

Simulation of Improvement Facilities and Number of Operators at Soekarno Hatta Airport Regulated Agents and Regulated Agent Facilities Planning of Kualanamu Airport Regulated Agents at PT. XYZ

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Abstract

The research was purposed to know the optimal number of operators and equipment during company peak time at shift 3 in Regulated Agent of PT. XYZ at Soekarno Hatta Airport. To determine the optimal number of operators, the researcher applied the arrivals simulation from 00:30 to 02:30, assuming that the earliest departure is at 05:00. The simulation result for the current condition is with the average number of goods arrived is 21,924 kg, and the number of goods served is only 12,241. After that, the researcher applied the calculation of capacity planning to get the optimal number of lines and operators, and the result was with the same amount of goods arrived able to be served 19,752 kg. Based on the capability and time process in Soekarno Hatta, the calculation of capacity planning and the proposed layout was made for the new Regulated Agent project of Kualanamu.

Keywords

Regulated agent, capacity planning, simulation, layout, and facility planning.

1. Introduction

Screening is carried out on all goods to be sent by air to ensure that the goods to be sent are safe and to ensure the safety of shipping operations. Based on the security requirements of the airport manager, the screening process is carried out in a warehouse so that the inspection process can be easier and the goods to be sent can be stored in the warehouse to wait for the delivery departure time. The security area is intended for the screening process so that all goods that will fly at the cargo airport are guaranteed security called Regulated Agent (RA). Goods that enter the screening process are goods that will fly at a certain time, and before the goods enter the first line of the cargo airport, the goods have been confirmed safe for delivery by the Regulated Agent (RA) itself.

PT. XYZ as the company that handles Regulated Agent at Soekarno Hatta airport experiences a condition where the company needs help from the agent who sends the goods or the customer to screen during rush hour, which should be carried out by the internal company, and if it is done by an agent who Should be a company customer, there is a concern that entering goods that are suspected of being DG, or the customer will feel burdened because the screening process takes a long time.

PT. XYZ, as a cargo and distributor service company as well as managing goods entering or leaving the airport, will also open a new business project, namely Regulated Agent (RA) at Kualanamu Airport in Medan to be able to support cargo or shipping activities at the airport.

To provide the best security and service guarantees, companies should implement the Capacity Planning module to get the optimal number of supporting equipment and operators in accordance with existing work processes. Given that the core of the Regulated Agent business is the screening process and supports line one at an airport, the company needs to calculate the optimal number of Xray servers, operators, pallets and the number of trucks using the Equipment Requirements and Labor Requirements methods (Leigh 2008, McCaughey et al. 2010, Mundell et al. 2013).

After all the calculations above have obtained the results, so that all processes run smoothly, the company must make a layout and facility planning from the Regulated Agent at the Kualanamu International Airport.

1. The simulation model was created using the Arena Rockwell Simulation software to determine whether the company can serve all existing arrivals at the current capacity without the help of any agent or party.
2. Planning for new capacity by calculating equipment and porters requirements is made for a regulated agent at Soekarno-Hatta Airport to serve all incoming arrivals during rush hour using the Little's Law method.

$$\text{Number of equipment needed} = \frac{(\text{n customer per hour})(\text{n product per order})}{(\text{n product per sheet})(\text{n cycle per hour})}$$

$$\text{Number of labor needed} = \frac{(\text{n customer per hour})(\text{n minute each})}{(\text{n minute per hour})}$$

3. Capacity planning and new layout design are made for the new regulated agent business project of Kualanamu International Airport. The layout design is made by minimizing material handling and distance displacement approaches by calculating the euclidian distance.

$$d_{ij} = [(x_i - x_j)^2 + (y_i - y_j)^2]^{1/2}$$

x_i = the x coordinate at the facilitation center

y_i = the y coordinate at the facilitation center

d_{ij} = distance between facility center i and j

4. To compare the proposed layout with the layout designed by the company, a process flow map table is used.

2. Research Method

The data collected in this research was carried out during the busy hours of regulated agents, namely the night shift from 23.00 to 07.00 with the arrival sample at 00.30 to 02.30 and the time data for each process was taken during the day. After all, the data has been collected, data adequacy and uniformity test are carried out so that the data can be said to be sufficient and reliable for research.

