**Slide 1**

Hello, everyone. Today, we’ll be presenting our work on 'Impacts on Airport Elevator Systems When Exposed to Disruptive Events: A Discrete Event Simulation Approach.' The paper focuses on understanding how elevator system failures impact airport operations, particularly waiting and circulation areas. I will be taking you through the first 8 slides and my teammate Mahek Thakkar will cover the remaining slides.

**Slide 2**

The main goal of the paper is to evaluate how temporary elevator system failures, or disruptive events (DE), influence operational areas in airports, particularly the zones where passengers wait and circulate around elevators. This paper challenges traditional airport design standards that fail to account for such disruptions and highlights the importance of using simulation-based methods to identify bottlenecks and optimize passenger flow and resource utilization. It aims to inform better infrastructure design and operational strategies for resilient airport systems.

**Slide 3**

The paper used the following resources for the simulation study:

1. ArcPORT® Simulation Software: This was used to model the passenger dynamics and operational scenarios within the airport terminal.

The image on the slide shows a 3D simulation of an airport terminal, with passengers moving towards the departure gate, demonstrating the passenger dynamics and operational scenarios modeled using the ArcPORT® simulation software.

**Slide 4**

1. Passenger Flow Data: The simulation utilized data based on the B737-800 operations, assuming 165 passengers per aircraft, which allowed for simulating passenger influx during peak times.

This image on the slide shows a Boeing 737-800 seating layout, which represents the passenger distribution on the aircraft. This slide also includes a graph illustrating passenger influx at a security checkpoint at Zurich Airport, with peaks showing the flow of passengers during peak times, simulating passenger movements during high-traffic periods.

**Slide 5**

1. Elevator Specifications: Parameters like elevator dimensions, speed, and acceleration were sourced from an elevator catalog.

The image on the left displays a table of technical parameters for the elevator used in the study. These parameters include the elevator's age, rated load, rated speed, traction ratio, and other mechanical specifications, which were sourced from an elevator catalog to ensure the correct simulation of its behavior.

1. Pedestrian Dynamics: Walking speeds and passenger behavior data were taken from established studies.

On the right, we have a bar graph showing the walking speed by age based on different data collection methods. The graph compares speeds for children, young adults, adults, middle-aged individuals, and seniors, with data collected using various techniques like videographic methods, manual counts, mixed methods, and detection systems. This helps in understanding pedestrian behavior and dynamics, crucial for modeling passenger movement in the airport terminal.

**Slide 6**

1. Design Guidelines: The IATA Airport Development Reference Manual, which recommends 1 square meter per passenger for optimal Level of Service (LoS) in arrival halls, was used as a benchmark.

The image on this slide presents a performance metrics chart that helps assess different airport scenarios. It illustrates four distinct scenarios for optimizing airport operations:

Scenario 0: Stochastic (represents random or unpredictable elements in the system)

Scenario 1: Optimized Guidance (focuses on improving passenger guidance)

Scenario 2: Minimizing Service Time (aims to reduce service time for passengers)

Scenario 3: Minimizing Waiting Time (focuses on reducing passenger waiting time)

In addition, there are 3 strategies highlighted:

Strategy 1: Technology Integration

Strategy 2: Trained Security Personnel

Strategy 3: Multiple Entry Points

**Slide 7**

The image here shows a 3D simulation of the airport terminal layout, with passengers moving between different sections. This simulation models the arrivals hall, the baggage claim floor, and the two elevators that connect these floors. The goal was to replicate real-world passenger dynamics within the terminal using Discrete Event Simulation (DES). The model configuration in the simulation enables us to visualize how passenger flow would behave under normal and disrupted conditions, which is crucial for understanding how elevator failures could impact the airport.

**Slide 8**

This diagram represents a flowchart of the passenger flow simulation. It shows the stages passengers go through, from check-in to arrival, with the assumption that all passengers use the elevators for their transit. The flow chart includes various steps, such as online check-in, baggage drop, and security checks, with different groups (G1, G2) representing passenger movements. This simulation helps track how passenger influx and disembarkation, based on flight schedules and passenger data, create peak periods and congestion at certain times.

**Slide 9**

The study examined elevator failures lasting different durations, from 5 minutes to 30 minutes. The baseline scenario (No DE) assumes no disruptions. These varying disruptions were analyzed to observe how long elevator downtime affects passenger waiting areas and circulation space.

**Slide 10**

This slide illustrates the key performance metrics tracked in the simulation. It shows the process flow for passengers from check-in to arrival, focusing on factors such as passenger buildup, circulation area usage, and how they deviate from IATA standards. The flowchart includes different stages, like security, customs control, and baggage claim, and helps us understand how these stages impact waiting times and crowding levels. It also highlights the optimum space per passenger and how disruptions can alter the efficiency of the process.

