ENGLISH EDITION

itransporte

Transport engineering & consultancy magazine

ineco

www.ineco.com

54

JUN | SEP 2015

DESIGN OF RETAIL AREA

The airport, the city's first showcase

INTERVIEW

J.M. Fernández Bosch

Director of Commercial Services and Property Management of Aena

"The commercial offer is a key element for the passenger's experience"

R&D+i (CEDEX)

A million axles in a laboratory

BI-OCEANIC RAILWAY CORRIDOR (BOLIVIA)

Environmental sensitivity

BRAND SPAIN

Beaches: nearby paradises

Editorial

The last contracts signed in Latin America, as well as in Europe, Africa and Asia, which include a number of expansion projects, are a clear example of the course the company has taken and the substantial achievements we have attained in a relatively short period of time. These accomplishments are both the core of our expansion project and also living proof that the competitiveness and know-how of Ineco's professionals is trusted and recognised beyond our borders.

Playing a greater role in the overseas market is also achieved by fostering agreements between companies and promoting collaboration among firms, institutions and states themselves. Intergovernmental rapprochement and participation in development programmes and projects are in engineering's nature, given that it is a science committed to both enhancing the mobility of populations and improving their quality of life, wherever they happen to be. The agreement with the National Secretary of Water in Ecuador was recently reached in this very spirit.

It is the backing of our clients, shareholders and institutions in Spain that enables us to take this course and enrich it day by day. Growing together is translated into projects such as our work with Aena, for whom we designed commercial areas in airports –as seen on the cover page of the magazine– and the innovative trials on the effects of sand on the track, conducted in the Spanish rail research laboratory, Cedex, which is a leading centre of its kind in the world.

Together with these articles, readers will find detailed information on other projects such as those undertaken for the governments of Brazil, Bolivia and Oman, and on the part we played in developing the Spanish high speed network with our recent work on the Ulla viaduct.

I am certain that readers will find these reports, with which we aim to bring engineering closer to society, stimulating to read.

Jesús Silva Fernández
President of Ineco

Contents

COVER IMAGE: WORLD DUTY FREE GROUP

Published by INECO
Paseo de La Habana, 138 - 28036 Madrid - Tel. 91 452 12 56
www.revistaitransporte.com
Editor-in-Chief: BÁRBARA JIMÉNEZ-ALFARO (*barbara.jimenez@ineco.com*)
Editorial Staff: LIDIA AMIGO (*lidia.amigo@ineco.com*)
Editorial Board: JOSÉ ANGUITA, RAFAEL MOLINA, JARA VALBUENA
Design: ESPACIO28004 / Mariano Serrano, Juanjo Jiménez
Printed by: GRÁFICAS 82
Legal Deposit: M-26791-2007

Follow us:

News

Peru

Modernisation of Chiclayo Airport

Ineco was awarded two new contracts in Peru, in both cases as part of a consortium with Cesel. In Lima, where it already supervises the enlargement works of the country's main airport, Jorge Chávez Airport (see it53), it will also provide consultancy services for assessing the levels of service. Likewise, it has begun to prepare various preliminary studies for the modernisation of Chiclayo José Quiñones Gonzales International Airport in the north east of the country. The works cover airside facilities (enlargement of the runways, signalling, etc.), landside facilities (passenger terminal, parking, entrances, maintenance

facilities, freight terminals, etc.), and road access. They also include aeronautical facilities, such as the antenna field and the control tower, air navigation systems, and many other elements and systems: electrical substations, baggage handling systems, passenger boarding bridges, parking charges, etc.

AIR-PORTS

Singapore

A new management system for Changi

Ineco has won the international tender to apply the ICAO service standards to Changi Airport, in Singapore, which is undergoing an expansion process, with a fourth terminal, which will be ready in 2017 and which will increase its capacity by 25%. This is the company's third work in the Asian airport, which, with 52 million passengers a year, is considered to be one of the best in the world (see it52). The objective is to provide the Civil Aviation Authority of Singapore, CAAS, with the most modern key indicator measurement systems.«

Angola

More safety for Luanda Airport

Aena Internacional and Ineco continue to carry out studies to improve the operations of the Angolan Quatro de Fevereiro International Airport in Luanda, the capital of the country, where work was begun in 2013 (see *it48).* The aim of these works, which will conclude at the end of 2015, is to identify and analyse all of the aspects of the airport's operations, from the facilities to the staff and procedures, and propose corrective actions, particularly in terms of safety.«

Spain

The representatives of ICAO visit Ineco

The president of the ICAO (International Civil Aviation Organization), Olumuyiwa Benard Aliu, visited Ineco's headquarters on 10 April as part of an institutional trip in which, amongst other meetings, he also met with the minister of Public Works, Ana Pastor. Aliu, a Nigerian, was elected in 2013, replacing the Mexican Roberto Kobeh (see interview in *it43).*

In the photo, from left to right: Corporate Managing Director, Ignacio Fernández-Cuenca, Aliu with the president of Ineco, Jesús Silva, Víctor Aguado, Spanish representative in the ICAO, and Deputy Director of Strategic Marketing and Communication, Rafael Molina.

Cape Verde

Driving forward tourism with airport enlargements

The aeronautical manager of Cape Verde, ASA *(Aeroportos e Segurança Aérea)* has commissioned Ineco with the supervision of the passenger terminal enlargement works on the islands of Boa Vista and Sal. It will also design the Global Navigation Satellite System (GNSS) procedures for the international airports of Boa Vista and São Vicente, and will develop the master plans for the local aerodromes. Airport development is vital for the economy of Cape Verde, where tourism already accounts for almost 25% of GDP.«

Mozambique

Improvement in air navigation

Ineco is collaborating with the Spanish multinational DF Núcleo to update the ATM system for the state body Airports of Mozambique (ADM). Specifically, it is providing its services in the support of the ATM systems design with integrated ADSC/CPDLC and ADS-B, the specification of the equipment and systems, and the support for their subsequent deployment. Likewise, it includes an analysis of air space and TMAs, a multilateration analysis, and a VHF coverage study. With this project, Airports of Mozambique aims to update its CNS equipment and optimise management of its air space and the safety of operations in the country.«

Beira Airport, Mozambique.

United Kingdom

RAILWAY PROJECTS

Agreement between Ineco and the British consultancy Capita

In February, Ineco and the British consultancy Capita Property and Infrastructure met in London to sign a collaboration agreement for five years. The agreement is a strategic alliance ahead of joint participation in all railway projects in the United Kingdom. Since 2012, both companies have collaborated in the preliminary platform design of the northern section of the British high speed line HS2, which will link the cities of London and Birmingham.

PHOTO: In the centre of the photo, Richard Marchant, CEO of Capita, with Jesús Silva, president of Ineco. Behind, José Manuel Tejera, director of Infrastructure and Transport and Pablo Ramos, country manager and Europe-North East Account Manager, representing Ineco, and Tim Healy, relationship manager and Phil Downes, HS2 Key account manager, representing the British consultancy.

Ecuador

Collaboration with the National Secretary of Water

Ineco, as the engineering company of the Public Works Group, collaborates with the National Secretary of Water in Ecuador (Senagua), in the revision and regularisation of right of use concessions and water use, the inventory of the drinking water, sewage system, and irrigation management boards, as well as the development and programming of the National Irrigation and Drainage Plan. The company has collaborated with Senagua since 2013, with the technical supervision of the studies for the National Integrated and Integral Management Plan for Water Resources in Ecuador.«

APPOINTMENT

Miryam Sánchez, Ineco's new Waste technical director

With a Bachelor's degree in Life Sciences and a Master's degree in Environmental Pollution, Miryam Sánchez is an expert in waste management. With over 23 years of experience, she has led more than 30 waste facilities projects in companies and public administrations, such as the City Council and the regional government of Madrid.«

News

First contract in Oceania

Ineco, along with an Australian partner SMEC, will take charge of the design, bidding and supervision of the overlaying of the runway of Faleolo International Airport in the archipelago of Samoa, located in the mid-Pacific Ocean. The airport, located near Apia, the capital of the country, has a single runway 3,000 metres long. The works are part of the Samoa Aviation Investment Project (SAIP), an initiative of the World Bank included in the Pacific Aviation Investment Program (PAIP), for the Pacific islands.

Portugal

Strategic plan in the ports of Sines and the Algarve

The port authority of Sines and the Algarve has awarded the Portuguese engineering company TIS and the Spanish company Ineco the development of a strategic plan to improve the services and management of its facilities. The study objectives include consultancy for the development of the investment plan and the new port administration model. Ineco recently performed similar works in the ports of Ecuador within the country's strategic mobility plan.

FAIRS/CONFERENCES

Paris

Passenger Terminal, 21st edition

During the World ATM dates, Passenger Terminal took place in Paris. It brought together more than 160 exhibiting companies from 85 countries and more than 3,500 professionals. Carlos Amigo, project manager of the KIA enlargement works, gave a presentation on the project, while Matthew Cornwall, manager of Air Transit Projects, described the experience of the company in the Apron Management Service (AMS).«

INSTITUTIONAL RELATIONS

Abu Dhabi Airports visits Ineco and Madrid and Barcelona airports

A delegation from Abu Dhabi Airports (ADAC), led by its head of operations, Ahmad Al Haddabi, visited Ineco's headquarters in March as part of an institutional visit to learn about the operations of the main Spanish airports, Barcelona-El Prat and Adolfo Suárez Madrid-Barajas. In the latter, the visitors were interested by the Apron Management Service (AMS) operated by the company. In the offices of Ineco, which along with Aena is carrying out the Operational Readiness and Transfer (ORAT) of the new terminal Midfield Terminal Complex (MTC) of Abu Dhabi Airport, the delegation met with the president Jesús Silva and company directors, as well as those of Aena.«

Muscat / Dubai

Conference on ORAT

Carlos Amigo (right), along with Santiago Gómez de Olea, Ineco delegate in the Middle East and the Persian Gulf, (left) also attended the first conference on ORAT (commissioning and operational transition), hosted by the capital of Oman, Muscat, on 25 and 26 March. On this occasion, Rafael Molina, Ineco's deputy director of Strategic Marketing and Communication (centre), gave a presentation on the company's experience in ORAT. Ineco, along with Aena, is currently in charge of the commissioning of the future new terminal that is being built in Abu Dhabi (see *it51*).«

During the first few months of the year, the president of Ineco, Jesús Silva, visited several Central American countries to hold meetings with authorities, institutions, and companies. In April he visited Costa Rica and in March, Ecuador and Guatemala, where he attended the business meeting between the SICA (Central American Integration System) countries and Spain. Furthermore, he met with official representatives of various countries in Madrid, such as the new ambassador of Albania, and the minister of Public Policies and the ambassador of Nicaragua, amongst others.«

BIM conference: intelligent infrastructure

On 28 April, Ineco, in collaboration with the Ramón Areces Foundation, organised a meeting in Madrid to share the BIM (Building Information Modeling, see *it52),* in which expert speakers of Ineco and various representatives of the national infrastructure sector participated. Mario Garcés, deputy secretary of Public Works, who closed the conference, announced the creation of a public-private working group for the implementation of BIM in Spain.

Taiwan

Air safety study for the Port of Kaohsiung

In March, Ineco along with the local company MITAC began a study for the main commercial port in Taiwan, Kaohsiung. The objective is to determine the potential effects on air safety of the 140 metres cranes installed in the new container terminal, located nearby to the airport. Kaohsiung, with 2.7 million inhabitants, is the island's second city after the capital, Taipei. Its port annually manages a cargo volume of 10 million TEU, and an enlargement process is underway.«

FAIRS/CONFERENCES

Madrid

World ATM

For another year, Ineco attended the main trade fairs of the aeronautical and airport sector, such as World ATM, organised in Madrid from 10 to 12 March by the world association of air navigation service providers, CANSO, along with ATCA. The minister of Public Works, Ana Pastor, opened the event, in which the company, which had a stand with the Public Works group, held two talks in which the speakers were Víctor Gordo and Carlos Barbas, who spoke about a number of air navigation tools developed by Ineco: Cover GNSS and proESTOP.«

PHOTO: In the centre of the photo, the minister accompanied by the secretary general of Transport Carmen Librero, Julio Gómez-Pomar, secretary of state and president of Enaire, with Ignacio Fernández-Cuenca, Corporate general director, José Ángel Higueras, director of Aeronautical Business, and Francisco Olmedo, Enaire Account director.

The airport, the city's first showcase

Airports see their commercial areas as a strategic business line

By **Alberto Calderón**, expert in business developments

Not only income is important, which may account for 50% of the turnover, but also the identity of the city, or a country, is at stake; airports need to know how to manage leisure areas, where the passenger may enjoy the travelling experience and satisfy consumption needs.

Even though airports have been traditionally considered as passing-through locations, it does not go unnoticed that today they are seen as a big shopping mall where the traveller and fellow travellers may find their leisure and consumption needs satisfied. 21st century airports are enriched by new spaces governed by complex codes, which are not always at plain sight. The personality of the airport, of the city or even of the country where they are located as well as their *modus operandi* come into play: routes and destinations, type of passengers and/or goods, facilities... All in all, a space with certain users, technologies and regulatory frameworks that condition the commercial offer of their facilities.

Aena, an experienced manager

With 47 airports throughout Spain, Aena is one of the most experienced managers of this activity all around the world: its experts plan, design and manage commercial areas in terminal buildings and exploit the land making up the so-called "general airport system" suitably from a commercial standpoint. In addition, they are in charge of calling for public tender the rental of retail areas to third parties that develop their activities there: the so-called concession holders or tenants. In 2014, 196 million people passed through all its airports, Adolfo Suárez Madrid-Barajas and Barcelona-El Prat airports being at the top of the list, as world-scale models due to their great volume of passengers, with 41.8 million and 37.5 million passengers respectively.

