

SYSTRA AND HIGH-SPEED RAIL: AN ENGINEERING LEADER FOR OVER 40 YEARS WITH LINES IN SERVICE THROUGHOUT THE WORLD



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FOREWORD

SYSTRA is one of the major transport engineering firms in the world and has been the undisputed champion of high-speed rail for over 40 years. A pioneer in high-speed rail since the 1980s, SYSTRA has contributed to the design of half of the high-speed lines currently in service worldwide.

Based on experience gained during the construction of the first French lines, the Group's engineers have exported the excellence of this expertise internationally, to more than ten countries, from Korea to the United States, including the United Kingdom, Morocco, and China, and now Canada, Portugal, and Sweden.

In a growing high-speed market, SYSTRA is one of the few engineering firms in the world that masters all stages of these projects, from preliminary studies to commissioning and maintenance.



«Choosing SYSTRA means choosing a group of excellence which has brought many high-speed lines into service around the world. Thanks to our mastery of the most advanced signalling, power supply and digitalisation technologies, we can offer resilient, safe and high-performance infrastructure. Every day, high-speed rail becomes a key solution for sustainability, population mobility and regional dynamism.»

**Prisca Flattot,
SVP Technical and Operational Performance of SYSTRA**



1. HIGH-SPEED RAIL: A MARKET WITH A PROMISING FUTURE AND A SUSTAINABLE TRANSPORT SOLUTION TO CONNECT THE CITIES OF THE WORLD

High-speed rail is the mobility solution for travelling quickly from city to city in a safe, reliable manner, while minimising environmental impact as much as possible. In the face of climate disruptions and an ever-increasing demand for transport services, it remains more relevant than ever for cities and states, to bring territories closer together and better interconnect populations.

A modern and sustainable solution to the mobility challenges of the 21st century

With programmes launched in Canada, Morocco, Australia, and Poland, high-speed rail is coming back to the forefront. To date, high-speed lines (HSL) are the most efficient, robust, and sustainable solution for interconnecting cities. Trains emit 50 to 70 times less CO₂ than aeroplanes, and a high-speed train filled to 80% capacity represents 370 car trips avoided¹. Additionally, there are notions of utility and environmental efficiency: an HSL helps to decongest road networks and is characterised by a sustainable and lasting infrastructure that can adapt to technological developments.

By bringing territories closer together, high-speed lines help to develop economic opportunities, contributing to the dynamism of the hubs served, with nearly one third of trips made for business purposes².

A rapidly increasing mode of transport

High-speed trains (HST), characterised by an operating speed of at least 250km/h³, reduce distances and bring city centres closer together. For example, it takes 2h18 to travel from Paris to London or from Seoul to Busan, and 45 minutes to reach Reims from Paris or Kenitra from Tangier. Travel times are drastically reduced, enabling efficient journeys that change users' lives.

For more than half a century, high-speed trains networks have been spreading across the planet, in nearly every continent, with a growing number of projects. From 2010 to 2023 in Europe, the number of kilometres of high-speed rail increased by more than 45%, from 8,543km to 12,545 km⁴.

¹ ADEME figures for the 'Grand project du Sud-Ouest', on the routes Paris – Toulouse compared between plane and train.

² 27% of business trips were made by HSL in 2019, according to the 2019 Survey of high-speed train travellers published by the Transport Regulatory Authority.

³ Category defined by the international union of railways (UIC).

⁴ UIC

FiAs of the end of 2024, 16,612km¹ of high-speed rail were under construction worldwide, while the total length of high-speed rail globally was 64,699km⁵. This represents a potential increase of 25% in the total length of high-speed rail worldwide expected in the medium term, across all continents except Latin America.

This also comes in the context of a re-evaluation of air travel for domestic and short haul trips⁶ (less than 3 hours of total travel), along with continued strong investments in the entire public transport market, with an expected growth of 8% in 2025⁷.

⁵ UIC

⁶ Hitachi Rail survey 'A new era of long-distance train travel' <https://www.hitachirail.com/press/#/pressreleases/a-new-era-of-long-distance-train-travel-3385974>.

