3rd conference of the EURO Working Group on the Practice of Operations Research

Challenges in the deployment of OR projects

EWG POR
PRACTICE OF OR

Thursday 19 March, 2020 (1:30pm) -
Friday 20 March, 2020 (4pm), Zuse Institute Berlin

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Programme

Thursday 19 March 2020

12:30 *Registration*

13:30 Opening session

13:50 **Keynote 1:** A.Zymolka (Axioma): *Optimization in Finance – Practice and Challenges*

14:50 Contributed talks (C1)

- M.Pozzi (Optit): *When the "world of ideas" meets the ground: Stories of applied Operations Research (and Machine Learning) in real life*
- S.Griffioen (Netherlands Railways): *Optimizing seating probability in passenger trains*

15:30 *Coffee break*

16:00 **Keynote 2:** C.Silvester (Uniper): *Delivering OR Solutions for Everyday Operations in Energy Trading*

17:00 Contributed talks (C2)

- M.Günther (Stadtwerke München): *Implementation and Operation of a Gas Market Model at Stadtwerke München*
- G.Ayres de Castro (SAP): *A Framework for Extending SAP IBP's Optimization Capabilities with FICO Xpress*
- E.Cakici (IBM): *ÇİMSA End-to-End Sales and Operations Planning*

18:00 **Keynote 3:** R.Werner (Open Grid Europe): *Operations Research supporting Germany's energy transition*

19:00 *Close*

20:00 *Conference dinner (optional)*

Friday 20 March 2020

8:00 *Registration*

8:00 Interactive poster session + coffee

8:40 Introduction to day 2

8:45 **Keynote 4:** S.Klosterhalfen (BASF): *Successful value chain optimization at a chemical company*

9:45 Contributed talks (C3)

- M.Moullin (Public Sector Scorecard Research Unit): *From snow ploughs to child obesity – Overcoming challenges in the deployment of OR projects in the public sector*
- M.Brandeau (Standford University): *Analytical Projects at Lucile Packard Children's Hospital Stanford: Successes, failures, and opportunities*
- M.de With (OrTec): *Creating an employee planning application that can be trusted*

10:45 *Coffee break*

11:00 Parallel discussion group sessions

12:30 *Lunch*

13:30 **Keynote 5:** B.C.Sal (DPDHL): *Putting Operations Research into Operations in Deutsche Post DHL Group*

14:30 Contributed talks (C4)

- Z.Balaporia (FICO): *Conquering the 'Last Mile' and 'Extra Mile' of Implementing Optimization Projects*
- T.Schlechte (LBW Optimization): *Trust is good, optimal control tours are better!*

15:00 Summary of parallel sessions

15:45 Closing remarks

16:00 *End of event*

Sponsors

Many thanks to all the sponsors of this event that has been entirely financed through their generous contributions.

Keynote talks

Optimization in Finance – Practice and Challenges

Darling, did you shrink my alpha?

Adrian Symolka

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The seminal work of Harry Markowitz in the 50's introduced mathematical optimization to the world of finance, based on quadratic programming which just became practically usable. His groundbreaking vision to optimally trade off risk and return however inspired many portfolio managers in their daily work and helped shaping the area known as quantitative finance. Meanwhile, finance has become a domain of economics, statistics, and – optimization.

This talk will (p)review usage of optimization in finance – from past to present, from theory to practice, and from vision to reality – and in some cases also back (into the future). It will also disclose who really (may have) shrunk the alpha.

Biography

Dr. Adrian Zymolka has over a decade of experience in working with clients of Axioma's sophisticated products in the financial industry. With his deep mathematical and optimization background, he is passionate about making sure that any users have maximum benefit from the portfolio construction, risk management and performance attribution software tools as well as content products like risk models and factor libraries.

Adrian heads the business development around Axioma's optimizer. Continued in parallel, Adrian also leads Axioma's business in the DACH region and the Frankfurt office, which was opened in 2015. Before that, he was leading the Client Services group in the US from 2010 to 2015, located in New York. Adrian joined Axioma's London office in 2007 as Director of Client Services Europe, offering training, consulting services and mathematical support to Axioma's users.

In his life prior Axioma, Adrian was a research assistant at the Zuse Institute Berlin (ZIB) in the Optimization department headed by Prof. Martin Grötschel. During his Ph.D. time, he developed optimization methods for highly complex problems in the area of telecommunication network design. Besides leading and participating in various industrial projects, he also carried out a strong research record. In 2006, he joined atesio GmbH, a ZIB spin-off company, where he worked as optimization developer and consultant.

Adrian holds a Ph.D. in Mathematics from the Technical University in Berlin and a diploma (Master) in Mathematics from Philipps University in Marburg, Germany.

Delivering OR Solutions for Everyday Operations in Energy Trading

Colin Silvester

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This talk will share some insights into the challenges faced over many years of implementing OR techniques as part of the daily operations of an energy trading business. The focus is on creating solutions that will be used by non-OR practitioners as part of their normal work within software environments that fit their day-to-day work.

Specialists in a particular business process will often have little appreciation of the capabilities of OR techniques and we will discuss how an OR-specialist can identify where optimisation can make a positive impact in the organisation. The implementation of OR will often need to overcome organisational and personal barriers as there will be a need to positively influence key stakeholders involved in making change happen and to allay fears that automation through optimisation could lead to a degradation of individual roles.

