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MAY | AUG 19

CONSULTANCY
Tracks for the Central Bioceanic Railway Corridor

ARTICLES

EDITORIAL

Expanding networks, improving services

Our work in designing solutions aimed at promoting the improvement of mobility through transport networks to increase the quality of life of people and economic competitiveness of territories prompts us, on this occasion, to highlight on the front cover of this issue a project carried out for the Peruvian government to develop the future Central Bi-Oceanic railway (CFBC), a corridor whose purpose is to transport passengers and freight across South America and promote trade between Peru, Bolivia and Brazil.

Also abroad, our experience in planning has led to our participation with Adif as part of the advisory services that Spain is providing to India in relation to its plan to develop an ambitious high-speed rail network, which has been manifested in projects such as the one covered here concerning a feasibility study on a 772-kilometre high-speed line between Mumbai and Nagpur. We also highlight projects such as our recent collaboration on New York's future Moynihan station and the development of a transport observatory for the Brazilian government, not to mention our proactive participation again at the World ATM Congress, a major international air traffic management trade fair.

In Spain, our commitment to forging ahead with a more efficient, sustainable and safe transport model, thus promoting continuous improvement in the quality of services provided, is also reflected in the goals of two projects carried out in Terminal 1 of Barcelona-El Prat Airport, a terminal that celebrates its tenth anniversary in June of this year 2019. The terminal's south pier redevelopment and enlargement project will increase its capacity, and the new tunnel that will extend Line 2 of Barcelona's c network will make it possible for more than 8 million passengers to travel from the Sants station in just 19 minutes. Lastly, we cover the improvements that are being made to the Port of Valencia and to the A Coruña railway station, works that will also contribute to these goals of quality and competitiveness.

We close this issue with a space on corporate social responsibility that features a report on the sustainable development goals of the United Nations 2030 Agenda for Sustainable Development, which Ineco has integrated into its strategy and which we would like to share with our readers. ■

"We continue to forge ahead with our firm commitment to connecting people in an efficient, sustainable and safe way"

CARMEN LIBRERO
President of Ineco

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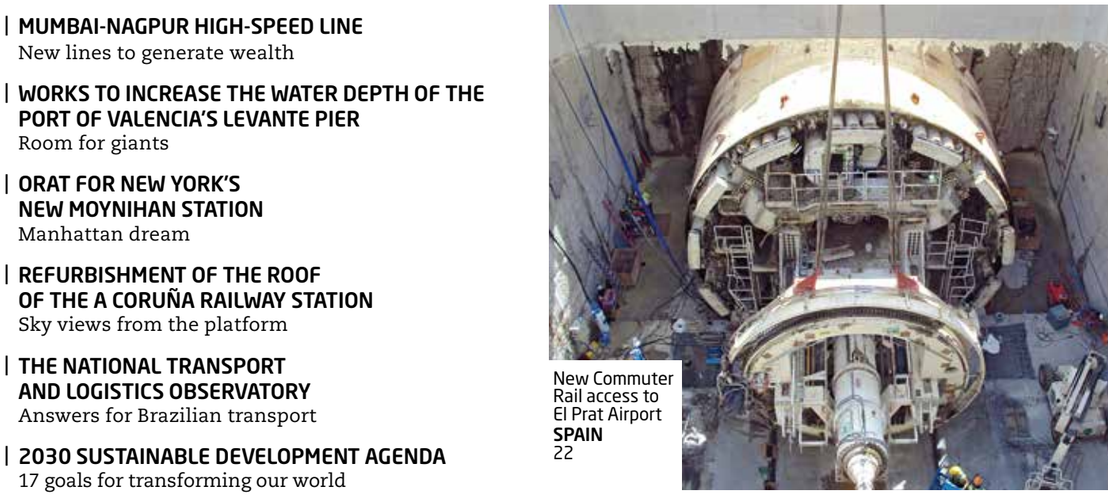

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TERRITORY THROUGH WHICH THE CFBC WOULD RUN CLOSE TO ILO, PERU. PHOTO_FRANCISCO ORTIZ.

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EUROPE

INECO JOINS THE RAIL BALTICA PROJECT, A CORRIDOR THAT WILL LINK NORTHEASTERN EUROPE

The company has been awarded two contracts that are part of the Rail Baltica project, a modern high-speed rail corridor that will link the Baltic Republics to the Trans-European Transport Network (TEN-T). The new infrastructure will connect Poland to Finland via Estonia, Latvia and Lithuania with an 870-kilometre double-track railway line (213 km in Estonia, 265 in Latvia and 392 in Lithuania).

One of the contracts involves the definition of a strategy to implement the energy system and, the other, the definition of maintenance facilities along the entire line. Both projects will be carried out in consortium with the Spanish company Ardanuy.

USA

IMAGE_TEXAS CENTRAL

SUPPORTING RENFE AND ADIF ON THE TEXAS BULLET TRAIN

Texas Central Partners, the private developer of a high-speed project that will link the cities of Dallas and Houston, has chosen Renfe and Adif as strategic partners for the operation and maintenance of the 379-kilometre line. Ineco, as a state-owned company in the Fomento Group, is providing technical assistance to Renfe Operadora in relation to the study and analysis of the documentation and technical parameters for the design, construction, operation and maintenance of the so-called Texas Bullet Train. It is a ground-breaking project in the US which involves connecting North Texas with Houston in less than 90 minutes, with an intermediate station in the Brazos Valley. The stations will be located next to road and public transport networks.

AUSTRALIA

FIRST RAILWAY CONTRACT

Ineco will be participating in the modernisation of Sydney's commuter rail network in Australia, operated by Sydney Trains. In its role as systems integrator, Ineco will be in charge of supporting Transport for New South Wales (TfNSW) in the definition, integration and implementation of new railway systems for the network, together with Network Rail Consulting, Acmena and The Go-Ahead Group.

The programme consists of three lines of action: updating of the entire signalling network to ETCS level 2; implementation of the automatic train operation (ATO) driver assistance system; and installation of a railway traffic management system to improve the efficiency of service and handling of incidents throughout the entire network.

INTERNATIONAL

PROJECTS FOR GRUPO AEROPORTUARIO DEL PACÍFICO

Ineco is preparing master development programmes for the 2020-2034 period on behalf of the twelve airports of Grupo Aeroportuario del Pacífico (GAP), which is partly owned by Aena Internacional: Bajío, Aguascalientes, Hermosillo, La Paz, Los Mochis, Morelia, Mexicali, San José Del Cabo, Manzanillo, Tijuana, Puerto Vallarta and Guadalajara. For the latter two airports, functional terminal designs are also being produced, something that has already been done for the Tijuana terminal.

The company began preparing these plans in 2003 for the 2005-2019, 2010-2024 and 2015-2029 periods. GAP has also been selected by the Jamaican government as a provisional preferred bidder to operate, modernise and expand Norman Manley International Airport in the capital city of Kingston for 25 years. Ineco provided support in the drafting of GAP's technical proposal, which was selected.

PHOTO_COURTESY OF JAMAICA AVIATION SERVICES

COLOMBIA

METRO DE MEDELLÍN MODERNISES ITS FLEET OF TRAINS

Metro de Medellín has decided to modernise its fleet of 42 first-generation trains. Manufactured by MAN and Siemens AG, they are close to the end of their 30-year service life. In 2016, Ineco carried out a viability study of the project, and is now in charge of supervising the work, which will involve complete internal and external refurbishment of the trains at half the cost of buying new rolling stock, according to Metro de Medellín.

The modernisation includes replacing the powertrain with a state-of-the-art DC/AC system, changing the existing auxiliary power supply and air production systems for new equipment with greater energy efficiency, installing air conditioning units in the cabin and updating the trains to a more modern and contemporary design (interior and exterior), as well as other improvements that will provide these trains with an additional 20 years of service life. In mid-2018, Metro de Medellín also took delivery of 38 new trains manufactured by the Spanish company CAF, all supervised by Ineco.

In the image, Ineco engineers Pablo Bielsa, Manuel Francisco and Jon Aizkorbe at Metro de Medellín's facilities in the municipality of El Bello.

A MASTER PLAN FOR THE LIMA AND CALLAO METRO

PHOTO_METRO DE LIMA

PERU

The Peruvian capital will soon have a public transport master plan drafted by Ineco and another Spanish engineering company, Typsa. The two companies won an international tender called by Peru's Autonomous Electric Transportation System Authority (AATE), part of the Ministry of Transport and Communications, with the cooperation of the Inter-American Development Bank (IDB). The plan, which has a time horizon of 2050, will analyse demand, define a fare policy and determine the location of the metro's interchange stations with future suburban lines. It will also include master plans for the metro and other transportation systems (bus and metrobus), and strategic environmental assessment of the projects, among other aspects.

CHILE

REFURBISHMENT OF METRO DE SANTIAGO'S NS74 TRAINS CONTINUES

Metro de Santiago has commissioned Ineco to carry out detailed engineering on the refurbishment of its Alstom NS74 trains, the first to operate in the city's suburbs. The project involves a total of 35 trains with pneumatic running gear, a total of 245 carriages. Manufactured between 1974 and 1981, they have reached the end of their service life but are being refurbished, a process that began in 2011 and will provide them with another 20 years of operation.

Since then, Ineco has been providing services to Metro de Santiago to supervise the entire process, which includes replacement of engines, installation of new HVAC and door closure systems, renovation of interiors and fitting of passenger information devices, in addition to corridor connections between carriages.

CHILE

NEW RAILWAY REGULATIONS

Chile's state railway company, EFE, has awarded Ineco, together with the company Louis Berger, a contract to draft its new technical regulations. The new legal framework, which is expected to be ready by the beginning of 2020, will regulate all aspects of rail activity, from signalling to stations, through rolling stock, tracks and safety.

EUROPE

AN ERTMS MANUAL FOR TRAIN DRIVERS

Ineco has been commissioned by the European Railway Agency (ERA) to draft a manual to assist train drivers to operate any European train equipped with the ERTMS signalling system. In the image, Ineco's Alfonso Lorenzo and Silvia Domínguez at the offices of the ERA in January for the launch meeting of the project, which also involves organisation of ERTMS training and train driver certification.

UNITED KINGDOM

A TRAFFIC STUDY FOR AN HS2 STATION IN LONDON

WSP, responsible for the design of the new Old Oak Common HS2 high-speed station, has commissioned Ineco to audit and supervise pedestrian movement modelling of its future users. The station, located in northwest London, will begin operations in 2026 and is expected to handle an estimated traffic of 250,000 commuters every day.

FOTO_CORTESÍA WSP

COLOMBIA

AIRPORT PLANNING

Last December, Ineco, in consortium with the Colombian consulting firm Concol (now WSP), presented Aerocivil, Colombia's aeronautical authority, with the master plan for the Germán Olano de Puerto Carreño Airport (Department of Vichada) and the planning outlines for the San Bernardo de Mompox (Bolívar) and Contador de Pitalito (Huila) airports. Ineco has extensive experience in airport planning in Spain as well as in other countries, including Colombia, where its first work dates back to the 1970s.

PERU

THE IQUITOS AIRPORT RUNWAY UPGRADE PROJECT

Aeropuertos de Peru, the operator of Iquitos Airport in the northeast of the country, has announced the award of its Air-side Upgrade and Maintenance Project (PRMLA) to a consortium headed up by Ineco and the Peruvian engineering company HOB. The project consists of drafting a technical dossier for the airport's runway, taxiway and apron improvement works. Coronel FAP Francisco Secada Vignetta International Airport is of great strategic importance for the city of Iquitos and its half a million inhabitants because it is located in the middle of the Amazon rainforest and there is no access by land, only by river and air.

WORLD ATM CONGRESS 2019

BRAINS AND BRAWN AT WAC 2019

The 7th edition of the World ATM trade fair, held in Madrid in March, was another opportunity for the European and Spanish aeronautical engineering industries to show off their muscles. In an increasingly congested airspace, the struggle to be at the forefront of advances in global air traffic management is unquestionably geared towards improving the operational safety, efficiency, profitability and environmental sustainability of ATM systems.

The annual World ATM Congress (WAC) event plays host to product demonstrations and launches, contract closures and networking opportunities, together with a busy schedule of conferences and high-level meetings. This year, a total of 225 exhibiting companies and 7,500 delegates from 130 countries took part. Every year, the World ATM Congress brings together around a hundred air navigation service providers (ANSPs), product developers, leaders and experts in the aviation industry, government representatives, manufacturers and industry suppliers from around the world.

Organised by the Civil Air Navigation Services Organisation (CANSO) –of which ENAIRE (formerly Aena) is a founding member and which brings together air navigation service providers from around the world– in partnership with the Air Traffic Control Association (ATCA), an association that represents the air traffic control sector, the World Air Traffic Management Congress is an indispensable event that Ineco has been attending for almost 20 years.

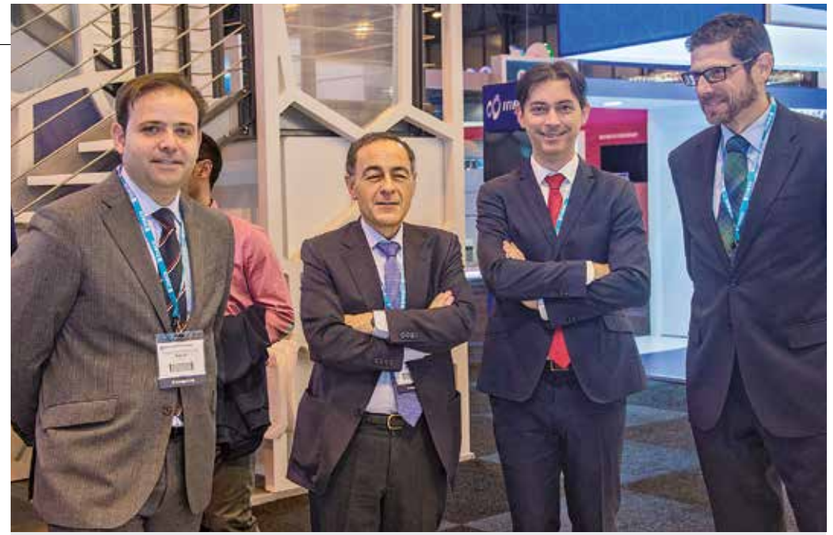
The Ineco, ENAIRE and Senasa stand at the 7th edition of the World ATM fair held in March in Madrid.

