Why Park and Ride (P&R)?

- P&R systems enable potential users to drive to a P&R facility where they could take a transit service to their destinations.
- P&R systems provide a good alternative to minimize high levels of congestion in cities such as: New York, Stockholm, and London.
- P&R is a way to provide suburban commuters an attractive transit alternative.

Abstract

The main objective of this project is to develop a methodology to assess where P&R facilities should be located to maximize their usefulness to New York City. In doing so, it is necessary to reach a set of analytical formulations that provide insight into the factors that would contribute to the success of P&R, and the implications of location decisions.

The novel approach developed by the team is based on the explicitly consideration of the conditions under which a rational user would find it beneficial to use P&R, and weaves these findings into a set of policy recommendations. The project builds on these results by considering the role that P&R location has in the determination of the potential demand for the system.

Project tasks

- Develop a comprehensive literature review in P&R design, location, operation, and plan.
- Suggest best practices for location analyses.
- Provide guidelines on how to design, and plan P&R facilities.
- Scan of potential sites in New York Metropolitan Transportation Council.
- Propose a methodology to evaluate P&R facilities.
- Apply the evaluation methodology and give a set of recommendations for specific P&R.

Mathematical formulation

Generalized cost is a measure of the separation between centroids in a zone based on a combination of different factors, i.e. travel time, tolls, and operational cost.

Definitions

- $g_{ij}^P$: Generalized cost of using auto
- $g_{ij}^P = t^P + c^d^P$
- $t^P$: In-vehicle travel time by auto from $i$ to $j$
- $c^d^P$: Auto out-of-pocket expenses (e.g., tolls)
- $P$: Transit out-of-pocket expenses (e.g., fares)$f_{ij}^P$: Transit out-of-pocket expenses (e.g., fares)$j^P$: PR out-of-pocket expenses, e.g., parking
- $P$: P&R system

A given P&R location provides saving when its generalized cost is lesser than the cost of using auto: $g_{ij}^P < g_{ij}^a$

Procedure:

- Compute generalized cost for each OD pair between every county and Manhattan for both modes, car and P&R.
- Compare generalized cost and determine whether a P&R facility generates saving to users.
- Determine the level of savings per P&R and produce a ranking.

Mathematical analysis of market potential in a corridor

The objective of this simplified analysis is to obtain insight in the location of P&R locations. The P&R can be located before, in, or after the beginning of the congested area.

Analytical results

$$u = \frac{d_{ij}^A}{s^A} - \left( \frac{d_{ij}^A}{x^A} + \frac{d_{ij}^P}{y^P} \right) + \frac{d_{ij}^P}{y^P} \left( f_{ij}^P + f_{ij}^T + f_{ij}^P + f_{ij}^T + c^d^P \right)$$

Performance measures

- Minimum wait and walk times are needed
- The lower the scheduled delays and walk time, the more feasible the PR facility would be as they would lead to a lower value of the right hand side. This implies that P&R facilities located near transit hubs with high frequency service would work better than those located near poorly served ones.

FAS TRANSIT SYSTEM

- A P&R facility would work best when it replaces a slow auto trip with a faster and shorter auto trip, plus a faster transit trip. These conditions happen when the P&R facility is located at the outside of a severely congested, where it connects to an efficient transit service.

- As a corollary of the previous item, the results imply that it is hard to make an economic case for use of the P&R facility if the transit speeds are no different than auto speeds.

INCENTIVES

- The lower the out of pocket expenses of PR are, in comparison with the auto-only alternative, the more attractive it becomes. As a result, an effort must be made to ensure that using PR facilities are as inexpensive as possible.

LONG DISTANCE IN FAST TRANSIT

- The longer the auto trip replaced by the transit trip, the better as this would increase the savings in distance traveled costs.

Work in progress

- The team is reviewing the NYMTC data in order to evaluate the proposed methodology.
- Next step is to run computer programs to identify OD pairs that benefit from P&R, in terms of both, generalized cost and travel time.
- Sensitivity analysis of mode choice to compute cost-benefit for various scenarios.

Conclusions and further research

This project developed analytical formulations to gain insight into the optimal location, i.e., the one that maximizes the potential market, P&R facilities. The analysis is based on a fundamental principle of rationality, i.e., that a traveler would only consider using a PR facility if the corresponding generalized cost is lower than the auto only alternative, which is taken as a necessary economic condition.

This implies that the P&R system must provide a service that is fast and frequent enough to overcome the transfer costs (waiting to the P&R, and waiting for the transit vehicle). As a result, it is very difficult to make an economic case for PR use when the transit system does not travel faster than the general traffic. Under these conditions, the necessary condition is not met.

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