TÉCNICO LISBOA

A pedestrian simulation model for airport performance analysis

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WORKSHOP ON PEDESTRIAN MODELS 2014

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“A pedestrian simulation model for airport performance analysis”

- Transport systems evolve rapidly
- Passenger expectations are increasing
- Huge investments, long life cycle, financial shortages
- Pedestrian behavior is highly unpredictable
- Degrees of freedom increase when offering more options/opportunities to people
- Technological innovations




Outline

- *Objective*
- *Airport components and users*
- *Airport performance and measures*
- *Passenger flow simulation methodology*
- *Case study*
- *Simulation results*
- *Uncertainties*
- *Next steps*

General Objective

Develop a simulation model to evaluate airport performance by integrating pedestrian/passenger behavior and space characteristics

Airport passenger building components, processes and users

Passenger Arrival

Check-in

Inside or outside the terminal

Non- aeronautical Services

Security control

Gate control

Airport/Airline Employee

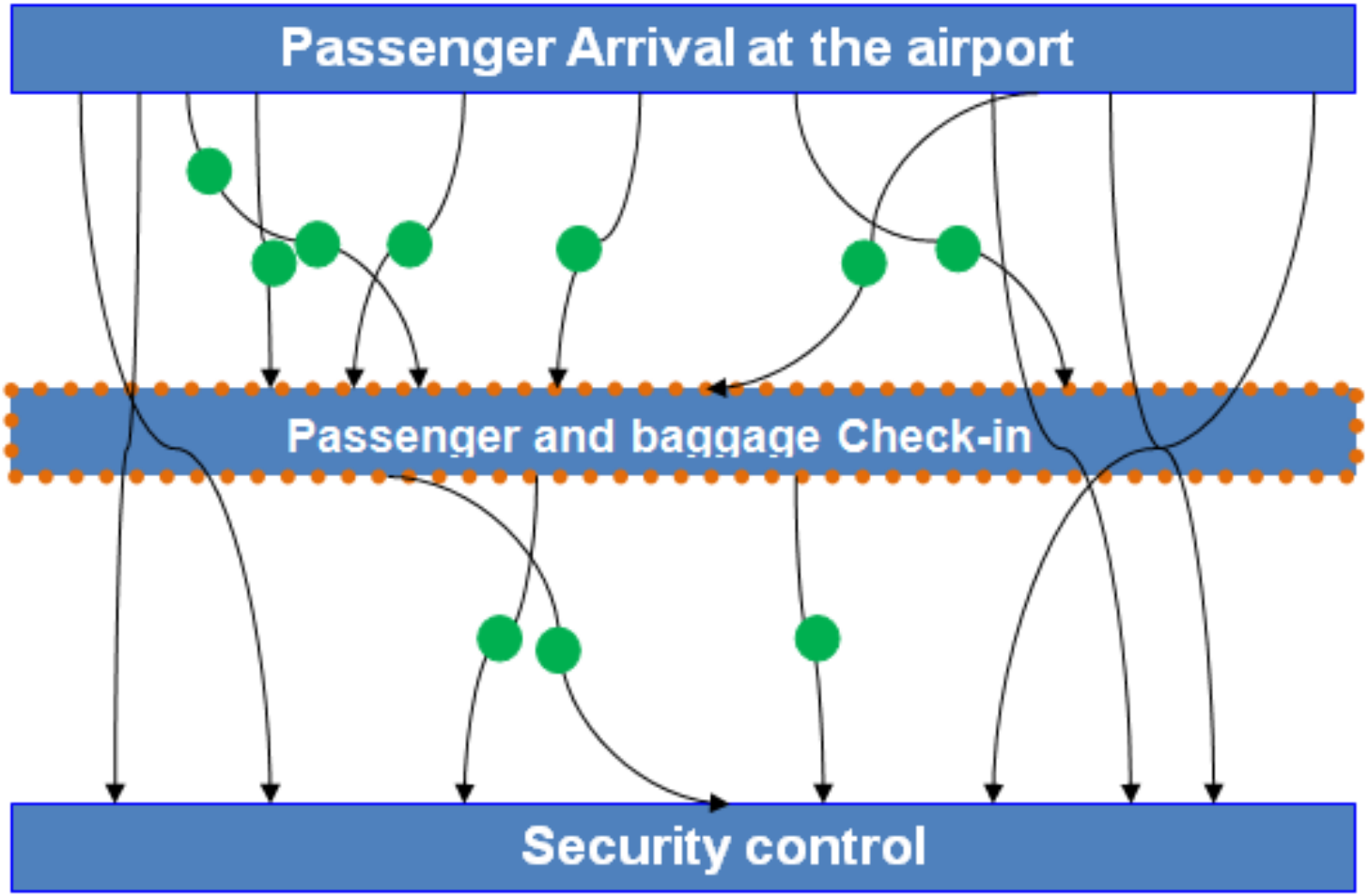
Passenger

Businessman

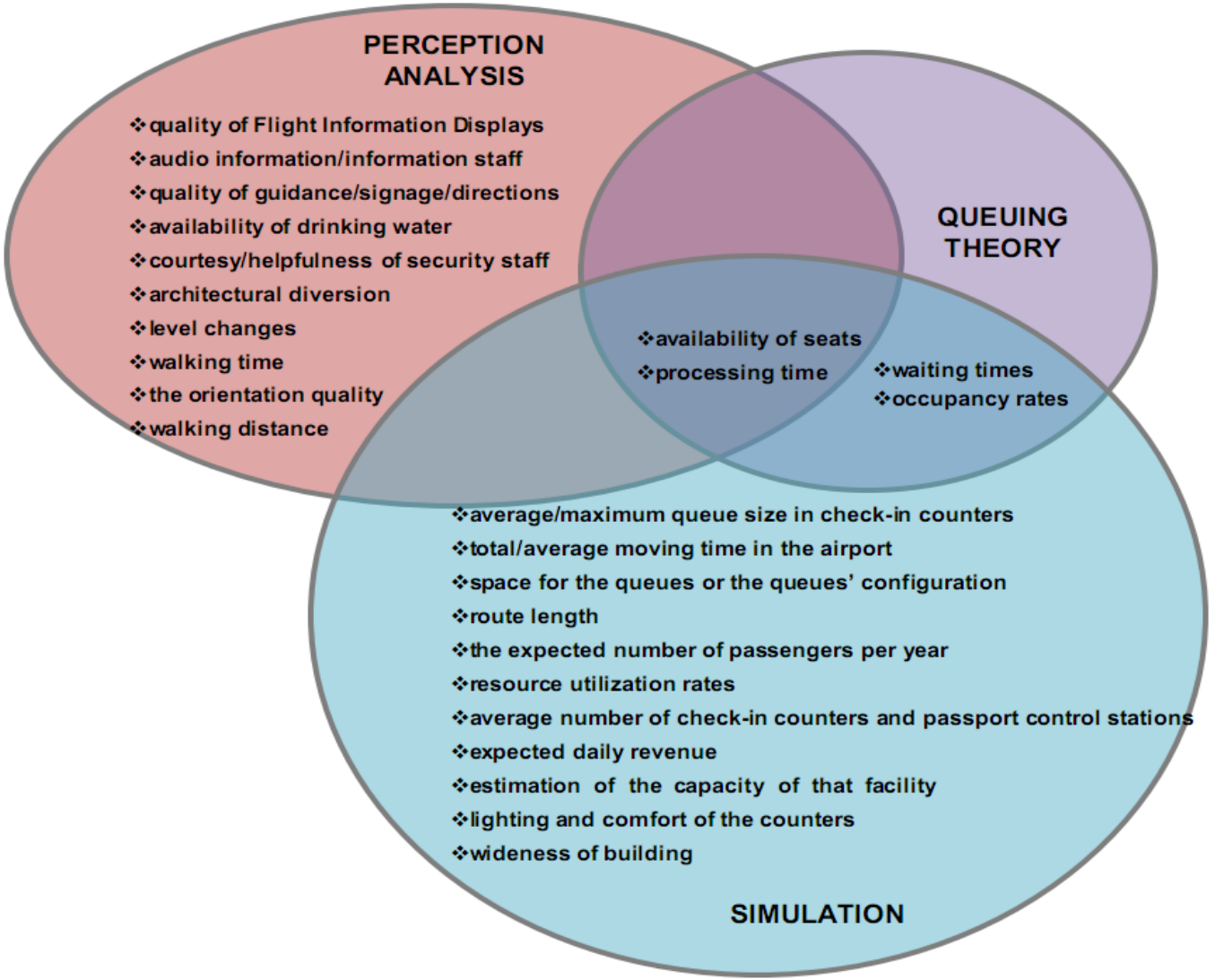
Security Emp.

