

**HIGH
SPEED RAIL**

SYSTRA

**Over 40 years of pioneering and delivering
HSR solutions worldwide!**



TRUST PROVEN SOLUTIONS THAT WORK ACROSS THE WORLD!

As the mobility demand still grows across the world, High-Speed Rail provides an intercity transportation response at national and international scale, while allowing a significant modal shift to rail. High-speed rail offers a reliable, efficient, and sustainable alternative to air and road travel, reducing journey time, time lost in transport thanks to connectivity technologies in trains, connecting cities, and unlocking new economic opportunities.

High speed railways transform our perceptions of time and space as distances become measured in a few hours of journey times rather than in hundreds of miles or kilometres, leveraging significant sociological, economic and environmental benefits at a country or continental region level.

HSR emits minimal CO₂ and establishes sustainable, long-term infrastructure for the future, unlocking also new opportunities to use existing conventional railways for increased freight traffics and local passenger services.

To tackle this challenge, the accurate balance has to be found between proven and innovative solutions to deliver all expected benefits while meeting every safety, performance, operating and commercial requirement.

OUR 10-STAGE APPROACH TO DELIVERING YOUR HIGH-SPEED RAIL VISION



Implementing High-Speed Rail poses unique challenges, affecting many people and places over a timeline that spans several decades, from initial planning to operational launch, and extending beyond standard governmental and political timeframes.

Therefore, it is crucial for both political and public authorities, as well as the railway industry, to collaboratively define and agree on the most effective and mutually beneficial approach for designing, building, and operating any new high-speed rail system. This collaboration will help deliver the anticipated benefits and address the associated technical challenges while minimizing costs (both CAPEX and OPEX) and socio-environmental impacts.

1—DEFINE AND REACH CONSENSUS WITH ALL STAKEHOLDERS ON THE EXPECTED KEY BENEFITS WHEN CONSIDERING A NEW HIGH-SPEED RAIL SYSTEM

Constructing a high-speed rail system requires acceptance challenges from local communities and taxpayers. Reaching an agreement and sharing the key expected benefits with all stakeholders, including the affected populations, before commencing land acquisitions and on-site work, is crucial for ensuring successful delivery later on.

Is it about:

- Reducing travel time between cities?
- Increasing capacity to transport more people on existing corridors?
- Facilitating more long-distance travel routes?
- Promoting a shift from air and road traffic to rail?
- Allocating more existing railways to local passenger and/or freight traffic?

2—BE AMBITIOUS BUT REALISTIC ON THE DELIVERY TIMESCALE

From the earliest opportunity stages to entry in service, a high-speed rail design and construction journey can be up to 20 years. Some specific funding and procurement mechanisms, such as Private Public Partnerships, can allow faster delivery than others, but our experience shows that the main time saving driver is the ability of all public and industry stakeholders to find and agree a mutually beneficial project funding, management, delivery and operating scheme.

3—PERFORM AN EARLY TRANSPORTATION PLANNING STUDY TO CONFIRM THE FUTURE NEEDS

A transportation planning study shall allow to confirm:

- Ridership demand between cities on the route.
- Additional socio-economic leverages to be unlocked (in terms of standard of living, working opportunities, economic and business growth,...).
- Where new stations or the use of existing ones (including upgrade) could be the most relevant.

