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OCTOBER 2012

CONTROL TOWER

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CORRIDOR STUDY

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TRAFFIC CONTROL SYSTEMS

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HIGH SPEED

The *Yüksek Hızlı Tren* steams towards Istanbul

BRAND SPAIN

The world wears Zara

Editorial

The launching of this publication marks the beginning of a new stage in Ineco's magazine. From now on, we will be offering a view of our work in three issues a year, with two editions, in English and in Spanish, improving communications with our international clients.
This new stage of the magazine is also meant to reflect a new stage of the company: our increasingly large presence on the international market poses new challenges and demands to become stronger, more agile and more competitive.

Today, Ineco is different from what it was back in 2007, at the start of the serious economic crisis in our country, and it must also be different in a few years, upon the end of this process. We have been getting ready for this situation for some time. The outstanding work of our teams of professionals has made it possible to play an important role in the execution of large infrastructures in Spain, while the internationalisation strategy has made great progress. The year 2011 was a good example of this effort, with the granting of Makkah-Madinah high-speed railway as ultimate proof of the outstanding work performed.

It is now time to move into a higher gear and complete the final transformation of our company, which is essential for its viability and future outlook. Our goal is growth, to expand in the world, to become more competitive and more essential wherever a large infrastructure is required.

We hope to continue enjoying the interest of our clients and reader friends, who we will keep well informed of our projects and works.

Pablo Vázquez Vega

President of Ineco

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COVER IMAGE: Computer graphics rendering of the future control tower at the Eldorado airport. GOP Studio. Bruce Fairbanks.

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News

New operational headquarters of the Spanish consortium on Sultan Street (Jeddah).

Ecuador

Road improvements, consultancy and preliminary design

The Ministry of Transport and Public Works of Ecuador has hired Ineco to carry out the technical, legal and financial work required for the road concession between Santo Domingo and Esmeraldas. The future concession of 185 kilometres connects Santo Domingo, in the central-northern part of the country, with the seaport of Esmeraldas, in the northwest. The project provides a response to the country's road communications problems, and is intended to expand and modernise the infrastructure and service provided by this corridor within the national road network. Ineco has been conducting the National Strategic Programme for Mobility and Transport of Ecuador since 2011, and has an office in Quito as well as a permanent team of four technicians.
The image shows Pedro Saldaña and Jonás Casquero, Ineco engineers stationed in Ecuador for the project.«

Saudi Arabia

The consortium members at the guarantee signing in Madrid.

NEW OPERATIONAL HEADQUARTERS IN JEDDAH

Work begins on the Pilgrims' High-Speed train

The Spanish-Saudi consortium Al Shoula Group has received Notice to Proceed from the SRO (Saudi Railways Organization) for Phase II of the Haramain High-Speed Railway project, which will join the holy cities of Makkah and Madinah. The consortium has a provision of bonds and guarantees amounting to 664 million euros, thanks to the syndicated group formed by the banks BBVA, Banesto, Banco de Sabadell, Crédit Agricole CIB, Spanish Branch, CaixaBank and Deutsche Bank, SAE. The financial design and organisation have been led by Banesto and Crédit Agricole CIB.

In addition, the consortium has inaugurated its offices in Madrid and new operational headquarters in Saudi Arabia: a modern eight-storey building in Jeddah, conditioned by a team of Ineco architects. The Spanish companies will share offices with the SRO and the supervisory firm Dar Al-Handasah.«

Spain / Galicia

Progress on the Atlantic Axis

After completing the excavation of the last tunnel in the Atlantic High-Speed Axis, work continues on the sections A Vacariza–Rialiño and Rialiño–Padrón, for which Ineco is in charge of technical assistance and coordination of works on the entire corridor, comprising 32 viaducts and 37 tunnels.«

The Ministry of Development promotes austerity and liberalisation of transport

The budgets of the Spanish Ministry of Development for 2013 foresee an investment of 10.16 billion euros, of which 47% (4.7 billion) will be devoted to railways. The rest shall be focused on conservation actions and projects promoting intermodality, such as railway accesses to sea ports or 'sea highways'. The minister, Ana Pastor, has also presented the 2012-2024 Infrastructures, Transport and Homes Programme (PITVI). Some key points in the Programme include liberalising railway passenger transport or increasing private participation.

Brazil

ONE OF THE LARGEST INFRASTRUCTURE PROJECTS

Ineco coordinates the works on the São Paulo ring road

Pablo Vázquez, President of Ineco, during his visit to the Ineco offices in Brazil.

The consortium led by Ineco, together with the Brazilian engineering firm EBEI, will support the mixed company DERSA (Desenvolvimento Rodoviário SA, owned by the State of São Paulo) in the coordination of the thirty contracts and different organisations involved in the works, which will begin in 2013 and are expected to finish in 2016. For the execution of the northern section, the 177 kilometres highway that surrounds the city will be closed, on which 65,000 vehicles travel each day.

The ring road, known as Rodoanel Mário Covas, was inaugurated in 2002. The last segment pending execution is the northern section, with a length of 43.86 kilometres and the most complex layout. It is designed for a maximum speed of 100 km/h and will vary from three to four lanes, depending on the stretch, requiring the construction of seven tunnels and 111 bridges and viaducts. Among other activities, Ineco will coordinate the project design, expropriations and environmental actions.«

Study of transport systems in São Paulo

Ineco, in a joint venture with Sistran Engenharia e Ineco do Brasil, has initiated a study on new drive technologies for reducing pollution in mid- and low-capacity transport systems (buses and trolleys) in the State of São Paulo. This study, requested by the National Association of Public Transports of Brazil, will analyse biodiesel, ethanol, electrical and other systems and will include an implementation plan.

Kuwait

New industrial complex in Shadadiya

After presenting the tender documentation for the construction of the industrial area of Shadadiya, on the outskirts of Kuwait, Ineco continues to provide technical assistance to the top Kuwaiti authority for planning and industrial development, the Public Authority for Industry (PAI) in order to begin the construction of this immense complex located some 25 kilometres to the southwest of Kuwait City.

The company has prepared the conceptual design for the industrial area and all the technical documentation for the project tender process, from the pre-qualification launching to writing up the tender documents. In addition, as project manager Ineco has coordinated the Spanish and Kuwaiti partners in the execution of the works.«

News

FAIRS | **InnoTrans 2012**

International railway meeting in Berlin

Ana Pastor, minister of Development, together with the president of Ineco, Pablo Vázquez, visited the company's stand at InnoTrans, the most important international railway technology fair in the world, with about 100,000 visitors. Ineco will be attending this edition with the support of Mafex, together with another 50 Spanish companies.
In the image, the minister and the president and executives of Ineco, of Mafex, the Spanish ambassador to Germany and the commercial attaché.«

Mexico

NEW WORKS IN MEXICO

Maintenance of the ICECOF system

Ineco has signed an agreement with Adif for maintenance of the ICECOF system, a computer tool developed by Adif for managing and analysing incidents related to railway traffic operation. Adif has implemented and adapted this system for Ferrocarriles Suburbanos de México (the company in charge of railway operation between the Mexican states and its Federal District) and Ineco will be in charge of its maintenance.«

Operational safety workshop in La Paz

In addition, technicians from the aeronautical area of the company have given a seminar-workshop on operational safety to personnel of the GAP (Grupo Aeroportuario del Pacífico - Pacific Airport Group) at the international airport of La Paz in Mexico (Baja California). The aim was to provide training on Operational Safety Management Systems and Aeronautical Safety Studies.«

Innovation project

Eurocontrol selected as a finalist among over 50 proposals an Ineco project on integration of meteorological data in flight preparation systems.
The SWIM Master Class European contest distinguishes new applications for air traffic management (ATM).

The solar aeroplane visits Spain

The Solar Impulse aeroplane visited Spain last July. In the image, the Swiss pilots and project starters, Bertrand Piccard and André Borschberg, with Manuel Sauca, director, and Ángel Villa, division head, of Ineco's International Department of Aeronautical Transport, during a presentation event.

Eldorado draws its new skyline

New control tower at Bogota international airport

By **Roberto Serrano**, aeronautical engineer (Head of Airport Construction) and **Víctor Quiñones**, aeronautical engineer (Head of CNS Systems), with the collaboration of **Juliana Sánchez**, Aerocivil project manager.

Ineco and the Spanish firm GOP are in charge of studying and designing the building's architecture and technical equipment. The tower seeks to become a technological and architectural icon of the Colombian capital.

In 2009 the expansion process began for the Eldorado international airport, located 16 kilometres from the centre of Bogota, the capital of Colombia. This expansion is now at its midpoint and will be completed towards 2014 to deal with the increasing demand for air transport and the economic growth of the nation. Eldorado holds the top place in Latin America in terms of cargo volume –648,000 tons recorded in 2011– and the third place in terms of passengers, with 20.4 million.

An ongoing expansion plan

This capacity will be doubled when the new installations, which include a new control tower, enter into service. The current control tower will be demolished in late 2013 as part of the construction of the new international terminal, with a surface of 104,000 m^2, and the expansion of the aircraft parking platform, which will increase from 21 to 33 stations. Taxi lanes are also being renewed, and a viaduct for vehicle entry and 1,500 parking spaces are being built.

In 2011, Colombia's Civil Aeronautics (Aerocivil) put out a tender for the architectural, civil and equipment studies and designs for building the new tower. Ineco, in consortium with the Spanish firm GOP –headed by the architect Bruce S. Fairbanks, who has designed most of the towers built in Spain in the last decade– was awarded the project.

Equidistant location

Eldorado has two parallel runways, 13L/31r and 13r/31L, with a length of 3,800 metres, between which is the terminal area and other airport installations. The location for the tower proposed by Aerocivil is equidistant from the four headers, in a strategic position.