⁷ 8% overall annual growth in railway infrastructure investments expected by 2025 (Global Data)

EXPERT WORD

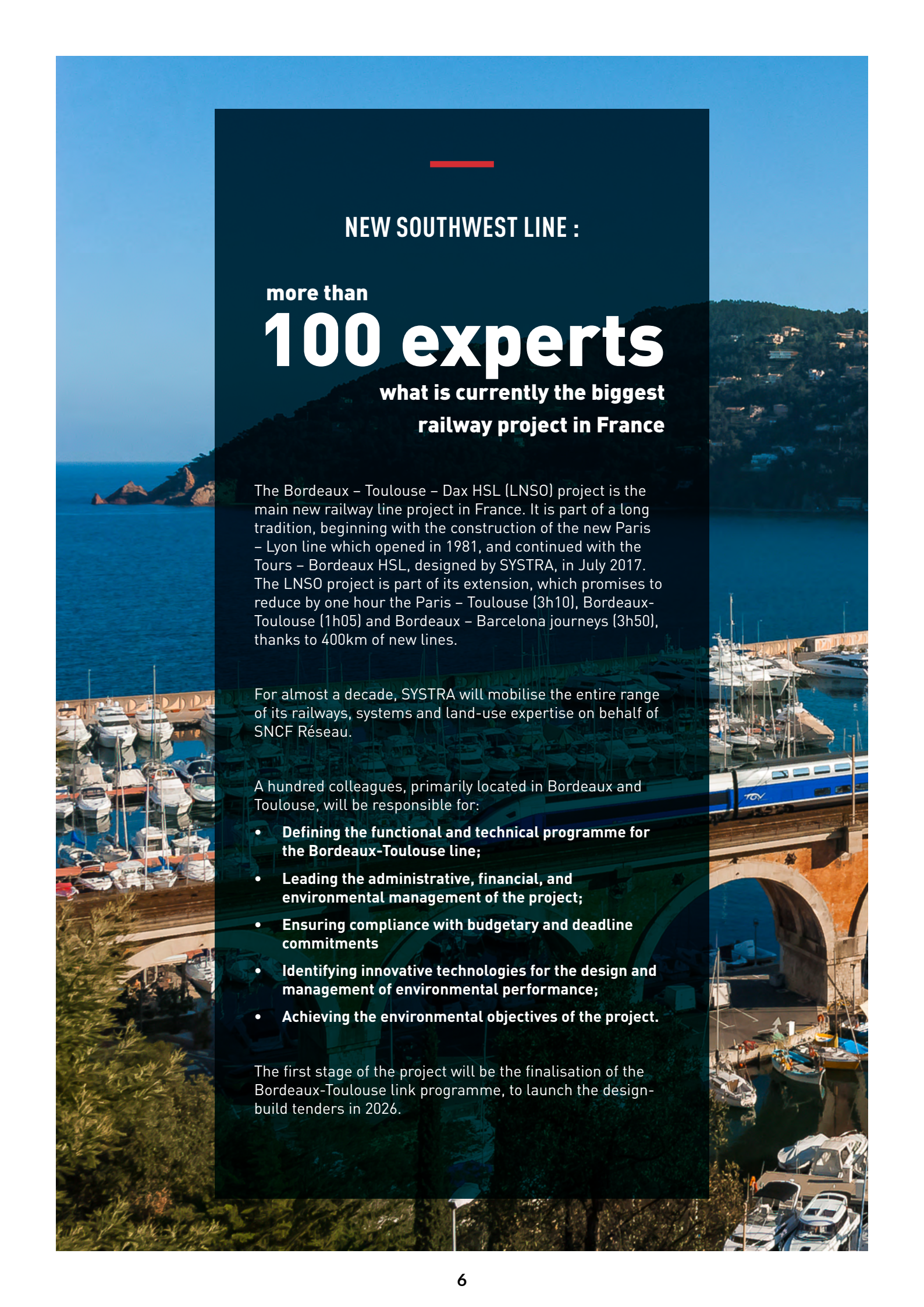
"With Canada's future high-speed network, Eastern Canada, which concentrates 40% of GDP and represents a major tourist area of the country, will fully benefit from faster city-to-city connections for the 18 million residents of the region, including over 700,000 students."

