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Flying-Carpet Boarding Process Simulation

The simulation conducted by Robotize was set up to compare the performance of the Flying-Carpet boarding process to other commonly used boarding processes: Random; Outside-In; and Back-To-Front. Details of these processes can be found at:

http://leeds-faculty.colorado.edu/vandenbr/projects/boarding/boarding.htm

Performance is judged based on amount of time taken to get all passengers onto the airplane from the time the first passenger heads down the aerobridge.

Setup

The four processes were setup in the same model with the same input parameters, performance parameters and seating configuration.

Common Parameters

150 passengers (100% capacity), all already in boarding lounge (no stragglers)

50m aerobridge

25 rows of seats, along a 25m aisle (each seat takes 1m of aisle)

6 seats per row (3 on either side of the aisle)

1.1 m/s walking speed down aerobridge (all passengers walk at same speed)

0.9 m/s walking speed down aisle (all passengers walk at same speed)

10 seconds taken to store baggage (all passengers take the same amount of time to store baggage, all passengers have baggage)

2 seconds taken to pass each seat on the way to correct seat

2 seconds to take seat

Once a passenger has reached the correct side of the correct aisle, they make their way straight to the closest seat to the window (no shuffling of passengers due to already seated passengers)

Outside-In Boarding

Passengers are sorted by seat number with all outside (window seats) passengers to board first, followed by middle seat passengers, followed by aisle seat passengers. Within these three groups, passengers are randomized by row number.

Back-To-Front Boarding

Passengers are sorted by seat number into 5 groups of 5 row numbers, with row numbers within these groups randomized. The groups are boarded with the rear group first, back to the front group last.

Random Boarding

Passengers are not sorted, and board the plane in random order.

Flying-Carpet Boarding

To replicate the effect the Flying carpet will have on boarding we created the following model.

Five Groups of 25 passengers board the plane at a time, with only 5 passengers per group of 5 rows. This model mimics people standing on the flying carpet, by evenly distributing people across the plane throughout the boarding process, minimizing localized congestion, and getting people into a rough order before boarding the plane. Adjusting the size of the groups would correspond the changing the size of the matt, and will yield different loading times.

Results

The summarized results for 100 runs of the simulation are shown below: (time in seconds)

Boarding Process	Mean	Standard Deviation	Min	Max
Random	691	22	640	736
Back-To-Front	946	27	884	1007
Outside-In	689	21	640	739
Flying-Carpet	537	15	505	583

Conclusion

Efficiency of Flying Carpet

It is obvious that the Back-To-Front method is the least efficient, taking much longer than any of the others. The Outside-In method and the Random method are nearly equal in performance.

The Flying-carpet simulation indeed seems to be more efficient than the three other simulations measured here, even with the simplified method described above implemented. It's mean time is over 2 minutes faster than the next fastest, Outside-In.

One of the impressive findings about the Flying Carpet method, is that it delivers a more consistent result, (lowest Standard Deviation) as it is less susceptible to normal variation in seating order.

More details for future simulations

Due to time restraints, the simulations performed were not as detailed as they could be, and a few shortcomings due to simplifications have been identified.

Shuffling of passengers due to already seated passengers will make a drastic impact on the seating times.

Variable walking speeds will have an effect on the results of the simulation.

Time taken to store baggage is assumed in the simulation to be constant, but this will not be the case in actuality. Not all passengers have baggage, some baggage will be bulkier than other baggage and take longer to stow.

In the case of the flying carpet, the group sizes are unlikely to be exactly the same size in every group, and different group sizes by design will have an impact also.