Newsletter

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Dear readers;

We hope that this newsletter finds you healthy! Challenging years are behind us – world-wide, but also locally. The COVID-19 pandemic has put significant workloads on our group to enable digital education and somehow compensate for the difficulties raising from travel restrictions and health constraints. Personally, I had to face some severe health issues independent from the virus in 2019. It is the credit of my team that we could master these two years without major implycations on the quality of research and education, and we have even reasons to be proud on what we have achieved.

Our research team has now grown to the nice critical mass of 16 researchers. Some have just started in the previous two years, several are in the completion phase of their thesis, and Majsa Ammouriova has just passed her dissertation defense in February 2021 with distinction. A selection of the ongoing research topics can be found in this newsletter.

International travel was difficult during the last time, but we have been just in time to welcome Prof. Jesus Gonzales-Feliu from La Rochelle in spring 2019. This cooperation has led to a conference publication and a journal contribution. We have also won a Gambrinus fellowship for Prof. Susan Sanchez from the Naval Postgraduate School in Monterey (CA) for 2020, which unfortunately had to be postponed two times now; we hope to make this fellowship happen in 2022. For the Winter Simulation Conference 2019, I was again able to serve as a proceedings editor. In 2020, this conference had to be conducted virtually, but together with Prof David Goldsman from GeorgiaTech in Atlanta is was possible to set up a very nice program

for the “Logistics, Supply Chain, and Transportation” track with impressive 13 sessions in 2019 and still nine virtual ones in 2020.

Several scientific papers could be published in the last two years, which you find at the end of this letter. These comprise three book chapters, three journal papers and 14 peer-reviewed conference contributions. Furthermore, I have been able to serve as an editor for a special issue on “Simulation in Production and Logistics” for *Simulation Notes Europe* and a special issue for the *Journal of Simulation.*

Starting from 2019, our faculty has switched to a modernized program for all our German majors, which had been developed during my period as a dean of students. ITPL took the chance to restructure our courses, especially in the master programs. We are now in the position to provide our engineering students with excellent education to master the IT challenge in their enterprises after the diploma. The numbers of students are continuously growing and we look forward to excellent interdisciplinary engineers originating from this innovative approach.

For now, we hope that you enjoy reading this little newsletter and wish that you stay healthy!

Markus Rabe

Teaching Concepts in the Context of Faculty Accreditation and Corona

The Faculty of Mechanical Engineering successfully re-accredited its degree programmes for the winter semester 2019/20. In this context, the ITPL has revised its teaching for the degree programs mechanical engineering, industrial engineering, manufacturing technology; and logistics. The modernised course “Introduction to Programming" forms a cornerstone of the engineering education in the Bachelor's degree programme. In addition, the ITPL offers information technology supplements to bachelor students with the two elective modules "Fundamentals of Simulation Technology” and “IT Systems in Industrial Production”. The modelling focus of the ITPL is supported by the module “Modelling of Digital Ecosystems in Production and Logistics”. In the master program, the department continues to offer its own profile for the Mechanical Engineering degree programme and enriches a variety of other profiles with its courses.

New guest lectures on exciting topics such as Digital Twin, Machine Learning, and Software Testing could also be made available to students in digital form.

Corona and the associated restrictions on attendance have also led to accelerated digitalisation at the ITPL. Not only were lectures digitised throughout, but new examination formats for digital teaching were also developed within a short period of time. Despite the successes and continuous online teaching, we are currently pleased that in the winter semester of 2021/22, the first courses can be held in presence again.

Teaching Supported by Experts from Industry and Consulting

Cooperation with other departments, institutions, and industrial partners has been strengthened and is reflected in numerous teaching formats. The specialised laboratory “Prototyping like a Start-Up", which is a cooperation between the Centre for Entrepreneurship/Transfer and the ITPL, is particularly popular. Dr.-Ing. Christian Knobloch from the company Knobloch & Gröhn supported the teaching in the bachelor's degree with his own teaching module on process modelling.