We will go on to describe the technical challenges of delivering a solution that is to be integrated into the daily operations of trading business. This encompasses the integration with other IT systems whilst retaining the ability to support and enhance the core optimisation solution. We will also discuss the needs for operational systems to be reliable and to prevent unhandled infeasibilities leading to process failures. It is also critical that these solutions deliver optimisation performance that is aligned with decision-making timescales and which are appropriate to the accuracy of the model inputs.

We will also look to the future and how containerisation of algorithms and data will allow more flexible development and reuse of optimisation solutions.

Biography

Colin Silvester is a Senior Modelling Specialist working at Uniper. Colin has over 20 years of experience in the energy sector. In recent years, Colin has focused on power and gas portfolio optimisation and price modelling. He has developed models that are used operationally within Uniper Global Commodities to optimise conventional, CHP and hydro assets across a wide range of timescales. Earlier experience has included market modelling of liberalising markets, power-to-heat and power-to-gas evaluations and developing and running business simulation games.

Colin holds a degree in Physics from Imperial College in London and is a Chartered Engineer.

Operations Research supporting Germany's energy transition

Ralf Werner

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The binding climate targets from the Paris Climate Agreement are leading to a profound change in the energy industry. Green hydrogen will play a central role in a decarbonized and secure energy supply. This leads to new challenges for Open Grid Europe, Germany's largest gas network operator.

Open Grid Europe meets these challenges with innovative products and solutions that are often based on Operations Research. We would like to provide an insight into our innovation process and show challenges and approaches to solutions based on sample projects.

One example is the navigation system for our technical network control. We are on the way to develop a smart, forward-looking, analytics-based decision support system. For this to work, it was necessary to utilize three types of analytics:

- Descriptive: modeling and simulating the gas flow in the network,
- Predictive: predicting future gas supply and demand from outside the network,
- Prescriptive: recommending network control measures to ensure safe and efficient operation of the network.

This system is designed to propose recommendations for the operation of 92 compressor units, almost 300 regulators and more than 3,000 valves to control 12,000 km gas network for delivering about two-thirds of Germany's natural gas demand.

Biography

Ralf Werner joined Open Grid Europe (OGE) in 2008 as Head of IT Management in OGEs predecessor company and established a modern state of the art IT and digital unit.

Beforehand he was in charge of different IT management roles at RWE focused on international projects and architecture roles. Ralf started his professional career as consultant in an international management consultancy.

Within the last years, Ralf's main focus was to establish an "agile first", "mobile first" and "cloud first" approach at OGE combined with a companywide digital transformation, always in line with OGE's strategy an aligned with all business units.

Successful value chain optimization at a chemical company

Steffen Klosterhalfen

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Chemical value chains are characterized by a largely divergent product structure where very few raw materials are converted through various production steps into a multitude of intermediate products which in turn are further processed and refined into hundreds or even thousands of finished products sold in different industries and different regions around the globe. The different target markets are managed by different business units. Hence, several business units participate in one and the same value chain and are responsible for steering their specific part of it. Traditionally, each business unit has planned and operated its value chain part mainly in isolation of the others. Due to the technological advancements in recent years a lot of progress has been made towards a more holistic approach to steering a value chain. In this talk, we illustrate our approach in developing value chain optimization solutions and share our experience and lessons learned.

Biography

Dr. Steffen Klosterhalfen is an Operations Research Expert at BASF. He holds a PhD in Business, Logistics & Supply Chain Management from the University of Mannheim, Germany. In 2015, he took a temporary leave from BASF to join the Robins School of Business at the University of Richmond, VA, USA, and the Luxembourg Centre for Logistics and Supply Chain Management as an Associate Professor. Since 2018 he is back in the Advanced Business Analytics team at BASF.

Putting Operations Research into Operations in Deutsche Post DHL Group

Baris Cem Sal

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Deutsche Post DHL Group (DPDHL) is home to two strong brands: Deutsche Post is Europe's leading postal service provider. DHL offers a comprehensive range of international express, freight transport, and supply chain management services, as well as e-commerce logistics solutions.

DPDHL has kicked-off its journey of building data analytics capabilities internally in 2014 through its Data Analytics Center of Excellence (CoE). Starting with only a few employees in the CoE, the topic has grown significantly over the last few years, growing into a community of several hundred Data Scientists around the globe.

The CoE has started building its Operations Research capability by 2017, and in only a couple of years, the Operations Research team has developed algorithms and solutions that can unlock double digit Million Euros in savings every year. The talk focuses on the challenges the team has encountered, as well as the achievements reached over the last years. Many of the team's use-cases have scales that make them complex from a mathematical perspective. But the real challenges faced were mostly around the business processes and change management than the technical challenges. So in this talk you will hear how we design the routes for more than 50.000 postmen, or route 20.000 parcel delivery vehicles daily and many other use-cases; but you will also learn, for example, why sometimes the best route is neither the shortest nor the fastest, but the one most likely to be accepted by the driver. Finally we share how (and why) the team integrates Machine Learning more and more into its Operations Research use-cases.

Biography

Baris Cem Sal is the Lead Data Scientist for Operations Research in Deutsche Post DHL Group Data Analytics Center of Excellence. Baris holds a BS degree in Industrial Engineering from Bilkent University/Turkey. Working in IT and logistics companies, he has brought multiple Machine Learning and Operations Research use cases to production, focusing on topics like forecasting, pricing, inventory optimization, network design, and routing.

