

**GOR-Arbeitsgruppe: Praxis der Mathematischen Optimierung**

Prof. Dr. Josef Kallrath,
Am Mahlstein 8
D-67273 Weisenheim am Berg
Tel: +49 172 747-0689
Fax: +49 621 60-6678297

Herewith we would like to invite you to a joint meeting of the Dutch NGB and the German GOR working group "Real World Mathematical Optimization" (84st meeting). This meeting will be hosted by TNT Express (www.tntexpress.com) and the topic is

Mathematical Optimization in Goods Transport Logistics

The meeting will be held on 15-16 April 2010 at TNT Express in Duiven, near Arnhem, The Netherlands. The program will start on Thursday 15 April at 10:00 and finish on Friday 16 April around 16:00. The program will include a dinner in Arnhem, and a guided tour of the TNT Express hub.

The working language will be English, since participants and speakers are expected from Germany, the Netherlands and elsewhere.

Please note that the participation in a GOR-AG-Workshop for non-members is subject to a registration fee, unless you are a speaker or a host.

Please send your confirmation of participation (via e-mail or fax) as soon as possible, but not later than 27 March 2010. The latest information on the meeting is available on the working group's homepage (<https://gor.uni-paderborn.de/Members/AG06/>), or on GOR's homepage (www.gor-ev.de) under the category *Arbeitsgruppen*.

Yours sincerely,

Josef Kallrath & Henk Hoornenborg & John Poppelaars & Frans de Rooij
(GOR AG) (TNT Express) (NGB & ORTEC) (AIMMS)

Vorstand:

Prof. Dr. Horst W. Hamacher (Vorsitz)
Dr. Ralph Grothmann (Finanzen)
Prof. Dr. Stefan Nickel (Tagungen)
Prof. Dr. B. Werners (Arbeitsgruppen)

Bürozeiten:

Dienstag bis Freitag von 10 bis 13 Uhr
E-mail:
gor@ruhr-uni-bochum.de
URL: <http://www.gor-online.de>

Bankverbindung:

Sparkasse Bochum
Konto-Nr. 1 465 160
BLZ 430 500 01

Mathematical Optimization in Goods Transport Logistics

Mathematical Optimisation is becoming an important differentiator in Goods Transport logistics. Because the Logistic Service providers (LSP's) offer similar products, have comparable technology and compete on a global scale, high performance business processes are among the last differentiators. As UPS mentioned: "In God we trust, everything else we measure and improve", underpinning the importance of Operation Research and mathematical optimization as an enabler for creating that competitive edge. In these times of economic downturn Operations Research is even more important. It gives guidance to management of the LSP's on where to invest and where to scale down, making the operation more agile.

This meeting will give an overview about the state-of-the art technologies illustrated by real-world applications. In a series of talks, each approximately 40 minutes, experts from practice, research institutions or software companies, will present selected problems and the corresponding solutions. Confirmations for their talks have been received from the following speakers:

- Alexander Ferrier (Director Operations TNT Express Germany)
TNT Express GmbH – Realization of Optimization within Changing Environments
- Bas Janssen (Director Operations & Services TNT Express Benelux)
Operations Benelux - Process & Project Engineering Update
- Henk Hoornenborg (GO M&A team, TNT Express)
Determining the optimal depot infrastructure for now and for the future
- Dr.-Ing. Annette Chmielewski (4flow AG) / Ina Goedicke (TU Dortmund)
Optimizing the yard management operations in transshipment terminals by using Column Generation and material flow simulation
- Dr. Michael Drexler (Fraunhofer SCS Nürnberg)
System-Assisted Cooperation of Independent Freight Forwarding Offices
- Dr. Tore Grünert (GTS Systems & Consulting):
Solution of a combined transport and sorting optimisation problem by column generation and mixed-integer programming
- Christoph Hemsch (Deutsche Post AG)
Allocation of international long-haul transportation lanes to sorting centers at Deutsche Post
- Prof. Dr. Stefan Irnich (Universität Mainz):
Models and methods for letter mail delivery
- Stephan Meisel (TU Braunschweig):
Dynamic routing of a vehicle by approximate dynamic programming
- Ineke Meuffels (Tilburg University & ORTEC)
Enriching the Tactical Network Design of Express Service Carriers with Fleet Scheduling Characteristics
- Dr. Frans de Rooij & Uneco de Meester (Paragon)
Optimization of industrial logistics networks with AIMMS
- Prof. Dr. Uwe Zimmermann (TU Braunschweig):
Large-scale vehicle routing for urban waste disposal

**Route description to
TNT Express Road Network
DUIVEN - CENTERPOORT**



Visitors Address: Express 1, Duiven, The Netherlands.