**Dave Spagnolo, CEO,
SYSTRA Canada**

THE NEW GOLDEN AGE OF HIGH-SPEED RAIL

SYSTRA is responding to this new golden age of high-speed rail with an increasing number of projects on all continents. In 18 months, the Group has recorded several major successes around the world:

- **In France**, with the general and technical project management assistance contract for the entire New Southwest Line (LNSO) (Bordeaux-Toulouse) on behalf of SNCF Réseau (GPSO agency). Our teams will be involved in all phases of the design and construction of this new line, which will reduce travel times between the major cities in the southwest of the country.
- **In Morocco**, with the project management assistance (AMO) contract with the extension of the high-speed line between Tangiers et Kenitra up to Marrakech (430km, in consortium with Egis and Novec), and for which works began in the spring of 2025.
- **In the United States**, in California, with the contract for the design of the track and catenary of the main section of the high-speed line linking Merced to Bakersfield (275 km, in a joint venture (JV) with TYP SA), which will form the backbone of the future Californian high-speed network.
- **In Canada**, with the Alto project, which aims to link the cities of Quebec and Toronto over more than 1000km. SYSTRA is a member of the Cadence consortium, selected by the Canadian authorities in March 2025 to carry out the project, which will put Montreal three hours from Toronto, with travel times reduced by half.

The background image is a composite of two photographs. The left side shows a coastal town with a marina filled with white sailboats and a blue sea under a clear sky. The right side shows a blue and white high-speed train crossing a stone arch bridge over a river, with a hillside in the background.

NEW SOUTHWEST LINE :

more than
100 experts
what is currently the biggest
railway project in France

The Bordeaux – Toulouse – Dax HSL (LNSO) project is the main new railway line project in France. It is part of a long tradition, beginning with the construction of the new Paris – Lyon line which opened in 1981, and continued with the Tours – Bordeaux HSL, designed by SYSTRA, in July 2017. The LNSO project is part of its extension, which promises to reduce by one hour the Paris – Toulouse (3h10), Bordeaux-Toulouse (1h05) and Bordeaux – Barcelona journeys (3h50), thanks to 400km of new lines.

For almost a decade, SYSTRA will mobilise the entire range of its railways, systems and land-use expertise on behalf of SNCF Réseau.

A hundred colleagues, primarily located in Bordeaux and Toulouse, will be responsible for:

- **Defining the functional and technical programme for the Bordeaux-Toulouse line;**
- **Leading the administrative, financial, and environmental management of the project;**
- **Ensuring compliance with budgetary and deadline commitments**
- **Identifying innovative technologies for the design and management of environmental performance;**
- **Achieving the environmental objectives of the project.**

The first stage of the project will be the finalisation of the Bordeaux-Toulouse link programme, to launch the design-build tenders in 2026.



IN ADDITION TO THESE MAJOR CONTRACTS, SYSTRA HAS WON PROMISING ASSIGNMENTS IN COUNTRIES WHICH ARE INVESTING IN HIGH SPEED:

PORTUGAL

In **Portugal**, with the awarding of the section between Porto and Oñá, beginning the first HSL in the country which will link Porto and Lisbon by 2030. SYSTRA Ibérica has been supporting the LusoLAV consortium since 2023 for the catenary studies, de power supply and stations, and then the systems integration.

SPAIN

In **Spain**, with the engineering of a section of the Cantabrian - Mediterranean High Speed Railway Corridor, which will improve links between the north and south of Spain, thus promoting regional and national mobility.

INDIA

In **India**, with the ticketing project for the Mumbai-Ahmedabad High Speed Rail Corridor, the aim of which is to enhance the passenger experience by enabling a more efficient and fluid management reservations.

