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The Mobility Leader

How the design of high-speed rail services affects the socio-economic sustainability of the investment

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8th and 9th September 2026

6th International Symposium on High-Speed Rail Socioeconomic Impacts

How the design of high-speed rail services affects the socio-economic sustainability of the investment

De Felici Laura

Introduction (Context and Objectives)

HS Italian network

- After almost 20 years of operation, the Italian HS system is mature and fully used;
- Several smaller territorial entities require direct access to the HS system with stops/stations;
- The introduction of stops/stations on the HS system determine points of discontinuity which must be assessed as trade off between increasing the number of passengers versus wasting time of the original passengers;
- The first step of the design is the analysis of the need for mobility;
- The demand that can be attracted by the rail carrier is connected to the possibility of reducing travel times on the main routes but also to the frequency of the service;
- An increase in frequencies generally leads to capturing additional demand; conversely, a reduction in frequency can limit the demand that can be captured;
- Service design must guide infrastructure design;
- Cost Benefit Analysis can support the technical choice of solution.

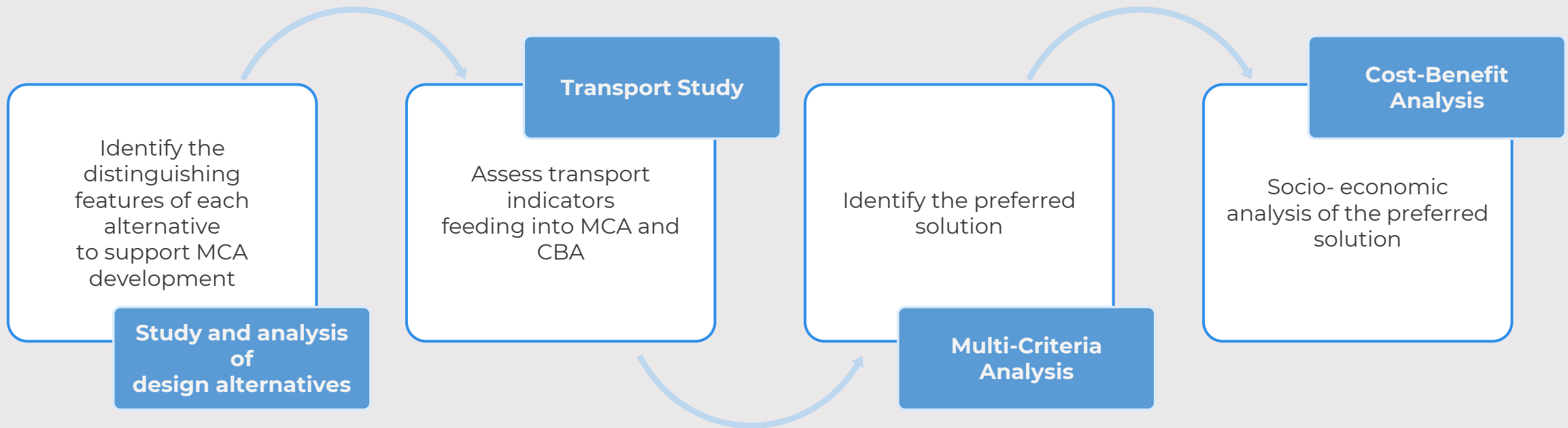
Literature background

Italian regulations governing the construction of public works require the **identification and definition of a framework of requirements based on the needs of the economic and social context**, as well as the associated objectives and performance indicators.

Based on the requirements framework, the Feasibility Document for Design Alternatives presents a **comparative analysis of the design alternatives**. **Cost-benefit analysis (CBA)** is the **primary methodological tool supporting the choice between project alternatives**.

The socio-economic and environmental assessment is prepared based on a **multimodal transport study** that simulates the demand response to the development of supply.

Alternative methodologies, including **multi-criteria analysis and cost-effectiveness analysis**, may be used whenever the required conditions are fulfilled.