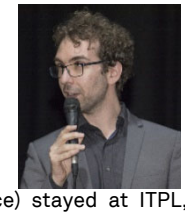
Highly topical issues that are the focus of our research activities could be transported into teaching through practical examples from industry. The lectures covered topics such as machine learning from PTC/Switzerland, test automation from Redbots and data structures in the supply chain from Relex.

The case study "Information Systems", which has already been successfully carried out several times with the company CGI, represents a special institution. Here we are pleased that our former student Kilian Hilpert, who now holds the position of director at CGI, has made his scarce time available to us for a great interactive format.

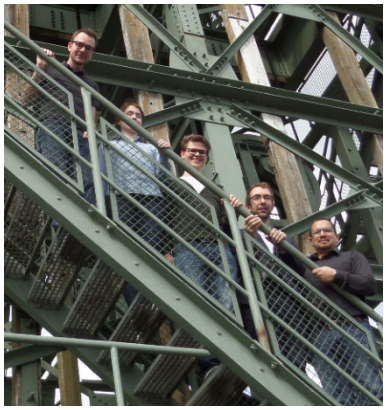
New Senior Engineer at ITPL

Since November 2019, ITPL has a new position for a post-doc senior engineer: Dr.-Ing. Anne-Antonia Scheidler supports teaching and research in our department. After her computer science diploma, she worked as a consultant for well-known IT companies. In 2012, she joined ITPL supporting the development of the new IT master courses there. She received her Ph.D. on a “Method for Derivation of Knowledge from Data Patterns in Supply Chain Data Bases” in 2017, and then changed to the dean’s office to organize the modernization of the faculty’s six German study programs, namely Mechanical Engineering, Logistics, and Industrial Engineering both for Bachelor and Master. We are glad to have her back at ITPL now and look forward to her scientific contributions.

Visiting Professors at ITPL



Prof. Jesus Gonzalez-Feliu (Full Professor of Supply Chain Management at Excelia Business School, La Rochelle, France) stayed at ITPL, funded by a Gambrinus fellowship grant, from July 1st until July 12th, 2019. Prof. Gonzalez's main research area is urban logistics, in which he has become a national and international reference. His work mainly focusses on demand estimation, transport flow modelling, sustainability assessment, and urban logistics platform analysis. In this context, he chairs the scientific committee of the Urban Logistics Lab in Melbourne (Australia), led by Deakin University. He has also led more than a dozen different research projects in Europe and Latin America.



Prof. Gonzalez held a Research Colloquium with our Ph.D. candidates. His stay was used for intensive research discussions. All members of ITPL took the opportunity to discuss their research in detail. In terms of teaching, Prof. Gonzalez gave two lectures on "Characterization, Modelling, and Assessment of Urban Logistics Flows: Approaches and Trends" as part of the master course "Materialfluss simulation".

In addition, Prof. Gonzalez gave a public speech on "Design, configuration and sustainability assessment of advanced food supply and distributions chains: collaborative approaches" at the 4th PhD Summer School of Logistics. The lecture was very well attended and the audience asked for detailed discussions about their research, which Prof. Gonzalez complied with in the following days.

We are very glad about this opportunity for intense scientific exchange and thank Gambrinus for the sponsorship facilitating this great cooperation. For 2020, we have had a Gambrinus grant for *Prof. Susan Sanchez* from the Naval Postgraduate School in Monterey (Ca, USA), which we unfortunately had to postpone due to the recent travel restrictions. We hope that we can finally perform this visit in our lab in spring 2022. Prof. Sanchez is a world-wide recognized expert in simulation modelling and data farming. We look very much forward to learning from her outstanding knowledge and gaining input to our ongoing research in fruitful discussions.

Simulation-based Optimization of Reconfigurable Production Systems

Deininger, M.: *Modellierungsmethode für die simulationsbasierte Optimierung rekonfigurierbarer Produktionssysteme*. Göttingen: Cuvillier 2019.