In the image, from left to right, next to the Ineco stand at WAC 2019, Ineco's deputy director of IT Solutions and Consulting, Ignacio Martínez, and president, Carmen Librero, show the Secretary of State for Infrastructure, Transport and Housing, Pedro Saura, the company's NAVTOOLS software with a virtual reality headset.

THE GALILEO SYSTEM: THE BRIGHTEST STAR

Galileo is the flagship project of European satellite navigation: a Global Navigation Satellite System (GNSS) that will boast a total of 30 satellites by 2020 –26 of which are already in orbit– managed by the European Global Navigation Satellite Systems Agency (GSA). Galileo is compatible and interoperable with systems such as the US's GPS and Russia's GLONASS, and will offer an unprecedented improvement in performance in terms of precision, resilience and robustness.

In 2016, the GSA entrusted its operation and maintenance to a consortium led by Spaceopal for the following 10 years. Spain is part of this consortium, through a group of public enterprises led by Ineco, in partnership with Isdefe and INTA (National Institute of Aerospace Technology). Ineco is in charge of the operation, top level maintenance and management of the hosting services of the European GNSS Service Centre (GSC) located at the INTA's facilities in Torrejón de Ardoz (Madrid).


In the image, from left to right, Ineco executives: Celestino Rodríguez, Director of the Office of the President; Casimiro Iglesias, General Director of National Business; Ignacio Martínez, Deputy Director of Information Technology; and Ignacio Fernández-Cuenca, General Director of International Business.

ORDERLY SKIES

With a marked international orientation, the air navigation sector moves in a world of extreme safety requirements and resulting advances in new equipment and technologies to ensure this safety.

Since 2007, Ineco has been part of the Single European Sky ATM Research (SESAR) project, which is currently in the deployment phase of unifying space and air traffic control in Europe. In this respect, WAC 2019 played host to SESAR guided walking tours which saw the involvement of Ineco's aviation experts Pilar Calzón, Víctor Gordo, Fernando Ruiz-Artaza, José Manuel Rísquez, Mercedes López and José Recio. There were also presentations on the integration of small drones and their application in airports and CTR environments by Víctor Gordo, and on the HEDIPRO flight procedure design tool by the engineers Javier Espinosa Aranda and Fernando Carrillo, also from Ineco.

The company has extensive experience in calculating and designing aeronautical charts for the publication of procedures based on PBN, GNSS, GBAS and vertical guidance approaches (APV SBAS), airspace restructuring –such as the restructuring carried out at Spanish airports and in countries of the likes of Egypt and Morocco– and navigation easement studies. Designs of instrumental flight procedures for the international market are also carried out, such as those implemented for the airports of the Sultanate of Oman, Cape Verde and Singapore Changi Airport.


Part of the Ineco GSC team at the European GNSS Service Centre (GSC) located at the INTA's facilities in Torrejón de Ardoz (Madrid).

In addition, in partnership with ENAIRE (formerly Aena), Ineco has carried out more than 2,000 radio simulations to assess the impact on airport CNS systems of infrastructures close to airports, such as shopping centres and housing developments, and within the airports themselves, for instance, new terminal buildings and runway extensions. To achieve this, the company uses its own NAVTOOLS proprietary software.

RPAS: ALL OF THE GUARANTEES FOR DRONE FLIGHTS

Ineco's *RPAS radio navigation aid verification* project, which was presented during WAC 19, is an innovative solution for in-flight recording of radio navigation aid signals and a console on the ground that makes it possible to determine the trajectory flown and quality of guidance provided by the radio navigation aid.

The company is certified to operate and owns a light commercial drone for inspection of bridges and viaducts, and has also acquired a drone with greater capabilities and autonomy able to carry payloads of up to 4 kg, enabling more complex operations to be carried out.

FROM SACTA TO ITEC

In terms of automated air traffic control systems, Ineco has historically worked in collaboration with ENAIRE and other industry partners on the evolution and development of its control system, known as SACTA, which was designed entirely by Spanish companies and is a benchmark at the European and global levels. The SACTA and ICARO systems and the ACC voice communication system (COMETA) provide all aeronautical information necessary for air traffic control in Spain and are constantly updated.

The company is currently collaborating with ENAIRE on the development of a future automated air traffic control system (iTEC). Ineco is also working on another fundamental element for air navigation safety: guaranteeing the quality of the aviation data that ENAIRE collects, publishes and supplies.

Freight trains belonging to Southern Copper Corporation, a multinational mining company and producer of copper, molybdenum, zinc, lead, coal and silver, which operates in Peru and Mexico.

THIS IS A LARGE-SCALE PROJECT WHOSE PROFITABILITY DEPENDS ON FREIGHT AND PASSENGER DEMAND ORIGINATING IN BOLIVIA AND, ESPECIALLY, BRAZIL, WHOSE RAIL NETWORKS WILL NEED TO UPGRADE THEIR INFRASTRUCTURE AND ROLLING STOCK, AND, IN THE CASE OF BOLIVIA, ALSO COMPLETE THE MERGING OF ITS TWO RAILWAY SECTORS.

Tracks for the Central Bioceanic Railway Corridor

The Central Bioceanic Railway Corridor (CFBC) –a passenger and freight line that will cross South America– is a project aimed at boosting trade between Peru, Bolivia and Brazil. The Bioceanic Consulting Consortium, made up of the Spanish engineering companies Ineco and Incosa, has carried out a feasibility and financial viability study for the railway to better define its route between the Peruvian Pacific coast and Bolivia.

By **Francisco Ortiz,** civil engineer

This major railway line is a project promoted by the Bolivian government. The plan is to cross the South American continent from east to west (Brazil, Bolivia, Peru), connecting the three countries and possibly adding branches to Paraguay and Argentina. The project involves building a total of approximately 4,700 kilometres of a freight and passenger line in order to establish a high-capacity transport route between the Pacific and Atlantic.

To analyse the feasibility of the project, the Spanish engineering company Ineco, in consortium with Incosa, carried out a feasibility study for Peru's Ministry of Transport in 2016 and 2017. The work, which focused on Peruvian territory, included analysis of possible route options and optimum technical and financial solutions; examination of freight demand forecasts until 2055; assessment of Bolivia's infrastructure situation; studies of the compatibility of the different existing track gauges; and calculation of works budget distribution. The analysis concluded with a social assessment of the project and its feasibility.

PHOTO_**FRANCISCO ORTIZ / INECO**

ANALYSIS OF OPTIONS

In order to define the best route, the consortium carried out a study of options on three corridors: two departing from the Desaguadero border post south of Lake Titicaca between Peru and Bolivia, and a third from a location proposed in the Bolivian government's project known as Milestone 4, located southeast of the Desaguadero border post.

The three routes would reach ports on Peru's Pacific coast: option 1 (originating at Milestone 4) and 2 (originating in Desaguadero), measuring 406.6 and 458.7 kilometres in length respectively, would join in the city of Moquegua into a common branch that would terminate at the port of Ilo; option 3 (originating in Desaguadero) would be the most extensive route, measuring 633.4 kilometres in length, 194 kilometres of which already exist and 439 kilometres which would need to be built. The latter would skirt Lake Titicaca, pass through the cities of Puno, Juliaca and Arequipa and terminate at the port of Matarani.

In all three options, the railway would need to negotiate considerably uneven terrain. The border between Peru and Bolivia is located at an altitude of 4,000 metres, which means that the railway would be required to wind between mountains and highlands to descend to a port on the coast. The basic geometric conditions of the project call for minimum radii of 250 metres and maximum slopes of 2.5%, in addition to the need to minimise the number of bridges, tunnels and earthworks.

SUMMARY OF BIOCEANIC STRUCTURES - TUNNELS AND BRIDGES

ALTERNATIVE	TOTAL LENGTH (km)	BRIDGES		TUNNELS	
		UNITS	LENGTH (km)	UNITS	LENGTH (km)
1	406.591	178	68.56	44	309.2
2	458.7	181	70.72	44	38.46
3	633.362	178	92.24	41	43.38

In all of the options, the railway will need to negotiate a considerable slope in order to descend to the coast. The basic geometric conditions of the project call for minimum radii of 250 metres and maximum slopes of 2.5%, in addition to the need to minimise the number of bridges, tunnels and earthworks.

DEMAND STUDY

An important part of establishing the feasibility of the Bioceanic Railway Corridor was a demand study to calculate freight volumes in Peruvian territory for all of the route options and their projections for the time horizon under assessment.

The time horizons of the CFBC project to which the study worked were 2025 for entry into operation, 2055 as the end of the maturity period and 2075 as the final time horizon.

In order to determine future demand for the Railway Corridor, a transport model was drawn up using spatial referencing (zoning) to relate the network (supply) with mobility data (demand). It was a macro transport model that enabled prediction of the layout of an origin-destination matrix (demand) across different transport mode networks (supply).

To create this model, Ineco used TransCAD, a powerful transport planning software that uses aspects such as socio-economic variables, the general characterisation of the infrastructure and road and railway demand as baseline information. In addition, field work was also required to collect additional data to calibrate the supply network entered and the demand in the final origin-destination matrices together with the Bolivian review of the transport model.

The three options analysed start from two points on the border with Bolivia to two ports on the Pacific coast of Peru, Ilo and Matarani.

PHOTO_ **FRANCISCO ORTIZ / INECO**

Demand scenarios were simulated for three time horizons: 2025, entry into operation; 2050, intermediate year; and 2075, the project's final time horizon. And the three supply scenarios for the three route options.

As a result of this model, the CBFC's demand corresponding to the area of direct influence was estimated as follows:

- **Internal Peru:** representing flows captured by the line between internal areas within Peruvian territory.
- **Bolivia-Desaguadero:** representing flows captured by the line between internal areas within Peruvian territory and Bolivia.

IN TERMS OF SOCIAL BENEFITS, THE STUDY ASSESSED SAVINGS ON THE OPERATION OF FREIGHT DIVERTED FROM THE ROADS; FREIGHT AND PASSENGER TRAFFIC TIMES; ENVIRONMENTAL BENEFITS; AND REDUCED ACCIDENT RATES.

TRACK GAUGES

The Peruvian rail network has standard gauge (UIC), except on the Cuzco branch to Aguas Calientes (Machu Picchu), which has metric gauge, meaning that any new railway line built in Peru must have standard gauge. Traffic on this gauge also has more transport capacity than on metric gauge.

For its part, the CFBC in Bolivia would have metric gauge, which would require trains to change gauge at the border with Peru. To solve the problem of gauge difference between the two rail networks, 3 options were analysed for the Peruvian section of the CFBC: metric gauge, standard gauge and mixed gauge. A set of indicators was considered such as, among others, compliance with the terms of reference, transport capacity, rolling

The passage of the railway through Juliaca, in Peru. Below, a woman crossing the track in this same city.

PHOTOS_ **JOSÉ ANDRÉS MAROTO / INECO**

stock requirements, network effect, benefits obtained by Peru and possible logistics activities in order to identify the possible advantages and disadvantages of the different gauge options.

Analysis showed that the standard gauge option would be the most beneficial for Peru.

SOCIAL ASSESSMENT OF THE PROJECT: COST AND BENEFIT

In the study carried out by the consortium, the parameters and values applied to the evaluations for quantification of costs and benefits were those indicated by the methodology defined by the National System of Public Investment (SNIP), with the following concepts assessed:

- ▶ Infrastructure conservation costs.
- ▶ Variable costs of freight train operation (fuel consumption).
- ▶ Variable costs of passenger train operation (fuel consumption).
- ▶ Rolling stock maintenance costs.
- ▶ Fixed costs of train operation (personnel costs and general expenses).

In terms of social benefits, the study assessed savings in freight vehicle operation diverted from the roads; time savings for freight and passenger traffic; and the benefits of reduced accidents (material losses and loss of human lives and injuries) and environmental benefits (noise, atmospheric pollution, climate change, nature and landscape, loss of biodiversity, soil and water pollution).

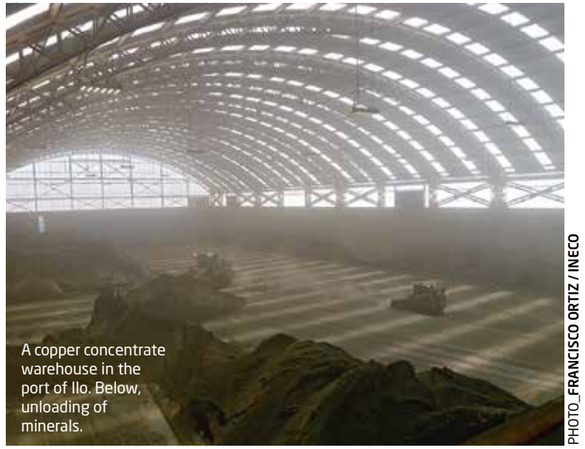
ROUTE OPTIONS

IMAGE_**CREATED BY INECO IN TRANSCAD**

In order to define the best route, the consortium carried out a study of options on three corridors: two departing from the Desaguadero border post south of Lake Titicaca between Peru and Bolivia, and a third from a point located southeast of Desaguadero.