Research Design (Methodology and Results)

Trade-off between more passengers and journey times

Expected effects of introducing a stop



New passengers

Road

- Lower operating costs
- Lower emissions
- Lower accident rates



Benefits



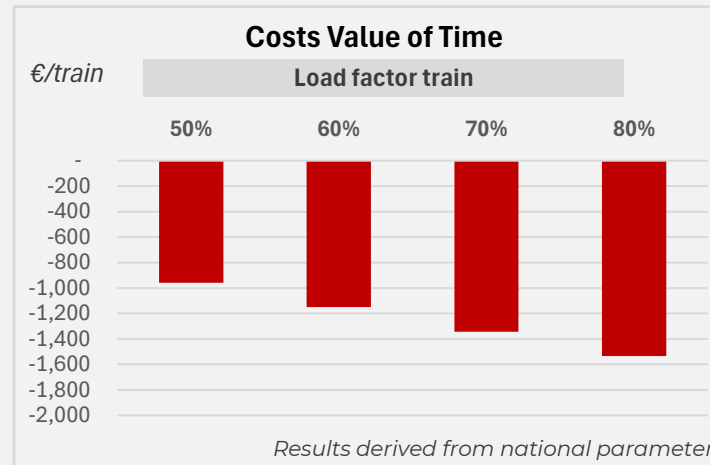
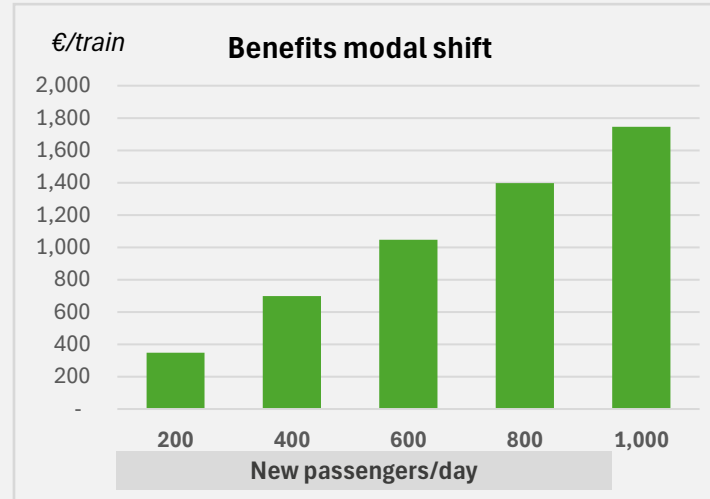
Conserved passengers

Costs

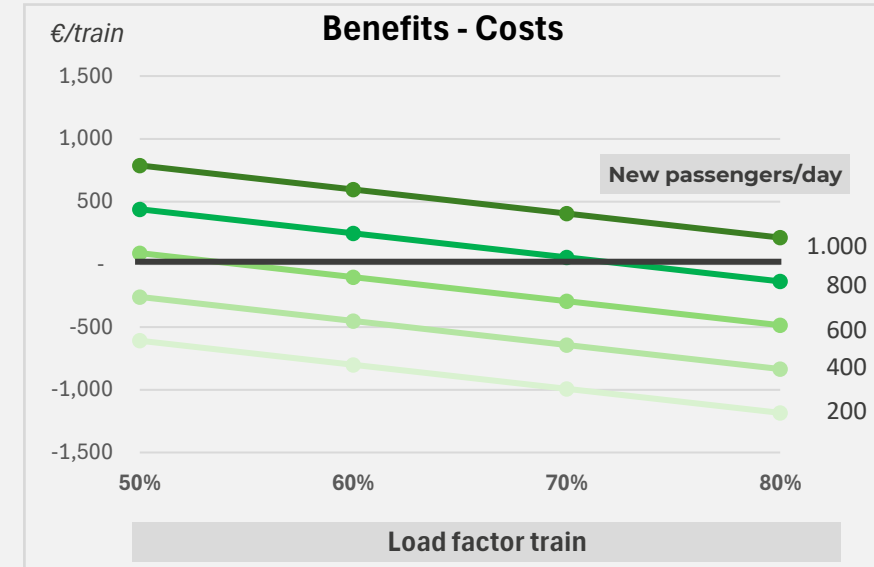


Rail

- Longer travel time



Introduction of a new high-speed stop (excluding investment costs)



