29. Workshop der quantitativen Betriebswirtschaftslehre

18.03.2019 bis 21.03.2019
Schloss Hirschberg
(Beilngries im Altmühltal)

Version 2.0 (11. März 2019)

Tagungsprogramm QBWL-Workshop 2019

Montag, 18.03.2019

14:30 Uhr – 15:00 Uhr **Kaffee und Kuchen**

15:00 Uhr – 15:30 Uhr **Begrüßung und Vorstellung der Lehrstühle**

Prof. Dr. Heinrich Kuhn (Katholische Universität Eichstätt-Ingolstadt)

1. Sitzung, Leitung: Prof. Dr. Horst Tempelmeier (Universität zu Köln)

15:30 Uhr – 16:30 Uhr **Humanitarian Logistics**

Sarah Jacke (Universität Duisburg-Essen) 30 Minuten
Synchronisierte Wiederherstellung von interdependenten Netzwerken

Yongsheng Zhu (Universität Hamburg) 10 Minuten
Cash Based Intervention in the Global Humanitarian Supply Chain – A Stochastic Application

Usama Dkaidik (Universität Hamburg) 20 Minuten
Spatial allocation of pilgrim groups based on their time preference

2. Sitzung, Leitung: Prof. Dr. Florian Sahling (TU Kaiserslautern)

16:50 Uhr – 18:00 Uhr **Energy Technology**

Stephan Fichtner (Universität Hohenheim) 20 Minuten
Biogas plant optimization by increasing its flexibility

Benedikt Finnah (Universität Duisburg-Essen) 30 Minuten
Optimale Betriebsführung von Pumpspeicherkraftwerken an den deutschen Auktionsmärkten

Gregor Godbersen (Technische Universität München) 20 Minuten
Using branch-and-price to plan charging infrastructure locations for electric taxis

18:00 Uhr – 19:00 Uhr **Abendessen**

3. Sitzung, Leitung: Prof. Dr. Dirk Briskorn (Bergische Universität Wuppertal)

19:00 Uhr – 20:00 Uhr **Lot-sizing**

Fabian Lenz (Universität Hohenheim) 10 Minuten
A multi-stage simultaneous lot-sizing and scheduling model for the chemical process industy

Michael Fuchs (Universität Duisburg-Essen) 30 Minuten
Losgrößenplanung unter stochastischen Bedingungen

Markus Mickein (Universität Hamburg) 20 Minuten
Mehrstufige Losgrößenplanung – Ein Praxisbeispiel aus der Brauindustrie

20:30 Uhr **Treffen der Professoren**

Dienstag, 19.03.2019

07:30 Uhr – 08:15 Uhr **Frühstück**

4. Sitzung, Leitung: Prof. Dr. Alf Kimms (Universität Duisburg-Essen)

08:30 Uhr – 09:40 Uhr **Retail Operations / *Revenue Management***

Jonas Schwamberger (Universität Mannheim) 10 Minuten
Challenges and Drivers of E-Fulfillment

Tobias Potoczki (Kath. Universität Eichstätt-Ingolstadt) 30 Minuten
Design of distribution systems in grocery retailing

Maximilian Herz (Universität Augsburg) 30 Minuten
Revenue management for dynamic order acceptance and scheduling

9:40 Uhr – 10:10 Uhr **Kaffeepause**

5. Sitzung, Leitung: Prof. Dr. Rainer Kolisch (Technische Universität München)

10:10 Uhr – 11:10 Uhr **Sequencing**

Stefan Schwerdfeger (Friedrich-Schiller-Universität Jena) 30 Minuten
Sequencing of picking orders to facilitate the replenishment of A-Frame systems

Stefan Bugow (Leibniz Universität Hannover) 30 Minuten
LKW-Reihenfolgeplanung an Paketsortieranlagen unter Beachtung flexibler Entladegeschwindigkeiten

6. Sitzung, Leitung: Prof. Dr. Erwin Pesch (Universität Siegen)

11:10 Uhr – 12:00 Uhr **Port Logistics**

Adriana Moros (Universität Hamburg) 20 Minuten
Port Community Systems (PCS) in emergent economies: case study Colombia

Lennart Zey (Bergische Universität Wuppertal) 30 Minuten
Twin-crane scheduling with a dedicated handshake area during seaside workload peaks

12:00 Uhr – 13:00 Uhr **Mittagessen**

Tutorium, Leitung: Prof. Dr. Moritz Fleischmann (Universität Mannheim)

13:15 Uhr – 14:45 Uhr **Tutorium**

Stefan Helber (Leibniz Universität Hannover) 90 Minuten

Markow-Ketten und ihre Anwendungen:
Vom Segen eines fehlenden Gedächtnisses und fehlender Koordination

14:45 Uhr – 15:15 Uhr **Kaffeepause**

7. Sitzung, Leitung: Prof. Dr. Jochen Gönsch (Universität Duisburg-Essen)

15:15 Uhr – 16:15 Uhr **Vehicle Routing I**

Michael Dienstknecht (Bergische Universität Wuppertal) 10 Minuten
Last Mile Logistics

Lukas Janinhoff (Universität Augsburg) 30 Minuten
Vehicle routing with delivery options

Finn Meissner (Helmut-Schmidt-Universität Hamburg) 20 Minuten
The Rebound Effect in Transportation

8. Sitzung, Leitung: Prof. Dr. Knut Haase (Universität Hamburg)

16:30 Uhr – 17:20 Uhr **Vehicle Routing II; Inventory Systems**

Stefan Voigt, Markus Frank (KU Eichstätt-Ingolstadt) 10 Minuten
Minimizing failed-delivery costs with customer-related data

