

## FEMM - Working Paper Series - 2022

› FEMM-Antrag ([https://fww.ovgu.de/fww\\_media/femm/FEMM.pdf](https://fww.ovgu.de/fww_media/femm/FEMM.pdf))

### Working Paper Series auf der OVGU-Journals-Plattform

22009

**Dmitri Bershadskyy, Sunil Ghadwal, Jannik Greif**

› MTV - Magdeburg Tool for Videoconferences ([https://fww.ovgu.de/fww\\_media/femm/femm\\_2022/2022\\_09.pdf](https://fww.ovgu.de/fww_media/femm/femm_2022/2022_09.pdf))

Abstract:

MTV is a software tool (citeware) for economic experiments facilitating researchers to gather video data from communication-based experiments in a way that these can be later used for automatic analysis through machine learning techniques. The browser-based tool comes with an easy user interface and can be easily integrated in z-Tree or oTree. It provides the experimenters control about several communication parameters (e.g., number of participants, duration), produces high-quality video data, and circumvents the Cocktail Party Problem by producing separate audio files. Using some of the recommended Voice-to-Text AI, the experimenters can transcribe individual audio files. MTV can merge these individual transcriptions to one conversation. This paper describes the underlying principles of the tool, technical requirements, possible areas of application, and current limitations.

JEL:

C80, C88, C90

Keywords:

22008

**Rosemonde Ausseil, Marlin W. Ulmer, Jennifer A. Pazour**

› Dynamic Optimization in Peer-To-Peer Transportation with Acceptance Probability Approximation  
([https://fww.ovgu.de/fww\\_media/femm/femm\\_2022/2022\\_08.pdf](https://fww.ovgu.de/fww_media/femm/femm_2022/2022_08.pdf))

Abstract:

Crowdsourced transportation by independent suppliers (or drivers) is central to urban delivery and mobility platforms. While utilizing crowdsourced resources has several advantages, it comes with the challenge that suppliers are not bound to assignments made by the platforms. In practice, suppliers often decline offered service requests, e.g., due to the required travel detour, the expected tip, or the area a request is located. This leads to inconveniences for the platform (ineffective assignments), the corresponding customer (delayed service), and also the suppliers themselves (non-fitting assignment, less revenue). In this work, we show how approximating suppliers' acceptance behavior by analyzing their past decision making can alleviate these inconveniences. To this end, we propose a dynamic matching problem where suppliers' acceptances or rejections of offers are uncertain and depend on a variety of request attributes. Suppliers who accept an offered request from the platform are assigned and reenter the system after service looking for another offer. Suppliers declining an offer stay idle to wait for another offer, but leave after a limited time if no acceptable offer is made. Every supplier decision reveals partial information about the suppliers' acceptance behavior, and in this paper, we present a corresponding mathematical model and a solution approach that translates supplier responses into the probability of a specific supplier to accept a specific future offer and uses this information to optimize subsequent offering decisions. We show that our approach leads to overall more successful assignments, more revenue for the platform and most of the suppliers, and less waiting for the customers to be served. We also show that considering individual supplier behavior can lead to unfair treatment of more agreeable suppliers.

JEL:

Keywords: peer-to-peer transportation, dynamic matching, supplier-side choice, stochastic acceptance behavior, restaurant meal delivery

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22007

**Charlotte Ackva, Marlin Ulmer**

› Consistent Routing for Local Same-Day Delivery via Micro-Hubs

([https://fww.ovgu.de/fww\\_media/femm/femm\\_2022/2022\\_07.pdf](https://fww.ovgu.de/fww_media/femm/femm_2022/2022_07.pdf))

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Abstract:

An increasing number of local shops offer local same-day delivery to compete with the online giants. However, the distribution of parcels from individual shops to customers reduces the rare consolidation opportunities in the last mile even further. Thus, shops start collaborating on urban same-day delivery by using shared vehicles for consolidated transportation of parcels. The shared vehicles conduct consistent daily routes between micro-hubs in the city, serving as transshipment and consolidation centres. This allows stores to bring orders to the next micro-hub, where the parcel is picked up by a vehicle and delivered to the microhub closest to its destination – if it is feasible with respect to the vehicle’s consistent daily schedule. Creating effective schedules is therefore very important. The difficulty of finding an effective consistent route is amplified by the daily uncertainty in order placements. We model the problem as a two-stage stochastic program. The first stage determines the vehicle schedules. The second stage optimises the flow of realized orders. The goal is to satisfy as many orders per day as possible with the shared vehicles. We propose a multiple scenario approach and suggest problem-specific consensus functions for this framework. We assess the method’s performance against an upper bound, a practically inspired heuristic, and the original consensus function. Our approach clearly outperforms the practically-inspired heuristic and the original consensus function. We observe that collaborative delivery via micro-hubs is worthwhile for delivery time promises of two hours or more. Noticeably, for these service promises, the cost of consistency are surprisingly low.