Considering the range of load factor values per train, at least 800 new passengers per day are required to offset the loss in value associated with the stop.

Scenario of 15 pairs of high-speed trains per day and average distance of 200 km

Research Design (Methodology and Results)

The market response to the increase in supply

Expected effects of increase of frequency

Among the variables that most significantly influence the successful delivery of a new high-speed station is the **market's response to the transport service offered**.

We analyzed the evolution of the transport supply and the response in terms of new rail passengers observed at the new Italian high-speed stations.

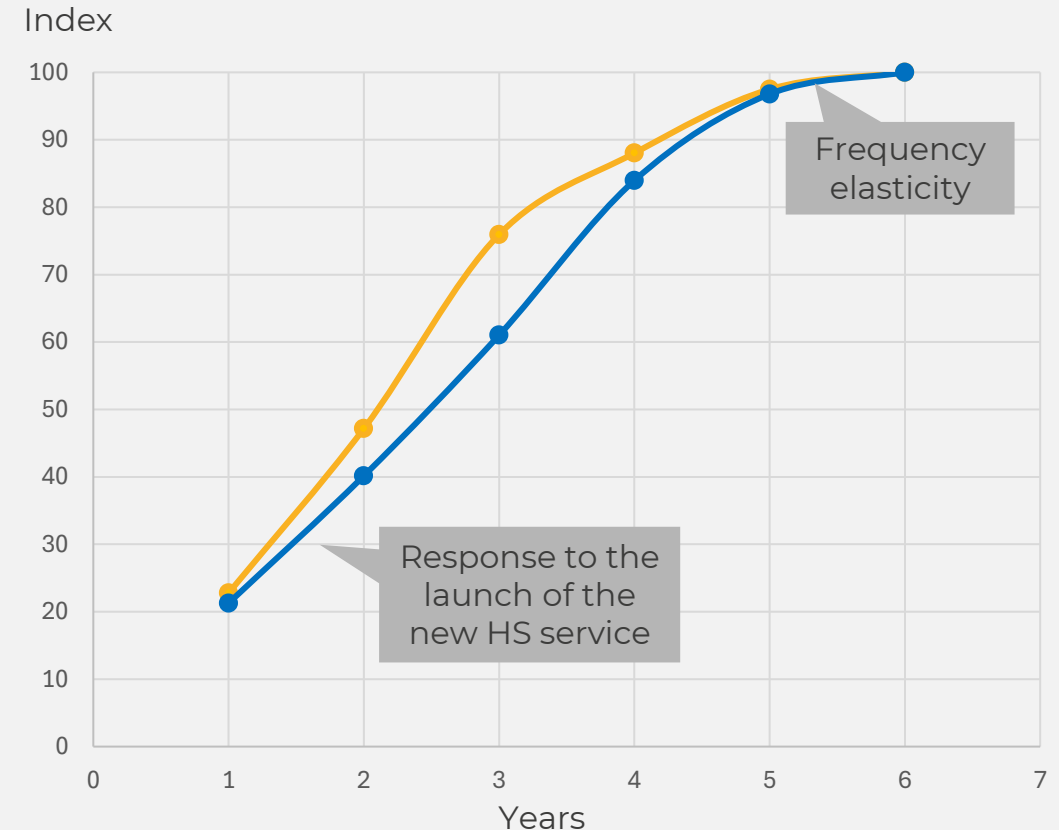
The greatest increase in the number of passengers choosing to use the train derive from access to the high-speed rail network.