From motorway A12 between Arnhem and Oberhausen:

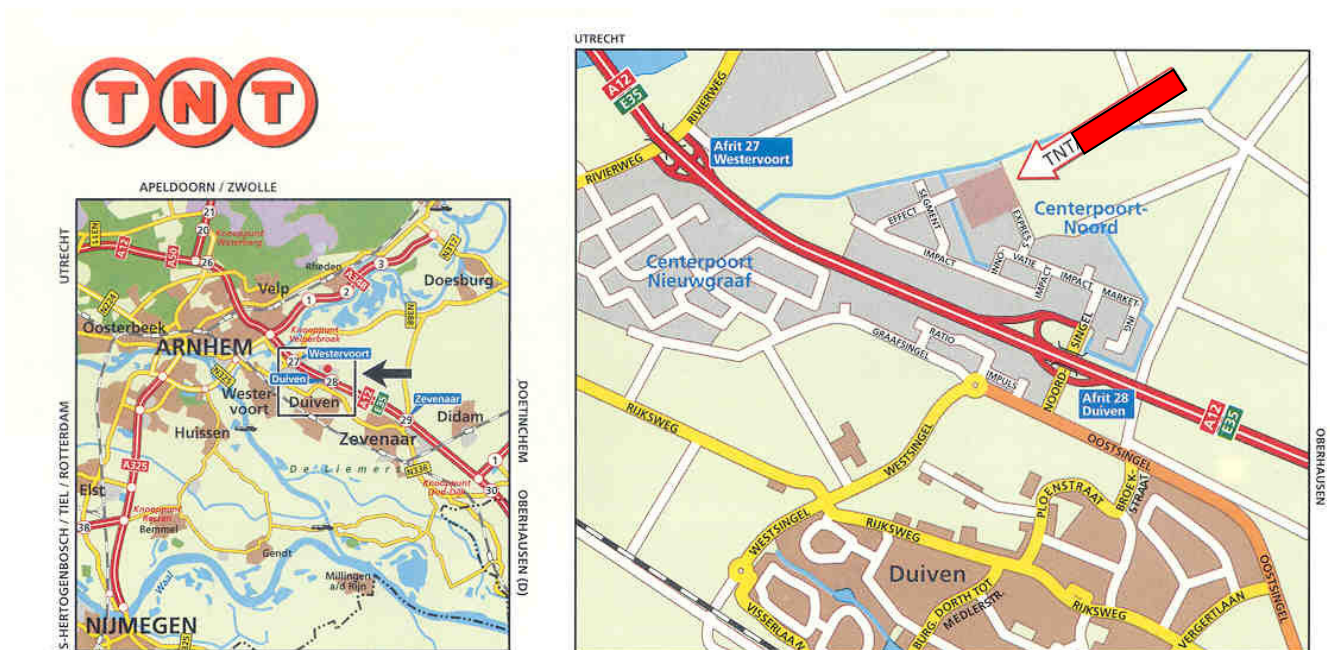
Take exit Duiven (Exit 28)

Turn left at traffic lights (Noordsingel)

Turn left at the end of the road (Impact)

Take the first road to the right (Express)

At the entrance, turn right to get to the large car park behind the building.



The *Postillion hotel* is at exit 26: Arnhem-Noord.
www.postillionhotels.com, Europaweg 25, Arnhem, Netherlands.



Gesellschaft für Operations Research e.V.