Manufacturing companies today face many challenges. Competition, technological progress, and the changing expectations of customers result in a constantly changing environment. This leads to a continuously changing product range, which is not only geared towards strategic realignment, but is also driven by customer demands. If a customer makes a request that does not correspond to the current product portfolio, decisions about the acceptance of the order must be made within a short time, often without a reliable forecast of their effects. Simulation studies can be used to investigate potential changes to a production system before applying them in the real world. In particular, the stochastic behaviour of processes in production systems, such as varying processing times, can be modelled and, thus, represent the actual behaviour of the staff. However, simulation is only able to evaluate a given system. Another aid to planning are optimization techniques. These allow for automated evaluation of various configurations of a system and providing a solution. The combination of simulation and optimization results in a method that supports a planner in the decision-making process, considering the stochastic influences. In the presented book, such a method is developed that enables the combination of simulation and optimization to determine which changes to a production system can be conducted to fulfil previously unachievable customer orders. These changes include, in the simplest case, the implementation of a new processing order for the customer orders. If this is not sufficient, it will be examined whether the addition of new resources enables the system to fulfil all customer orders. It is also possible to save or replace resources. Likewise, new processes can be added, e.g., for setup or qualification tasks. The implementation of this procedure is carried out by a multi-level simulation-based optimization, which is based on modular modelling. Using modules, individual processes of the production system can be represented and linked together. Further, this approach allows for adding, removing, and exchanging processes. As part of an optimization, it is, thus, possible to determine a collection of processes that enables to fulfil all customer orders. In addition to processes, modules can also represent resources that can be used to determine the necessary resources in parallel to the processes. Each identified con-figuration undergoes job shop scheduling and is evaluated using simulation. After carrying out the simulation-based optimization, the planner receives a Pareto diagram, which contains all the solutions investigated. From these, the solution to be implemented can finally be selected by the planner. Two application examples demonstrate the applicability of the method. It is shown that every stage of simulation-based optimization helps to present a solution to the planner, with which all customer orders can be fulfilled. To do this, each level is validated individually before considering their interaction.

Series "Fortschritte in der IT in Produktion und Logistik", Vol 2, available in book stores and online; print 89,90€; e-book 62,90€.

Meta- heuristic Techniques for the Optimization of Multi-echelon Distribution Networks

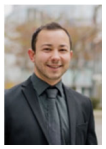
Majsa Ammouriova (M. Sc.) has conducted her PhD in the field of decision support systems for multi-echelon distribution networks at ITPL, sponsored by the German-Jordanian University.

Nowadays, increased competitiveness introduced by globalization raised the importance of the supply chain manager's decisions, such as the management of a supply chain distribution network. In many situations, the decision depends upon multiple objectives; reducing cost, maintaining a profit margin or customer service level. Accordingly, optimizing a distribution network becomes important for suggesting the most promising one.

Currently, research in ITPL has been conducted on developing a Decision Support System (DSS) for multi-echelon distribution networks. The DSS has been designed to analyse possible actions to improve the network performance. As multiple performance indicators are used to measure the network's performance, the analysis process of possible actions becomes a multi-objective optimization problem. The developed DSS is based on a simheuristic approach in the analysis of these actions. Further work is needed to investigate various optimization techniques and learning algorithms to improve the performance of the system.

Majsa Ammouriova has submitted her thesis in November 2020 and passed her oral defence in February 2021 "with distinction" (summa cum laude).

A Reference Model for Data-driven Sales Planning



Daniel Büttner (M. Sc.) is a member of the Graduate School of Logistics in Dortmund. He is conducting his Ph.D. studies at the ITPL and works together with the company Vorwerk.

Logistics is a connection in-between countries, companies and departments. Within the emerging digitization, data for planning and coordinating the supply chain become even more important to remain competitive.