Christian Jost (Technische Universität München) 20 Minuten
Consistent Vehicle Routing and Its Influence on Priority-Based Pickup Decisions

Jun. Prof. Dr. Danja Sonntag (Universität Mannheim) 20 Minuten
Controlling Distribution Inventory Systems with Shipment Consolidation and Compound Poisson Demand

18:00 Uhr – 19:00 Uhr **Abendessen**

20:00 Uhr **QBWL-Games im Großen Hörsaal**

Mittwoch 20.03.2019

07:30 Uhr – 08:15 Uhr **Frühstück**

9. Sitzung, Leitung: Prof. Dr. Sven Müller (Europa Uni. Viadrina Frankfurt/Oder)

08:30 Uhr – 10:00 Uhr **(Flexible) Assembly Lines; Packing**

Philipp Schulze (Friedrich-Schiller-Universität Jena) 30 Minuten
Workload Smoothing in Simple Assembly Line Balancing

Andreas Hottenrott (Technische Universität München) 30 Minuten
The benefits of operation and routing flexibility in automotive flexible assembly layouts

Hédi Király (Universität Duisburg-Essen) 30 Minuten
Zweidimensionales Packproblem von irregulären Objekten

10:00 Uhr – 10:30 Uhr **Kaffeepause**

10. Sitzung, Leitung: Prof. Dr. Martin Grunow (TU München)

10:30 Uhr – 11:50 Uhr **Scheduling / Retail Operations**

Ina Kortemeier (Universität Duisburg-Essen) 20 Minuten
Bestimmung von Ablaufplänen in mehrstufigen Produktionsprozessen unter Terminzielen

Matteo Biondi (Universität Mannheim) 30 Minuten
Maintenance and production scheduling for a single machine with maintenance mode selection

Christian Dethlefs (Technische Universität München) 20 Minuten
Omni-channel grocery retailing: an approach for multi-depot order fulfillment

Jonas Hense (Technische Universität München) 10 Minuten
Assortment optimization in omni-channel retailing

12:00 Uhr – 13:00 Uhr **Mittagessen**

13:30 Uhr – 17:00 Uhr **Wanderung**

18:00 Uhr – 19:00 Uhr **Abendessen**

11. Sitzung, Leitung: Prof. Dr. Michael Manitz (Universität Duisburg-Essen)

19:00 Uhr – 19:40 Uhr **Stochastic Systems**

Amir Foroughi (Universität Mannheim) 20 Minuten
Performance evaluation of time-dependent bulk queues

Mirko Beißner (Technische Universität München) 20 Minuten
Stochastic optimization of biopharmaceutical operations using MDP

Donnerstag 21.03.2019

07:30 Uhr – 08:15 Uhr **Frühstück**

12. Sitzung, Leitung: Prof. Dr. Herbert Meyr (Universität Hohenheim)

08:30 Uhr – 09:30 Uhr **Planning under Uncertainty**

Alexandre Forel (Technische Universität München) 20 Minuten
Campaign planning under seasonal and uncertain demand

Hendrik Weber (Technische Universität München) 20 Minuten
Stochastic Resource-Constrained Project Scheduling in a Dynamic Multi-Project Setting

Hossein Nikpayam (Universität Mannheim) 20 Minuten
Resource Allocation in New Product Development: Internal vs. External Projects

09:30 Uhr – 10:00 Uhr **Kaffeepause**

13. Sitzung, Leitung: Prof. Dr. Katja Schimmelpfeng (Universität Hohenheim)

10:10 Uhr – 11:30 Uhr **Shift Scheduling**

Sebastian Kraul (Universität Augsburg) 30 Minuten
Operational Offline Rostering of Physicians Integrating Robust Break Assignments

Seyed Mohammad Zenouzzadeh (Universität Mannheim) 20 Minuten
Shift Scheduling in Multi-stage Systems

Ferdinand Becker (Technische Universität Kaiserslautern) 30 Minuten
Integrierte Torbelegungs- und Personaleinsatzplanung in einem Cross-Docking-Zentrum

11:30 Uhr – 11:45 Uhr **Verabschiedung und Ausblick auf QBWL 2020**

12:00 Uhr – 13:00 Uhr **Mittagessen**

Abstracts

1. Sitzung, Leitung: Prof. Dr. Horst Tempelmeier (Universität zu Köln)

Sarah Jacke (Universität Duisburg-Essen, Prof. Dr. Alf Kimms)

Synchronisierte Wiederherstellung von interdependenten Netzwerken

Nach einer Katastrophe müssen unterschiedliche Netzwerke (z. B. Gas, Wasser, Strom) wiederaufgebaut werden, wobei zwischen den einzelnen Netzwerken Interdependenzen bestehen. Aus diesem Grund ist eine integrierte Betrachtung bei der Wiederherstellung der Infrastruktur vorzunehmen. Ziel ist es, die Einsatzpläne der verschiedenen Einsatzgruppen so aufeinander abzustimmen, dass eine ausreichende Versorgung der Bevölkerung schneller sichergestellt wird, als dies bei dezentralen Entscheidungsträgern der Fall ist.