Leisure visitor

Passenger activities and movements



Performance measures



Passenger Flow Simulation Methodology (1)

Combination of Discrete Event Simulation with Pedestrian Dynamics Simulation

Steps

- Determination of the characteristics of the entities to be simulated (flights and passengers)
- Modelling passenger events
  - ❖ Passenger arrival
  - ❖ Check-in
  - ❖ Discretionary activities
  - ❖ Security control
- Modelling passenger behavior
  - ❖ Walking characteristics (group formations, speed, collision)
  - ❖ Activity characteristics

Passenger Flow Simulation Methodology (2)

A) Walking characteristics (group patterns, speed, collision)

Moussaid et al. (2010): effect of group size on speed and U,V group patterns

Young (1999), speed in airport terminals

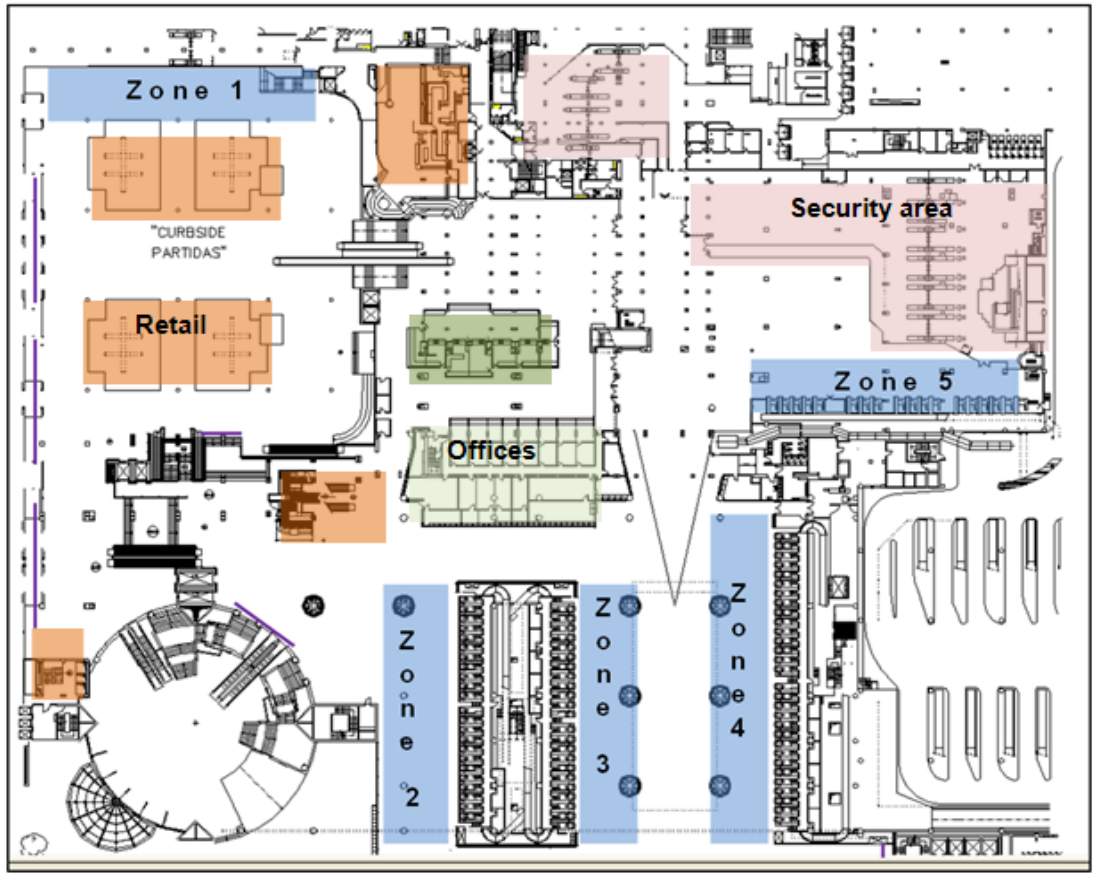
B) Activity characteristics

Activity choice might vary depending on the personal characteristics of the passenger and the characteristics of his trip.