The first step in this research is to create a process simulation model using Arena Rockwell Simulation software with input arrival time and processing time. There are six workstations in the simulation of this regulated agent process, namely arrival, unloading, Xray, acceptance, loading, and trucking in sequence. From the simulation results of the regulated agent process, it can be seen whether the company can serve all existing arrivals within its current capacity.

Furthermore, based on the results of the process simulation model, new capacity requirements are calculated, both in terms of equipment and porters, using the Little's Law method to meet incoming arrivals during peak hours. After the new capacity calculation results are obtained, a new process simulation model is created with the values obtained from the calculation to prove whether the calculation results of the new capacity are better than the current capacity. Next is making a new capacity planning based on the Little's Law method and a proposed layout design with a material handling minimization approach, euclidian distance calculations, and a process flow map for the company's new business project, namely regulated agents at Kualanamu International Airport.

3. Result and Discussion

3.1 Current Equipment and Porter at Soekarno-Hatta Airport Regulated Agent

The following is a table of the number of workers and equipment currently available at the Soekarno-Hatta Airport regulated agent to support operations (Table 1 and Table 2).

Table 1. Number of Porter of Each Workstation

No	Workstation	Equipment	Number of Server	Number of Operators for Each Line	Total
1	Unloading	Forklift, Pallet	3	1	3
2	Xray	Pallet	2	1	2
3	Transport 1	Forklift	2	1	2
4	Transport 2	Forklift	2	1	2

5	Loading	Pallet	2	3	6
6	Driver	Truck	6	1	6
Total					21

Table 2. Equipment

Equipment Regulated Agent
Outer Pallet
Xray
Inner Pallet
Truck RA

3.2 Current Process Simulation Model

The following is an illustration of the process simulation model currently available at the Soekarno Hatta Airport regulated agent (Figure 1).

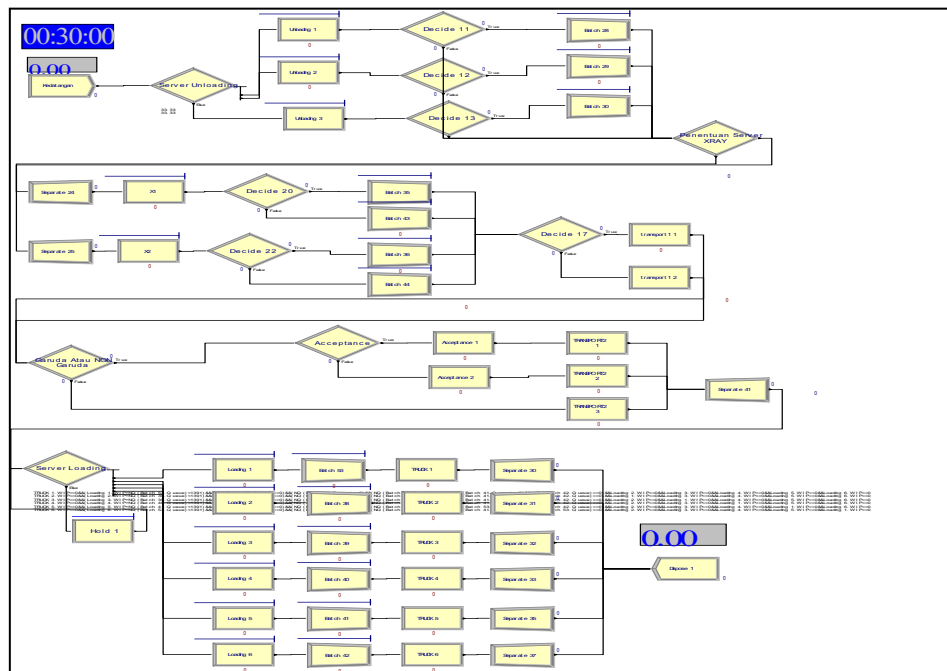


Figure 1. Current Process Simulation Model

To create a process simulation model that runs correctly, the distribution type of each workstation is determined. Each type of distribution is obtained from several tests carried out using the input analyzer software. The following shows the distribution types used at each workstation in the current regulated agent process simulation model.