To determine its appropriate height and confirm the location selected by Aerocivil, several preliminary studies were conducted including impact tests on landing and takeoff procedures, LOS (Line of Sight) tests to the manoeuvres area from the tower cabin, impact on aeronautical easements and optimisation of coverage provided by the SMR (Surface Movement Radar) placed in the top part of the tower.

The new tower is part of the current expansion process, which will be completed around 2014, in order to meet the growing demand

After analysing the results, it was decided to set a height of 80 metres, which makes it one of the tallest in the world.«

Conceptual design

Its considerable height and position in the centre of the premises will make the tower visible from a great distance. For this reason, special attention has been placed on the conceptual design of a building that is not only meant to be an installation to serve aerial navigation, but also an architectural icon for the airport and city of Bogota.

In order to emphasise this matter, the preliminary stages of the project included an in-depth analysis of the history, folklore and traditions of the area in which the city is located, known as the Sabana de Bogota. Thus, the legend of El Dorado and the Muisca culture were studied, in which the representation of animals has great symbolic relevance, particularly curled up snakes. The outer design of the tower –a concrete shaft covered by a structure made up of two steel spirals– was inspired by these images. At the same time, its truncated cone shape evokes the votive figures known as 'tunjos', elongated representations of human beings. These elements are reproduced in the architectural design, with a double beacon 14 metres in diameter and fully enclosed in glass that crowns the shaft.«

Spacial distribution

The building adjoining the tower base is connected by walkways and patios to the central shaft. Outside it is provided with accesses and parking spaces.
The proposed spacial distribution is based on prior experience with similar buildings and on the expected volume of equipment to be installed. It covers about 2,000 m^2, distributed over two floors and one basement.

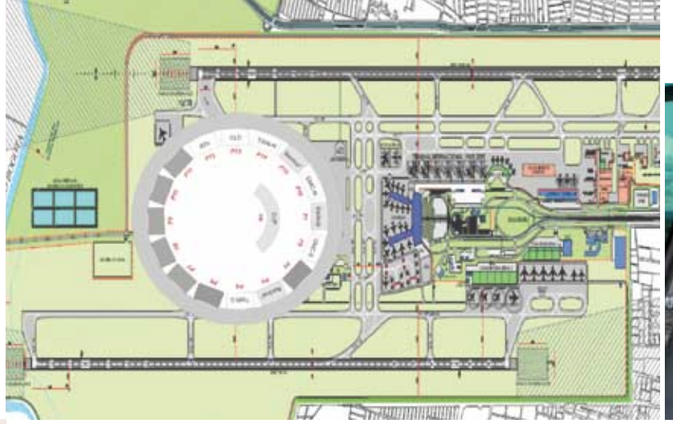
The second floor houses the offices for the tower management, the instruction unit classrooms and the leisure areas. The shaft houses several intermediate floors for evacuation purposes, while the top part houses technical floors (radiolinks, aeronautical communications equipment and air conditioning).

Due to operational requirements of the airport and in order to centralise aircraft control and management, the beacon consists of a double cabin, arranged one on top of the other.
The bottom cabin will house the Platform Management Service and the top cabin will house Air Traffic Control. In addition, on top of the beacon is the antenna array and surface radar, raising the highest point of the tower to 89 metres above ground level.«

INSPIRED BY ITS SURROUNDINGS

The truncated cone design is inspired by the votive figures of the local Muisca culture, representing elongated human figures. Standing 89 metres tall (including the antenna array and surface radar) it is one of the tallest towers in the world.

Eldorado, with an altitude of 2,545 metres and high volume of traffic, requires the most advanced aerial navigation systems



Left: model inside the wind tunnel. Middle: Arrangement of control stations. Right: View of the flight field from the current tower.

Facilities

The building is designed to have all the facilities needed for its correct operation, in accordance with Colombian and international regulations. In addition to the usual facilities are others that are of particular importance in the construction of a control tower. This is the case of the electrical installation, which enables the sending and reception of signals, of critical importance to aerial navigation.

Another essential installation is climate control: in addition to the conventional system, precision climate control elements will be provided

For this reason, it has a grid connection provided with a generator group in case of grid failure and several support points located near the critical loads to be powered, by means of continuity units. Another essential installation due to the sensitivity of the tower equipment is climate control. In addition to the conventional system, with VRV (Variable Refrigerant Volume) elements, the technical rooms will have precision climate control elements.«

Structural design

The seismic activity of the area has conditioned structural calculations and represented quite an engineering challenge (see box). After considering several options, an outer skin of steel joined to an inner concrete shaft was selected.

The adjoining building is resolved using concrete porticos. Because of the poor quality of the ground, the excavation must be performed dry, first executing a peripheral waterproofing screen with cement-bentonite. To guarantee resistance against vibrations and oscillations, a scale model was built and tested in the wind tunnel of the Aeronautical Engineering College of Madrid. The good results obtained in these tests confirmed the appropriateness of the structural type selected.«

Geotechnical study of the ground

Another of the tasks of Ineco's multidisciplinary team was to provide assistance in the design of the geotechnical campaign and the foundations. The Eldorado airport sits on the lake deposit of the Sabana de Bogota. This ground consists of so-called Sabana formation Bogota clay, which is actually composed not only of clay but also of clayey silt.
The phreatic level (underground water) in the area is rather superficial, at only one metre of depth.

■ To investigate the subsoil in the place of construction of the control tower, two mechanical rotational probes were drilled to a depth of 46 metres. The results of the laboratory tests revealed a very soft consistency of the ground for the entire thickness studied. However, despite its apparent high deformability, it was observed both in this study and in others performed in the surroundings of the airport that these materials show a certain preconsolidation.

■ In practice, this means that the settling (ground displacement) that occurs is smaller than might be expected, provided the load transmitted to the ground is below the preconsolidation value. This is the case for the designed load.

Air navigation

Another fundamental aspect of the project was determining the air navigation systems and preparing the technical specifications such that Aerocivil could tender their purchase.

The control tower is an infrastructure that must be properly equipped to fulfil its main purpose, that is, provide air traffic controllers the tools and technical means necessary to manage and control air traffic in a safe and efficient manner. For this purpose, a team of specialists in air traffic management (ATM) and air traffic control, communications, navigation and surveillance (ATC/CNS) has been created.

The navigation systems of an airport and the functionalities these must provide are determined in view of the current and future operational needs and air traffic. For this purpose, a team of ATM specialists composed of engineers and experienced controllers evaluate and analyse the operations of the airport, that is, how landings, takeoffs and other aircraft displacements are managed. These analyses enable areas for improvement to be detected and the optimum operational processes to be determined (control roles, positions in cabin and functionalities that air navigation systems should provide) in order to manage air operations. After this, the ATC/CNS experts determine the required air navigation systems, the most appropriate technology and the technical requirements. They also size their capacities and technical features and establish the needs of the collateral systems of the tower so that their integration is feasible and the impact of the transition on operations is minimised (see box). For this reason, the project also includes a technical-operational transition plan that identifies and foresees the requirements for entering into service.«

Navigation systems of the new Eldorado tower

The high complexity of operations at Eldorado airport, due to the geographical characteristics of its location (2,454 metres above sea level and near to mountains), the high current and future demand of operations and the large variety of aircraft types (jets, propeller aircraft, military aircraft, helicopters, etc.) require that the ATC/CNS systems that are to be implemented in the new control tower must provide the most advanced air traffic management functionalities and capacities.

The new control tower will be equipped with the following systems:
→ Air traffic control system with advanced functionalities for traffic management and control, such as advanced surface movement guidance and control system (A-SMGCS), electronic flight sheet (EFS) and takeoff management functionalities (DCL and DMAN), as well as integration and processing of flight plan information.
→ Information Integration System for the control station of the following subsystems: weather information, aeronautical terminal information system (ATIS) and radioassistance status information.
→ Voice communications and recording system (VCR) to manage and establish both ground/air communications with the aircraft and ground/ground communications with collateral installations (airport, Bogota ACC).
→ Ground/air VHF communications system providing the necessary radio equipment to contact aircraft.
→ Surface radar (SMR) and multilateration system (MLAT) to provide the surveillance sensors required for the A-SMGCS functionality.
→ Network node for air navigation data in charge of providing the necessary infrastructure for ground/ground communications in the control tower to interconnect the aforementioned systems with the outside world through the RTAN (Airport Aeronautical Telecommunications Network).

»

The external metal mesh provides strength and simplifies construction, essential in an area with seismic activity

Steel skin

Ineco has developed the structural design of the new tower, deciding on a metal mesh to cover the concrete shaft.

By **Jorge Torrico,** civil engineer (Head of Structures) and **Álvaro Ruiz**, civil engineer (Department of Architecture, Structures and Instrumentation)

Detailed view of the metallic mesh and concrete base.

The structural design of this 'steel skin' has faced several challenges. The main difficulty is the significant seismic activity of the region, with a calculation acceleration of 0.5 g. In addition to this are the considerable height of the tower and the thinness of the internal shaft, the weakness of the supporting ground –mainly composed of soft clays–, the need to adapt to the usual constructive means and capacities in Colombia and a short execution period. All of these conditions have led to designing the outer structure as an additional resistant element, that can provide stiffness against wind and seismic activity.

The design of the mesh focused on finding simple elements that by repetition would simplify the construction

Initially, concrete was considered as the construction material due to its greater structural rigidity and ease of molding, and the tradition in building with reinforced and prestressed concrete in Colombia. However, after weighing up the pros and cons, the selected solution was finally a metallic structure that incorporates the versatility of prefabricated concrete but is much lighter. It also simplifies the execution of the knots and joint details, and thereby allows a greater speed of implementation, making it possible to manufacture it in Colombia or abroad and simplifying its transportation to the worksite.