84th Workshop of the GOR Working Group on
Practice of Mathematical Optimization

Mathematical Optimization in Goods Transport Logistics

TNT Express, Duiven, The Netherlands, 15-16 April 2009

Thursday, 15.04.2009: 10:00 – 23:00

10:00-10:15 Opening [**Josef Kallrath** (GOR) & **John Poppelaars** (NGB)]

10:15-10:40 Introduction of TNT Express (**Marco Hendriks**)

10:40-11:20 **Henk Hoornenborg** (GO M&A team, TNT Express)
Determining the optimal depot infrastructure for now and for the future

11:20-12:00 **Alexander Ferrier** (Director Operations TNT Express Germany)
TNT Express GmbH – Realization of Optimization within Changing Environments

12:00-13:30 ----- Lunch Break -----

13:30-14:10 **Ineke Meuffels** (Tilburg University & ORTEC)
Enriching the Tactical Network Design of Express Service Carriers with Fleet Scheduling Characteristics

14:10-14:50 **Prof. Dr. Stefan Irnich** (Universität Mainz):
Models and methods for letter mail delivery

14:50-15:10 ----- Coffee Break -----

15:10-15:50 **Dr. Tore Grünert** (GTS Systems & Consulting)
Solution of a combined transport and sorting optimization problem by column generation and mixed-integer programming

15:50-16:50 **Panel Discussion**
All participants are invited to submit questions and suggestions for the panel discussion, ideally before 27 March 2010.

Conference Evening

17:00 Departure by bus to Arnhem, walk through park "Sonsbeek"

17:30 Dinner in "Villa Sonsbeek"

19:00 Return by bus to Duiven

19:30 Guided tour of TNT hub

21:30 Departure by bus to hotel

Friday, 16.04.2009: 09:30 – 16:00

- 9:00 Departure by bus from hotel to Duiven
- 9:30-10:10 **Dr.-Ing. Annette Chmielewski** (4flow AG) / **Ina Goedicke** (TU Dortmund)
Optimizing the yard management operations in transshipment terminals by using Column Generation and material flow simulation
- 10:10-10:50 **Stephan Meisel** (TU Braunschweig)
Dynamic Routing of a Vehicle by Approximate Dynamic Programming
- 10:50-11:10 ----- Coffee Break -----
- 11:10-11:50 **Prof. Dr. Uwe Zimmermann** (TU Braunschweig)
Large-scale vehicle routing for urban waste disposal
- 11:50-12:30 **Frans de Rooij** (AIMMS) & **Uneco de Meester** (Outperform)
Optimization of industrial logistics networks with AIMMS
- 12:30-14:00 ----- Lunch Break -----
- 14:00-14:40 **Bas Janssen** (Director Operations & Services TNT Express Benelux)
Operations Benelux - Process & Project Engineering Update
- 14:40-15:20 **Dr. Michael Drexl** (Fraunhofer SCS Nürnberg)
System-Assisted Cooperation of Independent Freight Forwarding Offices
- 15:20-16:00 **Christoph Hemptsch** (Deutsche Post AG)
Allocation of international long-haul transportation lanes to sorting centers at Deutsche Post
- 16:00-16:15 ----- **Final Remarks and End of Event** -----

The Speakers

Annette Chmielewski received her Ph.D. from Dortmund University of Technology, Chair for Transport Systems and Logistics, under Prof. Clausen in 2007. Her major work consisted of finding optimal door assignments for trucks in transshipment buildings by using a decomposition and column generation approach. Since 2010 Annette Chmielewski continues her work at 4flow AG, a leading provider of supply chain consulting, software and network management services based in Berlin. 4flow consulting offers one-stop management consulting, concept design, and support in the implementation of logistics and supply chain management. 4flow vista is the standard software for supply chain design and optimization. 4flow turn is the web-based standard software for dynamic inventory optimization. 4flow serves international clients and works for large and medium-sized companies.

Uneco de Meester heads up Outperform, a company he started in 2005 together with Raj Sreerangam in 2005. Outperform's mission is to bring the power of optimization to business users at all levels. Uneco has worked with optimization systems to support business decision making since 1998 and worked in various engineering and manufacturing roles for Unilever. He has a MSc degree in applied physics from Delft University of technology (NL).

Frans de Rooij works at Paragon Decision Technology in the Netherlands, where he is responsible for the European sales & marketing of the AIMMS mathematical modeling system. Frans previously worked as a consultant at Arthur D. Little and at Corus Steel. He has an MSc in physics from Eindhoven University of Technology (NL) and a PhD in applied mathematics from the University of Cambridge (UK).

Michael Drexl is with the department Networks at the Fraunhofer Centre for Applied Research on Supply Chain Services SCS in Nuremberg, Germany. He works in the field of applied operational research in logistics and transport.