4—DETERMINE THE OPTIMAL FUNDING AND FINANCIAL STRATEGY

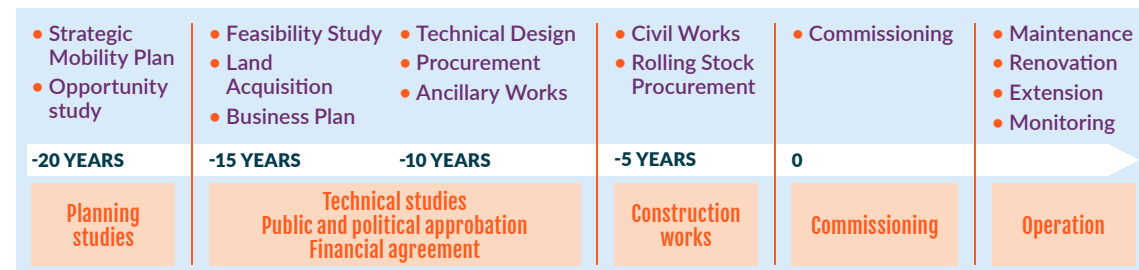
- Conduct upstream financial engineering to estimate investment and operating costs and integrate them into a dedicated business case that also provides an forecasted revenue during service and highlights return on investment forecasts.
- Integrate socio economical profitability.
- Develop a bespoke investment plan, which, in addition to direct public funding, can rely on financing schemes from international financial institutions, banks or other private partners.
- Estimate overall investment costs (Capex), operating costs (Opex) and revenue service fares from train operators.
- Determine appropriate fare levels for users.
- Define stakeholder management, including organizational and governance models.

5—ADOPT A NET-ZERO STRATEGY THROUGH SUSTAINABLE DESIGN AND OPERATION

- Regulatory frameworks and public opinion are more and more demanding on net-zero carbon projects, with an ability to control net GHG emissions throughout the whole project timeline.
- A sustainability strategy developed in close collaboration with subject matter experts, national and local authorities is the key to achieve the reduction of greenhouse gas emissions at all project phases.
 - Dedicated solutions and tools, such as SYSTRA's Carbon Tracker, allow the assessment, optimization, and monitoring of operational emissions at every stage, ensuring the project delivers its Net-Zero commitments.
 - Possibility for projects to satisfy their own needs in energy through renewable energies (Solar panel farms, wind mills, within the project area).



High speed Cairo (Egypt)



6-MAKE HIGH-SPEED RAIL AFFORDABLE CONSIDERING OPERATIONAL AND FUNCTIONAL REQUIREMENTS

- Clearly identify objectives, needs, and technical requirements from the start.
- Translate these into dedicated and clear technical standards for design.
- Control costs through standards.
- Implement as much as possible an already service proven HSR system
- Utilize existing networks for terminal station access, even if it requires speed restrictions.
- Potential upgrade of existing network to allow HS trains to run efficiently on conventional network.
- Limit operational speed to standard values (300-320km per h) to avoid cost overruns.
- Promote efficient Rolling Stock in terms of aerodynamics, weight, accelerating/braking performances.
- Consider intermediate stations only if they significantly improve traffic volumes.
- Minimize the number and length of tunnels, using maximum allowable gradients to reduce tunnel length and cutting depth.
- Avoid unproven innovative solutions that could pose technical risks.
- Propose standardized solutions for structures, promoting precast elements.
- Use proven systems for signaling, OCS, and railway systems.

7-CHOOSE THE RIGHT TECHNICAL SOLUTIONS

- Promote safe, affordable and proven solutions in standards, especially when local standards are insufficient or nonexistent.
- Consider international standards environments, such as European, Asian or North American, and their differing philosophies.
- Adapt international standards to the capacities of the country where necessary.
- Account for interoperability.
- Introduce and manage innovation to meet special requirements, drive better efficiency and tackle obsolescence.

8-INVOLVE OPERATORS AND MAINTAINERS AS SOON AS POSSIBLE

- Is a key partner, focusing on operations and aspects beyond technical ones: human resource management and energy contracts. He may have a broader mandate, including conception, policy, and planning.
- Start thinking about asset management when the investment is being programmed. The consequences of the technical and/or financial options chosen at the start of a projects may last for the next 40 years.
- Invest judiciously in a network (no matter if green field or brownfield) or fleet to get the physical assets needed to achieve stakeholders' objectives, in terms of performance, cost and risk.
- Keep the corrective or preventive maintenance of the assets to a standard compatible with the performance expected all along the lifecycle of the asset.
- Make well-informed decisions regarding maintenance by utilizing digital technology to benefit the physical world, transferring the physical asset to a Digital Twin. Gaining extensive knowledge about your assets improves data analytics and performance insights.