Yongsheng Zhu (Universität Hamburg, Prof. Dr. Stefan Voß)

Cash Based Intervention in the Global Humanitarian Supply Chain – A Stochastic Application

With the trend in shifting the traditional supply of goods to the beneficiaries, humanitarian aid organizations (HAOs) have commenced to introduce a new intervention mechanism in humanitarian emergency response, known as the Cash Based Intervention (CBI), providing cash directly to the beneficiaries. According to the World Food Programme (WFP)'s statistics, 1.4 billion US Dollars of cash was distributed in 2017, taking up 30% of its global food assistance portfolio. WFP used CBI to reach out directly to 19.2 million people residing in 61 countries in 2017, roughly 20 times of its original scale in 2009. There is a clear trend of growth in the beneficiaries, budget, geographical coverage of operations among the HAOs. This new intervention has brought changes to the global humanitarian supply chain, leveraging more uncertainties in its already complex operational planning and management. This research aims at applying a stochastic approach to capture the uncertainties in CBI distribution process by exploring the quantifiers of associated uncertainties and to support the decision making process for cash choices (cash voucher, cash card and physical cash) and the optimization of resource allocation for such choices to meet the emergency demand. This includes a scenario analysis when a fixed number of cash recipients in city X face an emergency, it is envisaged that these people will rush stochastically from various points to the limited number of CBI distribution points to obtain cash to purchase food. Therefore, it is important for the HAOs to ensure optimized cash and cash choices planning taking into account total cost analysis. This research also aims at laying the ground for future research in this realm.

Usama Dkaidik (Universität Hamburg, Prof. Dr. Knut Haase)

Spatial allocation of pilgrim groups based on their time preference

Hajj, is the annual Islamic pilgrimage to Mecca, Saudi Arabia. More than two million pilgrims perform the Hajj rituals every year. It is one of the largest pedestrian problems in the world. During the Hajj, pilgrim groups perform the stoning-of-the-devil ritual at several different times. Based on logistical (bus/air-shuttle schedules) and religious reasons, pilgrims may have different time preferences for performing the ritual. In the past, high crowd densities have repeatedly led to fatal accidents in the Mena tent city, where most pilgrims are accommodated during the event. In this research, we seek to find a spatial allocation of pilgrim groups within the Mena tent city such that we minimize the maximum pedestrian infrastructure utilization during peak times. We describe an optimization model and an integer-programming based solution technique to solve the allocation problem.

2. Sitzung, Leitung: Prof. Dr. Florian Sahling (TU Kaiserslautern)

Stephan Fichtner (Universität Hohenheim, Prof. Dr. Herbert Meyr)

Biogas plant optimization by increasing its flexibility

Increasing shares of volatile energy resources like wind and solar energy will require flexibly schedulable energy resources to compensate for their volatility. Biogas plants can produce their energy flexibly and on demand, if their design is adjusted adequately. By doing so, the biogas plant operator has the opportunity to generate more earnings by producing and selling electricity in higher price periods. In order to achieve a flexibly schedulable biogas plant, the design of this plant has to be adjusted to decouple the biogas and electricity production. Therefore, biogas storage possibilities and additional electrical capacity are necessary. This research addresses the investment decisions to increase the flexibility of a biogas plant by installing biogas storages and additional electrical capacities under consideration of revenues out of direct marketing at the energy spot market. In order to support the strategic, long-term investment decisions, an operative plant schedule for the future, considering (non-) linear technical characteristics and the legal framework is optimized in an uncertain environment.

Benedikt Finnah (Universität Duisburg-Essen, Prof. Dr. Jochen Gönsch)

Optimale Betriebsführung von Pumpspeicherkraftwerken an den deutschen Auktionsmärkten

Betrachtet wird ein Pumpspeicherkraftwerk an dem Day-Ahead und Intraday Markt. An diesen Märkten muss der Marktteilnehmer, vor dem Bekanntwerden der Preise, seine Kauf/Verkaufsgebote für den nächsten Tag abgeben. Das entsprechende Dynamische Programm ist aufgrund der genauen Preisprognose hochdi-

mensional und wird mit einem Verfahren aus dem Bereich des Approximate Dynamic Programmings gelöst. Erste numerische Ergebnisse zeigen die Notwendigkeit einer guten Preisprognose sowie dem antizipierenden Handeln an beiden Märkten.

Gregor Godbersen (TU München, Prof. Dr. Rainer Kolisch)

Using branch-and-price to plan charging infrastructure locations for electric taxis

We study the problem of planning charging station locations for an electric taxi fleet using data from a real world case. Compared to consumer vehicles, taxis have the ability to perform multiple shorter charges during a shift instead of blocking a charging slot overnight - allowing a finer grained optimization. Our solution method is based on transforming individual taxi shifts into directed graphs which are then combined in a column generation and branch-and-price approach.

3. Sitzung, Leitung: Prof. Dr. Dirk Briskorn (Bergische Universität Wuppertal)

Fabian Lenz (Universität Hohenheim, Prof. Dr. Herbert Meyr)

A multi-stage simultaneous lot-sizing and scheduling model for the chemical process industy

Thema der Dissertation

Michael Fuchs (Universität Duisburg-Essen, Prof. Dr. Michael Manitz)

Losgrößenplanung unter stochastischen Bedingungen

In diesem Vortrag wird ein heuristisches Lösungsverfahren für das mehrstufige kapazitätsorientierte Losgrößenproblem unter Betrachtung stochastischer Bedarfsmengen vorgestellt. Bei diesem Verfahren handelt es sich um eine Modifikation der Lagrange-Heuristik von Tempelmeier und Derstroff für das MLCLSP-Problem. Der Vortrag geht insbesondere auf die Modellierung des Ausgangsproblems, die Lagrange-Relaxation sowie auf die Modifikationen ein.

