Planning for Passenger Movement Flow Systems at Terminal 1 Juanda Airport Due to Health Protocol Implementation

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ABSTRACT

The passenger terminal is one of the most important aspects of the airport system because, in general, the terminal is the main link for passenger access to air transportation modes, namely airplanes. Many activities and processes are related to air travel at the terminal, from purchasing tickets on departure to baggage claim on arrival. As recorded on the online website of the Central Statistics Agency, the number of passengers at Juanda Airport has decreased significantly during the COVID-19 pandemic. Therefore, COVID-19 appeared at the end of 2019 and greatly affected operational activities in the terminal, especially at Terminal 1 Juanda Airport. This study analyzed the number of peak hour passengers after New Normal, changes in passenger movements after the implementation of the health protocol, namely the existence of COVID-19 free test facilities in the airport area, validation of COVID-19 free tests, the use of HAC, and analyzes the adequacy of existing facilities and area at T1 Juanda. It was to find out the number of passengers during peak hours that can still be accommodated while implementing health protocols, namely social distancing. In addition, to find ways to deal with the accumulation of passengers at specific points in the terminal. Based on the calculation results in this study, it was found that the number of passengers during this pandemic decreased by 228%, with the number of passengers during peak departure hours of 1607 passengers and passengers during peak arrival hours of 1991 passengers. Furthermore, to overcome the new queue points that appear in the Terminal 1 Juanda Airport area, it is planned to add deks and/or validation officers in the COVID-19 free test letter validation area located in the arrival's hall and the HAC validation area located in the baggage claim is doubled, namely 10 tables and 8 tables respectively. In addition, it is also planned to replace the x-ray device with an Automated Tray Return System system to overcome the buildup of passengers in the security checkpoint 1 area.

INTRODUCTION

Covid-19, or Coronavirus Disease 2019, is a new type of disease approved by the World Health Organization. This outbreak began to spread at the end of 2019 and originated in Wuhan City, China. Until October 2020, there were 38.723.640 cases of COVID-19 in the world. According to Worldometers, Indonesia was ranked 17th as the country with the highest number of deaths due to COVID-19 in the world. It had a major impact on many aspects in Indonesia, including the aviation industry.

Aviation is one of the industries most affected by the COVID-19 pandemic. This pandemic made the Ministry of Transportation impose a flight ban from April 2020 to June 2020. The Central Statistics Agency (BPS) noted that the number of passengers departing on domestic flights at Juanda Airport before the enactment of the flight ban, namely in March 2020, was 408.725 passengers. Meanwhile, the number of flights in April 2020 was only 97.748 after the flight ban was issued, and there were only 5.397 in May 2020. After the implemented flight ban was over, the number of passengers began to increase again in June 2020, namely 64.137 passengers.

After the easing of commercial flight permits, the Task Force for the Acceleration of Handling COVID-19 issued Circular Number 9 of 2020 concerning Criteria and Requirements for the Travel of People during the Adaptation Period towards New Habits to Promote a Productive and Safe Community in Consideration of Corona Virus Disease 2019 (COVID-19) [1], which contains requirements for prospective passengers who

