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Modeling and Evaluating Alternatives to Enhance Access to an Airport and Meet Future Expansion Needs

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Project 2120
April 2023

Introduction

The continued growth of air travel warrants the constant expansion of airports to meet increasing demand. With a forward-thinking mindset and a focus on continuous economic growth, airports such as Charlotte Douglas International Airport (CLT) in North Carolina sees itself rising to the forefront. Thus, there is a need to determine how airports can better manage existing infrastructure to accommodate this growth. This study, focuses on (1) investigating how changes in transportation infrastructure have affected travel time reliability (TTR) of the surrounding road network within an airport's vicinity over time, and (2) exploring selected unconventional intersection designs and proposing new inbound/outbound access routes from nearby major roads to the airport. The study used CLT as the case.

Study Methods

A data-driven approach was used to assess the effect of transportation projects on TTR at CLT. Google Earth was used to investigate the locations of the transportation projects within the airport's vicinity. Data from the National Performance Management Research Data Set (NPMRDS) and the Highway Performance Monitoring System (HPMS) were extracted and analyzed to generate nth-percentile travel time for different 1-hour intervals. Visual inspection of travel time distribution defined a boundary for extreme travel time events and reliability measures; planning time (PT), planning time index (PTI), travel time index (TTI), buffer time (BT), and buffer time index (BTI) were computed for each road link, each day of the year, and each hour before, during, and after each construction activity. This data-driven approach can be used to assess the effect of airport expansion projects on the TTR of surrounding road links.

A simulation-based approach was used to examin the potential expansion of CLT at selected intersections within its vicinity. The traffic volume, turning movement counts, and signal data were obtained from the City of Charlotte Department of Transportation (CDOT). The Wisconsin Department of Transportation (WSDOT)'s volume balancing macro-worksheet was used for traffic volume balancing, and a microsimulation platform was used to build the existing road network. The simulation model was developed and calibrated for different road facilities using observed travel time and traffic volume. Finally, the performance of unconventional designs such as continuous flow intersections (CFI), mini-roundabouts, and restricted crossing U-turn (RCUT) intersections for the West Blvd, Byrum Dr, and Steele Creek Rd intersection and selected bridge designs for the Wilkinson Blvd and Josh Birmingham Pkwy intersection were compared with conventional intersection designs. A yearly traffic growth rate of three percent was used in the study.

Findings

The study's key findings include:

- The effect on TTR varied spatially for the connectivity project, parking project, and staging area for ridesharing vehicles.
- The RCUT intersection design was observed to decrease delay considerably at the intersection of West Blvd, Byrum Dr and Steele Creek Rd.
- The north-south overpass results in minimum delay and number of stops at the intersection of Wilkinson Blvd and Josh Birmingham Pkwy.

Policy/Practice Recommendations

The key recommendations from the findings include:

- Data-driven methodologies and simulation-based approaches should be explored to better understand mobility issues as well as inbound/outbound surface traffic access issues and to evaluate/implement unconventional solutions for effective management.
- Analysts should consider using an outlier identification strategy to exclude extreme values in travel time data, as this can reduce the standard deviation by up to 30 percent.
- Airport planners should utilize predictive analytics to address transportation network connectivity challenges, optimize car park occupancy, and maximize revenue.
- Unconventional intersection designs can improve mobility and reduce congestion; they should be explored where appropriate.

About the Authors

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To Learn More

For more details about the study, download the full report at transweb.sjsu.edu/research/2120

MTI is a University Transportation Center sponsored by the U.S. Department of Transportation's Office of the Assistant Secretary for Research and Technology and by Caltrans. The Institute is located within San José State University's Lucas Graduate School of Business.