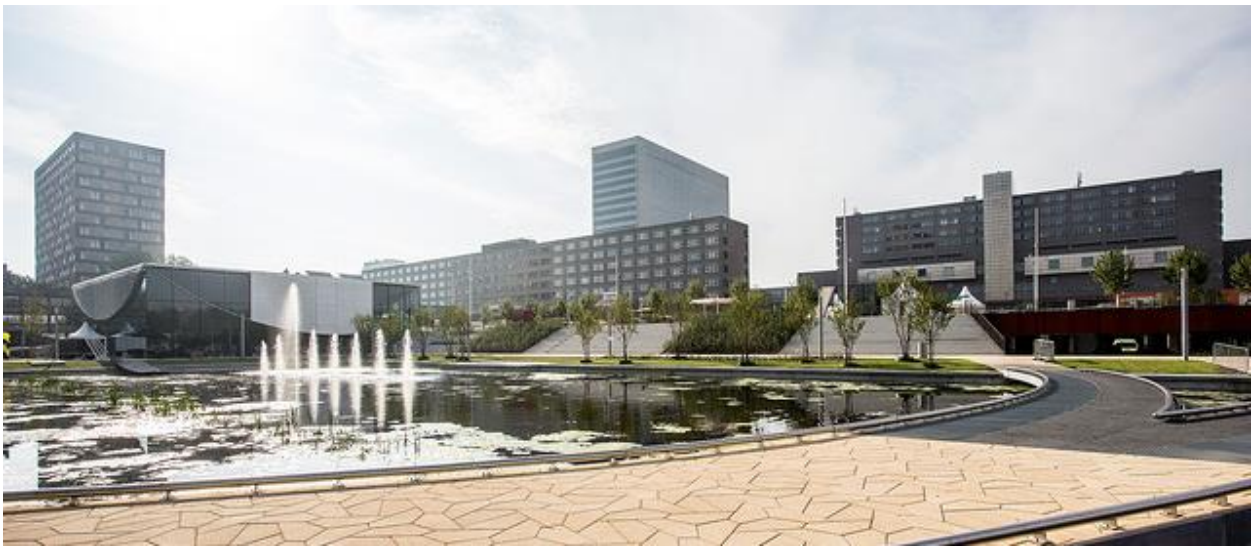
Program

TSL Workshop 2021

July 19-20



Erasmus School of Economics

RSM

Interaction in Transport and Logistics

The theme of this TSL workshop is Interaction in Transport and Logistics. This theme captures the two main goals of our workshops:

1. It refers to the main purpose of the workshop, interaction within our community. Especially given that the workshop is online, and social distancing is our everyday norm, this is an important design pillar for planning the workshop.
2. The focus of the theme is on the interaction between supply and demand, i.e., the interaction between providers and users of transport. This especially relates to the advances in demand and customer behavior models in the context of transportation and logistics.

Online platform: Zoom

We will use Zoom as our platform for the online workshop. You can download the app using this link: https://zoom.us/download. To participate in the workshop, a specific Zoom link is required which will be send to registered participants. Some instructions on using Zoom will be given at the start of the workshop, during the 'Opening'. Parallel sessions are held in so-called breakout rooms. The breakout rooms for the parallel sessions are given the names: Mandeville room and Tinbergen room. These names can also be found in this program for each parallel session. Additionally, several breakout rooms, designated as coffee rooms, will be available as well, which can be used e.g. for networking purposes.

Presentations

With the exception of a few plenary meetings, the presentations take place in six installments of two parallel sessions. Each such session is scheduled for one hour, and consists of four presentations. Each presentation lasts for 10 minutes, with 5 minutes slack for questions and setting up the next presentation. The workshop organizers will act as chairs to coordinate this in each session.

Time

The workshop will be attended digitally by people in different time zones. All times mentioned in this program are **CENTRAL EUROPEAN SUMMER TIME**. In the below table, this corresponds to the time in Amsterdam.

		Chicago	Amsterdam	Shanghai
Monday July 19	Formal program part 1	07:00 – 12:00	14:00 – 19:00	20:00 – 01:00
Monday July 19	Social event	13:00 – 15:00	20:00 – 22:00	02:00 – 04:00
Tuesday July 20	Formal program part 2	07:00 – 12:00	14:00 – 19:00	20:00 – 01:00

INFORMS

With over 12,500 members from around the globe, INFORMS is the leading international association for professionals in operations research and analytics. INFORMS promotes best practices and advances in operations research, management science, and analytics to improve operational processes, decision making, and outcomes through an array of highly-cited publications, conferences, competitions, networking communities, and professional development services.

TSL

The INFORMS Transportation Science and Logistics (TSL) Society provides INFORMS members with a specialized focus on all topics of transportation science and logistics, including current and potential problems and contributions to their solution, and supports efforts to extend, unify, and integrate related branches of knowledge and practice. The Society was formed in 2004 with the merger of the Transportation Science and Logistics Sections. The Society is the editorial home of one of INFORMS' flagship journals, Transportation Science. The Society includes five special interest groups: Air Transportation, Freight Transportation and Logistics, Urban Transportation Planning and Modeling, Facility Logistics, and Intelligent Transportation Systems.