Abstracts of contributed talks

When the “world of ideas” meets the ground: Stories of applied Operations Research (and Machine Learning) in real life

Matteo Pozzi

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There is no doubt that OR (and ML) can be incredibly useful to support decision making in business processes, but the actual application of mathematics and model-based approaches to real life is often not as straightforward as one might imagine: analysis of the issue, its description in a model, testing with real data and refinement of the model up to delivery to the end user remains a correct, yet over simplistic approach, that often does not take into account the human factor, interconnections with the local organizational structure and the infinite possibilities of mis-communication.

Through a series of first hand experiences, taken from Optit’s projects, we will highlight a series of typical situations that occur in many (if not all) applications of OR in real life:

- Whom to talk to .... Archetypes of customer references ...
- Managing expectations .... did we not say that we would reach optimality? I have found a better solution ....
- “I have been promoted” .... When organizational changes risk to disrupt a perfect project
- The magic wand .... When forecasting becomes the Key Success Factor
- What is a DSS, by the way? .... About the art of hiding complexity

Finally, we will present Optit’s strategies to deal with these factors, in the ever lasting strive toward delivering excellent and effective decision support systems to our customers.

Biography

Matteo Pozzi is Partner and Chief Executive Officer of Optit since 2010. Following his MSci in Physics and Diploma in International Relations, he spent more than 15 years in management consulting in the UK and Italy, working with increasing responsibilities in large business transformation projects with strong focus on the interdependencies between processes and ICT. This experience is now being leveraged upon in Optit, whose business model is evolving to meet market challenges leveraging on the potential of OR and data science at large.

Optimizing seating probability in passenger trains

Simone Griffioen, Pieter-Jan Fioole

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At Netherlands Railways the number of passengers in specific trains is uncertain in the rolling stock planning phase. For over a decade a OR-decision support system for rolling stock scheduling is used, where the number of passengers is assumed to be deterministic. With the availability of smart card data, more reliable crowding forecasts became available. We extended the rolling stock scheduling model in such a way that a probability distribution can be used to optimize seating probability. We will show this extension improves our customer service without raising the costs. However, the new stochastic approach (and its result) is even more difficult to use and understand by planners who work with the decision support system. So, we had to deal with a trade-off between quality for the passengers versus understandability for the planners. Can we have both? Maybe not completely, but they can grow together. Currently, we successfully implemented this improved way of optimizing our rolling stock scheduling. We will talk about compromises we had to make and challenges we came across during this implementation.

Biography

After obtaining her Master of Logic **Simone Griffioen** started as a Trainee at the Netherlands Railways, where working in different roles in several projects gave her a broad knowledge of the company. She ended up in the department of innovation, where she researched the possible impact of traveler distribution measures on rolling stock costs and service level. After that, she continued there in the role of business consultant, in which she stayed on after her traineeship. Among other things, she is concerned with providing support and training for the implementation of advanced decision support systems in planning and dispatching. Simone likes to challenge herself both professionally and personally, where she climbs rocks and mountains in her spare time.

Pieter-Jan Fioole has a master in econometrics and works at the OR department of Netherland Railways since 2002, currently as senior research leader. He conducted research on applied OR for many different planning problems at Netherland Railways, including strategic line planning, real time crew dispatching and timetabling. For his work on tactical rolling stock scheduling he was part of the Netherland Railways' team that won the Franz Edelman award in 2008. The main focus of the OR research department is to apply state-of-the-art algorithms into working prototypes which can be successful within the practical planning department of Netherlands Railways. Besides his work, Pieter-Jan solves practical problems related to planning and scheduling his household with 2 small children and embark on physical challenges like running a marathon and racing his bike.

Implementation and Operation of a Gas Market Model at Stadtwerke München

Maik Günther

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Stadtwerke München (SWM) has invested in all stages of the value chain of natural gas. It ranges from exploration and production in North Sea to distribution and downstream. SWM also owns gas-fired heating plants and power plants with cogeneration of heat and power. Thus, it is important for SWM to have a detailed knowledge of the global gas markets and gas prices. Additionally, the knowledge of price sensitivity to modifications of parameters such as gas demand, new pipelines or geopolitical situations is a competitive advantage.

Before 2013, SWM analysed the gas market solely based on external studies, workshops and expert interviews. The problem was that the underlying parameters were only partially transparent and own parameters could not be integrated. However, this is important because SWM has its own assumptions about parameters (e.g. exchange rates, oil price and gas demand). Furthermore, results from different external reports could not be compared accurately. Therefore, it was decided to operate a model for the gas market at SWM, which should be fully integrated into the existing model suite.

The first idea of developing an own gas market model was rejected because the required data set is very difficult to obtain. For example, comprehensive data on long-term gas supply contracts or future production are not publicly available. Therefore, commercial gas market models were analysed through workshops. The choice fell in 2013 on the worldwide gas market model PEGASUS from Pöyry Management Consulting (UK) Ltd. This model uses Linear Programming (LP) and was created in the Xpress Optimization Suite from FICO. Furthermore, the business intelligence software Tableau is integrated into the gas market model to visualize the large number of input data and results. A scenario until 2040 is calculated in the model on an RX600 with 1 TB RAM and 32 x 2 GHz in about 25 minutes. Each gas year is optimized separately by the model, whereby the gas year is broken down into individual days. The goal of the optimization is to minimize the total cost to cover the daily worldwide gas demand. These costs consist of the daily production costs, transport costs, storage costs and flexibility costs. Results of the optimization are detailed long-term gas flows and hub prices, e.g. for NetConnect Germany (NCG), in daily resolution.