Table 3. Types of Distribution of Each Workstation

No	Type of Activities	Distribution Type	Expression
1	Arrival	WEIBULL	$78 + WEIB(1.02e+003, 1.16)$
2	Unloading	NORMAL	$NORM(0.0223, 0.013)$
3	Xray	NORMAL	$NORM(0.0361, 0.0212)$
4	Transport 1	NORMAL	$NORM(0.881, 0.309)$
5	Acceptance	NORMAL	$NORM(2.01, 1.09)$
6	Transport 2	NORMAL	$NORM(1.14, 0.391)$

7	Loading	NORMAL	NORM(0.00788, 0.00171)
8	Truck	NORMAL	NORM(25.9, 9.14)

The simulation is run for 5 hours per replication with the assumption that it is to depart on the first flight, which is at 05.00, and 10 replications are carried out to get the output of the simulation model. Following are the queue levels and results table for the simulation model of the current regulated agent system (Table 3, 4 and 5).

Table 4. Current Process Simulation Queue Rate

No	Workstation	Average Waiting Time (Hours)	Number of Waiting (Kg/Hours)
1	Unloading	0,6252	3.279,27
2	Xray	1,2893	7.468,64
3	Loading	0,0093	29,0852
Total		1,92	10.777

Table 5. Input and Output Results of the Current Process Simulation Model

N	Input (Kg)	Output (Kg)
1	19.133	11.128
2	16.018	12.519
3	28.445	11.128
4	20.370	12.519
5	22.194	12.519
6	27.154	12.519
7	22.499	12.519
8	16.051	12.519
9	24.491	12.519
10	22.880	12.519
Average	21.924	12.241

The results of the simulation show that in 10 replications, the average arrival of goods is 21,924 kilograms, while the capacity of the regulated agent Soekarno-Hatta Airport is only able to serve as many as 12,241 kilograms during peak hours. This proves that the current capacity is only able to serve 55% of arrivals during peak hours. Therefore it is necessary to calculate the amount of capacity returned in order to increase the ability of regulated agents to serve arrivals during busy hours.

3.3 Calculation of the Amount Capacity of Equipment and Porter

Based on the simulation results of the current regulated agent process, it shows that the current amount of capacity is not able to serve arrivals during peak hours. Therefore, the calculation of the capacity of the equipment and porters is based on the Little's Law method. The following is the result of calculating the amount of equipment capacity using the Little's Law method (Table 6).

Table 6. Result Calculation of Equipment Amount

No	Equipment	Total
1	Outer Pallet	11
2	Xray	3+2
3	Inner Pallet	15
4	Truck RA	4+1

To calculate the amount of equipment needed, several values must be known in advance, here is an example of calculating the amount of equipment needed for outer pallets:

n customer per hour : 10.961,75 kg

n product per order : 1 pallet

n product per sheet : 120 kg
 n cycle per hour : 8,536 times

$$\text{Number servers needed} = \frac{(\text{n customer per hour})(\text{n product per order})}{(\text{n product per sheet})(\text{n cycle per hour})}$$

$$\text{Number servers needed} = \frac{(10961,75)(1)}{(120)(8,536)}$$

$$\text{Number servers needed} = \frac{(10961,75)}{(1024,358)}$$

$$\text{Number servers needed} = 10,701 \approx 11 \text{ pallet}$$

The following is a table of the results of calculating the number of porters needed to meet the arrivals at peak hours (Table 7).

Table 7. Results Calculation of the Number Porter

Activities	Number of Workers Needed
Unloading	5
Xray	7
Transport 1	2
Transport 2	2
Loading	5
Driver	4

The following is an example of calculating the labor requirements required for the Xray activity:

n customer per hour : 10961,75 kg
 n minute each : 0,036 minutes

$$\text{Number servers needed} = \frac{(\text{n customer per hour})(\text{n minute each})}{(\text{n minute per hour})}$$

$$\text{Number servers needed} = \frac{(10961,75)(0,036)}{(60)}$$

$$\text{Number servers needed} = \frac{(395997)}{(60)}$$

$$\text{Number servers needed} = 6,6 \approx 7 \text{ person}$$

From the calculation result of the number of porters, it is found that the company must add 4 porters who are employed during peak hours to meet the existing arrivals.