Analysing data for planning issues to gain transparency and flexibility through the supply chain is one of the main topics for companies to counteract future challenges in the digital competition. The usage of information in planning processes can provide this transparency and efficiency in supply chains. In order to be more client-orientated and to satisfy consumer needs fast, the forecast of future sales with historical data is vital. Accurate sales planning helps to provide the demanded products in advance to emerging customer demand. Especially when consumer products are built to stock, accurate sales forecasts are needed to plan production, inventory, and replenishment on the distribution warehouses. Consumers are getting used to short delivery times and product availability. This fact and great market volatility increase the importance of accurate forecasting and planning of future customer demand. Daniel Büttner is developing a reference model that shapes (data-driven) quantitative sales planning within the supply chain. The reference model guides the process of sales planning, the usage of methods, and the identification of required data. Thereby, it provides a framework for companies to make appropriate use of data within their sales planning task and gives recommendations on how to start and advance quantitative sales planning, within different levels of complexity.

Urban Logistics Systems Modelling

Jorge Chicaiza-Vaca (M. Sc.) is funded by a DAAD scholarship and is pursuing his Ph.D. at ITPL in the field of Urban Logistics Systems Simulation and corresponding Optimization Models.

Urban Logistics (UL) systems challenges have motivated research for decades. UL must take into account the nature of the freight transport sectors that cover retail, including e-commerce. E-commerce does not necessarily mean the absence of physical shops, but rather an evolution in the way retailers carry out orders. As a result, e-commerce has led to an increase in innovative combinations of physical and digital solutions such as home delivery, pick-up points, and other collection methods.

In this context, automated parcel locker (APL) systems such as packstations or locker boxes are emerging as one of the most promising initiatives to improve UL activities. The focus of the current work is on the use of APL. In this initiative, one of the main user expectations is localization. This includes proximity to home, commute to work, and parking availability. In this context, simulation and optimization techniques are used to define the system structure of APLs as an UL solution. Moreover, this study presents a procedure model that includes the main steps to combine a system dynamics simulation model with a facility location model for a specific application of APLs in the cities of Dortmund (Germany) and Pamplona (Spain) as case studies. The proposed model aims to improve the system representation of APLs and provide a new evaluation tool for future implementations of this initiative as a last-mile logistics system for cities.

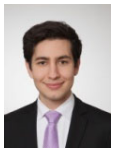
The application of the simulation–optimization model considers that the location planning of APLs is highly interdependent. The number of potential customers served by an APL depends on its location. Therefore, this work develops a holistic view to consider the capacitated number of APLs and their potential locations to help third-party providers in the future implementation of the APL initiative as a UL delivery scheme.

Combining Data Farming and Data Mining in a Logistics Assistance System

Joachim Hunker (M. Sc.) is a research assistant at ITPL since 2017. His research interests include simulation-based data generation, non-relational databases, and knowledge discovery in databases.

Nowadays, supply chains are fairly complex systems. Due to this complexity, decision-makers in supply chain management are confronted with various logistics tasks that can no longer be answered manually. Therefore, decision makers are supported by IT systems such as logistics assistance systems. A key factor in supporting decisions in supply chain management is gaining and visualizing knowledge. One of the widely established methods in theory and practice is known under the term knowledge discovery in databases. The core phase of the knowledge discovery process is known as data mining. Applying successful data mining, e.g., to find useful and previously unknown patterns, relies heavily on a valid and preprocessed input data basis, which is usually stored in a database. A challenge is that these consist of mainly observational data, which leads to different flaws. Typical examples are low data quality, e.g., missing or out-of-range data. A way to address this problem is simulation-based data generation, called data farming. The process of data farming uses large-scale experiments to grow massive amounts of synthetic data as simulation output. This allows the application of analytical methods on a well-suited database to support decision makers in supply chain management in answering complex logistics task. In this context, Joachim Hunker focuses in his research on combining data farming and data mining in a logistics assistance system to support decision makers in supply chain management.

