



## RESEARCH SERVICES SECTION

# TECHNICAL SUMMARY

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### PROJECT COST:

\$55,000



Minnesota statutes go beyond ADA mandates, requiring a larger paratransit service area, and more intensive pickup and drop-off services.

# Improving Capacity Planning for Demand-Responsive Paratransit Services

## What Was the Need?

The Americans with Disabilities Act mandates that communities with federally subsidized public transit systems must offer on-demand paratransit services for people with disabilities. Paratransit services must match the hours of operation of public transit, minimize service denials because of capacity shortages and maintain additional service quality measures beyond those applicable to public transit such as on-time pickups and drop-offs and acceptable ride times. Metro Mobility, the agency that provides paratransit services to the Twin Cities area through two contractors (Laidlaw and Transit Team), is also anticipating an additional same-day service requirement by the Federal Transit Authority.

To comply with these regulations and contain rising operating costs, it is essential that paratransit service providers schedule the most efficient routes and perhaps consider new ways to meet service demands. The tools necessary to make these improvements, however, are not built into existing software that these providers use for scheduling and creating routes.

## What Was Our Goal?

This project was initiated to create three products:

- A mathematical model for computing the level of service obtainable with each level of expenditure on dedicated paratransit service providers and nondedicated services such as taxis
- A framework for choosing the right mix of dedicated and nondedicated services
- A methodology to help paratransit service providers estimate resources required to respond to increasing demand and to move toward the goal of same-day service

## What Did We Do?

Researchers began by analyzing archived paratransit performance data, looking for correlations between metrics to identify patterns that could lead to operational improvements. The reviewed data included:

- Records of cancellations, no shows and overall productivity from January 2001 through August 2005
- Customer booking data and contractor productivity measures for 2004 and 2005
- Financial information on bonuses and damages for all of 2004 and the first eight months of 2005

Researchers also studied whether service providers could improve route efficiency. They analyzed historical trip data for one day of operations for each of the two service providers. On June 1, 2005, Laidlaw served 1,009 passengers on 103 routes. Transit Team served 1,534 passengers on 110 routes on May 9, 2007. Of those, researchers used 85 and 66 routes, respectively, as a proof of concept, as the remaining routes violated one or more service-level requirements.

Reviewing this data and accounting for additional parameters set by Metro Mobility and ADA requirements, researchers began building a reoptimization algorithm. Then they used this algorithm to resequence stops along each route and move passengers from one route to another. Researchers applied the algorithm to improve efficiency on individual

*“This research shows that we can reduce costs by reoptimizing customer pickups and drop-offs, swapping trips between scheduled routes, and allowing some customers to travel by taxi without affecting promised pickup and drop-off times.”*

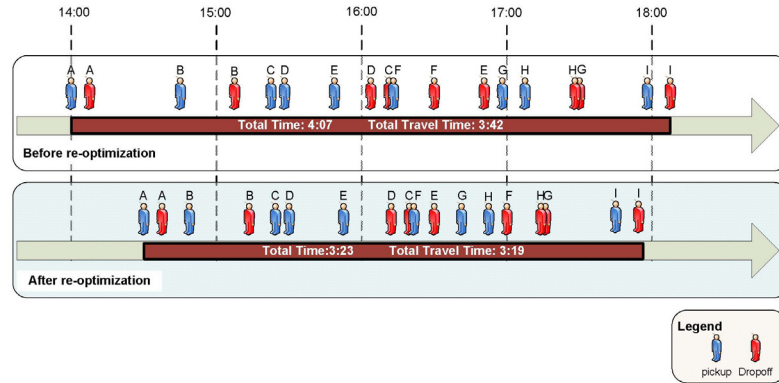
**–Diwakar Gupta,**  
Professor, University of Minnesota Department of Mechanical Engineering

*“Beyond its immediate utility for Metro Mobility, this study also has the potential for improving rural public transit service.”*

**–Sarah Brodt Lenz,**  
Program Administrator, Mn/DOT Office of Transit

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The reoptimization model (above) designed for this project can improve route efficiency. In this example, reoptimization saved about 45 minutes of travel time.

routes (a “first-pass” algorithm), and also explored a more time- and labor-intensive way of applying the algorithm to improve two routes simultaneously (a second-pass algorithm). Reoptimizing routes leads to greater efficiency and fewer hours needed to serve all customers.

Researchers also developed a procedure to identify preferred passengers who could be offered the option to travel by taxi at no additional cost. This procedure was then tested in a computer simulation where the probability that a passenger would accept the taxi offer could be changed; this allowed researchers to develop a more realistic estimate of potential savings.

### What Did We Learn?

The models and algorithms developed for this study can be used to help implement two approaches for improving efficiency: reoptimizing Metro Mobility routes and selectively using nondedicated service providers.

By using the reoptimizing approach with just the simpler first-pass analysis alone, which can be done on a daily basis during the overnight hours, Metro Mobility could save 5 percent of its operating costs. In 2004, Metro Mobility’s operating costs were \$19.5 million, so anticipated savings would have netted \$975,000.

Additionally, by supplementing paratransit services with nondedicated service providers, Metro Mobility could save hundreds of dollars per day, depending on the proportion of customers who agree to travel by taxi.

After completing the handbook update, researchers created a two-hour course providing an overview of this new resource for deployment through the Minnesota Local Technical Assistance Program.

### What’s Next?

Researchers created computer codes that can be automated by a programmer who knows Metro Mobility’s current system to allow reoptimization of the routes at the end of each day of booking. Investigators also recommend a pilot program to better understand what proportion of passengers would accept an offer to travel by taxi.

Another researcher recommendation concerns examination of Metro Mobility’s paratransit contract parameters. Currently, contractors can earn more by lowering their productivity during low-demand periods; contract adjustments are needed to remove this incentive misalignment.

*This Technical Summary pertains to Report 2008-09, “Improving Capacity Planning for Demand-Responsive Paratransit Services,” published April 2008. The full report can be accessed at <http://www.lrrb.org/PDF/200809.pdf>.*