SWM is applying this model under the name WEGA to increase acceptance internally, because the results of WEGA are based on an own view of the global gas markets by SWM. To ensure that the model is up to date, SWM obtains annual data updates from Pöyry and modifies them with own assumptions. For example, SWM has its own view on the development of the oil price, exchange rates, marginal costs of storage facilities, gas demand or production volumes. These modifications are based on SWM analyses, on publicly accessible sources or come from other commercial providers, some of which maintain their own gas market models.

The implementation of the model was relatively complex due to the number of involved stakeholders: Pöyry, FICO, Tableau, different roles in the IT department of SWM and users of the model at SWM. In addition, a large number of contracts had to be negotiated with the individual partners. After the implementation, the source code and the data set of the model were analysed in detail to guarantee that WEGA is working accurately. This helped to increase the acceptance for the model. Furthermore, many presentations were held internally to explain the model. Meanwhile, only long-term results of WEGA has to be used for all asset valuations at SWM. However, annual data updates and updates of the source code are still very time consuming due to the number of stakeholders and strict IT security rules at SWM. Additional information about WEGA can be found in [1-5].

[1] Fallahnejad, M.; Günther, M.; Eberl, B.: *Long-Term Forecast of Residential & Commercial Gas Demand in Germany*, in: Book of Abstracts of the Vienna Young Scientists Symposium (VSS), 2017, pp. 108-109.

[2] Günther, M.: *Practical Application of a Worldwide Gasmarket Model at Stadtwerke München*, in: Operations Research Proceedings 2015, Springer, 2017, pp. 715-721.

[3] Günther, M.; Nissen, V.: *Gas Flows and Gas Prices in Europe: What is the Impact of Nord Stream 2*, in: ENERDAY 2019 – 13th Conference on Energy Economics and Technology, 2019.

[4] Günther, M.; Nissen, V.: *Impact of Nord Stream 2 on Gas Flows in Europe*, in: 16th International Conference on the European Energy Market (EEM), IEEE Xplore, no. 388, 2019.

[5] Günther, M.; Fallahnejad, M.: *Analysis of NCG prices under different shapes of oil price recovery with a worldwide gas market model*, in: Handbook of Energy Finance. Theories, Practices and Simulations, 2020, in press.

Biography

Maik Günther received his PhD in economics from the Technical University of Ilmenau. He is expert for energy economics at Stadtwerke München GmbH and is in charge for long-term analyses of global oil and gas markets. He is also an affiliated researcher at the Center of Energy Markets at the Technical University of Munich and holds lectures at FH Vorarlberg, at FOM University of Applied Sciences and at Conenergy Akademie. He has more than 100 publications in the areas of energy markets, e-mobility, algorithms, artificial intelligence, workforce management and process optimization.

A Framework for Extending SAP IBP's Optimization Capabilities with FICO Xpress

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SAP IBP (Integrated Business Planning) is standard software widely used in a variety of industries to manage supply chain and planning processes. IBP provides the ability to create operation plans for supply and demand, control inventory, simulate supply chain scenarios, synchronize systems and processes in real time, and much more. Nevertheless, there are limitations to the types of mathematical optimization problems that SAP IBP can handle, and nonlinear optimization is not possible – we show how we solved this technical challenge with a framework for extending the functionality of SAP IBP to make use of state of the art optimization capabilities of FICO Xpress. The integration and process control for the solution relies on SAP Data Intelligence, a Kubernettes-based architecture, which allows for the required scalability, process flow orchestration and pipelining, and flexibility of integration points, with data from both native SAP applications and non-SAP ones.

The problem at hand involves the optimization of the supply chain for a process of iron ore blending at one of the world's largest mining companies and is at its core a nonlinear process due to the physicochemical and metallurgical properties of the blending process itself. The integration allows SAP IBP to seamlessly take advantage of FICO Xpress's nonlinear solvers to tackle this nonlinear optimization problem while preserving the customer's investment in the IBP framework and workflow.

Biography

Sricharan Poundarikapuram: PhD in Operations Research, UW Madison; and around 15 years' experience in the industry. 12+ years at SAP. Interested in solving complex, dynamic, and multi-dimensional challenges in Data Science, Machine Learning, Price Optimization, Supply Chain Management, Manufacturing Systems, and Optimization of Operations for high performance.

Gustavo Ayres de Castro holds a PhD degree in Control Systems from the EE department at UCLA. He is a principal data scientist with SAP, where he is interested in developing solutions to problems arising from complex business requirements in a variety of industries, requiring applied math tools from fields such as data science, operations research, statistical forecasting, signal processing, and others.

ÇİMSA End-to-End Sales and Operations Planning

Eray Cakici

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This presentation will cover the end-to-end supply chain (SC) optimization project of Cimsa – world's largest white cement producer. A typical SC involves many stages with each stage's own challenges and objectives. Managing SCs effectively is a big challenge and this challenge can only be addressed through integrated production and distribution planning strategies.

