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et. al

# Research Seminar

offered by Jonas Harbering (University of Goettingen)

in February 2014,

in Auckland, New Zealand

Subject: LinTim as a Toolbox for Integrative Public Transportation Planning

Problem: The usual approach for planning public transportation is to split up the entire problem into a sequence of several sub-problems. The problems which have to be solved are, among others, network design, line planning, timetabling, vehicle scheduling and delay management. Even though most of these sub-problems are very well studied and a lot of properties and complexity results are known, this approach for providing a public transportation system only remains a heuristic. And, even more, the relation between different problems has not been studied thoroughly. Still, solving all problems arising in this sequence at once remains impossible even for very small instances.

Thus, the idea of this work, and the LinTim software toolbox in particular, is to study the relations between the different sub-problems.

The idea is to apply the integrative perspective in order to obtain favorable solutions to the previously mentioned sub-problems and, in the end, the general problem of planning public transportation.

Main Results: A brief introduction into the functioning of the software toolbox LinTim was given in order to display the challenges of this software engineering project. Also, the necessary modularity for studying dependencies between the problems was discussed. From a mathematical point, the talk aimed to introduce the type of problems existing in public transportation. Even more, each of the problems may be solved by different models. The models implemented and solved by LinTim were discussed.

In order to give a deeper insight into the idea of integrative public transportation planning some examples for integrative planning approaches were explained in more detail.

By computational analysis we showed that an estimate for passengers' traveling time at the level of line planning can be stated even without having the actual timetable. We showed that the estimate and the realistic traveling time after computing a timetable seem to be correlated.

Another example for integrative planning depicts the importance of vehicle scheduling. Instances for the delay management problem were generated which either considered vehicle scheduling restrictions or not. For each instance we compared the quality of the solution of the delay management problem with and without vehicle scheduling constraints. Indeed, it turns out that whether or not considering certain vehicle scheduling requirements does, in most cases, not have a significant impact on the quality of the solution.

Participants: Researchers and Students from the University of Auckland and researchers from the universities of Copenhagen, Kaiserslautern and Göttingen.

Publication: M. Goerigk, M. Schachtebeck, A. Schöbel: "Evaluating Line Concepts using Travel Times and Robustness: Simulations with the Lintim toolbox." *Public Transport*. October 2013, Volume 5, Issue 3, pp 267-284.