S.A.M.S. Airport. Sepinggan. For example, Aji Pangeran Tumenggung Pranoto Airport, Sjamsuddin Noor Airport Banjarmasin, Juwata Airport Tarakan, and also pioneer airports such as Datah Dawai Airport.

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