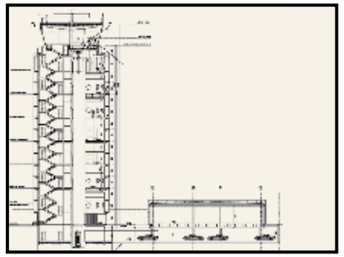
Assembly study

After selecting steel as the material to use, the design of the mesh was geared towards finding simple elements that by repetition would simplify the construction, reduce the execution time and conform as much as possible to the many conditions imposed by the geometry.

The assembly of the structure was the object of a detailed study. The goal was to minimise the installation time and analyse the auxiliary means necessary to lift the parts, intending these to be complete rings in order to minimise welding work on site.

The design of the tower foundations followed the same considerations as the development of the structural solution: it should minimise execution time, adapt to the small execution surface and fulfil the demanding geotechnical limitations.«

Ineco's experience in other towers



South Tower of the Barcelona-El Prat International Airport

Execution of the construction project and architectural technical assistance. South Tower of the Barcelona-El Prat International Airport. Spain. 2008.

North, South and West Towers of the Madrid-Barajas International Airport

Projects for definition and implementation of air navigation systems in the North, South and West control towers. Spain. 2004-2008. Construction project for NET (45 m) and SAT (36 m) coordination towers. Madrid. Spain. 2003.

Control Tower of the Murcia-San Javier Airport

Project design and environmental studies. Murcia-San Javier Airport, Spain. 2002. Air navigation systems, definition, control and monitoring of installations and entry into service. Murcia-San Javier, Spain. 2009.

Pablo Ruiz Picasso International Airport, Malaga

Air navigation systems, definition, control and monitoring of installations and entry into service. Malaga. Spain. 2002.

Control Tower in Boa Vista International Airport, Cape Verde

New 25 m control tower as well as other actions, such as expanding the flight field and new terminal building. Cape Verde. 2004.

Son Sant Joan International Airport, Palma de Mallorca

Air navigation systems, definition, control and monitoring of installations and entry into service. Mallorca. Spain. 2001.

Is high speed feasible between Haldia and Howrah?

Ineco at the head of the Spanish consortium in charge of the study

With the collaboration of **Alberto Váscones**, civil engineer (Railways Consultancy Director) and **Fernando Tejedor**, civil engineer (Railway Projects Department)
Photos: **Lopamudra Bag** (Kolkata)

The Indian government wishes to improve railroad communications between Haldia, an important industrial site, and Howrah, which is separated from its twin city Kolkata by the Hooghly river. Ineco has carried out the feasibility study for the Indian Railways together with the Spanish firms Prointec and Ayesa.

These three cities –Kolkata, Howrah and Haldia– have a joint population of over 14 million, in West Bengal State, in eastern India. The high-speed rail project in this densely populated region forms part of an ambitious plan by the Ministry of Railroads of India to build six main lines with speeds approaching 300 km/hour to improve and quicken railroad communications between the large population centres.

The government has assigned the National High Speed Rail Authority (NHSRA) the task of initiating the studies for constructing 3,539 new kilometres in the six selected corridors: Delhi-Chandigarh-Amritsar (450 km), Hyderabad-Dornakal-Vijayawada-Chennai (664 km), Chennai-Bangalore-Coimbatore-Ernakulam-Thiruvananthapuram (854 km), Delhi-Agra-Lucknow-Varanasi-Patna (991 km), Howrah-Haldia (135 km) and Pune-Mumbai-Ahmedabad (650 km). The study for the latter corridor gained official approval for construction last summer, at which time the High Speed Rail Corporation (HSRC) was created in order to expedite high-speed projects. The projects will be carried out by a firm that is to be created by the public company Rail Vikas Nigam Limited (RVNL).

The growth and improvement of rail transport is a main goal in a country that has 64,000 kilometres of railroads, an integrated and essential mode of transport for its 1.2 billion inhabitants. Indian Railways carry a daily average of 2.72 million tons of freight and 22 million passengers according to data from 2011. The growth outlook for GDP, is expected to increase from 1.2 to 3% in coming years, in order to deal with this expected growth in demand, the railway authorities have invited

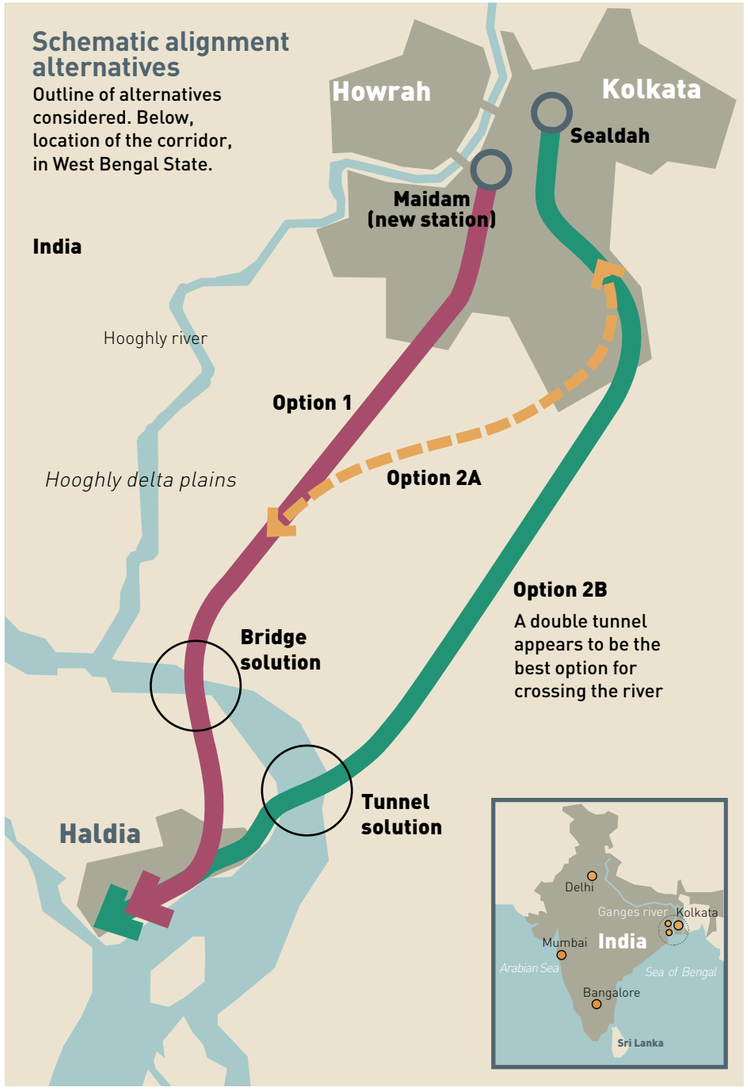
Improving transport in the Kolkata area will create jobs, attract tourism and investments and reduce road congestion

the private sector to invest in the modernization of its infraestructures. The plan is to invest in 25,000 kilometres of new lines and make important improvements in electrification, track gauge changes, rolling stock and equipment to reduce travel time and increase the speed and safety of the trains.

Roughly 44% of trips are work-related

The cities of Howrah and Haldia, in the plains of the Hooghly river which flows into the Ganges, generate an important economical and industrial activities due to the strategic location of the Haldia port, which is the fourth largest in India. Although the old capital is barely 50 kilometres away, the geographical barrier of delta river means that over 2,700 people, that travel between the two cities every day take an average of three hours, depending on whether they travel by car, train, bus or ferry. This represents an important waste of time, considering that almost 70% of trips are related to work or business. Another 9% has a tourist purpose.

THREE HOURS TO TRAVEL 50 KILOMETRES
Above, the station of Howrah, Kolkata's twin city. Although they are only 50 km from Haldia, the trip can take up to three hours because of the barrier set by the river. Centre: Local market. Below: Bidhanngar Road station, in the current railway line of Sealdah.



20 years of Spanish experience

The study carried out by the Spanish consortium led by Ineco received the local support of the subcontractors LEA Associates South Asia and Ernst & Young. It considers the feasibility of the future corridor for 25 years, the needs for new infrastructure, traffic forecasts and financial costs until the year 2045. The work also considers different layout options and investments in rolling stock, as well as the definition of the most appropriate vehicle types.

Ineco has extensive experience in high-speed rail in Spain, in which it has been involved since the 1980's. This work culminated with the entry into service of the first high-speed line, Madrid-Seville, in 1992. Currently, with almost 2,900 kilometres of high-speed rail in service, the company continues to be involved in many projects. Out of Spain, Ineco is actively participating in the new high-speed lines of Makkah-Madinah, Ankara-Istanbul and London-Birmingham.«

Ineco, with offices in Delhi since 2009, also provides technical assistance on line 2 of the Mumbai underground

THE HOOGHLY RIVER

The challenges of a holy river

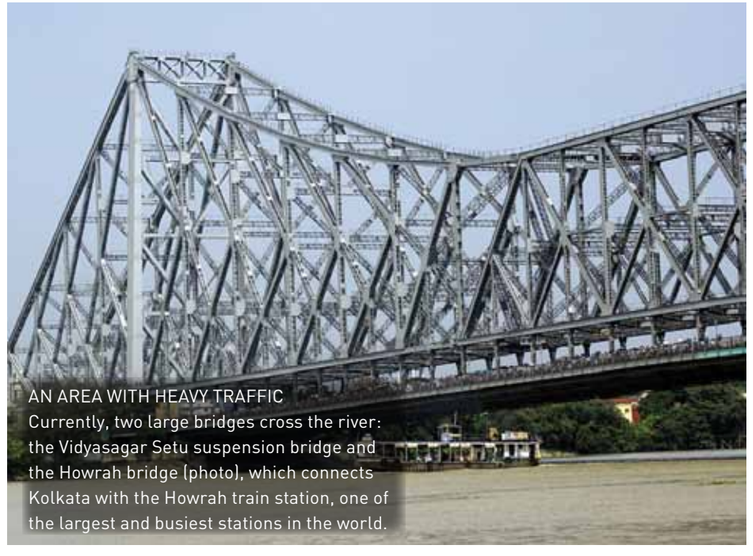
The Hooghly river is considered to be sacred, like the Ganges, and supplies water and wealth to the population and industry of Bengala since ancient times. However, crossing the delta and its waters represents a challenge for high-speed rail: obtaining economic viability to overcome the high cost of infrastructure investments until the new line is economically viable. The study conducted by Ineco and its partners concludes that even with private investment via Public Private

With a width of two kilometres, the space required by cargo ships make a double tunnel solution preferable

Partnerships (PPP), significant public financing would be required. In this respect, the study presents different financing and investment options, which include taking charge of construction by itself and leaving the subsequent operation of the line to private initiatives.

