We conclude therefore that the efficacy of BSC is still open to question. In this paper a generic System dynamics model is build to capture and understand the cause and effects of effectiveness of BSC as a first step. It includes variables for the BSC components, performance measures as well as delays, learning effects and weakening of measures and actions. The simulations highlight the drivers of efficacy of BSC, most prominently various delays and time lags between implemented actions and learning from their results. In a second step, the model helps to clarify what empirical information is needed to ground the model — and BSC - in a real context. Different industries, different companies with different strategies face different delays, feedback structures and possibilities to learn. Further empirical research should explore specific values of the parameters mentioned above. With such data we will be able to provide valid evidence of BSC efficacy.

■ TA-21

Thursday, 8:30-10:00
2116

Hybrid Models II – Traffic and Infrastructure

Chair: *Thomas Spengler*, Institute of Automotive Management and Industrial Production, Technische Universität Braunschweig, t.spengler@tu-bs.de

1 - Simulation-based Decision Support for the Introduction of Alternative Powertrains

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Regulatory requirements concerning CO_2 emissions of passenger cars as well as the expected scarcity of crude oil force car manufacturers to increase the fuel economy of new passenger cars. One promising measure is the introduction of alternative powertrains, which leads to an increasing number of powertrains available to manufacturers. With regard to long range vehicle portfolio planning these powertrains have to be assigned to different vehicle classes, leaving manufacturers with a high variety of portfolio options. Each option comprises decisions on the powertrains to be offered in a specific vehicle class at a certain point in time. The challenge is that the suitability of alternative options is both influenced by aggregated long term effects like infrastructure and technology development as well as by specific purchase decisions on short notice. Moreover, both effects are interdependent. The aim of this contribution is the development of a simulation-based decision support for the economic and environmental assessment of different vehicle portfolios. Special focus is given to the introduction of alternative powertrains as well as the integrated analysis of long term development processes and detailed purchasing behavior. To this end, we propose a simulation model, which integrates System Dynamics and Agent-based Simulation. System Dynamics is utilized to consider diffusion processes of new powertrains based on long term effects. Agent-based Simulation provides the opportunity to incorporate detailed purchasing behavior based on customer and vehicle characteristics, which are influenced by the long term effects. This way considering the competition between powertrains and vehicle classes as well as diffusion processes based on customer behavior becomes possible.

2 - Imitating Model of Estimation the Efficiency of the Ways of Traffic Process Transport Time Reduction

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Efficiency estimation problem for traffic process modes is considered. Railway field operation indices are computed. Mathematical description of the traffic process is constructed. System component operation, component interaction, information processing are imitated. Mathematical modeling system is introduced. Traffic process improvement tasks are stated and analyzed, new technologies and rail transit efficiency are estimated. The imitating system is developed by the stages. 1.Traffic process regularities and peculiarities are studied, problem is investigated, system development goals are generated, system main tasks are stated.

2.Modeling principles are analyzed, model description language, construction methods are chosen, the nature and form of aggregate representation objects are standardized. 3.Due to module modeling principle, complex of typical model component-aggregates reflecting traffic process characteristics, complex of constructive parameters reflecting legislative aspects are elaborated. The model is to solve a wide range of traffic process improvement problems. Any traffic route with service stations of various types can be investigated. Besides, optimization problems for car traffic volume and work amount distribution among service stations with respect to their way and technical characteristics can be set. The reasonability and the cost-effectiveness of service station modernization is analyzed. Various performance indices are calculated. On the base of such equipment operation efficiency indices as transit wagon turn-over and wagon transport capacity under standard and non-traditional technologies, it is possible to decide whether new technologies lead to transport time reduction.

3 - Agent based Simulation for Dynamic Risk Management

Andreas Thümmel, FB MN, Hochschule Darmstadt, andreas.thuemmel@h-da.de, *Dennis Bergmann*

In this work a complex dynamic economic model has been studied using agent based simulation. The actors are many firms and some banks, specified through financial objects like balance sheet, costs, etc. The related agents cooperate and compete in one economic world driven by global market rules and by their specific individual base strategies. The different strategies gives a specific behavior for the economic trades and deals between the players acting in their business. Interaction was simulated randomly. The results of these economic actions are influencing actors vitality (possible down to bankruptcy) and system stability. The system can be driven by outer variables, modeled by system dynamics cause-effect-chains, and global outer behavior like economic cycles up to crises and shocks. The results give hints for dynamic risk management through compliance structures and regulations (limitations, as the simplest example) in complex dynamic global economy to lead to robust system and individual behavior.

4 - Microscopic Pedestrian Simulations – From Passenger Exchange Times to Regional Evacuation

Gerta Köster, Informatik - Mathematik, University of Applied Sciences Munich, gerta.koester@hm.edu, *Dirk Hartmann*, *Wolfram Klein*

Pedestrian dynamics play an important role in diverse fields of application such as optimizing traffic logistics, e.g. the optimization of passenger exchange times, or egress planning of buildings, ships and even whole regions. Quantitative predictions of pedestrian dynamics, namely of egress times, is an essential part for optimizing pedestrian flows. To obtain quantitative results it is vital that simulations be as realistic as possible. In this talk we present a new microscopic pedestrian simulator which can simulate up to 50 000 pedestrians in real time. The simulator is based on a cellular automaton model introducing a spatial discretization allowing efficient and fast computational algorithms. Effects introduced via the spatial discretization are corrected within the movement strategies such that paths and travel times of virtual pedestrians do not reflect any artefacts. Their movement can hardly be distinguished from continuum approaches typically showing the most realistic movement behaviour but requiring significantly more computational effort. To enhance the quality of the simulator all parameters have been verified according to certain qualitative as well as quantitative test scenarios. Due to its computational efficiency and realism, the developed simulator could be used for online prediction of pedestrian flows based on camera input as well as a tool for optimizing pedestrian flows. The latter could be based on manually testing different scenarios or even on the optimization algorithms, which are currently used within the simulator for parameter estimation.