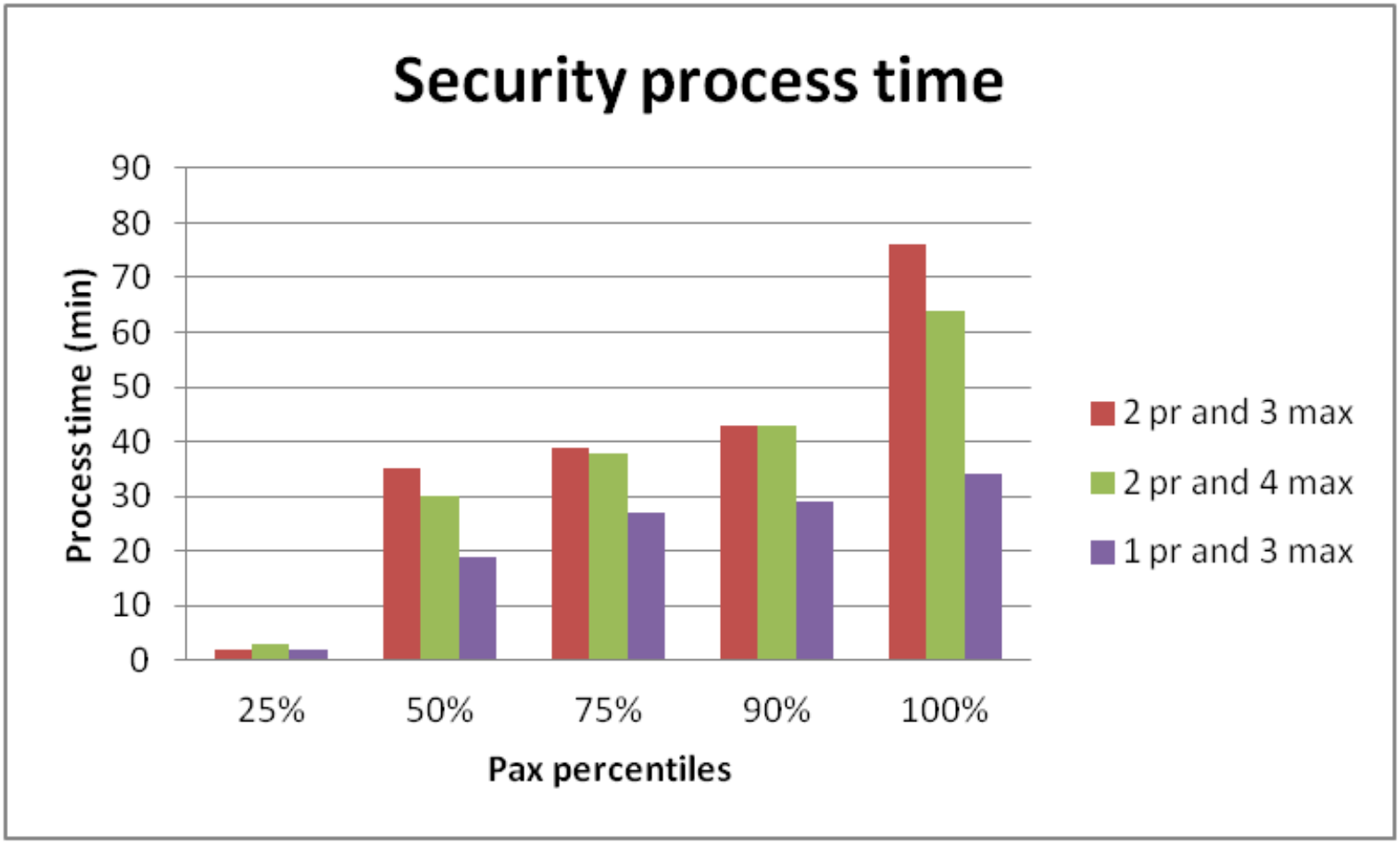
Case study

Departures area of Portela Lisbon airport