Over 12 years in the planning and design of commercial areas

Ineco has been cooperating with Aena for over 12 years in the planning and design of commercial areas, both in works aimed at the coming-into-service in new infrastructures, and the commercial redesign of operating airports. This job requires the joint work of technicians with multi-disciplinary knowledge and a high-degree of expertise, who are capable of developing a comprehensive commercial planning. Thanks to this experience, Ineco's work teams cover the whole process of a commercial development, from the initial stage –conceptual design and drafting of the construction project– to the final stage, providing support in the works of private operators and

21st century airports are enriched by new spaces governed by complex codes, which are not always at plain sight

in the operation tests required for perfect operation.

Business complexes

What does this commercial and leisure offer consist in? Besides the well-known *duty-free* shops, restaurants or VIP lounges, the commercial offer of today's airports is a much more complex puzzle with a wide variety of activities, including, among others, business centres, specialised or luxury stores, theme restaurants, latest advertising trends or numerous vehicle-related services.«

Ineco's works in commercial developments

1 Design, definition and dimensioning of the commercial offer
This stage comprises the organization of the information on the infrastructure and the existing offer and the definition of the actions aimed at the enhancement of the future commercial design.

2 Planning and follow-up actions of general commercial works
It implies identifying all the activities to be performed and their execution terms, agreed upon with the different stakeholders.

3 Technical documents on different fields aimed at the success of commercial actions
This stage comprises the commercial surveys performed to ensure a proper commercial implementation.

WDFG walkthrough stores for AENA.

PHOTO: WORLD DUTY FREE GROUP

The commercial offer of today's airports is a much more complex puzzle with a wide variety of activities, including, among others, business centres, specialised or luxury stores, theme restaurants, latest advertising trends...

PHOTO: AENA

Rest area in the Adolfo Suárez Madrid-Barajas airport.

PHOTO: CLIVE DARRA

Commercial areas in Heathrow airport.

PHOTO: TESCO

Tesco virtual store in Gatwick airport.

Infographic of the central area of the World Duty Free Group walkthrough store at T4 terminal in Madrid. Original glass floors were replaced by porcelain material and dropped ceilings were added, which also add personality to the whole set.

Latest trends: from walkthrough to grab and go

The integration of technological information systems as a means to support commercialization –screens and other elements of the so-called 'Spectacular marketing' strategy, dynamic advertising, interactive support– are part of airports' regular activities and open up an extensive range of possibilities, such as the use of smartphones and tablets as a means to receive any kind of airport-related information (flight departures, special commercial offers or location of certain required services).

But the airports conceived with this new approach also increase and simplify their security filters and redirect traffic flows. With every new reform, airport terminals multiply the size they had with the aim of meeting an air traffic demand that grows exponentially. Within this context, commercial areas are conceived as open spaces where the stores have large façades that invite the passenger to access naturally, minimising physical barriers. The greatest exponent of this concept is the walkthrough store, today present in the world's main airports and operated by the large Duty-free companies. The walkthrough concept lies in leading the total passenger flow towards boarding areas in a natural way passing by a wide variety of well-known brands in an attractive environment.

The implementation of the grab and go or takeaway food, which are increasingly growing as a result of the proliferation of low-cost companies

Commercial design cannot turn its back on the boom of virtual shopping: the need to board the items purchased in the boarding area conditioned the product ranges that were traded. Today airports such as the ones in Delhi and Frankfurt already offer shopping walls where the customer selects all kinds of virtual products through a QR code, which are delivered a few minutes later; in London-Gatwick, for instance, it is possible to do virtual grocery shopping through a smartphone application and have the items delivered when you get home.

Commercial design trends are actively involved when it comes to defining commercial layouts; restaurants are arranged together so that large food courts are created. These courts often share waiting areas offering a wide variety of dishes to travellers. New products and concepts continue to appear to cater for current demand such as, for example, the implementation of the grab and go or takeaway food, which are increasingly growing as a result of the proliferation of low-cost companies. All in all, they are very lively and dynamic environments where the aim is to meet the demands generated according to the type of passenger. This is why many commercial developments include concepts such as beauty, wellness and spa centres , recreational areas, hotels which offer rooms per hour, etc.«

BASIC PILLARS OF COMMERCIAL DESIGN AT AN AIRPORT

Unlike other centres, airports are complex areas where different agents who condition design are involved. It is essential to identify and assess these constraints.

Improving the passenger's experience: improved airport processes go hand in hand with the success of a new design of the commercial offer: a bad experience at check-in or having to go through an excessively long path will affect results.

Layout definition and proper commercial dimensioning: when it comes to layout design the architectural barriers and the morphology of the terminal building must be identified as constraints which should be taken into account. It is necessary to calculate the area according to reasonable m² /Mpax (million passengers) ratios, taking airports of the same size and typology as reference. An over-dimensioned area does not entail higher commercial income.

Passenger flow: knowing the path passengers follow and where they come from is essential when designing. The goal is that even if passengers do not go through the whole area, they should at least have the chance of seeing the whole offer, although it would be ideal to lead all passengers towards it.

Market surveys: an airport is a cultural melting pot and an international space. Benchmarking and consumption habit surveys allow being up to date with the latest trends, tastes and current international leading brands.

Balance, flexibility and diversity: an airport calls for a specific balance between specialised stores, restaurants and Duty-free. The aim is that the passenger is provided with a complete commercial offer. This requires flexible and adjustable designs, and an exquisite variety of services (bank, car park, beds, telephone services, gifts, beauty, etc.).

A pleasant but dynamic environment: time is money. Set in an atmosphere of restlessness which is inherent to air traffic activities, airport commercial areas are increasingly conceived in an island format, pleasant and attractive, where a cosy environment is generated, being aware that time is limited.

Methodology in commercial developments

1. Current situation per business line
2. Preliminary proposal for changes in the construction project
3. Analysis of the commercial mix
4. Definition of the commercial offer
5. Support to commercial tender

The experience gained by Aena and Ineco has allowed exporting their knowledge in commercial developments and designs to international projects, such as those conducted in the airports of Casablanca, El Salvador or Kuwait

PHOTO: AENA

On the picture, Barcelona-El Prat airport; on the right a Bulgari store at Adolfo Suárez Madrid-Barajas airport.

PHOTO: BULGARI STORE

Before and after: the spectacular transformation of Aena's commercial areas

The world's largest airport manager has bet on an ambitious restructuring and intensification of commercial areas in the main airports of its networks. For some years now, the commercial management of the company has given priority to improved accessibility and visibility of the stores located at the airports, offering an architectural environment which the traveller finds attractive and a modern and rich offer distribution. The extraordinary effort of the Spanish public company, which went public early this year, is reflected in the m² and turnover figures generated in the commercial areas of the large terminals of Madrid, Barcelona, Gran Canaria, Tenerife-Sur, Palma de Mallorca, Málaga and Alicante international airports, which together amount to 154,000 m² . In 2014, the total turnover resulting from Aena's commercial activities increased by 8.5 % as compared to the previous year. The combination of new design proposals at the stores has generated, over the last few years, new concepts of design, such as leading travellers across walkthrough stores, already mentioned in this article. Spain's largest walkthrough area of this kind, Mallorca Duty Free, has an area of 2,659 m² and is crossed by around 12 million travellers per year.

Today Aena is on the forefront of the airport commercial offer on a world scale

We can say that today Aena is on the forefront of the airport commercial offer on a world scale. Ineco has been its partner in this hard mission, which so far has been very successful.«

PHOTO: AENA

On the picture, a detailed view of the T4 terminal of Adolfo Suárez Madrid-Barajas airport.

THE PURSUIT OF EXCELLENCE

From casual wear to well-known luxury brands:

Well-known brands

The traffic volume of an international airport is increasingly attracting the world's largest fashion, luxury and restaurant brands, which, in turn, as they become one of the main interests of the traveller, boost commercial activity. Merging this offer into the airport environment has generated new spaces with courts and streets within the airport itself, where the traveller literally walks in between brand stores, ranging from casual wear to well-known luxury brands; restaurant services from fast food or self-service to linen-tablecloth-covered tables; wellness centres, showers, hair-dressing and beauty; VIP lounges, pharmacies, financial centres, etc. All this, obviously, with car parks and accesses which make their use easy.

Luxury brands

With this trend in mind, in 2013 Aena launched a new business line focused on the luxury segment in 26 stores, at Adolfo Suárez Madrid-Barajas, Barcelona-El Prat and Málaga-Costa del Sol airports, an area of more than 4,600 m², which in Madrid includes a wellness centre.

MAD Fashion Hub

As part of this same concept of luxury and high-end, Aena has coined the concept MAD Fashion Hub in Madrid airport, which in 900 m² incorporates high-street brands, present in the busiest streets of large capital cities.

PHOTO: PABLO NEUSTADT

Alicante airport.

More than car parks

Reaching the airport by car is becoming a more attractive option thanks to the new commercial offers: short-stay, long-stay, standard or low cost parking are alternatives which offer services ranging from pick-up and drop-off at the terminal's entrance, advance booking via telephone, email or web, oil check, exterior and interior cleaning, TVI, etc.

PHOTO: DANI GARCÍA

DeliBar, of Dani García, at Málaga airport.

"Tapas" at Michelin-starred restaurants

An example of adjusting to demand has been the integration of the Spanish cuisine in the country's airports, a sign of identity of the brand Spain which Aena has valued with an offer that is very hard to beat. It has not only incorporated the gastro bar concept –restaurants where the "haute cuisine" offer is combined with affordable prices– but also offers restaurants managed by prestigious Michelin-starred chefs in the airports of Madrid, Barcelona, Málaga and Alicante: Kirei by Kabuki at T4 terminal in Madrid-Barajas was the first Japanese restaurant in a Spanish airport; Porta Gaig, at T2 terminal in Barcelona-El Prat combines luxury with outstanding views; DeliBar at Málaga airport, where "haute cuisine" is offered as a hamburger or hot dog dish; Sabor a Mar, at Alicante airport, offers three types of menus adjusted to the traveller's needs. And all of them offer the passenger the option of tasting the food on the plane.

PHOTO: AENA

La Maison Paul of Barajas airport.

Interview | JOSÉ MANUEL FERNÁNDEZ BOSCH

Director of Commercial Services and Property Management of Aena

"The commercial offer constitutes a key element for the passenger's experience"

PHOTO: AENA

Fernández Bosch earned his degree as Telecommunications Engineer from the Universidad Politécnica de Madrid (Polytechnic University of Madrid), and his MBA from the IESE Business School. He was partner of The Boston Consulting Group in Madrid and before that he worked at Vodafone Spain and Accenture. As Aena's Commercial Services and Real Estate Management Director, he is in charge of managing stores, restaurants, car parks and car rentals, and of developing real estate in an airport network comprising 47 airports, which makes it one of the greatest airport networks in the world. He is also in charge of the airport marketing area, which focuses on the development of routes and traffic within Aena's network.

In the past few years, Aena has carried out an outstanding investment effort; which actions would you highlight in this regard?

Without a doubt, the most important project as far as transformation and investment is concerned is the one carried out in the commercial areas of Terminal 4 and its satellite terminal. This transformation, which took advantage of the termination of the contract of most of the commercial leases in these areas, not only has entailed a completely new distribution of commercial areas as to stores and restaurants, it has also entailed the creation of the concept of "malls", which allows passengers to rest and wait in a more comfortable and close environment until their boarding gate is announced.

The commercial transformations carried out in other airports are also worth highlighting, which in many cases did not receive such important investment by Aena, but a notable boost indeed in terms of re-distribution and generation of new spaces. For example, Terminal 2 in Barcelona or commercial actions in the airports of Palma, Málaga and Lanzarote.

Which is the percentage of commercial income for all of Aena and how has it evolved?

Commercial income accounts for 26% of Aena's total income. In the last few years, the evolution has been very positive, specially in 2014, when there was a 15% increase as compared to 2013. It is a clear response to the commercial transformation programme that began in 2012, which has included the remodelling of spaces such as those previously described

"Without a doubt, the most important project as far as transformation and investment is concerned is the one carried out in the commercial areas of Terminal 4 and its satellite terminal"

in several airports of Aena's network, the renegotiation of contracts and the implementation of new business models in parking spaces or VIP lounges.

Which are the main commercial operation lines?

The business line related to duty-free shops is, without a doubt, the most important one, due to its central position in airports and its contribution to commercial income, which accounts for almost 25%. Restaurants and stores are also highly significant, just as leasing areas for car rental. Furthermore, both in business and operating terms, the real estate business is also very important and it includes leasing offices, hangars, loading bays, plots and other facilities. Finally, parking accounts for a business volume that is also noteworthy; a service for which Aena provides several products based on their proximity to the terminal, the length of stay or other additional characteristics of the offer.

What do you think of the use of devices such as smartphones and tablets as a means of support to commercialisation in airports?

Aena has a smartphone application that allows passengers to check the status of their flights, the location of shopping services (stores, restaurants, services) in the airport they will be using, as well as booking a parking stay or buying access to a VIP lounge. We are working so that parking or access to VIP lounges may also be paid through smartphones. Doubtlessly, this is a field where we want to speed up our development.

What other actions have been carried out to improve the passengers' experience?

Aena is working on many initiatives; for example, improvements on signalling, both commercial and operational, an easier and more comfortable way to go through security checks or the improvement of basic services such as restrooms, etc. From a purely commercial point of view, we have worked in the enhancement of spaces so that the passengers' stay and traffic are more comfortable and attractive.