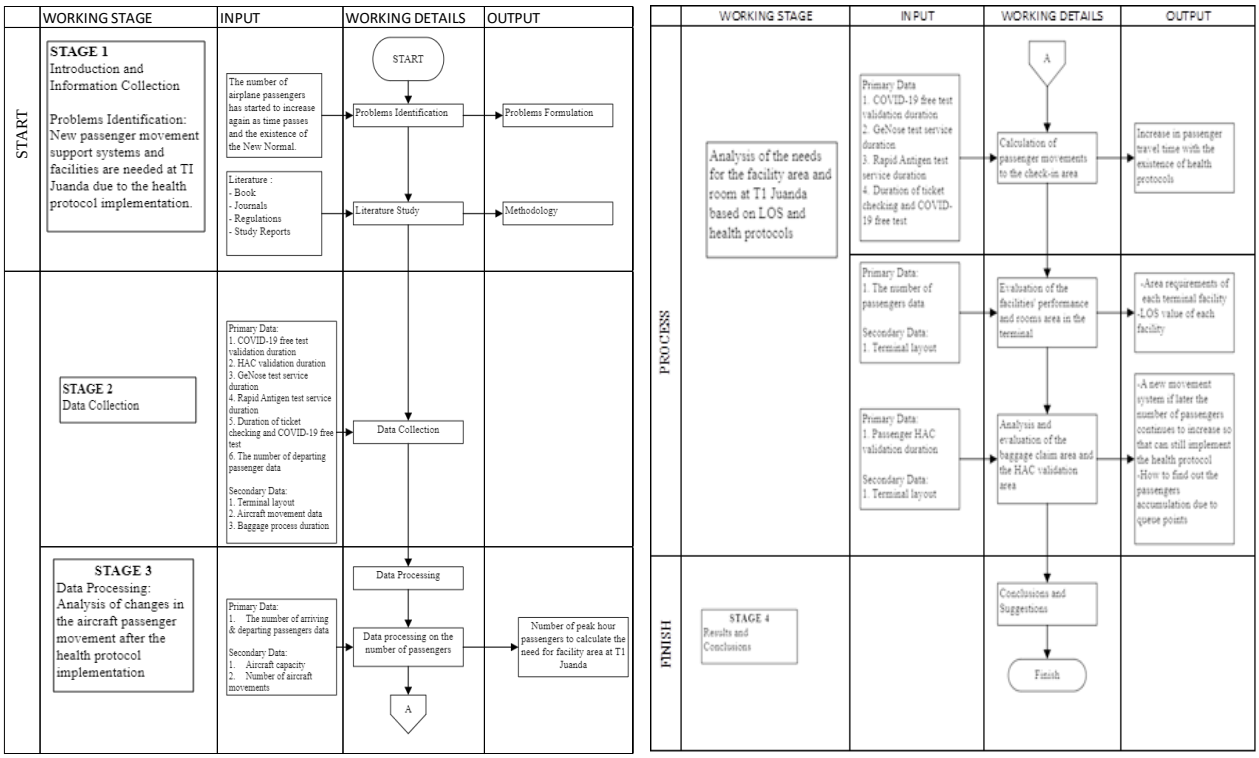

Figure 1. Research Completion Flowchart

wish to travel by air but remain safe from COVID-19 transmission. Some of the health protocols implemented at Juanda Airport include implementing a one-way entrance flow system at the departure terminal, attaching proof of a COVID-19 free test in the form of a rapid/PCR Swab test result, using the eHAC application, namely Electronic Health Alert Card, and enforce social distancing in all corners of the terminal.

Implementing the health protocol at Terminal 1 Juanda Airport certainly requires sufficient space to ensure the flow of passenger movements. The high increase in flight demand during the New Normal and Post-COVID-19 era greatly affected terminal operational activities. Later, the terminal will have a certain limit on the number of passengers that can still be accommodated while still implementing health protocols, considering the previous terminal design did not consider social distancing and the implementation of health protocols.

Therefore, it is necessary to review the capacity and passenger movements at Terminal 1 of Juanda Airport so that they can continue to carry out operational activities that consider social distancing and can deal with an increase in the number of passengers. Problems that will be reviewed in this study can be seen as follows:

1. How many peak-hour passengers during New Normal era at Terminal 1 Juanda Airport?
2. How long does passenger movement to the check-in area in New Normal era?
3. How much area is required for each departure and arrival terminal facility in New Normal era?
4. How does the existing LOS value of each departure and arrival terminal facility in New Normal era?
5. How to overcome the accumulation of passengers due to the emergence of queue points at Terminal 1 Juanda Airport?

METHODOLOGY

Methodology can be seen in Figure 1.

ANALYSIS AND DISCUSSIONS

A. Decrease in the Number of Passengers during Pandemic

Based on data from the online website of the Central Statistics Agency, the number of domestic passengers flying through Terminal 1 Juanda Airport decreased by 228% in 2020.