PHOTO_**FRANCISCO ORTIZ / INECO**

TO MAKE DECISIONS REGARDING THE DIFFERENT CFBC OPTIONS, AN ANALYTIC HIERARCHY PROCESS (AHP) WAS USED IN ORDER TO SELECT SEVEN CRITERIA: CONSTRUCTION, ENVIRONMENTAL IMPACT, ECONOMIC ASPECTS, SOCIAL IMPROVEMENT SERVICES, CONCESSIONAIRES, OPERATIONS AND PORTS.



A copper concentrate warehouse in the port of Ilo. Below, unloading of minerals.

PHOTO_**FRANCISCO ORTIZ / INECO**

PHOTO_**JOSÉ ANDRÉS MAROTO / INECO**

The project has negative NPV social indicators because it only considers Bolivian freight in its analysis. In addition, IRR social indicators are below investor expectations. For the project to be socially profitable, the railway must be assessed taking the Bolivian and Brazilian freight that the railway could potentially use into account.

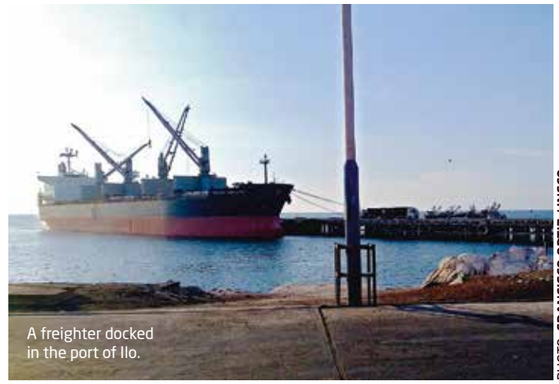
MULTI-CRITERIA ANALYSIS

To make decisions regarding the different CFBC options, an analytic hierarchy process (AHP) was used. This is a system used in large infrastructure projects in Peru which is acknowledged and valued for the multiple benefits it provides in the analysis of complex problems involving multiple variables.

For the analysis, seven criteria were selected –construction, environmental impact, economic aspects, social improvement services, concessionaires, operations and ports– and each one included a set of sub-criteria that were analysed for the three proposed options. The AHP system uses a scale of 1 to 9 to rate the relative preferences of the two elements to be compared. This method is based on the comparison of all of the options in a paired way for each of the sub-criteria selected.

Once the summarised values of the sub-criteria and criteria had been acquired, they were multiplied to obtain the weight of each of the sub-criteria. With these weights and summarised values of the comparison of the options, the matrices were multiplied to obtain the overall value for each one of the options.

The main conclusion of the study was that this is a large-scale project whose profitability depends on freight and passenger demand originating in Bolivia and especially in bordering countries, whose rail networks will need to upgrade their infrastructure and rolling stock, and, in the case of Bolivia, also complete the merging of its two railway sectors. ■



A freighter docked in the port of Ilo.

PHOTO_**FRANCISCO ORTIZ / INECO**

One of the three options studied skirts the western shore of Lake Titicaca.

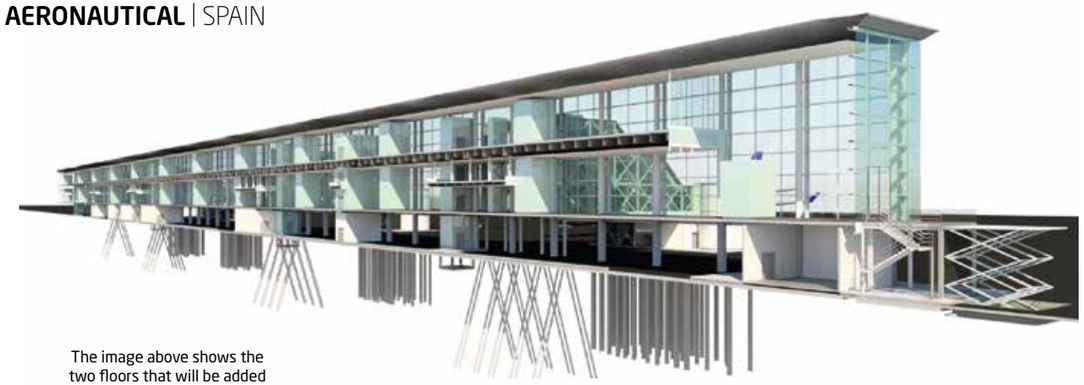
PHOTO_**JOSÉ ANDRÉS MAROTO / INECO**

More international stands for Barcelona-El Prat

The redesign and enlargement of the South Pier of Barcelona-El Prat Airport's Terminal T1 will allow it to receive large-capacity aircraft. Thanks to a solution designed by Ineco for Aena, the South Pier of Terminal T1 will change from operating regional flights to handling international flights with wide-body aircraft, with improved quality of service provided to passengers.

By **Roberto Serrano,** aeronautical engineer

IMAGES_INECO



The image above shows the two floors that will be added to the building. Below, the new walkways. These images were taken from the BIM model developed by Ineco.

WITH THE ADDITION OF TWO FLOORS AND THE INSTALLATION OF PASSENGER BOARDING BRIDGES, THE SOUTH PIER OF EL PRAT'S TERMINAL T1 WILL BE ABLE TO SERVE GREATER NUMBERS OF LARGE AIRCRAFT ON INTERNATIONAL ROUTES

The Barcelona-El Prat Airport has seen an increase in the number of wide-body aircraft operations in recent years. To manage this growth, Aena considered it necessary to increase the number of aircraft stands and boarding gates to accommodate aircraft that require a passenger boarding bridge and larger stands.

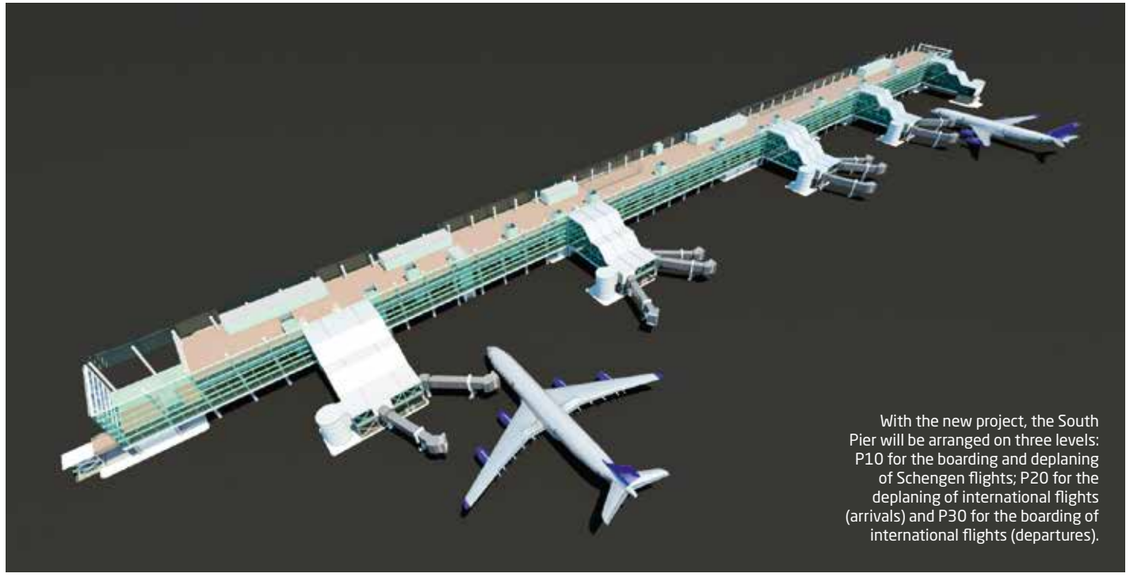
With the addition of two floors along the whole of the South Pier –approximately symmetrical to the North Pier– and the installation of several pre-boarding bridges, the airport will be able to serve more large aircraft on international routes.

Terminal T1 of Barcelona Airport has three boarding docks: the Longitudinal Pier, North Pier and South Pier. The Longitudinal Pier is generally used for Schengen flights, the North Pier for international flights (and also for the shuttle), and the South Pier for regional flights.

Because of the different kinds of operations carried out in each one, the docks have different configurations: the Longitudinal Pier has a single level on floor P10, through which boarding and deplaning take place; the North Pier has three levels (P10 for domestic boarding and deplaning, P20 for international deplaning and P30 for international boarding); and the South Pier currently has a single level for boarding and deplaning.

Along both the North and South Piers, there are a number of aircraft stands that are used for operations with large-capacity aircraft (type-E and F). Due to an increase in the number of operations with these aircraft at Barcelona-El Prat Airport, the number of aircraft stands and boarding gates that can accommodate these types of aircraft needs to be increased, since they require two and sometimes even three passenger boarding bridges (at different levels) at the same time, and larger stands on the apron.

Aena will be undertaking two main infrastructure projects in the airport's Terminal T1: the first one involves reconfiguring the apron of the South Pier to create 9 type-C positions, 3 type-E and 2 type-F. The second consists of redesigning the South Pier to adapt it to the new operations, namely, arrivals and departures of international flights and accommodation of large-capacity aircraft.



With the new project, the South Pier will be arranged on three levels: P10 for the boarding and deplaning of Schengen flights; P20 for the deplaning of international flights (arrivals) and P30 for the boarding of international flights (departures).

INECO AT EL PRAT AIRPORT

Designed by the architect Ricardo Bofill, the T1 project, which concluded the major expansion of the airport that began in 1999, was the result of a competition in which eight international teams participated. The building, which was opened on 17 June 2009 and consists of a stylised sword-shaped structure that also evokes birds in flight as well as the outline of an aircraft, was designed to integrate into the environment, with the natural light of the Mediterranean playing a prominent role. For the new terminal area, Ineco provided comprehensive supervision services, supported the integration of architecture and engineering and coordinated the operational readiness and transfer of the new facilities. It also drafted the projects for a new apron control tower, common retail areas and a new underground Commuter line that runs under the airfield (see pp. 20-23).

Above: an aerial view of T1 with the South Pier highlighted. Below: an interior view of the building.

REDESIGN AND ENLARGEMENT

The South Pier redesign and enlargement project drafted by Ineco proposes an expansion of the constructed areas of the Terminal T1 building, with the completion of the P20 and P30 floors along the entire length of the dock (approximately symmetrical to the construction arrangement of the North Pier) and the construction of four new walkways with separation of departure/arrival flows.

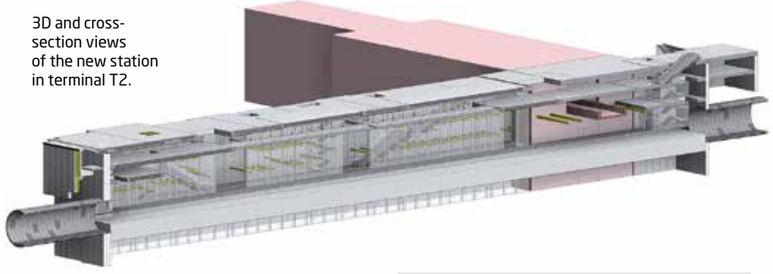
Later, 10 new passenger boarding bridges will be added to the new walkways (two or three per walkway) to enable type-E and F aircraft to board and deplane with at least two boarding bridges simultaneously, in addition to a second boarding bridge attached to the existing walkway (P37) of the South Pier so that type-E aircraft can operate.

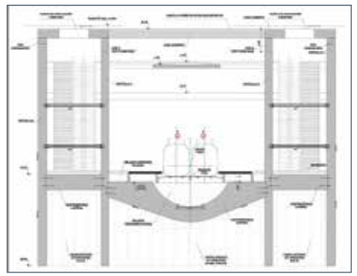
On 30 July 2018, Aena awarded the works to Sacyr Infraestructuras and Sacyr Construcción. ■

A tunnel for flying

The tunnel more than three kilometres long to extend Line 2 of Barcelona's commuter rail suburban train network to terminal T1 of El Prat Airport is now a reality. In December 2018, tunnel boring under the airfield at a depth of 20 metres was completed. Having drafted the project in 2009, Ineco is now managing the works, which include a new intermodal station currently under construction in terminal T2. The company is also drafting the project for the phase two.

With the collaboration of **Ismael Romero** and **Juan Hungría,** civil engineers, and **Martí Segret,** graduate with a bachelor's degree in Environmental Sciences





3D and cross-section views of the new station in terminal T2.

When the new commuter rail access is completed and operational, it is estimated that between 8 and 9 million passengers will be able to use it to travel from Sants station to Barcelona-El Prat Airport's terminal T1 in just 19 minutes. Until now, the commuter rail line (known locally as Rodalies) only reached the old terminal, T2, where a new underground intermodal station is currently being built.

With the excavation of the final metres of the 3,400-metre tunnel –3,048 metres of which were excavated using a TBM– in December 2018, one of the major milestones of the works, which began in 2015, was achieved. This first phase, for which Ineco was commissioned by Adif to carry out site and environmental management, will conclude when the works on the new intermodal station and shafts are completed. The next step will be to install and equip the tracks, power supply and railway facilities and commission the two new stations, projects on which Ineco is also working.

The new double-track stretch starts on the Barcelona-Tarragona conventional line, and runs to terminal T1, with an intermediate stop at terminal T2, where it will connect to Metro Line 9. The access includes a new station at terminal T1, not included in this project (the civil works were executed during the construction of the terminal itself). According to Adif, it is the largest project of its kind in terms of scope and budget currently being carried out on Spain's conventional and commuter rail network.