Alexander Ferrier is Director Operations and Member of the Executive Board of TNT Express Germany since 2007. He was born in Berlin in 1966 and studied chemistry before starting in 1988 in Berlin in several positions in the logistic sector. In 1993 he became Manager Pick-up & Delivery, following Depot Operations Manager at TNT Express Berlin, and in 1997 Depot Operations Manager of the depot and Hub Manager of the international Road Hub TNT Frankfurt. He became Leading Project Manager for planning, building and startup of the TNT Road Hub Wiesbaden in 2000, solely responsible Road Hub Manager in Wiesbaden in 2001, and Senior General Manager Hub & Depot Wiesbaden in 2003. He is married and has 1 daughter.

Ina Goedicke is a Ph.D. student at the chair for transportation systems and logistics and works on simulating materialflows and operation strategies for yard management processes in transshipment buildings (e.g. Less-than-truckload and parcel sector). Her aim is to increase a network node's performance by analyzing its complex and time-dependent structures and developing improved operation strategies.

Tore Grünert is General Manager of GTS Systems and Consulting GmbH (GTS). GTS offers systems and consulting expertise for all tasks in the field of logistics involving optimization, simulation, planning and control. Tore received a diploma in electrical engineering from the Technical University of Darmstadt, a master degree and a Ph.D. in Operations Research from RWTH Aachen. He has written and edited several books on transport optimization and supply chain management and published papers on this subject in international

journals. At GTS he heads the consulting division which has specialised in transport and network optimisation.

Christoph Hemptsch works as a senior expert for the operational concepts group in the letter mail division of Deutsche Post DHL. Before joining Deutsche Post he spent four years at the Deutsche Post endowed chair of optimization of distribution networks at RWTH Aachen University focusing on mathematical modeling of logistics functions and networks.

Marco Hendriks is Director Optimisation & Engineering within TNT Express. In this position, he is responsible for the Operations Strategy and Global Optimisation project (GO) of TNT Express. Global Optimisation is TNT's Supply Chain Optimisation Programme in the area of Networks, Hubs, Country Depot Infrastructure and Pick-up & Delivery. Marco Hendriks has worked with TNT for over 25 years. He held a number of different positions, in which he gained great commercial and operational management expertise. Marco Hendriks is experienced in Network development, Operations Systems Development, Re-engineering, Acquisition and Post Merger Integration.

Henk Hoornenborg works at TNT Express in Duiven in the Netherlands. He is Global Programme Manager Modelling & Analysis. This department is taking care of the data, the tools and the analysis for the Global Optimisation initiative. Henk studied Applied Mathematics at the university of Twente (NL). He started working for an IT company but after one year he joined ORTEC to combine his mathematical skills, IT skills and business, for him this business was the production planning for Shell refineries. After more than 10 years he moved to Elan Energy Consulting, a company that provides consultancy services, modeling software and fundamental data for the European power market and now he's working for TNT Express.

Stefan Irnich is full professor for business administration and logistics management at Johannes Gutenberg University in Mainz since 2009. He received a diploma degree in mathematics in 1995 and a master degree in Operations Research in 1998 from RWTH Aachen University. At Deutsche Post Chair for Optimization of Distribution Networks in Aachen, he worked in several industry projects mostly for Deutsche Post World Net. After his Ph.D. in 2002 and Habilitation in 2007, he was visiting professor at RWTH Aachen University at the chair of OR and logistics management and the chair of OR and SCM. From an applications point of view, his research interests lie in logistics problems with a focus on transportation network design, vehicle routing, and crew scheduling. From a methodological point of view, he conducts research in discrete and combinatorial optimization. Stefan's contributions are on exact methods, e.g., column generation and branch-and-cut, as well as heuristics approaches related to efficient local search in metaheuristics.

Bas Janssen (44) started working for TNT 18 years ago. In 2008, he became Director Operations & Services TNT Express Benelux. The Operations & Services department supports the depots and thus the customers, ensuring the safe, fast, reliable, traceable and clean delivery of 15,000,000 shipments in 2009, with a total weight of more than 500,000,000 kilo and accompanied by 550,000 customs documents, by over 2000 vehicles to more than 200 countries.

Stephan Meisel graduated from the University of Karlsruhe and is now a Ph.D. student at the University of Braunschweig. The main focus of his research is on anticipatory optimization for dynamic and stochastic vehicle routing. He currently works on approximate dynamic programming for dynamic vehicle routing problems occurring in a Less-than-truckload context.