9-DECIDE ON SPEED CHOICE

- Consider the impact of speed (320km/h vs. 200km/h) on design.
- Operational speed affects energy consumption, infrastructure costs, alignment, structure dynamics, ground velocity limits, noise mitigation, and maintenance costs.
- Balance operational speed with project costs.
- Choose track systems carefully, considering all costs related to slab track.
- Carefully assess the consequences on cost and maintenance of a slab track on earthworks in relation with strict long term settlements limitations.

10-START THE DELIVERY AND STICK TO THE PLAN UNTIL THE ENTRY IN SERVICE

- Start the delivery when there is a global alignment on the elements above.
- Set the best efficient organization with the accurate level of governance, responsibility and accountability within the whole engineering and delivery structure.
- Deliver with an 'end in mind' approach: anticipate and mitigate risks related to construction, testing, commissioning, operation and maintenance from day one of design: an HSR shall be designed and built for the end users first, so think always of them!
- Then, time is money, so stick to the plan and think carefully for any change (only if really necessary) until the handover to operation and maintenance is achieved.



Al Boraq in Tangier train station in Morocco



HS2, Colne Valley Western Slopes (England)



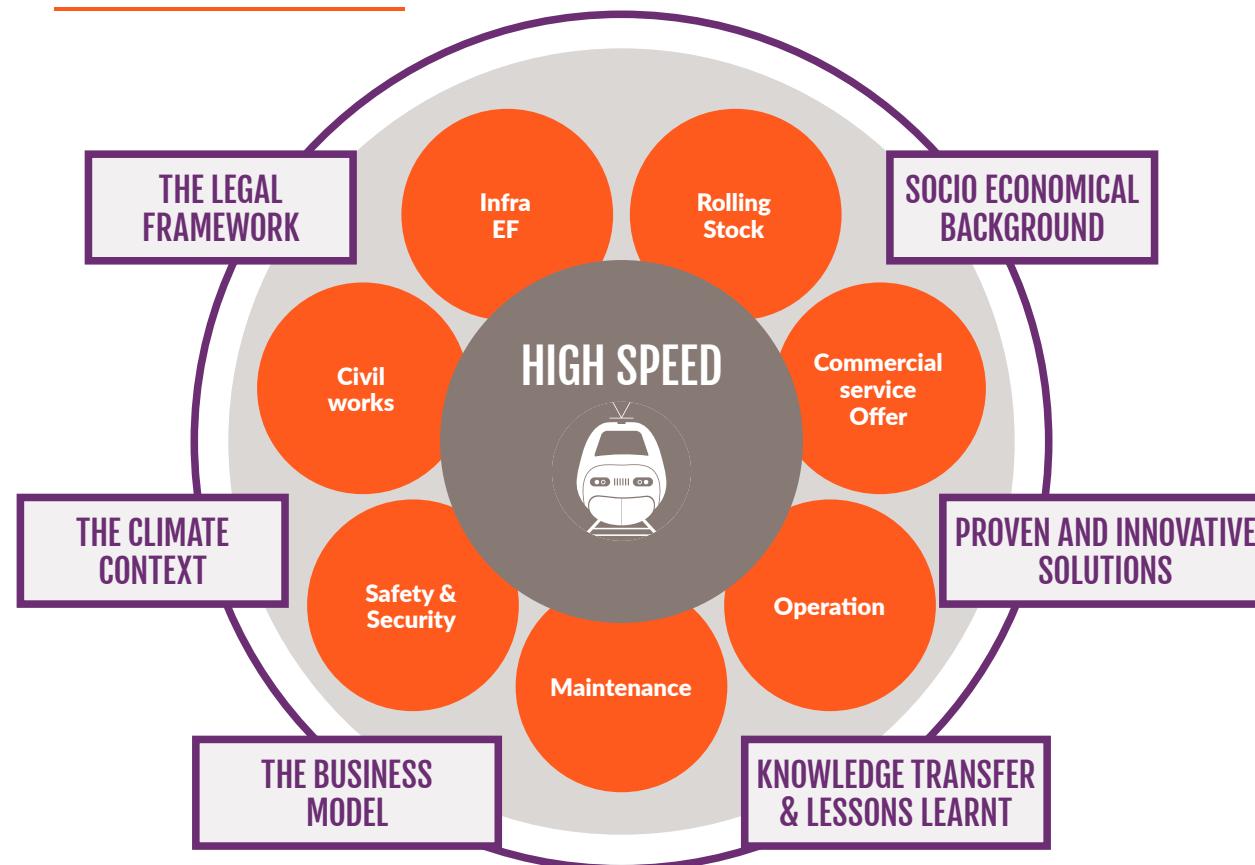
Taiwan high-speed rail

HIGH-SPEED RAIL: A SYSTEMIC APPROACH

High-speed rail (HSR) is not just about fast trains. It's a complex system that relies on the coordination of multiple, interdependent components to ensure success. High-Speed Rail is at the center. This is the core of the system of Environmental, contextual/legal factors and of technical elements. Everything revolves around it and contributes to its effectiveness. SYSTRA has already successfully demonstrated on various worldwide projects it can manage all constituents of this eco-system.

Before land acquisition, SYSTRA provides at early stage concept design to help for the choice of the system.

360° SERVICE, PROVEN ENGINEERING EXPERTISE



WHY SYSTRA IS YOUR TRUSTED AND RELIABLE PARTNER

