

Newsletter

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Dear readers,

the team of the “IT in Production and Logistics” department wishes you a successful year 2015! For me, it is now the fourth year in Dortmund. It has been an awesome time since I arrived in autumn 2010, called for establishing a brand-new department to facilitate the interdisciplinary work between computer science, hands-on IT management, and its many applications in production and logistics. Many successful activities could be initiated in this period, and it’s time to share some of them with you.

The first years in Dortmund have been characterized by many start-up activities. Several research topics have been explored and then intensified. A European project has been started in 2011 and concluded last year, and the next will start in June. New projects are in the pipeline, some just as proposals and one having passed the first stage of evaluation – let’s cross fingers that we finally win the (huge) competition! After the very first time where my department has been virtually unknown by the students, today we have long waiting lists of students that desire to write their bachelor and master thesis with us, and we are lucky to say that many of them are brilliant and contribute their own ideas and lots of enthusiasm to our research.

Of course, setting up teaching was a real challenge, with little stuff to build upon. There have been simulation courses that I held in Berlin and also programming courses based on my early teaching times in the eighties. But, of course, we wanted to achieve much more. Luckily, there has been a new accreditation of the faculty’s programs in 2011. We could install a new master program that educates



engineers with interdisciplinary knowledge about IT applications in enterprises, knowing what they need to support with their IT, and at the same time speaking the language of the IT guys, communicate with them about web servers and databases, and finally knowing how to design, run, and control successful IT projects. We are glad that these new courses enjoy unexpectedly high attention.

In 2012 I had the honor to act as the Local Chair of the first Winter Simulation Conference outside the United States, and it has been sufficiently successful that the 2018 conference will come to Europe again. Also, we have attracted the well-known ASIM Conference, which I had been entitled to chair already four times in Berlin, to Dortmund in 2015, chaired together with my colleague Uwe Clausen.

In 2014, I have been elected the dean of studies of the faculty, leading to new challenges and chances. In the next years we will already start to prepare the next accreditation, and it could be time for a major redesign of our programs. We will have to report in the next years’ newsletters...

I hope you enjoy reading, and feedback will always be welcome!

Markus Rabe

European project successfully closed: Simulation of supply chains

Protecting the environment has become a severe social issue, and enterprises increasingly have to demonstrate that they take this goal into account in their activities. However, in complex logistics networks the consequences of logistic measures on the environment are often hard to understand, and even more hard to prove. Especially with consumer goods being most near to the customers, as for example in the Fast Moving Consumer Goods (FMCG) industry, there is a need for new methods and advanced management systems to support decisions and to prove evidence of effectiveness to the public.

In a large European consortium, we have contributed to the e-SAVE project (www.e-save.eu), supported by the European Commission in their seventh framework program. The project has developed an information infrastructure, applications and decision support tools to support operations and supply chain management and design decisions, taking into account environmental KPIs and the dynamic energy profile of products and processes. Mechanisms have been developed to automatically capture data regarding the dynamic energy profile of processes and products through sensors, automatic identification technologies, etc. Together with the German simulation service provider SimPlan AG, our department has been responsible to develop a simulation tool that can accept data from this infrastructure and conduct a discrete-event simulation, forecasting the environmental impact of specific scenarios in conjunction with the logistics and cost KPIs, and thus support decision-making in the complex distribution supply chain. The results are incorporated in the toolkit SimChain as an advanced product of SimPlan, based upon the Siemens Plant Simulation solution as the simulation kernel. It enables the user to set up what-if scenarios, e.g. by adding or removing supply chain nodes, by modifying transport options, or by re-allocating products. During the

project, the prototype has been evaluated in a country-wide network of Barilla as one of the major European players in the food market, exploiting the new technology for investigating different future network scenarios and evaluating them with respect to typical logistics key performance indicators such as service level, costs for transportation and stock in direct conjunction with environmental indicators.