Ineke Meuffels is a Consultant at ORTEC and a PhD candidate at Tilburg University since

2007. At ORTEC, Ineke advises a large express service carrier, which inspires the work she is doing in her research project. Her research focusses on the design of express networks, and in particular tries to solve practical problems from a scientific perspective. Her supervisors are Prof. Dr. Ir. Hein Fleuren, Prof. Dr. Ir. Edwin van Dam and Dr. Frans Cruijssen.

Uwe T. Zimmermann is Director of the Institute of Mathematical Optimization of the TU Braunschweig with previous positions at the TU Kaiserslautern (1984-1986) and at the University of Trier (1986). In mathematics, he received his Dr. rer. nat. (1976) and finished his habilitation (1980) at the University of Cologne. He served as council member-at-large of MPS (1998-2000) and chaired the Discrete Optimization WG (1995-2001) of IFIP, SIGOPT (1997-1999) of DMV, and GOR (2001-2002). Among other editorial engagements, he is associate editor of Operations Research (since 2000). His research centers around combinatorial optimization, linear and integer programming with recent applied work focusing on large systems in logistics and transportation.

Optimizing the yard management operations in transshipment terminals by using Column Generation and materialflow simulation

Annette Chmielewski
4flow AG
Hallerstrasse 1, 10587 Berlin
e-mail: a.chmielewski@4flow.de

Ina Goedicke
Dortmund University of Technology
Chair of Transportation Systems and Logistics
Leonhard-Euler-Strasse 2, 44225 Dortmund
e-mail: goedicke@vsl.mb.tu-dortmund.de

Transshipment terminals in the Less-than-truckload (LTL) or in the parcel sector consist of large buildings with 80 or more doors. Yard management operations in this context comprise all movements of arriving and departing trucks from long distance or local traffic tours plus the rearrangement of swap bodies on the premise for transshipment purposes. Trucks have to be assigned to empty doors and to time slots for being loaded and unloaded and good operation strategies for manoeuvring swap bodies on the yard by special resources have to be chosen. The aim is to minimize the inner distances for transshipping the units (e.g. pallets) from one truck to another and to minimize the waiting time of trucks on the yard. Based upon a time-discrete multicommodity network, the task of assigning trucks to doors and to time slots has been modelled and a decomposition and column generation approach was developed and applied to real world problems. In addition, a simulation model was designed for choosing good operation strategies for further movements on the yard, using the results from the door assignment as input.

Optimization of industrial logistics networks with AIMMS

Frans de Rooij

AIMMS

Paragon Decision Technology B.V.

Schipholweg 1, 2034 LS Haarlem, The Netherlands

e-mail: frans.de.rooij@aimms.com

Uneco de Meester

Outperform B.V.

Oude Delft 197, 2611 HD Delft, The Netherlands

e-mail: uneco.demeester@2outperform.com

There is often a gap between theoretical optimization concepts and operational practices. Bridging this gap can bring significant business benefits in areas such as supply chain planning and logistic network design.

In the first part of this presentation, we will discuss how the AIMMS modeling system can help to bridge this gap. The model development environment enables fast and interactive development of accurate models for real-life situations. Links to many mathematical solvers and advanced modeling concepts (such as rolling horizons, Stochastic Programming and Robust Optimization) deliver the power to solve these models. The integrated graphical user interface can visualize data quickly, making the results understandable for end-users. With a small "OR-challenge", we will show how this can be used to stimulate interaction and create understanding among end-users.

In the second part of this presentation, we will explain how Outperform's Network Analysis application supports business decision making. Network Analysis has been implemented at BBH (the former joint venture between Carlsberg and Scottish & Newcastle), Remia (Netherlands) and Wastech (Canada). A generic demand and supply chain model provides decision support for these three business problems. BBH used Network Analysis to review investment plans against different demand scenarios. Remia and Wastech use the system to create their mid term business plan.

System-Assisted Cooperation of Independent Freight Forwarding Offices

Michael Drexl

Fraunhofer Centre for Applied Research on Supply Chain Services SCS

Nordostpark 93, 90411 Nuremberg

e-mail: michael.drexl@scs.fraunhofer.de

The talk gives an overview of the central ideas and the preliminary findings of a publicly funded research project in the road transport sector. The project deals with non-specialized partial and full truckload (FTL) tramp transports by non-specialized less-than-truckload (LTL) forwarders. This business sector is characterized by individual and manual planning processes, the lack of computer-aided dispatching, and virtually no information interchange between local offices. The purpose of the project is the improvement of the planning of FTL road transports in independent, decentral forwarding offices by means of a decision support system (DSS) for collaborative planning.

