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Improving inward luggage flow using Simulation: Case Study at a Private Medium-scale Airport

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Abstract: - Loading luggages in the aircraft is the primary step in Air Travel. The flow time involved in the movement of passengers and luggage from parking to the Aircraft reflects the Airport Management as well as is a primary metric to determine customer satisfaction. This paper presents a case wherein the time involved in the loading of luggage from parking to Aircraft from both customer and service provider's point of view is analyzed. Simulation is used to model the existing system and find alternate ways to reduce the overall time taken in loading luggage. Simulation results showed that by using alternate process of loading operation, the overall time can be reduced along with lower congestion and delays. Implementation of the proposed operational model would result in greater customer satisfaction as the overall time spent in loading luggages onto the aircraft would be reduced.

Keywords: - *simulation, flow time, loading, Airport management.*

I. INTRODUCTION TO EXISTING SYSTEM

The flight can only take-off after all the luggages are loaded onto the Aircraft. Thus loading is one of the most critical activities in Air Journey. Delays in flights due to high flow time of loading luggages in aircraft reflect poor Airport Management. This paper presents a case study at a medium scale private Airport wherein the process of loading luggages is analyzed. The present Operational set-up is associated with delay of flights, congestion, and panic during peak load i.e. when the number of luggages is high. The number of flights that take off and the number of luggages handled during takeoff is shown in figure-1.

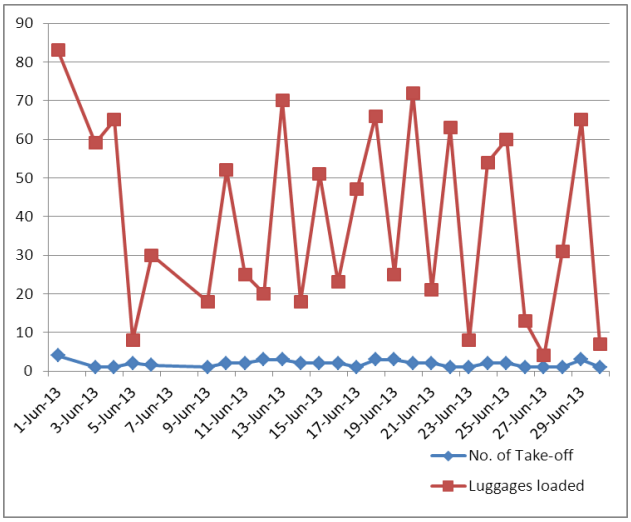

Figure-1: Number of luggages handled and number of take-offs. Figure shows the fluctuation in number of luggages and the peak number of luggages handled per day

The overall loading process starts from the moment the passenger arrives at the parking lot and ends when the passenger as well as the luggage is loaded onto the Aircraft. The passenger hands over the luggage to the loaders (manpower responsible for loading to aircraft) and subsequently signs the luggage tag. All the other activities such as movement of luggages to x-ray machine, loading/ unloading from x-ray machine, loading luggages to aircraft etc. is done by the loaders. The flow of luggages and passengers during the loading operation is shown in Figure-2.