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JEL:

Keywords: micro-hubs, same-day delivery, routing consistency, two-stage stochastic programming, multiple scenario approach

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22006

**Alexander Bosse, Marlin W. Ulmer, Emanuele Manni, Dirk C. Mattfeld**

› Dynamic Priority Rules for Combining On-Demand Passenger Transportation and Transportation of Goods

([https://fww.ovgu.de/fww\\_media/femm/femm\\_2022/2022\\_06.pdf](https://fww.ovgu.de/fww_media/femm/femm_2022/2022_06.pdf))

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Abstract:

Urban on-demand transportation services are booming, in both passenger transportation and the transportation of goods. The types of service differ in timeliness and compensation and, until now, providers operate larger fleets separately for each type of service. While this may ensure sufficient resources for lucrative passenger transportation, the separation also leaves consolidation potentials untapped. In this paper, we propose combining both services in an anticipatory way that ensures high passenger service rates while simultaneously transporting a large number of goods. To this end, we introduce a dynamic priority policy that uses a time-dependent percentage of vehicles mainly to serve passengers. To find effective time-dependent parametrizations given a limited number of runtime-expensive simulations, we apply Bayesian Optimization. We show that our anticipatory policy increases revenue and service rates significantly while a myopic combination of service may actually lead to inferior performance compared to using two separate fleets.

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JEL:

Keywords: Routing, Stochastic dynamic vehicle routing, Ride-hailing, Instant delivery, Bayesian Optimization

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22005

**Nils Boysen, Stefan Schwerdfeger, Marlin Ulmer**

› Robotized sorting systems: Large-scale scheduling under real-time conditions with limited lookahead

([https://fww.ovgu.de/fww\\_media/femm/femm\\_2022/2022\\_05.pdf](https://fww.ovgu.de/fww_media/femm/femm_2022/2022_05.pdf))

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Abstract:

A major drawback of most automated warehousing solutions is that fixedly installed hardware makes the

inflexible and hardly scalable. In the recent years, numerous robotized warehousing solutions have been innovated, which are more adaptable to varying capacity situations. In this paper, we consider robotized sorting systems where autonomous mobile robots load individual pieces of stock keeping units (SKUs) at a loading station, drive to the collection points temporarily associated with the orders demanding the pieces, and autonomously release them, e.g., by tilting a tray mounted on top of each robot. In these systems, a huge number of products approach the loading station with an interarrival time of very few seconds, so that we face a very challenging scheduling environment in which the following operational decisions must be taken in real time: First, since pieces of the same SKU are interchangeable among orders with a demand for this specific SKU, we have to assign pieces to suitable orders. Furthermore, each order has to be temporarily assigned to a collection point. Finally, we have to match robots and transport jobs, where pieces have to be delivered between loading station and selected collection points. These interdependent decisions become even more involved, since we (typically) do not possess complete knowledge on the arrival sequence but have merely a restricted lookahead of the next approaching products. In this paper, we show that even in such a fierce environment sophisticated optimization, based on a novel two-step multiple-scenario approach applied under real-time conditions, can be a serviceable tool to significantly improve the sortation throughput.

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JEL:

Keywords: Warehousing; Robotized sorting systems; Dynamic scheduling; Multiple-scenario approach

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**22004**

**Julia Zimmermann**

› On the design of a flow line with intermediate buffers and mixed corrective maintenance

([https://www.ovgu.de/fww\\_media/femm/femm\\_2022/2022\\_04.pdf](https://www.ovgu.de/fww_media/femm/femm_2022/2022_04.pdf))

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Abstract:

We considered a mixed corrective maintenance policy for machines in a two-machine one-buffer flow line. The machines had stochastic processing times and suffered from unexpected failures. In the case of a failure, the machines were either minimally repaired or their failing components were replaced by spare parts. While the replacement strategy is rapid and the system can be considered new thereafter, spare parts provisioning and storage costs are very high. Thus, we additionally considered minimal repairs, which are less expensive and restore the system to a working condition at a minimum. We modeled the system as a continuous-time Markov chain. This approach was used to measure the performance of the flow line and the mixed corrective maintenance policy employed. To facilitate design decisions for the flow line, we considered both the cost of an interstage buffer and the maintenance costs for machines in line. We formulated an optimization problem based on a profit function that enables the simultaneous optimization of the buffer size and maintenance strategy. Our numerical analyses reveal useful insights into the performance and optimal design of the flow line depending on the utilized maintenance strategy.