Markus Mickein (Universität Hamburg, Prof. Dr. Knut Haase)

Mehrstufige Losgrößenplanung – Ein Praxisbeispiel aus der Brauindustrie

Gegenstand des Vortrags ist ein mathematisches Modell in Kombination mit einer Heuristik zur mehrstufigen Losgrößenplanung unter Berücksichtigung einer divergierenden Produktstruktur. Es werden die Ergebnisse eines realen Anwendungsbeispiels vorgestellt. Zudem wird ein Ausblick auf die Integration der Ablaufplanung und Interaktion mit der Materialflussplanung gegeben.

4. Sitzung, Leitung: Prof. Dr. Alf Kimms (Universität Duisburg-Essen)

Jonas Schwamberger (Universität Mannheim, Prof. Dr. Moritz Fleischmann)

Challenges and Drivers of E-Fulfillment

With the rapid spread of convenient Internet access, the importance of online commerce is steadily increasing. Global retail e-commerce sales amounted to 2.3 trillion US dollars in 2017 and e-retail revenues are predicted to grow to 4.88 trillion US dollars in 2021. Designing and managing appropriate fulfillment processes is generally recognized as a key challenge to the profitability of this business sector. This talk will review recent literature on e-fulfillment. It will highlight focal areas of published research and indicate complementing research gaps. The talk will conclude by proposing avenues for relevant future research in e-fulfillment.

Tobias Potoczki (KU Eichstätt-Ingolstad, Prof. Dr. Heinrich Kuhn)

Design of distribution systems in grocery retailing

We examine a distribution network design problem that integrates both the strategic decision of determining the number of distribution centers (DC), their location and store assignments, as well as the decision of allocating products to different types of DCs. The underlying distribution network structure is that of grocery retailers who choose to operate several types of warehouses which store a distinct set of products each. We propose an MIP solution approach considering costs which result from operating the warehouses, inbound transportation, inventory holding at the DCs, outbound transportation and instore logistics.

Maximilian Herz (Universität Augsburg, Prof. Dr. Robert Klein)

Revenue management for dynamic order acceptance and scheduling

We consider an optimization problem at the interface of revenue management and parallel machine scheduling. The planning horizon is subdivided into a booking and a service period, with the latter one succeeding the first. During the booking period, customer requests arrive stochastically and dynamically. They differ concerning their associated revenues as well as their release and due dates within the service period, but not in the resources required for their execution. For each request, it has to be instantaneously decided, whether it is accepted or rejected. The objective is to maximize the total revenue. To execute the accepted requests, a number of resources are provided. Interpreting accepted requests as jobs, the task of feasibly assigning jobs to resources boils down to solving an identical parallel machine scheduling problem. Potential applications for the problem on hand can, among others, be found in digital service settings. For example, a virtual assistance firm may offer services like transcription of memos, calendar management, or accounting, the booking of which is done via the internet. In order to control the ac-

ceptance process during the booking period, we develop a stochastic, dynamic program. Since it cannot be solved to optimality, an approximate dynamic programming approach is proposed.

5. Sitzung, Leitung: Prof. Dr. Rainer Kolisch (Technische Universität München)

Stefan Schwerdfeger (Friedrich-Schiller-Uni. Jena, Prof. Dr. Armin Scholl)

Sequencing of picking orders to facilitate the replenishment of A-Frame systems

A-Frame systems are among the most efficient order picking devices. Stock keeping units are stockpiled in vertical channels successively arranged along an A-shaped frame and a dispenser automatically flips the bottom most item(s) of each channel into totes or shipping cartons that pass by under the frame on a conveyor belt. While order picking itself is fully automated, continuously replenishing hundreds of channels still remains a laborious task for human workers. We treat the research question whether the sequencing of picking orders on the A-Frame can facilitate the replenishment process. In many real-life applications, workers are assigned to fixed areas of successive channels which they have to timely replenish. Our sequencing approach, thus, aims to properly spread the replenishment events of each area over time, such that each worker has sufficient time to move from one replenishment event to the next. In this talk, we report on the resulting order sequencing problem, the computational complexity, suited solution procedures, and a simulation study of the replenishment process to explore the gains of our approach.

Stefan Bugow (Leibniz Universität Hannover, Prof. Dr. Stefan Helber)

LKW-Reihenfolgeplanung an Paketsortieranlagen unter Beachtung flexibler Entladegeschwindigkeiten

Im Rahmen des Betriebs von Paketsortieranlagen gilt es eintreffende LKW zu Entladetoren zuzuordnen. Diese LKW sind mit Paketen für unterschiedliche Zielorte beladen. Nach der Entladung werden die Pakete sortiert und, häufig unter Verwendung von Fließbändern, zu abfahrenden LKW an verschiedenen Beladetoren transportiert. Mögliche Ziele sind hierbei die Minimierung der Gesamtentladedauer oder der Verspätung der einzelnen LKW an den Beladetoren. Bei der Zuordnung der ankommenden LKW sind unter anderem die Bandkapazitäten in der Sortieranlage und festgelegte Abfahrtzeiten der LKW an den Beladetoren zu beachten. Erste numerische Untersuchungen haben gezeigt, dass durch flexible Entladegeschwindigkeiten eine gleichmäßige Auslastung der Fließbänder erreicht werden kann. Demnach können die vorhandenen Kapazitäten effizienter genutzt werden als bei der Annahme starrer Entladegeschwindigkeiten. Im Rahmen des Vortrags werden Ansätze zur Modellierung der Problemstellung unter besonderer Beachtung flexibler Entladegeschwindigkeiten vorgestellt. Weiterhin werden Ergebnisse einer numerischen Untersuchung und einer Simulationsstudie vorgestellt.