T2'S MULTIMODAL STATION

Construction work has begun on the new intermodal station in T2 to replace the existing station. It will be completely underground and arranged on four levels:

- **Commuter rail-rail platform level.**
- **Intermediate level** (only at the two ends of the line), where the Metro station platforms and the bridge that allows Line 9 to cross over the railway are located.
- **Concourse level:** this will have two sectors, the central one, which will collect passengers from the Metro and commuter rail, connected by a central footbridge to allow access to the T2 building.
- **Surface** covered level.

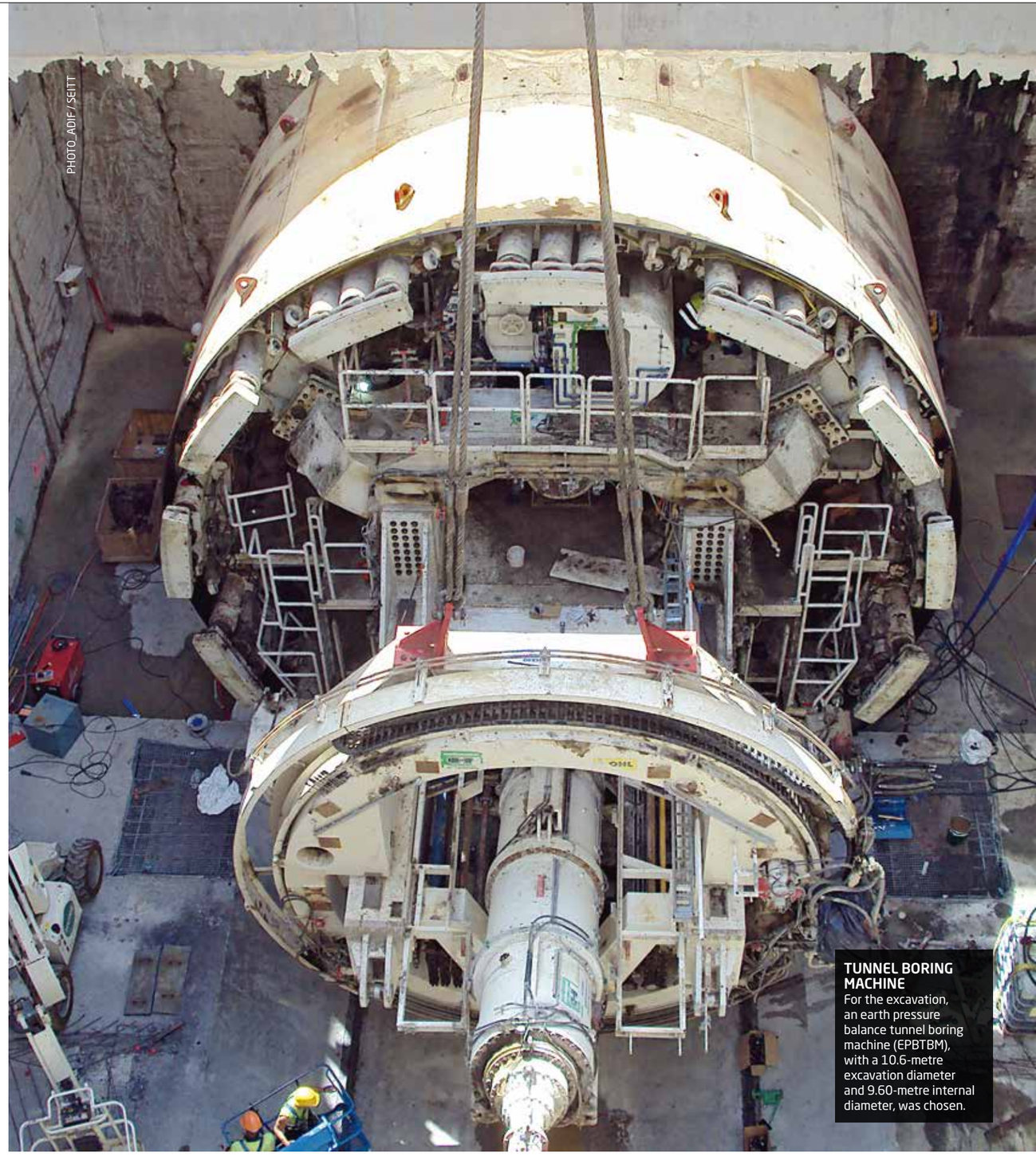


PHOTO: ADIF / SEITT

TUNNEL BORING MACHINE
For the excavation, an earth pressure balance tunnel boring machine (EPBTBM), with a 10.6-metre excavation diameter and 9.60-metre internal diameter, was chosen.

UNDERGROUND CHALLENGE

Excavating a tunnel with an enormous tunnel boring machine through ground with low bearing capacity –Barcelona Airport is located on the delta of the Llobregat River, meaning that terminal T1 had to be built on a gigantic concrete caisson– and under a large building (terminal T2) and runway that operates 24 hours a day, was no easy task.

Ineco drafted the construction project in 2009 (see *ITRANSPORTE 28*) taking all of these factors into account. To resolve the issues of soil quality and presence of a shallow water table (just over 2 metres), ground improvement treatment was carried out: a total of 126,802 m³ of ground was jet grouted (soil improvement using high-pressure reinforcement material) and 4,410 metres of micropiles were installed.

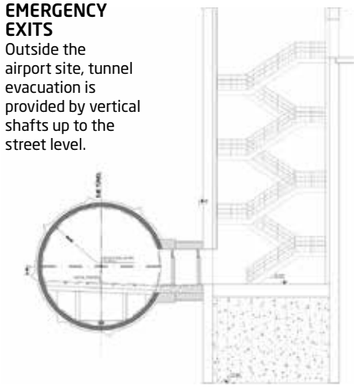
For the excavation, an earth pressure balance tunnel boring machine (EPBTBM), with earth pressure balance shield and 10.60-metre excavation diameter and 9.60-metre internal diameter, was chosen. The tunnel, which is lined with 32-cm thick concrete segments, has a maximum depth of approximately 28 metres and was executed between 56,700 m² of screen walls.

In the end, the excavation was completed with no significant subsidence on the surface. Special care had to be taken under the T2 building, where the TBM had to manoeuvre between foundation piles with a margin of just over one metre, and, under the runway, which Aena decided to close for 20 days in order to excavate a 300-metre section below it. In addition to hydrogeological and geotechnical studies prior to the beginning of the works, during excavation, a sounding system, consisting of more than 3,000 devices, was installed, including automated systems to monitor the stability of the ground and construction at all times.

THE NEW STRETCH STARTS ON THE BARCELONA-TARRAGONA CONVENTIONAL LINE, AND RUNS TO TERMINAL T1, WITH AN INTERMEDIATE STOP AT TERMINAL T2, WHERE IT WILL CONNECT TO METRO LINE 9

EMERGENCY EXITS

Outside the airport site, tunnel evacuation is provided by vertical shafts up to the street level.



The layout of the new commuter rail access to El Prat Airport. The tunnel section is marked in blue.

ENVIRONMENTAL WORKS MANAGEMENT

Ineco was also in charge of environmental works management to ensure compliance with the project's environmental impact study (EIS) during the different phases of the work and after acceptance.

From the environmental point of view, the most notable aspects were monitoring impact on the hydrogeological system of the area, consisting of two aquifers, one deep and the other on the surface, management of anthropic landfills (soil containing waste) found in some areas and corrective measures to avoid noise disturbances.

To supervise the hydrological system, in 2012, before the start of the works, a network of 14 piezometers was installed (nine in the surface aquifer and five in the deep one, which supplies part of the city of Barcelona) to learn about the aquifers' charging and recharging processes. Monitoring of the piezometric levels and water quality carried out previously and during the execution of the works will continue for two more years, once the civil works have been completed, in accordance with the requirements of the Catalonian Water Board (ACA). The application of preventative and corrective measures, together with the above monitoring, has minimised the potential impact of the works and reduced the risk of the tunnel affecting communication between the aquifers, causing contamination and creating a drainage barrier effect.

The anthropic landfills found in the area of emergency exit No. 3 (Vidaleta shaft) were examined, sorted and transferred to the appropriate waste management centres. To address noise issues, temporary acoustic screens were installed near a hotel and tennis academy located next to the construction site.

Tunnel boring, the construction of access ramps and the building of the multimodal station generated large volumes of excavated earth, which, in accordance with the EIS, was collected and removed and will be reused on other projects such as works on the port of Barcelona and the regeneration of two nearby quarries located in the municipality of Gavá. All removed soil containing vegetation was also reused later to restore any affected areas to their former state.

Excavating below the water table also required the drainage and collection of excess water (effluents), which were then treated and purified before being discharged into either the public water system through the airport's drainage network or storm drains or reused on construction site roadways to reduce dust. To ensure the quality of the air, filters were also fitted to lime, bentonite and cement silos, and sprinkler systems were installed in the concrete plant to clean machinery before leaving the site. All works waste was collected, sorted and disposed of appropriately.

Regarding the protection of cultural and natural heritage during the works, no archaeological remains of interest were found and none of the local animal life was affected.

THE MULTIMODAL STATION IN FIGURES

Length	**237 m**
Width	**40 m**
Height (below ground)	**26 m**
Number of platforms	**2**
Length of platforms	**200 m**
Number of lifts on platforms	**4**
Number of escalators on platforms	**8**
Emergency exits	**6**
1.2-metre-thick concrete screen	**16,731 m²**
1-metre-thick concrete screen	**10,678 m²**
Concrete for slabs	**29,738 m³**
Reinforcement steel	**11,415 t**
Structural steel	**1,111 t**
Excavation between screens	**150,153 m³**
Jet grouted ground	**62,034 m³**

THE WORKS CONTINUE

Ineco is also participating in the second phase of the works, for which it is drafting the project of necessary actions for the operational readiness of the new commuter rail access. These works include connection to the main line, track superstructure, electrification, telecommunications, facilities inside the tunnel and design of the stations at terminals T1 and T2.

INECO'S WORK ON THE NEW COMMUTER RAIL ACCESS TO EL PRAT

The company –which also planned the expansion of the south pier of T1 (see pages 18-21)– started working on the new commuter rail access in 2009:

▶ **2009. Drafting of the construction project,** which included the tunnel and the T2 station.

▶ **2012-2013. Construction project optimisation study.**

▶ **2012-2013. Hydrogeological monitoring** in accordance with the requirements of the Catalan Water Board. The works included the installation of piezometers to monitor the two aquifers (shallow and deep) and check piezometric levels and water quality on a bimonthly basis for 12 months.

▶ **2015-2019. Works and environmental management.**

▶ **2018-2019. Drafting of the project of necessary actions for operational readiness:** connection to the main line, track superstructure, electrification, telecommunications, facilities inside the tunnel and design of the stations in T1 and T2.

Temporary acoustic screen installed to protect the hotel, located next to emergency exit No. 2.

Reservoirs of extracted water, reused for spraying down roadways.

The drafting of the project needs to consider certain specific conditions that affect both the design and the execution of the works, such as ensuring that connection to the existing line does not affect its operation. The tunnel evacuation plan will need to take into account that the T1 and T2 stations are separated by more than one kilometre, but an evacuation exit cannot be built because that section of the tunnel runs under the airfield. The T2 station will have to be compatible for use by passengers from both the Metro and the commuter rail, and in the T1 station, the design of the emergency exits and fume extraction system will be subject to the conditions imposed by its location in the air zone.

Lastly, the security facilities will be considered by Adif. ■

PHOTO ALBERTO ORTEGA / INECO

CHHATRAPATI SHIVAJI STATION
Located in Mumbai and listed as a World Heritage Site by Unesco in 2004 for its beauty as an example of late 19th-century British colonial architecture.

New lines to generate wealth

A feasibility study for a 772-kilometre high-speed line between Mumbai and Nagpur, the first phase of the Mumbai-Kolkata corridor, is the latest project that Ineco and Adif are carrying out for the Indian government. The study is part of the advisory services that Spain is providing to India in relation to its plan to develop an ambitious high-speed rail network (The Diamond Quadrilateral Project).

By **Alberto Ortega,** civil engineer

FROM MUMBAI TO NAGPUR
The connection of these two large cities by high-speed corridor would benefit more than 20 million inhabitants. Mumbai is the capital of the Indian state of Maharashtra, the second most populous in India. Greater Mumbai is not only the most populated city with 12.4 million inhabitants, it is also one of the country's economic and tourism engines, as well as an important port in Southeast Asia. Nagpur, nicknamed the 'Orange City' for being an important commercial centre for oranges grown in the region, is one of the most populated cities in Maharashtra with approximately 4.65 million inhabitants according to the 2011 census. It is also important to note that Nasik, with 6.1 million inhabitants, would be just 47 minutes from Mumbai BKC station by high-speed train. In the photo above, Igatpuri railway station in the state of Maharashtra.

Its extensive experience in the planning of high-speed lines, gained over the course of many years of constructing the Spanish network, led Adif, an Ineco shareholder, and the Indian state-owned enterprise High Speed Rail Corporation of India Ltd (HSRC) to sign a collaboration agreement in 2016. Adif and Indian Railways (IR), the parent company of HSRC, began collaborating in 2012 after the signing of a tripartite memorandum of understanding between Adif, Renfe and IR, establishing a framework for collaboration between the three companies in areas of technological development. This process of cooperation has led to recognition of Adif and other companies in the Spanish rail sector by one of the world's major markets: India. The country has 64,460 kilometres of railway lines, on which more than 18,000 trains and 20 million people travel on a daily basis, an enormous and complex network that the government proposes to renew by modernising its infrastructure and improving travel times and safety.