B. Peak Hour Calculations

Busy days were obtained from the highest number of aircraft movements in 7 days, and peak hours were obtained from seeing the maximum value of the number of aircraft movements within 60 minutes. Table 2 and 3 show the recapitulation of peak hours at Terminal 1 Juanda Airport.

Based on the determination of peak hours above, observations were made to get the number of peak hour passengers to get the real value. Table 4 shows the observation results for the number of departure and arrival passengers at peak hours.

C. Departure and Arrival Passenger Movement Flow Before and After the Health Protocol.

Passenger movement flow is a structured process in a system that regulates passenger processing places, both passengers who will travel by air and those who have already traveled by air. Figures 2 and 3 show the passenger movement flow before the pandemic in Indonesia.

This movement flow has developed over time, especially after the New Normal and the existence of the

Table 1. Decrease in the Number of Annual Domestic Passengers at Juanda Airport

Year	Number of Passengers
2016	8.019.635
2017	7.924.393
2018	8.167.118
2019	6.288.591
2020	2.747.248
2021	759.813 (per-April)

Table 2. Recapitulation of Departures during the Existing Peak Hours

Flight	Destination	Type	Pax
ID6136	Makassar (UPG)	B738	189
ID6597	Jakarta (CGK)	A320	180
JT360	Balikpapan (BPN)	B739	215
JT376	Samarinda (AAP)	B738	189
JT708	Makassar (UPG)	B739	215
Flight	Destination	Type	Pax
JT971	Batam (BTH)	B739	215
QG350	Makassar (UPG)	A320	180
QG430	Balikpapan (BPN)	A320	180
QG484	Banjarmasin (BDJ)	A20N	180
QG711	Jakarta (CGK)	A20N	180
GA305	Jakarta (CGK)	B738	189
QG1502	Blimbingsari (BWX)	AT76	70
ID8136	Makassar (UPG)	B738	189
QG600	Kupang (KOE)	A320	180
JT224	Banjarmasin (BDJ)	B739	215

Table 3. Recapitulation of Arrivals during the Existing Peak Hours

Flight	Origin	Type	Pax
JT225	Banjarmasin (BDJ)	B739	215
QG441	Balikpapan (BPN)	A20N	180
ID7517	Jakarta (HLP)	A320	180
QG451	Palangkaraya (PKY)	A320	180
JT261	Balikpapan (BPN)	B739	215
QG720	Jakarta (CGK)	A320	180
JT596	Jakarta (CGK)	B739	215
QG951	Batam (BTH)	A20N	180
ID6137	Makassar (UPG)	B738	189
SJ567	Makassar (UPG)	B738	189
JT663	Palangkaraya (PKY)	B738	189
QG489	Banjarmasin (BDJ)	A320	180
GA320	Jakarta (CGK)	A333	300

Table 4. Observation Results of Peak Hour Passengers

Flight Type	Number of Passengers
Departure	1607
Arrival	1991

Health protocol. Passenger movement flows at Juanda Airport can be seen in Figures 4 and 5.

After implementing the health protocol at the airport, there were several changes to passenger travel time at Terminal 1 Juanda Airport. Table 5 and 6 are the recapitulation of passenger travel time due to implementing the health protocol.

D. Room Requirement Calculations of Passenger Facilities

The calculation of the area needed for passenger facilities at Terminal 1 Juanda Airport referred to IATA [2] and SKEP/77/VI/2005[3] and used a distance between passengers of 1.5 meters to implement social distancing, which refers to regulations issued by ICAO[4]. The calculation results are obtained as shown in Table 7.