The main challenges lie in the track infrastructure. The weather and ground conditions, subjected to large flooding in the monsoon season, lead to a track on slab solution, built on an embankment, viaduct or tunnel depending on the

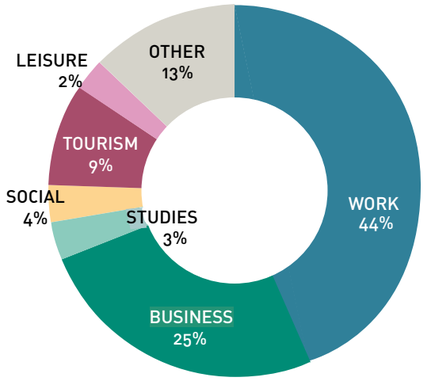
Agriculture and livestock farming are a source of wealth in the delta.



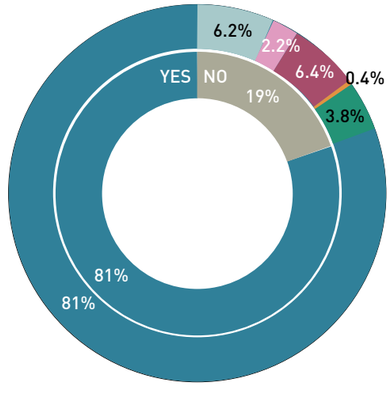
AN AREA WITH HEAVY TRAFFIC
Currently, two large bridges cross the river: the Vidyasagar Setu suspension bridge and the Howrah bridge (photo), which connects Kolkata with the Howrah train station, one of the largest and busiest stations in the world.

Current types of trips and willingness to shift to HSR

1_Distribution of purpose of travel between Kolkata and Haldia



2_Willingness to shift to HSR



characteristics and requirements of each section. The report also considers the national policy regarding minimising the effects on harvested land in order not to harm farmers.

In all, the crossing of the Hooghly river is one of the greatest challenges of the project. With a width of two kilometres, the space required by cargo ships that travel from Haldia to the Kolkata port make a double tunnel solution preferable. The study also considers the option of a viaduct, changing the layout.

To solve the access to Kolkata, the feasibility study also considers two infrastructure options: viaduct or tunnel, analysing the different costs and technical challenges of each one. Currently, two bridges cross the river. One of them is the well-known Vidyasagar Setu suspension bridge, the longest of its type in India, which links the twin cities of Howrah and Kolkata. Hundreds of vehicles cross it every day, all of which pay a toll except bicycles. Even busier is the Howrah bridge, connecting Kolkata to the Howrah station, one of the largest and busiest train stations in the world.

In short, the construction of a railway line with modern standards in service, comfort and speed is a highly desirable project for the socioeconomic development of the region. The traffic demand studies reveal a good response from the population, for whom great benefits would be announced, among which are improved accesses, reduced travel times and costs, reduced road congestion and improved business opportunities. With less poverty and more job options, the image of the region would benefit greatly, encouraging tourism.

Ineco has an office in Delhi since 2009 with five employees. The company is also conducting technical assistance in the construction work for line 2 of the Mumbai underground for the Mumbai Metropolitan Region Development Authority (MMRD). Line 2 is a corridor that will cross the city from north to south-east, with a length of 32 kilometres, 27 stops and one exchanger. The underground network will have 9 lines and 146.5 kilometres in total, and should be completed by 2021. Mumbai, with over 20 million inhabitants, is the largest city in India, with 11 million persons using public transport every day according to data from the MMRD.«

Characteristics

- Dual electrified track
- Slab track
- Signalling with ERTMS - 2 (ETCS 2)
- Maximum commercial speed: 250 km/h
- Trip time: 30 minutes
- 200 metres of platform in each terminal (to be expanded to 400 metres)
- Maintenance deposit in Haldia
- Lay-by 40 km away
- 18 hours of service (5 am/11 pm)

Spain, a pioneer in commuter rail ERTMS

The Madrid C4 line becomes the first complex line in Europe to install it

Area of Railway Installations and Systems

The ERTMS European traffic control system has been implemented for the first time in a complex commuter rail line; the C4 line of Madrid. Ineco has taken part in this project from the outset.

At this time, according to the latest statistics available from the UNIFE industrial railway association, the ERTMS has already exceeded its initial applications as well as its geographical scope: in 2012, there are some 62,000 kilometres of railway lines in 38 countries worldwide, 50% of them outside of Europe, which are already executing or contracting the implementation of the system, and there are currently 17,000 kilometres of lines with the system in service.

In Europe, Spain is at the top of this list with 1,712 kilometres in operation, according to data from Adif. Together with the Netherlands, Denmark and Switzerland, Spain has been one of the first countries to implement the system since it operated for the first time in 2006 on the Madrid-Lleida high-speed rail line. Since as early as 1994, Ineco has collaborated closely with Renfe, Adif and the Ministry of Development in several ERTMS projects, for both high-speed and commuter rail lines (see *itransporte 32* and *English Edition 2*).

ERTMS technology has matured in the last decade, and high-speed lines are no longer its only field of application. The advantages afforded by increased traffic capacity, safety and reliability, and interoperability between railway networks of different countries have proven to be highly useful for conventional rail applications too. Such is the case with cross-border cargo transportation, which relies hugely on interoperability (saving time and costs) and increased capacity of cargo containers, which UNIFE has determined to be up to 40%.

The infrastructure was executed by Thales and Dimetronic; Renfe Operadora has installed Alstom technology in 112 Civia trains

ERTMS, also for commuter rail

Outside of Europe it is already in place or its installation is planned for the commuter lines of Auckland (New Zealand), Rio de Janeiro (Brazil), Sydney (Australia) or the Gebze-Halkali line in Turkey. In Spain, the largest commuter rail network is that of Madrid, managed by Renfe Operadora. It serves a metropolitan area of 6 million people and has 10 lines.

One of these lines, C4 from Colmenar Viejo to Parla, as well as its branch line to Alcobendas and San Sebastián de los Reyes, has become the first line in Europe to be equipped with ERTMS level 1. The system was put in service on 11 February 2012 on this 62.2 kilometres line, which spans the region from north to south, with 18 stops in seven different towns, crossing the two largest stations in the country located in the capital: Chamartín and Atocha stations. These are connected by three tunnels, two of which are in service and the third is in the execution stage, planned for exclusive use by high-speed trains.

The highly complex installation of the system represented quite a challenge, but it will not be the only one: work is already in progress towards implementing ERTMS level 2, also for the first time in commuter rail, in the Atocha and Chamartín stations and in the Atocha-Sol-Chamartín tunnel, which was opened in July 2008. The first tests of this second implementation stage took place in March 2012. It is also the first time that communication has been achieved between two RBCs with different technologies, those developed by Dimetronic and Thales.«

Ineco's contribution

Ineco has over a decade's experience with ERTMS. As an integral provider of railway services, it has actively participated in the implementation of the system on line C4 with different tasks:

- **Drafting the infrastructure project.**
- **Independent safety evaluation.**
- **Evaluation of interoperability of the control, command and signalling subsystem.**
- **Coordination of worksite health and safety.**
- **Technical assistance:**
  _Control and monitoring of infrastructure works.
  _Rolling stock tests.

FIELD AND LABORATORY TESTS
Civia train entering Tres Cantos. The eurobalises transmitting information to the train can be seen on the tracks. As well as the field tests on the pilot sector between Tres Cantos and Colmenar Viejo, a laboratory was also used for the first time.

Two subsystems

The ERTMS consists of two subsystems: infrastructure and on-board equipment. As regards infrastructure, for the installation project on the Madrid C4 line the promoter and party in charge of project management was the Railway's General Directorate of the Ministry of Development. Ineco provided technical assistance for the control and surveillance of the work and for validation, all within the framework of the system supplied by the temporary joint venture formed by Dimetronic and Thales, with Ineco as the independent safety assessor.

As regards the on-board system, Renfe Operadora has installed Alstom technology in 112 Civia trains. Ineco has monitored the supply and putting into service of the on-board ETCS units until their commissioning. It is currently performing the same task for the implementation of ERTMS level 2.«

Line C4 of Madrid is one of the highest traffic in Spain, with 200,000 users a day, 18 stations and 62.2 kilometres

THE WORK,
STEP BY STEP

Project drafting

The project in terms of infrastructure was promoted by the Railway's General Directorate of the Ministry of Development, and drafted by Ineco in 2005. It included the safety and communications installations of the Atocha-Sol-Nuevos Ministerios-Chamartín tunnel, and the installation of the ERTMS system on the Madrid commuter railway lines that would use this new tunnel. Work began in mid 2007.«

Execution and test

After the work was awarded to the joint venture Thales-Dimetronic and the technical assistance for works management was awarded to Ineco by the Railway's General Directorate, the next step involved selecting a testing area in which the impact on traffic and maintenance was as small as possible. The selected pilot sector was that between Tres Cantos and Colmenar Viejo. One of the main problems involved having to conduct dynamic tests for both infrastructure and rolling material using non-certified versions of the eurocabins and the track.

