C4R
Capacity for Rail

Towards an affordable, resilient, innovative and high-capacity European Railway System for 2030/2050

WP3.2 – Simulations and Models

Scope

The purpose of SP3.2 of the Capacity 4 Rail project is to increase capacity with better methods for timetable planning and operational traffic and to analyse and evaluate the capacity of infrastructure and new traffic systems.

The project covers strategic, tactical and operational rail capacity planning processes, as well as driving advisory systems (DAS) in several European countries, and how modelling tools and simulation are used in planning and control. The perspective is mainly from the point of view of the infrastructure manager.

Research gap

An overview gap analysis has been performed, from the viewpoint of the infrastructure manager, with a vision for 2020 of tactical planning and operational traffic control.

Operational control of railway traffic is recognised as the critical factor in railway systems that requires an improvement. The application of novel computer-based decision support systems is recognised as a potential approach. The discrepancy between the current state of the existing tools for real-time traffic control and the practical operational requirements is identified as the main gap.

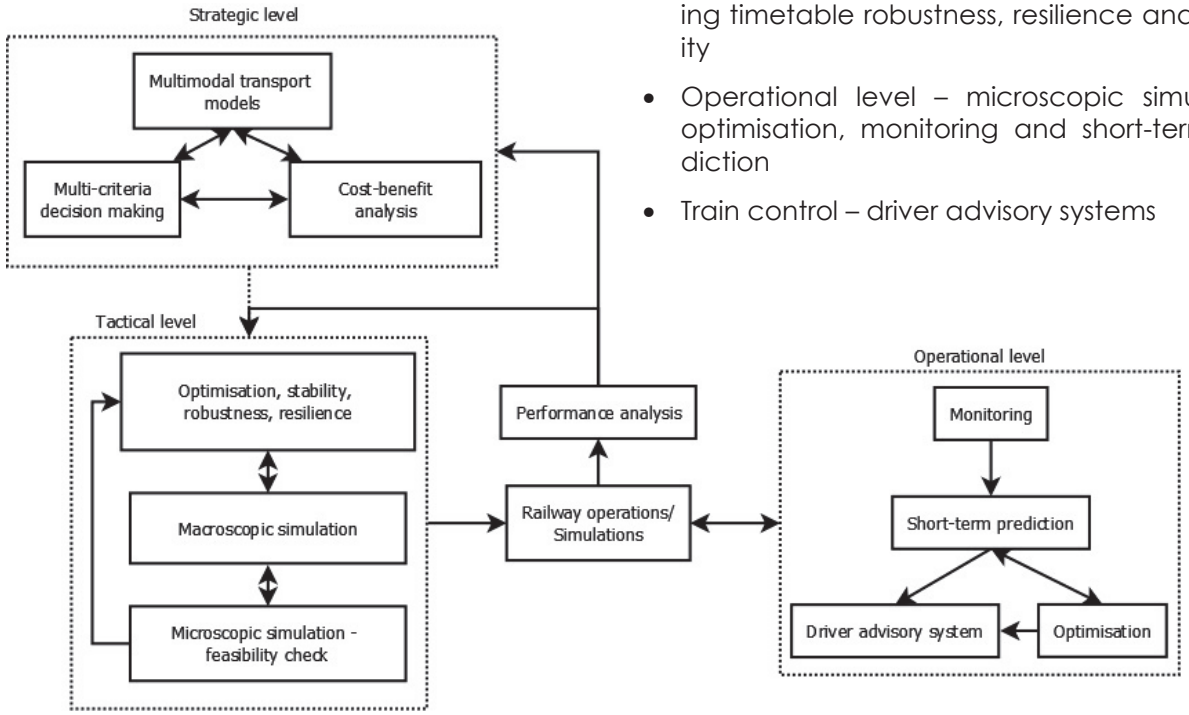
Existing framework

The figure shows the existing framework for decision support using modelling and simulation.

Modelling and simulation is used for analysis of transport systems – infrastructure investments, timetable planning one year and ad-hoc and operational traffic.

The modelling and simulation techniques are:

- Strategic level – socio-economic analysis, cost benefit analysis, multi-criteria decision making, integrated multimodal transport models, etc.
- Tactical level – macroscopic simulation, stochastic simulation, optimisation, and improving timetable robustness, resilience and stability
- Operational level – microscopic simulation, optimisation, monitoring and short-term prediction
- Train control – driver advisory systems



EXISTING FRAMEWORK FOR MODELLING AND SIMULATION

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement n° 605650

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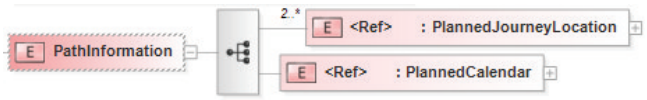
The CAIN system, developed by Oltis Group, serves as real time software for the input of ad-hoc train paths into the real timetable. The subsequent optimisation of the timetable and simulation of different scenarios is one of the main tasks, where CAIN interacts with the model from LiU, Linköping University.

CAIN Demonstrator

The CAIN demonstrator has been developed by OLTIS Group. The process follows several consecutive steps:

- Import static data of railway infrastructure, timetable and vehicles – the corridor Malmö – Hallsberg [data in RailSys and railML format]
- Process the data, create a virtual network and display the railway network
- Make new request for an ad hoc path (manually or imported)
- Optimisation and creation of an ad hoc path
- Construction of a new timetable and render a new train path
- Export of a new timetable in **TAF TSI structure** (PathInformation) for interaction with the LiU model by mutual data exchange



STRUCTURE OF ELEMENT PATHINFORMATION

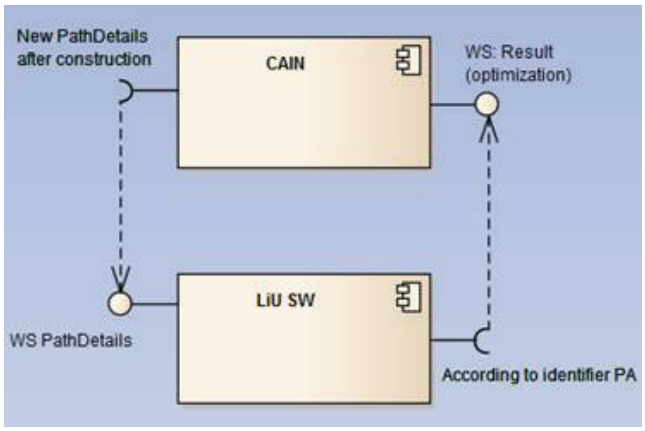
Interaction CAIN – LiU

The LiU team is analysing the data from the Trafikverket "Lupp" database of historical traffic data. The goal is to evaluate suggested ad-hoc path requests with respect to robustness. Preliminary results show that this problem is particularly interesting for the selected corridor as there are many freight trains that are rescheduled at short notice. The distribution of freight train delays indicates that many of them take paths that are not included in the planned daily timetable and thus had to be inserted into the existing one.

Principle of the conceptual link between CAIN and the LiU model:

- LiU model provides a system for real time train positions and predictions
- Cooperation of LiU and Oltis to integrate different data exchanges
- LiU to evaluate by simulation the new timetable with respect to overall robustness and returns a prediction of the expected delay.
- The target is to develop a traffic prediction module able to be integrated into a real time dispatching system and ad hoc timetable system

The CAIN demonstrator will be documented in "Deliverable 32.2 Capacity impacts of innovations (PU, R)" planned to be published in March 2017 according to the project plan.



COMMUNICATION SCHEME VIA WEBSERVICE CAIN WITH USE OF MESSAGES ACCORDING TO TAF TSI VERSION 2.1

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