CREATING AND VALIDATING A MICROSCOPIC PEDESTRIAN SIMULATION TO ANALYZE AN AIRPORT SECURITY CHECKPOINT

2015 Winter Simulation Conference, Huntington Beach, CA

Martin Jung
Mail: m.jung@dlr.de
Initial situation

- International medium size airport
- About 10 Mio. passengers (PAX) per year
- 2 Terminals
- About 8000 Pax per day pass throw the concerned terminal security checkpoint
- Two main waiting peaks
- Queue reach's outside the security area
Requirements specification

- Analyze waiting times and throughput
- Easily change main impact parameter of the security checkpoint
- Test new security procedures
- Flight plan with more passengers
- Optimize security operation schedule
let's get started

- Process specification
- Input Parameter
  - Flight plan
    - Schedule of flights
    - Number of PAX booked on every flight
  - Opening periods security lane
  - Process times
  - Arrival distribution based on passenger survey
  - Ground plans
Implementation

- Flight plan
  - Schedule of flights
  - Number of passengers
- Opening periods security lane
- Passanger arrival distribution

@Runtime
- Opening periods of every security lane
- Process times

Output
- Next slide
Simulation Output

- paxSuminSimulation: 58
- paxSumProcessed: 4006
- MaxWaitingTimeInMinutesEco: 45
- MaxWaitingTimeInMinutesBus: 3
- NoOfPaxWaitingMoreThan35Min: 94
- SecLaneOpenMinutes: 5220
- AvgWaitingTimeEco: 1.7

(log file)
Validation

• Feedback meetings with different airport practitioners
• Real World observations
• Iterative development
• Which processes are missing or can be skipped?
• Data records from the airport
  • Planned and realized security operation schedule
  • Observed queue lengths
  • Waiting times
• Analyze log files
Validation

• Movie in Python
• Passenger that wait more than 35 minuets
Validation

- Movie in Blender
  - Waiting Time
    - Lower 10 min. -> blue
    - 10 to 20 min. -> yellow
    - More than 20 min. -> red
Validation – Improvement
Refinement of the Queue choose algorithm

- Reality is a mix of shortest and closest queue
  - Passenger take closest queue if lengths differ by a small amount
  - Check every 3 minutes or when a new queue opens if there is “a better queue”
- Not everyone takes the better queue
Optimization
Varying schedule of the security operations plan

• Reduce the maximum waiting time between 6:00 and 8:00 am from over 25 minutes to 15 minutes and between 10:30 to 12:30 from 26 to 22 minutes. (”De-Peaking“)
• Reduce the average waiting time decreased from 17 to 12 minutes
• All with the same amount of staff
next steps

• Use the built-in optimization software optquest® to determine an optimum resource management by balancing waiting time and operating costs
• Bring the optimized plan from simulation to the “real world”
• Bring in more different agents types
  • Families
  • Elderly passengers
• Export Simulation to virtual reality enviroment (e.g. Oculus Rift)
• Incorporating train-arrival schedules in the simulation, as arriving trains also induce passenger peaks at the security checkpoints
• Optimization of “space usage”
• Incorporating dynamic tensator-belts
Thank you for your attention