How much do you think that these remodellings have influenced users into choosing Madrid and Barcelona airports as the first and second best airports in Southern Europe in the World Airport Awards?

"Ineco has vast experience in the development of the airport business, including the commercial segment"

The airport's commercial offer is a key element for most passengers during their travel experience. Therefore, I am sure that, when it comes to evaluating an airport, users take this highly into consideration. In addition, in the last few years Aena has made a huge effort in different areas, which led Madrid and Barcelona Airports to be among the best airports around the world.

Will the inflow of private capital in Spanish airport management change the strategy somehow?

In view of the recently submitted 2014 results, the strategy developed has been a success. Aena has managed to improve efficiency significantly which, along with the increase in income, such as commercial income, have led the company to show a great improvement in EBITDA during the 2012-2014 period. In this regard, the basic elements of the strategy are in progress. As of now, this strategy will need to be adjusted and more focus is to be placed in certain aspects of the business to which less time was devoted during the recently concluded process, such as the development of the real estate business.

"Business income accounts for 26% of Aena's total income. Its evolution in the last few years has been very positive, specially in 2014"

Which is the role that you think Ineco may play in this process?

Ineco has vast experience in the development of the airport business, including the commercial segment. In addition, Ineco is familiar with Aena, its infrastructures, their business specifics and its organization. I am sure that a smart combination of these two strengths will put Ineco as a potential key partner to develop many of the challenges Aena will be facing in the future.«

A million axles in a laboratory

A Spanish centre simulates the Haramain train traffic

By **José Peña**, industrial engineer and **Irene García**, forestry engineer

Mariano Navas, director of Cedex, (left) and Vicente Cuéllar, director of the Geotecnia laboratory, with Jesús Silva, president of Ineco, during the visit to the facilities.

Ineco and Cedex experts draw the first conclusions about the effects of sand on the track for the Makkah-Madinah high speed project, in Saudi Arabia.

Once the test device has been prepared, and with just one week's work in the laboratory, the effect that the annual train traffic has on a real track section in normal traffic conditions can be determined. This is a measure of the strength of the results that can be obtained from the tests that are carried out in the facilities of the Spanish rail research laboratory Cedex.

This unique centre has the equipment necessary to simulate rail traffic that is 2 or 3 times higher than that which is normal for any line in Spain. Therefore, its main advantage resides in the fact that it can simulate the behaviour of the infrastructure under different scenarios in controlled laboratory conditions, and speed up the train circulation rate that is normal on real lines in service.

Studies on the subgrades of the track

It is for this reason that the Spanish consortium Al Shoula, conscious of the challenges of building a high speed line with high traffic density that passes through areas that are subject to sandstorms in which there may be contamination of the ballast bed, has commissioned Cedex rail experts to carry out certain studies on the behaviour of the subgrades of the track, and the materials that constitute it, in extreme weather conditions; particularly with regard to the involvement of desert sand on the track and the effects that this contamination may have on the normal operation of the line service.

The tests focussed on determining the relationship between the different degrees of contamination of the ballast and the mechanical behaviour of the infrastructure by adding sand. As such, the test was divided into various stages, considering the volume of the ballast beneath the underneath surface of the sleeper, and the sand is capable

The tests reveal that sand deposits have only a mild effect on the overall mechanical properties of the track

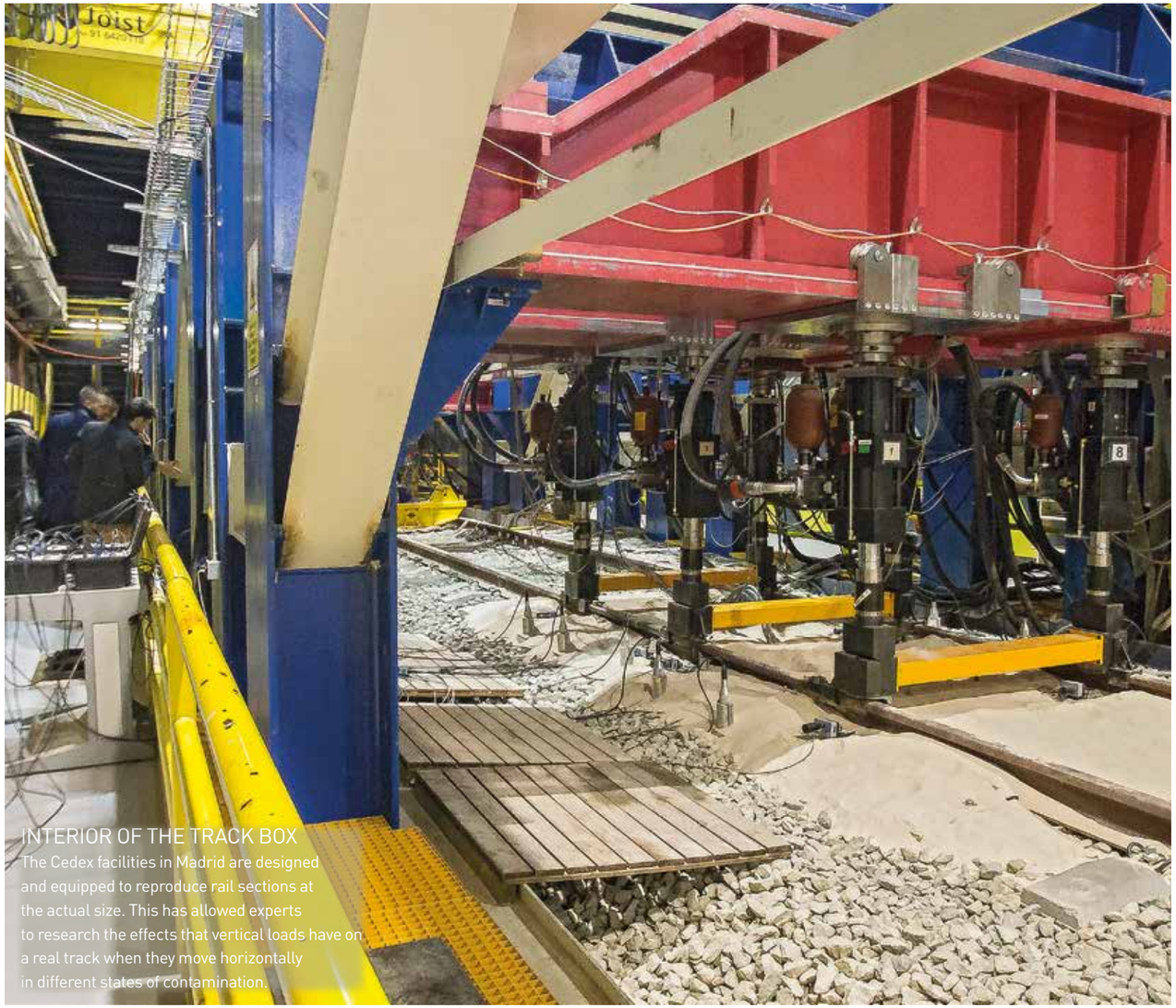
of entering until it reaches the point of simulating the effects of a storm (complete incrustation). At each stage, and after the passage of a certain amount of traffic, the parameters of interest of the track are evaluated in static and quasi-static terms by a large number of sensors distributed throughout the tested section, through the accelerations, speeds, and journeys measured in their components and the interfaces between them.

Revealing conclusions

The first conclusions of the tests carried out since June 2014 allow us to anticipate that, after simulating the passage of a million bogies (about 45,500 trains), the line's mechanical properties are affected by the sand deposits, but not to any great extent. Although at a local level the ballast is rigid after the full set of tests, this behaviour is not apparent in the same way in the overall rigidity of the whole from the quasi-static point of view, as a result of the contribution of the ballast to the overall elastic properties of the track (20%-30%). This information has been received as great initial news, although, for the researchers in this project, it remains to be seen what will be

The first conclusions of the tests carried out since June 2014 allow us to anticipate that, after simulating the passage of 45,500 trains, the line's mechanical properties are affected by the sand deposits, but not to any great extent

the maximum traffic limit at which the line can endure the erosive or cumulative effects of the sand without losing its properties. For this, it would be necessary to take into account the deterioration caused by the abrasion, both of the profiles of the wheels of the rolling stock and of the rail tread surface, as well as the intense traffic planned, which will be two to three times higher than that of the Spanish high speed lines.«



INTERIOR OF THE TRACK BOX
The Cedex facilities in Madrid are designed and equipped to reproduce rail sections at the actual size. This has allowed experts to research the effects that vertical loads have on a real track when they move horizontally in different states of contamination.

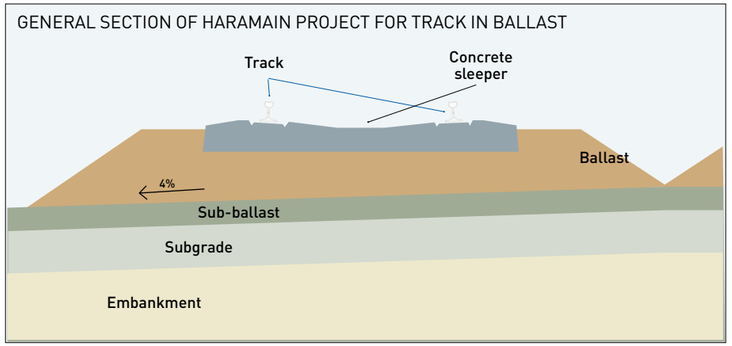
The Spanish Cedex (Centre of Studies and Experimentation of Public Works) laboratory has unique installations which simulate the way a high speed train functions when circulating a 1:1 scale track

Michael Ashiabor and Irene García in the foreground. On the right: José Peña, César Leal and Almudena Díez.

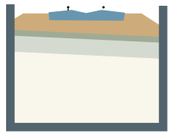
Simulation development and description

FULL-SCALE INSTALLATIONS

The Track Box is a 21-m-long installation which allows entire real-scale rail sections to be simulated. The 'typical section' planned for Haramain has been reproduced in a 7-m- long by 5-m-wide section within the Track Box.
In addition to testing the mechanical behaviour of the infrastructure in its materials when subjected to varying degrees of sand contamination, studies were also carried out on a waterlogged ballast through large-scale triaxial tests



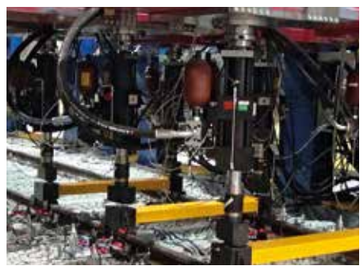
SECTION IN TRACK BOX



The structural section is made up of an embankment formed of 1.37 m of clayey gravel at the bottom with a 1.25-m-thick layer of clay on top. Above this is a subgrade with an average thickness of 0.54 m, which serves as a base for the 20-cm-thick granular sub-ballast and 4% slope.
The under sleeper ballast is 35 cm thick at the inner rail and 41 cm at the outer.

A HIGHLY DETAILED REPRODUCTION

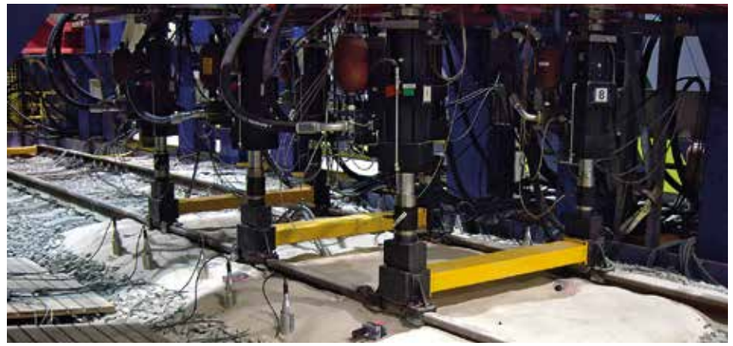
Similar materials to those used in the Haramain project, as well as desert sand, were required for tests in the Track Box in order to simulate features of the real track. In particular, the ballast and sand have been carefully selected from Spanish quarries. Andesite has been chosen for the ballast as it is the same type of volcanic rock used in Arabia. Its geometric, physical and chemical properties are in line with the required project specifications



and it is commonly used for this type of infrastructure.
The sand (the contaminating agent), collected from quaternary continental dunes, has been selected so that its grading curve and statistical values represent Saudi desert sands with sufficient accuracy. Lastly, to construct the rail tracks in the same conditions as planned, rail profile 60E1, elastic Vossloh fastening W14 (60 kN/mm) and pre-stressed monoblock concrete sleepers AI-04 EA have been used. This leaves a 1,435 m standard gauge track of 7 m in length, with 13 sleepers spaced at 60 cm intervals. This is to produce as close a replica as possible to the superstructure planned for Haramain.

INSTRUMENTATION OF THE SECTIONS

The application of the loads was carried out using six dynamic actuators, one by one located on each rail and 1.5 m apart. They were duly dephased and reproduced the approach, passage, and departing effect of any type of train, as occurs in a real track in use. In this case, it is a Talgo S112, 207.13 m in length consisting of 2 locomotives with 4 bogies and 13 wagons, adding 14 more bogies. Furthermore, the fact that the system of actuators allows simulation of the horizontal movement of the bogies at speeds of between 100 and 400km/h, the effect of loads per bogie of up to 50 t, its high precision (0.01 mm), and the high number of sensors with which it is measured in the different components of the track, allow the simulation of a large number of scenarios, as well as a very reliable calibration of numerical models in 3D.