16th ASIM Dedicated Conference in Dortmund

ASIM (Arbeitsgemeinschaft Simulation) is the association for simulation in the German speaking area. The organization was founded in 1981 and has about 700 individual members and 40 institutional or industrial members. Since 1985, ASIM organizes the **ASIM Dedicated Conference on Simulation in Production and Logistics (ASIM'SPL)**, which is the largest European simulation conference. The conference provides an outstanding platform to present new developments and interesting applications of simulation from research to industrial use including innovative developments.

One of the most important issues on the next dedicated conference will be the application of simulation, for example in the automotive industry, one-of-a-kind production, transport logistics, and supply chain management. For 2015 the focus is set on

international participation. The first keynote on "Irregular Simulation: Input Modeling and Applications" will be given by one of the authors of the original old „Law & Kelton Bible of Simulation“, Prof. Dr. David Kelton. From the industrial side, the senior vice president and member of the divisional board DHL Paket, Andreas Marschner, will give a keynote on "Redesigning a Parcel Network for Growth". The speech of the day will be held by the winner of the Communicator Award Prof. Dr. Metin Tolan. He is professor for experimental physics at the TU Dortmund University and known for his presentations about physics and its relation to James Bond, soccer, or Star Trek. The title of his speech at the conference is "Shaken not Stirred! – James Bond in the Focus of Physics!" Further international experts confirmed their participation to conduct sessions about various topics. Conference languages are English and German, with partial simultaneous translation.

The 16th ASIM'SPL will take place 23rd – 25th September 2015, in Dortmund situated in the west of Germany. The city of Dortmund is a centre of industrial culture, science and technology. Whether as a conference venue or holiday destination, Dortmund provides a variety of facets and is noted for its rich cultural and leisure offerings. The conference venue is located on the South Campus of the TU Dortmund University, which is above all noted for its green Campus.



The accompanying exhibition takes place in the Rudolf-Chaudoire-Pavillon, situated just next to the lecture hall building and offers a great opportunity for an exchange with exhibitors.

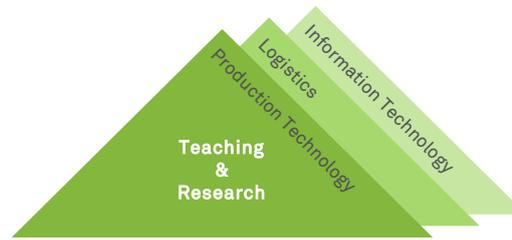
www.asim-fachtagung-spl.de

Patterns, patterns, patterns, everywhere are patterns – especially in supply chains

In times of growing data streams, information extraction and its analysis are becoming more and more important. A huge amount of data is created within supply chain nodes. However, this fountain of data is still insufficiently exploited. Supply chains are often complex, and their behaviour is only partially understood. Thus, it would be a significant competitive advantage to discover logical relationships and inherent knowledge that are dormant in the big data generated during the supply chain operation. Well hidden in the huge amounts of data, there are structurally anchored principals of cause and effect, which can be modelled and understood using adequate techniques. Such models are called patterns, where a pattern describes the causality between network elements, their relationships and their development over time. Such patterns can be (and are today) directly modelled if the knowledge to be represented is known a priori. However, this will not help to exploit dormant knowledge that is by definition not known in advance. Actually, we have to search for the unknown effects. Thus, ITPL conducts research for discovering patterns that are representing so far unknown relationships, exploiting supply chain databases. A pattern can demonstrate the interaction between specific supply chain elements, e.g. if delays appear in connection with certain cross-company processes or if delays are correlated with specific supply volumes. The discovery of unknown patterns is based on principally well-known knowledge discovery in databases (KDD) techniques. However, just applying these methods on supply chain data has proven not to deliver useful results, as the real-

Models

- Business Process
- System Architectures
- Optimisation and Simulation



IT-Systems

- Interoperability
- Identification Standards, Control
- Web Technologies

world relationships show large distance in terms of the data network, or deliver huge sets of uninteresting, sometimes even trivial, data. Therefore, our research is focussing on the preparation of data (what to feed best into the actual data mining?) as well as the filtering and windowing mechanisms that lead the “eye” of the data mining mechanisms towards the interesting patterns.