To shorten the duration of the process and simplify its execution in a commercial network with such a large number of lines and great traffic intensity as that of Madrid, field tests were conducted and, for the first time in an ERTMS project, the new Interoperability laboratory of the CEDEX (Public Works Studies and Experimentation Centre of the Ministry of Development) in Madrid was used.

While the CEDEX team was in charge of hardware integration of data and supplier equipment in the lab, Ineco selected and executed the test cases by building scenarios to check the technical compatibility between the on-board and track equipment.«

CEDEX laboratory in Madrid, Spain.

Data and reports

Many data were gathered in the field and laboratory tests. A video recording was made of the DMI (Driver Machine Interface), which displays information to the driver, and notes were taken on incidents, state of signalling and track situation (temporary speed limits, occupied track circuits, timers, etc.), extracting data from the legal record for subsequent analysis. Ineco provided support to the work team made up of the Railway's General Directorate, Adif and Renfe in the creation of the format of the test cases. This was the starting point for defining a common European format. The results of the tests, the analysis of the test cases and the detected incidents were included in test reports, with special emphasis on cases with unsatisfactory results. These reports were received, analysed and approved by the committee made up of the Railway's General Directorate of the Ministry of Development, Adif, Renfe and Ineco.

Among the new aspects of the project it is worth noting the coexistence of a testing sector adjacent to a sector in construction. In order to isolate the pilot sector from the rest, a new national function was developed, FN125.«

ERTMS in commuter rail vs. high-speed

Among the novel situations that were encountered (which do not exist in high-speed rail) are the following:

- The existence of separation sensors in interlockings that are not compatible with the timers of the ERTMS movement authorisation sectors for operation.
- The creation of new strategies for executing the large number of line exit transitions: Line C4 has 30 level transitions.
- The need, for operation purposes, to have segments with temporary speed limits lower than in the track circuit (the distance between the limits has been reduced to approximately 200 metres).
- Those resulting from implementing an ERTMS system on a line that is already in use: for example, very short distances to the danger point, obsolete kilometre marks, RS sleepers or the presence of electric interlockings.«

Civia entering Colmenar Viejo station.

Validation

After validating the pilot sector between Tres Cantos and Colmenar Viejo and certifying the eurocabins, tests continued on the rest of the line to Chamartín station. The pilot sector was also used to train drivers.«

The works started in 2007 and have been promoted by Spanish Ministry of Development, through the Railway's General Directorate

Evaluation

Independent safety evaluation

Another of Ineco's tasks was to check compliance with regulations on safety and risk management. In the railway sector, the set of regulations by CENELEC (European Committee for Electrotechnical Standardisation) is used as a reference for evaluating the safety of the signalling and control systems: UNE-EN 50126, UNE-EN 50128 and UNE-EN 50129. Compliance with these standards is also part of the interoperability requirements for the on-board and track equipment.

The task of the Independent Safety Assessor (ISA), in this case Ineco, is to certify that the system is safe according to these standards. For this purpose, it follows a predetermined methodology that includes data gathering and analysis, detection of potential hazards and resolution proposals. All of this documentation is included in the 'safety dossier'.

The task of the Independent Safety Assessor (ISA), in this case Ineco, is to certify that the system is safe according to regulations on safety and risk management

The process ends with the evaluation of the final safety case and the publication of a report that the railway authorities, in this case Adif, can use to issue the Safety Certificate required for entry in service.

Evaluation of interoperability

A team from Ineco was involved in the agreement between the Railway's General Directorate and Cetren (the sole notified body in Spain at the time of granting), acting as an evaluator of compliance with the Technical Specifications for Interoperability (TSI) for Control, Command and Signalling, in order to obtain the interoperability certification for the ERTMS L1 subsystem installed in the track, which mainly consists of checking coherence between the selected design and that finally put in service.«

Project milestones

→ This is the first time that ERTMS has been installed on a complex commuter rail line, with over 200,000 users per day, 18 stations –two of which are the largest in Spain; Atocha and Chamartín–, and a length of 62.2 km.

→ It is also the first time that tests were conducted in the reference laboratory of CEDEX.

→ Another novelty was the development of a new national function (specific adaptation of software) to allow the coexistence of ERTMS segments in service with segments being tested or under construction.

→ It is the first time that communication has been achieved between two RBCs with different technology.

The examiner examined

Pilot4safety, European training for road safety experts

With the collaboration of **Elena Puente**, civil engineer (Roads Department)

For two years, the European Commission has promoted a common pilot training experience for professionals in charge of road audits and inspections, particularly secondary roads. Ineco has been assisting the government of Catalonia, one of the participating European members.

ASOCIACIÓN ESPAÑOLA DE LA CARRETERA (AEC)

A small video camera installed inside a car's windshield records the road and the GPS display, identifying and locating each segment that the car travels on. In the meantime, the technicians travelling onboard observe and record the state of road signs, safety barriers, visibility of crossings, the radius of the curves and many other details. The path is travelled several times, in the day and at night, and in different weather conditions. The result is a comprehensive view of the safety of the road that makes it possible to detect and correct the deficiencies found, which will be specified in a detailed report.

A pilot experience

This is the fieldwork performed by road safety inspectors, such as those who participated in Pilot4safety, a project cofinanced by the DG MOVE (Directorate General for Mobility and Transport) of the European Commission. The group of experts was completed by the auditors, whose work allows road studies and projects to include road safety criteria from the outset. Ineco, which already had prior experience in road inspections and audits, has provided technical support to the government of Catalonia, one of the members of the project.

This is a pilot experience which for two years brought together regional institutions, road investigation institutes and universities from eight different European countries with the purpose of preparing a common training syllabus for technicians that analyse roads and, more specifically, conventional interurban roads. The fact is that these inspectors receive prior training that has not yet been harmonised throughout the European Union, so that each country differs in the duration and validity of the certification. This lack of homogeneity is an obstacle to the application of common road safety standards.

For both audits and inspections, the public institutions or operators entrust accredited experts to check the design and elements of the roads –signalling, layout, conditions of pavement, intersections, tunnels, etc.–, so that they can detect deficiencies and propose possible solutions. The main difference is that while audits begin at the project stage, inspections are performed on roads in use, as part of an integral road safety programme.«

Five countries and a common project...

Over two years (from 1 June 2010 to 31 May 2012), five regional or local institutions from Spain, Italy, Denmark, Greece and the Czech Republic have acted as members and hosts of a project endowed with a budget of 1.3 million euros. The Forum of European National Highway Research Laboratories (FEHRL) acted as the coordinator. Research institutes such as the Belgian Road Research Centre (BRRC), the Austrian Institute of Technology (AIT) and the German Federal Highway Research Institute (BASt) also collaborated. In addition, it enjoyed the collaboration of the companies that supported the members, such as Ineco or the Danish company COWI, and the Italian universities of Roma TRE and Catania.

All of these debated and put together a study plan and a manual of procedures to be used as a reference text for future road inspectors and auditors. However, Pilot4safety was not just about exchanging experiences and 'good practices': it has also been put to the test. As part of the training courses held in Brussels, technicians formed mixed teams with one local and one foreign expert, plus one observer, who travelled to each of the member countries, which in turn acted as hosts. In total, five audits and as many inspections were performed.

Ineco collaborated with the government of Catalonia, which audited two road projects: local road C-242, with a length of 25 kilometres, in Lerida (Spain), and a bypass in the Czech city of Chýnov. In the former case it teamed up with the Italian member Astral, the road manager of the Lazio region, and in the latter with CDV, the Directorate General of Roads and Highways of the Czech Republic. As regards inspections of roads in service, the Spanish technicians and the Danish technicians from the town of Randers checked road C-155 in Sabadell. They also inspected provincial road 25 A, in the Central Macedonia Region of Greece, together with local technicians.«

Harmonising road examiners training in Europe will make easier the application of common road safety standards

...for an European training syllabus

The conclusions of Pilot4safety suggest that the ideal duration of the training period should be two weeks (plus another two weeks for studying the documentation before attending the courses), and a final exam enabling them to obtain a renewable certificate with a three-year validity. It is estimated that applicants should have an engineering education and at least three-year experience in road design, road safety engineering and/or accident analysis. These conclusions have been communicated in activities such as the workshops organised by Ineco on 3 May, in collaboration with the government of Catalonia, on the subject of road safety audits and inspections. The project was also presented in the 3rd Iberoamerican Congress on Road Safety held in Colombia from 12 to 16 June 2012.«

1

2

3

1_Inecos's inspector with GPS.
2_Inspection vehicle showed in the manual. It has the obligatory safety road signals.
3_Inspector's training in Brussels.