**Slide 11**

Disruptive events caused severe passenger congestion near elevators. As seen in the image, the airport terminal is overcrowded with passengers, which leads to operational inefficiencies. The longer the disruption lasts, the more passengers accumulate in waiting areas, requiring more space. This overcrowding far exceeds the IATA guidelines, which recommend 1 square meter per passenger. These findings highlight the need for better dynamic sizing of waiting areas to accommodate such disruptions.

**Slide 12**

On the left side, we have Figure 1(a), which displays the required area for each disruption scenario. The graph compares different disruption durations (from 5 minutes to 30 minutes) and shows that longer disruptions lead to more space being required for the accumulated passengers. The peaks in the graph represent the times when passenger accumulation is highest, which directly correlates to the severity of the disruption. For example, the DE30 (30-minute disruption) results in the highest passenger buildup, requiring almost 900 m² of space, far exceeding the IATA guidelines.

On the right, Figure 1(b) shows the percentage of time the passenger area exceeded IATA’s recommendations during both normal and disrupted operations. This percentage increases as the elevator failure duration grows, demonstrating how prolonged disruptions cause persistent overcrowding, and highlighting the inadequacies of current airport design standards in managing such disruptions.

**Slide 13**

The Discrete Event Simulation (DES) model effectively predicted the degree and location of bottlenecks caused by disruptions—an aspect that traditional analytical models often overlook. By accurately pinpointing areas of congestion, the DES model helps improve operational efficiency and infrastructure planning for airports under real-world conditions.

**Slide 14**

Disruptive events significantly disrupt the equilibrium between passenger flow and infrastructure capacity, leading to operational inefficiencies. For example, when elevators fail, passengers accumulate in waiting areas, causing overcrowding and delays. The second critical point is that waiting and circulation areas require dynamic sizing strategies, particularly for systems prone to failures, to better manage passenger flow during such disruptions.

The image shows a scatter plot or radial distribution of data points, with dots representing passenger accumulation at different times during 15-minute and 25-minute disruptions. The higher concentration of points further from the center indicates greater congestion. This visual aids in understanding how disruptions lead to increased waiting areas, far surpassing the expected IATA guidelines.

**Slide 15**

The second part of the inferences discusses the implications for airport design. The study emphasizes that tools like Discrete Event Simulation (DES) can provide actionable insights for designing resilient infrastructures. Traditional design methods are often static and fail to consider the real-world disruptions that can occur. Therefore, an integrated approach to design—using simulation to anticipate issues such as elevator failures—can help align infrastructure capacity with actual operational challenges.

The image shows a 3D diagram of an airport terminal layout with labeled sections such as arrival gates, security, baggage claim, and terminals. This helps illustrate how integrated approaches in airport design should account for dynamic factors such as passenger flow during disruptions, ensuring that airport systems are resilient and can handle real-world scenarios.

**Slide 16**

Finally, here are the references used in this study, following the IEEE format. These references include key sources such as the IATA Airport Development Manual, which provides guidelines for designing optimal airport spaces, the ArcPORT Terminal for simulation, and important research on pedestrian walking speeds and the resilience of airport systems in response to disruptions like severe weather events.

**Key Findings:**

Now, let’s hear from each team member about their contributions and key learnings from this project. I will pass it on to my teammate Chandana.

I worked on the initial 8 slides, where I covered the background of the paper, the problem being solved, and the key resources used in the simulation study. I learned a lot about how simulation-based approaches like Discrete Event Simulation (DES) can play a critical role in improving real-world operational systems. Specifically, I found the study of disruptive events (elevator failures) and their impact on passenger flow to be very insightful, as traditional analytical methods often overlook these critical disruptions.

Thank you, Chandana. I worked on slides 9 to 16, where I covered the results, inferences, and implications for airport design. One of the key learnings for me was understanding how disruptive events can create severe bottlenecks in systems that rely on precise timing, such as elevators in airports. The use of simulation models like DES allowed us to see how passenger flows could be impacted by something as simple as an elevator failure, something that would otherwise go unnoticed in traditional models. The implications of these findings are important for designing more resilient infrastructures, capable of handling unforeseen disruptions.

**Collective Learning**

To conclude, this project has provided valuable insights into the importance of resilient infrastructure and the role of simulation models like DES in anticipating disruptions. We learned how elevator failures can lead to significant congestion and operational inefficiencies, something often overlooked in traditional airport design.

Using ArcPORT® simulation software deepened our understanding of passenger flow dynamics and highlighted the need for dynamic sizing strategies in waiting and circulation areas. This project has reinforced the value of integrating simulation tools into infrastructure design, helping us create more robust and adaptable systems for airports.