AUSTRALIA

Finally, in **Australia**, SYSTRA is in a consortium with Arup to plan the use of the country's future high-speed network, notably on the Melbourne - Brisbane stretch, on behalf of the High Speed Rail Authority. Eventually, this project will transport 14.9 million passengers per year between Sydney and Newcastle, to desaturate the existing line, the most congested in the country, and to connect the main activity hubs of the east coast of Australia via Canberra, Brisbane, and Melbourne.

2. 40 YEARS OF HIGH-SPEED PROJECTS SIGNED BY SYSTRA SUCCESSFULLY PUT INTO SERVICE WORLDWIDE

SYSTRA has been a pioneer in high-speed rail since the 1980s and has contributed to the design of half of the high-speed lines in service and under construction in the world .

These achievements help make the French engineering group an international specialist in high-speed rail, and one of the few engineering firms capable of managing an HSR project from the preliminary phases to commissioning and maintenance. An overview of a planet that is transported at high speed thanks to SYSTRA.

Emblematic projects in Europe

The first positive impact of high-speed trains is to bring territories closer together. In Europe, the first British high-speed line, HS1, opened in 2007, has made it possible to reach London in 2 hours and 20 minutes from Paris and 2 hours from Brussels, through 109km of high-speed line between the Channel Tunnel and the British capital.

SYSTRA mobilised up to 250 experts and technicians for this project, the first new line built in the UK in a century, during 12 years of project work that led to the design and construction of more than 25km of tunnels and over a hundred engineering structures. Thanks to high speed, the United Kingdom has come closer to the rest of Europe.

Connecting Switzerland to the European Union was the challenge of the Rhine-Rhône HSL, which brings the French, German, and Swiss networks closer together at speeds of up to 320 km/h between Strasbourg and Dijon.

SYSTRA, the technical project management assistant, was at the heart of the project's coordination for signalling, interface management, conducting tests, and developing operational rules and safety documents. This line has reduced travel time by about half an hour on trips from Paris to Basel/Zurich and Dijon to Strasbourg and strengthened the connections between France and Switzerland.

⁸ *Excluding China.*



An expertise that exports internationally

In addition to having contributed to the definition of European standards for high-speed rail, SYSTRA has been at the heart of creating networks around the world.

Thus, in Asia, SYSTRA has assisted China in several high-speed rail projects to provide our technical support to constructors and the China Academy of Railway Sciences (CARS). Its assignments notably focused on civil engineering and systems checks for the Beijing – Tianjin line between 2005 and 2008, and on construction supervision and prefabrication site management for the Zhengzhou – Chongqing link between 2016 and 2019. By ensuring quality control, safety inspections, audits, and independent certification, SYSTRA has ensured that these connections are of the highest level of excellence.

For the Taipei – Kaohsiung HSL in Taiwan, SYSTRA teams carried out planning and feasibility studies from 1990 to 2007, up to independent certification and preparation for operation and maintenance, enabling the concessionaire THSRC to put this line into service without technical difficulties or delays. As the largest transport project designed on the island, this connection links all economic hubs, serves three-quarters of the population, and has helped alleviate congestion on the road network in the western plain.

To create the high-speed KTX (Korean Train eXpress) network in South Korea, SYSTRA was alongside the operator Korail and the constructor Alstom for a quarter of a century, from 1989 to 2015. SYSTRA got involved from the preparation of the calls for tenders, then in the provision of the Core System, which covers signalling, track laying, overhead lines, and rolling stock, and then in the project management assistance for the civil engineering of the Seoul – Busan line, which opened in 2004. It was on this line that we deployed the technique of standardised viaducts with prefabricated spans to reduce construction time, and Korea became the first country to choose SYSTRA for high speed in Asia, before Taiwan and China.

⁹ Taiwan High Speed Rail Corp.

Speed records

To obtain certification for high-speed lines, SYSTRA oversees test runs and validations prior to commissioning. In this context, the Group has participated in speed records achieved on the European continent, in France, and in Africa, in Morocco. On April 3, 2007, it was on the HSL Est Européenne (East European HSL) phase 1 designed notably by SYSTRA that the world speed record on rail was achieved, at 574.8km/h, on the new line connecting Paris to Baudrecourt.