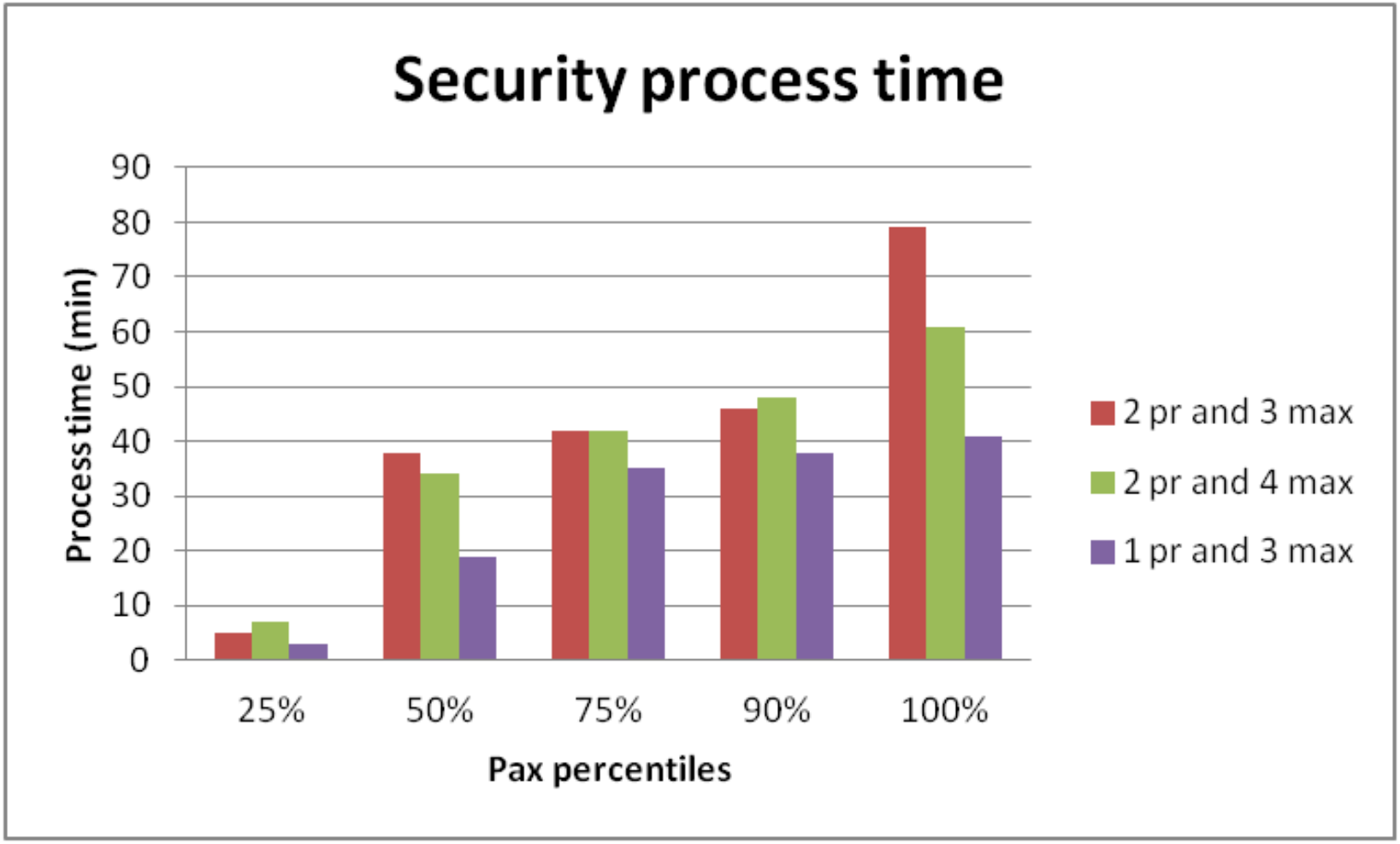
- Check-in Zones
- Retail activities
- Offices
- Security