Service planning generally assumes the operation of one pair of trains per hour. **Subsequent increases in service frequency result in progressively smaller modal shifts, until the maximum passenger attraction capacity is reached.**

The sizing of the stations is linked to the expected passenger flow.



Interaction between supply and demand
(average values normalized on a base of 100)

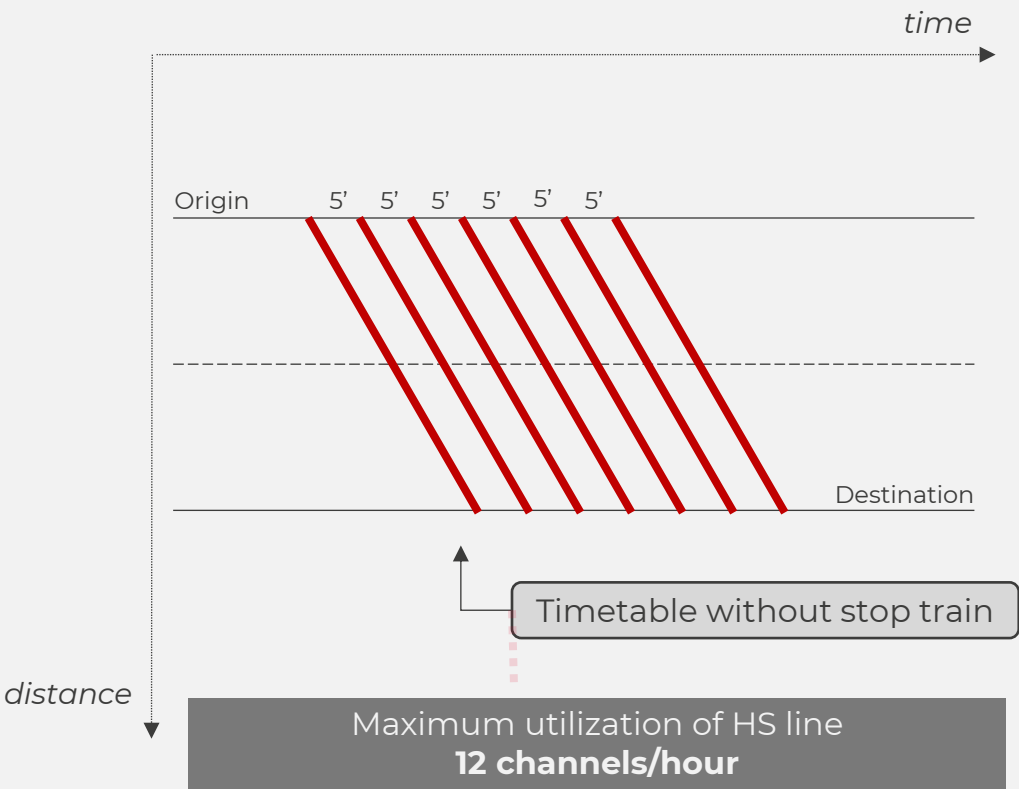


Research Design (Methodology and Results)

The Transport capacity: a finite resource

The insertion of a new stop on a congested high-speed line

On congested lines such as the Italian high-speed corridor, adding a stop to the timetable can result in a reduction of overall transport capacity.



Case A

On congested lines the stop takes 10 minutes.