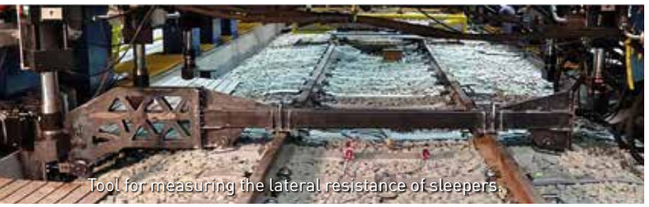
The instrumentation equipment for the development and implementation of the Track Box measure a large number of parameters including: relative and absolute movement values and measurements of speeds and acceleration of the movement on the rail, sleepers, ballasts, sub-ballasts, subgrade and embankments.

CONTAMINATION OF THE TRACK AND ITS MEASUREMENT

To analyse the mechanical response of the contaminated ballast, a dosing system was used, which was designed by Cedex technicians. It allows sand to be dispensed onto the track in a uniform and controlled manner. With this device, tests were carried out, starting by not contaminating the track and ending with 100% contamination and subsequent full saturation (thus simulating a storm) through five intermediate contamination stages. Use of an endoscope demonstrated the evolution of the contamination of the ballast bedding in each stage of the test.

Dosage system dispensing sand (left) and endoscope for measuring the contamination of the ballast.

International delegations of high speed experts from Saudi Arabia, the United Kingdom, and Germany travelled to Spain to learn about the work of Ineco and Cedex


Tool for measuring the lateral resistance of sleepers.

Other tests of interest

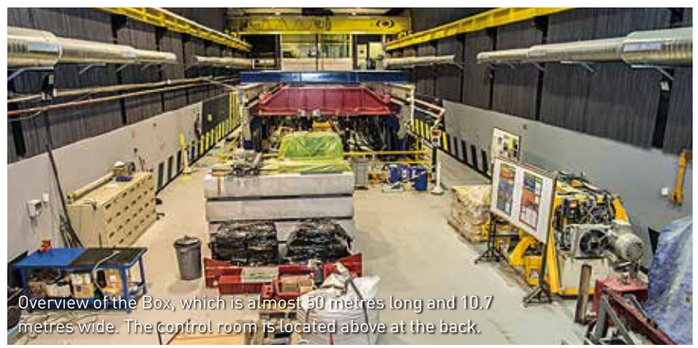
To measure the lateral resistance of the shoulder-sleeper system for horizontal loads, a haulage test on a sleeper was designed, in which a traction force is applied and the response is measured. This test was carried out on a section of the track of the Box in two different conditions: when the track was not contaminated with sand and when the track was completely contaminated: For this purpose, a tool designed by Cedex was manufactured.
The instrumentation has a load cell, two laser sensors to measure the horizontal movement of the sleeper, and two potentiometers to measure the relative movement between the sleeper and the rail.

The result of the test highlights an increase in resistance to the lateral movement of the sleeper on the contaminated ballast, and these results are consistent with the numerical modelling carried out and the values recorded in the technical literature, which validates the test method followed.

Lastly, and in addition to the large-scale triaxial tests carried out in the initial stages of the set of tests to establish a preliminary relationship between contamination of the ballast and its deformability (through Young's Modulus), the same tests were performed in water saturation conditions in order to observe its influence on this load bearing capacity.«

Anatomy of a Track Box

- **Test building 49.70 m long and 10.70 m wide at a level -7.85 m below ground, with a 32 t overhead crane and a removable cover for introducing large parts and the materials of which the rail infrastructure is composed. It has temperature and humidity sensors.**
- **Trench at a level -11.85 m and rectangular floor plan of 23.70 m by 6.70 m where the Box is located along with the MGCplus modular architectural analogue-to-digital converter for 128 sensors.**
- **Freestanding metal structure with 9 fixed reaction frames for applying the loads in each of the three zones, of 7 m in length, and 12 sleepers, which constitute the Box.**
- **Portable load application system, which includes 3 large metal beams that, with the help of an electric motor, can be transferred along the metal structure to be set.**
- **Control room, where the freight trains are designed, the actuators are controlled, and the signals from the sensors are received.**
- **8 hydraulic servo actuators of 250 kN load and 150 mm stroke, with a dynamic response of up to 50 Hz at full capacity and up to 100 Hz at a lower load.**
Controlled by three-stage servo valves of 680 litres/minute.
- **1 hydraulic servo actuator of 10 kN capacity and dynamic response of up to 200 Hz at full load.**
- **2 piezoelectric actuators of 20 kN capacity and dynamic response of up to 300 Hz at full load.**
- **High precision level with micrometer and an invar staff to corroborate the measurements of the ballast sensors during the operations of tamping and raising the track.**
- **Analogue ruler for measuring the width and cant of the track.**
- **Equipment for checking the tightening torque and correct placement of the coach screws on the sleepers.**
- **Independent ballast tamping machine with remote control.**


Overview of the Box, which is almost 50 metres long and 10.7 metres wide. The control room is located above at the back.


Interior of the control room.


INECO ENGINEERS

The Ineco engineers and specialists who worked on the project to analyse contamination of the ballast with sand on the Makkah-Madinah HSR, from left to right: Irene García, Juan Viñas, Juan Hungría, José Peña, Elena González, Michael Ashiabor, César Leal, Manuel Lombardero and Almudena Díez.


PROJECT HEADS

The main project heads met in March in the Cedex facilities in Madrid. The photograph shows the Ineco and Cedex directors and researchers, led by Jesús Silva, president of Ineco and Mariano Navas, director of Cedex. Next to them is the Ineco Special Projects team –María Sánchez-Palomo, Miguel Ferrández, and Michael Ashiabor– and Cedex staff: Miguel Ángel Andreu, José Estaire, Miguel González, Fernando Pardo, Jaime Tamarit, Vicente Cuéllar, Jorge Iglesias and José Manuel Gállido.

Greener *ônibus* for São Paulo

Survey on sustainable technologies for buses

By ***itransporte***, with the collaboration of **Emilio Miralles**, **Patricia Rey** and **Aldara Tadeo**, civil engineers

PHOTO: ANDRÉ LEMES

Heavy traffic on *Marginal Tietê*.

Reducing the pollution caused by over 70,000 buses and improving the quality of life of 24 million citizens is the goal of the survey conducted by Ineco, in consortium with Sistran, for Brazilian National Association of Public Transport and São Paulo's transport company.

São Paulo and the 173 towns of the three metropolitan regions surrounding it make up one of the largest urban areas on the planet, where the bus –*ônibus* in Portuguese– is the most used collective passenger transport means. Although Brazil has one of the world's biggest automotive industries and has pioneered in the development of some sustainable transport technologies –such as the so called biofuels–, 98.5% of the fleet of 70,400 buses existing in the three São Paulo's metropolitan regions (São Paulo, Campinas and Baixada Santista) uses diesel oil engines, and, therefore, fossil fuel.

Alternative propulsion technologies

The company responsible for this means of transport is São Paulo's Metropolitan City Transport Company (EMTU-SP), created in 1977. According to data from ANTP (Brazilian National Association of Public Transport), its 800 lines transport between 2 and 2.5 million passengers every day, which entails around 23% of the total metropolitan passengers. As compared to railway modes (train and subway), the bus is the one causing the strongest environmental impact, in terms of air and noise pollution. This is why, the ANTP and the EMTU have requested a consortium made up of Sistran Ingeniería, Ineco and Ineco do Brazil the performance of a comparative study of the alternative propulsion technologies, so as to be able to analyse and select the best technologies and apply then to São Paulo's fleet and thus reduce environmental effects. The study *Estudo Comparativo de Tecnologias Veiculares de Tração Aplicáveis a Ônibus Urbanos*, published in November 2014 within the set of technical papers of the ANTP, is part of the STAQ (Sustainable Transport and Air Quality) programme sponsored by the World Bank.«

The ANTP and the EMTU have requested Sistran and Ineco the performance of a comparative study of alternative propulsion technologies

PHOTO: EMTU/SP

São Paulo, an urban giant

The city area of São Paulo has 24 million inhabitants distributed in three metropolitan areas, all of them catered by the EMTU-SP which, since 2014, also renders service to the areas of Valle del Paraíba, Litoral Norte and Sorocaba. They were not taken into account in the study as they were recently incorporated.

São Paulo city_11 million inhabitants; including the metropolitan area (39 towns in total) 19.6 million. It has 9.1 million vehicles, more than 58,500 of them being buses. This entails 13% of the total country's fleet and 46% of the state of São Paulo.

Campinas_20 towns, 2.8 million inhabitants and 1.4 million vehicles, more than 9,100 being buses.

Baixada Santista_9 towns, 1.6 million inhabitants, almost 600,000 vehicles and about 2,800 buses.«

Transport and public health

- **Among the damages to the public health caused by city pollution are the worsening of breathing, allergic and heart problems, besides the carcinogenic effects of some substances such as methane or aldehydes.**
- **Some data are revealing: a medical study conducted in São Paulo in 2001 showed that, on days with high levels of pollution, hospital admissions for respiratory diseases increased by 30%, and death rate in senior citizens by 12%.**

The benefits of the technological change are not restricted to reducing polluting emissions but will also translate into an improved quality of life and well-being of citizens

TECHNOLOGIES UNDER CLOSE REVIEW

DIESEL OIL

It is the world's most used fuel. Among its drawbacks are noise and polluting emissions, although the new technologies –such as the use of catalysts or incoming air control systems to reduce consumption– have produced cleaner and less noisy vehicles.

BIODIESEL

It is a chemically synthesised product, which can be used straight (B100) or mixed with standard diesel oil in different proportions, regularly between 5% (B5) and 20% (B20), with the advantage that it is not necessary to make modifications in most of the engines. Above this proportion, the solvent capacity of biodiesel increases, which damages some parts of the engine, particularly rubber parts, and increases maintenance costs, as well as consumption. Brazilian legislation obliges to use a blend of 7% although the EMTU's fleet already has 34 buses which run 100% on biodiesel in the city of Curitiba, among others.

ETHANOL

Ethanol is an alcohol obtained from cereal sugar (corn, barley, wheat or soy) or vegetables such as sugar cane, beetroot, etc.; it does not contain sulphur and requires little adjustment in engines. In light vehicles it is possible to use it directly as fuel but in heavy vehicles, such as buses, it must be mixed with 5% additive, which represents a problem as a result of its high price. In addition, as it has lower energy capacity than standard diesel fuel, vehicles require larger tanks. Although Brazil is the world's largest producer of ethanol, together with the USA, and in spite of the low level of polluting emissions it produces, its use is not very widespread in public transport, above all, due to the operating cost of the technology. Nevertheless, as from mid 90s, several tests have been performed in the cities of Curitiba and São Paulo, where 60 ethanol-powered buses run today.

SUGAR CANE DIESEL OIL

Brazil is one of the few countries that develops this technology. São Paulo and Rio use sugar cane diesel in part of their bus fleets (total 200 vehicles), mixing it with biodiesel oil and standard diesel oil. However, operating costs continue to be high as a result of the scale of production.

NATURAL GAS

It has the disadvantage that it must be compressed or liquefied because of its large volume, and vehicle fuel tanks must be larger and heavier than standard ones. On the other hand, it has a high energy capacity and produces a low level of polluting emissions.

TROLLEY BUS

It is exclusively electric-powered and is supplied by an overhead contact line. It has been operating in several Brazilian cities since 1949. For proper operation, it requires permanent contact with the overhead line, which in itself entails added installation and maintenance costs, and has a negative visual impact, coupled with the prices of electricity. On the positive side, it emits no pollutants, does not consume when it is stopped and can recover energy. The EMTU already has a fleet of 80 trolley buses operating in the ABD corridor of the city of São Paulo and the system is currently being enlarged.

ELECTRIC BUS

It operates with an electric engine powered by rechargeable batteries. The advantage over the trolley bus is that it does not require any external infrastructure, only recharge points and also has zero emissions. Among the disadvantages are the short driving range of the vehicles and costs highly related to electricity prices.

HYBRIDS

Any vehicle that has a double source of energy. The most widespread is the diesel-electric hybrid which combines an electric engine and a standard internal combustion one. When the diesel fuel of the latter is replaced by biodiesel or ethanol, they are called "hybrid-electric" vehicles. Operator SPTrans already has 100 of these vehicles, and the EMTU introduced them in 2003; today it has 14 vehicles operated by the company Metra.

HYDROGEN

There are two types of technology, both based in the mixture of hydrogen with oxygen: fuel cells –still underdeveloped worldwide, although it is considered the most promising one– and internal combustion engines. They offer high energy efficiency as compared to diesel oil and the only emission they generate is steam. In exchange, it is the most expensive technology and hydrogen storage is more complex. Between 2010 and 2011, a project promoted by the government was developed, where a consortium of Brazilian companies manufactured a hybrid bus (fuel cell plus rechargeable batteries) with a hydrogen-powered engine, which was tested for 23 days with good technical and environmental results.«

Hydrogen-powered *ônibus*

PHOTO: EMTU/SP

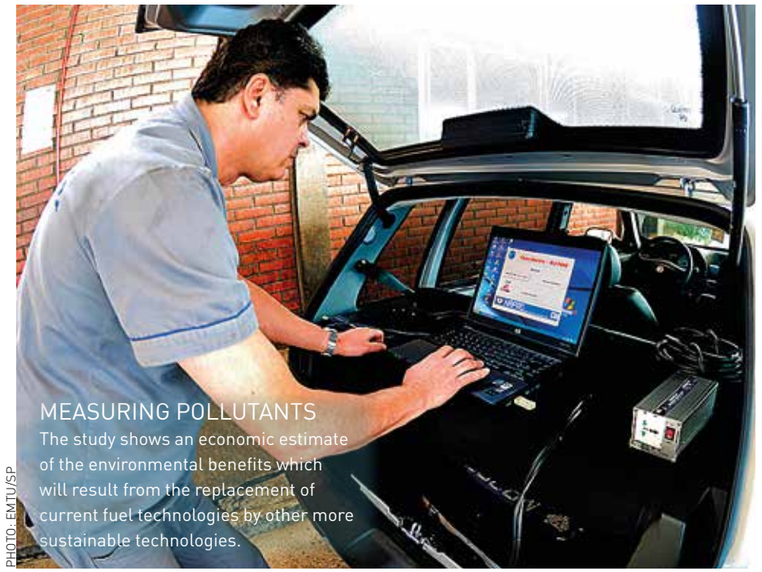
HYDROGEN-POWERED
They offer high energy efficiency and the only emission they generate is steam. In exchange, it is the most expensive technology and hydrogen storage is more complex.