It has been found that audits and inspections reduce the number and seriousness of traffic accidents on secondary roads

ESTRATEGIES AND OBJECTIVES

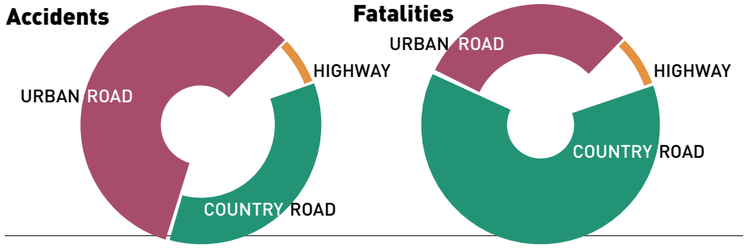
Road safety prevention tools

Although throughout Europe accident rates and deaths show a clear downward trend in the last decade, the road safety strategies of the European Union up until 2020 have set the goal of reducing the current number of deaths by half. One of the proposed measures is to unify and raise the safety level of European roads, for which purpose Directive 2008/96/EC regulates the implementation of road safety audits and inspections. Spain incorporated this Directive to its legislation by means of a decree in 2011.

Ever since these tests were first performed in the United Kingdom in the early 90's, they have been shown to be highly effective prevention tools for reducing the number and seriousness of traffic accidents. However, they are only mandatory for roads included in the European Transport Network, despite the fact that it is conventional or 'secondary' roads –i.e., those found outside urban areas, paved, with a single carriageway and two lanes– which record the highest mortality rates.

Thus, although in absolute numbers there are more accidents in urban areas, there are more deaths in interurban roads. In Spain, according to data from the Directorate General of Traffic, 75% of accidents with victims occurring out of urban areas took place on conventional roads.«

Traffic accidents in the European Union (2010)



Other Ineco work on road safety

→ROAD SAFETY INSPECTIONS

From 2008 to 2010 Ineco inspected the 3,955 km stretch of Andalusia's complementary road network, which required 32 days of fieldwork and generated 320 GB of information.

→INNOVATION PROJECTS

Involved as a member in project RIPCORD-ISEREST (2005-2007), included in the 6th Framework Programme of the European Union. Its purpose was to develop various predictive tools for improving road safety. Its contributions were included in Pilot4safety.

→ROAD SAFETY AUDIT

_For the Study and executive project for constructing the second stretch from km 69+100 to km 108+200, including connections, structures, drainage work, signalling, complementary works and collection booths for the road segment Guadalajara–Colima, in Mexico.

_For the construction project: Individual local improvements to road LZ-2 between kp 12+600 (Mácher roundabout) and kp 14+400 (Playa Quemada roundabout). Island of Lanzarote.

_For the construction project involving the conditioning of road A-348. Segment: Lanjarón-Órgiva (Granada).

_For informative study phase B: connection options between the dual carriageway Trujillo-Cáceres (A-58) and the Autovía de la Plata dual carriageway (A-66), around Cáceres.

→SUPPORT PLANS

Since 2009, Ineco lends support to the Ministry of Development for drafting projects, coordinating, monitoring and controlling the First Generation Highway Adaptation Programme.

Blind-spot-free surveillance

Comissioning of the multilateration system in Barcelona

By **Rafael Marín**, aeronautical engineer, and **Cristina Membrado,** telecommunications engineer (CNS Systems Department)

Ineco has collaborated with Aena in the comissioning of the multilateration system, which is able to locate and identify, even in low-visibility conditions, any aircraft or vehicle moving on the surface of the airfield. This solution has been integrated in SACTA, Aena's air-traffic control system.

A multilateration system came into service last March at Barcelona airport, enabling it to increase its traffic handling capabilities in both normal and reduced visibility conditions, with low cost and with a low environmental impact. The multilateration system complements the surface surveillance systems already in service, by providing greater accuracy in the location of vehicles and aircraft in the airfield. At the same time, it supplies information to identify the vehicles and provides other relevant data for coordinating takeoffs and landings.«

ONSCREEN INFORMATION
The controller can view the position of each vehicle or aircraft within one second, as well as its identification.

Ineco's contribution and experience

■ **All traffic on the surface of the airfield is displayed to the controller in the control station of SACTA, the Automated Air-Traffic Control System used by Aena in all control towers and centres it operates, and a worldwide reference in air-traffic management technology and capabilities (see *itransporte 25*). Ineco has collaborated with Aena since 1998 in the development and engineering of SACTA, participating in the design, definition of specifications and testing of the continuous updates. These changes respond to variations in traffic demands, the introduction of improvements, advanced functions or standards, compliance with regulations or incorporation of new integrated systems, as is the case of the multilateration system at Barcelona airport.**

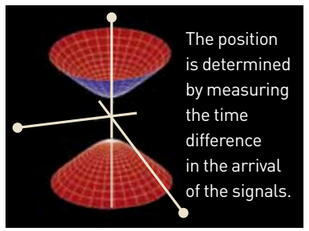
■ **Previously, the company has also collaborated on the coming into operation of multilateration systems in the Palma de Mallorca (2005), Asturias (2007) and Madrid-Barajas (2011) airports.**

■ **Currently, Ineco is collaborating in the start-up of a multilateration system at the Tenerife Norte airport, analysing the signal received (data quality and integrity) and the behaviour of the system. This analysis is remotely performed based on the definition and execution of a testing plan used for remote work from the Experimentation and Development Centre in Madrid; and at a later stage, in the control towers.**

HOW IT WORKS

The system processes several radio signals

It is based on processing signals from transponder units fitted in aircraft and other moving vehicles. The signals emitted by the transponders are captured by receiving stations that retransmit the signals they receive in real time to a central processing station. The position is determined by measuring the time difference in the arrival of these signals.
These time differences allow several hyperbolic surfaces to be generated that define a position. At least four signal receivers are needed to accurately determine the position of a moving object. When the position of a new moving object has been detected, the system proceeds to its identification. In Barcelona, seven interrogating stations indicate the identification parameters of the moving element. Identification is performed by selective interrogations. In this phase, information on the identity of the moving element is acquired by means of the Mode-S 24 bit data link. When the element is an aircraft, it will provide the information data that the system will then use to associate it with the corresponding flight plan. All of this information is provided to the air controller.



The position is determined by measuring the time difference in the arrival of the signals.

The greater the number of antennas, the greater the accuracy. A total of 32 antennas have been installed at Barcelona airport

At Barcelona airport, 32 remote reception stations make up the constellation of antennas of the system that ensures an accurate and reliable location in real time, as well as identification within range, supplying new information to the tower controller. This is a critical function, as it is their responsibility to separate aircraft from each other and from other vehicles in the airport regardless of visibility levels. This requires an accurate knowledge of the position and identification of the aircraft, as well as their direction of motion.
It is worth noting that multilateration systems are not limited to positioning moving elements on the ground. There are also stations with the necessary range to detect aircraft in flight, in a similar manner performed by conventional radar systems.«

The multilateration system can operate in low-visibility conditions, it is quick and reliable, improves coverage in complex orography and has a lower cost than radar systems

System elements

➔ANTENNA SYSTEMS
Composed of several antennas or sensors distributed throughout the surroundings and areas of the airport (taxiways, runways, approach paths). They are in charge of receiving emissions from vehicle transponders.

➔AIRCRAFT OR LAND VEHICLE TRANSPONDERS
These are on-board systems in charge of replying with the vehicle identification and aircraft altitude (in take-off or landing situations).

➔GROUND STATION
In charge of calculating the data of the various aircraft or vehicles identified, supplying for each one their position, speed, identification, altitude, etc. This calculation is performed considering the data received by the different multilateration stations or sensors that have been installed within the airfield geography.

➔FIXED REFERENCE TRANSFORMERS
They send signals to receiving stations with a known position in order to calibrate and adjust the signals.

Benefits and advantages over other surveillance systems

- **The multilateration system provides considerable improvement in the management, safety and fluidity of operations of the vehicles moving in the airport area. Mainly for aircrafts, but also for all other ground vehicles, regardless of environmental and visibility conditions.**
- **Faster refresh rate of displayed data than in other systems: once per second, corresponding to the frequency of multilateration data, instead of four or more seconds corresponding to the period of air radars. High reliability in the detection of vehicles.**
- **Improved surveillance coverage in complex landscapes or with elements that may generate blind spots in the emission of a radar antenna.**
- **Lower installation, operation and maintenance costs than conventional radars.**

PABLO NEUSTADT

Although generally visual control is performed in control towers (see right), the use of automated systems such as SACTA is essential. Bottom: MML antenna.

Repercussions on control system

By integrating systems such as the multilateration system, SACTA offers a more efficient tower control service, enabling air traffic control in adverse conditions, such as low visibility due to weather factors (fog, rain...). It also supplies detailed information, using the radar systems, flight plan information, weather information, etc. and allows for the coordination of information between the different air-traffic control centres. The SACTA system is in constant evolution, due to the changes in traffic demand to include new improvements, advanced functions, standards and compliance with regulations. It also incorporates information on new integrated systems, such as the multilateration system at Barcelona airport.«

Surface control

Closely related to the multilateration system, and to the latter's functions, is the A-SMGCS (Advanced Surface Movement Guidance & Control System). Developed by ICAO, the International Civil Aviation Organisation, and Eurocontrol, the European air safety agency, it defines the requirements that must be fulfilled by control systems intended to provide safe control and guidance of aircraft on the airfield surface.

PABLO NEUSTADT

The multilateration system allows airports to reach A-SMGCS level 1, which involves having the systems and procedures necessary to obtain accurate information on the operations that occur on the airport surface, regardless of visibility conditions.«

The *Yüksek Hızlı Tren* steams towards Istanbul

High speed in the heart of Anatolia

With the collaboration of **Pedro Elizalde**, civil engineer (Department of Railway Maintenance and Equipment)

LUKE W. L. LI

Ineco participates in one of the largest railway projects in Turkey: the adaptation of the Ankara-Istanbul line to speeds of up to 250 km/h. This is a vital infrastructure for modernising transportation in the country, as well as an extremely complex project from a technical standpoint, which is now in at the half-way line.

