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.