WP05
EAG meeting
Hitchin, 25 June 2014

[Optimal Networks for Train Integration Management across Europe]
Collaborative Project
7th Framework Programme

Rob Goverde
WP5: Operations management of large scale disruptions
Outline

• WP5 objectives
• Main reports so far
• WP5 disruption management approach
• WP5 demonstration
• **Objective 3:** To reduce overall delays and thus service dependability through improved traffic management techniques that can recover operations following minor perturbations as well as major disturbances

• Focus: blocked tracks
Main reports so far


2. **ONT-WP05-D-IFS-015-03** - D5.1 Functional and technical requirements specification for large scale perturbation management

3. **ONT-WP05-T-UON-011-01** - HF ANNEX TO D5.1

4. **ONT-WP05-D-EUR-026-03** – D5.2 Decision support tools for the optimal human supervisory control of the recovery processes
WP5 approach

- Set of exchangeable modules to prove concept
- Standardized RailML I/O data format (with extensions)
- Internal data structure with transformations between micro/macro models
- Four-level iterative approach by team of three partners
  - Microscopic timetable rescheduling and data transformations
    - Detailed computations on local level, including local rerouting and conflict-free timetable at all stops
  - Macroscopic timetable rescheduling
    - Timetable optimization at (affected) main stations only
  - Rolling stock rescheduling
    - Feasible rolling stock assignment to non-cancelled train services
  - Crew rescheduling
    - Feasible crew duties to non-cancelled train services
WP5 architecture

Plan/Actual state/Rules

Change TT Macro

Change TT Micro

Change RS

Change Crew

New TT

Feasibility check

Trips without RS and the conflicted trips

Trips without crew and the conflicted trips

New parameters, like running times and headway times

New TT
Objectives

- Conflict-free and realizable adjusted timetable

Approach

- Replatforming and rerouting for short-turning trains
- Running time and minimum headway calculations on alternative routes and temporary speed restrictions
- Operational speed profiles for given run time supplements
- Conflict detection using blocking times (rejection criteria)
- Aggregation to macroscopic model
- Partly the same algorithms as WP3
Objectives

- Compute adjusted timetable w.r.t. disruption
- Minimize cancelled train services
- Minimize delays w.r.t. original timetable (departures after short-turning and delays elsewhere)

Approach

- Using short-turning of (partially) cancelled train services
- IP problem based on event-activity network
- Solution computed by C-PLEX commercial solver
Rolling stock model

Objectives

• Feasible rolling stock circulations to adjusted timetable
• Minimize additional cancelled train services
• Minimize deviations from original rolling stock circulations
• Minimize amount of shunting movements
• Minimize end-of-day balance at overnight stations

Approach

• MIP based on multi-commodity flow with extensions
• Split in model with no end restrictions and with day balance
• Model solved by C-PLEX (Branch & Cut)
• Model by Lars Nielsen (EUR PhD thesis 2011) based on Fioole et al. (EJOR 2006) and Maróti & Kroon (TS 2005)
Crew rescheduling model

Objectives

- Feasible crew assignments to adjusted timetable (with cancelled train services)
- Minimize additional cancelled train services
- Minimize deviations from original crew duties

Approach

- Driver and guard are a team
- MIP based on a set covering model
- Solved by Lagrangian relaxation and column generation
WP5 demonstration

Dutch case study

- Two intersecting corridors
  - Utrecht-Eindhoven and
  - Tilburg-Nijmegen
- Hourly timetable pattern with
  - 4 IC and 6 Local train lines
  - 2 trains/h each
- Blocked tracks between s’ Hertogenbosch and Oss from 7:30-8:30 AM