In the centre of the Anatolia peninsular, the geographical centre of Turkey, is Ankara, the capital since 1923. However, the historic city of Istanbul, on the Bosphorus strait, triples its population with 12.9 million inhabitants, according to the census of 2009. A railway line of 576 kilometres built in the early 20th century connects the two cities, linking the official capital and the main economic centre. However, although it is one of the most important cities in the country, 75% of the line has a single track, resulting in trip times of over six hours.

For this reason the TCDD, the state railway organisation, has promoted the adaptation of the line (*Yüksek Hızlı Tren*, Turkish for high-speed train) to speeds of up to 250 km/h, a complex project that includes work on renewing the existing alignment and constructing new sections. The first phase of the project, between Ankara and Eskişehir, 276 kilometres long, entered into service in 2009. In March 2012 an additional 30 kilometres were inaugurated to Inönü, meaning that in total over 50% of the new line is already operative.

When the work is completed, the time of the trip from Istanbul to Ankara will have been reduced from six to three hours

A project in progress

In the meantime, work on the rest of the alignment continues to advance from east to west, towards Istanbul. According to the TCDD, once the work is completed (which according to estimates by the Ministry of Industry will require at least another two years), the total length will be 533 kilometres of line, able to carry 50,000 passengers daily, 78% more than before, and the trip duration will be reduced from six to three hours.

An additional goal of the project is to reduce congestion on the Ankara-Eskişehir highway, as well as air pollution. In addition, when it is completed the line will connect Europe and Asia through the underwater tunnel being built under the Bosphorus strait, known as Project Marmaray. In both projects it is worth noting the participation of Spanish companies such as OHL, Dimetronic, CAF or Thales Spain, as well as Ineco, which provides technical assistance in the high-speed section between Inönü and Köseköy.«

Spanish companies in Turkey

Spanish investment has continued to grow in recent years, and the development of the transportation sector requires the services of construction and engineering firms such as Ineco, which was awarded its first contract in Turkey in 2010.

■ The OHL Group, which had already built a 206 km section of the Ankara-Istanbul line between Hasanbey and Esenkent, also participates in the new tunnel under the Bosphorus, together with Invensys Rail Dimetronic. The latter firm, operating in the country since 2008, is carrying out four projects related to the development and installation of railway signalling and control equipment and has offices in Ankara and Istanbul.

■ Thales Spain, manufacturer of railway signalling equipment and systems, has been working in Turkey since the 90's and is also taking part in the Ankara–Istanbul high-speed line; in 2009 it opened a subsidiary based in the capital. CAF has built 10 high-speed trains that run between Ankara and Inönü, as well as rolling stock for the Antalya tram and the Izmir commuter railway. Adif also signed a collaboration agreement with TCDD in 2008 by virtue of which it has already provided technical assistance to its Turkish counterpart.

The entire project is highly complex due to seismic activity, the effect on urban areas and the rugged terrain in some sections

MODERNISATION OF TRANSPORT

Focus on railways

For an economy and a population in strong expansion, the performance and capacity of the existing railway network has proven to be insufficient to absorb the growing demand in passengers and freight. At the same time, roads (the main mode of transportation, accounting for 95% of passengers and 90% of freight in 2009) have become increasingly congested. For this reason, the government of the Republic initiated at the beginning of this decade an ambitious modernisation program for all of its transportation networks. These plans include opening management and operation to the private sector and expanding and renewing infrastructures. This represents a great effort, as reflected in the official figures: in 2011, 28.2% of public investment was dedicated to transportation, with the greatest share (13.7%) dedicated to rail.«

The line

This is the context for the construction of the Ankara-Istanbul high-speed line based on the existing conventional line, which in some sections will be conserved exclusively for freight. Almost three quarters of the current line is a single track, with the exception of the section between Istanbul and Köseköy, and several sections between Eskişehir and Inönü. Between the latter and Ankara, the line is already operating with high-speed performance since 2009. The remaining 217 kilometres are under construction.«

The Inönü-Köseköy section

Ineco, together with its local partner, the Turkish consultancy firm UBM, provides consultancy and construction supervision services on the central stretch, Inönü–Köseköy, which at 150 kilometres long is the longest section in construction. This is in turn divided into two sections: section 1, from Köseköy to Vezirhan, and section 2, from Vezirhan to Inönü. The contractor is the same in both, a consortium formed by two Turkish companies, Cengiz and Içtaş, which are in charge of the infrastructure, and two Chinese companies, CRCC and CMC, which work on the superstructure (track, electrification, signalling and telecommunications). Both the development of the projects and the execution of the work have undergone changes to deal with the complexity of the work. The Turkish government decided in 2008 to modify the original projects in order to solve issues such as landslides or ground liquefaction, which in an area with high seismic risk such as Turkey are of great importance. To do so, the jet-grouting technique has been used to improve over 30 kilometres of ground under the alignment, modifying the number and length of tunnels and viaducts among other structures. The alignment itself was also changed at some points, such as in the town of Bozüyük, where it was decided to move the line away from the urban centre due to the effect on the urban area and the conventional railway line.

In the first section, (100 kilometres), it is worth noting the complex process of expropriations in Sapanca, a tourist location on the shores of the eponymous »

The work, section by section

A total of 306 kilometres are in service in the following sections:

- **Ankara - Sincan, 24 km**
- **Sincan - Esenkent ,15 km**
- **Esenkent - Eskişehir, 206 km**
- **Eskişehir - Inönü, 30 km (since March 2012)**

The following are still under construction:

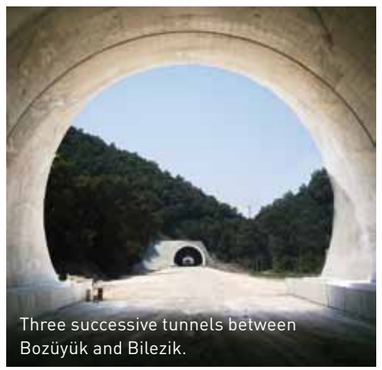
- **Inönü - Köseköy, 150 km (Ineco/UBM)**
- **Köseköy - Gebze, 56 km**
- **Gebze - Istanbul, 44 km**

Ineco's role

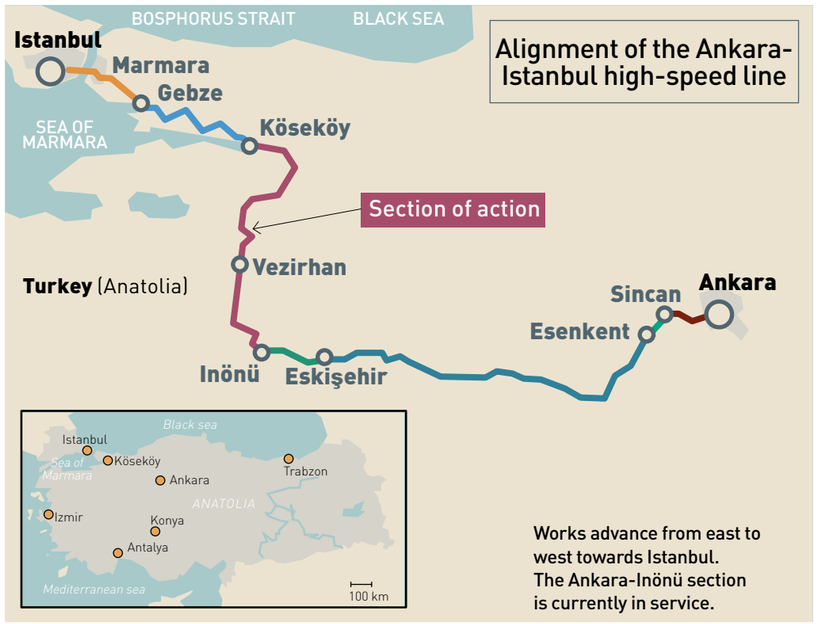
Since July 2010, Ineco and its partner UBM provide consultancy and construction supervision services, which includes:

- **Review of the construction project and contractor's documentation**
- **Defining the quality assurance system**
- **Monitoring of the contractor's work programme**
- **Qualitative, geometric and quantitative control of the works**
- **Budgetary monitoring**
- **Environmental measures**
- **As-built project supervision**
- **Final report**

Viaduct in construction above highway and tunnel in the background.



Three successive tunnels between Bozüyük and Bilezik.



Viaduct and tunnel near Bozüyük.

Installation of track panels.

The work includes the duplication, electrification and renewal of the track; telecommunications, new stations and maintenance installations

OVERCOMING OBSTACLES
The railway alignment crosses the highway between Eskişehir and Istanbul several times. In the image, viaduct 16 near Osmaneli.

Material provision area near Pamukova.

Track works, also in Pamukova.

lake. In the area between this town and Geyve, known as the Doğançay Passage, the original alignment has been changed considerably, as it did not conform well to the demands of high-speed rail. For this reason, TCDD decided to eliminate this section from the contract in force and make it the object of a new tender. Finally, about 22 kilometres will run almost continuously in tunnels and on viaducts in order to overcome the extremely rugged landscape in the area. In the Pamukova valley between Geyve and Mekece, with about 30 kilometres of flat and sloping ground, the main difficulty arose from the poor

Since July 2010, Ineco and its partner UBM provide consultancy and construction supervision services for the project

conditions of the natural ground to settle embankments and the risk of ground liquefaction. For this reason, jet-grouting was used to improve the foundation conditions.

In the second section of the stretch (54 kilometres), at Vezirhan, changes to the original alignment were also made due to the geotechnical problems related to the stability of the embankments observed in another nearby construction project, the highway between Eskişehir and Istanbul, which is parallel to the new railway at many points. In addition, the original alignment had many crossing points with the conventional track, which will remain in service, and effects on the Sakarya river.