Trolley bus.


Microbus.

Hybrid bus.

Technologies were assessed from two different perspectives: economic-financial and multi-criteria, which combines a variety of factors including environmental, energy-related, urban, social, technical and operating aspects



MEASURING POLLUTANTS
The study shows an economic estimate of the environmental benefits which will result from the replacement of current fuel technologies by other more sustainable technologies.

PHOTO: EMTU/SP

ABD São Paulo corridor.

Expresso Tiradentes.

ASSESSMENT AND CONCLUSIONS

Once the technologies available in the market were characterised, the next step was to select the most appropriate and efficient ones for the specific case of the region of São Paulo. Then the starting point was a standard operating scenario which would reflect the actual situation if at all possible.

The technologies were assessed from two different perspectives: economic-financial and multi-criteria, which is broader and combines –applying a strict methodology– a variety of factors including not only strictly economic aspects and the possible sources of financing, but also the environmental, energy-related, urban, social and institutional and the technical and operating aspects, with a total of 26 indicators.

As a result of this multi-criteria assessment, technologies have been classified into groups, according to their total score, and three deadlines are proposed for the replacement plan, as from 2016: first the biodiesel B20 (6-year term), followed by ethanol, hybrids and trolley bus (15-year term), and finally, in the long run, battery electric, and hydrogen-powered. It is also proposed that all the parties involved in the process be identified: federal and state administrations, development banks, companies and transport associations, suppliers, researchers, etc.

The study also shows an economic estimate of the environmental benefits which will result from the replacement of current fuel technologies by other more sustainable technologies. To this end, a cost has been assigned to each type of pollutant (carbon monoxide, inhalable particles, sulphur, etc.). As a conclusion, 2.3 million Brazilian reales would be saved per year in the short term, 7.5 in the medium term and up to 31.3 in the longest time horizon. It is also pointed out that the benefits of the technological change are not restricted to reducing polluting emissions but will also translate into a better quality of life and well-being of citizens, besides contributing to reducing dependence on fossil fuels, in keeping with Brazilian and international legislation.«

The renaissance of transport in Muscat

Oman's capital bets on public transport

By ***itransporte***, with the collaboration of **Eva Hitado**, **Emilio Miralles** and **Juan Francisco González**, civil engineers

Creating a urban bus service, regulating and unifying the taxi sector and coordinating it under a single transportation authority are some of the main proposals of the Public Transport Master Plan that Ineco has concluded for the capital city of the sultanate.

Oman is the world's third fastest-growing country in terms of tourism, according to the forecasts of the last report issued by the World Travel and Tourism Council. Its capital city, Muscat, with over one million inhabitants is a quiet and welcoming coastal city where more than one quarter of the country's population lives, that is, four million inhabitants. It combines thousands of years of history with a modern high-range commercial, hotel and restaurant offer as well as museums and cultural centres among which it is worth mentioning the Royal Opera House, a modern opera theatre which opened in 2011 and offers top-notch artists and shows, or the spectacular Grand Mosque, an example of modern religious art.

The Omani "Renaissance"

The whole country has experienced an economic and social upturn since 1970 known as "Renaissance", which has entailed opening up to the world and constructing all kinds of facilities and infrastructure, including transport infrastructure, which play a significant role for tourism, a key aspect in today's diversification strategy of the economy that the sultanate is developing. Within this framework, the Omani Ministry of Transport and Communications entrusted Ineco, in January 2014, with the drafting of a Master Plan that would allow planning both the infrastructure and the management of a new modern and efficient urban transport system for Muscat (see *itransporte 50)*. The goal is to achieve a 25% public transport modal split by the year 2040.

The Master Plan comprises all public urban passenger transport modes, both in the land and at sea

The Plan, which has already been completed, starts with an accurate diagnosis of the situation, performed after collecting and analysing the data from multiple sources, both institutional and private. It comprises all public urban passenger transport modes, both in the land (buses, microbuses and taxis, future railway systems) and at sea (ferry).

Based on this analysis, the Plan defines a series of action programmes aimed at improving mobility in the city, traffic and passengers' safety, as well as the quality and reliability of services. It also intends to get the private sector to participate in public transport –so far state-run– and reduce dependence on fossil fuels promoting other modes which are more eco-friendly.«

MASTER PLAN FOR MUSCAT

The Plan starts with an accurate diagnosis of the situation performed after collecting and analysing the data from multiple sources, both institutional and private. And it comprises all transport modes: : buses, microbuses, taxis, railway systems and ferries.

KEY POINTS OF THE PLAN

→**The diagnosis shows that the first step would be to unify and organize** regulation and management of public transport issues creating a single authority (Public Transport Authority, PTA), headed by the Ministry of Transport and with a very strong involvement of Muscat Municipality. This would allow eliminating duplication and overlapping of roles existing today in the different institutions and public bodies dealing with transport-related issues as well as coordinating mid- and long-term planning with a strategic vision which had been impossible to undertake so far.

→**Creation of a urban bus network**. The two existing lines only cover a small area –Wadi Adei, Wadi Kabir and Ruwi–, with travel times severely affected by traffic congestion. The Plan provides for the implementation, in several stages, of a city bus network made up of some main lines ("trunk") and a series of secondary lines ("feeder") to facilitate access to the network from different neighbourhoods. Later on the system would be completed with the building of park-and-ride facilities, bus stations and with the development, if the increase in demand was high enough, of a BRT (Bus Rapid Transit) with specific roads for bus traffic.

→**Regulation and modernisation of the taxi sector.** According to data provided by the Royal Oman Police, 13,400 taxis and microbuses offering different services run in the city: airport, hotels, etc. and they currently represent the main alternative to the 317,000 cars which collapse Muscat's streets. During the study, it was determined that the quality and reliability of the service could be considerably improved. As a result, the Plan suggests the reorganization of the sector with a new regulation where the different types of taxis and an improved quality of the services with the incorporation of new technologies are defined.

→**The Plan suggests starting the preparation process** for the development of some type of light rail system –light rail, tram, etc.–, which, because of its nature, requires a long time period for its planning and execution.

→ **Besides, the Plan comprises a great number of additional proposals** aimed at favouring the use of public transport and discouraging the use of private cars, including it in the urban planning, as well as promoting non-motorised transport modes such as walking or the use of the bicycle.

→**The implementation of the future public transport system** has been divided into three stages: in the first (from two to three years), besides the Public Transport Authority (PTA), the implementation of the main lines of the bus network and the restructuring of the taxi sector are foreseen. In the following (from three to seven years), new secondary lines, park-and-ride facilities and new bus stations will be added. Seven years from now, the possible evolution of the trunk bus network to the already-mentioned BRT systems or light-rail (according to demand) would be considered; and new sea public services would be implemented (sea taxis).«

"Experience in *Primavera* required"

The role of systems managers in the management of big projects

With the collaboration of **management and planning teams** of the projects **Makkah-Madinah high speed line** (Saudi Arabia), **High Speed Two** (United Kingdom) and the project management of the **Kuwait International Airport** (KIA)
Photos: **Elvira Vila**

Infrastructure management tools have seen an unprecedented development in the last few decades, mainly connected to the momentum of big projects, the evolution of databases and the possibilities offered by the Network to share data from remote locations.

Generally, the projects entail complex efforts, and why not challenges that, as it is the case of big infrastructure works, involve the use of enormous amounts of resources, stringent quality requirements, and strict delivery deadlines, which must be kept within a budgetary framework previously established by the client.

Within project management, planning tools are key elements for the supervision and comprehensive control of the projects throughout all its stages, being the basis of most of the management processes. In this context, the planning and scheduling tasks intend to create a model that allows predicting which activities and resources are critical to conclude the project in due time. It thus works as a tool, both for the project manager and for the client, facilitating decision-making for the implementation of strategies that guarantee that activities and resources related to the project are correctly managed, thus allowing the project to be concluded in due time and within the budget provided.

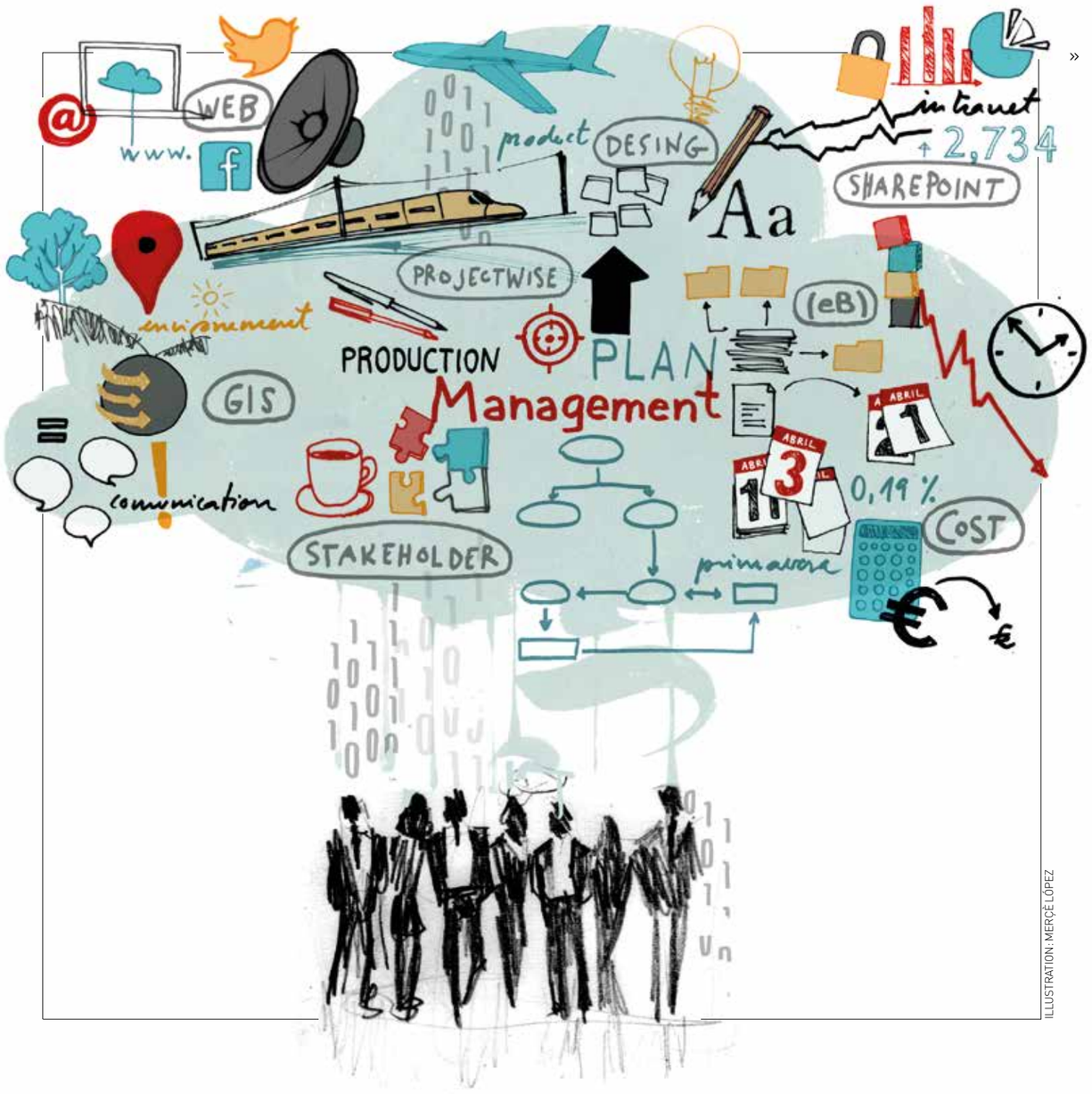
In the early eighties, contemporary to the widespread use of desktop computers, a series of planning software applications were spread, which made it easier for project managers to create a plan with the resources assigned for the tasks, to make the progress follow-up and to manage the related budget.

Ineco uses management packages and information platforms in big infrastructure projects developed in countries such as the United Arab Emirates, Saudi Arabia, Kuwait and the United Kingdom

The trend is to integrate

With the change of century, the trend is to integrate planning tools with other management packages (Document, Contract, Financial, Risk and Issue Management, etc.) which are embraced under data platforms accessed through the web or cloud. This model is often benefited from the addition of data from the BIM (Building Information Modeling), thus making these platforms valuable tools for management and decision-making in big infrastructure projects, specially in countries where the use of management models has Anglo-Saxon roots.

The market offers comprehensive tools of management packages and information platforms aimed at managing big infrastructure projects. Oracle's developments, Aconex and Primavera, among others, are examples of available software with great market penetration that co-exist with solutions created *ad hoc*.«



3 BIG INFRASTRUCTURE PROJECTS

Haramain. Saudi Arabia PROJECT

The image shows Ineco's planners during the Haramain project: from left to right, Francisco Maestre, Fernando Romero, Francisco Gómez and Tomás Blanco, Head of Planning. The team has perfect command of the Primavera P6 Project Management model and the technical processes comprising the design, supply, installation, test and commissioning of the track and systems of the line throughout 450 kilometres and five stations.

