Decision-Making Approaches for Airport Surrounding Traffic Management

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INTRODUCTION

The experienced imbalance between demand and supply for airport services forces all air travelers and providers to rethink airport surrounding capacity and its utilization and management of experienced capacity shortages. Although the global airline industry is affected by the Covid-19 pandemic, the issue of airport ground congestion has not been fundamentally solved. The recovery of the air traveling market is expected in the near future, thereby emerging again into the forefront road capacity saturation around major airports. Such a situation triggers considerable costs and negative impacts reflected upon the efficiency of airport managements and the quality of the surrounding road operations. From the public authority's perspective, policy makers and city operators search for optimal airport efficiency and expansion of airport infrastructure to address issues of saturated airport surrounding roads towards implementing environment-friendly solutions and efficiently operational initiatives.

The assessment of the airport landside performance forces the usage of complex modeling and decision support systems in order to extract the manifold measures of the airport operational matrix, including capacity, delays, safety, security, and cost-efficiency, along with their trade-offs. It is important for airport managers and public authorities to consider the airport surrounding traffic congestion involved through the entire airport system. Although existing experiences in models and tools are rich for assessing the operational performance of a variety of airport components, limited elements of the airport operational decision-making process are modeling and formulating. Little is known for modeling traffic congestions and airport landside road system designs. A well-designed decision support system provides an integrated and intelligent view of landside operations and analytics for airport managers and policymakers in terms of the evidence-based decision-making process towards trade-offs among multiple airport operational measures. Existing tools or platforms lack modeling landside capabilities supporting problems and data-driven approaches to airport surrounding traffic management and planning. Advanced landside modeling for decision support of the road traffic prediction should be developed with concentrated on integrating traffic engineering architectures and data-driven approaches.

In response to the demand of the automatic decision-making process for airport surround traffic management, a survey study of the decision support system will be proposed in this chapter, concentrated on the operational management and planning of airport landside traffic congestions. Such a study provides a comprehensive insight to empower decision makers and analysts to discover the road congestion pattern of the landside of the airport in a problem-oriented manner by monitoring the spectrum of the traffic pattern surrounding the airport. The objective of this chapter is to investigate a variety of data-driven

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approaches that can be applied in constructing the automatic decision-making system by illustrating vast state-of-the-art techniques, such as statistical modeling, data mining, machine learning, and deep learning.

BACKGROUND

Airport operational management and planning assessments are the subject of extensive studies in the field of both airside and landside modeling and optimization, thereby a huge number of existing models and simulations have been made available to both research domains and industrial applications. Existing studies and practices cover a broad range of predictive models for different aspects of decision-making process and multiple categories of airport management operations, both airside and landside, throughout elements and entities involved in the airport flow processes (Zografos et al., 2013; Ravizza et al., 2014; Bruno et al., 2019). However, existing studies about the decision support system are limited in airport surrounding traffic management.

Existing studies in this field mainly focus on investigating the capability of infrastructures in airport surrounding management, e.g., an underground rapid transport system (URTS) has been examined for the international airport hubs (Liu & Liao, 2018). On the other hand, most studies are concentrated on discussing various factors causing traffic congestion. Earlier studies focused on people-centered integrated transport hub (Li & Loo, 2016), whereas most recent studies intensively aim on urban road networks with considering the cascading failure of a complex network system (Wang et al., 2020; Tian et al., 2021; Yin et al., 2021), as the airport surrounding traffic problem is one of the most critical parts in urban traffic system. However, such approaches and investigations are not sufficient for the construction of the automatic decision-making framework in airport surrounding traffic systems as they have not yet incorporated how such a system makes decisions about future or otherwise unknown events.

Predictive analysis, on the other hand, can be applied to simulate future or unknown conditions based on analyzing current and historical facts by encompassing a variety of cutting-edge techniques, such as statistical modeling, data mining, machine learning, and deep learning. With the development of data-driven technologies, big data approaches have also been incorporated in traffic engineering in terms of predicting the traffic congestion in urban road systems (Salazar-Carrillo et al., 2021), whereas similar studies are rare for the airport surrounding traffic management, in particular, traffic congestion predictions. Therefore, a huge gap between the airport surrounding traffic management and big data analytics is significant, along with the discussions in decision-making processes.

FOCUS OF THE ARTICLE

To fill up such a gap, this chapter designed to investigate the automatic decision support system in terms of analyzing airport surrounding road networks. Several decision-making approaches are illustrated and examined based on a board range of data-driven methods, including data mining, machine learning, and deep learning. Each method has been investigated by providing a survey study that involves the most recent and comprehensive understanding in traffic engineering. As a specific problem in urban traffic congestions, airport surrounding traffic management can be referenced from the similar studies in urban traffic congestion. The proposed study can be used in improving the airport services in terms of the operational efficiency and the airport landside management, further supporting the construction of the smart airport.