Oral Defense Announcement
University of Missouri – St. Louis Graduate School

An oral examination in defense of the dissertation for the degree
Doctor of Philosophy in Business Administration with an emphasis in Logistics & Supply Chain Management

Juan Zhang
B.S. in Logistics Management, 2015, Huazhong University of Science and Technology

Economic and Environmental Impacts of Drone Delivery

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Place: Remote

Abstract
Motivated by the potential huge economic and environmental benefits of drone delivery, this dissertation developed mathematical models using the continuous approximation methodology to quantify the cost and emissions savings that drone delivery can provide relative to conventional truck delivery on multi-stop routes for a range of operating characteristics, delivery environments, and carbon intensities of power generation. This research considers two types of drone delivery: drone-only delivery and truck-drone delivery. In drone-only delivery, drones travel out-and-back from a depot to make each delivery. In truck-drone delivery, a truck and drone tandem make deliveries in parallel with the drone being launched and recovered at the truck. The research suggests that the delivery cost and emissions savings relative to conventional truck delivery can be substantial, but strongly depend on drone operating cost and emissions rates and their interrelationship.

Because drone emissions depend on both the drone energy consumption rate and the electricity generation, Chapter 3 classifies five fundamental drone energy consumption models, and documents wide variability in the published drone energy consumption rates, due to different drone types, operating conditions and fundamental modeling assumptions. Chapters 4 and 5 provide continuous approximation models for the cost and the emissions with truck-only delivery and the two drone delivery services (drone-only and truck-drone), and show how the savings with drones depend on key characteristics of the drone and the operational setting. Chapter 6 examines the cost and emissions tradeoffs with optimal use of drone-only delivery and truck-drone delivery and shows the importance of the drone operating cost and energy consumption rates, as well as the delivery density and truck capacity. Results show that replacing truck-only delivery with drones can provide both cost and environmental benefits, with drone-only delivery preferred when drone operating cost and emissions rates and/or delivery density are very low and truck-drone delivery preferred when drone operating cost and emissions rates, truck-drone capacity, and/or delivery density are not very low. Results also show there can be a large tradeoff between cost and emissions when the ratio of drone operating cost rate to drone emissions rate differs from the ratio for trucks.

Defense of Dissertation Committee
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