ERIM

ERIM is the host institute of the TSL workshop 2021. Consistently ranked in the top of management research centers in Europe, the Erasmus Research Institute of Management (ERIM) has created an environment for the development of internationally recognized management knowledge with academic and societal impact since 1998. ERIM is the joint research institute of the Rotterdam School of Management and the Erasmus School of Economics both at Erasmus University of Rotterdam. It aims to bring together top researchers in business and management from each of these schools. ERIM researchers shape a community of over 350 management scientists dedicated to produce relevant and excellent research that adds innovative dimensions to management knowledge.

We wish everyone an enjoyable, productive and interactive workshop.

Niels Agatz, Shadi Sharif Azadeh and Remy Spliet

Program overview

Monday July 19 (Central European Summer Time)

14:00 – 14:30 **Opening**
14:30 – 15:30 **Parallel sessions 1**
1A (Mandeville room): *Behavior in planning and design*
1B (Tinbergen room): *Crowdsourcing*
15:30 – 15:45 **Break**
15:45 – 16:45 **Parallel sessions 2**
2A (Mandeville room): *Parking and urban mobility*
2B (Tinbergen room): *Aviation and pricing*
16:45 – 17:30 **Plenary by Emma Frejinger**
17:30 – 17:45 **Stretching event by Vitality-Superstar Zeki**
17:45 – 18:00 **Break**
18:00 – 19:00 **Parallel sessions 3**
3A (Mandeville room): *Collaborative transport*
3B (Tinbergen room): *Multimodal transport*

20:00 – 22:00 **Social event**

Tuesday July 20 (Central European Summer Time)

14:00 – 14:30 **Plenary by Jan Fabian Ehmke and Catherine Cleophas**
14:30 – 15:30 **Parallel sessions 4**
4A (Mandeville room): *Prediction and behavior*
4B (Tinbergen room): *Emerging technology*
15:30 – 15:45 **Break**
15:45 – 16:45 **Parallel sessions 5**
5A (Mandeville room): *Workforce scheduling*
5B (Tinbergen room): *Vehicle routing*
16:45 – 17:30 **Discussion Transportation Science by Karen Smilowitz and Ann Campbell**
17:30 – 17:45 **Break**
17:45 – 18:45 **Parallel sessions 6**
6A (Mandeville room): *Transport platforms*
6B (Tinbergen room): *Reliability*
18:45 – 19:00 **Close**

Monday July 19 - 14:30-15:30 (CEST)

Parallel session 1A (Mandeville room)

Behavior in planning and design

14:30 **Iterative Approaches for Integrating User Behavior into the Large Scale ODMTS Design Problem**

Beste Basciftci, Hongzhao Guan and Pascal Van Hentenryck

We study how to integrate rider mode preferences into the design of On-Demand Multimodal Transit Systems (ODMTS). We propose a bilevel optimization model, where the leader problem determines the ODMTS design while considering a choice model for riders, and the follower problems identify the most cost efficient and convenient route for riders. Although exact algorithms are important in finding optimal solutions, they may have limitations over large-scale instances. We propose several iterative solution algorithms to address this issue and present a case study demonstrating their effectiveness.

14:45 **Posted Price versus Auction Mechanisms in Freight Transportation Marketplaces**

Sungwoo Kim, Xuan Wang and He Wang

We consider a truckload marketplace where a platform serves an intermediary to match shippers with carriers. The objective of the platform is to design a mechanism that specifies how to set prices for shippers and payments to carriers, as well as how carriers and loads should be matched, to maximize its long-run average profit. This research analyzes theoretical performances of posted price, auction, and hybrid mechanisms which combines posted price and auction mechanisms.

15:00 **Modeling and solving line planning with integrated mode choice**

Johann Hartleb, Marie Schmidt, Dennis Huisman and Markus Friedrich

We present a MILP for line planning with integrated mode and route choice. The mode and route decisions are modeled according to passengers' preferences and commercial solvers can be applied to solve the corresponding MILP. The model aims at finding profit-maximizing line plans while estimating the corresponding passenger demand with choice models. By suitable preprocessing of the passengers' utilities, we can apply any choice model for mode choices using linear constraints. In experiments we show possibilities and limitations for operators when reacting to changes in travel demand.

15:15 **Customer-centric dynamic pricing for free-floating car sharing**

Jochen Gönsch, Christian Müller, Matthias Soppert and Claudius Steinhardt

As free-floating carsharing systems allow one-way rentals, they usually create imbalances: Some areas have a surplus of cars, while others have a shortage. To counteract this, providers use two strategies: The traditional one is active relocation, where employees drive the cars to where they are needed. Since this is quite costly, passive relocation via demand management through pricing incentives for customers is increasingly being considered. Our dynamic pricing approach builds on approximate dynamic programming to approximate expected future revenues with historical vehicle usage data.