Cimsa S&OP team was relatively new to operations research (OR) based applications and the ultimate goal for Çimsa is to be proficient in the use of the technology to make this as part of the S&OP process and conduct it internally. The existing black-box optimization solution was not able to address all business objectives, rules/constraints and not flexible enough to examine different what-if scenarios. Cimsa was seeking a solution for both replacing the existing system and for further expanding optimization-based applications within the company.

This project has many first-of-a-kind features in cement manufacturing. All stages of supply chain (procurement, manufacturing, warehousing, transportation and sales) involved and both strategic (yearly) and operational (hourly) decisions are covered. In the delivery, we mainly had challenges with setting up scope and deliverables in addition to challenges with data and model performance. Complete supply chain was in scope and this led to expectations towards optimizing many different processes.

This project has been delivered by IBM Services with the support of IBM Data and AI Elite team. Very efficient optimization models are developed using IBM Cplex Optimization Studio and the system is fully integrated with Cimsa's SAP system. As Cimsa has many specific requirements, business rules and objectives, custom developed models are supported thru custom user interfaces. Implementation challenges will be discussed together with achieved savings and future roadmap.

Biography

Eray Cakici is Senior Operations Research Engineer at IBM Data Science and AI Elite Team. He has 15+ years of experience coupled with academic knowledge of optimization and scheduling. Prior to joining Elite Team, Eray took consulting and business development roles at IBM, Selco, and Transplace. He received his BS in Industrial Engineering (IE) from Baskent University and MS/PhD in IE from University of Arkansas. He taught business analytics courses at Bogaziçi, Koç and Baskent Universities.

From snow ploughs to child obesity – Overcoming challenges in the deployment of OR projects in the public sector

Max Moullin

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This paper will discuss challenges in the deployment of a number of OR projects over the years – from snow ploughs to child obesity. The projects described all had deployment difficulties. However in many cases these were anticipated in advance with good results.

The author's approach to OR was heavily influenced by senior practitioners in his first two projects where in particular he learnt about the importance of involving staff and other key stakeholders. The first was an 18 month project advising on snow clearance on English motorways. This included monthly meetings with the relevant director and his staff including a former snow plough operator. This meant that the assumptions and analysis were agreed as they went along and implementation of the project's conclusions proved much easier. The second project on comparison of treatments for acute myeloid leukemia was based on regular contact with clinicians at all levels, including writing joint research papers. This project was later described as having led to 'a major breakthrough in the treatment of AML'.

When the author moved to British Coal, the involvement of staff at all levels proved crucial both to the wide deployment of a colliery production planning system and to a marketing model for use with clients that was featured on BBC television. However it was only after moving to Sheffield Business School, who received sponsorship from the UK OR Society for the Community OR Unit, that he learnt from a number of OR experts about the importance of involving service users. Not only were patients and service users often the best source of information on how a service works in practice, involving and empowering them within the project led to more successful implementation. He also learnt first hand about the usefulness of 'soft' OR facilitation methodologies. This experience helped greatly when developing the methodology of the Public Sector Scorecard (PSS).

So when the author was asked to help improve Sheffield's Stop Smoking Service, he began with three interactive workshops attended by over 100 service users and then worked with a reference group including senior managers, staff, service users and other key stakeholders. This involvement was crucial to the success of the project where the number of people stopping smoking doubled and has stayed at that level ever since. A similar approach was used in a city-wide project aimed at reducing child obesity. However this only proved to be successful once the project team took explicit account of behavioural aspects by integrating the PSS with the Theory of Planned Behaviour.

Also, arguably, one of the reasons why otherwise excellent OR projects are not deployed successfully is that they often take strategy as given. However unless that strategy is understood and agreed widely within the organization, the project sponsor is likely to find implementation of OR's findings difficult. One way to avoid this is to help the organization develop and articulate its strategy before identifying the best way forward. Finally, it is important that the organization has the right performance measures in place, as otherwise a good OR solution may appear not to perform so well.

The paper concludes that many problems arise because of practitioners' implicit definition of what makes a good OR project. Rather than trying to come up with the best solution to a problem, they should frame the issue as how they can assist the client in implementing successful change. This may include the involvement of staff, service users and other stakeholders; using a combination of hard and soft OR methods; making use of Behavioural OR where appropriate; and if possible trying to get involved in strategy and performance measurement as well as service improvement.

Biography

Max Moullin worked in OR in central government (Health, Environment and Transport) and in British Coal for over ten years before becoming a principal lecturer at Sheffield Business School. He is author of the book Delivering Excellence in Health and Social Care and a Fellow of the Operational Research Society and the Chartered Quality Institute. In 2001 he developed the Public Sector Scorecard which has been used in Canada, Chile and South Africa as well as in Europe. He is currently director of the Public Sector Scorecard Research Centre. He is an experienced plenary speaker and workshop facilitator.

Analytical projects at Lucile Packard Children's Hospital Stanford: Successes, failures, and opportunities

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Improving healthcare value by improving quality and reducing cost is a priority for all health systems. Numerous technical proof-of-concept projects in the use of optimization, machine learning, and other analytical methods to solve clinical and operational problems in hospitals and other healthcare settings have been published but relatively few have been shown to provide sustained value. A question of central importance for operations researchers is how to develop tools that will be successfully implemented and that will lead to sustained, measured value – that is, reduce the cost or improve the quality of care on a sustained basis. For a project to provide sustained value it must succeed in each of four successive stages: stakeholder engagement, technical performance, implementation, and sustained use (with measurable impact).

