

# A Complete Model of the Deutsche Bahn - Prosim and Beyond

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The railway market in Europe is opening up, competitors enter foreign countries, as of today more than 300 mostly small railway companies drive on german tracks. The big national companies are mostly privatized, the need for more efficiency and faster adaption to the needs of a quickly changing traffic market is a question of survival. Thus there is a big need for modelling, simulating and optimizing, for computer-based decision support, from the strategic planning process to the short-term disposition tasks.

We are right now at that moment in time where the algorithmic knowledge accumulated in science and small software companies makes it into the core of the german and other railways. For this reason the Deutsche Bahn has set up the so-called Konzernmodell *prosim*, a fast growing software model embedded, developed and maintained by a central department, called Konzernentwicklung. Prosim stands for prognosis and strategic simulation.

Here the different tasks of the planning and production process of DB can be performed simultaneously on a common virtual infrastructure. We have modeled the planning of the network, we will deal with the planning of the rolling stock, we simulate the production processes of DB Cargo, DB Reise&Touristik and DB Regio. As we are working on the top level of our company we have to find a compromise between reaching for a full detail model that is even useful in the “dirtiest” of the production realities and having at the same time the whole process in view and under control.

So the first step is to roughly understand the planning and production process as a whole from longterm strategic infrastructure planning via timetable construction to the fine points of disposition. We e.g. learn how to judge the profitability of a new highspeed line, how to forecast the change in demand because of its introduction, how the different cargo production forms are governed and according to which rules passenger trains wait for each other.

The second step is to find knowhow on the methods necessary to perform the parts of the process in such a form that we can add it to our model. There is e.g. a surprisingly well developed method for automated timetable

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construction, there are brandnew elegant and simple approaches to the circulation planning of rolling stock and personnel, that for the first time can cope with the complexity of DB.

The third step consist in evaluating different strategic scenarios of a future DB with the help of part of the modular tool constructed so far, this can concentrate on the network 2020, the line system 2005 or the placement of new stations or stops along the existing network.

The fourth step consists in running optimization algorithms on top of the whole model using the evaluation as a subroutine. So far we have only experimental experience with this approach but we are setting up a generic optimization shell for this task.

A future step which is not realized at all at the moment is the integration of all these single modules such that we can e.g. construct timetables that allow for good crew scheduling or network development plans that yields efficient timetables. We have to overcome the artificial stepwise organization of the planning process.

At the DB-Konzernmodell we are currently positioned with most of the tasks between step three and four. The fourth step needs an extremely fast simulation and evaluation in the running time range of a few seconds in order to keep the overall optimization time below the typical limit of a day. Since in the next years some of the subtasks as timetable construction will not lie in the desired range of a few seconds we will have to look for different approaches. One possibility is to design a generic model of a railway company, that has a much lower complexity than DB, but contains “in a nutshell” all characteristic features of such a huge railway company. Structural questions like “What does it yield to shorten the breaks of the engine drivers?” or “What does it cost to decrease the number of overnight stays for the personnel of the short distance trains?” or “Which timetable yields an efficient usage of shunting capacities?” or “How should we change our plans on buying new rolling stock given the new pricing system” could be answered in such a generic model.