Monday July 19 - 14:30-15:30 (CEST)

Parallel session 1B (Tinbergen room)

Crowdsourcing

14:30 **Dynamic Same-day Delivery with Crowd-shipping: Approximate Dynamic Programming approach**
Kianoush Mousavi, Merve Bodur, Mucahit Cevik and Matthew Roorda
We present a dynamic crowd-shipping model which employs in-store customers as crowd-shippers for delivering online orders within few hours to their delivery locations. Furthermore, we present an approximate dynamic programming solution algorithm to obtain a high-quality matching policy by incorporating spatial and temporal uncertainty of crowd-shippers and online orders.

14:45 **Fleet Size Problem with Crowdsourcing for Last-mile Delivery**
Juntaek Hong, Kangbok Lee, Kyungduk Moon, Haju Jang and Sunil Chopra
Industry-leading online retailers are operating their own last-mile fleet, expecting more control over the logistics networks and reduced total cost. As a result, they should manage private and crowdsourced vehicles at once. We present a fleet composition problem for a strategic decision on private fleet size regarding daily decisions on crowdsourced fleet size to minimize total cost. We also discuss regulations to be applied to crowdsourcing; We observe that an elaborated combination of minimum wage regulation and the benefit regulation may promote crowdsourcing in last-mile delivery.

15:00 **Marketplace Design for Crowdsourced Delivery**
Adam Behrendt, Martin Savelsbergh and He Wang
Crowdsourced delivery platforms face the challenge of meeting dynamic customer demand using couriers not employed by the platform. As a result, the delivery capacity of the platform is uncertain. To reduce the uncertainty, the platform can offer a reward to couriers that agree to make deliveries for a specified period of time. We consider a crowdsourced courier scheduling problem where scheduled and ad-hoc couriers serve dynamically arriving orders. We present a prescriptive method that combines simulation optimization for offline training and a neural network for online solution prescription.

15:15 **Personal Shopper Systems in Last-Mile Logistics**
Jelmer Pier van der Gaast and Alp Arslan
The demand for instant delivery has grown substantially recently. Nevertheless, instant delivery in last-mile logistics is complex and requires a novel service design. We develop a framework to study On-demand Personal Shopper Systems (OPSS) as an alternative instant last-mile logistics solution. Our customized real-time dispatching tool is able to explore the economic viability of an OPPS. Using empirically and synthetically created urban delivery environments, we study under which conditions an OPPS performs best and compare the system with an inventory-owned last-mile solution.

Monday July 19 - 15:45-16:45 (CEST)

Parallel session 2A (Mandeville room)

Parking and urban mobility

15:45 **Does parking matter in routing last-mile deliveries?**

Sara Reed, Ann Campbell and Barrett Thomas

Parking the delivery vehicle is a necessary component of traditional last-mile delivery practices but finding parking is often difficult. We explore the impact of the search time for parking on optimal routing decisions for last-mile delivery. The Capacitated Delivery Problem with Parking (CDPP) is the problem of a delivery person needing to park the vehicle in order to service customers on foot. We compare the CDPP to industry practices as well as other models in the literature to understand how including the search time for parking impacts the completion time of the delivery tour.

16:00 **A continuum approximation based approximated dynamic programming algorithm for designing largescale smart parking systems**

Xiaotian Wang and Xin Wang

This work considers a smart parking system, where the arrival (parking demand) and departure (parking supply) are dynamically managed through pricing instruments. A spatial pooling mechanism is used to improve the parking service quality under high market uncertainty. To incorporate the variation of market over time and describe the evolution dynamics of the system, a Markov Decision Process (MDP) is used to model the parking system. Then a Continuum Approximation (CA) based algorithm is proposed to tackle the curse of dimensionality, and provide accurate pricing and pooling decision supports.

16:15 **Can Autonomous Vehicles Solve the Commuter Parking Problem?**

Neda Mirzaeian, Soo-Haeng Cho and Sean Qian

We investigate a potential change in the commuting patterns in the era of autonomous vehicles (AVs). We characterize a user equilibrium for commuters by developing a continuous-time traffic model that takes into account parking fees and traffic congestion. In our model, commuters decide on their departure times and parking locations between downtown and outside downtown parking areas. We show that adjusting downtown parking fees and imposing congestion tolls lead to a significant reduction in total system cost and congestion. We illustrate our results using data from the City of Pittsburgh.

16:30 **Demand-Driven Scheduling for a Metro Corridor Using a Short-Turning Acceleration Strategy**

Tommaso Schettini, Ola Jabali and Federico Malucelli

In this paper, we propose a demand-driven optimization strategy for scheduling a two-directional metro corridor. In the proposed strategy, we avoid imposing any predetermined structure to the timetable and allow short-turning in the schedule of the trains, i.e., trains may reverse direction at intermediate stations of line. We present a MILP formulation for the problem, and develop an exact algorithm using cut generation. Through our experiments, we show the effectiveness of the developed algorithm and the added value of the proposed strategy in improving the passenger's waiting times.