What are the right measures to improve our logistics network?

Large logistics networks are complex systems. Even nowadays, with complex Data Warehouse technology for business analytics, network management is a challenge. In order to cope with complexity, companies have installed specific logistics departments, dedicated to provide their managers with accurate business reports and the technology they need to decide about the right actions in the network. This includes dedicated Performance Measurement Systems with Key Performance Indicators (KPIs) as well as catalogues with possible actions for certain network situations where KPIs are unsatisfying. Nevertheless, even with state-of-the-art Data Warehouse technology, the outcomes of such actions are very hard to predict. In many situations, managers are groping in the dark when it comes to decide about the right corrective actions in their network. The task becomes even more difficult if a manager tries to predict the consequences of a change in the network regard-

Production and Logistics

- Project Planning & Monitoring
- Networked Enterprises
- Self-controlled Systems

ing multiple KPIs at once, including the temporal development of the network. As a logical consequence, especially trading businesses are demanding for better solutions to plan possible changes in their logistics networks. ITPL is facing these challenges by developing a smart system, which uses a Discrete-Event Simulation (DES) model inside to predict the consequences of possible changes in the logistics network. A mechanism is under development to measure real world Data Warehouse KPIs on the simulation data. With the idea of a central heuristic unit, the system is designed to automatically suggest smart changes in the network. Furthermore, it is aimed to suggest smart combinations of changes in different areas of the network and predict their temporal effects regarding the overall development of the network. With a solidly developed architecture at hand, the team of ITPL is currently developing a prototype of the simulation-based heuristic system (sim-heuristic) for large logistics networks.

Everything is changing... a challenge for optimisation

In the industrialized countries, production environments become more and more dynamic. Customers expect individual products, high quality and short delivery times. As a result, the product variety has exploded and manufacturers are faced with high numbers of individual orders. In order to determine whether an order can be fulfilled and whether the production will be economically beneficial, a

system is necessary that is able to schedule every order with respect to existing and future resources and constraints. Such a system requires a proper model of the considered production system. In order to represent a transformable system, the model needs to be transformable, too. Such a model would allow for analysing the future behaviour of a system, including changes that are applied to comply with upcoming requests. This research task is faced at ITPL using Timed Hierarchical Object-related Nets (THORNs): The production system is considered as a combination of modules. Each module is represented through a small THORN model that may be connected to other modules. This way, an existing production system can be modelled and single modules may be removed, added or exchanged at any point of time. The variation of the model will be controlled through a heuristic optimisation that dynamically creates different scenarios which are evaluated against existing and expected orders. Each evaluation run will be based on a discrete event simulation that is built up on THORNs. As a result, combing optimisation, simulation and transformable models, a simheuristics methodology will be created that supports a planner with the decision whether an order can be accepted or not. The planner will be provided with a schedule for the orders and a list of timed changes that have to be applied to the production system.

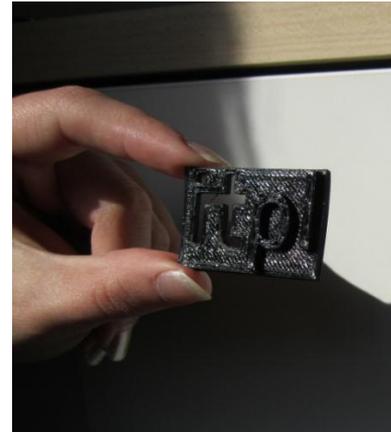
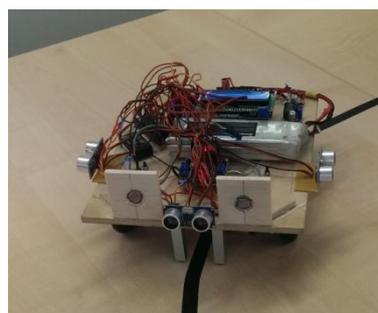
New at the Faculty of Mechanical Engineering: Master profile "IT in Production and Logistics"