Adding 1 train stopping every hour at a new intermediate station could **reduce capacity by 1 channel/hour...**

Case B

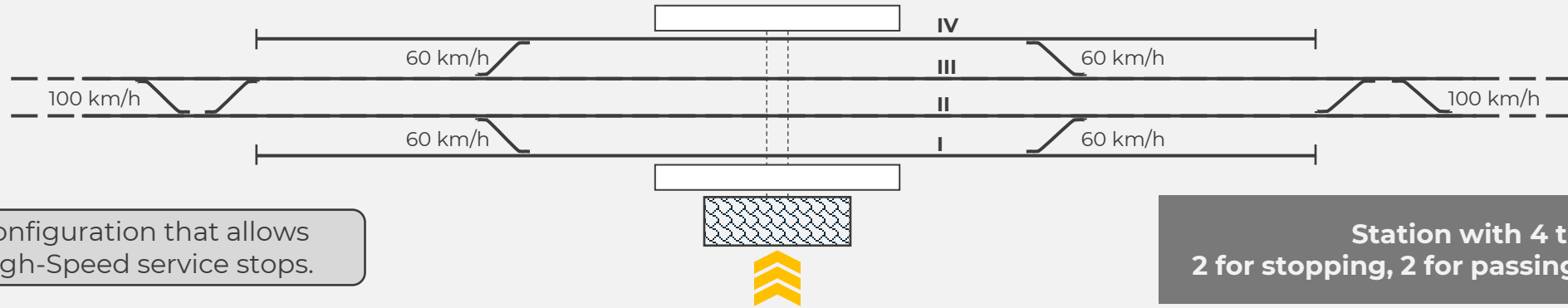
...but the correct functional design of the new station can **avoid reduction of line capacity**

Different colors represent services that use different train tracks

Research Design (Methodology and Results)

Infrastructure solutions to support the transport supply model

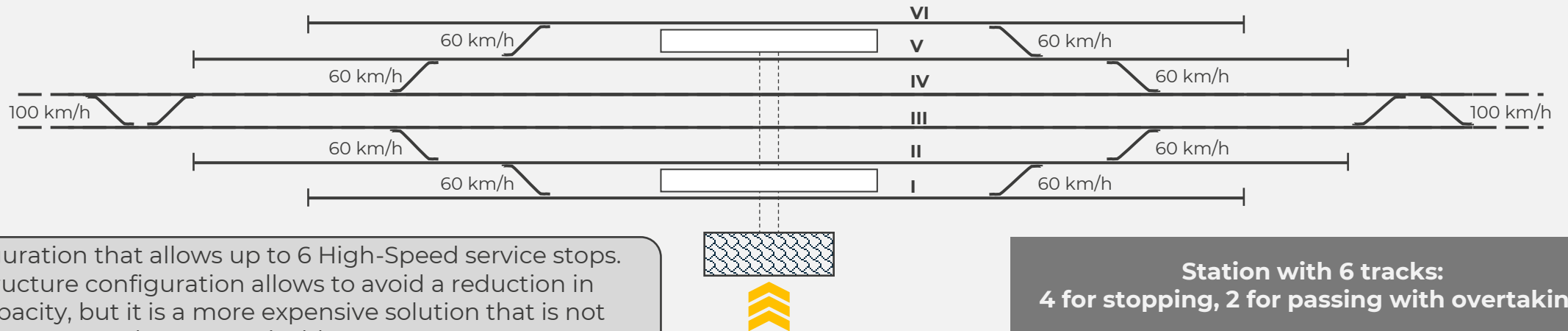
Case A



Station configuration that allows up to 4 High-Speed service stops.

Station with 4 tracks:
2 for stopping, 2 for passing with overtaking

Case B



Station configuration that allows up to 6 High-Speed service stops.
This infrastructure configuration allows to avoid a reduction in transport capacity, but it is a more expensive solution that is not always practicable

Station with 6 tracks:
4 for stopping, 2 for passing with overtaking

Research Design (Methodology and Results)