Ten years later, in 2017, as part of the commissioning of the Kenitra – Tangiers line, the tests of the first high-speed line on the African continent reached 335km/h, a record that confirms the quality of the infrastructure delivered to the National Railway Office, for which the same qualification measures and practices were followed, comparable to those of high-speed lines built in France.

HALF A CENTURY OF HIGH-SPEED EXPERTISE IN FIGURES

The contribution of SYSTRA to the rise of high-speed rail worldwide is essential. And these figures prove it:

- More than **40** years of expertise in high speed
- SYSTRA has contributed to **1 in 2 LGVs worldwide** (excluding China)
- **574.8km/h**: world rail speed record achieved in 2007 on an HSL designed by SYSTRA
- **58** HSL created (studies, construction, in service)
- More than **7,300km** of HSL in service
- **More than 22,000km** of HSL designed in total (in service or submitted as designs)
- **1 billion**: number of passengers on the Korean KTX high-speed network over 20 years





3.

THE SYSTRA SIGNATURE: MASTERING ALL THE EXPERTISE OF THE HIGH-SPEED RAIL ECOSYSTEM

The experience gained by SYSTRA in France and around the world enables it to master all technical solutions on the market and to undertake all types of assignment, both for infrastructures and systems. As an expert in the design and integration of HSL, SYSTRA supports its clients throughout the entire lifecycle of high-speed infrastructures: from the preliminary phases to the maintenance and modernisation of existing infrastructures, including design, construction, operation, and commissioning.

Advise our clients from the early stages of the projects

When creating a new HSL, SYSTRA supports its clients from the route determination phases and modelling projects and manages the overall framework of the HSL ecosystem: regulations, climatic environment, economic and commercial model, socio-cultural environment, existing networks, and historical feedback.

SYSTRA assists its clients according to the most suitable forms of contractualisation for the project's needs: integrated project management, project owner assistance, independent certifier, stakeholder in a public-private partnership (PPP), or delivery partner in Design & Build.

Depending on the projects undertaken worldwide, we fulfil these different roles:

- Stakeholder in the construction and maintenance of the Tours-Bordeaux HSL within the companies COSEA and MESEA alongside VINCI;
- Since 2019, SYSTRA has been a tier 1 partner in the design and construction of the Old Oak Common railway interconnection hub in North London alongside VINCI and Balfour Beatty;
- And within the Cadence Group, SYSTRA is one of the 5 partners in the design-build project for the 'Alto' high-speed connection between Toronto and Quebec.

To support Portugal in the creation of its first high-speed rail lines, SYSTRA has signed a letter of intent to strengthen technical cooperation with 'Infraestruturas de Portugal', the country's transport infrastructure manager.

EXPERT WORD

"SYSTRA is at the heart of the first Portuguese high-speed rail line. Our international production model allows us to be best positioned to meet the project's budgetary and timing criteria, while excelling in technical prerequisites and references. This project will serve as a valuable benchmark for establishing a sustainable presence in the country."

Joan Serrano, Managing Director of SYSTRA Ibérica



SYSTRA'S ADDED VALUE: EXPERTS PRESENT THROUGHOUT THE WORLD AND MOBILISED SIMULTANEOUSLY

SYSTRA's international organisation is one of its major assets: each subsidiary, each team can call upon experts from around the world to assist them with their project. SYSTRA also has a network of expertise in high-speed rail with specialists who have participated in projects in France, South Korea, Morocco, Taiwan, and China.

Thus, to successfully create the new HS2 high-speed line between London and Birmingham, SYSTRA brought together teams based in 9 different countries, representing more than twenty nationalities, totalling over 1,000 employees at the peak of mobilisation.

Our teams are also at the forefront of future railway trends, whether it be with very high-speed catenary studies (the V360 catenary of SNCF Réseau) for the HS2 network, the next generation of signalling system (ERTMS Level 3), or the upcoming radio communication standards (Future Railway Mobile Communication System) in Europe, the deployment of which will take place during the 2030s.