IT has become the core of many enterprise activities. Today, large logistics providers are investing more in information technology than in the "hard" assets. Thus, the success of IT projects is obviously of utmost importance. Frighteningly, investigations have shown that only around one third of such IT projects can finally be considered as successful, while the other two thirds deliver only a part of the intended results or even fail completely. The reasons are rarely in the technology, but in the communication

and management of the projects. It becomes obvious that frequently the software engineers don't understand the real needs of their customers, while the production and logistics companies are not able to communicate their specific requirements in a clear and comprehensible way. This gap needs urgently to be closed if the enterprises want to stay successful in a world that is driven and sometimes even dominated by information technology.

The department ITPL, positioning itself in the interdisciplinary border area between IT and the production or logistics enterprises, has faced this challenge by implementing a new master profile "IT in Production and Logistics" within the master of mechanical engineering program, accredited in 2012 as one of now seven profiles offered to our students. The master course requires a bachelor of mechanical engineering or a comparable qualification. Therefore, engineers graduating from the profile will combine a solid engineering knowledge with technical and managerial skills of information system development and deployment. Furthermore, the courses provided by ITPL may also be attended by students with other majors, such as industrial engineering or logistics.

The new profile comprises three core courses in the IT framework, accompanied by a choice of IT-related topics from other mechanical engineering profiles. The first course is focused on information exchange within an enterprise and among companies. It has started in 2012, now having a stable figure of about 80 registered students. The second course, "IT design in production and logistics" has been held in 2013 for the first time and is providing knowledge on software development techniques. During ex-



ercises we are operating with C++, which continues to enjoy great popularity by our students. The course "IT-technologies for engineering and logistics" is a combination of traditional and recent information techniques. Key issues are database knowledge, data mining and web technologies. The second part of this course, for the first time conducted in the summer semester 2015, is a practical project group on a complex IT topic. With this last course established in 2014/15, the profile is now complete.

Monitoring some of the first students passing the courses already offered in the past, we recognize that they seem to face great possibilities in the labour market, some of them in the development divisions of production enterprises, and several at consultancy companies. This is further supported by guest lecturers giving presentations during the courses mentioned above.

Enabling students to learn about the world of automation first hand

Factory automation has been a very important topic for aspiring engineering students ever since the raise of computer technology in production and logistics in the seventies. Today, with the growing trend of the Internet of Things, automation is even coming to our cities and homes. It is nowadays thus even more critical for young engineers to learn about the world of automation and particularly to understand the IT mechanisms and technologies behind it. At ITPL, we are currently establishing a small lab

factory, composed out of fischer-technik components mixed with state-of-the-art industrial computer technology. The aim is to teach the students first hand automation principles, bridging from the physical actors and sensors up to warehouse- and MES-related functions. Also, students working in dedicated groups can understand the challenges of system architecture and interfacing IT systems on different control levels. Building an adaptable model of a factory, we are providing our students with an experimental environment in which they can test new concepts and explore the functional differences in their own experiments. Using this concept of teaching, we are preparing our students for a broad variety of jobs, including more classical ones as well as the ones resulting from the approaching fourth industrial revolution.

Basic lectures at the Faculty of Mechanical Engineering

Our department is teaching a wide range of IT-related topics in the faculty's bachelor degree programs. The mandatory course "Engineering Informatics" is aimed at students of mechanical engineering as an introduction to the computer science world, comprising programming capabilities as well as knowledge in basic information technology, such as databases, networks, or IT security. An important part of this course is the project group. Students, organized in small groups, can choose between different medium-sized programming challenges that cover car behaviour models, house heating models, and also some more sophisticated tasks like robot programming or elevator controls. The "IT-Systems in Industrial Production" course has been redesigned in 2014 as lecture series of different departments under the direction of ITPL. Some of the key issues are digital factory, supply chain management and database technologies. The third course deals with one of our key expert fields – discrete event simulation. The general objective of this "Fundamentals of Simulation" course is a brief insight into the simulation area. The course is

accompanied by a practical exercise, which enables the students to design and execute their own simulation experiments. This offer is completed by the course "material flow simulation" in the master degree program and our specialist labs concerning engineering technologies and business process modelling (in collaboration with the Fraunhofer Institute for Production Systems and Design Technology in Berlin).