6. Sitzung, Leitung: Prof. Dr. Erwin Pesch (Universität Siegen)

Adriana Moros (Universität Hamburg, Prof. Dr. Stefan Voß)

Port Community Systems (PCS) in emergent economies: case study Colombia

Information technology systems are commonly used in the port communities to improves their competitiveness in the global markets. A usual development in the port communities is the Port Community System (PCS). However, for successful introduction of a PCS in emerging economies, it is necessary to evaluate the feasibility of adoption. Therefore, this study identifies and assesses the key factors for a successful adoption of a PCS and identifies associated barriers, using a statistical analysis based on a survey with different stakeholders in the Port of Barranquilla, Colombia. One of the main findings is that the low level of technology maturity and the lack of use of IT systems, as well as the lack of expertise regarding a PCS are currently the main barriers of PCS adoption. However, the clear interest of the different stakeholders in IT systems makes the successful adoption of PCS a viable option. In addition, it was found that currently there is a need to evolve the existing PCS and adapt them to new markets, due to the increase of new technologies and the growth of emerging economies around the world. Also, it was found that in order to adopt PCS in emerging economies, like Colombia, those systems need to have special features, mostly related to the freight hinterland transport processes. One way to do meet the needs of emerging economies and evolve the current PCS is to add new services as added value. Because of this, we propose a hinterland intermodal service as an added value service for the current PCS, case study Colombia. In this study, we propose to develop a prototype for a hinterland transportation system module for an emerging economy like Colombia, while measuring the impact of using an intermodal transport network by executing an optimization model. The optimization model showed that the use of an intermodal hinterland transport network can reduce the total transportation costs about 67% and the CO2 emission by 47%. This solution could help to mitigate the environmental impact of the Colombian hinterland transport and the transportation cost of the country. While providing a value-added service when programming and coordinating the hinterland transportation system of the import and export cargo of the country.

Lennart Zey (Bergische Universität Wuppertal, Prof. Dr. Dirk Briskorn)

Twin-crane scheduling with a dedicated handshake area during seaside workload peaks

In this talk we consider a container transport scheduling problem for two twin-cranes that serve a storage block. Containers enter and leave the block at the seaside access point, resembling e.g. the ongoing (un-)loading of a vessel. The storage block is divided into two halves by a handshake bay and each of the cranes exclusively serves one of the sides. Whenever a container needs to be transported across

that bay on its way to its final destination, it first is stored in one of multiple, capacitated storage slots within the handshake bay by one crane before afterwards the transport is completed by the respective other crane. We detail the precedence relations arising from stacking containers on top of each other and present multiple branch-and-bound approaches allowing to obtain minimum makespan schedules. Finally we provide some managerial impact on where to position the handshake area.

Tutorium, Leitung: Prof. Dr. Moritz Fleischmann (Universität Mannheim)

Prof. Dr. Stefan Helber (Leibniz Universität Hannover)

Markow-Ketten und ihre Anwendungen:
Vom Segen eines fehlenden Gedächtnisses und fehlender Koordination

7. Sitzung, Leitung: Prof. Dr. Jochen Gönsch (Universität Duisburg-Essen)

Michael Dienstknecht (Bergische Uni. Wuppertal, Prof. Dr. Dirk Briskorn)

Last Mile Logistics

Skizziert wird ein Forschungsvorhaben, bei dem eine Menge von Kunden per LKW zu beliefern ist. Der LKW kann dabei von einer Drohne unterstützt werden. Gesucht ist der kostenminimale Fahr- bzw. Flugplan für LKW und Drohne.

Lukas Janinhoff (Universität Augsburg, Prof. Dr. Robert Klein)

Vehicle routing with delivery options

As a consequence of the steady increase of B2C e-commerce and the resulting growing parcel volume, many parcel service providers consider imposing a fee on home delivery. Instead of being served at home, customers may choose shipment to parcel pickup stations at reduced fees. In this talk, I present a MIP formulation for the vehicle routing problem with delivery options and explain the underlying assumptions.

Finn Meissner (Helmut-Schmidt-Uni. Hamburg, Prof. Dr. Florian Jaehn)

The Rebound Effect in Transportation

Sometimes measurements taken to increase resource efficiency do not reach the estimated magnitude as part of the reduction vanishes due to the reaction of entities to the changed environment. In this talk, the so-called rebound effect will be examined in a transport network of a Traveling-Purchaser-Problem (TPP). The implementation, which is a generalization of the TSP, will serve as decision space in which the procurement of various amounts of products inside a logistics network will be optimized in regards of total cost while the consumption of fuel is monitored. Different parameterizations of the environment will be tested in an attempt to find critical values that determine the occurrence and magnitude of rebound effects.

8. Sitzung, Leitung: Prof. Dr. Knut Haase (Universität Hamburg)

Stefan Voigt, Markus Frank (KU Eichstätt-Ingolstadt, Prof. Dr. Heinrich Kuhn)

Minimizing failed-delivery costs with customer-related data

The absence of the customer during the delivery in attended-home delivery applications leads to high failed-delivery costs. Specific external customer-related data allows for an estimation whether the customer is at home within certain time windows or not. The so derived probability that the delivery will be successful is used to minimize overall costs by assigning the optimal time window, considering the trade-off between vehicle routing costs and failed-delivery costs.