Executive Summary

The range of solutions for a congested high-speed line

Services



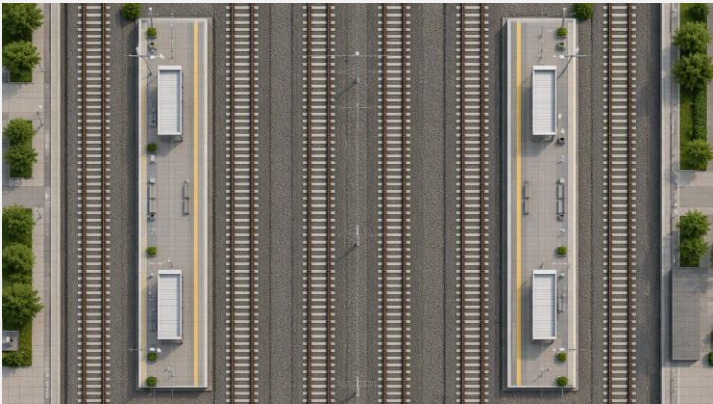
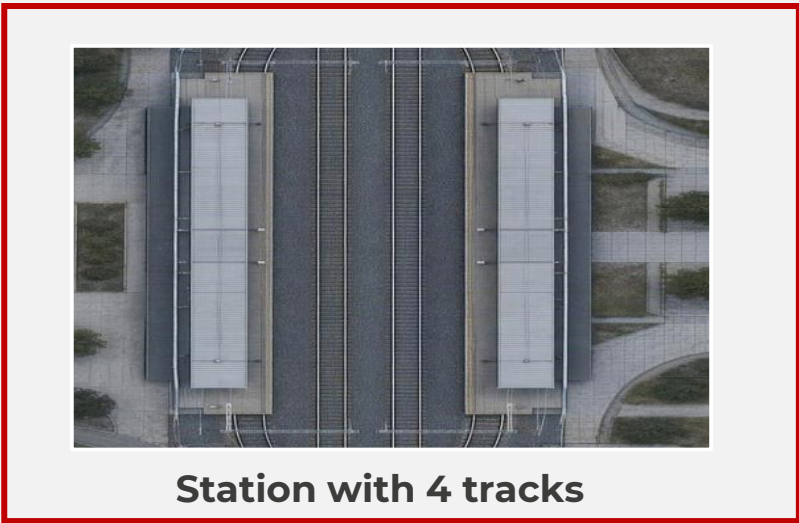
Infrastructures

Increase service with stop:	Up to 4 channels/h	Up to 6 channels/h
Decrease capacity fast services:	1 channel/h per stop	Null

In the recent past, we studied high-speed stations serving areas with limited demand.

Consequently, a 4 tracks station configuration was adopted in all cases.

It should be noted that 6 tracks stations require a larger land footprint and are difficult to integrate into urbanized areas.



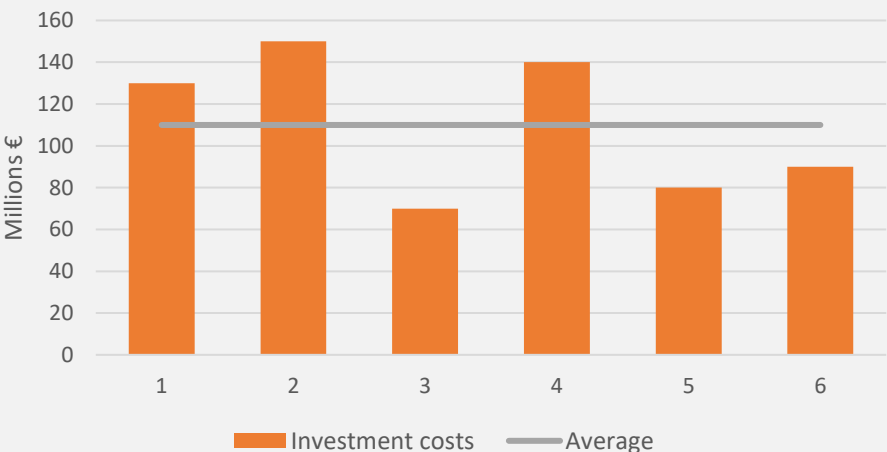
Station with 6 tracks

Research Design (Methodology and Results)

