This topic is "practice ready." ☒ **Yes** ☐ **No**

Strategic Design for Delivery with Trucks and Drones

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Abstract

Home delivery by drones alone, or in combination with traditional truck delivery, has drawn considerable attention from major logistics companies such as Amazon, UPS, DHL, etc. While drones may provide better performance (by reducing delivery time) and economic savings (by reducing delivery costs), the fundamental issues of how best to deploy drones for home delivery are not well understood. While much attention focuses on legal and technical issues of using drones, less attention has been paid to the operational challenges of implementing drones in delivery networks. Thus, we are motivated to investigate: (1) "How can hybrid truck-drone routes best be used to serve a region?" and (2) "How does hybrid truck-drone delivery compare with truck-only delivery?" We apply continuous approximation modeling techniques to develop strategic insights for designing a hybrid truck-drone delivery system. We provide mathematical formulations incorporating key operating parameters (including the relative operating costs per mile for trucks and drones, the relative stop costs per delivery for trucks and drones, and the spatial density of customers) for analyzing and optimizing the design of hybrid truck-drone delivery, where drones make deliveries simultaneously with the truck. In particular, we investigate the following two scenarios: (1) one delivery drone per truck, where the drone launches and returns to the truck at different customers with the drone making a single delivery between two truck deliveries; and (2) multiple delivery drones per truck, where several drones (each making a single

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delivery) launch and return to the truck at a subsequent customer location. Our results show that hybrid truck-drone delivery has the potential to provide significant cost savings, allowing multiple drones per truck offers larger, but marginally decreasing savings, and the benefits of hybrid truck-drone delivery strongly depend on the relative operating parameters of trucks and drones.

Keywords: drone delivery—vehicle routing—continuous approximation models