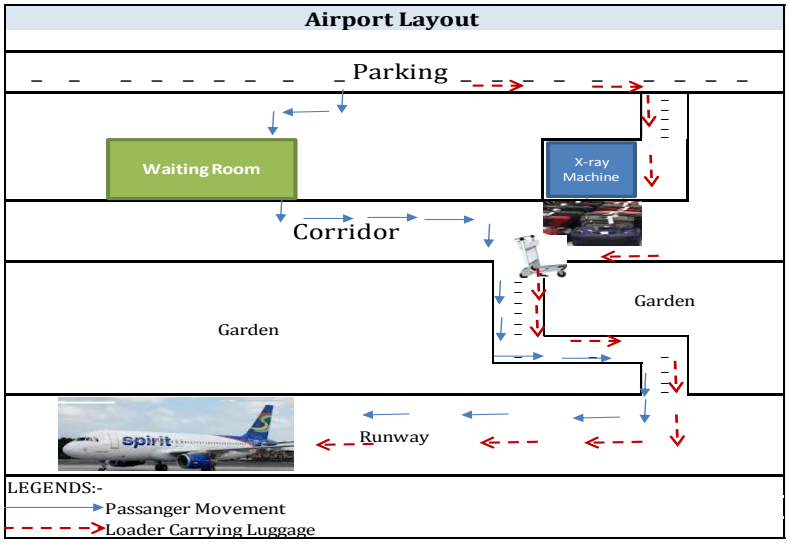

Figure-2: Flow of luggages and passengers during loading operation

The present operational set up is able to handle about 30-35 luggages in 60 minutes. However, it is been forecasted that the number of passengers and thereby the number of loaders may increase. The present operational setup can cater more number of luggages only if a certain set of manpower is increased or the time duration in loading in increased. However, the outcomes of this study show that by redesigning some operational practices, greater luggages can be handled in a lower time span with reduced work-load.

II. MODELLING APPROACH

To analyze the movement of the luggages in the as-is situation, the entire loading process is simulated in the software package ARENA. The simulation is then run by changing some parameters through which an optimal solution is output. The methodology used in this paper for simulation and deriving an optimal solution shown in figure-3.

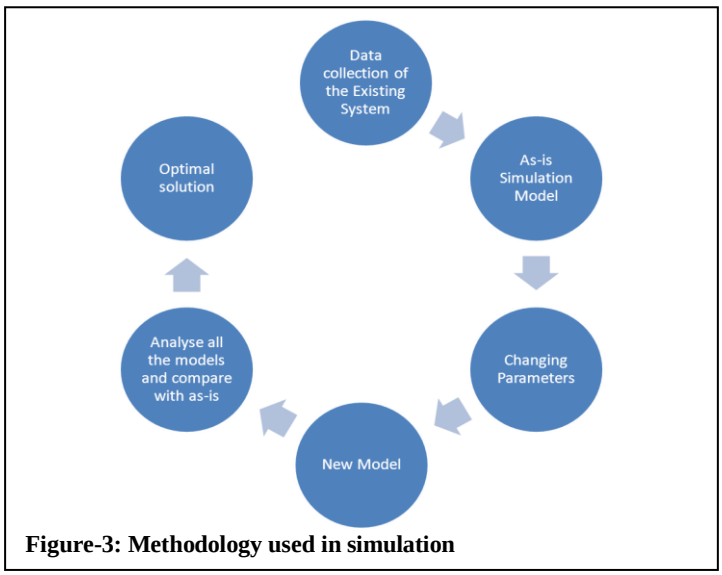

Figure-3: Methodology used in simulation

III. DATA COLLECTION

Data collection is an important aspect in simulation modeling for accurately representing the actual system. The data that were collected includes arrival pattern of the passengers, number of luggages handled, lot size of luggages, time taken in each activity and the overall time taken in the entire loading operation. The simulation should take into account all these parameters. ARENA software was used for building the simulations. Data collection of the existing system is done by direct field observations, video recording and data analysis. The parameters that are analyzed are value added time, waiting time of entity, number of luggages handled and overall time taken in the entire loading operation. The activities involved in the entire loading process and the average time taken per luggage is shown in Figure-3.

IV. MODELLING THE AS-IS SYSTEM

The as-is scenario is modeled in ARENA software package. The model is compared with the data collected from field observation in order to validate the model developed in the package. The arrival pattern showed that the average arrival rate of passengers start from about 45 minutes to 60 minutes prior to the take-off of flight. This implies the entire loading activity is to be done within a time span of 60 minutes for a batch size of 35-40 luggages. Time span greater than 60 minutes would result in delay of the take-off of the flight.