Cost Benefit Analysis Investment for a new station

Project solutions subjected to economic, social and environmental evaluation

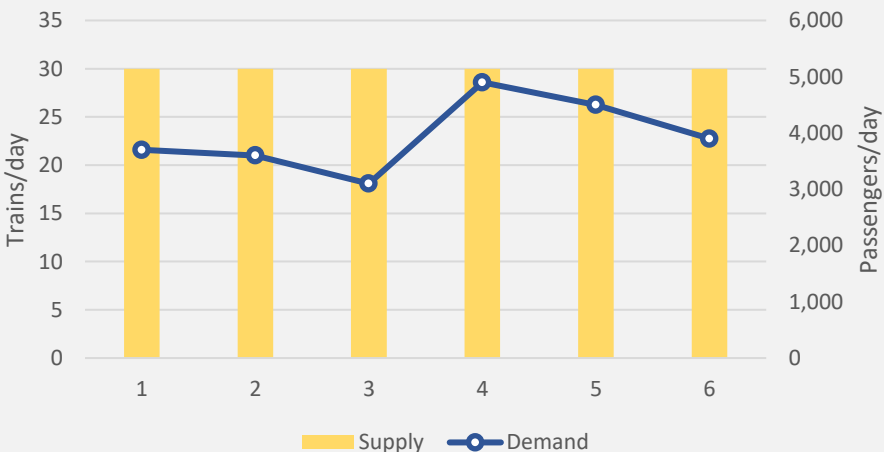
Investment costs



In the case studies examined, a service frequency of one train per hour in each direction was assumed.

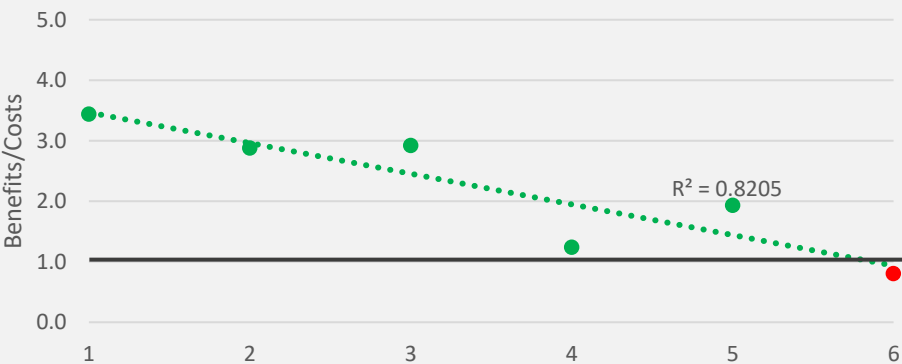
The market response ranged from 3,000 to 5,000 passengers per day.

Interaction between supply and demand



Benefits/Costs

(Economic, Social and Environmental Assessment)



Even with the same 4 track configuration, investment costs vary significantly.

In addition to the strictly railway-related infrastructure, costs include the station building, parking facilities, access roads, and other elements.

The outcomes of cost-benefit analyses depend not only on modal shift and the investment cost, but they are also determined by the travel time savings generated for users by high-speed services.

Furthermore, the results depend on the **distance traveled by users attracted to high-speed services.**

Final Summary

Multiple variables are involved in the sizing of an intermediate station on congested HS lines

- Mobility demand analysis is the starting point for defining the potential of a new stop or station on the HS system;
- Additional HS service stops/stations can improve accessibility and attract new passengers, but the demand-response to service supply is not linear, requiring an optimal balance between attractiveness and efficiency;
- On congested HS line, introducing additional stops may affect network capacity and timetable robustness;
- Station and service design should jointly consider accessibility, capacity constraints and future service development opportunities, particularly on congested HS lines where capacity is a scarce resource;
- Cost Benefit Analysis can support the technical choice of the infrastructural solution that maximises long-term socio-economic value.



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