The two main challenging research issues in the development such a DSS were (i) to find a practically viable process of collaboration, i.e., a scheme for trading transport requests and vehicles, and (ii) to devise a heuristic algorithm capable of solving large instances of multi-period, multi-depot pickup and delivery problems with heterogeneous fleet, time windows and driver rules.

The central aspects of the solution approaches developed in the project are presented and discussed, and some new research issues that have arisen during this work are pointed out.

Realization of Optimization within Changing Environments

Alexander Ferrier
Director Operations TNT Express Germany
TNT Express GmbH
53842 Troisdorf, Germany
e-mail: Alexander.Ferrier@tnt.de

TNT Express GmbH Germany operates a network with 31 depots and 3 main hubs in which ca. 1,800 PUD rounds perform daily pick-up and delivery of express consignments. In order to ensure an efficient production from both service and cost point of view, it is important to constantly optimize the fleet setup and capacity utilization. The economical situation of the last year stressed the importance of cost management even more, while market developments affected express service providers very quick.

10 years ago the domestic and international network operation of TNT Germany were integrated which resulted in new requirements for location planning and PUD fleet optimization to realize synergies and cost savings. In the last years the manual planning methods were more and more supported by databases, statistical analysis and planning algorithms. We will describe the development of optimization approaches, operational setup and restrictions, as well as customer requirements.

The analysis and optimization of resources is mainly based on a tactical level while there is an important link to implementation and daily monitoring & reporting on the other hand. These aspects are parts of communication and change management which builds the bridge between local depot management and central head office departments. Those developments are supported by the global optimization (GO) team at divisional level.

Solution of a Combined Transport and Sorting Optimisation Problem by Column Generation and Mixed-Integer Programming

Tore Grünert
GTS Systems and Consulting GmbH
Raiffeisenstr. 10, 52134 Herzogenrath
e-mail: gruenert@gts-systems.de

The networks of Courier, Express, and Parcel (CEP) companies are configured in such a way that shipments are collected locally, sorted at the local sorting centre, transported to the sorting centre in the destination region and distributed to the consignees within this region. The long-haul transport between the sorting centres usually takes place during night. In this talk we present a solution approach that minimizes transport costs while taking the limited sorting capacity of the sorting centres into account. The approach is based on an extended set partitioning model, column generation, and mixed-integer programming. It enhances a heuristic that was developed earlier and uses AIMMS web services to solve the mixed-integer program. The model is used for tactical optimisation by a large German parcel distribution company.

Allocation of international long-haul transportation lanes to sorting centers at Deutsche Post

Christoph Hemsch
Deutsche Post DHL
Sträßchensweg 10, 53113 Bonn
e-mail: Christoph.Hemsch@DeutschePost.de

Deutsche Post delivers about 2.5 million parcels in Germany every day. The national parcel network contains 33 major sorting facilities. In this network parcels are first collected and then sorted during the outbound shift of the sorting centers. Over night, parcels are interchanged between all 33 sorting centers through a long-haul transportation network followed by a final sorting during the inbound shift of the sorting centers. Last, parcels are fed to delivery bases and from there on delivered to the receiving customers.

About 3% of the national parcel volume at Deutsche Post is exported to European countries via an international long-haul road network. The export preparation of parcels for European countries are concentrated at a subset of the 33 national parcel sorting centers. Each country is allocated to one sorting center and the international long-haul lanes to gateways in this country are starting at the corresponding national sorting center. This talk presents a mixed-integer model applied at Deutsche Post trying to determine the potential of alternative allocations of international lanes under demanding service-level requirements.

Supply Chain Optimisation within TNT Express

Henk Hoornenborg
Global Programme Manager M&A
BU Global Networks & Operations
Express 1 6921 RB Duiven, The Netherlands
e-mail: henk.hoornenborg@tnt.com

The supply chain of TNT Express has been translated into a nice game that will show all elements within the chain and, even more important, all relationships. You can play this game on line via www.tnt-ortec-game.nl to get a perfect understanding of this supply chain. During the presentation you will be introduced to this game, the objective, the user interface and the rules will be explained. Indirect you will be introduced into the world of optimisation within TNT Express. The GO (Global Optimisation) toolbox will be presented and when time allows more time will be spent on how we determine the optimal depot infrastructure. This infrastructure is an important part of the real life and the game.