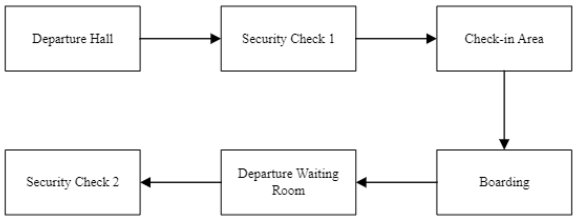

Figure 2. Departure Passenger Movement Flowchart in Normal Conditions

Figure 3. Departure Passenger Movement Flow in Normal Conditions

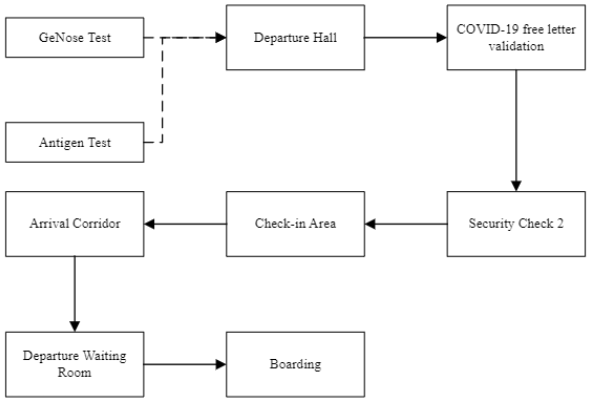

Figure 4. Departure Passenger Movement Flow in New Normal Era

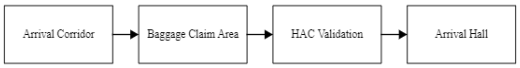

Figure 5. Arrival Passenger Movement Flow in New Normal Era

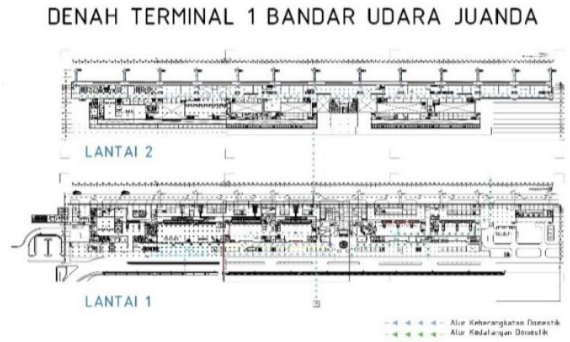

Figure 6. Arrival Passenger Movement Flow in New Normal Era

E. Level of Service Value of Passenger Terminal Facilities

LOS value analysis was carried out at the departure curb facility, check-in area, departure lounge, baggage claim area, COVID-19 free test validation area, GeNose test area, rapid antigen test area, and HAC validation area and used the standard level of service value from IATA as shown in Table 8.

F. Addition of COVID-19 Free Test Validation Tables/Officer

An effort to increase the LOS value in this area was to increase the number of tables and/or validation officers. Currently, there are 5 validation tables with 763

Table 5. Recapitulation of Departure Passenger Travel Time with Health Protocols

Departure				
Information	Test Duration and/or Running Time	COVID-19 Free Test Validation	Ticket Checking & COVID-19 Free Test Validation Results	Total Duration
Departure passengers who have COVID-19 free test independently	40 seconds	22 seconds	12 seconds	1 minute and 14 seconds
Departure passengers who do GeNose test	22 minutes and 15 seconds	22 seconds	12 seconds	22 minutes and 49 seconds
Departure passengers who do rapid antigen tests	1 hour 9 minutes and 52 seconds	22 seconds	12 seconds	1 hour 4 minutes and 39 seconds

Table 6. Recapitulation of Arrival Passenger Travel Time with Health Protocols

Arrival			
Information	Longest Queue Time	Validation	Validation
Arrival passengers who do HAC validation	1 minute and 29 seconds	7 seconds	1 minute and 36 seconds

Table 7. Recapitulation Results of Service Room Requirements

Service Room	Existing Area		Results of Service Room Requirements	
Departure Curbs	195	m	79	m
Departure Hall	3164	m2	1898	m2
COVID-19 Free Validation Area	703	m2	497	m2
Check in Area	3150	m2	663	m2
Departure Waiting Room	19134	m2	2916	m2
Toilet	1403	m2	354	m2
GeNose Test Area	1012	m2	40	m2
Antigen Test Area	550	m2	168	m2
Baggage Claim Area	3543	m2	1142	m2
HAC Validation Area	2813	m2	287	m2
Arrival Hall	6032	m2	5600	m2
Arrival Curbs	225	m	208	m

passengers served, with an average of one table serving 153 passengers with an average service time of 22 seconds. Table 9 shows the number of passengers that can be served for 1 hour for each number of tables added.

