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Simulation and Optimization of Smart Logistics Nodes

In this PhD project, we evaluate and quantify the impact of digitalization and Connected Automated Transport (CAT) in the transition from traditional to Smart Logistics Nodes (SLNs). In fact, logistics companies, ports, and business parks alike are considering various emerging technologies, such as digital ecosystems and electric, connected and automated vehicles (ECAVs). However, the value and implementation process of digital and CAT technologies are uncertain to logistics operators and governing bodies at logistics nodes, especially when it comes to operational challenges and how they fit together. After defining the SLN concept, we describe how current logistics nodes could transform into SLNs by means of digital integration and infrastructural support for automated driving. Next, we present a reusable and detailed simulation framework that can automatically generate logistics infrastructure and model freight flows, with the addition of little input data. Finally, we present some algorithms (traditional and AI-based) to dispatch ECAVs for freight transport and battery charging. These algorithms have three main goals: allocate a shared fleet between independent stakeholders at the logistics node, combine freight drop-offs & pick-ups, and manage ECAVs' battery levels.
We end this presentation with a first analysis of the impact of CAT at a future SLN in the Netherlands: the Port of Moerdijk. By means of a simulation study, we will evaluate the effect of SLN design and technology choices under different scenarios, such as information availability and operational constraints, e.g., tighter due dates for deliveries, round-the-clock operations, etc. Finally, the evaluation will be based on (i) delivery timeliness and waiting times, (ii) CO2 reductions due to electrification and traffic control, and (iii) optimal SLN design choices and ECAV fleet management.