Models and Methods for Letter Mail Delivery

Stefan Irnich

Johannes Gutenberg University
Mainz School of Management and Economics
Chair of Logistics Management
Jakob-Welder-Weg 9, D-55128 Mainz
e-mail: irnich@uni-mainz.de

In Germany, Deutsche Post World Net services approx. 40 Mio. private households and companies in 50,000 postal districts every day. Obviously, a good design of the underlying logistics network is crucial for the success of every postal company. The talk focuses on planning models and methods for the so-called 'last mile', i.e., the routing of mailpersons through their districts. We briefly recall classical models and methods which relate to the fundamentals of graph theory and matching theory. These classical approaches are well-suited for the routing of mailpersons that service a city district on foot or by bicycle. For rural areas, however, the delivery by car (or by car and on foot) is the rule. The planning of these tours requires a much more detailed modeling, since, e.g., cars have to respect turn prohibitions at crossings, one-way-streets etc. The talk presents several extensions of classical postman problems identified to be relevant in real-world letter mail delivery. Moreover, we show several computational studies (based on exact and heuristics approaches) indicating that real-world instances can be solved reasonably well.

Operations Benelux - Process & Project Engineering Update

Bas Janssen
TNT Express Benelux
Operations & Services
Meidoornkade 14, 3992 AE Houten, The Netherlands
e-mail: bas.janssen@tntexpress.nl

Methods to define the optimal location and number of depots / sub-depots within the Benelux with the same or an improvement of the service, given the actual and future logistical profiles, including what can be achieved within country borders and what can be achieved by considering borderless pickup and delivery between Benelux countries.

Dynamic routing of a vehicle by approximate dynamic programming

Stephan Meisel
University of Braunschweig
Carl-Friedrich Gauß Department
Decision Support Group
Muehlenpfordtstr. 23, 38106 Braunschweig
e-mail: stephan.meisel@tu-bs.de

This contribution considers approximate dynamic programming for dynamic routing of a vehicle in the presence of stochastic customer requests. Two distinct groups of customers are considered. Early requesting customers definitely request for service, whereas late request customers appear randomly over time according to individual request probabilities. Late requests must be either confirmed or rejected directly after becoming known. The goal is serving the maximum number of requesting customers within a fixed period of time. The performance of the approximate dynamic programming approach is compared to the performance of state-of-the-art heuristics for the problem.

Enriching the Tactical Network Design with Fleet Scheduling Characteristics

Ineke Meuffels
ORTEC & Tilburg University
Groningenweg 6k, PO Box 490
2800 AL Gouda, The Netherlands
e-mail: ineke.meuffels@ortec.com

Express service carriers provide time-guaranteed deliveries of parcels via a network consisting of nodes and hubs. In this, nodes take care of the collection and delivery of parcels, and hubs have the function to consolidate parcels in between the nodes. The tactical network design problem assigns nodes to hubs, determines arcs between hubs, and routes parcels through the network. Afterwards, fleet scheduling creates a schedule for vehicles operated in the network. The strong relation between flow routing and fleet scheduling makes it difficult to optimise the network cost. Due to this complexity, fleet scheduling and network design are usually decoupled. We propose a new tactical network design model that is able to include fleet scheduling characteristics (like vehicle capacities, vehicle balancing, and drivers legislations) in the network design. The model is tested on benchmark data based on instances from an express provider, resulting in significant cost reductions.

Large-Scale Vehicle Routing for Urban Waste Disposal

Uwe T. Zimmermann
Institut für Mathematische Optimierung
TU Braunschweig
Braunschweig
e-mail: u.zimmermann@tu-bs.de

A current project with waste disposal companies aims at simultaneously planning routes and crews of collection-vehicles. We focus on the optimization of routes. We illustrate practical constraints extending classical Arc Routing. Best exact methods for Arc Routing solve instances with up to 200 demand arcs to optimality. Our street network of the German city of Bochum consists of about 15000 arcs with demand, i.e. street segments with waste to collect. Based on adequate aggregations and relaxations we present optimization approaches for finding efficient routes. We discuss computational results for real world data and we compare our solutions with the routes applied in practice. We conclude with some remarks on coordinating plans for routes and crews.