Politecnico di Torino
Dipartimento di Automatica e Informatica

PhD in Computer and Control Engineering
XXXIV cycle

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Last-mile logistics optimization in the on-demand economy

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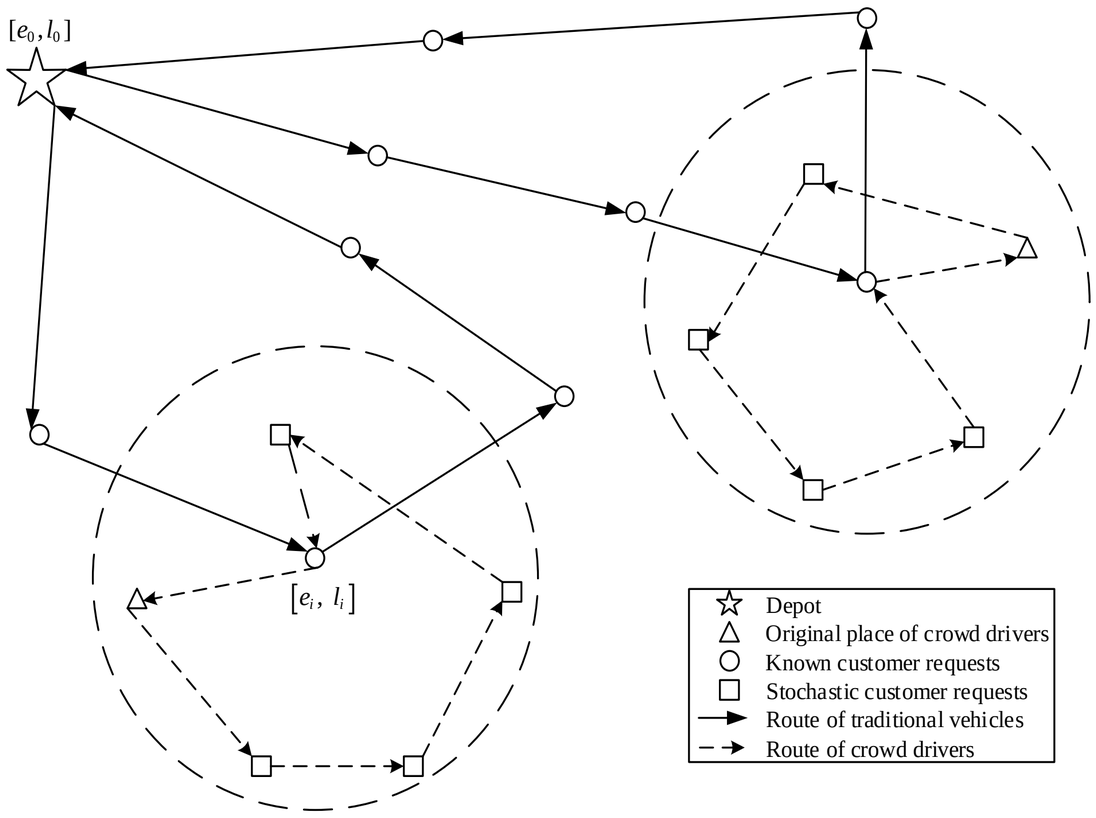
1.Introduction / Context

Urban logistics aims to find efficient and effective approaches to move freights in urban areas while considering the negative impacts on congestion, environment, and safety. The advantages of crowdsourcing are lower operation costs, higher flexibility and lower emissions comparing to traditional delivery options. We investigates a dynamic and stochastic vehicle routing problem with time windows (DS-VRPTW) that consider the adoption of multiple delivery options and crowd drivers, reflecting the synchromodality in the urban context[1].