In April 2015, India's Ministry of Railways asked the Spanish Ministry of the Economy and Competitiveness to carry out a feasibility study for a high-speed line between Mumbai and Nagpur, the first phase of the Mumbai-Kolkata corridor. The study was entrusted to Ineco and Adif, with up to 80 people involved over a period of 24 months, and with the goal of providing HSRC with sufficiently detailed technical, economic and environmental data and criteria to enable it to make decisions with respect to the development of high speed in the country.

The section between Mumbai and Nagpur, running through Maharashtra (India's second most populous state with more than 100 million inhabitants), will complete one of the routes of the so-called '*Diamond Quadrilateral*',

A feasibility study map of the high-speed line between Mumbai and Nagpur, the first phase of the Mumbai-Kolkata corridor. In blue, the new high-speed line and its 5 stations, in green, a highway proposal being studied by the Indian government.

a project to connect India's four great metropolises –Mumbai, Kolkata, Chennai and Delhi– through a network of 11,000 kilometres of high-performance railway lines.

The project carried out by Ineco and Adif included the initial step of analysing 10 alternative routes at a scale of 1:50,000 and preparing a study of the demand and of the existing transport network to enable selection of the best three routes to be studied in greater detail. These three alternative routes were then defined and analysed, including estimates of operating speed and travel times for each one. The result of this analysis, presented to and validated by HSRC, was the selection of 'Alternative 2' as the optimum HSR route to be developed in the feasibility study to be executed through the cities of Mumbai BKC, Thane, Nasik, Aurangabad, Akola, Badnera/Amravati and Nagpur. Lastly, the study and technical definition of this alternative was carried out with the participation of experts in the design of high speed projects, construction, station building, signalling and communications, and specialists in track integration and deployment of gauge-changeover facilities.

In summary, the study included demand studies; prior analysis of the different routing alternatives; an operational plan with calculation of travel times and traffic grids for different scenarios; a rolling stock proposal; analysis and selection of railway technology to be implemented (gauge, track superstructure, electrification, safety and communications facilities, etc.); necessary special works; redevelopment and relocation of the population from affected areas; environmental analysis; rail operation and maintenance; cost estimates; and, finally, an economic/financial analysis that will be used to determine the viability of the new high-speed line, as well as a financing proposal for the project.

13 KEY ASPECTS OF THE INECO PROJECT

1. 772.36 km of double track for passenger traffic designed in accordance with the UIC's international high-speed rail standards.

2. Maximum speed: 350 km/h.

3. Maximum gradient of 25%.

4. Mapping at 1:25,000, including critical points (urban accesses, railway crossings).

5. Geological mapping by *in-situ* visual inspection of the terrain.

6. Demand studies and projection of passenger traffic growth with a time horizon of 2050.

7. Pre-design of 5 stations, two workshops and 6 maintenance workbases.

8. Pre-design of eight tunnels and **526 structures.**

9. ERTMS-Level 2 and GSM-R signalling systems, with ERTMS-Level 1 backup.

10. Electrification: pre-dimensioning of the 2x25 kV 60 Hz system and siting of substations.

11. Design of the operational plan and study of possible connections with the conventional network.

12. Centralised traffic control (CTC) in Nasik.

13. Drastic reduction of times.

a. Mumbai-Nasik (from 3h 25m by conventional rail to 47m by HSR).

b. Mumbai-Aurangabad (from 6h 10m by conventional rail to 1h 29m by HSR).

c. Mumbai-Nagpur (from 12h 55m by conventional rail to 3h 34m by HSR).

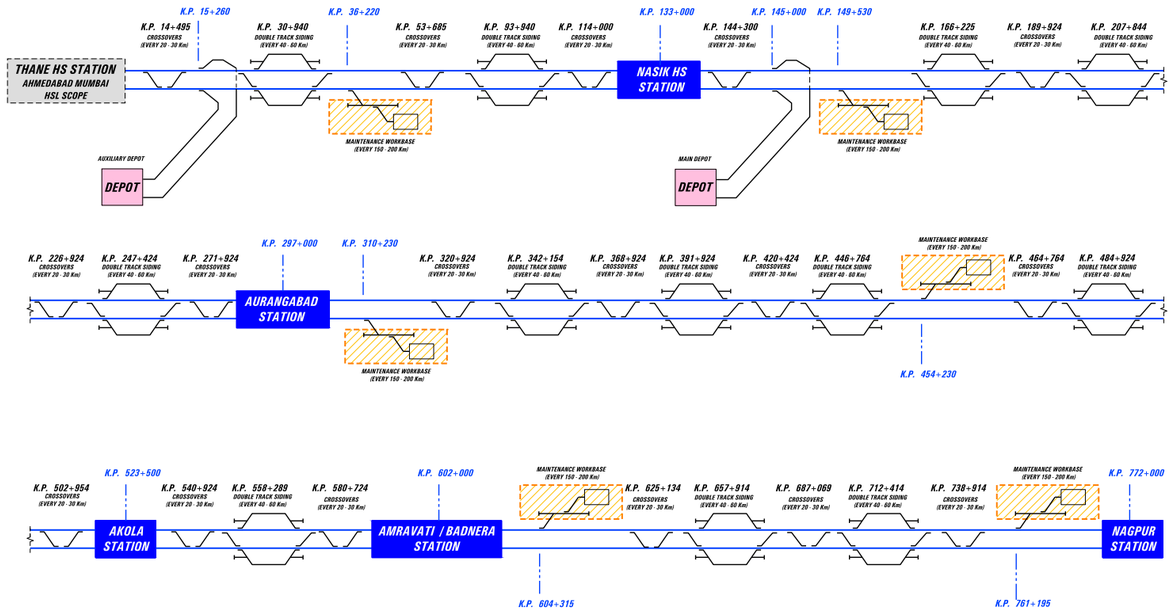
d. Possibility of extending these benefits to the conventional network using gauge changeover facilities in Nasik and/or Nagpur.

INECO IN INDIA

Ineco's presence in India dates back a decade to 2009, when it opened an office in New Delhi. In 2011, it began technical assistance on the construction works of Line 2 of the Mumbai metro. That same year, it led a consortium together with Prointec and Ayesa to carry out a pre-feasibility study on a 135-kilometre corridor between the port city of Haldia and Howrah, located in the Kolkata metropolitan area, in the north-east of the country. The work included demand studies, layout proposals, rolling stock and a preliminary estimate of costs to determine technical and economic viability. In 2015, the Indian government again entrusted a consortium led by Ineco, involving the participation of the engineering company Typsa and the Indian consultancy ICT, to carry out another project, this time a new 1,500-kilometre high-speed corridor between Delhi and Kolkata. The study was commissioned by the state-owned enterprise High Speed Rail Corporation of India Ltd (HSRC). The line ran through a fairly flat area, along the banks of the Ganges River for much of the corridor, crossing rivers and streams, and passing through cities of great commercial, social and tourist interest such as New Delhi, Agra (home to the iconic Taj Mahal), Mughal, Varanasi and Kolkata. Teams from Ineco, Adif and Indian Railways at Jalgaon (above top), Akola and Amravati (above middle) stations. In the bottom photo, the Spanish team from Ineco, Adif and the Ministry of the Economy with members of HSRC and the Indian Railways Ministry during the presentation of the Mumbai-Nagpur high-speed project on 22 February 2018 in Mumbai.

Above left, a meeting with local transport officials. Above and left, Mumbai Central railway station on the Western line, which handles more than 4 million passengers a day. Below, a general layout of the new line showing its main operation and maintenance facilities.

GENERAL LAYOUT



The construction of 526 structures required to negotiate obstacles such as rivers, railway lines and roads has been planned. In the image above, the existing railway bridge over the Ulhas River on the outskirts of Thane.

To carry out the study of medium and long-term traffic demand, the mobility needs and socio-economic characteristics of the populations along the entire corridor were analysed in conjunction with local development plans and United Nations population growth projections. In addition, a temporary demand scenario was developed for several years ahead, determined by the development of the infrastructure in phases: 2025 (Thane-Nasik), 2030 (Thane-Nasik-Aurangabad), 2035 (Thane-Nasik-Aurangabad-Akola-Badnera/Amravati-Nagpur) and finally 2050 with arrival in Kolkata.

TECHNICAL DEFINITION OF THE CORRIDOR

The section consists of double-track line exclusively for passenger traffic and five new stations (Nasik, Aurangabad, Akola, Amravati/Badnera and Nagpur), with connection at the Thane station of the Ahmedabad-Mumbai project being developed by Indian Railways. The infrastructure is designed in accordance with European standards including tunnels, viaducts and special infrastructures. The entire track runs on ballast except in stations and tunnels longer than 1.5 kilometres, where slab track is used. Functionally, the line is standard-gauge double track designed with sidings every 40-60 kilometres and intermediate crossovers every 20-30 kilometres, which provides maximum operating flexibility.

Cuts more than 30 metres high will require the construction of tunnels, eight in total, one of which will be a twin-tube tunnel 7 kilometres long excavated with a tunnel boring machine. Embankments of more than 15 metres will require special works such as bridges or viaducts and it is anticipated that a total of 526 structures will need to be constructed to negotiate obstacles such as rivers, railway lines and roads.

As for the five proposed stations, four standard models have been designed to optimise the size of the buildings and tailor them to actual passenger volumes. Maintenance workbases have been located every 150 kilometres and as much as possible close to towns and cities to facilitate the movement of personnel; the main rolling stock depot will be in Nasik, with a second auxiliary depot located on the outskirts of Thane (Mumbai). The project includes a preliminary proposal for the installation of 12 traction substations (every 60-70 km) and the necessary connections to the existing power supply network.

The feasibility study includes an economic/financial analysis that reflects the project's operational feasibility, cost effectiveness and balance. It also takes into account suitable management and governance frameworks for the implementation of HSR in India, financial assessment and risk analysis. ■

PHOTO_ROBERTO VÍLCHEZ / INECO

THE USE OF CONTAINERS HAS REVOLUTIONISED THE TRANSPORTATION OF GOODS ON A GLOBAL SCALE SINCE THEY WERE FIRST USED IN 1956 ON A VOYAGE BETWEEN NEW YORK AND HOUSTON

In the foreground, the container terminal of the Levante Pier.

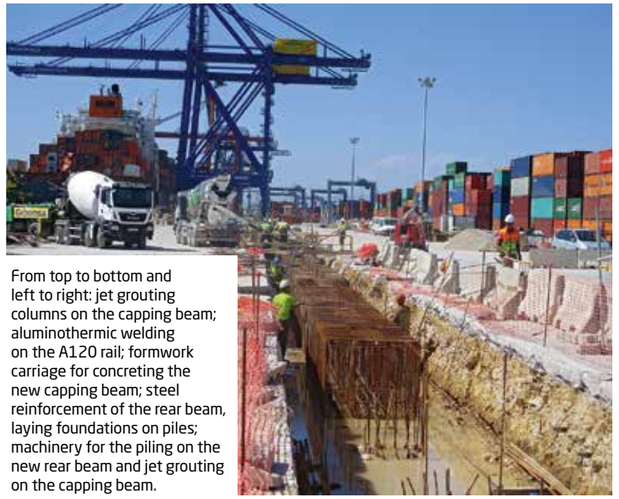
TECHNICAL ASSISTANCE FOR VALENCIAPORT

Room for giants

The Port of Valencia is ranked 30th in the world for container traffic, an activity that uses increasingly large vessels which, in turn, require larger cranes. To accommodate these gigantic ships, the Port Authority of Valencia has undertaken work to increase the water depth and reinforce the foundations of its Levante Pier, a project for which Ineco provided technical assistance services for the monitoring and supervision of the works and coordination of health and safety.

By **Roberto Vílchez**, civil engineer

In January 2018, one of the Port of Valencia's piers (the Príncipe Felipe) received the largest container ship in its history: the MSC Eloane, a vessel with a length of 400 metres, draught of 16 metres and maximum capacity of 19,472 TEU (twenty-foot equivalent unit). The use of containers has revolutionised the transportation of freight on a global scale since they were first used in 1956 on a voyage between New York and Houston in a former World War II tanker that carried 58 containers on deck.



From top to bottom and left to right: jet grouting columns on the capping beam; aluminothermic welding on the A120 rail; formwork carriage for concreting the new capping beam; steel reinforcement of the rear beam, laying foundations on piles; machinery for the piling on the new rear beam and jet grouting on the capping beam.

THE LEVANTE PIER WORKS IN DETAIL

The works, which lasted just over eight months, were executed along a 600-metre section at the south-east end of the pier, next to the Llovera Pier. The main works, which were carried out without disrupting port activity, were as follows:

▶ REINFORCEMENT OF THE PIER
To reinforce the ground, the superjet technique (high-pressure jet grouting) was used, consisting of injecting reinforcement material at high pressure (in this case, air+cement grout), which mixes with existing material, thus increasing its bearing capacity. A screen of secant jet grouting columns was executed and arranged in a staggered pattern in two rows, from the foot of the sea side of the pier. The injected columns were executed down to the firm gravel layer, in other words, improving only the cohesive layers of the ground under the foundations of the pier at about a depth of 17 metres. To assess effectiveness, geophysical sounding techniques were used before and after the reinforcement treatment.

▶ INCREASE OF WATER DEPTH
The level of the bottom was lowered to increase the water depth from the existing 14.3 and 16.7 metres to 17 metres to accommodate container ships.

▶ SUPERSTRUCTURES
On the capping beam, two sections of the pier's plain concrete superstructure were demolished, and a new reinforced concrete one was built, including a services gallery equipped with manholes and an enclosure to house the rail of the front leg of the crane, which was replaced with a type A120. On the rear beam, which supports the rear leg, a reinforced concrete beam was built along the entire length of the pier on a row of piles one metre in diameter embedded into the bottom and equipped with an A150 rail.