New Approaches in Creating Dynamics Data Mining Models



Reza Jalali Sousanabady (Dipl.-Inf.) is an external Ph.D. student at ITPL and currently working as a business IT consultant for Senacor Technologies.

Today, the world stands on the brink of a technological revolution that will fundamentally alter every aspect of people and companies' existence. The scale, scope, and complexity of the transformation in the ways these entities live, work, and inter-relate to one another will be unlike anything mankind has ever experienced before. Manufacturing and logistics companies will not be exceptions. Various aspects including increased competition, demand for reduced time to market as well as higher complexity of products and processes will be treated using new tools and methodologies. One such tool is data mining, through which critical knowledge can be obtained. This goal is achieved by extracting and accumulating critical data, detecting patterns and extracting highly sought new knowledge. But, methodological issues, in research design, sampling methods, data collection and data analysis techniques would arise. Another drawback lies in time-consuming procedures of data preparation and model development. Realization timespans, reusability of the developed models as well as the high amount of required resources for modification of existing models are further key factors that need to be addressed. Dynamic data mining models can be used for a specific application domain to create instances for a variety of problems. Using them, reutilization of models increases and hence, the aforementioned obstacles can be circumvented. Two major tasks exist: creating a generalized meta-model for a sub-domain of problems and customizing it to generate an appropriate solution instance for a given problem. In the present research, ITPL focuses on proposing a novel hyper-heuristic approach to tackle these challenges in the domain of supply chains. The proposed methodology introduces a new approach for domain-based generalization of data mining models to develop meta-models and utilize hyper-heuristics to create problem-specific solutions derived from meta-models. Ultimately, this approach has exhibited a more robust ability for dynamic adaptation to complex variations of data subsets in supply chains.

Embedding Track and Trace Solutions

Henrik Körsgen (M. Sc.) is external PhD student at ITPL and currently working as a consultant with dxk in Zurich, Switzerland.

Several events in the last year have revealed how severely production can be impacted by distortions in the supply chain. Gaining reliable control on the supply chain is, therefore, to be considered a must today and – even more – in the future. Track & trace solutions are an important technical basis to reach this goal.

Up to now, track and trace has mostly been just an add-on to the current supply chain system landscape. However, the benefit of such tools is best unravelling if the complete scope of logistics operations is covered. Our research addresses this challenge by designing a framework that guides enterprises in the precision engineering industry on where to start with the integration of track & trace solutions and which procedures to follow in their planning and implementation. In the first step of this investigation, information has been collected about the technical options that are available to organizations. In a second step their resulting benefits are evaluated.

Track & trace solutions comprise the three major steps (i) identifying the item, (ii) receiving its status, and (iii) triggering the follow-up action. To put this into practice, organizations require detailed information about the set-up of the solution and how to integrate the related processes. Thus, the main research question is, which digital architecture forms a suitable basis for the track & trace application. For this purpose, a track & trace maturity assessment reference model facilitating embedding track & trace solutions is designed, considering the entire digital architecture. Additionally, the blockchain technology for track & trace solutions is compared to other technologies. The next step is to collect data for the track & trace maturity assessment reference model.

Creating Customized Actions for the Simulation of Logistic Networks

Dominik Schmitt (Dipl.-Inf.) is member of the Graduate School of Logistics in Dortmund. In cooperation with thyssenkrupp he is conducting his Ph.D. at the ITPL.

Today's logistics networks are very complex systems, which are influenced by many external and internal factors. To adjust the system in order to pay attention to these effects and to guarantee an almost perfect performance of the network's continuous changes in its structure and configuration are needed. This kind of changes depends on multiple objectives such as increasing the profit, changing the range of goods, or adding new suppliers.

Optimizing such complex systems can become a huge challenge for managers. Facing this problem, ITPL has developed a decision support system (DSS) that supports the user by suggesting promising actions for the given logistics network. This DSS addresses different logistic areas of the network and chooses the best integrated action sets from a given catalogue of actions to be applied while respecting their interdependencies.