Monday July 19 - 15:45-16:45 (CEST)

Parallel session 2B (Tinbergen room)

Aviation and pricing

15:45 **Vertiport Planning for Urban Aerial Mobility: An Adaptive Discretization Approach**

Kai Wang, Alexandre Jacquillat and Vikrant Vaze

This study optimizes the vertiport planning for Urban Aerial Mobility (UAM). It formulates an optimization model that captures interdependencies between vertiport deployment, operations, and adoption. The model includes a "tractable part" but also an intractable non-convex customer adoption function. To solve it, we develop an exact algorithm based on adaptive discretization. Computational results suggest that the algorithm converges to a 1% optimality gap effectively. Practically, we find that UAM networks vary widely across metropolitan areas due to geographic, urban, and commuting patterns.

16:00 **The value of flexible flight-to-route assignments in pre-tactical air traffic management**

Jan-Rasmus Kuennen and Arne Strauss

To inform current discussions on the future role of the network manager in air traffic management, we illustrate the value of flexible flight-to-route assignments by dynamically influencing airspace users' choices by pricing decisions to make flexible options more attractive when needed; the overall aim is to reduce costs arising from re-routings, tactical delays, and penalties (for violating fairness and revenue neutrality conditions). This problem is structurally related to the last mile next day delivery problem but poses some special challenges.

16:15 **Airline Network Planning: Data-driven Optimization with Demand-supply Interactions**

Sebastian Birolini, Alexandre Jacquillat, Mattia Cattaneo and Antonio Pais Antunes

This paper develops an original data-driven optimization model to address airline network planning decisions, while capturing interdependencies between airline supply and passenger demand. The model is formulated as a non-convex mixed-integer program. To solve it, we develop an exact cutting plane algorithm and show that it outperforms state-of-the-art discretization benchmarks. Case study results based on the network of a major European carrier show that the proposed approach provides stronger solutions than baselines that ignore—fully or partially—demand-supply interactions.

16:30 **A Benders decomposition approach for the choice-based uncapacitated facility location and pricing q problem**

Stefano Bortolomiol, Michel Bierlaire and Virginie Lurkin

We consider an uncapacitated facility location and pricing problem where demand is modeled at a disaggregate level using discrete choice models. Specifically, utility functions are included in the supplier's optimization problem by means of simulation. We propose a Benders decomposition approach which exploits the problem's block-diagonal structure and we develop a branch-and-Benders-cut algorithm. We present results that compare our approach with a black-box MIP solver. Finally, we discuss algorithm enhancements and future extensions to other classes of choice-based optimization problems.

Monday July 19 - 16:45-17:30 (CEST)

Plenary by Emma Frejinger

16:45 **Towards Integrated Forecasting and Optimization**

Emma Frejinger

Demand forecasts play a central role when solving various types of transport-related optimization problems. Yet the forecasting and optimization problems are typically studied separately, well aligned with the standard predict-then-optimize paradigm. In this talk we discuss problem settings arising in transportation where integrating the prediction and optimization problems is beneficial. In this context, we provide an overview of data, modelling and algorithmic challenges and we outline avenues for future research.

Monday July 19 - 18:00-19:00 (CEST)

Parallel session 3A (Mandeville room)

Collaborative transport

18:00 **Collaborative Transportation for Attended Home Delivery**

Steffen Elting, Jan Fabian Ehmke and Margaretha Gansterer

A challenge of last-mile deliveries is that customers and freight forwarders mutually agree on delivery time windows upon request arrival while future demand is stochastic. This may lead to situations where some deliveries are costlier than anticipated. We investigate whether the exchange of requests by means of horizontal carrier collaboration can reduce the total costs of delivery. Thus, we integrate ideas of auction-based request exchange in acceptance mechanisms of attended home deliveries. We show that request exchange allows for higher efficiency of attended home delivery operations.

18:15 **A collaborative planning model for sustainable intermodal transport**

Yimeng Zhang, Bilge Atasoy, Arne Heinold, Frank Meisel and Rudy Negenborn

A collaborative planning model is established for sustainable intermodal transport. Eco-labels, a series of different levels of emission ranges, are used to reflect shippers' environmental preferences. Each carrier uses an optimization model to minimize cost and the eco-labels are set as constraints. The carriers receive requests from shippers and exchange requests in a distributed collaboration. Results show that the number of served requests increases significantly after collaboration and shippers are more satisfied because emissions are reduced by using more barges.

18:30 **Scheduling Collaborative Passenger and Freight Transport on a Fixed Infrastructure**

Lena Hörsting and Catherine Cleophas

While last-mile transport increases congestion rates and pollution in urban areas, integrating deliveries with existing public transport infrastructure might make them more sustainable. This work presents a simulation to evaluate interlinking design decisions for collaborative passenger and freight transport on fixed infrastructure. To obtain a suitable train schedule and the allocation of cargo, we introduce a linear mixed-integer program with a lexicographical objective function. It minimises firstly the average number of passengers waiting at stops and secondly the mean delivery delay.