3.4 Proposed Process Simulation Model

To prove whether the calculation of the new capacity is able to better serve existing arrivals during peak hours, a new simulation model is made based on the new capacity. The following is an illustration of the new process simulation model (Figure 2).

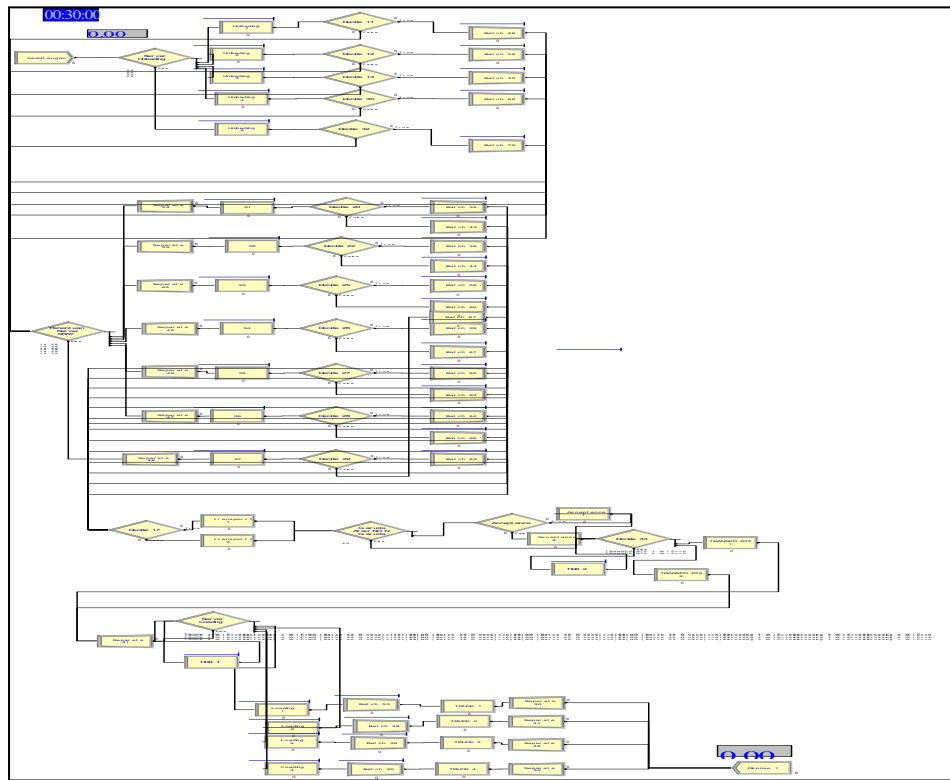


Figure 2. Proposed Simulation Model

From the proposed simulation model, the queue level is obtained and the following results are 10 replications (Figure 3).

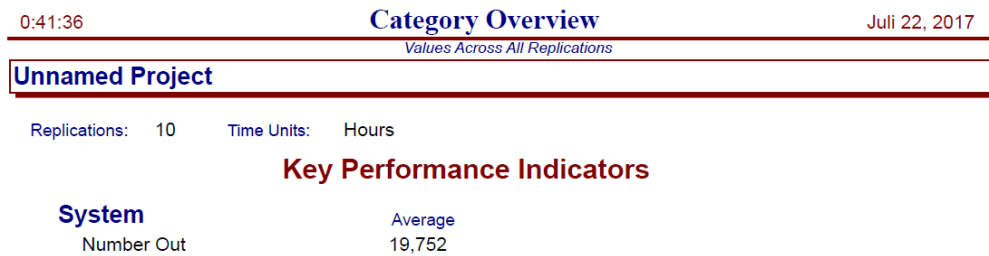


Figure 3. Input and Output Results of the Proposed Process Simulation

Table 8. Queue Level on Proposed Simulation

No	Workstation	Average Waiting Time (Hours)	Number of Waiting (Kg/Hours)
1	Unloading	0,6659	3.151,87
2	Xray	0,3403	1.494,81
3	Loading	0,0226	103,7143
Total		1,03	4.750,39

The results of the proposed simulation show that with the new capacity, the company can serve arrivals of 19,752 kilograms (Table 8). This amount has increased compared to the current capacity. The queue rate has also decreased compared to the simulation with the current capacity.