Gender equality at ITPL

The proportion of female students at the Faculty of Mechanical Engineering has a relatively constant rate of 17%. The female participation in research is 13%, and only one professorship at the faculty is currently represented by a woman. In order to increase this proportion, some measures have taken place supported by the faculty, starting even at schools with actions like the "girls' day". An activity under preparation by ITPL is named "Investigate, student! - A network of students, funded by companies". It targets to implement a project that builds up a country-wide network of female research assistants to share experiences and knowledge. The aim is to promote the exchange of industry and academia, such as lectures and discussion groups with employed women (role models) or to acquire students.

The project is based on former actions bringing female students close to scientific work, contributing to projects, conferences, or scientific bodies, and in this way also starting to

establish their own scientific networks. A next target is to set up a special room for female students and female researchers of the faculty to have a central contact point to exchange know-how and experiences. A researcher of the ITPL, Mrs. Anne Antonia Scheidler, is also the equal opportunities commissioner of the Faculty of Mechanical Engineering since 2014. This is a big benefit for the project because information concerning gender activities has short official work paths.

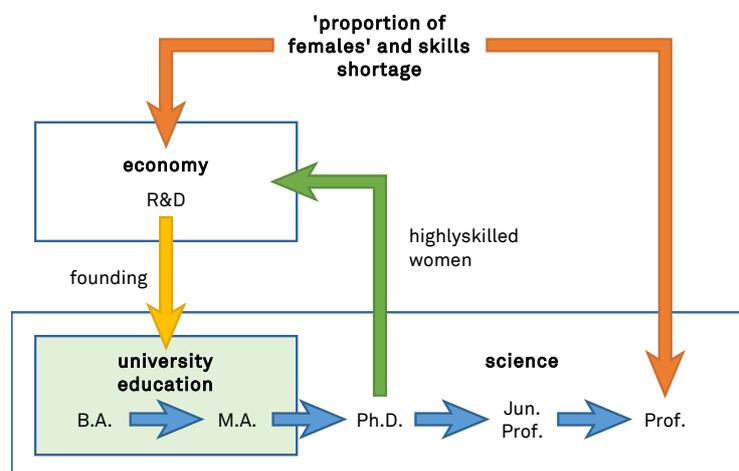
Contributions to bodies

Association of German Engineers (VDI)

- VDI GPL Fachausschuss 204 Modellierung und Simulation; Member Markus Rabe
- VDI Richtlinienausschuss (Guideline Committee) 3633.9 „Simulation und Tabellenkalkulation“ (VDI 3633 Blatt 9); Member Markus Rabe
- VDI Richtlinienausschuss (Guideline Committee) 3633.10 „Geschäftsprozessmodellierung“ (Business Process Modelling); Chairman Markus Rabe
- VDI Richtlinienausschuss (Guideline Committee) 3633.13 „Verifikation und Validierung“ (Verification and Validation); Chairman Markus Rabe; Member Maik Deininger
- VDI Richtlinienausschuss (Guideline Committee) 4465.1 „Modellbildungsprozesse“ (Model Building Processes); Member Markus Rabe

German Simulation Society (ASIM)

- Working Group „Simulation in Production und Logistics“ (SPL); Deputy Chairman Markus Rabe



- Expert Group “Dedicated Conferences”; Chairman Markus Rabe; Member Arzu Kocyigit