Managing 14 companies in Haramain

In the case of the Makkah-Madinah high speed line, Ineco's planning team collaborates with the consortium composed by twelve Spanish companies and two Saudi Arabian companies, drafting the initial plan (baseline) and the regular update of the programme, covering the design, supply, installation, testing and commissioning stages by means of the management tool defined in the contract: Primavera P6 Project Management.

To create the plan, elements defined by other project management processes, among other elements, are used for defining scopes and the work breakdown structure established. A model of milestones and activities logically linked is thus created, with durations and estimated resources, arising from the information received by the consortium's members. The model includes the beginning and end of each activity and milestone and allows for obtaining the conclusion date of the project by applying the Critical Path Method. This initial plan or programme is included in the project management plan, serving as a basis for other management areas, such as document management, drafting of a cash flow plan, risk management or issue management, to name a few.

The programme allows the contractor to prove how feasible it is to comply with the conclusion date of the project, while the client's approval of this programme sets a contractual base to verify possible claims arising from any delay whatsoever by any of the parties during the execution stage of the project. Once the project is in the execution stage, the programme works as a supervision and control tool of the work progress, and is updated by the planning team according to data from production teams.«

KIA. Kuwait PROJECT

Ineco's management and planning team in Kuwait's airport has developed its own system, which together with the commercial applications Aconex, Primavera and Presto, adjusts to the requirements and magnitude of the project. The image shows, from left to right, Sara Cañamero, John Mathew, Salvador Gómez, Rajan Sellathurai, Rafael Lara and Aina Ferrer.

A versatile management system

In 2011, Kuwait's Civil Aviation Authorities awarded Ineco, in cooperation with its local partner KUD, the Project Management Services contract for the development of Kuwait's international airport (KIA). As project manager, Ineco is in charge of the integration, coordination, follow-up and control of more than 76 construction and technical assistance projects which are to be executed in the next 10 years and whose value stands at more than 9 billion dollars.

The complexity of the plan arises not only from the volume of the enlargement, but mostly from the physical interfaces imposed by the operation of the airport itself, apart from the great number of interlocutors that need to be coordinated. Other added variables are the diversity of managed contracts –ranging from Design & Build projects in EPC to Design & Supervision or BOTs–, simultaneously managing projects that are in different stages of their life cycles, and the legal and regulatory framework. For all the above, a management system model with different superimposed levels was defined: the first level comprises a "cooperation platform" that manages the project's documentation and communications. The second level is composed by applications to manage data related to the scope, time and cost of the projects. The third level includes analysis and control applications: preparing progress indicators, flow control, cash flow predictions, etc. The fourth level comprises executive applications such as scorecards, GIS interface graphics or special reports. These applications also integrate the data provided by the remaining levels of the system. This information system was called KITAB (KIA IntegraTed Airport scoreBoard) for the Arabic word *Kitab* (book). KITAB is an *ad hoc* constructed web for this project taking as a model those developed by Ineco for the Barajas and Málaga Plan.

Since there is no software in the market containing all these functionalities, commercial applications such as Aconex, Primavera, Presto, SQL Server, MS Access, MS Excel, etc. and some of them developed by Ineco, which work in an interconnected way, have been adopted.«

HS2. United Kingdom PROJECT

Ineco's team involved in planning the project of a stretch of the second high speed line in the United Kingdom conducts its daily work in a fully integrated manner, handling several information systems. The image shows, from left to right, Rail Track and BIM expert, Iker Garteizgogeaskoa, Documentation Control Head of the Capita-Ineco Consortium, Dolores Pérez Castañera and ProjectWise and GIS expert, Cristina Calvo.

Involvement in the HS2 high speed line

High Speed Two (HS2) Limited is the company in charge of the development and promotion of the new high speed railway, financed by the English government and dependent on the Transport Department. The aim of this project is ensuring that the second high speed network in the United Kingdom is designed, built and operated with the highest quality and safety standards, and that it is carried out in a sustainable, responsible and respectful way towards the communities and the environment of the affected places, achieving a perfect integration with current transport systems.

Ineco, together with the English company Capita, both part of a consortium since April 2012, participates in this project preparing the design of one of the network's stretches as an HS2 contractor company. From the beginning of the management, Ineco has been in charge of controlling documents within the consortium.

HS2 works with all of its suppliers by means of 58 different contracts in a joint and coherent way. This kind of projects are based on the exhaustive control of all the information ranging from physical assets, processes, contracts, people, documents, plans and evidence. And, to ensure that all the information is significant and accurate, the information management system must be configurable to match the business processes and contractual needs.

For said purpose, HS2 has developed with Bentley a system to produce and manage comprehensive documentation (EDMS), which covers the MicroStation platform for infrastructure design and modelling, the Power Rail Track V8i platform for track alignment design in 3D (which in 2013 earned Ineco the Bentley award), the ProjectWise platform for infrastructure project, and the Enterprise Bridge Information Manager platform, which controls changes throughout the project's life cycle.«

Environmental sensitivity

Social integration and respect for biodiversity, the key concepts of the study

By **Virginia Fuentes,** forestry engineer

PHOTO: BALUXETIO (FLICKR)

The Bolivian highlands.

PHOTO: SAM BEEBE (FLICKR)

The Amazon rainforest.

The Ineco-Cobodes consortium has developed a strategic environmental assessment study for the Central Bioceanic Railway Corridor, a project undertaken by the government of Bolivia and funded by the Inter-American Development Bank (IDB), which will connect the Pacific Ocean to the Atlantic Ocean.

With this infrastructure, the government of the country is confident of laying the foundations for a great change in the history of Bolivia, since the connection between the ports on both oceans through Peru, Bolivia and Brazil, linking large cities, the jungle, and the highlands in the central part of South America, will be a logistical and transport alternative to the main Latin American sea corridors. Its implementation will promote economic growth, improve the capacity of trade relations in the region, and allow the exploitation and industrialisation of its natural resources. There will, in short, be a significant activation of local trade, offering the population the opportunity to travel at a lower cost and for their products to reach export destinations. In a country with just over eight million inhabitants, of which the indigenous population accounts for a high percentage, the recovery and construction of the railway corridor is key to economic development and the eradication of poverty, inequality, and social exclusion.

It is calculated that, over the next decade, the level of rail freight demand will be about 40 million tons, mainly including agricultural products and minerals that will be sent both to the Pacific ports and to the Atlantic Ocean via the Paraguay-Paraná waterway.

Within this ambitious project, the Ministry of Public Works, Services and Housing of Bolivia, through the Vice-Ministry of Transport, has commissioned the consortium, formed by the Spanish public engineering company Ineco and the Bolivian consultancy company Cobodes, to identify and assess the strategic social and environmental impacts along the entire route of the CFBC in Bolivia.«

Through the whole country

The Corridor will pass from west to east through the whole country, crossing regions with diverse environmental and social characteristics: the westernmost section, between the Peruvian border and Oruro, runs through the highlands, where the continental climate is extreme and the economy is based on potato and quinoa cultivation, and camelids. The central section crosses the Andes and the pre-Andean valleys and is characterised by high geological instability. It also boasts numerous protected natural areas and populations have a very low development index. The eastern section, between Santa Cruz de la Sierra, the largest and most populous city, and Puerto Quijarro, on the banks of the Paraguay River next to Brazil, runs through a tropical region belonging to the Amazon basin area, with the highest growth rate in Bolivia.«

PHOTO: LON&QUETA (FLICKR)

Shoemaker in Comarapa.

A BROAD ACTION PLAN

The action plan defined by the consortium covers aspects such as the protection of ecosystems, water resources, and heritage, to the reinforcement of the legal framework, environmental education, and the promotion of ecotourism.

PHOTO: JASPER NANCE (FLICKR)

Partial view of Villa Tunari, in the central region of Bolivia.

The study aims to safeguard the vast natural heritage in the region, which consists of a multitude of natural areas with high biodiversity; and improve the quality of life of Bolivian people

PHOTO: MARTHA DE JONG-LANTINK

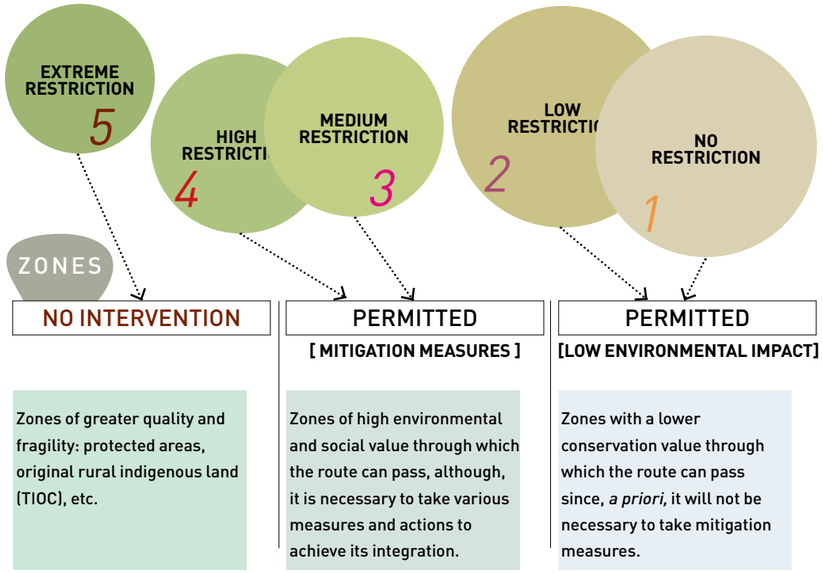
Basilica of Santa Cruz.

PHOTO: CÉSAR CATALÁN (FLICKR)

Bolivian municipality of Laja.

Territorial diagnosis

The strategic environmental assessment performed by Ineco-Cobodes has allowed internalisation of the most sensitive environmental and social aspects in the planning process for the whole corridor. The first step of the analysis consisted of a territorial diagnosis, which allowed a map of the whole region to be created and its capacity to receive railway infrastructure to be assessed.
To obtain a global map of restrictions, different criteria were established in accordance with the territorial characteristics of the study area. For example, in the tropical zone the risk of flooding was much greater than in the Andes, and as such, its restriction was also greater; in the highlands the risk of poverty or vulnerability to food insecurity is much more significant than in the low areas closer to the border with Brazil and, therefore, they also have a more significant influence on the development of the rail.

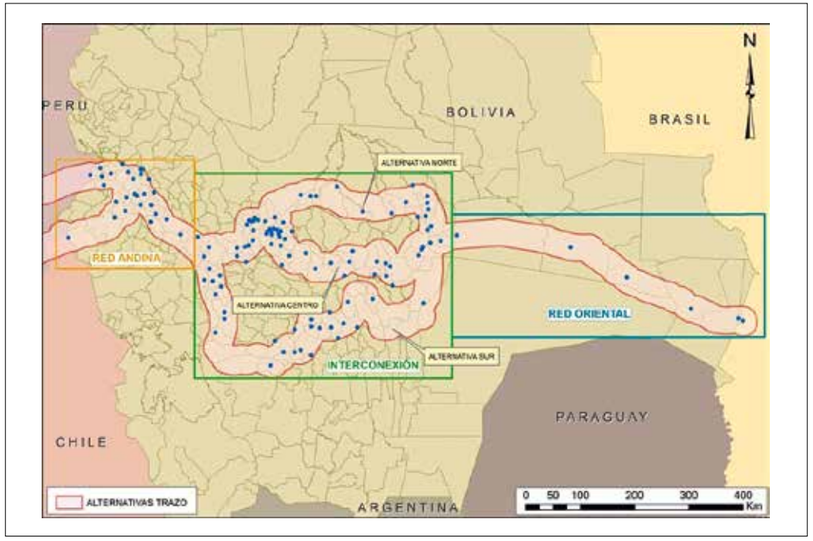


In search of the lowest environmental impact

From this map of restrictions, the most appropriate 100 kilometre-wide corridor was selected for the new route, and, within this corridor, the alternative that had the lowest impact, taking into account both the technical, economic, environmental, and social aspects, and the route with the lowest environmental impact created by Ineco.
Once the most appropriate alternative was selected, the strategic effects and impacts were identified. *A priori,* the existence of the railway corridor involves increased economic growth, which has direct consequences for the population, both positive (increased income, decreased poverty rate, etc.) and negative (compulsory purchase deriving from the right of way, conflicts, or changes in traditional activities). More specifically, in the tropical zone the most significant effects of the railway line will result from the enlargement of the agricultural frontier due to cost and transport time reduction. This increase in the agricultural production area will result in a reduction of the woody vegetation with the consequential increase in the negative effects that can cause abundant rain and flooding. Furthermore, in this zone there is already evidence of the effects of climate change, which is something that can be aggravated if the increase in land productivity is not promoted instead of increasing the change in the use of soil.

Impact on the Andean regions

In the Andean region, the most significant impacts will result from the high slopes and geomorphological instability; furthermore, in this zone it will be necessary to promote measures that improve quality of life and decrease the rate of poverty in the population. In the highlands, the railway corridor may change the economic dynamics, altering the traditional use of soil; this will involve a very significant increase in competition for water use both for human consumption and irrigation.«



PROPOSAL OF CORRIDORS FOR THE CFBC

The Bolivian rail system consists of two non-connected networks: the Andean network, connected to Chile and Argentina, and the eastern network, connected to Brazil and Argentina.
The CFBC will allow the corridor to be completed and the connection to be closed through the construction of new infrastructure and the restoration of the already existing infrastructure.