Digital, the engine of acceleration and optimisation of high speed

The digital engineering teams at SYSTRA are at the heart of reducing project completion times and real-time optimisation of plans and deliverables. BIM (Building Information Modelling) models are the sustainable foundation of projects as a digital twin of the built infrastructure. They enable acceleration and reliability in the design phase, real-time visualisation of costs and schedules, and preparation for the operation and maintenance phase by obtaining an exact replica of the railway assets.

Applications have been developed internally to obtain these results:

BIMinOneClick

A unique collection of BIM linear modelling tools that uses a parametric approach to quickly design infrastructures and systems along a route, model all components of a project, based on a database and a professional library of standardised BIM objects.

Pablo

A framework for the creation and structuring of BIM data to centralize information about an asset for its operation and maintenance. This framework, necessary for the digital twin, facilitates the transfer of information between the construction phase and the commissioning of an infrastructure.

Carbontracker

A decision support tool combined with a measurement, management, and control solution for carbon emissions at every phase of a project, to make our projects as sustainable as possible in the face of climate disruptions.

GIS tool

A governance system for all data, based on mapping technology from the company Esri, to connect BIM data from Geographic Information Systems (GIS) in order to enhance the design of linear infrastructures and enable the establishment of platforms to aid public consultations.



THE SWEDISH EXAMPLE

In Sweden, SYSTRA has been supporting the Swedish transport administration, Trafikverket, since 2015 on the Ostlänken project, the largest ongoing railway project in the country. This is the first high-speed line (250km/h) serving the east of the country between Stockholm and the railway hub of Linköping. Public consultation is a fundamental step in this project, as the Swedish authorities want to ensure its acceptance by the population. In this context, SYSTRA has created 3D modelling that was used for a virtual reality film of the line, with construction expected to begin in 2025.

SYSTRA is also involved in the design of a 15km section including the Kölmdalen tunnel, which is 8km long, and will become the second longest underground structure in the country. From the management of the BIM model to constructability, our experts are carrying out execution studies for earthworks, preparation of the work, water management, drainage, and access galleries, in order to meet the ambitious goal set by Trafikverket: to reduce the project's CO2 emissions by 62% compared to conventional railway construction.

Concrete solutions to support the creation of infrastructures

During the construction phase, SYSTRA acts as the conductor of high-speed projects, whether alongside our clients as project management assistant or project management consultant to monitor and control all implementation parameters, or as project manager or general consultant to oversee all execution tasks.

Since more than half of the cost of an HSL is attributable to earthworks and civil engineering, SYSTRA pays particular attention to these areas by advising on the use of innovative solutions such as the installation of an asphalt gravel sublayer, a base structure for the track platform that allows for less material consumption, and enables a significant portion of the work to be carried out as if it were a road, which facilitates the work of site teams and their movement across the track area.

To rapidly implement railway lines, SYSTRA filed a patent for a slab laying solution called 'Slab Track,' suitable for both the renewal of existing lines and the creation of new lines. Entirely prefabricated, the Slab Track is the only slab track designed with a low carbon reinforced concrete structure that has a reduced environmental impact.

The prefabrication of infrastructures also includes civil engineering works: the construction of the HS2 high-speed rail line in the UK includes several monumental concrete crossings, which are preassembled near the site before being moved to their final location, thus reducing traffic disruptions on roads and railway lines.

Accompany all development phases

Our clients trust us to represent them and supervise all their high-speed projects. Thus, in Egypt, the National Authority for Tunnels entrusted us in 2021 with the assignment of Project Management Consultancy to oversee all the construction sites of the new Electric Express Train network, which plans to build 1,825km of high-speed rail in the country and 21 stations. Daily, SYSTRA teams monitor, verify, and manage all the construction sites to ensure their progress and the quality of the work delivered.

On the SEA project for the Tours-Bordeaux HSL, SYSTRA has provided training for over 5,000 construction workers to ensure the highest standards of quality and safety on the line's construction. Today, SYSTRA France still maintains a unique service offering near the Poitiers construction site, originating from the SEA project, called 'SYSTRA Academy,' where several thousand railway operators are trained each year.