Unfortunately, these suggested changes are typically predefined within the simulation program. To increase the flexibility and usability of the DSS, a concept of deriving specific actions from generic action types has been created. To realize this concept, a method to generate, integrate and execute user-generated generic action types is a precondition.

ITPL is addressing this challenge by creating a formal description of changes in DES models for large logistics networks. Based on the formal description of actions, it is possible to transform the changes from a very technical-level into a more intuitively accessible way, e.g., in a graphical editor. On this abstraction level, it is possible for the user to modify or create new actions and apply these to the simulation model.

Method for Real-time Forecasting of Production Key Figures

Erwin Sirovnik (Dipl. Wirt.-Ing.) is an external Ph.D. student at ITPL and working for thyssenkrupp in Rasselstein.

Nowadays the production scheduling pursues several objectives inside a flexible flow production in the steel industry, which are mainly located in the field of logistics. Besides an adherence to delivery dates the primary target within a steel industry – characterized by capital-intensive plants – is represented by running at full capacity. Further objectives based on production key figures like maximized material productivity, minimized energy costs, improved quality etc. are only covered to some extent, if any, manually by a responsible planner with few general rules. Although there are individual isolated solutions for specific plant-related objectives, e.g., on the subject of quality, a holistic view is still missing. These aspects are gaining importance – especially in situations of unplanned events like plant or material failures within an intermediate production step – regarding re-scheduling of the planning objects in the short-term.

In order to cover this resulting complexity, a production scheduling has to be developed that generates optimized production plans for each individual material unit at each production step considering all available data from the shop floor. Thereby, the multi-objective optimization has to be supported by a real-time capable forecasting of all relevant production key figures derived from machine learning and data mining approaches on data concerning quality, orders, maintenance and further relevant information. On this basis, transparency regarding all key performance indicators concerning the production as well as an immediate reaction to critical situations like insufficient target values will be enabled.

Reference Model Based on Value Stream Simulation

Tobias Sohny (M.Sc.) is an external Ph.D. student at ITPL and currently working as a research assistant at the Koblenz University of Applied Sciences with Prof. Dr.-Ing. W. Wincheringer.

Suppliers of a customised material flow system guarantee a throughput performance when submitting their offer. There are high risks that the finally realised material flow system does not fully meet this promise. Oversizing the system, with the consequence of additional costs, leads to decreased competitiveness. Therefore, the guaranteed throughput of the system needs to be secured at the time of the bidding phase. The quality of the planning results cannot be adequately evaluated without discrete event simulation (DES). However, DES, especially the required modelling, is too time-consuming and cost-intensive at the time of the bidding phase, taking into account the unclear probability of finally winning the bidding. Therefore, DES is only used when the order has already been placed. As the result, possible planning deficiencies are recognised too late and lead to costly adjustments.

The target of our research is to develop a reference model (RM) for the simulation of material flow systems based on the value stream method (VSM). This RM based on the VSM enables an efficient development of simulation models for customer-specific material flow systems during the bidding phase. This enables suppliers to secure the throughput performance already during the bidding phase.

Modeling of Intralogistic Processes for the Implementation of WMS

Felix Stadler (M. Sc.) is external Ph.D. student at ITPL and working in the IT consultancy of Windmöller & Hölscher KG in Lengerich.

Due to the growing complexity of intralogistics systems, the use of warehouse management systems (WMS) is becoming increasingly attractive for companies. As an often business-critical management system of internal material flows, however, their implementation or change is complex and carries risks. Especially the insufficient knowledge of companies about their own processes leads to a high capacity and cost burden due to the time-consuming involvement of their own experts and, often, also contracted WMS consultants. In this context, models and modeling methods are gaining additional importance. But, particularly in intralogistics, with its special demands and characteristics, there is a lack of methodological support for mapping and transferring process knowledge appropriate for the WMS implementation. The consequences, besides a low level of acceptance among the affected employees, are project abortions and production downtimes. Therefore, we are conducting research to collect experiences from industrial practice during the implementation of WMS. With the assumption that a supporting method is urgently required in this context, we work on a modeling language for mapping intralogistic processes in line with the requirements for the implementation of WMS as well as procedural method components that support the generation and transmission of the process knowledge.