18:45 **Large-Scale Collaborative Vehicle Routing**

Johan Los and Frederik Schulte

Carriers can remarkably reduce transportation costs and emissions when they collaborate, for instance, using digital platforms. Such gains, however, have only been investigated for relatively small numbers of carriers. We develop auction-based methods for large-scale dynamic collaborative pickup and delivery problems, combining techniques of multi-agent systems and combinatorial auctions. Using a real-world data set of over 12000 orders, we show that travel costs can be reduced by about 75% when 1000 carriers collaborate, while individual rationality is guaranteed in each auction.

Monday July 19 - 18:00-19:00 (CEST)

Parallel session 3B (Tinbergen room)

Multimodal transport

18:00 **Eco-Labeling in Stochastic Dynamic Multimodal Transportation**

Arne Heinold, Frank Meisel and Marlin Wolf Ulmer

We analyze the impact of introducing eco-labels in the operations management of a multimodal long-haul freight transportation network. Shipments appear spontaneously over the planning horizon with uncertain characteristics (load, eco-label, etc.). Decisions are to be made sequentially about the used transport mode: consolidated via high-capacity vehicles or direct deliveries via trucks. We model the problem as a multi-objective MDP and solve it via value function approximation with basis functions, using objective specific feature sets and a combined supervised/unsupervised learning approach.

18:15 **Plan Your Trip and Price for Free: Designing a Multimodal Transit System**

Qi Luo, Siddhartha Banerjee, Chamsi Hssaine and Samitha Samaranayake

We consider a multimodal mobility system in which a transit agency controls on-demand vehicles and mass transit. Central to the operations of such an integrated system is to design a system that is consistent with commuters' choice. The joint pricing and line planning is proved to be no harder than vanilla line planning. An algorithmic framework disentangles the complexity of welfare maximization: finding an optimal set of lines to open and modes to display, and computing equilibrium prices. We demonstrate the practicality of this framework via numerical experiments on a real-world dataset.

18:30 **A Novel MILP Formulation and Lagrangian-based Heuristic for Transfer Synchronization in Transit Networks**

Zahra Ansarilari, Merve Bodur and Amer Shalaby

We study the transfer synchronization problem which aims at reducing passenger transfer waiting times in a transit network. We propose a mixed-integer programming model with new features and details that have been rarely considered in the literature such as dwell time and vehicle capacity. We develop a Lagrangian-based heuristic to obtain high-quality solutions efficiently for large networks. Our experiments on instances with up to 14 transfer nodes in the City of Toronto illustrate the potential benefits of the proposed model over a conventional model representing the state of the literature.

18:45 **A real online transportation supermarket: a two-sided assortment problem for freight**

Alberto Giudici, Jan van Dalen, Tao Lu and Rob Zuidwijk

Many transport marketplace problems have been treated in the literature through matching or assignment models where available transport capacity is matched to incoming demand.

In the real marketplace we consider, the mechanism leading to observed matches is principally different as transport dynamics are strictly related to market ones. In our model, we capture the interaction between transport supply and demand both at the operational and market-level by means of a dual-sided assortment model. We implement and test our data-driven solution at a 4PL platform operator.

Tuesday July 20 - 14:00-14:30 (CEST)

Plenary by Jan Fabian Ehmke and Catherine Cleophas

14:00 **Collaborative Urban Freight Transport: Challenges and Perspectives**

Jan Fabian Ehmke and Catherine Cleophas

Freight transport can negatively impact the quality of life in urban areas through congestion, emissions, and space consumption. Yet, environmentally friendly alternatives that rely on collaboration face severe challenges. Technological advancements and innovative business models may help to both distribute the pain and gain of collaboration and balance supply and demand. We analyze vertical and horizontal collaboration and strategic, tactical, and operational planning problems. Based on innovative examples of collaborative urban transportation, we highlight factors of failure and success.

Tuesday July 20 - 14:30-15:30 (CEST)

Parallel session 4A (Mandeville room)

Prediction and behavior

14:30 **Predicting the Performance of Multi-compartment Vehicle Fleets for Attended Home Delivery Services**
Christian Truden and Mike Hewitt
Grocery home delivery services, also known as attended home delivery services, have increased in popularity ever since they appeared in the early 2000s and have gained significant market share. Typically, vehicles having different temperature compartments are used to deliver groceries. Finding the right fleet size and mix is a crucial problem for the companies when extending delivery regions or establishing new delivery regions. We propose an approach to predict the performance of a given fleet mix based on the expected number of purchases and basket sizes.

14:45 **Dynamic Time Slot Management with Uncertain Basket Sizes**
Liana van der Hagen, Niels Agatz and Remy Spliet
E-grocers typically let customers choose a delivery time slot to receive their groceries. The retailer wants to only accept orders that are feasible given the fulfillment capacity (i.e., vehicles). At the same time, many e-grocers let customers reserve a time slot before filling an order basket and they allow customers to change their order at any time before the cut-off. As a result, the capacity required for each order is uncertain when evaluating the feasibility of a certain time slot offering. We evaluate the impact of this uncertainty on the delivery schedule using a simulation study.

