Capacity Pricing and Capacity Allocation Strategies in Shared Railway Systems


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Motivation

New pieces of legislation such as PRIIA (2008) or EU directives 91-440 and 2007-58 promote the use of **shared systems**

Shared railway systems are systems in which different railway operators may use the same infrastructure.

It allows for **efficient use of the infrastructure**, which is expensive: represents 60-80% of total rail transportation costs.

It **requires coordination**: when different operators request access to the infrastructure the regulator should decide who gets access, when, and at what price.

Research Question and Objectives

Research Question

How do different **capacity market designs** for capacity pricing and capacity allocation affect the **performance** of shared railway systems?

Objectives

1. Identify representative capacity market designs for shared railway systems, and
2. Understand implications of a market design for the infrastructure manager, the operators, and other stakeholders.

Capacity Market Design

Rules for capacity pricing and allocation. Decision making process for deciding what trains to schedule, when, and at what prices

Three different representative capacity market designs have been identified:
1. Auctions
2. Auctions + flat tariff per operator
3. Cost allocation methods + priority rules

Infrastructure

Railway capacity is constrained by the infrastructure (signaling systems, topology, etc.).

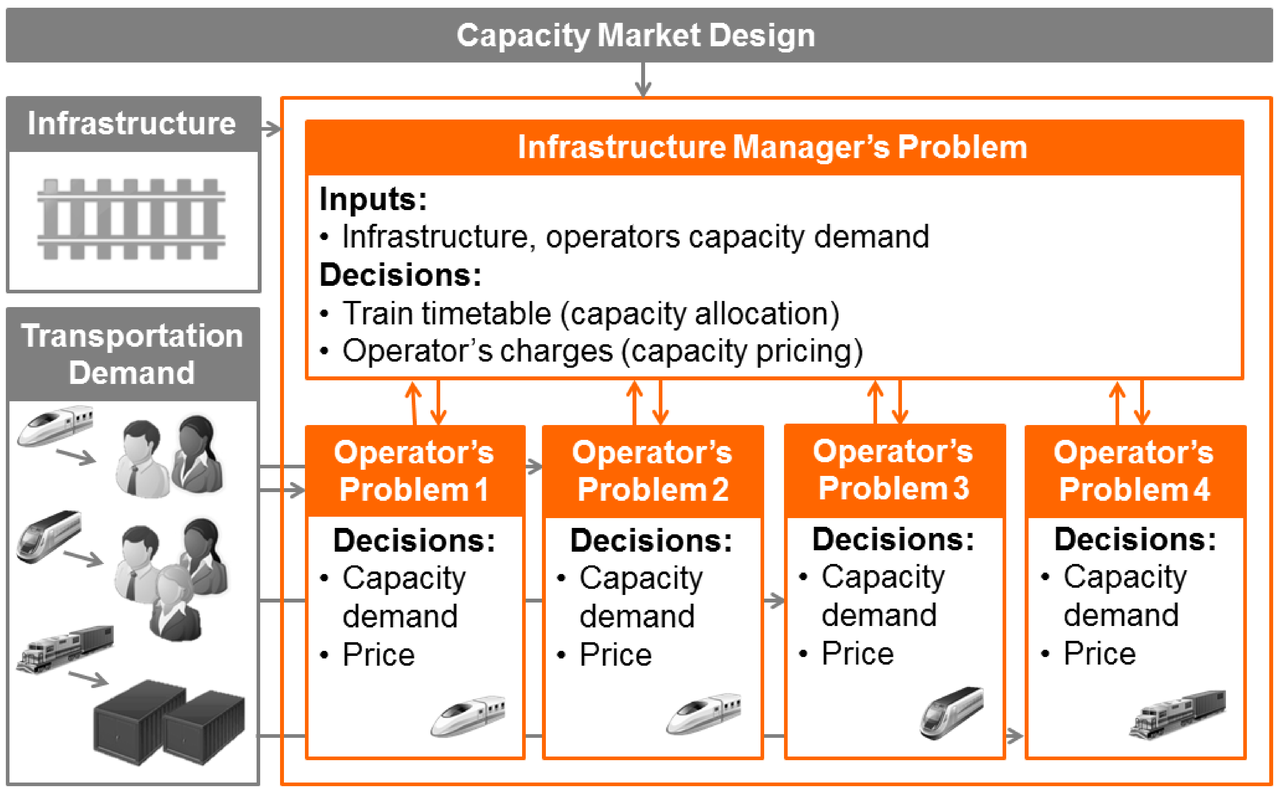
Transportation demand

Initially, shared railway systems are designed to accommodate different types of services in the same infrastructure. As a consequence, the transportation demand consists of intercity passenger demand (including high-speed rail demand if there are high-speed services in the system), commuter passenger demand, and freight demand.

Capacity Allocation ⟷ Capacity Pricing

Decision of which trains get access to the infrastructure and when

Decision of the access fee that each train scheduled should pay to the infrastructure manager



Methodology

This research is developing a framework to evaluate the performance of shared railway systems under generic capacity pricing and capacity allocation strategies considering both technical and behavioral aspects.

This framework integrates two modules:
1. **Operator's problem:** simulates the strategic behavior of the operators and its impact on the demand for transport (industrial organization),
2. **Infrastructure manager's problem:** replicates the infrastructure manager and designs the best timetable that consider all technical constraints for the infrastructure and the information about the desired slots for each operator (operations research).

Equilibrium problem between the demand for transport and the available infrastructure capacity to schedule trains.

Performance

The performance is measured using multiple criteria:
1. Infrastructure cost recovered
2. Level of service
3. Use of capacity
4. Demand served
5. Operator's market structure and behavior

Acknowledgements

The research team acknowledges Rafael del Pino Foundation for sponsoring this research.

References

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Future Work and Expected Contributions

Future work:

1. Finalize the design of the framework to analyze different capacity market designs (integration of the infrastructure manager's problem and the operator's problem)
2. Analyze identified representative capacity market designs

Expected contributions:

1. Increase the understanding of different capacity market designs,
2. Provide a framework to evaluate other capacity market designs,
3. Generalize capacity pricing and allocation for shared systems, and
4. Analyze the implications of the results for different railway systems such as the Northeast Corridor in the U.S.