3.5 Planning of Regulated Agent Project Facilities in Kualanamu Airport

For the company's new project, namely setting up a new regulated agent at Medan's Kualanamu International Airport, the company has a target that the new regulated agent can serve arrivals of up to 50,000 kilograms in one day. The company's target is the input used to calculate facility planning using the Little's Law method in terms of the number of equipment and workers needed to meet these arrivals. The following is a Table 9 of the results of calculating the number of equipment needed to meet the existing arrivals.

Table 9. The Result Calculation of the Total Kualanamu RA Equipment

Equipment	Needs
Outer Pallet	27
Xray	3
Inner Pallet	16
Forklift	5
Truck	3
ETD	1

The following is the calculation of the number of porters based on the company's target (Table 10).

Table 10. Results Calculation of the Number of Porters

Activities	Needs	Group	Total
Unloading	2	4	8
Xray	2		8
Acceptance	1		4
Transport	1		4
Trucking	2		8
TOTAL			32

The following is an example of calculating the number of porters on Xray based on the assumption that the arrival of 1 day is 50 tons, and the number of arrivals at busy times is 2 times the number on regular shifts:

$$n \text{ customer per hour} : 25.000/8 = 3.125 \text{ kg}$$

$$n \text{ minute each} : 0,036 \text{ minutes}$$

$$\text{Number persons needed} = \frac{(n \text{ customer per hour})(n \text{ minute each})}{(n \text{ minute per hour})}$$

$$\text{Number persons needed} = \frac{(3125)(0,036)}{(60)}$$

$$\text{Number persons needed} = 1,8 \approx 2 \text{ person}$$

3.6 Kualanamu Regulated Agent Layout Design

The company has made a layout that is intended for regulated agents at Kualanamu Airport. The following is the layout made by the company to regulated the Kualanamu Airport agent (Figure 4).

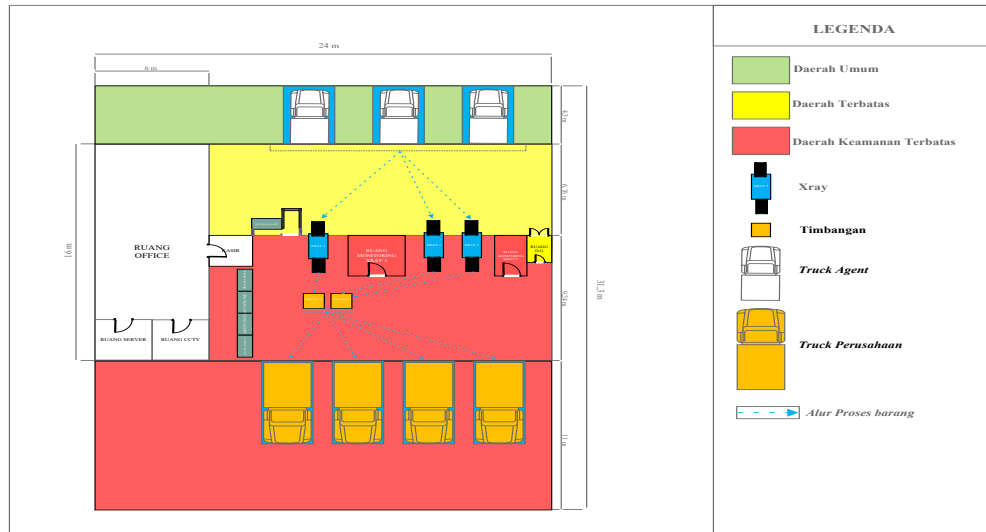


Figure 4. Layout of RA Kualanamu from the Company

To find out the total time required for one process on this new regulated agent, a process flow map is created. The processing time for each workstation is obtained from the results of observations on the regulated agent at Soekarno-Hatta Airport, and the time for transfer is obtained from the comparison of the distance between the regulated agent at Kualanamu Airport and the regulated agent for Soekarno-Hatta Airport. The following is a process flow map from the regulated agent layout of Kualanamu Airport (Figure 5).