Once the construction sites are completed, SYSTRA is one of the few engineering firms in the world to handle the dynamic testing phases of integration and trial runs in preparation for the commissioning of high-speed lines. These tests aim to certify the quality of the infrastructure and to provide the operator with the safety file, prerequisites for the launch of commercial operations.

Maintenance, increasingly innovative solutions to extend the lifespan of infrastructures

SYSTRA also intervenes during the operation, maintenance, and modernisation phases of high-speed rail, offering a wide range of services for railway network operators. In advance, we prepare maintenance with digital predictive maintenance solutions to maximise infrastructure availability rates and reduce maintenance costs. SYSTRA also advises the use of drones during maintenance inspection phases, allowing for the safety of agents while optimising their response time and maximising the quality of asset management deliverables.

Following the same safety requirements for maintenance interventions, SYSTRA has developed an automatic announcement system with Zöllner that allows the teams on site to be alerted of an incoming train. This system has been successfully tested on the LGV SEA (Tours-Bordeaux), enabling the extension of intervention windows on the tracks without compromising the safety of the agents.

Finally, maintenance is a daily mission for SYSTRA on the LGV SEA, where the company is a partner of MESEA alongside VINCI (30/70) to maintain the line throughout the 340km of HSL and its connections, from the commissioning until 2061.



THE MODERNISATION OF THE HSL PARIS-LYON, OR HOW TO MODERNISE THE MOST FREQUENTED HSL IN EUROPE

Every year, over 50 million travellers use the Paris-Lyon line, also known as LN1. To increase the number of trains by 25%, SYSTRA is assisting SNCF Réseau in the migration to the interoperable ERTMS¹⁰ system. This modernisation will allow trains to run every 2 minutes and 30 seconds instead of every 4 minutes and increase capacity from 13 to 16 trains per hour in each direction by 2030.

This project represents a world first in terms of its technicality and scale, and it is the first time that SNCF Réseau is outsourcing such a significant number of assignments to an external engineering firm. Such migrations of high-speed lines to the ERTMS system will multiply, both in France and worldwide. SYSTRA once again positions itself at the forefront of technology and the needs of network operator clients.

¹⁰ European Rail Traffic Management System level 2.

