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Modular multimodal freight transport systems

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This paper investigates the potential improvements in multimodal freight systems through the use of modular vehicles (MVs), aiming to enhance operational adaptability and integrate these vehicles within the mobility-as-a-service (MaaS) concept. The research examines a specialized form of the Pickup and Delivery Problem (PDP) adapted for rail and road logistics, presenting a new mathematical model for the Pickup and Delivery Modular Vehicle Routing Problem (PDMVRP) that includes road and rail. This model tackles significant operational issues such as routing of MVs on road, platooning and the scheduling of MVs on railways and transfers between road and rail MVs. A practical example in a regional road and railway network demonstrates the effectiveness of the proposed model, indicating their ability to decrease costs(energy and emissions), shorten travel times, and boost the efficiency of rail capacity, thereby promoting the advancement of MV usage in future transport systems.