Peta Aliran Proses										
Rigkasan										
Kegiatan	Sekarang		Usulan		Beda					
	Jumlah	Waktu	Jumlah	Waktu	Jumlah	Waktu				
	Operasi	3	8,90							
	Pemeriksaan	1	2,01							
	Transportasi	3	3,06							
	Menunggu	0	0							
	Penyimpanan	0	0							
	Total	7	13,97							
	Jarak Total	18,39								
Langkah	Uraian Aktivitas	Simbol					Alat Pemindahan	Waktu Proses (menit)	Waktu Tempuh (Menit)	Jarak (meter)
		Operasi	Pemeriksaan	Transportasi	Menunggu	Penyimpanan				
1	Unloading						Koli	2,68	-	-
2	Menuju Xray						Pallet	-	2,15	7,59
3	Xray						Koli	4,34	-	-
4	Transport 1						Pallet	-	0,49	4,86
5	Acceptance						Pallet	2,01	-	-
6	Transport 2						Pallet	-	0,42	5,94
7	Loading						Koli	1,89	-	-
	Total							13,97		18,39

Figure 5. Process Flow Map of Company Layout for Regulated Agent of Kualanamu Airport

With the aim of minimizing the material handling process and good room design, a layout is made with the following suggestions (Figure 6):

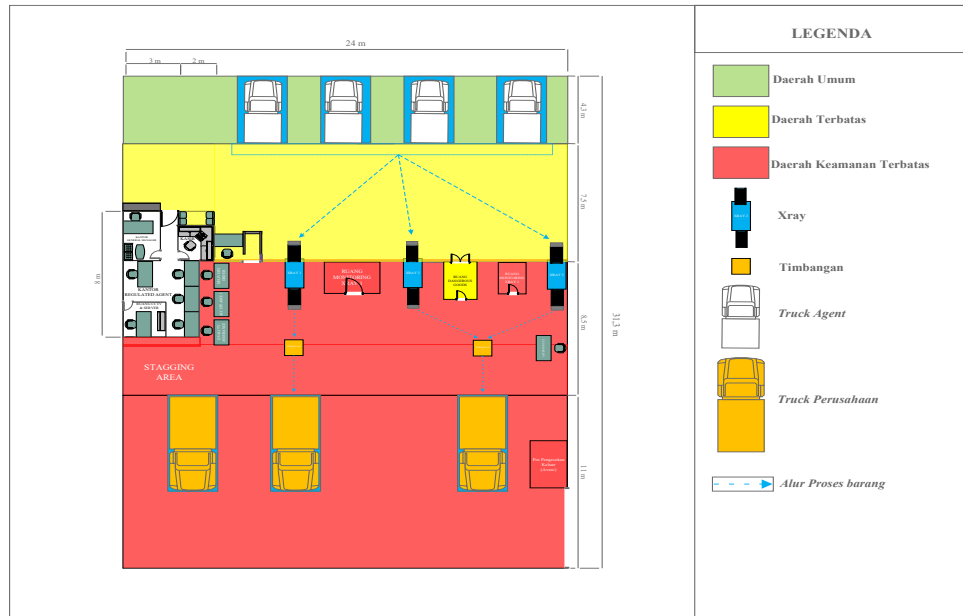


Figure 6. Layout of the Proposed Kualanamu Regulated Agent

Based on this figure, the new proposed process flow map can be recalculated as follows (Figure 7):