Christian Jost (TU München, Prof. Dr. Rainer Kolisch)

Consistent Vehicle Routing and Its Influence on Priority-Based Pickup Decisions

As a service, TSG 1899 Hoffenheim (TSG) provide a van transfer for around 100 youth players on each training day. Currently, the manual assignment of players to tours is a complex and time-consuming task, which leaves many players unserved. Our approach increases the rate of served players by up to 21 %. Given limited van capacities, players are prioritized according to their age group (U12-U19). The objective is to find tours that maximize the priority sum of served players. However, a tradeoff exists with TSG's organizational and safety requirements aiming for players to be picked up by the same driver each day they request a transfer. We present a two-stage heuristic framework based on Tabu Search. Results suggest that high driver-player assignment consistency can be reached at low pickup priority losses.

Jun. Prof. Dr. Danja Sonntag (Uni. Mannheim, Prof. Dr. Moritz Fleischmann)

Controlling Distribution Inventory Systems with Shipment Consolidation and Compound Poisson Demand

We consider a one-warehouse-multiple-retailer inventory system where the retailers face stochastic customer demand, modelled as compound Poisson processes. Deliveries from the central warehouse to groups of retailers are consolidated using a time based shipment consolidation policy. This means that replenishment orders have to wait until a vehicle departures, which increases the lead time for the retailers and therefore also the safety stock. Thus, a trade-off exists between shipment cost and holding cost. Our aim is to determine the shipment intervals and the required amount of safety stock for each retailer and the warehouse to minimize total cost, both for backorder costs and fillrate constraints. Previous work has focused on exact solutions which are computationally demanding and not applicable for larger real world problems. The focus of our present work is on the development of computationally attractive heuristics that can be applied in practice. A numerical study illustrates that the proposed heuristics perform well compared to the exact cost minimizing solutions. We also show that the approaches are appropriate for solving real world problems using data from a large European company.

9. Sitzung, Leitung: Prof. Dr. Sven Müller (Europa Uni. Viadrina Frankfurt/Oder)

Philipp Schulze (Friedrich-Schiller-Uni. Jena, Prof. Dr. Armin Scholl)

Workload Smoothing in Simple Assembly Line Balancing

We consider a version of the well-known simple assembly line balancing problem (called SALBP-SX) which is to level the workloads of the different stations given the cycle time and the number of stations based on an adequately defined smoothness index SX. Most corresponding research considers minimizing SX or another levelling criterion as a secondary objective of other SALBP versions which minimize the number of stations (SALBP-1) or the cycle time (SALBP-2). However, in automotive and other high-tech industries, the SX-objective typically arises as a primary one in mid-term to short-term production planning, e.g., once per month, when task-station assignments have to be adapted to changed problem data, e.g., due to modifications of production processes or changed demands for different product variants. This aims at avoiding overloaded bottleneck stations and achieving a fair distribution of work among workers. We define and model SALBP-SX based on an analysis of different SX-definitions and develop a branch-and-bound procedure for optimally solving it. It contains a new station-oriented branching scheme, new lower bound arguments, logical tests and, particularly, a dynamic programming scheme for the pre-calculation of potential station loads which accelerates the procedure greatly. In comprehensive computational experiments, we are able to show that the new procedure clearly outperforms the only existing approach.

Andreas Hottenrott (TU München, Prof. Dr. Martin Grunow)

The benefits of operation and routing flexibility in automotive flexible assembly layouts

Inspired by technological advances in factory digitalization, the automotive industry has started to investigate flexible layout alternatives to the widespread mixed-model assembly line. In such flexible layouts, the stations are neither arranged serially nor linked by a paced transportation system. Instead, automated guided vehicles are used to transport the vehicles. The sequence of tasks is not predetermined, but can differ for each vehicle (operation flexibility). Also, the same task can be performed at multiple stations (routing flexibility). Due to these flexibilities, the work in progress can be reduced. Assembly scheduling, in contrast, becomes more complex because process planning and routing are optimized simultaneously. In this research, we develop a framework to quantify the benefits of operation and routing flexibility in automotive flexible assembly layouts. We compare the simultaneous approach to a hierarchical approach in which process planning and/or routing are decided a priori. In addition, we compare flexible layouts to mixed-model assembly lines.

Hédi Király (Universität Duisburg-Essen, Prof. Dr. Alf Kimms)

Zweidimensionales Packproblem von irregulären Objekten

Zweidimensionale Packprobleme von irregulären Objekten treten in unterschiedlichen Industriebereichen auf, beispielsweise in der Bekleidungs- Möbel- oder Schuhherstellung. Hierbei werden Schablonen von unregelmäßigen Objekten im effizientesten Layout auf ein Grundmaterial bzw. Rohstoff gelegt, sodass alle Teile zugeordnet werden können und sich nicht überlappen. Nach einem kurzen Überblick beschäftigt sich der Vortrag mit einem ersten Modellierungsansatz. Mit dessen Hilfe werden kleinere, konvexe Polygone auf einem großen rechteckigen Objekt positioniert.