With the values obtained from the calculations above, the queue level in the COVID-19 free test validation area can be reduced if it is assumed that the number of passengers validating is the same, namely 763 passengers.

G. A shift of Arrival Time Distance Between Arrival Flights

An effort to increase the LOS value in the baggage claim area was to analyze the arrival time interval for each plane. The duration data used as a reference for shifting arrival schedules were obtained from a previous study entitled *Sistem Penanganan Bagasi pada Terminal 2 Bandar Udara Juanda Surabaya* [5], with values shown in Table 10.

Based on the duration data above, it was obtained that the passenger movement time in the baggage claim area was 13 minutes and 54 seconds. This duration can be used as a reference as the time needed for the arrival lag between planes so that passengers in the baggage claim area do not exceed the existing capacity.

Based on this value, 10 minutes was used so that the distance between flights was not too far and did not affect the following flight schedule too much. The results of the schedule shift based on the calculation can be seen in Figure 7.

H. Addition of Tables/HAC Validation Officer

An effort to increase the LOS value in this area was to increase the number of tables and/or validation officers. Currently, there are 4 validation tables with 1991 passengers served, with an average one table serving 498 passengers with an average service time of 7 seconds. Table 12 shows the number of passengers that can be served for 1 hour for each number of tables added.

With the value obtained from the calculation above, the queue level in the HAC validation area can be reduced if it is assumed that the number of passengers validating is the same, namely 1991 passengers.

I. Improved Security Check and X-Ray Devices Facilities

Based on the calculation results, it was found that the number of x-ray devices needed was 7 units, whereas there were only 4 x-ray devices in the existing state. It can be overcome by adding x-ray units or changing the x-ray type used.

The type of x-ray facility that can be applied is Automated Tray Return System (ATRS). This facility is considered can increase security guarantees and accuracy and reduce queue levels at security checkpoints.

Based on sampling data taken at I Gusti Ngurah Rai Airport as written in the Sustainability Report of PT Angkasa Pura I [6], an efficiency of 383% was obtained when using the ATRS system. This facility is proven to save screening process time by 3.83 times faster than using a conventional system.

Table 8. Recapitulation of Service Room LOS Values

Service Room	Service Space LOS Values
Departure Curbs	A
Check-in Area	A
Departure Waiting Room	A
Baggage Claim Space	C
COVID-19 Free Validation Area	F
GeNose Test Area	A
Antigen Test Area	A
HAC Validation Area	C

Table 9. Number of Passengers Who Can Be Served If Adding Tables/Covid-19 Free Test Validation Officers

Number of COVID-19 Free Test Validation Tables	Average Number of Passengers Who Can Be Served in 1 Hour	Average Number of Passengers Served Per 5 Minutes
5	153	13
6	128	11
7	109	10
8	96	8
9	85	8
10	77	7

Table 10. Passenger Duration Data Related to Baggage Claim Area

Information	Time (Minute)
Passenger waiting time at the baggage claim area	12.29
Longest queue time of HAC validation	1.5
Service time of HAC validation process	0.11

J. Number of Passengers that Can Be Accommodated By Implementing Social Distancing

According to "*Development of Risk Estimation Model for COVID-19 Transmission on Passenger Handling Process in Airport Terminal"* [7], the risk of COVID-19 virus transmission is influenced by the use of masks, the type of pre-flight COVID-19 test, passenger distance or room density, exposure time, and the type of ventilation in the waiting area. This study will discuss the relationship between passenger distance or room density and passenger capacity that can still be accommodated with social distancing. Table 13 shows the probability of infection risk and the number of passengers in the room affected by the distance between passengers, according to Rohmana, 2021.