15:00 **The short term impacts of a bunker levy as a maritime MBM**
Sotiria Lagouvardou and Harilaos Psaraftis
This presentation focuses on the short-term impacts of implementing an MBM, i.e., a levy on bunker fuels as a decarbonization policy for ships. Based on the industry's response during market price fluctuations, we determined the range of emissions reductions achieved upon implementing a bunker levy. We focused on the tanker segment and the evolution of spot rates and fuel prices from 2010-2018. Finally, we developed a model that can estimate the optimal laden and ballast speed for various levy scenarios and calculates the final CO2 emissions for a tanker case study.

15:15 **Periodic Freight Demand Forecasting for Large-scale Tactical Planning**
Greta Laage, Emma Frejinger and Gilles Savard
Most problem settings for service network design problems assume that a cyclic plan is repeated over a tactical horizon. The aim is to find a plan to satisfy demand at minimum cost. For computational tractability, most real large-scale problems require a deterministic formulation whose central input is the periodic demand. We focus on its estimation. Through a multilevel formulation, we link time series forecasts to the service network design problem to estimate the periodic demand which minimizes the cost. We illustrate on a large-scale application from the Canadian National Railway Company.

Tuesday July 20 - 14:30-15:30 (CEST)

Parallel session 4B (Tinbergen room)

Emerging technology

14:30 **Multi-visit traveling salesman problem with multi-drones**

Mark Poon, Zhihao Luo, Zhenzhen Zhang and Andrew Lim

The problem aims to minimize the makespan required by the truck and the drones to serve all customers, where the energy consumption depends on the flight time and the total weight carried by the drone. The problem is formulated into a mixed-integer program. A heuristic algorithm is developed with tailored neighborhood structures and a two-level solution evaluation method with drone-level segment-based evaluation and a solution-level critical path method. The experimental results show a significant cost reduction when considering multi-visits, multi-drones, and powerful drones.

14:45 **Robust Drone-Aided Delivery**

Yu Yang, Chiwei Yan and Yufeng Cao

We consider a robust drone-aided package delivery problem where a truck and a drone serve a set of customers in coordination. The drone has limited capacity and range, and has to frequently come back to the truck for charging and reloading. We consider the problem under travel and delivery time randomness as the coordination of the routes can be (easily) disrupted with uncertainty. We develop an original robust-optimization based formulation and an exact branch-and-price-and-cut algorithm to efficiently compute robust routes.

15:00 **Load Retrieval in a Puzzle Based Storage System with Autonomous Mobile Robots**

Tal Raviv, Yossi Bukchin and Rene de Koster

We study a puzzle-based storage (PBS) system, where pods of items are carried on a limited number of automated mobile robots (AMRs). The PBS contains cells, where each cell may be occupied by a pod or be empty. The AMRs can move parallel to the walls of the rectangular PBS units either in empty cells or beneath the pods. Upon requesting a load retrieval, a series of AMRs and loads movements are performed to enable the requested load to arrive at the I/O point. We present a set of algorithms for minimizing the time or number of movements for load retrieval from such a system.

15:15 **Full Cover Charging Station Location Problem With Routing**

Omer Kinay, Fatma Gzara and Sibel Alumur Alev

A new modeling framework is developed to determine charging station locations to enable long-distance transportation. This model determines the optimal locations of charging stations and builds origin-destination routes for every long-distance trip on a transportation network. A Benders decomposition algorithm is developed to solve real-life instances. A subproblem solution algorithm is developed to generate non-dominated optimality cuts and strong feasibility cuts. This novel algorithm is shown to accelerate the performance of the Benders algorithm significantly.

Tuesday July 20 - 15:45-16:45 (CEST)

Parallel session 5A (Mandeville room)

Workforce scheduling

15:45 **An Incentive Problem in Order Dispatching with Heterogeneous Drivers**

Chiwei Yan

I will discuss a driver incentive problem motivated by the heterogeneous driver base in ridesharing/delivery platforms. Drivers have different compatibilities over jobs (e.g., destinations of the rides). We show that naively reserving flexible drivers incentivizes drivers to pretend to be more specialized and can potentially deliver worse outcomes for the platform. We devise a simple yet robust policy under strategic environment. We also discuss a real-world implementation of the proposed policy at Uber. The talk is based on the working paper: "Matching Queues, Flexibility and Incentives".

16:00 **Increasing Driver Flexibility through Personalized Menus and Incentives in Ridesharing Platforms**

Hannah Horner, Jennifer Pazour and John Mitchell

Allowing ridesharing drivers to choose from a menu of requests provides much-needed autonomy. While stochastic, a driver's acceptance of requests is influenced by the platform's offered compensation. Therefore, in this work, we formulate a stochastic linear integer program and develop solution methods to determine personalized menus and incentives to offer drivers. Experiments using parameters influenced by real-world data provides insights into how a ridesharing platform can strategically use incentives to increase driver participation, increase drivers' incomes, and match more requests.

