

COMPARISON BETWEEN CENTRALISED VS AT-THE-GATE SECURITY SCREENING USING SIMULATION METHODS

I.M Thrimavithana, V.V. Adikariwattage *

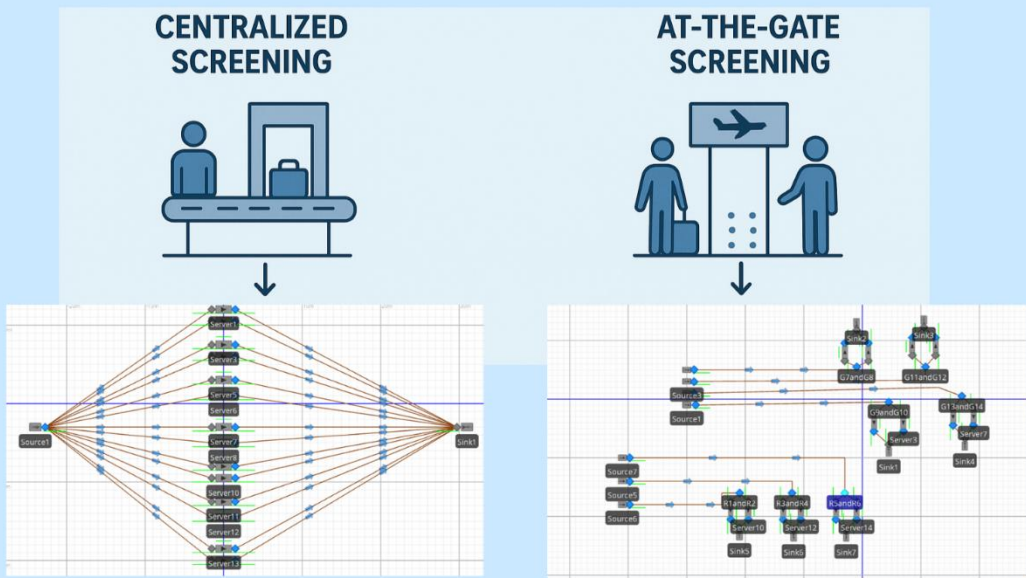
Department of Civil Engineering, University of Moratuwa, Moratuwa

Air transportation has grown substantially and steadily throughout the decades due to economic development, technology, globalisation and increased passenger and air cargo demand. The last ten years have seen the air transportation industry in the Asia Pacific region experience noteworthy growth due to economic growth, increased middle-class income, the development of tourism industry, infrastructure investments, and the swift rebound following the COVID-19 pandemic. In Q1 2025, the region had the highest rate in passenger increase in the world and the growth rate is increasing because of increasing demand. Bandaranaike International Airport has seen a large growth in passengers up to the 2010s, a drastic decline during the pandemic, and a robust recovery over the past few years with further growth anticipated through 2024 and beyond. With the increasing international air travel, Bandaranaike International Airport (BIA) is under increasing pressure to streamline its security screening procedures to enable the airport to meet the future projections of over 15 million passengers per year by 2030. This paper assesses the feasibility of switching to a centralised screening (DES) system instead of the current decentralised at-the-gate screening of BIA through a Discrete Event Simulation (DES) model. By examining the relationship between passenger flows, screening times, and congestion patterns based on Weibull-distributed arrivals, and stochastic service times, the study can contrast the two methods on several important performance measures such as throughput, wait times, queue lengths, and resource utilisation. Findings show that centralised screening will increase peak-time throughput by 20-30% by removing duplication of resource use whereas the current at-the-gate system will make the most of the available space but exhibit fluctuating passenger streams and wait times when flights occur in clusters. The research also offers important, empirical information on the nature of screening optimisation in BIA operational context, which proves useful in understanding how complicated systems at the airports could easily be studied through simulation modelling without incurring expensive real experiments. Although centralised screening demonstrates better operational effectiveness, cost-benefit analysis must be conducted carefully, and implementation may be introduced in stages or combined with alternative measures to strike a balance between performance improvement and financial sustainability at this expanding aviation hub. Centralised screening offers a promising operational efficiency gain to BIA, which can enable it to manage the expected growth and peak demands, and long-term flexibility to respond to the emerging global trends in the aviation industry. Its cost-effectiveness, however, should be planned. With the development of BIA, the use of data driven simulation modelling and incremental implementation of centralised screening will streamline resource efficiency and effectiveness in security. This is a balanced approach to ensure operational enhancement keeps up with high rates of passenger traffic which is expected to have topped up to over 15 million passengers by 2030, establishing BIA as a major aviation hub in South Asia and maintaining high safety and service levels.

Keywords: Airport security, Discrete-event simulation, Passenger flow, Queue length, Bandaranaike International Airport

* Correspondence: varunaa@uom.lk

COMPARISON BETWEEN CENTRALIZED VS AT THE GATE SECURITY SCREENING USING
SIMULATION METHODS FOR BANDARANAIKE INTERNATIONAL AIRPORT



	Decentralized	Centralized			
Number of Servers	12	12	10	8	6
Time Period	3 hours	3 hours	3 hours	3 hours	3 hours
Throughput	1750	2007	1880	1880	1520
Average Waiting Time in Checkpoints	7 min 45 s	1 min 20s	3 min	7 min	17 min 15s
Maximum Waiting Time in Checkpoints	15 min	8 min	12 min 40s	17 min 30s	44 min 32s
Average Queue Length	18	0.7	2	9.8	36
Maximum Queue Length	35	6.1	10.1	27	86

- For the centralized security screening system, a configuration of eight security channels has been identified as the optimum solution, balancing efficiency with acceptable levels of passenger waiting time and queue length
- The data clearly demonstrates that centralized screening systems achieve significantly faster processing times and higher throughput compared to decentralized screening systems