PHOTO: LUIS FERNANDO TERCEROS

Pailas bridge.

PHOTO: LUIS FERNANDO TERCEROS

Andean rail network.

PHOTO: PATRICIA CABALEIRO

Informative workshop.

Informative workshops and public dissemination

Given the importance and the effects of the corridor on the Bolivian population, social participation and public dissemination of the results have been very important aspects. As such, various informative workshops were carried out in different points of the study area with representatives of social and indigenous organisations, and production sectors in order to seek out their opinion regarding this infrastructure. Once the study was completed, two workshops were held with renowned experts in the country and four public meetings were held for the population in general. Lastly, in order to better disseminate the project, a publication was published with a print run of 2,400 copies and a summary of the main points, more than 3,000 leaflets with key information about the project were distributed, and 240 guides on how to perform a Strategic Environmental Assessment were printed, which were distributed to technical schools.«

More landings, less pollution

The end of OPTA-IN, the European project related to 'green landings'

By ***itransporte***

After two years of tests, the consortium led by Ineco, together with AirEuropa, Crida, Enaire and Indra, and with the collaboration of Air Berlin, ends the OPTA-IN* project: the so-called "green landings" will help to reduce environmental impact and operating costs.

Test flights have been carried out in the air space of Palma de Mallorca's terminal area, where continuous descent operations (CDOs) or "green landings" have been carried out with the aim of reducing emissions and fuel consumption to its minimum.

Within the consortium composed by AirEuropa, Crida, Enaire and Indra, Ineco is the leader of this project that began in 2013. In addition, the company is also responsible for the communication and awareness plan, and co-responsible for the environmental assessment. It has also contributed to the operational development and assessment.

OPTA-IN TESTS
OPTA-IN tests have been carried out in 101 flights at Palma airport. The image shows an Air Berlin airplane.

SESAR Joint Undertaking (SJU) initiative

OPTA–IN is part of the SJU *SESAR Integrated Flight Trials and Demonstration Activities* programme and operates under the AIRE (Atlantic Interoperability Initiative to reduce Emissions) framework. The project carries on the legacy of the OPTA project with the aim of reducing the environmental impact of the aviation sector. The procedure consists in the aircraft performing CDOs for a pre-defined and fixed route, whose only separation method for ATCs is adjusting speed.

OPTA-IN has given us the chance to apply CDOs without new ATM/CNS equipment in an airport that operates with a considerable traffic volume

OPTA-IN success mainly lies in joining and directing, during a short period, the industry's effort to develop a prototype appropriate for the operating requirements. It is worth highlighting the work of airlines, since they have allowed and trained their crew to apply the procedures; the supplier of air navigation services, which has provided adequate air traffic control without neglecting the operation of the rest of the users; and engineering companies, which have provided the necessary support for the different areas.

Throughout the two years that the OPTA-IN project lasted, 101 test flights involving Embraer 190, Airbus 320/1 and Boeing 737/8 aircraft have been carried out at Palma de Mallorca airport. The trials have been highly valued both by air traffic operators and pilots.«

* *Optimised Profile descenT Approaches Implementing wiNdows*

FERNANDO FERRÁNDEZ
Head of Enaire's European Convergence Unit
"This kind of initiatives enables us to verify in a real environment the environmental benefits that had been proved in simulations, and also leads us to consider the possibility of implementing them in airports that allow them due to the features of their approaches."

PETER LUBRANI
Aeronautical engineer and OPTA-IN Project manager
"OPTA-IN has proved that it is possible to increase the use of continuous descent in airports with average traffic density, without the need of updating ATM systems and providing ATCs with the necessary support."

MIGUEL ÁNGEL PÉREZ LORENZO
Indra's software and systems engineer
"At Indra we have developed a tool that enables the ATCO to know in a quick and simple way, thanks to its HMI, when and at which speed must he/she instruct an airplane to perform an OPTA-IN procedure".

ALEXANDER DORTA
Engineer, Ineco's ATM expert
"The main contributions have been both in the coordination of stances and/or needs of pilots and controllers and in the development of a new procedure based on a simple speed adjustment technique".

ANDREA VILLA-GARCÍA
ATM R&D engineer at Crida
"The operational environmental assessment has quantified and proved a reduction in fuel use and emissions (CO_2) of about 7% and 12%, (in the case of NO_x, it stands at about 50%), depending on the kind of aircraft flown".

JOAN ROSSELLÓ
Deputy Director of Operations at AirEuropa
"From the pilots' standpoint, this kind of operations are easy to perform without increasing their workload. And they clearly contribute to the improvement of efficiency during a sensitive stage of the flight".

SASCHA FISCHER
Senior Manager of ATM Operations at Air Berlin
"The tests have been successful in terms of quantifying fuel savings: even though the benefit offered in a single flight may be little (20 kg), annual savings may account for up to 360 tons of fuel".

Model behaviour

This 1.6 kilometres viaduct is a key section in Galicia's Atlantic Axis

With the collaboration of **Justo Carretero** and **Pablo Sánchez Gareta**, civil engineers.

A team of Ineco's professionals has performed for Adif the load tests of railway viaduct of the Ulla river, between A Coruña and Pontevedra. The tests guarantee that the structure is safe and ready to come into service when Galicia's Atlantic Axis is completed.

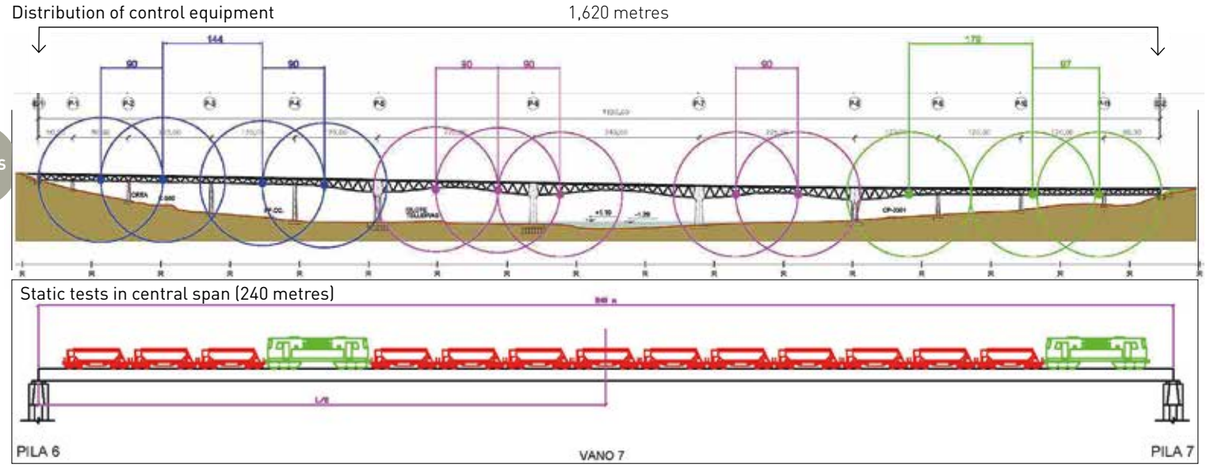
It is a key section in the Atlantic Axis, the 241 kilometres railway corridor that runs all along Galicia's Atlantic coast, the section between A Coruña and Santiago de Compostela, from where it will connect with the future high-speed line to Madrid, being already in service since 2011. Its final goal is to connect Galicia's seven largest cities in between them: Ferrol, A Coruña, Santiago, Pontevedra and Vigo. Among the sections in an advanced stage of execution is the one that coincides with the viaduct of the Ulla river, in the provincial border between A Coruña and Pontevedra.«

PHOTO: INECO

Galicia's Atlantic Axis | Ulla river viaduct

The tests were performed in three consecutive days, which sets an efficiency record for such a long bridge and with 177 measuring points, controlled in real time

SCHEMES




Pablo Sánchez, project manager, and Jorge Benito, in one of the recording and computer-based control points.

With a total length of 1,620 metres, construction started in 2009 and it was designed to cause the least possible impact on the river and its surroundings. This is why it was supported with eleven cup-shaped piers, with variable-width spans which in the central section have a maximum gap of 240 metres, a world record in bridges of this kind. The design solution for this peculiar structure is completed with a Warren-type variable-edged high-quality steel truss, distributed in 15-metre-long modules (in almost all the length of the viaduct) to minimise the joints to be performed on the work site and an on-site concrete slab deck, with a thickness ranging from 25 to 46 cm. The platform is 14 metres wide and has double track.

In mid February 2015, a team of Ineco's professionals performed for Adif-Alta velocidad the load tests of the structure, which guarantee that the structure is operating properly and that there are no hidden defects which could jeopardise its safety. The tests were distributed in three consecutive days, which sets an efficiency record in this kind of tests for a bridge of this length and with so many measuring points, in total 177, making up a network of 13 perfectly synchronised control points. The instruments recorded and sent 5,000 readings per second to seven recording and computer-based control points, where results could be viewed in real time, being at the same time stored for future analysis.

Four locomotives of 120 tonnes in weight and 40 hoppers of 80 tonnes were used in two types of tests: static, 18 in total, with trains stopped –with 3,680 tonnes in total–, and the corresponding dynamic tests, with trains running on one single track, at speeds of 10, 40 and a maximum speed of 80 km/h, with and without braking. Two trains were made to run in parallel at a minimum speed to obtain the stress envelope.

In the case of the Ulla river viaduct, the results obtained confirm the proper operation of the structure for the coming-into-service

Measurements taken during a load test are, among others, slope, movement, vibration and temperature of all the parts of the structure and contact points in between them: stirrups (supports of both ends of the bridge), deck, piers, etc. In the case of the Ulla river viaduct, the results obtained confirm the proper operation of the structure for the coming-into-service.«

EQUIPMENT


New arrow-based measuring system.


Details of the distributed equipment.

STATIC AND DYNAMIC TESTS

Up to 18 static tests were conducted, with trains stopped (two per track), and a total weight of 3,680 tonnes.
They were supplemented with the corresponding dynamic tests, with trains running on only one track, at speeds of 10, 40 and a maximum speed of 80 km/h, with and without braking.


A team of 12 Ineco's professionals performed the tests, under the supervision of the expert in Instrumentation, Monitoring and Tests Justo Carretero (on the picture), together with the project manager.

Reality at sight

Ineco does research in supervision of structures with Google Glass

By **Iván Hernández**, IT systems engineer

Works in the *Trecho Norte* of the São Paulo ring road, in Brazil, have witnessed the first field trials with Google Glass smart glasses with which Ineco is testing novel applications for civil engineering.

Being in the work site and viewing *in situ* and in 3D how the structure will look when finished, checking its current status, making daily work reports easier and verifying one by one the elements composing it, is already a real option thanks to the augmented reality offered by Google Glass smart glasses. Light, comfortable, easy to handle, and with a vast variety of potential uses in the engineering sector. Despite the device is still in development phase (future versions are expected in 2015), Ineco has started exploring its possible uses by using available prototypes and has developed and proved its specific application for linear works and buildings.

The study is part of an innovation project carried out by Ineco that commenced in mid 2014. Among the new investigated applications, we find, for example, automatic calculation of KP of an alignment, automatic uploading of photos or exploration of BIM *(Build Information Modelling)*, virtual models (view *itransporte 52)* with augmented reality. These specific functionalities are to be added to more general ones, such as taking pictures, recording videos or data georeferencing, etc.«

Google Glass smart glasses are light, comfortable and easy to handle. Above, Ineco's engineer Isidro Díaz, in front of a viaduct of the Rodoanel Mário Covas, in São Paulo.

ON-SITE TESTS

The first on-site tests were carried out in Brazil in early 2015, where Ineco participates in the construction of the final 44-kilometre stretch -or *Trecho Norte*- of the ring road in the city of São Paulo, the Rodoanel Mário Covas, with a total length of 177 kilometres. The works, which began in 2013 and are expected to end in 2016, entail great complexity, since the stretch will contain three or four lanes in each direction, seven double-tunnels and 111 bridges and viaducts.

Ineco, as part of a consortium with the Brazilian engineering company EBEI, is providing support to the mixed-capital company DERSA (Desenvolvimento Rodoviário S.A., investee of the São Paulo State) in the works follow-up. Therefore, along with the tools used by DERSA itself, Ineco is using its own development, SIOS Singular Works, which centralises and manages plenty of work data. During the trials, the visualization with smart glasses of information stored in SIOS has been successfully proved. Therefore, thanks to the augmented reality interface, the user may have access to information in real time, superimposing it to the image seen by the user.«

Google Glass uses in civil engineering

The tests carried out by Ineco have made it possible to verify the advantages of using them for following up works and supervising structures:

→ Augmented reality in the work-site: identifying elements and their related information by means of an interface.

→ Uploading and taking photographs, and recording videos of the field *in situ*, with the possibility of adding more as attributes or geospatial localisation.

→ Viewing virtual models developed in BIM in the work-site.

→ Calculating KP, along with other date records, altitude, etc. in linear works.

→ More agile daily updates of the work progress, thus allowing an element to be modified in a dynamic way.

→ Communicating and receiving messages in real time, without the need of any movement, which also allows distant parties to view the current situation by means of video conferences or even video streaming.

→ Generating reports in real-time.

→ Enabling the incorporation of useful audio-visual material to the reports in order to correct wrong practices, lack of experience, etc.

→ Entering historical data which allows schedules and future previsions to be corrected, as well as performing a follow-up of set goals.

→ Contextual and support information of the work-site at all times (plans, project, issues etc.).«

Nearby paradises

Spain has one of the longest coasts in the world and more than 3,000 beaches of all kinds, some of which considered natural heritage.