We describe recent work on a variety of analytical projects that we have carried out at Lucile Packard Children's Hospital Stanford (LPCH) with a focus on key reasons why projects failed or succeeded at each stage. Our work at LPCH aims to facilitate the delivery of cutting-edge advances in medical care through advances in hospital operations. To achieve this goal we are applying a range of analytical techniques including machine learning, mathematical optimization, simulation, and a variety of statistical, probabilistic, and computational tools. Our projects target various parts of the care process including telemedicine and patient access; procedures and diagnostics; the intensive care and acute care units; and discharge.

Our projects have achieved varying degrees of success to date. We discuss factors leading to project success or failure, focusing on the extent to which projects have succeeded in engaging stakeholders, in solving the technical problem, in implementation, and in sustained use. For the latter three stages we describe a project that failed at that stage, the changes we made to address the failure, and one or two projects that were successful.

We conclude with discussion of lessons learned and we present principles and best practices for the design of analytical projects intended for implementation in healthcare settings.

Empirical evidence suggests that, to date, analytics-based system design has failed to provide the full benefits that could be achieved in hospitals and other healthcare settings. Operations researchers must use the lessons of these failures, including many of our own, to inform the design, implementation, and evaluation of their analytical solutions.

Biography

Margaret L. Brandeau is the Coleman F Fung Professor in the School of Engineering and Professor of Medicine (by Courtesy) at Stanford University. Her research focuses on the development of applied mathematical and economic models to support decisions in health policy and healthcare operations management.

David Scheinker is Director of Systems Design and Collaborative Research at Lucile Packard Children's Hospital Stanford, and Associate Clinical Professor of Pediatric Endocrinology and Adjunct Professor of Management Science and Engineering at Stanford University. He leads an initiative, Systems Utilization Research for Stanford Medicine, that aims to facilitate the delivery of cutting-edge advances in medical care through advances in hospital operations.

Creating an employee planning application that can be trusted

Meike de With

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The employees of a large specialized manufacturing company fly all over the world to do complicated, multi-phase projects that can take up to half a year to complete. For that purpose, a planning needs to be made several months in advance. This planning needs to take the employees' specific skills and personal planning into account, while incorporating and minimizing travel and considering the different priorities of projects.

Previously, this planning was created in Excel, but this had a number of drawbacks: manual planning in Excel cost a lot of time, multiple versions needed to be synced manually, there were no checks on data integrity and most information was only in the planners' heads. To replace the Excel planning, we have created an AIMMS application which supports manual planning by using business rules and automating manual actions. In addition, the application can create an automated optimal planning, using an implementation of the GRASP algorithm.

From the start, the planners were very interested in using an algorithm to save them time and create a better planning. However, to get to this end-result, two things are needed: first, the planners need to trust and accept the application by using it for manual planning, before they can allow for automated processes and optimization algorithms. In addition, for an automated process to work well, we need to distill business knowledge from the planners' heads: what are the KPIs, which business rules need to be followed, why do they take certain decisions and how can we create explicit constraints from implicit preferences?

We will discuss how this was done, by giving users full control over the planning, allowing them to make conscious decisions, and having flexibility in e.g. the weight of the different soft constraints. This, in the end, led to an application that the customer could trust for both manual and automated planning.

Biography

Meike de With has a background in Physics and holds a PhD in Astroparticle Physics from the Humboldt University in Berlin. After her PhD, she left academia, moved fields and in 2016 she started working as a consultant at ORTEC in the Netherlands. She has been involved in a number of projects for different customers, and in the past few years she has specialized in building, implementing and supporting custom-built OR software at multiple clients.

Conquering the Last Mile and Extra Mile of Implementing Optimization Projects

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In telecom and supply chain management, the last mile refers to the challenging final step of getting services and products into the hands of customers. We see the same challenge in the deployment and adoption of optimization projects. Deploying optimization into business processes can be a very challenging step itself, and technology can help conquer this “Last Mile” problem.

But what if the last mile isn’t the last mile? Technology can help with deployment, but the final hurdle is adoption and usage, and getting this adoption requires us to go the “Extra Mile”. Optimization solutions often face significant cultural and organizational barriers which cannot be solved through technology alone. As optimization projects grow in complexity and power, this problem becomes even more important to address early on as part of every optimization project.

This presentation will describe the implementation challenges under a “Politics of Analytics” framework, and then explore five strategies that help drive adoption to realize the full business impact of OR projects.

Biography

As Senior Director of Solutions Consulting at FICO, **Zahir Balaporia** leads a delivery team that helps clients design solutions for their advanced analytics needs, with a strong focus on deployment and change management. He brings 20+ years of experience in manufacturing, transportation, logistics and IT, having led the advanced analytics team within a $4B company prior to joining FICO. Zahir is also an active INFORMS volunteer having served in a variety of roles including President of the Analytics Society of INFORMS.

Trust is good, optimal control tours are better!

Ralf Borndörfer[1], Torsten Klug[2], Markus Reuther[2], Thomas Schlechte[2], Stephan Schwartz[1], Elmar Swarat[1]

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Planning control resources is an important challenge in many real-world applications, e.g., police inspections, ticket inspections or other security related tasks. Here, we focus on the enforcement of the distance-based truck toll on German motorways and main roads (around 50k kilometers). The enforcement of the toll is the responsibility of the German Federal Office for Goods Transport (BAG). It is conducted by a combination of traffic control gantries or devices for automatic stationary camera control and spot-checks by more than 400 mobile control inspectors.