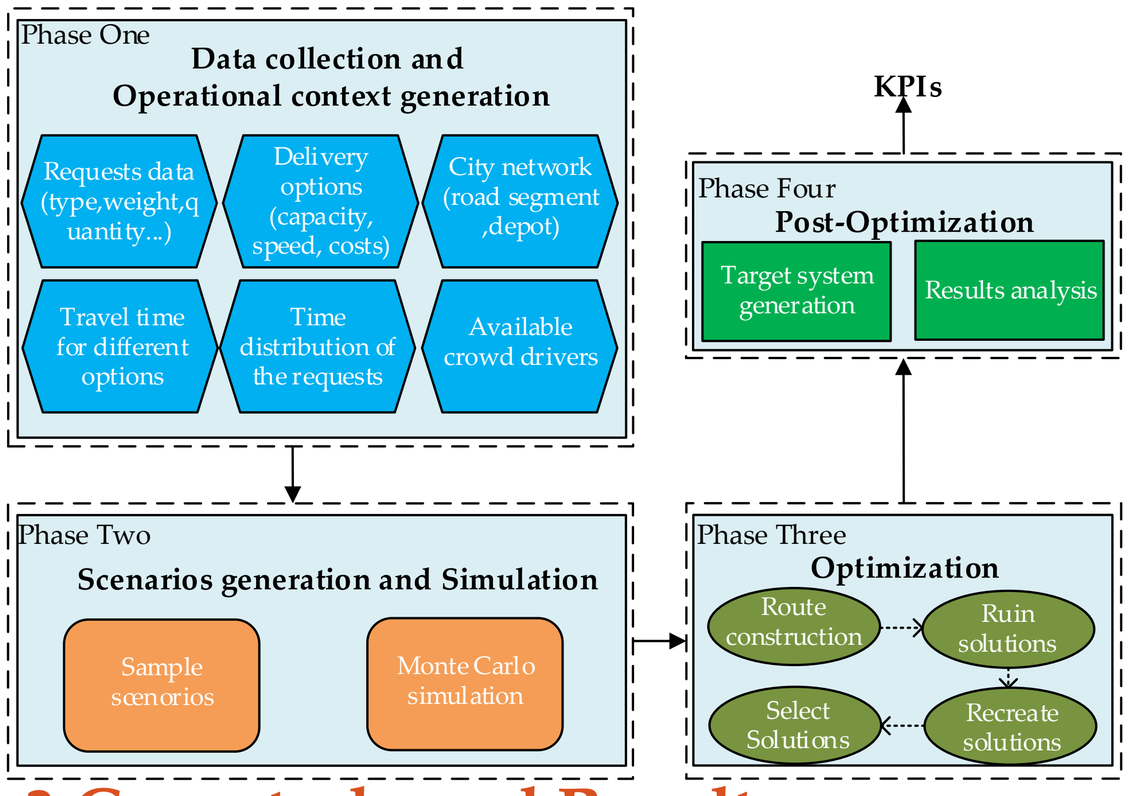


2.Objectives

Formulate a multi-stage stochastic model for parcel delivery.

Apply Simulation-optimization framework for solving efficiently the DS-VRPTW.

Conduct a case study in the medium-sized city of Turin, to analyze the influence of using multiple delivery options in parcel delivery in terms of operational cost, environmental cost, and delivery efficiency.



3.Case study and Results

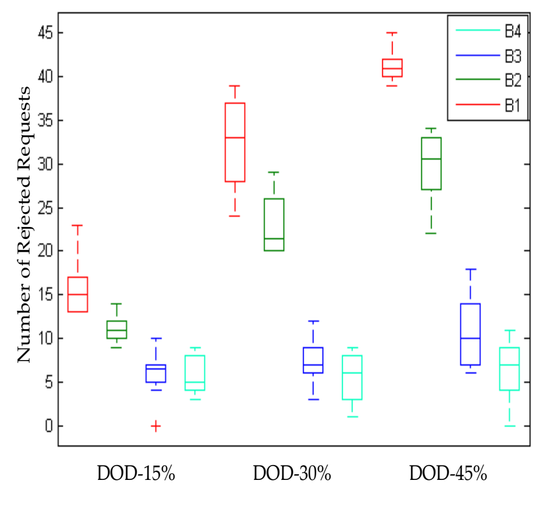
Benchmark generation and initialization

Delivery Options	Maximum parcel size(kg)	Capacity	Coverage (km)	Speed (km/h)	Service time(min)		
					Mailers	small parcels	large parcels
Van	70	700kg	NA	40	4	4	5
Cargo Bike	15	70kg	NA	20	2	2	—
Crowd Driver	6	4 Parcels	2	15	2	—	—

Comparing rejected requests for different benchmarks

High level of Degree of Dynamism (DOD), lower level of rejected requests.

Benchmark 4 (multiple delivery options with crowd drivers) remains stable for all cases.



4.Conclusion

Combining crowd drivers and green carriers into traditional van delivery is beneficial in economic and environmental cost-saving. Crowdsourcing are promising and flexible solutions for online requests.

5.References

[1] Perboli, G., Rosano, M., & Wei, Q. (2021). A Simulation-Optimization Approach for the Management of the On-Demand Parcel Delivery in Sharing Economy. IEEE Transactions on Intelligent Transportation Systems.