By *itransporte*

Los Genoveses beach, Almería.

PHOTO: FLICKR / CASTANIAS

Only the temperature of the water reveals reality: that one of the world's best rated beaches is not in the Caribbean or in Hawaii but on the European Atlantic coast: Rodas sandbank, on Cíes islands, a small archipelago located in Galicia's coast, which is part of a natural park, with restricted access for visitors to protect its outstanding environment. In 2007, British newspaper *The Guardian* published a list of the "world's best ten beaches" in its travel section *where* Rodas ranked first.

It is not the only Spanish beach which has received wide international recognition by travellers: in 2014, users of the well-known travel website TripAdvisor chose the Balearic island beach of Ses Illetes, on Formentera island, as the world's sixth best beach; and ranked Las Catedrales beach, in the town of Ribadeo (Lugo), in position number 16, of a list of 25 beaches led by Brazil and which included other international tourist destinations such as the Mexican Caribbean, Greece or Hawaii.

Blue flag

Even the most crowded beaches reach very high quality levels, as evidenced by the 573 "blue flags" Spain has and which make the country rank in the first positions in Europe. This annual award of the non-profit organization Foundation for Environmental Education in Europe, is granted to more than 4,000 beaches and marinas of 49 countries, according to their compliance with certain standards: quality of water, facilities and services, and degree of environmental information, among others. In 2014, the Spanish region with more "flags" was Galicia with 142.

LARGE SANDBANKS_ As it is a peninsula, Spain has Europe's longest coast and one of the world's 15 longest: 7,880 kilometres of coast distributed in 22 provinces, around 2,000 of which are beaches, distributed in 3,000 sandbanks which offer all the possible varieties of landscapes and occupancy rate: from very long and isolated beaches with fine sand, cold and rough waters in the coasts of Galicia, Asturias, Cantabria or Basque Country to the warm coves of a few hundred metres surrounded by vegetation on the Costa Brava or Costa Dorada in Catalonia, crossing the well-supplied but crowded Mediterranean beaches of Valencia, Alicante, Murcia, Ibiza or Mallorca; the surfer paradises of Cádiz or Almería or the wide variety offered by the Canary islands with their subtropical climate and their volcanic geology.

From the take-off of the Spanish tourist industry, in the 60s of the past century, the "sun and beach" offer has become the backbone of the most important sector of the national economy. The massive urban development which followed the arrival of the first tourists transformed most of the coast, specially the area of Levante and the Balearic and Canary islands, which because of their climate and geographical location fulfilled the ideal conditions for the development of hotel and leisure infrastructure. Nevertheless, the Spanish coast continues to keep hidden treasures and areas which, either because of their climate, because they are within natural protected areas, or for other reasons, have escaped the impact of urban development and massive tourism.«

Bolonia beach, Cádiz.

PHOTO: FLICKR / ARWED.STUERZE

Kitesurfing in Fuerteventura.

PHOTO: FLICKR / EL TURISTA ACCIDENTAL

Las Catedrales beach, Lugo.

PHOTO: FLICKR / JL CERNADAS

Spain has Europe's longest coast and one of the world's 15 longest

REFERENCES

→In Aguas Santas, Ribadeo (Lugo), commonly known as "Las Catedrales" (The cathedrals), erosion has sculpted stone arches of up to 30 metres in height.

→The wind and the sea have also shaped the caves of the Cuevas del Mar beach, 16 kilometres from Llanes, in Asturias, a region which offers another distinctive rarity: Gulpiyuri, a small inner beach surrounded by cliffs, although not so high as those of playa del Silencio beach, near Cudillero.

→In the Basque country, it is worth mentioning isolated sandbanks such as La Barrika, in Vizcaya.

→The Catalan coast, where tourist centres such as Salou or Lloret del Mar are located, has several coves surrounded by rocks and Mediterranean vegetation, such as the ones along the coast of Gerona, which are true natural swimming pools. Among them we can find Sa Futadera or Cala Pola, near Tossa del Mar. The long and calm beaches of Guardamar del Segura (12 kilometres), in Alicante, have little to do with crowded tourist towns such as Santa Pola or Torrevieja which are very close though.

→The Balearic and Canary islands, top tourist destinations, have beaches such as Ses Illetes, in Formentera, Sotavento, in Fuerteventura, or coves such as Macarella and Turqueta, in Menorca. On the Canary islands, El Hierro island has the hidden Charco Azul, a natural swimming pool in between volcanic rocks, which offers an alternative to Maspalomas, in Tenerife or Las Canteras, in Las Palmas.

→The desert and the sea meet in Almería, offering lunar landscapes only overturned by the presence of the sea, such as Los Muertos or Los Genoveses beaches, in Cabo de Gata natural park.

→The coast of Cádiz offers surprises such as the Roman ruins of the city of Baelo Claudia, next to Bolonia beach, in Tarifa, a paradise for surfers, who also gather in other beaches like Punta Paloma. Los Alemanes beach, in Zahara de los Atunes, offers 1.5 kilometres of calmness and crystal-clear waters.

→Among the many beaches of Huelva, it is worth highlighting Nueva Umbría and Caño de la Culata beaches, located in a 12-kilometre-long sand strip called "Flecha del Rompido", which is peculiar as it grows about 30 metres every year.

Sotavento beach, Fuerteventura.

PHOTO: FLICKR / XAVIPAT

Flecha del Rompido beach, Huelva.

PHOTO: FLICKR / KDPERICO

ineco **Solutions**

Experience, competitiveness and technology at the service of society

Ineco has extensive experience in transport engineering: over 45 years planning, designing, managing, operating and maintaining airports, railways, roads, ports and urban transport systems throughout the world.

Ineco is a global leader in transport engineering and consultancy.
For over 45 years, its expert team of around 2,500 employees has been contributing to the development of infrastructures in the aviation, railways, roads, urban transport and ports sectors in more than 45 countries.

Thanks to our technical specialisation, our activity has diversified into new markets and we have reinforced our presence in those where we are already established.
Our high-level technological capability allows us to offer the most advanced and cost effective solutions to the projects we work in, both for private and public sectors.«

MODES

Aviation · Railways · Roads · Urban Transport · Ports

- High Speed Makkah-Madinah. **Saudi Arabia**
- Operational readiness and airport transfer of the new MTC terminal of Abu Dhabi airport. **UAE**
- Strategic Mobility Plan. **Ecuador**
- Spanish High Speed network. **Spain**
- HS2 high speed. **United Kingdom**
- Modernisation of the airport network and reorganisation of airspace. **Spain**
- CPTM lines, São Paulo. **Brazil**
- Supervising Agent Guadalajara-Colima highway. **Mexico**
- Airport Expansion Project Management and Master Plan update. **Kuwait**
- High speed train Istambul-Ankara. **Turkey**
- Heathrow Winter Resilience Programme. **United Kingdom**
- Strengthening of Civil Aviation. **Nepal**
- Shadadiya industrial complex project management. **Kuwait**
- National Transport Plan. **Costa Rica**
- Expansion and improvement of the Spanish railway stations. **Spain**
- Muscat's Public Transport Plan. **Oman**
- Studies for high speed train Haldia-Howrah. **India**
- Works on the Spanish port network. **Spain**
- Mário Covas Ring-road, Northern section project coordination, São Paulo. **Brazil**
- Tram line 4 in Tallinn. **Estonia**

INECO IN THE WORLD

America

Mexico, Colombia, Venezuela, Brazil, Argentina, Panama, Costa Rica, Jamaica, Peru, Chile, Ecuador, Bolivia

Europe

United Kingdom, Turkey, Italy, Portugal, Serbia, Poland, Norway, Greece, Lithuania, Bulgaria, Estonia, Denmark, Belgium, Spain, European Commission

Africa

Cape Verde, Algeria, Morocco, Mauritania, Namibia, Ethiopia, Mali, Egypt, Angola

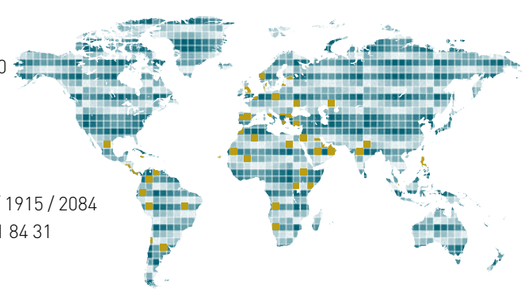
Middle East

Saudi Arabia, Kuwait, Qatar, Oman, UAE, Jordan

Asia

India, Philippines, Nepal, Singapore, Kazakhstan

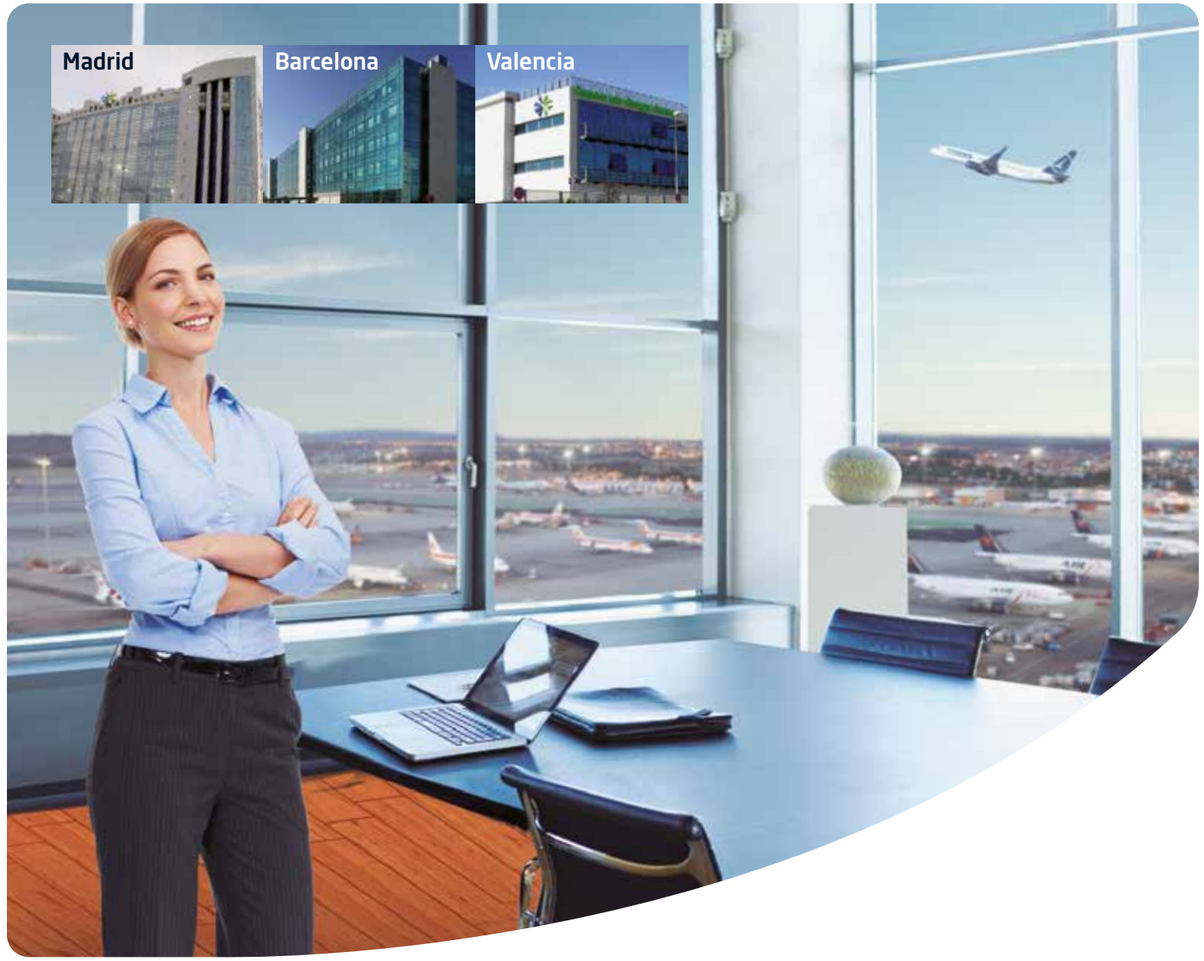
OVER 45 COUNTRIES



SPAIN (CORPORATE HQ)
Paseo de la Habana, 138
28036 Madrid
Tel.: +34 91 452 12 00
Fax: +34 91 452 13 00
info@ineco.com

www.ineco.com

SAUDI ARABIA / Jeddah +34 91 788 05 80
UAE / Abu Dhabi +971 2 495 70 00
BRAZIL / São Paulo +55 11 3287 5195
ECUADOR / Quito +59 39 7942 1220
KUWAIT / Kuwait City +965 6699 2395
MEXICO / Mexico D.F. +52 55 5547 4110 / 1915 / 2084
UNITED KINGDOM / London +44 78 27 51 84 31
SINGAPORE +34 91 452 12 00



Your office, located where things happen

With **Aena** you can have your own office at an ideal location on the grounds of the **Adolfo Suárez Madrid-Barajas**, **Barcelona-El Prat** or **Valencia** airports.

- **Near operation areas** for cargo handling, Customs, the Border Inspection Post, and with quick access to the airside.
- For every 50 m² of surface area leased we offer you **1 free parking space**.

And, if you don't work in Logistics, but need an office that is connected to the world, we have an option for you too.

Find out more. Contact us at **cargaaerea@aena.es**

Aena. Committed to your business.

aena

We are
the air navigation
service provider
in Spain

ENAIRE

enaire.es

GOBIERNO DE ESPAÑA
MINISTERIO DE FOMENTO

So you can get there