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JEL:

Keywords: flow line, buffer, spare parts, mixed corrective maintenance

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**22003**

**Jarmo Haferkamp/Marlin Wolf Ulmer/Jan Fabian Ehmke**

› Heatmap-based Decision Support for Repositioning in Ride-Sharing Systems

([https://www.ovgu.de/fww\\_media/femm/femm\\_2022/2022\\_03.pdf](https://www.ovgu.de/fww_media/femm/femm_2022/2022_03.pdf))

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Abstract:

In ride-sharing systems, platform providers aim to distribute the drivers in the city to meet current and potential future demand and to avoid service cancellations. Ensuring such distribution is particularly challenging in the case of a crowdsourced fleet, as drivers are not centrally controlled but are free to decide where to reposition when idle. Thus, providers look for alternative ways to ensure a vehicle distribution that benefits both users and drivers, and consequently the provider. We propose an intuitive means to improve idle ride-sharing vehicles' repositioning: repositioning opportunity heatmaps. These heatmaps highlight driver-specific earning opportunities approximated based on the expected future demand, fleet distribution, and location of the specific driver. Based on the heatmaps, drivers make decentralized yet better-informed repositioning decisions. As our heatmap policy changes the driver distribution, we propose an adaptive learning algorithm for designing our heatmaps in large-scale ride-

sharing systems. We simulate the system and generate heatmaps based on previously learned repositioning opportunities in every iteration. We then update these based on the simulation's outcome and use the updated values in the next iteration. We test our heatmap design in a comprehensive case study on New York ride-sharing data. We show that carefully designed heatmaps reduce service cancellations therefore revenue loss for platform and drivers significantly.

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JEL:

Keywords:

mobility-on-demand, vehicle repositioning, crowdsourced transportation, heatmap, stochastic dynamic decision making, adaptive learning

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**22002**

**Dr. Dirk Betz/Dr. Claudia Biniossek/Harald Wypior/Dr. Claus-Peter Klas/Narges Tavakolpoursaleh**

› Metadata Schema x-econ Repository ([https://fww.ovgu.de/fww\\_media/femm/femm\\_2022/2022\\_02.pdf](https://fww.ovgu.de/fww_media/femm/femm_2022/2022_02.pdf))

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Abstract:

Since May 2017, the x-hub project partners OVGU Magdeburg, University of Vienna, and GESIS dispose of a new repository, called x-econ (<https://x-econ.org>). The service is dedicated to all experimental economics research projects to disseminate user-friendly archiving and provision of experimental economics research data.

The repository x-econ contains all necessary core functionalities of a modern repository and is in a continuous optimization process aiming at functionality enhancement and improvement. x-econ is also one pillar of the multidisciplinary repository x-science (<https://x-science.org>).

The present documentation, which is primarily based on the GESIS Technical Reports on datorium 2014|03 and da|ra 4.0, lists and explains the metadata elements, used to describe research information.

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JEL:

Keywords:

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**22001**

**Barbara Schöndube-Pirchegger**

› Internal and External Information System Choices and Mutual Interdependencies

([https://fww.ovgu.de/fww\\_media/femm/femm\\_2022/2022\\_01.pdf](https://fww.ovgu.de/fww_media/femm/femm_2022/2022_01.pdf))

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Abstract:

In this paper, we consider a one shot principal agent problem. The owner of the firm (principal) hires a manager (agent). As firm value is non-contractible by assumption, an incentive contract is written on accounting income. The manager performs some productive task that increases firm value as well as income but can also engage in earnings management to increase income only.

The owner needs to make several simultaneous choices. First, he needs to decide whether to implement an internal information system (IIS). Second, he has to choose from a set of (external) financial reporting systems that differ with regard to accounting discretion. Third, he needs to specify contracting details.

If an internal information system is implemented it provides the manager with private information about the business environment, which, in turn, affects effort costs. In contrast, the financial reporting system choice affects the effectivity of earnings management activities undertaken by the manager.

In the absence of an internal information system, the agency problem considered is a moral hazard problem that arises from private effort choices of the manager. Implementing an internal information system creates an adverse selection problem on top of the moral hazard problem.

We find that for both problems agency costs increase if the business environment becomes more volatile. Holding either the IIS choice or the accounting system choice constant, we observe the following: Without an IIS, it is optimal to choose the least discretionary accounting system available. With an IIS it can either be advisable to choose the most or least discretionary accounting system depending on the probability distribution of business environments to be present.

For any given accounting system, the principal implements an IIS if the volatility of the business environment is sufficiently high and v.v. The less discretionary the accounting system, however, the more volatile the business environment needs to be for an IIS to become favorable.

It follows that both, accounting system and IIS choice, are mutually interdependent. E.g. it might be optimal for the principal to choose the most discretionary accounting system along with implementing an IIS. In contrast, it might be optimal not to implement an IIS along with the least discretionary accounting

system depending on parameter values.

JEL:

Keywords:

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