EPSTEIN INSTITUTE SEMINAR ▪ ISE 651

Optimizing Relay Operations Toward Sustainable Logistics

ABSTRACT– Relay logistics decompose long-haul shipments into short segments through a pit-stop network, traveled by separate drivers. This operating model enables truck drivers to come home regularly, and offers consolidation opportunities to mitigate the environmental footprint of the sector. To be successful, however, relay logistics require dedicated analytics capabilities to consolidate operations spatially and temporally across the network. This paper proposes a Relay Pickup-and-Delivery Problem (RPDP) to optimize the routing of orders, drivers and vehicles. We develop an integer optimization formulation across coupled time-space networks, using a journey-based representation of driver movements (from home to home). We solve it with an exact multi-arc generation algorithm, by iterating between a sparse master problem that solves the problem with a subset of candidate time-space arcs, and a multi-arc subproblem that seeks a path of negative reduced cost within a relaxed and projected polyhedron. This algorithm leverages primal feasibility conditions to generate multiple "synergistic" arcs at a time and to guarantee optimality in the presence of variables with negative reduced cost. Extensive experiments using real-world data show that the algorithm terminates much faster and scales to larger instances than several benchmarks. From a practical standpoint, optimized relay operations introduce strategic detours and delays for a few orders to consolidate operations along high-volume corridors, resulting in fewer miles traveled. Relay logistics, armed with our modeling and algorithmic methods, can ultimately provide win-win-win outcomes toward the "3 E''s" of sustainability: equity (better driver lifestyles), economy (shorter lead times, lower operating costs), and environment (smaller footprint).

Dr. Alexandre Jacquillat
Assistant Professor
Dept. of Operations Research and Statistics
MIT

SPEAKER BIO – Alexandre Jacquillat is an Assistant Professor of Operations Research and Statistics at the MIT Sloan School of Management. His research focuses on data-driven decision-making, spanning integer optimization, stochastic optimization, and machine learning. His primary focus is on scheduling, operations and pricing in transportation and logistics, with the goal of promoting efficient, reliable and sustainable mobility of people and goods. Alexandre is the recipient of several awards, including the Dantzig Dissertation Award from INFORMS, the Best Paper Prize from INFORMS Transportation Science and Logistics, the Pierskalla Best Paper Award from INFORMS Health Applications, and the Best Paper Award from the INFORMS Workshop on Data Mining and Decision Analytics. Prior to joining MIT, Alexandre was an Assistant Professor at Carnegie Mellon University. He received a Master of Science in Applied Mathematics from the Ecole Polytechnique and PhD in Engineering Systems from MIT.

USC Viterbi
School of Engineering
Daniel J. Epstein Department of Industrial and Systems Engineering

TUESDAY, APRIL 11, 2023
3:30 PM – 4:50 PM
USC ANDRUS GERONTOLOGY CENTER (GER), ROOM 206