Results(1) – Pedestrian simulation model with current activity patterns

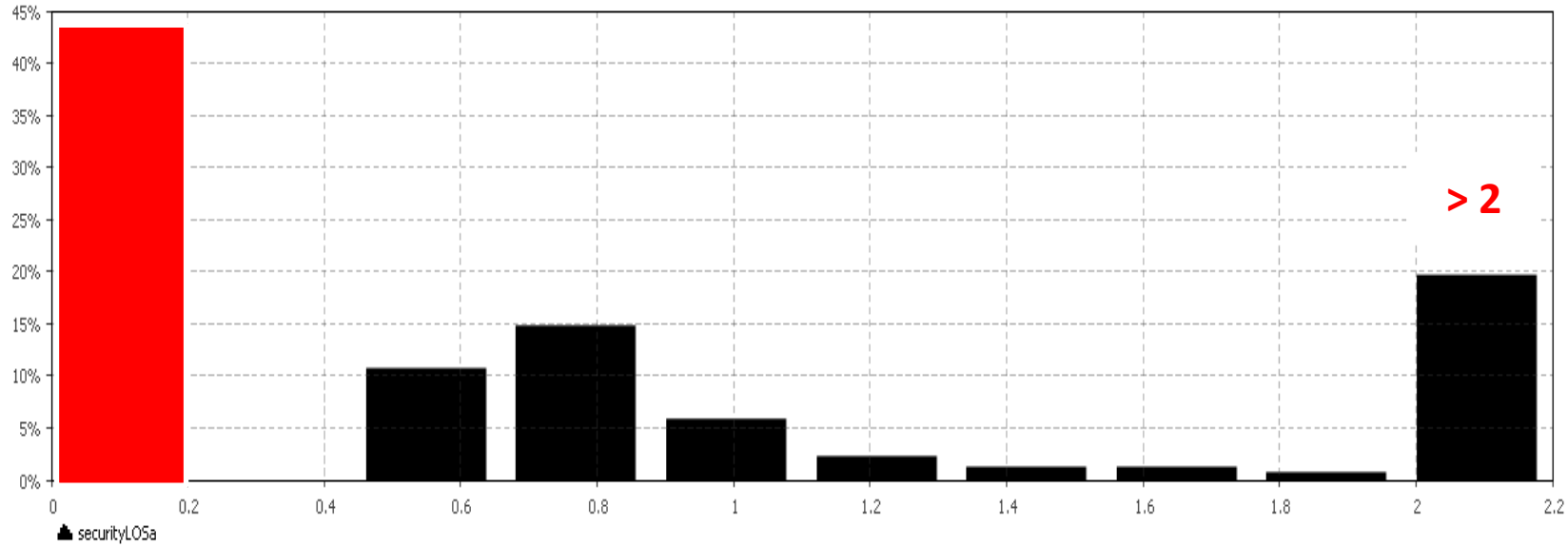


Results(2) – Pedestrian simulation model with different activity patterns

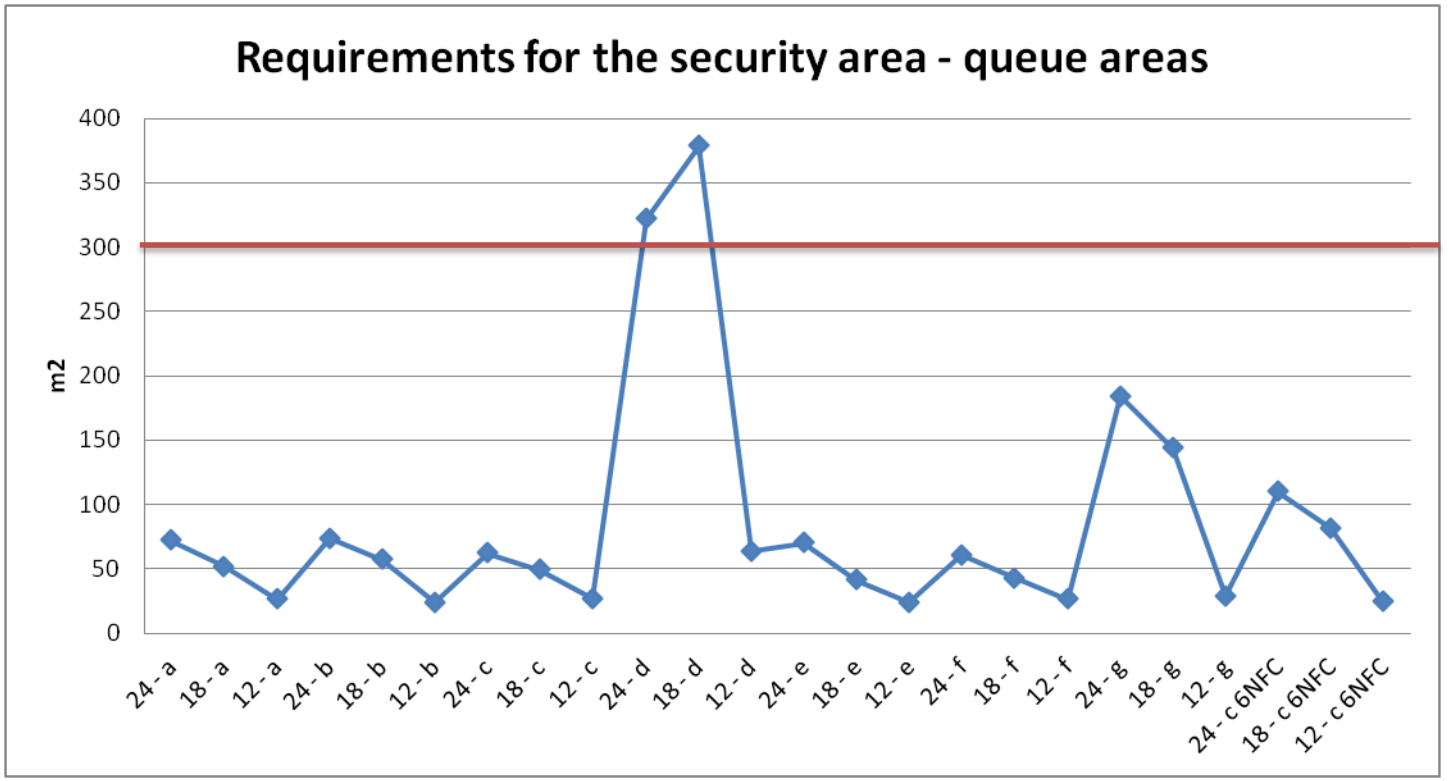


Results(3) – space / pax

Unused space



Results (4) – Future space requirements scenarios with varying check-in, security machines and probability of security risk



Paper under submission




Next steps

These are the results of the base model.