Conference Organization

- ASIM Dedicated Conference „Simulation in Produktion und Logistik“; Chairman Markus Rabe 1998, 2000, 2004, 2008, 2015
- ASIM Dedicated Conference „Simulation in Produktion und Logistik“; Program Committee Markus Rabe 1993-2015
- Winter Simulation Conference; Local Chair Markus Rabe 2012 (Berlin)
- Winter Simulation Conference; Track Chair Markus Rabe 2012, 2013, 2014, 2016
- International Conference on Engineering, Technology, and Innovation (ICE); International Review Committee Markus Rabe 2005-2015

Publications 2014

Dross, F.; Rabe, M.: A SimHeuristic Framework as a Decision Support System for large Logistics Networks with complex KPIs. In: Wittmann, J.; Deatcu, C. (Eds.): 22. Symposium Simulationstechnik. 3. - 5. September 2014, HTW Berlin, ARGESIM / ASIM - Verlag, Wien, 2014.

Rabe, M.; Scheidler, A. A.: An Approach for Increasing the Level of Accuracy in Supply Chain Simulation by Using Patterns on Input Data. In: Tolk, A.; Diallo, S.; Ryzhov, I.; Yilmaz, L.; Buckley, S.; Miller, J. (Eds.): Proceedings of the 2014 Winter Simulation Conference. Savannah (GA): IEEE Press 2014, pp. 1897-1906.

Spieckermann, S.; Rabe, M.: SimChain and e-SAVE. In: Kunze, R.; Fichtner, W. (Eds.): Einsatz von OR-Verfahren zur Analyse von Fragestellungen im Umweltbereich. Tagungsband zum Workshop der GOR-Arbeitsgruppe „OR im Umweltschutz“ am 07. und 08. März 2013 in Karlsruhe. Aachen: Shaker 2014, pp. 35-45.

Theses and scientific project works 2014

Arndt, V.: Ereignisdiskrete Simulation einer Supply Chain zur Generierung

von Transaktionsdaten. Master thesis, 2014.

Becker, M.; Gerl, N.; Panke, S.: CO₂-Berechnungsmethoden in der Distributionslogistik mit Fokus auf den Transport. Scientific project work, 2014.

Birkholz, L.; Janßen, G.: Einflussfaktoren und Ansätze zur Optimierung des Energieverbrauchs in der Distributionslogistik im Kontext der Nachhaltigkeit. Scientific project work, 2014.

Bugla, T.: Methode zum strukturellen Abgleich unternehmensspezifischer Logistikprozesse mit Best-Practice-Prozessen. Master thesis, 2014.

Geese, D.: Konzeptentwicklung für veränderliche Geschäftsprozessmodelle zur Untersuchung von Produktionssystemen bei dynamischer Auftragslage. Bachelor thesis, 2014.

Guhl, P.: Erstellung eines konzeptuellen Datenbankschemas im Umfeld von Supply Chains. Master thesis, 2014.

Halverscheidt, S.; Sackmann, A.; Töpfer, C.: Verfügbarkeitsbewertung von Einkaufsteilen für die mittelfristige Planung dynamischer Produktionssysteme. Scientific project work, 2014.

Hilpert, K.: Einsatz maschineller Lernverfahren im Decision Support von Wertschöpfungsnetzwerken. Master thesis, 2014.

Köster, C.: Recherche und Bewertung statistischer Zusammenhangsmaße für in Supply Chains anfallende Daten. Scientific project work, 2014.

Köster, C.: Recherche und Bewertung statistischer Zusammenhangsmaße für in Supply Chains anfallende Daten. Scientific project work, 2014.

Piep, D.: Systematische Untersuchung des Datenqualitätsbegriffs in Supply Chains. Scientific project work, 2014.

de Riese, R.: Modellierung wandlungsfähiger Produktionssysteme zur Kapazitätsplanung. Master thesis, 2014.

Schmitt, D.: Entwicklung eines computergestützten Modells zur Abbildung wandlungsfähiger Produktionssysteme für Scheduling-Algorithmen. Diploma thesis, 2014.

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