In an on-going research and development project with the BAG we consider two important tasks. On the one hand we optimize the activation intervals of the stationary devices, and on the other hand, we are aiming at optimal control tours and crew rosters of the inspectors. The major task is to find a compromise between quality and quantity of controls as well as providing fair roster schedules for the inspectors such that the acceptance of the optimized schedules can be increased.

We report on the current status of the deployment of the developed software and on the change management from rules to models. In particular, we will discuss how we mastered the challenge to bring the tools into production and how to gradually increase the planner and inspector acceptance with concrete cases.

The modeling power of Mixed Integer Programming and the ability of rapid model modifications in order to cope with moving targets guided our travel.

Biography

Thomas Schlechte is partner at LBW Optimization and expert for mathematical optimization problems in traffic and transport. He graduated at TU Berlin with a dissertation on optimal track allocation in railway traffic that has been recognized with severals awards.

Elmar Swarat is a research assistant at Zuse Institute Berlin.

Abstracts of poster presentations

A Three-Phase Optimization Framework for Warehouse Operations: Order Allocation, Batching and Picking

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E-commerce companies often want to deliver products which are ordered through their websites to their customers as early as possible. In order to achieve this aim, they have to optimize their supply chains, logistics and inventory operations. In this study, we focus on optimizing the operations in inventory for an e-commerce company located in Turkey. When an order is received, it goes through a set of processes it has to abide by. Firstly, if an order is composed of several items distributed in the different locations of mezzanine, one has to allocate the right items to the order. This stage is called order allocation. An item might be stored in different locations of the mezzanine with different quantities. Once the items are allocated to the orders, then a different process is triggered to assign orders into work-lists. This process is called order batching. A batch is either composed of orders with single items or orders with multiple items. Depending on the orders' size, a work-list is called single or multiple. Finally, work-lists are grouped together and assigned to employees in order to pick the items. This stage is called pick-list creation. A pick-list is composed of four work-lists where one of the work-lists must be single and the remaining three must be multiple. In order to optimize the inventory operations and decrease the time spent while collecting the orders, we introduce a three-phase optimization framework. We use a mixed-integer programming model for order allocation stage where the model tries to assign items to the order with the closest distances. For the order batching stage, an Adaptive Large Neighborhood Search (ALNS) algorithm runs to determine which orders to group together. For the pick-list creation stage, a fractional programming model is designed and linearized. The goal of the model is to maximize the number of items collected per corridor. The optimization framework is integrated into the warehouse management system (WMS) and the allocation, batching and picking decisions are given by the mathematical models and ALNS algorithm. We observe significant improvements in the number of items collected per corridor. Before the models are integrated into the WMS, the average number of items collected was around 2.48 whereas the new algorithms provided substantial increases up to 5.32 items on average during certain hours in the day in the last three months.

Biography

Ahmet Cinar is the leading operations research scientist and developer in Trendyol. He joined Trendyol in 2019. Before Trendyol, he worked in different industries and developed several algorithms for finance, supply chain and logistics sectors. He has a PhD in Industrial Engineering and Operations Management.

Why puzzles are such good training paths for OR consulting?

Alex Fleischer

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Trying to solve puzzles, practitioners can train themselves on OR techniques (and other techniques). Puzzles are good ways for large and small companies to have OR practitioners from academia and consulting have a look at their specific issues (ROADEF / Euro challenges). Puzzles can help challenge students to show motivation and skills.

Why puzzles are very interesting with regards to equivalent computations challenges ?

We need to map real world concepts to mathematical concepts and that's useful! They tell a story so they're very easy to share and explain.

Kaggle challenges are part of the buzz around data science and here I'll mention other public challenges with examples. The IBM Ponder this challenge, the Decision Management challenge not to forget the "Comité International des Jeux Mathématiques".

And I will challenge the audience with regards to decide whether challenges are good training paths for OR consulting or conversely business OR helps get better at challenges

Biography

Alex Fleischer is an Optimization Expert at IBM in Europe. His expertise is in computer science, mathematics, artificial intelligence and Optimization. He has recently been involved in several projects with financial institutions in Europe including commercial banks, securities companies and central banks.

The Intelligent Machinery behind Airline Ground Ops

Claude Philippe Medard, Nidhi Sawhney

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SAP HANA is an in memory database that allows very efficient collection of data points for building custom digital twins that provide real time situational awareness, parallel complex computations, and native in built ML algorithms. Extending SAP HANA with Fico Xpress Optimization allows solving a collection of complex scheduling and orchestration problems found in airline ground operations. This short talk describes the solvers built for stand and tow scheduling (a more complex variant of the gate allocation problem) and subsequent turn around ground ops processes critical to deliver on time performance.

These solvers first relieve the ground ops controllers from tedious manual tasks of improving customer connections and minimizing tow, currently a 3 to 4 hour manual process, down to less than 2 to 3 minutes, and subsequently allow for efficient TOBT (time off block time) real time predictions for securing slots during turn arounds.

Biography

Claude Philippe Medard started at Decision Focus Inc (now JDA) in the bay area on price optimization and demand forecasting. He then joined Carmen Systems (now Jeppesen) and coded and maintained the suite of optim products around crew pairing and crew rostering and developed the crew recovery engines. After a 3 year stint at Ilog in UK working on assortment management solutions for Debeers/DTC, he joined SAP Deutschland in Waldorf in 2010 as part of the data science start up practice. His expertise remains in SAP HANA applications for ML and optimization topics around scheduling. His renewed interest in airline has brought him close to ground operations and its unique links to ... air operations.

