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IMPACTS ON AIRPORT ELEVATOR SYSTEM WHEN EXPOSED TO DISRUPTIVE EVENTS: A DISCRETE EVENT SIMULATION APPROACH

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ABSTRACT

In this paper we present the results of a Discrete Event Simulation (DES) of an elevator system that connects the arrivals hall and the baggage claim room of a fictitious airport. Disruptive events (DE) were simulated causing the elevator system to stop for some time intervals. Then, the impacts of these DE on the sizing of the area for processing and operation were analyzed. We conclude that elevator failure highly impacts nearby circulation areas, where passengers wait for the elevator service. Such impact is not covered by current guidelines, which consider airport components by means of an isolated, analytical approach.

1 INTRODUCTION

In normal situations, airport waiting and circulation areas can be sized based on design guidelines (analytical equations), which consider the passenger (pax) flow and the area required to obtain a predefined Level of Service (LoS). In the case of arrival halls, an area of 1 m^2 per passenger is recommended, in order to obtain an optimum LoS (International Air Transport Association 2019).

However, passenger flows need to be balanced in terms of the processor's capacity and its reliability, as these processing components are designed based on threshold waiting time. The lack of proper balance can lead to unexpected bottlenecks, which are the result of unconsidered disruptive events (DE) acting on the system. Our hypothesis rests in the fact that circulation areas, waiting areas and processors are better assessed under an integrated approach, especially if DE are considered. This study analyses an elevator system and its surrounding areas, where passengers hold for the elevator service or circulate through.

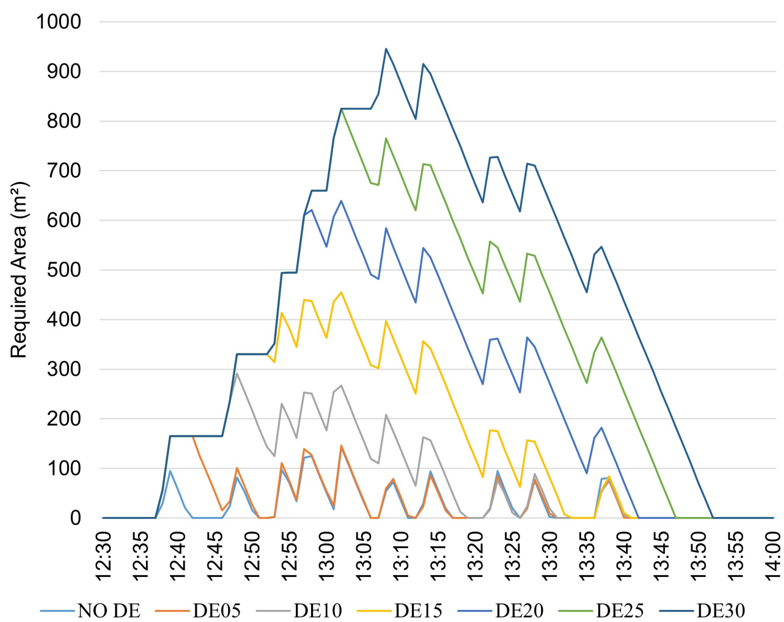
2 METHODS

We adopted the DES paradigm, using the ArcPORT® software. The model consists of an arrivals hall in an airport passenger terminal, where two elevators make the connection between the baggage claim floor and the arrival hall (Transoft Solution 2020).

For initial dimensioning, it was considered that all passengers used the elevators. The arrival curve was simulated from B737-800 operations (165 pax) and a fictious flight schedule during 1 hour. Pedestrian dynamics parameters were taken from the literature (Young 1999; Zhou and Chen 2020). We also adopted elevator areas, speeds, accelerations and decelerations based on an elevator technical catalog. We consider disruptive events that interrupted the elevator operation by 5, 10, 15, 20, 35, 30 minutes (DE05, DE10, DE15, DE20, DE25, DE30), and also the situation in which there is no interruption in the elevator system (NO DE).

3 RESULTS AND DISCUSSION

Figure 1 (a) shows the required area for each disruptive event, showing the accumulation of passengers by times of disruption. These disruptive events are not foreseen analytically and can affect circulation areas and the baggage claim sectors operation.



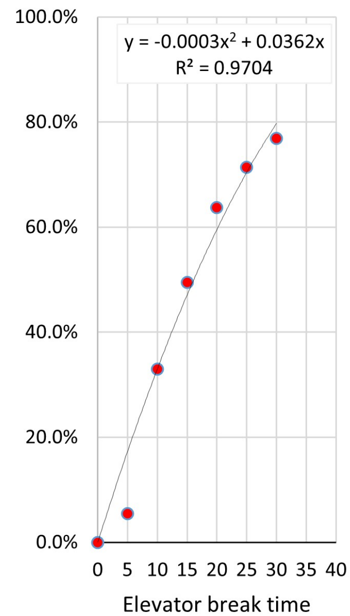


Figure 1: (a) Required area for each disruptive event and (b) Relation between elevator failure times and percentage of time above IATA recommended area considering normal operation

One can see in Figure 1 (b) the percentage of time between 12:30 pm to 2:00 pm that the area required for passengers is above the IATA recommended area without considering disruptive events.

We conclude that the simulation assists in the processing area's dimensioning and in the prediction of bottlenecks that analytical models fail to predict. Simulation can also aid in the prediction of bottlenecks' degree of impact on the airport structure and operation.

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