Driving Sustainable Urban Logistics with Digital Twins

The surge in e-commerce and resulting business needs have contributed to a substantial rise in inner-city package deliveries, posing challenges such as increased greenhouse gas emissions, air pollution, road accidents, noise, and congestion. The last-mile delivery, specifically, is fraught with difficulties, including finding parking spaces and adhering to regulations, which contribute to environmental and logistical concerns. To address these issues, researchers are exploring innovative solutions that leverage the concept of the Physical Internet. The Chaire Internet Physique (CIP) at MINES Paris-PSL in France is a research initiative dedicated to the Physical Internet, applying internet principles to logistics. Researchers from MINES and Orange are also partners in the ASAP-Project. With a focus on sustainable urban logistics, the CIP aims to create an open, interconnected network for end-to-end logistic services, promoting efficiency and sustainability. The collaboration between MINES Paris-PSL and Orange involves the use of digital twins to tackle the last-mile problem, optimizing delivery routes and reducing the environmental impact of deliveries.

Digital twins, representing synchronized models of physical environments and associated business processes, play a pivotal role in optimizing last-mile delivery routes. Using the Thing'in platform, developed by Orange, researchers model parking spaces, destinations, and packages as digital twins, enabling the consolidation of deliveries to reduce carbon footprint and noise pollution. The innovative approach involves a mobile app for delivery drivers, utilizing digital twins to find available parking spaces in advance. The system pools parking spaces to reduce vehicle distance traveled, subsequently decreasing delivery time, cost, and greenhouse gas emissions. Key performance indicators (KPIs) such as delivery distance, time, cost, and emissions are calculated to assess the benefits of consolidating deliveries through parking spaces. Thing'in, the digital twin platform, exhibits five main characteristics: cross-vertical applicability, multisided collaboration, graph-based modeling, federation and distribution across instances, and historization. These features enable the platform to address diverse use cases in different verticals, ensuring flexibility and scalability. The demonstration involves modeling parking spaces, destinations, and packages as digital twins, sourced from Open Data Paris. The Thing'in platform aids in choosing parking spaces and determining the order of visits, effectively consolidating deliveries. Real-time updates on parking space status, assuming sensor-equipped spaces, allow dynamic adjustments to the delivery route.

Simulation results show that consolidating deliveries through parking spaces can reduce vehicle distance traveled by up to 40%, leading to a significant reduction in emissions. Future perspectives include incorporating new constraints such as package weight and delivery windows, exploring multimodal transportation options, and facilitating collaboration among delivery drivers through proactive digital twins. The integration of digital twins in sustainable urban logistics represents a groundbreaking approach to address the challenges of last-mile delivery. By leveraging the Physical Internet concept and innovative digital twin technology, researchers are paving the way for more efficient, environmentally friendly, and collaborative delivery solutions in urban areas. This paradigm shift holds promise for mitigating the adverse impacts of growing trade on the environment and enhancing the overall logistics ecosystem. For more detailed information, please refer to the original article.