Based on the research above, it was found that the number of passengers who could still be accommodated by implementing social distancing with a distance of 1.5 meters was 356 passengers. With this number of passengers, the LOS value at each airport facility will receive a LOS A value.

Therefore, the number of passengers can be used as a reference in determining the maximum number of passengers that can be served to make the health protocol implementation run properly.

CONCLUSIONS

A. Conclusions

1. Based on observations in the terminal area, the number of peak hour passengers at Terminal 1 Juanda Airport and the number of departure peak hour passengers was 1607 passengers at 05.00-06.00, and the number of arrivals passengers was 1991 passengers at 18.00-19.00.
2. After observing the new health protocol implemented at Terminal 1 Juanda Airport, the duration of the departure passenger travel to the check-in area was obtained as follows. Passengers travel duration who did COVID-19 free test independently for 1 minute and 14 seconds, passengers who did the test GeNose at the airport for 22 minutes and 49 seconds, passengers who did the rapid antigen test at the airport for 1 hour 4 minutes and 39 seconds, and passengers arriving for 1 minute and 36 seconds due to the HAC validation process.
3. By using the number of peak hour passengers, the required facilities area at Terminal 1 Juanda Airport was obtained as follows. The length of the departure curb was 79 m, 1898 m2 of the departure hall, 497 m^2 of COVID-19 free test validation area, 7 tables for COVID-19 free test validation counter, 6 centralized security gate units, 663 m^2 of the check-in area, 29 check-in counters, 2 security gate hold rooms, 2916 m^2 of the departure lounge, and 210 seats in the departure lounge. In addition, it also required 354 m^2 of toilets, 40 m^2 of GeNose test area, 2 GeNose test counters, 168 m^2 of the rapid antigen test area, 2 rapid antigen test counters, 1142 m^2 of baggage claim area, 6 baggage claim device units, 287 m^2 of HAC validation area, 4 HAC validation counters, 5600 m^2 of the arrival hall, and 208 m of arrival curbs.
4. The calculation to find the level of service value for each existing service room was obtained as follows. The LOS value for the departure curb facility was LOS A, the check-in area with LOS A value, the departure waiting room with LOS A value, the baggage claim area with LOS C value, the COVID-19 free test validation area with LOS F value, the GeNose test area with LOS A value, the rapid antigen test area with LOS A value, and the HAC validation area with LOS C value.
5. In the LOS value calculation for each service room, the LOS values obtained for the COVID-19 free test validation area facility, the baggage claim area, and the HAC validation area were LOS F, LOS C, and LOS C with a space area per passenger of 0.4 m2, 1.8 m2, and 1.4 m2 respectively. This value does not correspond to the minimum area for the social distancing of 2.25 m2, and the existing conditions on the number of x-rays at the security check were less than the number required. Therefore, an analysis was carried out to reduce density in these areas. The results were obtained to shift arrival hours between flights to 10 minutes per flight, add counters and/or

17:05	17:10	17:15	17:20	17:25	17:30	17:35	17:40	17:45	17:50	17:55	18:00	18:05	18:10
	JT225												
		QG441	QG441										
		ID7517	ID7517										
			QG451		QG451								
			JT261		JT261								
					QG720		QG720						
					JT596		JT596						
						QG951			QG951				
						ID6137			ID6137				
							SJ567				SJ567		
							JT663				JT663		
									QG489				QG489

Figure 7. Table of Arrival Flight Schedule Shifts Results

COVID-free test validation officers and add counters and/or HAC validation officers doubled, namely 10 tables and 8 tables to accelerate the arrival passenger movement process and replacing the x-ray system with Automated Tray Return System.

B. Suggestions

Suggestions for further research development with additions are as follows:

1. Airside calculations have not been carried out in this study, and it should be done to meet passenger needs in 2021.
2. Further research is required related to changes/shifts in the arrival flight schedule so that the remaining flight schedules during that day can be adjusted to the planned shifts. Thus, future passenger movements can continue to implement health protocols.
3. The analysis in this study used observational data and theories available at IATA. In this analysis, there are still important things that need to be analyzed more deeply regarding the passenger movement system planning.

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