Literature Review, 1st Draft.

As part of our project, we conducted a literature review focusing on the use of data science and machine learning to optimize or research public transportation trends around the world. These research papers largely focused on finding ways to improve transit systems in major cities by optimizing schedules or finding the optimum place for new routes or stations. The methods used varied considerably between different projects. In the United States some researchers focused on optimizing specific times when the transit system could be overwhelmed by sudden increases in riders (Santanam, 2024), while others focused on the availability of transportation for low-income urban areas (Griffin, 2016).

Internationally, researchers took different approaches such as in Taiwan, researchers created a model to find the optimum site of a new metro station based on urban use data (Wey, 2015). In China, K-Means clustering was used to develop models that could predict short term subway usage to better optimize passenger flows (Dong, 2023), while in Germany, a study was conducted to see if the current public transportation gird would be able to easily replace commuter cars to reduce emissions (Mocanu, 2021).

**Challenges and Strategic Responses in Public Transportation**

Ahangari et al. (2020) highlight the significant decline in public transit ridership during the COVID-19 pandemic. To address this issue, the authors propose several measures for recovery, including enhanced cleaning protocols, financial support, and flexible operations to adapt to the changing circumstances brought about by the pandemic. Aston et al. (2020) address transit mode location biases in research on the built environment. The authors stress the need for more nuanced geographic and contextual analyses to better understand and improve transit systems and urban development.

**Innovations and Sustainable Planning in Urban Development**

Liu et al. (2023) investigate the spatiotemporal patterns and driving mechanisms of urban expansion in China's Min Delta. Through multi-scenario simulations, the study emphasizes the importance of sustainable planning, influenced by economic and policy factors, to manage urban growth effectively. Alexandre, Bernardini, and Pantoja (2023) categorize various applications of machine learning in bus transportation. Their focus is on improving service reliability and passenger information through innovations such as travel time prediction and passenger flow analysis, which are crucial for enhancing the overall efficiency of bus services.

Lee and Miller’s (2018) time geographic accessibility analysis of residents' accessibility to job and healthcare in an underserved neighborhood of Columbus using a high-resolution space-time accessibility measure can be used to measure the accessibility impacts of new or proposed public transit services.

Kuo, Leung, and Yan (2023) discussed the challenges of designing and operating public transport systems with five performance goals: service, mobility, accessibility, responsiveness, and technology. Their paper summarized recent research on integrated planning, timetable synchronization, feeder services, and disruption management.

Sun et al. (2019) presented research on a DDDAS-enabled (dynamic data-driven applications systems) smart public transportation decision support system. The results can be used to optimize bus schedules and improve rider satisfaction.

Caliwag et al. (2022) developed a fault occurrence prediction method based on a machine learning model to predict the remaining useful life of a train subsystem, which can be used to either clear a fault before it occurs or set an alarm for an inevitable fault. The method will increase the reliability and safety of the train system.

Branda et al. (2020) developed a methodology, DA4PT (Data Analytics for Public Transport), to predict whether users will buy a ticket or not and to define different dynamic pricing strategies to increase ticket sales and revenue. Analyzing user-generated event logs revealed that factors like occupancy rate and ticket fare have significant influence on users’ ticket purchasing behavior.

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