10. Sitzung, Leitung: Prof. Dr. Martin Grunow (Technische Universität München)

Ina Kortemeier (Universität Duisburg-Essen, Prof. Dr. Michael Manitz)

Bestimmung von Ablaufplänen in mehrstufigen Produktionsprozessen unter Terminzielen

In diesem Vortrag wird ein spezieller Problemtyp aus dem Bereich der Maschinenbelegungsplanung betrachtet: Das Flexible-Job-Shop-Problem mit reihenfolgeabhängigen Rüstzeiten unter Berücksichtigung vorgegebener Fertigstellungstermine. Bei einem Flexible Job Shop handelt es sich um eine mehrstufige Werkstattfertigung mit mehreren parallel arbeitenden Maschinen je Produktionsschritt. Im Rahmen der Maschinenbelegungsplanung werden die Produktionsaufträge den Maschinen zugeordnet und die Auftragsfolgen unter Beachtung anfallender Rüstzeiten festgelegt. Um negative Konsequenzen aufgrund von Nichteinhaltung von Fertigstellungsterminen zu vermeiden, wird die Minimierung von Auftragsverspätungen angestrebt. Neben einer Modellformulierung des zugrundeliegenden Ablaufplanungsproblems werden mögliche Erweiterungen vorgestellt.

Matteo Biondi (Universität Mannheim, Prof. Dr. Raik Stolletz)

Maintenance and production scheduling for a single machine with maintenance mode selection

Preventive maintenance on manufacturing units are necessary to maintain the machines in a condition to produce and to execute the required tasks. A maintenance typically allows the machine to work for a certain amount of time before it is required for the machine to be taken off-line again for the next maintenance. In some situations, more than one maintenance modes can be selected for a maintenance occurrence, i.e. the machine can be taken off-line for a longer time therewith allowing the machine to work uninterrupted for a longer time afterwards. In this work, we detail a new optimization problem for the integrated scheduling of maintenance and production on a single machine with maintenance mode selection. Structural properties of the optimal solution will then be introduced and solution methods discussed.

Christian Dethlefs (TU München, Prof. Dr. Alexander Hübner)

Omni-channel grocery retailing: an approach for multi-depot order fulfilment

When trying to succeed in the online world, grocery retailers with established offline business need to develop a strategy in which online and offline operations work efficiently together. While some retailers decide to keep online and offline operations separate from each other, an integrated omnichannel business can generate benefits that pure one-channel retailers do not retrieve. The question arises which fulfillment concept generates highest profits and customer satisfaction for a specific retailer whilst ensuring a sustainable business model in an industry that is

facing strong and fast moving competition. While large distribution centers generate faster economies of scale, local stores are more central to the customer and therefore guarantee higher customer service levels. The problem we aim to solve is an extension of a classical multi-depot vehicle routing problem and focuses on the efficient selection of the best depot and delivery mode. We consider depots of different sizes and locations, from large distribution centers, located far from customers, to local stores, located close to a customer. Our work focuses on the allocation of customer orders to a fulfillment depots as well as the efficient selection of delivery vehicles while considering a homogeneous fleet per depot and heterogeneous vehicle types between depots.

Jonas Hense (TU München, Prof. Dr. Alexander Hübner)

Assortment optimization in omni-channel retailing

An assortment optimization model accounting for both online shop and retail store. Model is based on Stochastic Capacitated Assortment and Shelf-Space Problem. Listing, facing and stocking decision are adapted to omnichannel-context and objective function is adapted to channel peculiarities.

11. Sitzung, Leitung: Prof. Dr. Michael Manitz (Universität Duisburg-Essen)

Amir Foroughi (Universität Mannheim, Prof. Dr. Raik Stolletz)

Performance evaluation of time-dependent bulk queues

Bulk queues are a special class of queueing systems, where jobs arrive in batches or they are served in batches. They have many applications in production and service systems. For example, appointment systems in healthcare can be considered as bulk queueing systems with scheduled arrivals. We study a time-dependent bulk queue with deterministic timedependent batch arrival but generally distributed processing time. We present a new approximation approach for the expected waiting time of such a time-dependent $D^{X(t)}\G\1$ queue. The proposed approximation method can evaluate underloaded, overloaded, and critically loaded systems.
First numerical examples assess the accuracy of the proposed approximation approach by comparison to a simulation and a Fluid approximation.

Mirko Beißner (TU München, Prof. Dr. Martin Grunow)

Stochastic optimization of biopharmaceutical operations using MDP

Biopharmaceuticals are pharmaceutical drugs derived from biological sources. The production process is structured into two main stages: The upstream process containing production steps related to the cultivation of the living cells, while the

downstream process contains different purification steps. The required purification steps and respective processing times depend on the inflow from the upstream process, i.e. the composition of the cultivation broth. This is complicated by the fact that the use of living cells in the upstream process leads to process-inherent operational uncertainties, like variable product yields and broth compositions. Existing literature considering production planning under uncertainty in this industry mainly apply stochastic programming techniques. Those approaches can generate useful results for specific case study instances, albeit lack to provide structural insights on the decision and solution space. In our research we model the up- and downstream process in the form of a Markov Decision Process (MDP). The purpose of the model is to define optimal decision policies maximizing the overall system performance and to derive structural properties of the solution.

12. Sitzung, Leitung: Prof. Dr. Herbert Meyr (Universität Hohenheim)

Alexandre Forel (TU München, Prof. Dr. Martin Grunow)

Campaign planning under seasonal and uncertain demand

In the agrochemical industry, tactical production planning is done using uncertain sales forecasts as demand can depend on unpredictable parameters such as the meteorological conditions of the next growing season. In order to deal with uncertainty in the forecasts, it is common in practice to implement a production plan in a rolling horizon fashion. However, frequent updates of demand forecasts may lead to high nervousness: important variations in the quantities planned at successive production plans. Due to tight capacity constraints, long lead-times and overall low flexibility of the processes, it may be expensive, or even impossible, to frequently adjust the campaign plan to include more recent forecasts. In other words, the adjustment of the production plan may sometimes not be worth the nervousness cost it induces. This may especially be the case at the peak of the selling season, when the demand can be forecast most accurately but the production is already running at full capacity. This research project investigates a strategy to design a campaign plan that is both robust to uncertainty in the sense of maximising customer satisfaction, and at the same time guarantees a certain level of stability in successive plans. Based on a detailed analysis of the historical data of our industrial partner, we determine the production plan in the face of seasonal demand and especially focus on the pre-season or in-season production decision.