▶ PIERING AND MOORING ELEMENT
The existing system of C-type fenders on the mooring line of the pier was replaced with a system of SC 1150H class A double fenders. The existing mooring system on the pier was completed with the placement of 150-ton bollards.

▶ REPLACEMENT OF SERVICES
As a result of the execution of the works, the mains services that run through the area had to be replaced: drinking and fire-protection water, electricity and communications and lighting.

This is a trifling number compared to today's stratospheric figures: the Port of Valencia, ranked first in Spain for this type of traffic, beat its own record in 2018 with 5.1 million containers, which places it in 30th position in the world in a fiercely-competitive market. Shipping companies are building larger and larger vessels because the greater the volume of freight transported at one time, the lower the costs, according to the principle of economy of scale.

GIANTS OF THE SEA

In the 1950s, the capacity of the first container ships ranged from 500 to 800 TEU; today's Triple-E (*economy of scale, energy efficient and environmentally improved*) ships belonging to the world's largest shipping company, Maersk, have a capacity for up to 19,000 TEU.

This escalation in the size of ships has had global repercussions: they became too wide for the Panama Canal, requiring it to be enlarged to accommodate them, and the 20 or so ports around the world that have sufficient capacity to receive these ships have had to be adapted. The size of the cranes used to load and unload containers has also had to be increased, which in turn has led to the need to reinforce piers to support these structures, which can weigh between 1,600 and 1,800 tonnes.

This is the case with the Port of Valencia, which in 2017 undertook a strategic project: to increase the water depth of the Levante Pier to 17 metres and reinforce its foundation to install new 100-foot cranes (30.4 metres, which refers to the distance between the legs of the structure), compared to the existing 50-foot cranes. Ineco, which began providing services to the Port Authority almost two decades ago, was this time responsible for technical assistance services involving the monitoring and supervision of the works and coordination of health and safety.

This first project was followed by two others: works to increase the water depth of the central section of the Príncipe Felipe Pier and the coastal transversal pier (currently in execution and also involving Ineco), both part of the southern expansion of the Port of Valencia and with the objective of reaching a water depth of 18 metres at the foot of the pier.■

THE PORT OF VALENCIA HANDLED 5.1 MILLION CONTAINERS IN 2018, MAKING IT THE NUMBER ONE PORT IN SPAIN FOR THIS KIND OF TRAFFIC

PHOTO_PORT AUTHORITY OF VALENCIA

The Levante Pier (highlighted) where the work was carried out to increase water depth, reinforce the pier and install a new capping beam.

Manhattan dream

The historic Farley Building, in the heart of Manhattan, is being transformed into a new railway transfer station called the Moynihan Train Hall, which will relieve the congested Penn Station, the busiest for passenger traffic in all of the US. Ineco is providing operational readiness and transfer (ORAT) services to the engineering firm WSP USA, which is responsible for overall project management for the end client Empire State Development Corporation (ESD).

With the collaboration of **Ignacio Alejandre** and **Antonio Martín,** aeronautical engineers, and **Pablo Fernández-Victorio**, architect

Each year, New York's Penn Station handles more passengers than the JFK, Newark and LaGuardia Airports put together. With more than 650,000 users a day and connections to subway, bus lines and taxis, it is the busiest railway station in the US. As a result, it suffers from severe congestion, which greatly affects the comfort and welfare of users, since the space available and facilities were not designed for such a large volume of travellers. In addition, in 1963, much of the original station was demolished to build Madison Square Garden. Since then, the number of passengers has tripled.

IMAGE_SOM | AT CHAIN

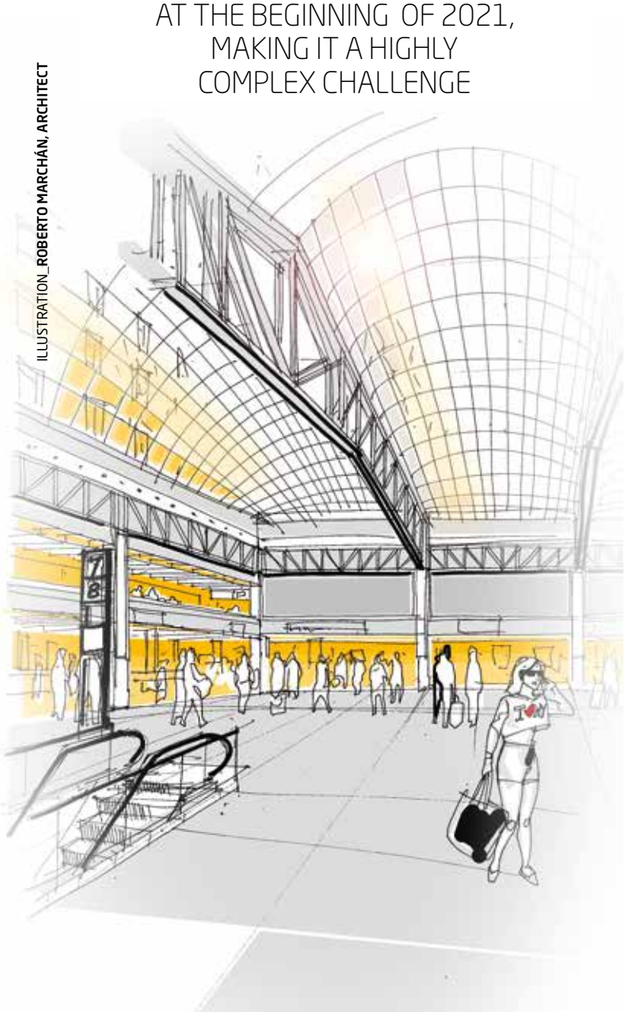
MOYNIHAN TRAIN HALL
The Moynihan Train Hall project, named in honour of the senator who promoted it three decades ago, will serve two operators: Amtrak, with 16 medium and long-distance lines, and LIRR, with 10 commuter lines.

After years of projects and negotiations, the State of New York, through the public entity Empire State Development Corporation (ESD) finally reached an agreement with a private investment trust and concessionaire (Related-Vornado) to convert the Farley Post Office into a modern railway station in the centre of Manhattan. The railway complex is completed by the Farley Building, a spectacular construction that occupies two blocks –32,000 m^2– completed in 1913, which until now housed New York's main post office, located opposite Penn Station.

The Moynihan Train Hall project, named in honour of the senator who promoted it three decades ago, will service two operators: Amtrak, with 16 medium and long-distance lines, and Long Island Rail Road (LIRR), with 10 commuter lines. In the interim, work is being carried out in the current station (new access routes, renovation of the traveller information system, etc.) to alleviate saturation and improve quality of service while the new transfer station is being built.

Moynihan is slated to go into operation at the beginning of 2021, making it a highly complex challenge. WSP USA, acting as programme manager (overall project supervisor) for Empire State Development (ESD), selected Ineco's proposal to provide operational readiness and transfer (ORAT) services for the new facilities in September 2018.

THE MOYNIHAN IS SLATED TO GO INTO OPERATION AT THE BEGINNING OF 2021, MAKING IT A HIGHLY COMPLEX CHALLENGE



ILLUSTRATION_**ROBERTO MARCHÁN, ARCHITECT**

A CENTURY-OLD STATION FOR THE 21ST CENTURY

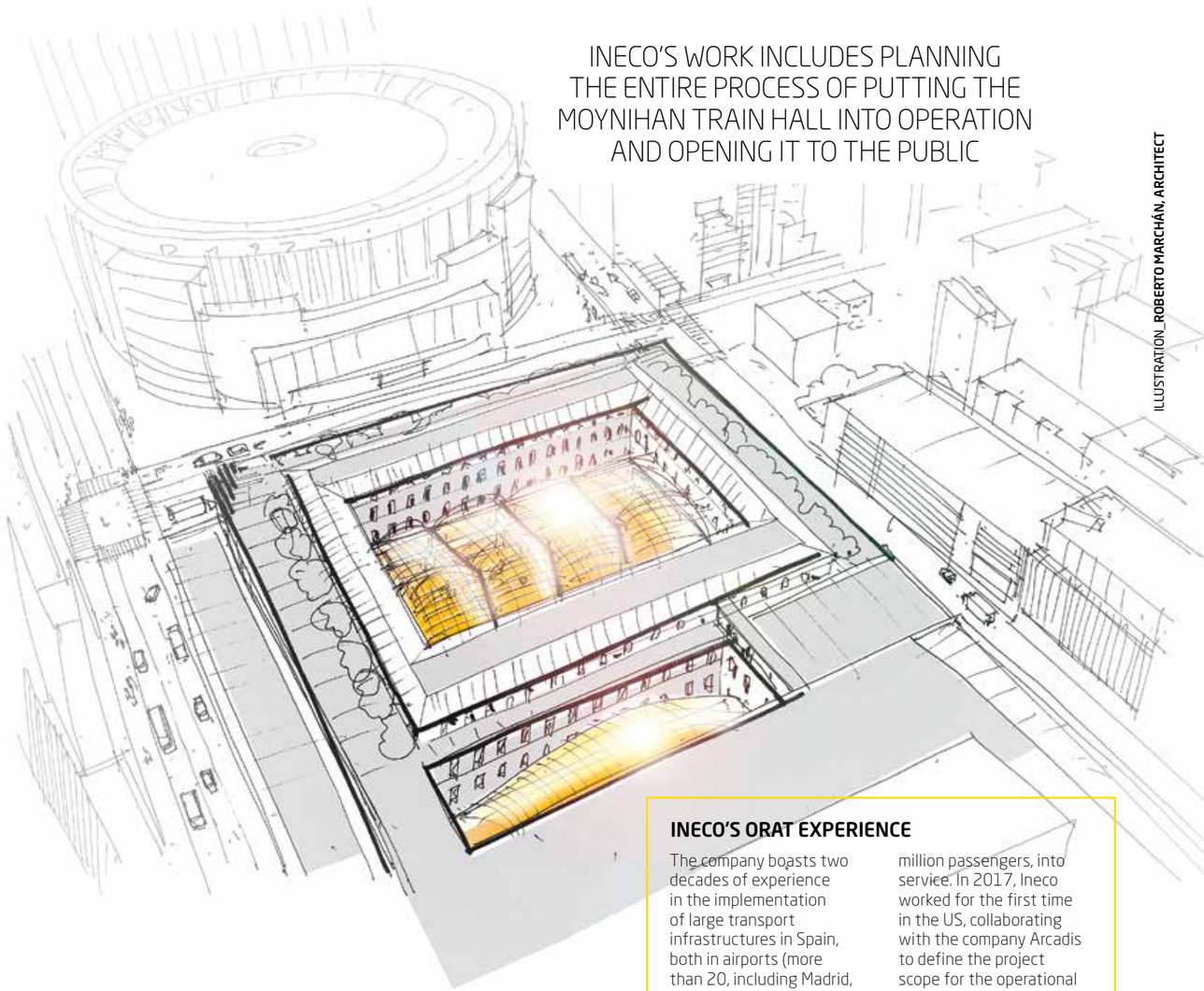
The James A. Farley Building, one of the city's most iconic buildings, was designed by the same architects as original Penn Station (McKim, Mead and White) and declared a New York historical landmark in 1966.

IMAGE_**SOM | AT CHAIN**

The project includes 11 escalators and 7 elevators that will serve 9 platforms and 17 tracks. On the upper levels, the large central space, the former mail-sorting room, will be covered by a new 23,690 square meter steel and glass skylight, reaching a height of 28 meters. Ticket offices, waiting rooms, luggage handling areas and commercial spaces and restaurant services will be installed in this naturally-lit space. The building will also house areas for freight and will also have a space reserved for the United States Postal Service. The new station will be equipped with state-of-the-art sign and information systems for travellers.

The redevelopment will respect the building's historical elements, such as the spectacular staircase and the façade featuring 20 huge Corinthian columns and famous frieze dedicated to the Postal Service, where an inscription by the Greek historian Herodotus reads: *"Neither snow, nor rain, nor heat, nor gloom of night stays these couriers from the swift completion of their appointed rounds."* The building's windows and interior decorative elements, such as mouldings and terracotta tiles, will also be preserved.

INECO'S WORK INCLUDES PLANNING THE ENTIRE PROCESS OF PUTTING THE MOYNIHAN TRAIN HALL INTO OPERATION AND OPENING IT TO THE PUBLIC



ILLUSTRATION_**ROBERTO MARCHÁN, ARCHITECT**

A month later, the company began work to ensure that everything would be ready for the opening. While the works are being executed, the interventions of a long list of participants must be coordinated: owners, contractors, architects, tenants, private investors and numerous municipal, state and federal authorities.

Ineco's work includes planning the entire process of putting the Moynihan Train Hall into operation and opening it to the public. This will take 30 months and includes coordination of the different work groups, planning and execution of operational trials, designing and carrying out familiarisation and orientation of the personnel of the different project participants and completion of the process with operational transfer and opening. To achieve all of this, Ineco will be applying the ORAT methodology that it has developed and refined over the years and which has demonstrated its effectiveness. ■

INECO'S ORAT EXPERIENCE

The company boasts two decades of experience in the implementation of large transport infrastructures in Spain, both in airports (more than 20, including Madrid, Barcelona, Alicante and Malaga) and in thirty railway stations (including the largest in the country, Atocha and Sants). Outside Spain, since 2014, Ineco has been working with Aena Internacional to put Abu Dhabi Airport's new terminal, the Midfield Terminal Complex, with capacity for more than 30 million passengers, into service. In 2017, Ineco worked for the first time in the US, collaborating with the company Arcadis to define the project scope for the operational readiness and transfer of Newark Liberty International Airport's new terminal in New Jersey for the Port Authority of New York. The new terminal, which is at an advanced stage of construction, will replace 'Terminal A,' which opened in 1973 and is the oldest of the airport's three terminals.