SYSTRA is a pioneer in high-speed rail, leading the field for over 40 years by planning, designing, overseeing, and testing nearly half of the world's high-speed rail lines. We support projects from the earliest phases, including appraisals, engineering feasibility studies, traffic forecasting, and socio-economic and environmental assessments. We collaborate with clients from early modeling to determining high-speed routes. Our specialists prepare robust patronage forecasts and successful business cases for new routes, line extensions, and stations. We support clients throughout project execution and completion, overseeing construction phases, testing, and commissioning.

SYSTRA teams are committed to advancing high-speed rail to make it more affordable and faster to build, with resilient and easier-to-maintain infrastructure. We continually develop new concepts, such as short-span bridges for train speeds up to 350-400km/h. Innovations include standardizing and prefabricating elements to reduce material consumption, accelerate work schedules, and cut construction costs.

OUR ADDED-VALUE

- Holistic approach, including environmental studies and public consultation.
- Capability to manage the entire project lifecycle, with strong Testing & Commissioning and Operation & Maintenance knowledge.
- Proven ability to mobilise extensive design resources through our international production model.
- Diverse roles: client-side, contractor-side, PMC/delivery, design/construction.
- Through our subsidiary MESEA, we have access to real-time knowledge, feedback and lessons learned of the operation and maintenance on a HSR we have designed and built.
- SNCF legacy and world record in high-speed rail.
- We have helped write the European standards for ultra-high-speed railways and adapt them to local contexts.



Yongsan Station, Seoul (Korea)

WE DELIVER PROVEN HIGH-SPEED RAIL REFERENCES WORLDWIDE

■ PROJECT NOW IN OPERATION
■ PROJECT IN PLANNING OR CONSTRUCTION PHASE



OUR KEY FIGURES

ENGINEERING NEWS-RECORD (ENR) RANKING 2024

#2
MASS TRANSIT & RAIL

#6
TRANSPORTATION

SYSTRA INVOLVED IN

→ **58** NUMBER OF LINES

→ **7,300 KM** LINES IN OPERATION

→ **22,000 KM** TOTAL LINES

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