The existing system is modeled in ARENA as shown in Figure-5. The outcomes of the model matched the direct field observations. The results of the as-is model is shown below:

Table-1: Simulation results for each entity in As-is Model

PARTICULARS	TIME (Mins)
Total Value Added time	2.5
Waiting time	7.9
Transfer time	4.5
Total Time	14.9
Number of Luggages handled	36

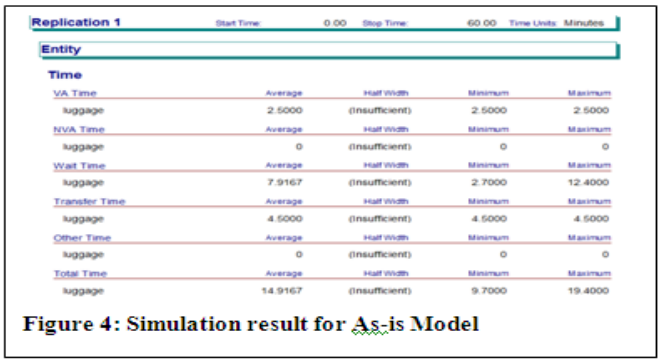

Figure 4: Simulation result for As-is Model

V. RE-DESIGNING OPERATIONAL PRACTICE:

1. Model-1: Self Service Concept:

This model introduces Self-service concept similar to the operational practice followed in commercial flights. In the as-is system, all the activities from tagging luggages to loading the luggage in Aircraft is done by loaders (manpower involved in loading activity). The existing system results in delays when there are greater number of luggages and uncertainty in the number of luggages leads to greater flow time of luggages. Model-1 suggests introduction of self-service i.e. all the activities up to loading the luggage in trolley is to be done by the passengers themselves. For this to be operational, certain sign boards and display monitors may be used so that the passengers can do the activities such as tagging, x-raying and loading luggages in trolley without confusion. Secondly a proper pathway is proposed to be constructed so that the trolley carrying luggages may be moved from trolley near x-ray to aircraft directly. The results obtained after simulating this system is shown in table-2.

Table-2: Simulation results for each entity in Model-1

PARTICULARS	TIME (Mins)
Total Value Added time	2.5
Waiting time	5.2
Transfer time	4.5
Total Time	12.2
Number of Luggages handled	42

2. Model-2: LMV Trolley (Batch size-4):

Model-2 suggests introduction of self-service as in model-1 as well as using a LMV (Light motor vehicle) to transfer the luggages from x-ray to aircraft. Further, a batch size of 4 luggages per trip is considered in this model. This model is simulated for one hour prior to the take-off. The results obtained after simulating this system is shown in table-3

Table-3: Simulation results for each entity in Model-2

PARTICULARS	TIME (Mins.)
Total Value Added time	2.5
Waiting time	5.2
Transfer time	1.5
Total Time	9.2
Number of Luggages handled	42

3. Model-3: LMV Trolley (Batch size-6):

Model-2 suggests introduction of self-service as in model-1 as well as using a LMV (Light motor vehicle) to transfer the luggages from x-ray to aircraft. Further a batch size of 6 luggages per trip is considered in this model. The results obtained after simulating this system is shown in table-4.

Table-4: Simulation results for each entity in Model-3

PARTICULARS	TIME (Mins)
Total Value Added time	2.5
Waiting time	3.4
Transfer time	1.5
Total Time	7.4
Number of Luggages handled	45

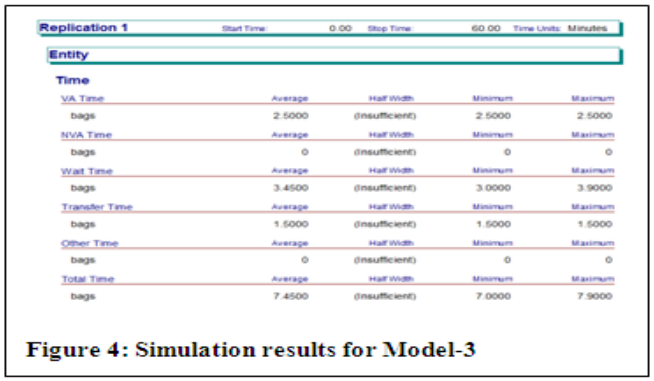

Figure 4: Simulation results for Model-3

4. Model-4: LMV Trolley (Batch size-8):

Model-2 suggests introduction of self-service as in model-1 as well as using a LMV (Light motor vehicle) to transfer the luggages from x-ray to aircraft. Further a batch size of 8 luggages per trip is considered in this model. The results obtained after simulating this system is shown in table-5.