Peta Aliran Proses										
		Rigkasan								
Kegiatan		Sekarang		Usulan		Beda				
		Jumlah	Waktu	Jumlah	Waktu	Jumlah	Waktu			
	Operasi	3	8,90	3	7,01	0	1,89			
	Pemeriksaan	1	2,01	1	2,01	0	0,00			
	Transportasi	3	3,06	3	2,39	0	0,67			
	Menunggu	0	0	0	0	0	0,00			
	Penyimpanan	0	0	0	0	0	0,00			
Total		7	13,97	7	11,41	0	2,56			
Jarak Total		18,39		13,77		4,62				
Langkah	Uraian Aktivitas	Simbol					Alat Pemindahan	Waktu Proses (menit)	Waktu Tempuh (Menit)	Jarak (meter)
1	Unloading						Koli	2,68	-	-
2	Menuju Xray						Pallet		2,13	7,54
3	Xray						Koli	4,34	-	-
4	Transport 1						Pallet	-	0,08	3,73
5	Acceptance						Pallet	2,01	-	-
6	Transport 2						Pallet	-	0,18	2,5
7	Loading						Koli	-	-	-
Total								11,41		13,77

Figure 7. Process Flow Map of Kualanamu Regulated Agent Layout Process

There are several proposed improvements to the layout, which are described in the process flow map for the proposed layout, such as the placement of several servers that are moved from their original positions. The change in position occurs on the X-ray activity server and acceptance. This displacement results in a decrease in the overall processing time. The total proposed process activity flow travel time is 11.41 minutes for one pallet. Meanwhile, the calculation of the overall distance travelled is 13.77 meters for one pallet, where the time is reduced due to changes in processing time in transport 1, transport 2, and loading activities because, during the loading process, this can happen if the company uses trucks with The car body is 2 m wide and 6 m long so that the load on the pallet does not need to be packed into the truck, it is only enough to load it into the truck. In addition, a proposal was made for a tool to be used on the Xray server to facilitate material handling of the goods to be transported or put into the Xray

device, namely making a tool in the form of an inclined plane so that the pallet can be inserted into the Xray without the need to put the goods into the Xray device. one by one. With this inclined plane equipment, the material handling process for 1-layer and heavy items will be much easier because it does not require any material handling processes.

The following is a three-dimensional and two-dimensional view of the proposed inclined plane (Figure 8 and figure 9):

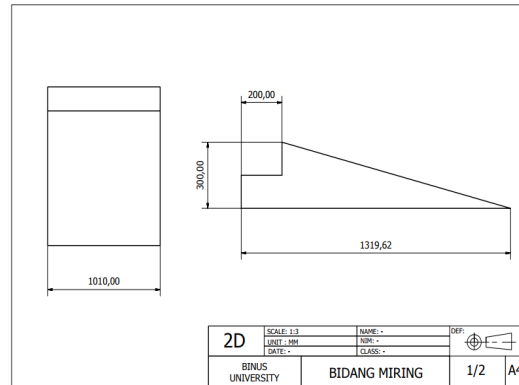
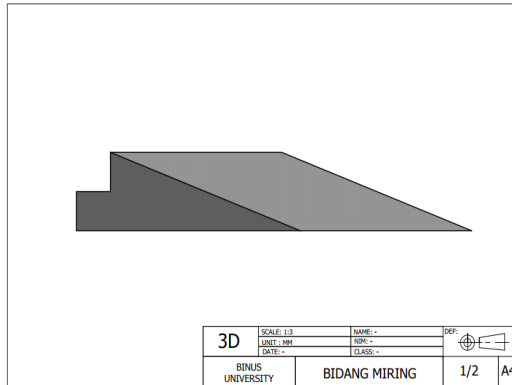


Figure 8. Dimensional Inclined Plane

Figure 9. Dimensional Inclined Plane

The degree of inclination of the inclined plane is 15 degrees, and the distance between the tip of the x-ray and the ground is 15 cm, so the height requires a length of 1.32 m which is calculated from the "Pythagorean" principle. The reason for using 15 degrees for the inclined plane is because when the lifting process uses a hand forklift, it is not in contact with the end of the inclined plane. Based on the results of stress analysis using INVENTOR software, the three categories of materials have a stress factor below ten, so they can be said to be safe. Iron is the material chosen because it is safe to use and has economic value. The following is a three-dimensional view of the layout of the new proposed Kualanamu Regulated Agent (Figure 10):