A Decision Support Software for Production Planning in Brewery Industry

Markus Mickein, Knut Haase

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In practical applications of production planning, mostly only a small part of the manufacturing process is considered. This is due to the increasing computing time of large-scale problems. Thus, the solution of common Material Requirements Planning (MRP) systems neglect relevant restrictions and are therefore infeasible for the real problem. The aim of this work is to considerate interactions between the production levels. Therefore, we propose a problem specific multi-level capacitated lot sizing problem (MLCLSP) solved by a fix-and-relax-and-optimize approach. Furthermore, we introduce a cloud-based optimization framework. The production planner updates the product, resource or demand data in an user interface and analyzes the results in a visualization tool. In the cloud, a virtual high performance computer solves the MLCLSP in GAMS via CPLEX. The advantage is to find a near optimal solution in a reasonable computing time. The software is used for long and mid-term analyses. Long-term analyses evaluate the impact of different scenarios. A scenario includes new products, resources or the change of production parameters. This supports top management decisions based on mathematical programming. Mid-term analyses determine capacity requirements and lot sizes. This improves the operational planning quality, cost savings and indicates the necessity of overcapacity. The software is applied by a swiss brewery company. The production process consists of 13 production and 8 storage resources divided into 3 production levels. The production portfolio consist of approximately 100 semi-finished and 220 finished products. A planning horizon includes up to 52 weeks.

Biography

Markus Mickein studied industrial engineering and management at the Universität Hamburg. His research includes work on integrated production planning. He is a PhD student at the University of Hamburg and has professional experience in consulting and production companies.

Knut Haase is the director of the Institute for Transportation at the University of Hamburg. At the University of Kiel he received his diploma and doctoral degree and his lecture qualification (habilitation) in business administration. After two years as a professor at the University of Hohenheim (Stuttgart), he was full professor for transportation and logistics at the Technische Universität Dresden. His research topics are focused on optimization approaches for solving large-scale problems with applications in logistics and public transport.

Deriving Application-specific Column Generation Principles for Automatic Freight Train Timetabling

Julian Reisch[1,3], Peter Großmann[1], Daniel Pöhle[2], Natalia Kliewer[3]

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In the annual railway timetabling process, thousands of train path applications need to be coordinated to yield a conflict-free timetable for the next year. In a project called neXt at DB Netze, an optimization algorithm is developed to automatically schedule as many freight trains as possible in the capacity that remains after all passenger trains are planned.

A common model for this business case is the multi-commodity-flow problem. More precisely, each train path application from A to B at a given time represents a commodity in a time-expanded infrastructure graph. In this graph, an edge represents a specific track at a specific time. The problem then reads as follows. Assign flow to as many commodities as possible such that a) flow conservation is preserved and b) capacity constraints are fulfilled. The capacity constraints typically ensure that each edge is used by at most one unit of flow, that is, at most one train uses a track at a specific time.

Even though the problem can be modelled easily in this manner, it is rather hard to solve. Firstly, the multi-commodity-flow problem is shown to be NP-hard. Secondly, instances for the whole of Germany consist of a huge number of edges. Recall that for each track at each point in time, there exists an edge. Moreover, track utilization with different speeds need to be modelled by different edges.

Therefore, the problem is computationally not tractable as a whole and column generation techniques have been proposed in the literature and implemented in the neXt project at DB Netze. The master problem is the assignment of flow to edges. The pricing problem is the search for new edges for the commodities. Due to the weak LP relaxation of the problem, however, the common technique of column generation with shadow prices improves only the LP bounds, but not the IP solution. Therefore, two heuristic approaches for column generation were employed that do without LP-relaxation.

On the one hand, bottleneck edges are detected and forbidden to use in the subsequent iteration. However, it is computationally expensive to detect the bottlenecks repeatedly. Furthermore, this approach can be parallelized only in a very complicated way so that practitioners might not be able to analyse and interpret the results.

On the other hand, current solutions to the master problem are calculated. New columns in the following iterations are then found by computing detours around these current solutions. This second approach yields better results in reasonable time. However, this technique tends to lead into local optima only.

Summing it up, the learnings from the neXt project are that for large problem sizes, common OR techniques are helpful to develop easier heuristics that can both yield good results in acceptable time and be understood and accepted by practitioners.

Biography

Daniel Pöhle is the head of the neXt lab at DB Netz AG, a departement that develops software for automatic timetable generation, both for ad-hoc timetables and the annual timetable.

Julian Reisch and **Peter Großmann** work for Synoptics GmbH, a software company that supports the neXt lab in algorithm design and software engineering.

Natalia Kliewer is the head of the informations systems department at Freie Universität Berlin and gives scientific advice for the project.

Discussion group topics

1. Change management issues in practical projects
2. Promotion of OR
3. How to state requirements and project specifications at the beginning
4. Relationship/collaboration between academia and industry

Maps

Conference venue:

Zuse Institute Berlin (ZIB), Takustraße 7, 14195 Berlin – Dahlem, Germany
http://www.zib.de

Conference dinner:

Restaurant Alter Krug Dahlem, Königin-Luise-Straße 52, 14195 Berlin, Germany
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