Table-5: Simulation results for each entity in Model-3

PARTICULARS	TIME (Mins)
Total Value Added time	2.5
Waiting time	6.55
Transfer time	1.5
Total Time	10.55
Number of Luggages handled	40

VI. SENARIO ANALYSIS AND RESULTS

Out of the four models the overall value added time per entity is the same for all models. However, maximum number of luggages that can be handled in one hour is maximum for Model -3. The overall time per entity is also the least for Model-3. Therefore, model-3 i.e. using self-service system along with a LMV that can carry 6 luggages is suggested to be implemented

VII. CONCLUSION

Results show that on implementation of Model-3, the overall time per luggage in loading can be decreased by about 50 % and the capacity of handling luggages can be increased by about 25% with the same number of workforce. The implementation of the model suggested will lower the delays occurring due to the wait time involved for the loading of luggages to take place.

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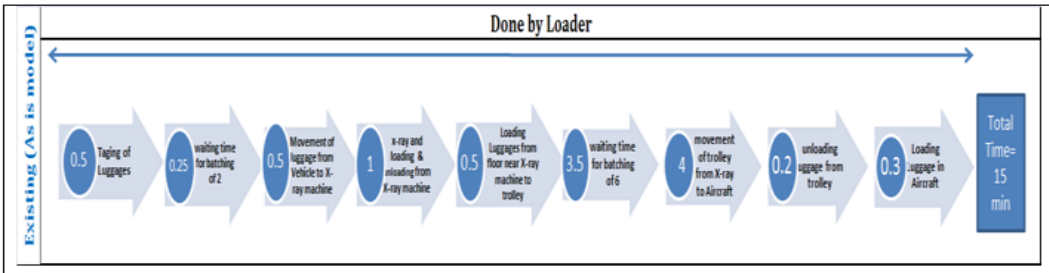

Figure 6: Process flow of As-is system. The overall time per luggage is about 15 minutes.

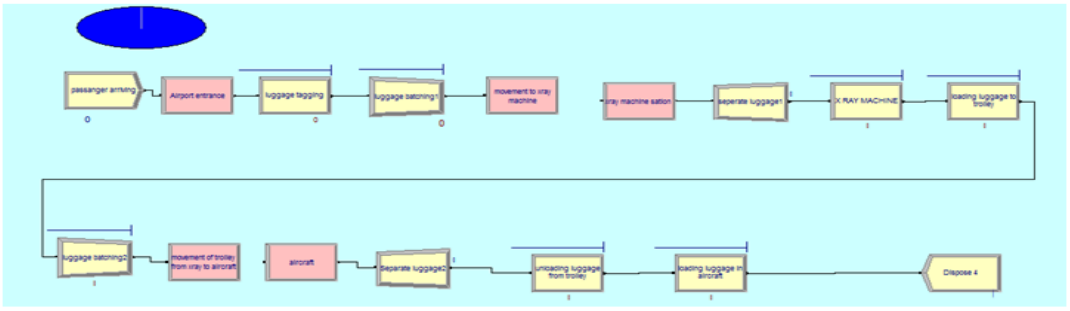

Figure 7: As-is process flow and simulation in arena. The results show that about 36 luggages can be handled in one hour with the existing workforce

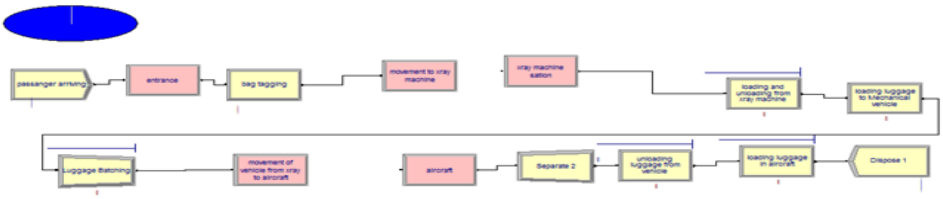

Figure 8: MODEL-3 simulation in arena. The results show that about 45 luggages can be handled in one hour with the existing workforce

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