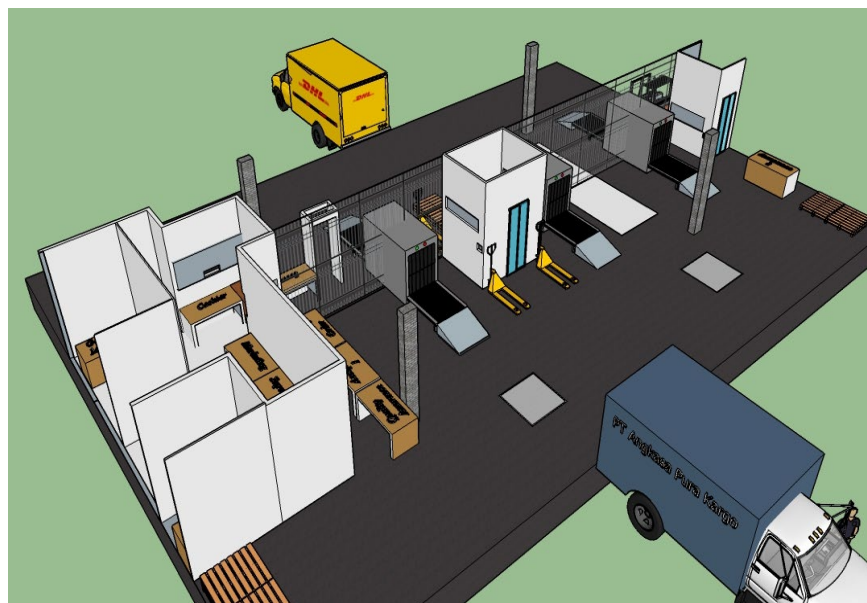


Figure 10. Layout of Regulated Agent Proposal for Kualanamu Airport in 3 Dimensions

In addition, to prove that the capacity calculation and proposed layout are better than those designed by the company, a comparison of time and cost savings is made which is illustrated in the following table (Table 11).

Table 11. Time and Cost Savings Comparison

No	Comparison	Now	Proposed
1	Process Mileage	18,39 meter	13,77 meter
2	Processing Time per Pallet	13,97 minute	11,41 minute
Total Processing Time per Year		2.124.604 minute	1.735.270 minute
Total Time Savings per Year		389.334 minutes	
3	Number of Porters	40	32
4	Annual Income (according to target)	Rp 14.600.000.000,00	Rp 14.600.000.000,00
5	Porter's Salary Expenditures per Year	Rp 1.213.440.000,00	Rp 970.752.000,00
Company Profits per Year		Rp 13.386.560.000,00	Rp 13.629.248.000,00
Total Additional Profits per Year		Rp 242.688.000,00	

4. Conclusion and Suggestion

Based on data processing and analysis that has been done, the conclusions of the research that has been carried out at PT. XYZ are as follows:

1. In the current condition, Regulated Agent Soekarno Hatta is unable to perform screening services at the arrival of peak hours with an average arrival of 21,924 kg, which is obtained from the simulation results of ARENA software using ten replications with an average output of 12,240 kg.
2. With the proposal given based on the calculation of capacity planning average arrival of 21,924 kg can be served as much as 19,752 kg so as to increase the company's profits by Rp. 167,083,696.00.
3. There are two suggestions for the design of RA Kualanamu, suggestion one made by the company, and proposal two made by researchers. Based on the process flow map, proposal two is better because it saves 2.56 minutes for one pallet, and the calculation of the distance saves 4.62 meters.

The following are suggestions that can be given to PT. XYZ, including:

1. Companies should increase the number of operators and the number of equipment in order to meet the number of goods arrivals during peak hours.
2. To balance the workload of each porter, the company should implement a rolling workstation system.
3. The company should buy a long cabin truck with a length of 6 meters to be used as a transport truck to minimize material handling.

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