Get on the Bus: Innovating and Optimizing Student Transportation

Interim Report

Submitted by Carnegie Mellon University/Metro21 Team

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Background

Period of Performance: December 1, 2021 to November 30, 2022.

The purpose of this project is to find efficiencies related to transporting K-12 students, whereby, the CMU team will facilitate route optimization and research-based innovative practices for transportation services for charter and nonpublic school students. This work will include comparing CMU's proposed transportation services with the collection of transport services utilized by districts. Deliverables are outlined in the Grant Award Contract and below is an update of our accomplishments to-date, and next steps going forward.

Accomplishments

The team is collaborating with four school districts to develop a pilot route for non-public school students located in Penn Hills, East Allegheny, Plum and Woodland Hills school districts. To meet the goal of ideating and analyzing innovative solutions related to improving the quality and efficiency of student transportation services, the team has focused on the following activities:

- ***Data Collection-*** The team developed a template for the school districts to provide data on: anonymized student locations, student destination schools, and the set of existing district bus stops. To date, 3 of the 4 school districts have shared their data with CMU. The challenge is that the data is not consistent across all school districts and some gaps in the data still remain. For instance, Penn Hills data assigns students to bus stops, while data from Plum School District does not. The team has developed this strategy to manage these challenges (and confirmed the strategy with the school districts on our April 11, 2022 meeting):
    - For Plum, the team will assign students to the closest stop given.
    - For East Allegheny, the team will use student home addresses as bus stops if necessary. However, East Allegheny has informed the team that they should be able to provide bus stop information.
    - For Woodland Hills, the team is still waiting to receive 2021 data and our backup plan will be to use 2020 data if necessary to produce initial plans.

- ***Available Vehicles*** - Additional information needed includes the number (and sizes) of vehicles that individual school districts currently use to transport non-public school and charter school students to their destination schools and could be made available for cross-district routing. To date, only Penn Hills has provided

this data. The team will continue to work with Allies for Children to obtain this information from the other 3 districts. We will also attempt to generate routes that minimize the amount of vehicle capacity that is needed to transport all students.

- ***Optimization and Feasibility of Routes*** – The team is working to further refine the route sheet generation procedure to incorporate any missing constraints and is also developing system interfaces for subsequent transition as an end-user route generation tool. Progress on planning shared routes and determining feasibility has included:
    - Developing a template for the collection and tracking of anticipated travel constraints that will impact routes.
    - Working with districts to conduct a detailed analysis of the potential routes.
    - Facilitating the process for districts to develop protocols for audit and liability purposes.
    - Taking incremental steps toward having school districts share routes when possible. This includes beginning conversations amongst collaborators about logistical challenges, including cost savings, vehicle and driver information, insurance, discipline, etc.

- ***Route Development – A Staged Approach -*** The CMU research team applied clustering techniques for matching vehicle types to destinations (or sets of destinations) upfront and then creating vehicle itineraries. In other words, we examine the number of students per destination school and assign the best size vehicle to transport these students prior to developing the actual pickup and delivery routes, instead of our current approach which dynamically selects the vehicle to be used during the construction of each route. The reasoning for pursuing this clustering and vehicle size assignment staged approach is the possibility that it may produce a better overall set of routes than our original solution approach.

Next Steps

Next steps will focus on the following tasks:

- Development of route sheets, as described above, sharing the information with the school districts and their transportation agencies to ensure that the routes are feasible/optimal/efficient.
- Development of preliminary recommendations and suggestion of innovative practices for transportation services that will maximize impact on relevant areas of interest.
- Work with project participants and contributors to collect the additional information required to examine other recommendations.
- Discuss the creation and customization of secure and user-friendly software with Allies for Children.