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UTC Spotlight

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METRANS Researchers Seek Ways to Make the Urban Freight System More Efficient

Given the high construction costs, physical restraints, and limited impact of simply building more infrastructure to resolve congestion issues, METRANS researchers are looking for new and better ways to efficiently manage existing capacity.

National and international trade flows tend to be concentrated in large metropolitan areas, adding demand to already overburdened highway and rail networks. Reducing total truck and train miles and shifting demand to less congested times, routes, or modes are two ways of increasing efficiency identified by METRANS researchers while reducing vehicle emissions and energy consumption. Possible solutions range from better routing of truck pickup and delivery to virtual chassis pools to various forms of congestion pricing—a method of reducing demand during hours of peak usage by surcharging users, thereby encouraging them to shift usage to off peak hours.

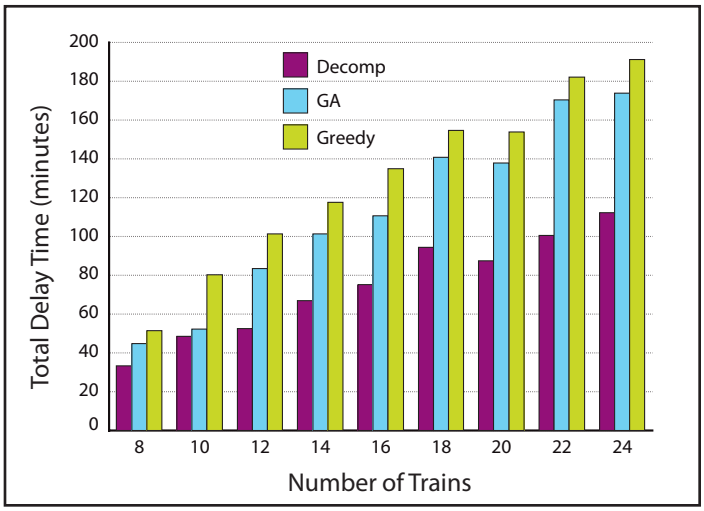
Efficient train routing and scheduling

Metropolitan areas that serve as international or national trade centers are frequently bottlenecks in the national rail system. Intermodal exchange, warehousing, and distribution activities concentrate around a complex rail network that not only must carry growing freight volumes, but also accommodate passenger services.

METRANS researcher Maged Dessouky works on developing efficient ways to schedule and dispatch trains in urban areas. Improving productivity on existing routes has numerous potential benefits, such as avoiding the costly—and in dense urban areas often impractical—option of simply adding more track.

Train routing and scheduling is an optimization problem; for a given set of demands on a network, what is the best way to schedule and route trains to minimize total travel time? In a simple network (e.g., a few trains per day in either direction) finding the optimal solution is relatively easy. But in a complex network, with many potential routes, train lengths, and performance characteristics, the problem rapidly becomes intractable with current analytical tools. Given these limitations, rather than seeking an optimal solution, managers may opt to use simple rules that assure safety but are far from efficient.

The greater Los Angeles rail network provides an ideal setting for testing solutions on complex networks. Dessouky and his students have developed and tested several different mathematical methods. In one example, three methods for a static problem (i.e., all train arrival times are known) were tested: genetic algorithm, greedy algorithm, and decomposition. Decomposition performed the best, generating substantially lower total delay. All three methods performed better than existing state-of-the-art methods. Other methods were developed for dynamic problems (arrivals are known only as they occur). The new methods reduced total delay by up to 40 percent. Dessouky's research shows that significant efficiency gains are possible from better routing and scheduling.



Using truck tolls to reduce congestion costs

METRANS researcher Seiji Steimetz has explored the congestion costs of port-related truck traffic. He examined the San Pedro Bay ports' PierPass program, which charges a "traffic mitigation fee" of $100 for each 40-ft loaded container ($50 per twenty-foot equivalent unit (TEU)) arriving at the ports during peak, weekday daytime hours. The purpose of PierPass is to reduce congestion both at terminals and on the highway system. Other METRANS research found that highway congestion around the port area was significantly reduced during daytime hours after PierPass was implemented.

The PierPass fee was set to recover the costs of operating terminal gates for extended hours. Steimetz asked, "Is the fee reflective of the actual congestion costs generated by these trucks?" He used data on truck volumes, highway travel times, and estimates of time value to generate congestion cost estimates for peak and off-peak trips to the ports. Results are given in the table, which shows that the estimated actual congestion costs are far lower than the PierPass fee, and that most of the cost is related to delay on the highways, where port traffic imposes delays on large volumes of peak hour passenger traffic, rather than at the terminal gates. Thus PierPass only approximates truck tolling, and it may be more effective at reducing highway congestion if all trucks were tolled according to actual congestion costs.

Table: Summary of Roundtrip Cost Estimates

	Peak	Off peak
Average highway cost	$19.75	$3.63
Average terminal gate cost	$2.13	$0.00
Sum of costs	$21.88	$3.63

Steimetz finds that tolls reduce peak period truck travel to and from the ports, and could reduce peak truck traffic more generally. He suggests a variable toll structure that more closely reflects congestion costs as a way to reduce the negative externalities caused by all types of truck traffic.

These examples are illustrative of the many possibilities for increasing efficiency of urban freight flows. METRANS is committed to developing innovative solutions that can be implemented in metropolitan areas throughout the US. See www.metrans.org/research for more examples of improving our urban freight system.

About This Project

METRANS, headed by Director Genevieve Giuliano, is a partnership between lead University of Southern California and California State University, Long Beach. Research is funded by the U.S. DOT's UTC program and matching funds from the California Department of Transportation.

Maged Dessouky, Ph.D., Professor, Epstein Department of Industrial and Systems Engineering, USC, received his B.S./M.S. degrees in IE from Purdue University and his Ph.D. degree in IEOR from UC Berkeley. He was recipient of the 2007 Transportation Science & Logistics Best Paper Prize. He is a Fellow of the Institute of Industrial Engineers.

Seiji Steimetz, Ph.D., is Associate Professor of Economics at the California State University, Long Beach, specializing in transportation, urban, and environmental economics.. His research has been published in leading economic and interdisciplinary journals.