16:15 **Workforce scheduling to match supply and demand in emergency response**

Mariana Escallon-Barrios, Reut Noham and Karen Smilowitz

Emergency response operations are characterized by uncertainty in event occurrence. We analyze how to satisfy the demand combining two types of scheduling processes: one that self-schedule (SSW) and one that is scheduled by a centralized planner (CSW). We explore ways in which the anticipated choices of SSWs can be incorporated into plans for CSW work shifts, thus efficiently matching supply and demand. We present a choice exercise to understand the SSW response and parametrize the CSW scheduling model. We present a case study based on operational data from an emergency response organization.

16:30 **Learning- and optimization-based strategies for AMoD systems with service quality contracts and on-demand hiring of idle vehicles**

Breno Beirigo, Frederik Schulte, Javier Alonso-Mora and Rudy Negenborn

Aiming to consistently meet the expected service quality of autonomous mobility-on-demand (AMoD) users, we propose an approximate dynamic programming (ADP) algorithm and a multi-objective matheuristic to hire idle independently-owned AVs on short notice. We consider these freelance AVs (FAVs) occasionally work for the AMoD provider to guarantee that heterogeneous user preferences, formalized as service quality contracts, are entirely fulfilled. Our approach allows AMoD providers to adequately cater to different segments of the user base without necessarily owning large AV fleets.

Tuesday July 20 - 15:45-16:45 (CEST)

Parallel session 5B (Tinbergen room)

Vehicle routing

15:45 **A branch-price-and-cut algorithm for the multi-commodity two-echelon capacitated vehicle routing problem with time windows**

Tayeb Mhamedi, Guy Desaulniers and Marilène Cherkesly

We address the multi-commodity two-echelon capacitated vehicle routing problem with time windows (MC2E-VRPTW). In the MC-2E-VRPTW, first-echelon routes handle transportation of goods from depots to satellites while second-echelon routes, departing from satellites, ensure that goods are being shipped to customers within their allowed time windows. Each customer's demand is available at a specific depot and is supplied by a single first-echelon vehicle. We propose a branch-price-and-cut algorithm to solve the MC2E-VRPTW.

16:00 **Solution Approaches for the Rendezvous Vehicle Routing Problem**

Eric Oden, Bruce Golden and S. Raghu Raghavan

We consider a novel scheme for same-day delivery, in which small vehicles (shuttles) intercept trucks moving along their fixed routes to transfer packages ordered at the last minute. This scheme can lead to significant transportation savings, as shuttles need not travel as far to serve the last-minute requests. We present a column generation algorithm which can generate optimal solutions for reasonably-sized instances. We also develop and demonstrate the effectiveness of a specialized heuristic for use in larger instances.

16:15 **Multi-period Vehicle Routing: Quantifying the Long-term Cost Savings from Flexibility in Delivery Day Windows**

Aliakbar Izadkhah, Anirudh Subramanyam, Jose M. Lainez-Aguirre, Jose M. Pinto and Chrysanthos E. Gounaris

We explore the potential benefit of flexible delivery day windows in the context of distribution operations that involve vendor-managed and customer-managed orders. To that end, we have created a simulation framework with a built-in forecast that incorporates historical data to estimate daily customer-specific order placements. The engine solves weekly snapshots using a combined exact branch-and-cut and branch-price-and-cut multi-period vehicle routing problem solver, adopts the optimal routes for the next day, evolves the forecasts, and repeats the procedure in a rolling horizon fashion.

16:30 **A Fast and Scalable Heuristic for the Solution of Large-Scale Capacitated Vehicle Routing Problems Luca** Accorsi and Daniele Vigo

We propose a fast and scalable, yet effective, metaheuristic called FILO to solve large-scale instances of the Capacitated Vehicle Routing Problem. Our approach consists of a main iterative part, based on the Iterated Local Search paradigm, which employs a combination of existing acceleration techniques and strategies to keep the optimization localized, controlled and tailored to the current solution. Results on extensively studied benchmark instances show the effectiveness of the proposed approach, making FILO highly competitive with existing state-of-the-art algorithms.

Tuesday July 20 - 16:45-17:30 (CEST)

Plenary discussion Transportation Science by Karen Smilowitz and Ann Campbell

16:45 **Transportation Science: An open discussion of recent changes to the journal**

Karen Smilowitz and Ann Campbell

Having recently celebrated its 50th Anniversary, Transportation Science is in a period of significant growth. In January 2021, the journal introduced a new editorial structure to accommodate this growth and maintain the rigor and quality that is the hallmark of the journal and its review process. In this interactive session, we will present an overview of the new editorial structure, along with other changes introduced to support the new structure and foster continuous improvement for the journal. Attendees will participate in an activity mapping exciting topics in transportation science to the topical areas and envisioning ways to ensure that more of those papers are directed to the journal. We will also discuss the ways in which these changes are linked to broader INFORMS initiatives related to Diversity, Equity and Inclusion.

