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Examples in/from mainports in the Netherlands

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Intermodal Freight Transport Networks Under Uncertainty: Examples in/from Main Ports in the Netherlands

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In the Netherlands, the main port Rotterdam, is confronted with a steady growth in total volume, mostly resulting in a direct increase of the road transport; the resulting road congestion led to various initiatives increasing the share of transport over water and rail. Overall, this intermodal situation is vulnerable to many sources of uncertainty, ranging from relatively common, low impact events, to relatively rare, high impact events.

For instance, a major disruption on the railway link around Rastatt, in Germany, some 600 km upstream the Rhine valley, on the main freight corridor to Switzerland and Italy, caused large problems in summer 2017 and almost 12 million euros losses per week. The freight route, roughly used by 200 freight trains a day, was completely unavailable for almost 2 months, and moreover there were extremely limited diversion routes. The reaction to this disruption, can be categorized along the three axes software, hardware, orgware (see, e.g., Corman Negenborn 2018) as:

- on the **hardware** side (i.e., the bare infrastructure), to put in place round the clock shifts, to repair as quickly as possible the disrupted location;
- on the **software** side (optimizing the flow to avoid bottlenecks and maximizing the utilization of the network), to choose alternative paths or destination when possible;
- on the **orgware** side (organizations aspects, when and where which goods can be transported) an impressive collaboration of multiple train operators was required in three different countries, to allow capacity on minor or side corridors to take some of the diverted freight traffic.

Also the water transport faces disruptions, including inland vessels transporting containers between large sea ports and hinterlands. About 77,000 such inland vessels moored in the port of Rotterdam in 2014, often facing long waiting times, and limited possibility to update loading/unloading schedules. New advanced, automated planning systems can instead optimize the routes and visiting sequences of inland vessels to terminals in a more efficient way (S. Li and Negenborn, 2018)

The ultimate goal would be to consider integrated road, rail and waterway infrastructures to deliver the best transport performance under uncertain circumstances. Concepts such as synchromodal transport stimulate this direction (see, e.g., van Riessen et al, 2015). This requires dealing with complex optimization problem, limited information due to time or privacy issues , and decisional power spread over many stakeholders (See L. Li et al , 2017). Overall, single modes might be unreliable, but their coordination, under some intelligent management spanning software and orgware, is not.

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