

Optimising load planning and container routing in intermodal rail transport

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Optimising load planning and container routing in intermodal rail transport

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1 This is a summary of the author's PhD thesis supervised by An Caris, Kris
2 Braekers (Hasselt University, Belgium), Stan van Hoesel and Andre Berger (Maas-
3 tricht University, The Netherlands). The thesis was defended on June 19, 2019
4 at Maastricht University as a results of a double-degree programme with Has-
5 selt University as main institution and Maastricht University as partner institution.
6 The thesis is written in English and is available from the author upon request at
7 hilde.heggen@uhasselt.be. This work deals with decision support in the
8 context of intermodal rail transport by studying two planning problems, integrated
9 intermodal routing and multi-objective train load planning.

10 With the rising focus towards more sustainable transport systems, intermodal trans-
11 port is a promising alternative for unimodal road transport. However, it also presents
12 a number of challenges for intermodal operators and planners who are in charge of
13 executing transport planning in an increasingly dynamic environment. As multiple
14 transport modes and decision makers are involved, intermodal transport is more com-
15 plex. Moreover, the level of integration of different transport modes and decision
16 levels influences the attractiveness of intermodal transport. Innovative and integrated
17 transport systems reflecting real-life problems should be developed in order to provide
18 adequate decision support tools for intermodal planners and support a synchromodal
19 vision. However, a gap between academic research and practice can be observed,
20 because real-life characteristics of intermodal transport companies are ignored. There-
21 fore, the focus of this thesis is on decision support for human planners at the operational
22 decision level during the planning process of intermodal rail transport.

23 This dissertation aims at offering intermodal planning support in order to minimise
24 total transport costs and maximise service capacity utilisation, which in turn decreases
25 costs of the transport system. Two decision support tools are proposed by means of
26 fast planning algorithms which include real-life characteristics. These concepts are
27 inherent to the synchromodal vision in order to encourage a modal shift away from
28 unimodal road transport. After a literature review on intermodal routing and vehicle
29 routing in intermodal transport, two problems usually considered separately, an inte-
30 grated intermodal routing problem is presented. Both a mathematical formulation as
31 well as a large neighbourhood search heuristic algorithm are presented for the sequen-
32 tial and the integrated version of the problem. In the integrated version, operators are
33 dedicated to the integrated nature of the problem. By including information of local
34 vehicle routes in the assignment of transport requests to long-haul routes through a

35 service network, better-informed decisions can be obtained. Insights are presented on
36 how such integrated approach can be used for decision analysis in practice by means
37 of a real-life case.

38 With transport requests assigned to intermodal routes through an intermodal rail
39 service network, they should be assigned to specific locations on an intermodal train.
40 This is the train load planning problem. It includes detailed loading restrictions, as
41 omitting relevant loading constraints could result in infeasible solutions. Both an
42 exact and a multi-directional local search heuristic solution approach are presented.
43 Multiple objectives and additional real-life loading constraints are included, resulting
44 in multiple feasible train load plans. Routes might still change for some transport
45 requests and information about future orders should be accounted for. By providing
46 multiple plans, planners can select the most appropriate load plan at a specific moment
47 in time. The problem is applied to a real-life case to demonstrate advantages for
48 practitioners.

49 Decisions on these two planning problems, intermodal routing and train load plan-
50 ning, influence the throughput and efficiency of the intermodal transport system. Fast
51 decision support by means of planning algorithms is provided for improved, more
52 efficient planning. Results contribute to a better understanding of the way in which
53 intermodal operators can maximise their service network's transport capacity based on
54 the expected demand of transport orders, and lead to an increased transport capacity
55 utilisation and a minimisation of total transport costs.

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