Tuesday July 20 - 17:45-18:45 (CEST)

Parallel session 6A (Mandeville room)

Transport platforms

17:45 **Supplier Menus for Dynamic Matching in Peer to Peer Transportation Platforms**

Rosemonde Ausseil, Jennifer Pazour and Marlin Ulmer

In crowdsourced peer-to-peer transportation, it is not certain that suppliers (drivers) accept matching decisions. To mitigate this uncertainty, a platform can offer each supplier a menu of requests to choose from, balacing the trade-off between selection probability and duplicate selections. We propose a multiple scenario approach, sampling a set of selection scenarios and creating menus accordingly. Our method leads to more balanced assignments over the system and better system performance for all stakeholders involved, including increased revenue and decreased waiting times.

18:00 **Assessing the operational impact of planning models for bike-sharing redistribution**

Bruno Albert Neumann Saavedra, Dirk Christian Mattfeld and Mike Hewitt

We discuss the value and limitations of stochastic programming for bike-sharing redistribution. We analyze variability in ride data from three bike-sharing systems which mainly differ in the intensity of commuting. The data analysis shows that stations that are mainly used by commuters display less demand variability than stations that are used for leisure purposes. To evaluate the operational implementation of redistribution plans, we rely on simulation. The results show that demand variability is a leading indicator about whether redistribution plans perform well operationally.

18:15 **Data-driven fleet steering in meal delivery operations**

Alp Arslan, Martin Savelsbergh, Shadi Sharif Azadeh and Yousef Maknoon

One of the main challenges of on-demand meal delivery platforms is to provide an on-time fulfillment service while using limited delivery resources. In case the platform has a predetermined courier capacity, we investigate the impact of fleet steering, in which couriers can be repositioned with respect to future order arrivals. In particular, we propose a mechanism that governs the order-driver assignment decisions through steering actions. We test our approach in Berlin, Germany. The results reveal that the fleet steering framework increases on-time meal deliveries.

18:30 **Fleet Sizing and Service Region Partitioning for Same-Day Delivery Systems**

Dipayan Banerjee, Alan Erera and Alejandro Toriello

We study fleet sizing and service region partitioning for same-day delivery from a tactical system design perspective. To facilitate partitioning a service region into zones, we first consider the problem of maximizing the area of a single-vehicle zone. Using continuous approximation methods, we solve an optimization model to characterize the maximum zone area as a function of a zone's distance from the depot. We show how these zone areas can be used to determine the minimum required fleet size, and we validate our approach by constructing a feasible partition and simulating order arrivals.

Tuesday July 20 - 17:45-18:45 (CEST)

Parallel session 6B (Tinbergen room)

Reliability

17:45 **Schedule-based assignment for unreliable transit networks**

Pramesh Kumar and Alireza Khani

The current research proposes a schedule-based transit assignment for transit networks with unreliable service. It models the real-time information accessed by the passengers through cellphone applications in making adaptive routing decisions. Passengers are assigned on routing policies with minimum generalized cost computed using the Bellman equation. A numerical example is shown on Tong and Richardson's (1981) network.

18:00 **Robust-stochastic models for profit maximizing hub location problems**

Gita Taherkhani, Sibel Alumur Alev and Mojtaba Hosseini

This paper introduces robust-stochastic models for profit-maximizing hub location problems in which two different types of uncertainty including stochastic demand and uncertain revenue are simultaneously incorporated into the problem. First, a two-stage stochastic program is presented where demand and revenue are jointly stochastic. Next, robust-stochastic models are developed to better model uncertainty in the revenue while keeping the demand stochastic. Mathematical formulations for each of these cases are presented and exact algorithms based on Benders decomposition are developed.

18:15 **Incorporating Service Reliability in Multi-depot Vehicle Scheduling: A Chance-Constrained Approach**

Margarita Castro, Merve Bodur and Amer Shalaby

The multi-depot vehicle scheduling problem (MDVSP) is one of the main planning problems for transit agencies. We present a novel stochastic variant of the MDVSP that guarantees service reliability, measured by on-time performance (OTP) at route terminals. We propose a chance-constrained optimization model and a logic-based Benders decomposition (LBBD) algorithm to solve it. Our experimental evaluation shows the value of our stochastic variant to achieve OTP as well as the computational advantages of our LBBD approach.

18:30 **Reinforcement Learning for Fleet and Demand Control in Stochastic Dynamic Pickup and Delivery**

Florentin Hildebrandt, Žiga Lesjak, Arne Strauss and Marlin Ulmer

The demand for same-day pickup and delivery has grown rapidly in recent years (e.g., meal delivery). Fast, scalable, effective assignment of couriers is crucial for high-quality service. Another powerful tool is nudging customers towards choosing the "right" pickup location (restaurant). We learn both at once with the help of an attention-based Q-network. The network considers the state of the entire delivery fleet in detail and is independent of the fleet size. Our study, based on customer selection data from a meal delivery platform, highlights the benefits of anticipation and nudging.