Sky views from the platform

For several months now, travellers passing through the A Coruña railway station have been able to enjoy new natural lighting thanks to the refurbishment of its historic roof, a project that Ineco carried out for Adif.

By **Lucía Esteban** and **Ana Rodríguez**, architects

The passage of time had damaged the structure of the large canopy roof of the San Cristóbal railway station in A Coruña. For its refurbishment, Adif commissioned Ineco to draft the project. Before the works began, a study was carried out on the condition of its columns.

Based on the data obtained, a design solution and final report were produced to address the detected issues and provide alternatives for action. The work took 12 months and was completed in May 2018. The canopy roof is 100 m long, 33 m wide and 16 m high and covers the entire central hall of the station, an area of 3,300 square metres, which houses six tracks and four platforms (two lateral and two central).

It consists of a large-span metal structure, with 11 segmental arches (broader than the classic rounded arch), at a height of 16 metres on hot-riveted supports (typical of the industrial buildings of the late 19th and early 20th centuries). Beyond the large canopy roof, the platforms have additional protection that extends for a further 160 metres.

As a result of the renovation works, passengers can now enjoy new lighting after the removal of the last fibre-cement (uralite) features installed in the 1980s, which partially blocked the natural light. This, together with the repainting of the metal structure in light blue –replacing the previous red rust colour– have made the building brighter.

In addition to the aesthetic improvements, the project also involved a comprehensive renovation of the entire structure: the roof support straps and hooks were replaced with fireproof and anti-corrosion treated versions, and a new rainwater collection and discharge system, including drainpipes and gutters, was installed to ensure the watertightness of the roof. All rusted metal parts, such as profiles, bolts, joints, etc., were renovated, as was the paintwork.

76 YEARS OF HISTORY

The A Coruña railway station, which opened in 1943, is located in the city centre very close to the main thoroughfare, Avenida del Alcalde Alfonso Molina. It was designed in an austere neo-Romanesque style by the engineer and architect Antonio Gascué Echeverría, who chose granite, steel and glass as materials. It is an L-shaped terminal, with a façade of uncut granite ashlars with openings all of the way up and a corner tower that houses the clock. The passenger building is grade II listed, meaning that features such as the façade, sidewalls, interior yards, basic structural and typological elements and layout of spaces had to be preserved in their entirety.

Although construction was completed in 1935, it did not open until 14 April 1943 because of the Spanish Civil War and difficulties in building some sections of the railway.

In the 1980s, the central section of the original fibre-cement canopy roof was replaced with other material to provide greater light to the tracks. In the 2000s, the possibility of integrating all modes of transport –rail, buses, taxis and light rail, together with other amenities– on the same site began to be studied. ■

THE MAIN WORKS CARRIED OUT

1. Replacement of roof material:

▶ Removal of fibre-cement, polycarbonate and fibreglass roof.

▶ Installation of aluminium sandwich panel roof and double polycarbonate panel.

2. Renovation, modernisation and repair of the structural system, including:

▶ Replacement of the metal structure's roof support straps and hooks.

▶ Cleaning of deteriorated and rusted paintwork.

▶ Removal of deteriorated and rusted profiles and welded metal plates.

▶ Replacement of joints, consoles, bolts and screws.

3. Building services:

▶ Upgrading of rainwater collection system.

▶ New canopy roof lighting.

▶ Replacement of affected services.

From top to bottom and left to right: damage to the structure from corrosion and rust, work outside and under the roof.

Above, the roof before the start of the works. Below, the façade and clock tower.

PHOTO_EDSOM LEITE / MINISTRY OF INFRASTRUCTURE OF BRAZIL (MIB)

ONTL
EPL and Ineco have collaborated to design, develop and launch the National Transport and Logistics Observatory (ONTL), a project for which the company has shared the knowledge it has gained since 2013 with the Observatory of the Ministry of Public Works in Spain.

Answers for Brazilian transport

In a country with one of the highest agricultural productions in the world, how can the most appropriate modes of transport for high-volume freight be promoted? How does the evolution of the economy influence transportation costs? To answer these and many other questions, since October 2018, Brazil has had a new instrument: the National Transport and Logistics Observatory, which was launched by the public entity EPL, with the collaboration of Ineco.

With the collaboration of **José Batlles,** civil engineer, and **Enrique Monfort,** industrial engineer

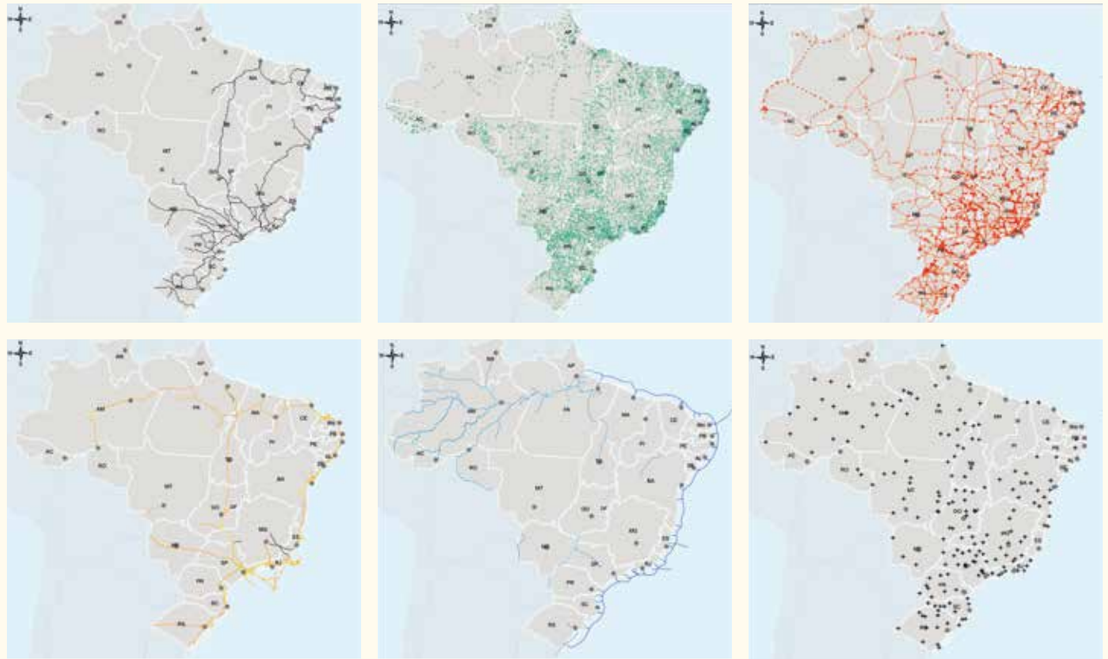
Everything in Brazil is enormous: its territory, the fifth largest on the planet; the largest hydrographical basin –the Amazon River and its thousands of tributaries– covering half of the country; and its economy, the ninth most powerful in the world.

It is the world's leading producer of coffee and sugar cane, the fourth largest of wood and one of the largest soybean producers, which attracts numerous multinational companies from the agri-food and biofuels industries; the agricultural sector represents just 5% of GDP, but it accounts for 40% of exports. Brazil also has a powerful industrial sector that contributes a quarter of GDP. It produces oil, aluminium and coal, and its textile, aeronautics, pharmaceutical, automotive, steel and chemical industries are also very important.

All of these goods travel through a network of 1.5 million kilometres of roads, 29,000 kilometres of railways, 32 public ports and 128 private ports, more than 4,000 airports and aerodromes and a network of 28,400 kilometres of waterways , including cabotage (coastal navigation) routes.

The federal government's objective is to plan the considerable investment required by this immense transport network as effectively as possible in order to reduce logistics costs and thus increase the country's competitiveness. To this end, it has launched the National Transport and Logistics Observatory (ONTL) through the public entity EPL (Empresa de Planejamento e Logistica), part of the Ministry of Infrastructure of Brazil, with which Ineco has collaborated.

Thanks to the ONTL, planners –and the general public– can consult the website *www.ontl.epl.gov.br/index.php* at any time for invaluable information to facilitate the decision-making process when it comes to optimising investment in infrastructure. For example, if data indicates that agricultural production, a type of large volume freight, is increasing, how can the waterway and port network be strengthened to transport it more cheaply and sustainably? And when improving the road network, in which regions has the demand for transport increased the most? How does the evolution of the country's economy influence logistics costs?



AN IMMENSE TRANSPORT NETWORK
From top to bottom and left to right: railway lines under concession; road network under state control; road network under federal government control; pipeline network (oil, gas, water and minerals); waterway and cabotage route network; and map of airports and aerodromes. All maps are freely available on the ONTL website: www.ontl.epl.gov.br.

"A LOGISTICS OBSERVATORY HAS THE POTENTIAL TO STRENGTHEN DECISION-MAKING. UNDERSTANDING LOGISTICS PERFORMANCE IS ESSENTIAL TO ASSESS AND DETERMINE TRANSPORT AND TRADE FACILITATION POLICIES"

OECD INTERNATIONAL TRANSPORT FORUM (CASE STUDY, 2014)

PHOTO_**EDSOM LEITE / (MIB)**

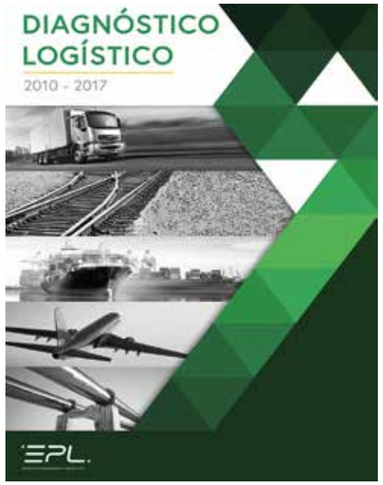
PHOTO_**ALBERTO RUY / (MIB)**

PHOTO_**INFRAERO**

In Brazil, river transport is vital for the mobility of people and goods, especially in the Amazon.

"TRANSPORT INFRASTRUCTURE IS FUNDAMENTAL TO CONTRIBUTING TO THE DEVELOPMENT OF THE COUNTRY. PUBLIC RESOURCES FOR THE MODERNISATION AND CONSTRUCTION OF NEW TRANSPORT INFRASTRUCTURE SHOULD BE USED RESPONSIBLY AND TO PROVIDE THE GREATEST COVERAGE POSSIBLE. THE PARTICIPATION OF BODIES AND ENTITIES THAT DEVELOP STUDIES AND PLAN TRANSPORTATION IS ESSENTIAL TO EXPANDING AND STRENGTHENING THE SCOPE OF THE PLAN"

NATIONAL LOGISTICS PLAN 2025 (GOVERNMENT OF BRAZIL, 2018)



THE OBSERVATORY, IN OPERATION SINCE 2018
Above top: Emilio Miralles, Fernando Cámara and Javier Anibarro, from Ineco, during an external awareness day with the project coordinator Lilian Campos Soares, from EPL. Above bottom: the cover of one of the Observatory's publications (freely available on the website).

EPL VISIT TO SPAIN
A delegation from EPL visited Spain in November 2018. From left to right: in the top image below, José Andrés Maroto (Ineco), Adriana Segabinazzi de Freitas do A. Carvalho (EPL), José Batlles (Ineco), André de Araújo Costa (Ministry of Infrastructure) and Enrique Monfort (Ineco) during an AVE trip to Valencia after visiting Ineco's offices in Madrid. In the bottom image below, Lilian Campos Soares (EPL), José Batlles, José Andrés Maroto, André de Araújo Costa and Enrique Monfort at the entrance of the Port Authority of Valencia.

These are just some examples of the usefulness of a transport observatory, an entity that more and more countries, including Spain, are creating, and which also collects very useful data provided by satellite tracking systems on the deforestation of the Amazon rainforest, information on fuel prices or the production of all kinds of goods, freight and passenger movements, tariffs and freight costs behaviour, average transport costs, macroeconomic indicators, etc. All of this data is provided by both large companies in the country and the different departments and public bodies of federal and state government that participate in the observatory, and is then processed and organised for easy consultation on the website.

The ONTL is the result of cooperation between the governments of Spain and Brazil, which have maintained close economic relations since the 1990s, with strong investment flows between both countries. Collaboration on transport infrastructure has crystallised in the signing of multiple agreements since 2012. As a result, in 2014, Ineco carried out a study to calculate transport costs on Brazil's waterways. With the ONTL, Ineco transmits the knowledge it has accumulated since 2013 in the Observatory that it designed and runs for the Spain's Ministry of Public Works.

The Brazilian observatory gathers data from more than 50 sources of information supplied by numerous agents related to infrastructure, operations, security, financing and other key aspects of the Brazilian transport and logistics system: airport authorities and concessionaires, ports and roads, ministries and governmental entities, the police, merchant marine, sectoral associations and large public and private companies that represent the principal industrial sectors (oil, aeronautics, mining, automotive, etc.). All of these sources generate valuable knowledge that is disseminated in work sessions, specialised workshops and seminars, data panels, an annual newsletter, etc. and is collected on the website for consultation.

As in the case of the Spanish observatory, Ineco designed the information collection and processing system and the database and website, which is open to both sector agents and the general public. It has also developed a set of indicators which serve to harmonise data from different sources and facilitate the analysis of information and its dissemination. ■

WHY A TRANSPORT OBSERVATORY?

The Observatory will also serve as an instrument to monitor the National Logistics Plan of Brazil, approved in July 2018. The Plan defines the necessary actions to address the problems of inadequacy and bottlenecks in its infrastructure network and the high logistical costs that undermine the country's internal and external competitiveness.