Preserving biodiversity: a challenge met by HSL

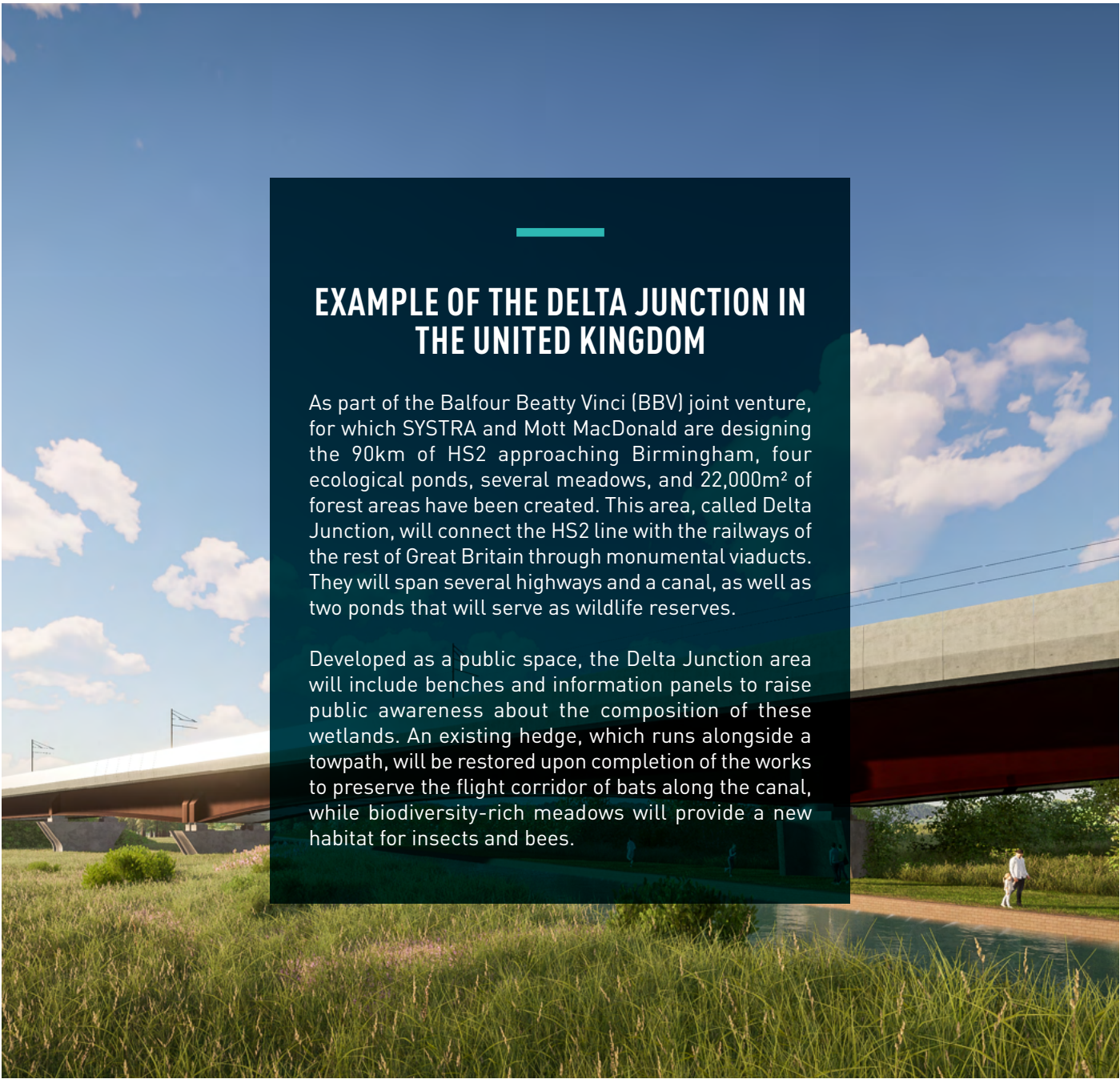
Throughout the routes, the preservation of biodiversity is subject to impact studies and conservation measures, which even include optimising the robustness of the infrastructure against climatic hazards.

Thus, for the Nîmes-Montpellier bypass, the line underwent hydraulic transparency of its route to allow water to spread in case of flooding without risking damage to the line, built on rail bridges. Similarly, for the South Europe Atlantic line between Tours and Bordeaux, the modal shift from air travel to high-speed train represents a savings of 50,000 tonnes of CO2 per year: the line includes 3,500 hectares of environmental compensation measures and 223 protected species, for which 800 wildlife crossing

structures have been created, 138 ponds reinstated nearby, along with 48km of hedgerows and 1,310 hectares of compensatory woodlands¹.

This environmental requirement for high-speed rail has set a precedent, particularly in the United Kingdom, where each phase of the High Speed 2 (HS2) project design mobilises 10 disciplines, ranging from hydrology for the preservation of water resources and flood risk prevention, ecology and archaeological preservation as part of cultural heritage for landscape management, to acoustic and vibration engineering for managing noise pollution, as well as the preservation of agriculture and soils.

"LISEA, file « LGV SEA, a railway line that fits into its environment », 2018



EXAMPLE OF THE DELTA JUNCTION IN THE UNITED KINGDOM

As part of the Balfour Beatty Vinci (BBV) joint venture, for which SYSTRA and Mott MacDonald are designing the 90km of HS2 approaching Birmingham, four ecological ponds, several meadows, and 22,000m² of forest areas have been created. This area, called Delta Junction, will connect the HS2 line with the railways of the rest of Great Britain through monumental viaducts. They will span several highways and a canal, as well as two ponds that will serve as wildlife reserves.

Developed as a public space, the Delta Junction area will include benches and information panels to raise public awareness about the composition of these wetlands. An existing hedge, which runs alongside a towpath, will be restored upon completion of the works to preserve the flight corridor of bats along the canal, while biodiversity-rich meadows will provide a new habitat for insects and bees.



SYSTRA

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