Optimizing Service Networks of Eurasian Rail Freight Transport

Jing Shan¹, Henning Preis¹, Nikola Bešinović¹ and Jörn Schönberger²

1. Chair of Railway Operations,"Friedrich List" Faculty of Transport and Traffic Sciences, TU Dresden, Germany
2. Chair of Transport Services and Logistics, "Friedrich List" Faculty of Transport and Traffic Sciences, TU Dresden, Germany

Corresponding author: jing.shan1@tu-dresden.de

Keywords: Global supply chain, Eurasian rail freight transport, Intercontinental rail freight freight, I-SSND, Scheduled Service Network Design, Physical Internet, Information Integration.

Conference Domain Fitness: Our contribution to IPIC 2024 closely aligns with the themes outlined in the call for contributions, with a particular emphasis on the optimization of intercontinental rail freight transport in the Eurasian region. By addressing the challenges posed by diverse stakeholders and fragmented rail networks. The Intercontinental-Scheduled Service Network Design (SSND), which is specifically tailored for Eurasian rail operations, aims to improve the efficiency and reliability of the intercontinental rail system.

Physical Internet (PI) Roadmap Fitness: Select the most relevant area(s) for your paper according to the PI roadmaps adopted in Europe and Japan: ☐ PI Nodes (Customer Interfaces, Logistic Hubs, Deployment Centers, Factories), ☐ Transportation Equipment, ☐ PI Networks, ☒ System of Logistics Networks, ☐ Vertical Supply Consolidation, ☐ Horizontal Supply Chain Alignment, ☐ Logistics/Commercial Data Platform, ☐ Access and Adoption, ☐ Governance.

Contribution abstract

Eurasian rail freight transport has made significant progress in recent years, demonstrating its potential as a critical player in the global supply chain. However, this intercontinental rail transport involves a wide range of stakeholders, including shippers, logistics service providers, rail undertakings, infrastructure and terminal operators, railway operators, and other equipment operators. Multiple interfaces across totally different rail systems complicate information exchange. Due to a lack of information integration, intercontinental rail freight planning has a long history of manual rail planning, relying heavily on planner experience and knowledge. This work extracts relevant information from the supply chain and rail freight system to create a time-space formulated Intercontinental-Scheduled Service Network Design (SSND) that is specifically designed for Eurasian rail system. This model aims to incorporate heterogeneous service requirements from the global supply chain into intercontinental rail planning. It calculates potential delays, determines the length of stay for each order at each terminal, and synchronises order schedules at border crossing terminals. The initial application of this model in Eurasian rail freight transport has produced promising results, demonstrating its potential for wider implementation in intercontinental rail freight transport.
Figure 1: Parts of Eurasian rail network based on naturalearthdata

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<thead>
<tr>
<th>Pre-rail haul</th>
<th>Main transit</th>
<th>Post-rail haul</th>
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</thead>
<tbody>
<tr>
<td>Shipper</td>
<td>RU</td>
<td>Receiver</td>
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<td>Terminal Operator</td>
<td>RU</td>
<td>Terminal Operator</td>
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<tr>
<td>Pre-carriage</td>
<td>Transport time</td>
<td>Handling time</td>
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<td>Handling time</td>
<td>Border crossing time</td>
<td>Delivery</td>
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<td>RU</td>
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</tbody>
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### Market Segmentation
- Rail Data
- Terminal
- Border crossing
- Land transport
- Rail line
- Operational characteristics

### Information Flow
- Demand Data
- Rail data
- Load calculation
- Departure and destination
- Train routing
- Steel quality
- Inventory
- Supply chain
- Decision
- Accept or reject
- Service level
- Train plan
- Due time

### Efficiency goals
- Frequency
- Routing
- Capacity charge

### Service Goals
- Capacity
- Frequency
- Routing
- Capacity

Figure 2 Actor-related information on Eurasian rail freight transport

Figure 3 Information integration in the I-SSND model