Hendrik Weber (TU München, Prof. Dr. Rainer Kolisch)

Stochastic Resource-Constrained Project Scheduling in a Dynamic Multi-Project Setting

We consider a dynamic multi-project scheduling setting where projects arrive stochastically over time. While activity durations of each arriving project are stochastic, all other parameters such as resource-consumption and availability are deterministic. The overall objective is to minimize the average flow time of each project. In the examined setting, scheduling decision are not made before project execution but “online / ad hoc” via so-called scheduling policies. These policies provide a rule set on which activities to execute next once an activity of uncertain duration has finished processing. This decision is solely based on the information that has been revealed up until the corresponding decision point in time. As these policies are defined by a list of pending activities, they are updated accordingly as new projects arrive. Recent research proposes preprocessor policies: Using a two-stage approach, additional predecessor constraints are added heuristically to the underlying problem. These newly added constraints then govern the subsequent solution procedure of the second stage in which the priority ordering of the activities is determined. We evaluate these different scheduling policies by simulation.

Hossein Nikpayam (Universität Mannheim, Prof. Dr. Moritz Fleischmann)

Resource Allocation in New Product Development: Internal vs. External Projects

New product development (NPD) is the process of turning novel ideas into technologically feasible and economically successful products in the market. Senior management manages this process through resource allocation to different NPD projects. The decision of whether or not to pursue an NPD project has vital importance for almost any firm's success. The NPD projects under consideration for the resource allocation can include projects developed internally in the firm, as well as external projects developed outside of the firm. Bringing the external projects into the resource allocation decision adds to the complexity of the problem. Competition between internal R&D teams and external actors changes the underlying economics. Although there is a vast literature on resource allocations to internal projects, academic papers that study NPD portfolio management in collaboration with external partners are scant. Thus, the aim of our project is to investigate how firms should allocate resources to NPD initiatives when they have access to a pool of internal and external projects. We particularly want to study the agency issues corresponding to this setting, and find out ways to manage their impact.

13. Sitzung, Leitung: Prof. Dr. Katja Schimmelpfeng (Universität Hohenheim)

Sebastian Kraul (Universität Augsburg, Prof. Dr. Jens Brunner)

Operational Offline Rostering of Physicians Integrating Robust Break Assignments

We introduce a new model for constructing biweekly rosters for physicians based on regulations of a German teaching hospital considering the viability of breaks. Up to now, rosters are manually created by experienced physicians with basic spreadsheet knowledge. This process is cost and time intensive due to the complexity of the problem and especially the individual working conditions of the physicians. Moreover, the generated rosters are often invalid resulting in potential overtime hours and employee dissatisfaction. An often appearing negative consequence is the resulting inability of physicians' to take their breaks, even though these are mandatory by law. This does affect not only employee motivation but also the service level of the hospital. Therefore, a new formulation of an operational physician scheduling problem is presented. The sophisticated scenario-based formulation considers overstaffing and overtime hours as the main cost-drivers and shift preferences as well as the viability of breaks as ergonomic objectives. Since standard solvers are not able to generate high-quality solutions within a reasonable time, the proposed model is reformulated by using a Dantzig-Wolfe decomposition. A branch-and-price algorithm is developed to solve the problem to optimality. We evaluate the algorithm and analyze the effect of the break assignment in a computational study using real-world data of a German training hospital.

Seyed Mohammad Zenouzzadeh (Uni. Mannheim, Prof. Dr. Raik Stolletz)

Shift Scheduling in Multi-stage Systems

Many production and service systems consist of serial stages operated by (partly) multi-skill workers. These systems face time-dependent demand and the workload of each stage is not determined in advance, but rather obtained from the output of the predecessor stage. We present a mixed-integer linear model for daily shift scheduling of multi-skill workers in multi-stage systems considering such interdependencies among the stages. Numerical examples based on realistic data from a warehouse illustrate the performance of the proposed model.

Ferdinand Becker (TU Kaiserslautern, Prof. Dr. Florian Sahling)

Integrierte Torbelegungs- und Personaleinsatzplanung in einem Cross-Docking-Zentrum

Cross-Docking ist ein Konzept, das durch eine zeitliche und mengenmäßige Koordination der ein- und ausgehenden Warentransporte einen schnellen Warenumschlag anstrebt, um somit die Lagerhaltungskosten zu reduzieren. In diesem Zusammenhang ergibt sich die Fragestellung, wann und an welchen Toren die LKW be- bzw. entladen werden. Durch die Torbelegungsplanung werden die im Cross-Docking-Zentrum durchzuführenden Prozessschritte determiniert. Für die Be- und Entladung der LKW kann neben dem Stammpersonal auch Zusatzpersonal eingesetzt werden, das durch einen Personaldienstleister kurzfristig bereitgestellt werden kann. Im Vortrag wird eine integrierte Modellformulierung zur Torbelegungs- und Personaleinsatzplanung in einem Cross-Docking-Zentrum vorgestellt. Dabei sollen die Kosten des eingesetzten Zusatzpersonals minimiert werden. Zur Lösung dieses Entscheidungsproblems wird ein heuristisches Lösungsverfahren vorgestellt.