The performance of the aeronautical activities is highly dependent on the discretionary activities and behavioral issues of the passengers/pedestrians.

need to model more accurately behavioral aspects and passenger choices

Uncertainties to be studied

Need to evaluate and restrict the effect of uncertainties

- Arrival pattern
- Activity pattern
- Distribution of service times
- Number of check-in machines
- Security category probability

Perform factorial design and ANOVA tests

Pedestrian Planning

In the literature 5 categories have been identified as pillars in pedestrian planning

- Wayfinding
- Pedestrian cognition
- Space configuration
- Safety
- Modeling

Pedestrian Modeling

- Explore any latent relationships between space characteristics, passenger choices and flows of passengers
- Indicate the value of each area as derived from the way the passengers perceive it and the value they add to it
- Pave the way for future in-terminal location choices
- Incorporate pedestrian choices in flexibility of terminal planning as inputs that have the potential to indicate areas that are often preferred

Pedestrian modeling

Issues

- How do the passengers perceive the airport environment and move in it?
- Which factors determine pedestrian choices?

Data collection through a survey:

•Passenger and flight characteristics

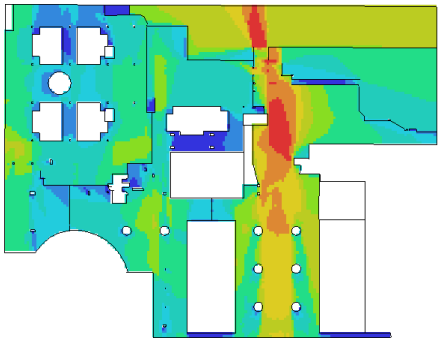
• Activity choices

• Wayfinding

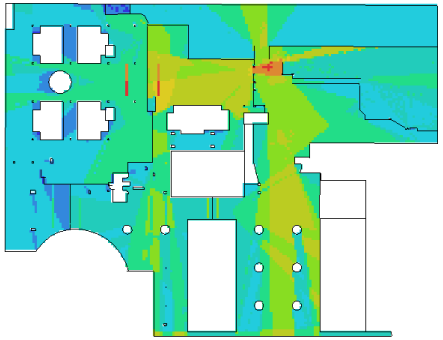
• Trajectories

Space characteristics

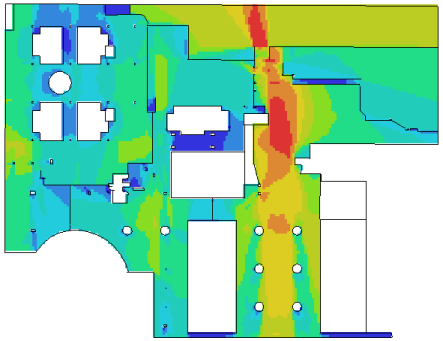
Connectivity



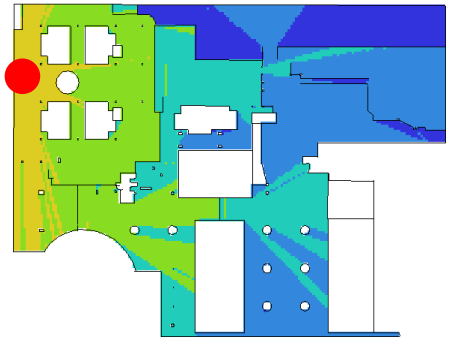
Integration

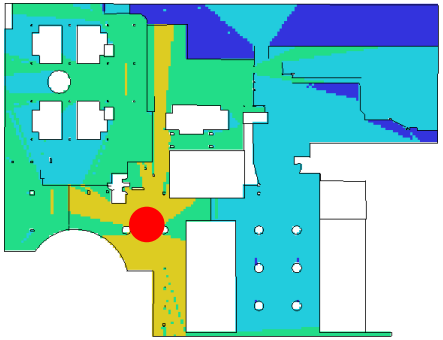


Isovist area



Visual step depth





Model improvement

How do the passengers distribute their available time inside the airport

5 categories of explanatory variables

- What they feel (time availability, time to gate)
- What they are (SDC, trip purpose)
- What they do (activity choices, criterion selection)
- What they see (signage, space configuration)
- What they perceive (confusion, space configuration)




Questions ?

Discussion