Lectures Given by the Department IT in Production and Logistics

Bachelor

- Introduction to Programming
- Fundamentals of Simulation Technology
- IT-Systems in Industrial Production

- Modelling Digital Ecosystems in Production and Logistics

Master

- Information Exchange of Manufacturing Companies
- IT Design in Production and Logistics
- Data Analysis and Knowledge Representation in Production and Logistics
- Fallstudie Informationssysteme
- Material Flow Simulation
- Planning and Implementation of IT Projects
- Lab "Prototype like a startup"

Contributions to Bodies

Association of German Engineers (VDI)

- VDI GPL Fachausschuss 204 Modellierung und Simulation; Member Markus Rabe
- VDI International Gremium Digital Information (IGDT), Member Markus Rabe
- VDI Richtlinienausschuss (Guideline Committee) 3633.10 „Geschäftsprozessmodellierung" (Business Process Modelling); Chairman Markus Rabe, Member Joachim Hunker
- VDI Richtlinienausschuss (Guideline Committee) 3633.13 „Verifikation und Validierung" (Verification and Validation); Chairman Markus Rabe; Member Maik Deininger
- VDI-Richtlinienausschuss (Guideline Committee) 3633.3 „Experimentplanung" (Experiment Planning); Member Markus Rabe and Anne Antonia Scheidler
- 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
- Expert Group „Consideration of Energetic Impact Factors in SPL"; Member Markus Rabe

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 1993-2021
- Winter Simulation Conference; Local Chair Markus Rabe 2012 (Berlin)
- Winter Simulation Conference; Lead Proceedings Chair Markus Rabe 2018; Proceedings Chair Markus Rabe 2019.
- Winter Simulation Conference; Track Chair Markus Rabe 2012, 2013, 2014, 2016–2021.

Board memberships

- Graduate School of Logistics; Board Member Markus Rabe

Journals

- Advisory Board Journal of Simulation (Taylor & Francis); Member Markus Rabe

Publications 2019/2020

Rabe, M.; Goldsman, D.: Decision Making Using Simulation Methods in Sustainable Transportation. In: Faulin, J.; Grasman, S. E.; Juan, A. A.; Hirsch, P. (eds.): Sustainable Transportation and Smart Logistics: Decision-making Models and Solutions. Amsterdam: Elsevier 2019, pp. 305–333.

Rabe, M,; Schmitt, D.; Klüter, A.; Hunker, J.: Decoupling the Modeling of Actions in Logistics Networks from the Underlying Simulation Data Model. In: Clausen, U.;.Langkau, S.; Kreuz, F.: (eds.): Advances in Production, Logistics and Traffic. Proceedings of the 4th Interdisciplinary Conference on Production Logistics and Traffic (ICPLT) 2019. Cham: Springer Nature Switzerland, pp. 32–44.

Rabe, M.; Schmitt, D.: Domain-specific Language for Modeling and Simulating Actions in Logistics Networks. In: Mustafee, N.; Bae, K.-H.: Lazarova-Molnar, S.; Rabe, M.; Szabo, C.; Haas, P.; Son, Y.-S., (eds.): Proceedings of the 2019 Winter Simulation Conference. Picataway: IEEE 2019, pp. 1579–1590.

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Rabe, M.; Klüter, A.; Juan, A. A.; Bayliss, C.; Panadero, J.: Using Simheuristics for Supporting Risk-aware Decision Making in Transport and Logistics under Uncertainty Scenarios. In: Putz, M.; Schlegel, A. (eds.): Simulation in Produktion und Logistik 2019. Auerbach: Verlag Wissenschaftliche Skripten 2019, pp. 499–508.

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