This is important because the capacity and quality of a country's transport infrastructure -roads, railways, airports, sea ports and waterways- largely determine the cost of bringing raw materials or goods produced from their point of origin to the manufacturer, marketer and end consumer, with all the corresponding intermediate steps. These processes, which can be highly complex, are known as supply and logistics chains.

Given the increase in world trade in recent decades, logistics costs have a significant impact on the wealth of a country or region. To measure their efficiency, a calculation is made of the percentage they represent with respect to GDP, that is, all of the goods and services produced. In the case of Brazil, it is estimated that they represent between 15% and 18% of GDP, twice the average for OECD countries.

A UN PROJECT

17 goals for transforming our world

On 25 September 2015, at the historic Sustainable Development Summit in New York, world leaders adopted a set of global goals to eradicate poverty, protect the planet and ensure prosperity for all over the coming years (2015-2030) as part of a new Sustainable Development Agenda.

By **África Jiménez,** graduate with a degree in Business Administration, and **Beatriz Vázquez,** economist

The Agenda has 17 sustainable development goals (SDGs) and 169 targets that range from the elimination of poverty to combating climate change, education, women's equality, environmental protection and the design of cities. Each goal has specific targets that have to be achieved in the coming years and, to do so, all of the agents –governments, the private sector, civil society and citizens– have to play their part.

These goals are unique in that they urge all countries, whether rich, poor or middle-income, to adopt measures to promote prosperity while protecting the planet. They recognise that initiatives to end poverty must go hand in hand with strategies that promote economic growth and address a range of social needs, including education, health, social protection and employment opportunities, while combating climate change and promoting environmental protection.

Although the SDGs are not legally binding, many governments have adopted them as their own and established national frameworks to achieve them.

On 18 June 2018, the Spanish Government created the post of high commissioner for the 2030 Agenda reporting directly to the prime minister and holding the rank of undersecretary, who will be responsible for coordinating initiatives to ensure fulfilment of the United Nations' 2030 Agenda.

Also in 2018, the Cabinet approved the *2030 Agenda Implementation Action Plan: Towards a Spanish Strategy for Sustainable Development*, which involved the participation of all ministries, regional governments, local bodies and civil society organisations.

PHOTO_ ITWILLBE

EURO SOLIDARITY CAMPAIGN 2018

The Protection of Street Children against the Exploitation by Mafias at Train Stations in India project, led by the Spanish NGO It Will Be, has been chosen by Ineco's employees for the Euro Solidarity campaign 2018.

More than 10 million children live alone on the streets of India. Every year, over 80,000 are lost and hundreds of them flee from abuse, poverty or violence. Every five minutes, a child arrives at a train station alone. The mafias take advantage of the difficulty of providing the children with an identity to exploit them sexually or for labour and for the trafficking of organs and drugs. Their lack of documentation means that they are excluded from government health and education systems.

It Will Be has developed this programme in collaboration with the local Indian NGO Don Bosco through 81 centres spread throughout the country (Childmiss). Thanks to the Child PPa app – a technological biometric recognition tool that It Will Be is installing in these reception centres – the NGO's social workers will be able to identify, monitor and protect them from possible abuse. In 2018, nearly 400 Ineco employees participated in the campaign. For 2019, they chose to designate their donations to the project for "Treatments to fight child malnutrition" that Doctors Without Borders is carrying out in Jharkhand, (India).

Ineco, as part of its corporate social responsibility activities, has joined this initiative, reinforcing its commitment to the SDGs and the 2030 Agenda by incorporating them into the company's general strategy. The company has also undertaken to spread awareness of the Agenda through external and internal campaigns to ensure that its more than 3,000 employees and stakeholders are aware of it and can work towards fulfilling these goals. ■

CAMPAIGN DAY 2030 AGENDA

On 22 February, Ineco held an event to kick off the support campaign, which was attended by Carlos Sallé, Director of Energy Policy and Climate Change at Iberdrola; Ana Benavides, General Manager of the Fundación Lealtad; Carmen Librero, President of Ineco, Cristina Gallach, High Commissioner for the 2030 Agenda, Cristina Sánchez, Deputy Director of Red Española de Pacto Mundial; and Iván Hernández, from Ineco, (the RONIN Project). This event, which was broadcast in real time to all employees, demonstrates Ineco's commitment, as a public corporation, to contribute, to the achievement of the SDOs.

PHOTO_SILVIA ALLER GONZÁLEZ

Hispano-Bretón horses in the foothills of the Ubiñas de San Emiliano massif in the Babia y Luna natural park and biosphere reserve.

Magical and unknown

Spread over its 17 regions, Spain has 132 natural parks which are home to true natural and scenic treasures, many of which are virtually unknown.

By ***ITRANSPORTE***

Natural parks, unlike national parks, are designated by the regions or autonomous communities, which have exclusive powers to manage them. Spain has 132 and they are an essential part of environmental protection as they cover a total area of 3.5 million hectares (compared to the just over 380,000 hectares belonging to the 15 national parks that exist), approximately 7% of the area of the country.

These extensive protected areas remain largely unknown to both Spaniards and international tourism, which usually associates Spain with 'sun and beach' holidays. The country does, however, boast a wide variety of geography, geology and climate that, over the centuries, along with human action, has created remarkably diverse landscapes, with an equally varied wealth of fauna and flora.

MOUNTAIN AREAS

The first steps to protect Spain's natural spaces date back to 1918, when Picos de Europa became a national park, the first in Spain and the second in the world (after Yellowstone, in the USA in 1872).

Interestingly, the most recently-created park can be found on the Leonese side of this mountain range, which separates Castilla y León from Asturias: Babia and Luna Natural Park, which received this designation in 2015, along with the Ter and Freser Headwaters Natural Park in Girona (Catalonia). It is a mountainous area of outstanding natural beauty and ethnographic significance associated with pastoral farming and livestock. It is home to populations of wild Iberian wolves, mountain birds and birds of prey, and European bison (in reserves), among other species, such as the native Hispano-Bretón horses.

The list of natural parks in mountain areas, in a country with some of the most rugged terrain in Europe, is extensive. The natural parks of Somiedo and Redes in Asturias are worth mentioning, among many others. The latter includes the Tabayón del Mongayu, a 60-metre-high waterfall of glacial origin, listed as a natural monument in 2003.

WATER AND ROCK

The interaction between rock and water has created spectacular mountain lakes such as Lake Certascan in Catalonia's High Pyrenees Natural Park and the Laguna Negra and Glacial Circus of Urbión in Soria. Between the provinces of Salamanca and Cáceres is the Las Batuecas-Sierra de Francia Natural Park, the location of the Meandro del Melero, a truly magical and little-known landscape where a hairpin bend on the river forms a meander connected to the bank by a narrow strip of land, which, from the Mirador de la Antigua vantage point, looks like an island in the middle the forest.

Inland Spain conceals other wonders that have also been sculpted by the action of water, such as Hoces del Rio Duratón Natural Park, in the north-east of Segovia, and Cañón del Río Lobos Natural Park, between Soria and Burgos. In the Galician province of Ourense, the Baixa Limia-Serra do Xurés Natural Park is the location of the mouth of the A Fecha stream in the form of a waterfall, which, during rainy times of the year, is the highest waterfall in Galicia. In the province of Guadalajara is the Alto Tajo Natural Park, with its canyons and river gorges, needles and monoliths of limestone and red sandstone, with golden eagles, peregrine falcons, Egyptian and griffon vultures and Eurasian eagle-owls flying overhead.

GREEN TREASURES

The beech tree, characteristic of European temperate forests, is a protagonist in spaces such as the Hayedo de Tejera Negra beech forest in Guadalajara and Pagoeta Natural Park in Guipúzcoa. In Las Fragas del Eume, A Coruña, oak, birch, chestnut and other tree species form a lush forest on the seashore. In the Canary Islands, where there are 11 natural parks, some of the most notable are Tenerife's Corona Forestal and Gran Canaria's Pinar de Tamadaba natural parks.

Elsewhere, the Iberian Peninsula's largest cork oak forest is located in Los Alcornocales Natural Park in the province of Cádiz, and Sierra de María-Los Vélez Natural Park in the north of Almería boasts a thousand-year-old Spanish juniper tree. In Sierras de Cazorla Natural Park, there are almost a hundred pine trees that are over 1,300 years old, as well as what is considered to be the oldest yew tree in Europe, which is over 2,000 years old.

DESERTS AND COASTS

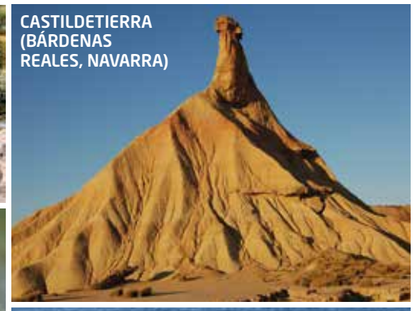
On the other landscape extreme are desert areas, such as those in Cabo de Gata Natural Park in Almería. Curiously, a thousand kilometres to the north, in Navarra, is the Bárdenas Reales desert, an arid lunar landscape that is difficult to associate with such a northern region. It is the site of a natural monument known as Castildetierra, a peculiar cone-shaped rock formation fashioned by erosion. To the east, Girona's Garrotxa Natural Park conceals another geological wonder: more than 40 volcanic cones and 20 basaltic lava flows. Also of volcanic origin are the Columbretes Islands archipelago and natural park in Castellón.

Spain's extensive 5,900-kilometre coastline boasts numerous protected natural areas, such as the salt lagoons of La Mata and Torrevieja in Alicante, the Albufera lagoons of Valencia and Majorca, noted for its colourful flamingos, among other birds, and the Ibiza and Formentera Ses Salines Natural Park in the Balearic Islands. In terms of sea life, the Canary Islands' Lobos Island (Wolves Island) in the north-east of Fuerteventura is named after the monk seals, or sea wolves, that inhabit it. For its part, the Strait of Gibraltar Natural Park is considered to be one of the best places in Europe for the sighting of cetaceans, such as dolphins, sperm whales, rorquals, pilot whales and a permanent population of Iberian killer whales, which feed on Mediterranean bluefin tuna. ■

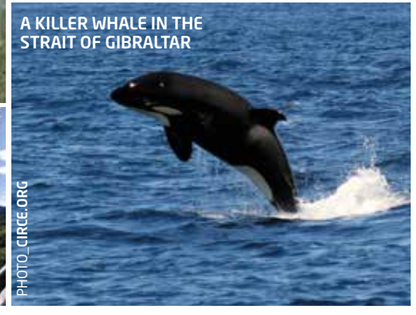
ALTO TAJO NATURAL PARK

AN IBERIAN WOLF

MEANDRO MELERO (CÁCERES)



CASTILDETIERRA (BÁRDENAS REALES, NAVARRA)



A KILLER WHALE IN THE STRAIT OF GIBRALTAR

PHOTO_CIRCE.ORG

THE ALBUFERA IN VALENCIA

PHOTO_CC-MOISÉS PASTOR

TORREVIEJA'S PINK LAGOON

A VOLCANO IN GARROTXA (GIRONA)

ÁFRICA JIMÉNEZ LACACI

“If we all join forces, we can really change things”

Holding a bachelor’s degree in business administration from the CUNEF, Africa Jiménez Lacaci has more than 10 years of experience in institutional relations and corporate social responsibility programmes.

PHOTO_ELVIRA VILA

PROMOTER OF CSR

Born in Madrid, África joined Ineco in 2001 and, in addition to being the Deputy Director of Institutional Relations and Corporate Social Responsibility (CSR), since 2002, she has been the secretary of the Management Committee. She has spent most of her career in the president’s office, which has involved dealing with senior executives from other companies and public authorities.

As a result of the development of CSR and the growing promotion of social action at Ineco, she has also established close relationships with many institutions, foundations and NGOs in Spain. As a promoter of CSR since 2007, she has developed this area at Ineco and since then she has launched numerous social projects every year, both in Spain and abroad.

1 HOW MANY INSTITUTIONS AND NGOS HAS INECO COLLABORATED WITH IN THE LAST DECADE?
More than 100, without a doubt. But the important thing isn’t quantity; it’s the quality of the projects obtained thanks to the involvement of the company and employees. The social value generated by this joint work is incredible.

2 IS IT DIFFICULT TO PERSUADE SENIOR EXECUTIVES TO GET INVOLVED IN CSR PROJECTS?
Not at Ineco. When faced with a sound project that is aligned with our strategy and requirements, senior management has always supported these initiatives. They have always been aware of the benefits they represent for any company. In addition, Ineco, as a state-owned company, has to set an example.

3 WHICH ARE MORE CONVINCING, RATIONAL OR EMOTIONAL ARGUMENTS?
Decisions are made by people, based on that balanced combination of emotion and rationality that we all have to a greater or lesser extent. In order to persuade, it is essential to generate trust, a feeling that is hard to create if one isn’t scrupulous in their work.

4 HOW DO YOU RECONCILE THE DIFFERENT FUNCTIONS YOU PERFORM FOR THE COMPANY?
The truth is that they fit together perfectly. My work in the president’s office and management committee enriches the vision to define a CSR strategy that is aligned with Ineco’s general strategy.

5 IS MONEY IMPORTANT?
I would be lying if I said no. Yes, it is important, but it is not the *sine qua non*. There are great examples in which other elements such as institutional partnerships, personal effort, creativity and passion have replaced the scarcity of resources with extraordinary results, especially with regard to institutional relations and CSR.

6 WHAT’S YOUR MOST EXCITING CURRENT PROJECT?
Giving the final push to Ineco’s commitment to the United Nations’ 2030 Agenda for Sustainable Development and increasing awareness of it. If we all join forces, we can really change things. ■

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