Another significant change was the alignment of tunnel 26, the longest in the section, which initially ran very close to the highway where the embankment collapses were observed. It was decided to move it for this reason, resulting in an increase in its length.«

Pegaso City opens its wings

Development of an old industrial park

By **Amador Álvarez**, civil engineer (Department of Roads)

Partial view of some of the buildings designed. On the right, the completed Aena headquarters buildings.

With its sustainable buildings, a strong emphasis on green spaces and its proximity to Barajas airport, the future business park in the eastern part of Madrid is starting to become a reality.

The Pegaso City business park is located in part of the former grounds of the emblematic Pegaso motor vehicle factory (nowadays Iveco), and forms part of the Partial Programme for Internal Renovation of APR.20.07 in Madrid, next to highways A-2 and M-21 and a short distance from Barajas airport.

Ineco has participated in this project from its beginnings, carrying out, besides the development plan, the preliminary plan for adapting the land, as well as additional projects organising access to the business park from the A-2 and M-21 roads. During the stages of implementing and starting the work, Ineco also provided technical advice to the City Council of Madrid and to the owners of the land.

Reutilisation of rubble

Particularly noteworthy is the action protocol designed by Ineco for the reutilisation of more than 6,000 m^3 of concrete from the demolished buildings located on the development site. This material, after suitable treatment, was used as a sublayer in the construction of roads in the development, with excellent results. This action represented an unquestionable environmental achievement, allowing a huge volume of material that would otherwise have been sent to the rubbish dump to be recycled.

The carrying out of the works was the responsibility of Dragados SA, a building company belonging to Grupo ACS, commissioned by the owners of the land, Inmobiliaria Urbanitas, SL. The green spaces were designed by the Dutch company West 8.«

A modern business park in the east of Madrid

Providing adequate worksites for the new century this is the aim of Pegaso City, which will offer its future users large green spaces, restaurants, gyms and child care services inside the business park, with the LEED environmental certification for all of its buildings. Its 520,000 m^2 of building area will make Pegaso City one of the largest business parks in Madrid. Its location will allow future links to Barajas airport as well as to the Alameda de Osuna underground

station and the San Fernando de Henares commuter rail station.
It will have a central boulevard, large green spaces and many trees coexisting with the modern buildings that are to house companies with all types of needs. Aena has been the first organisation to settle in the business park.

Isolating risks

New approach to airport safety management

By **David Formariz**, aeronautical engineer (Department of Aeronautical Operations and Services)

Since 2003, Ineco has worked with Aena Aeropuertos in the ambitious project of defining and implementing the Safety Management Systems (SMS) in its network of airports. To achieve this, the company has a team of experienced engineers who specialise in the development and implantation of these systems.

Absolute operational safety does not exist; there is always a residual risk associated with any activity. With this premise, operational safety is defined as the conditions under which the risk of injury to persons or material damage due to activities generated as a result of airport activities is reduced to an acceptable level, and is maintained or reduced by a continuous process of risk identification and management.

What, when and who

Until the early 90's, safety management models used in the aeronautical industry were mainly based on analysing human error. Accident investigation focused, in the absence of technical failures, on detecting improper assessments, erroneous decisions and faulty judgment by staff, so that the result of this investigation was determining 'what happened', 'when it happened' and 'who did it'. The safety recommendations associated with the investigation concluded by assigning blame, resulting in personnel recycling or even punishment.

Preventing human error

A characteristic feature of this approach was that operational safety recommendations addressed the immediate and specific safety problem identified as the cause of the safety failure, ignoring the context and circumstances in which it occurred. Although it is true that most accidents are ultimately due to human error, attributing them to these errors will not provide an answer to the question 'Why did the accident happen?' and 'How did it happen?'

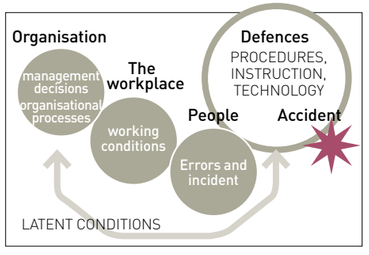
ICAO has created the regulations needed to develop and implement the SMS

Human error is a symptom of the existence of a deeper problem with the system, and as it is inevitable it is necessary to design airport infrastructures, facilities and procedures that will 'tolerate' errors, that is, in which system failures will not lead to accidents.

In this sense, in the early 90's a conceptual revolution took place due to professor James Reason, who established a model that is in place to this day. According to this model, active errors of personnel occur within an operational context that includes a set of latent conditions associated with the organisation.

AEROPLANE IN THE FOG
When there is fog in an airport, it is essential to apply low-visibility procedures. The indicators associated with proper compliance with these procedures permit the identification of potential operational risks and guarantee safety.

DAVE HIGHBURY



Operational Safety Management Systems (SMS) constitute the framework in which this new working philosophy is applied, resulting in a new management approach. With this in mind, the ICAO has created the regulations needed to develop and implement these systems in the aeronautical industry. For airports, Annex 14 requires all certified airports to have an SMS in place, setting out guidelines for its implementation in the operational Safety Management Manual (Doc. 9859). According to these criteria, Aena Aeropuertos began work with Ineco's support on developing an SMS model applicable to the airports in its network.«

Development and implementation

The implementation of the SMS in the airport must be tailored to each organisation, so that it is solid and effective, and integrated in its daily operations. Some basic premises are necessary to lay down the grounds which allow the project to be completed successfully:

1_An initial phase including a gap analysis and the definition of policies and goals regarding operational safety.

2_Project planning, with manageable steps, in view of the characteristics and complexity of the organisation.

3_Generation of a new work philosophy that involves all the staff and changes the point of view of the organisation.

By means of the gap analysis, the strengths and weaknesses of the airport are identified, allowing for the prioritisation of the existing needs in accordance with the four pillars of the SMS: policy and goals; safety risk management; safety assurance; and safety promotion.

The next step involves defining a structure of responsibilities and establishing a policy that considers the organisation's commitments.

■ The Safety Manager will be in charge of promoting the implementation of the SMS and involving the remaining airport units in this objective:

_Guaranteeing that the contribution of airport activities to aviation safety is optimum, as the prime objective above all others.

_Safety Management for airport activities will be a formal, explicit and systematic activity of a preventive nature.

Of these processes, the risk management system is the basic pillar for safety management

REACTIVE PROCESSES

Communication culture

These establish mechanisms to ensure gathering of information on accidents or incidents in the airport, so that their analysis provides lessons learned to be communicated to all airport staff.

It is essential to create a communication culture with staff members

To ensure that it is effective, it is essential to create a communication culture in the airport in which staff members are willing to communicate errors and incidents in which they are involved or which they witness.

Creating this culture requires implementing the non-punitive principle in communications, understood as an atmosphere of trust in which the staff is encouraged to provide information. This principle is explicitly stated in the Safety Policy and is notified to all staff members.«

PROACTIVE PROCESSES

Managing potential risks

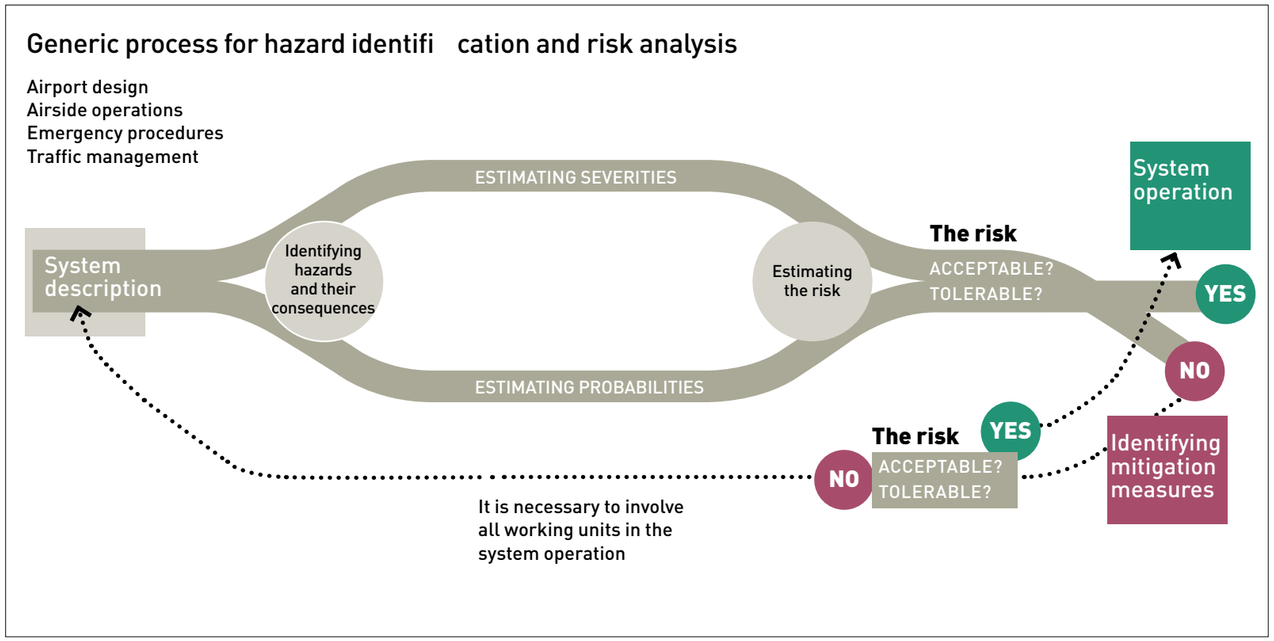
The identification of potential risks by assessing the different activities (management of infrastructures, procedures, existing environment and organisational aspects) and the changes that take place is one of the pillars of the SMS. To this end, proactive processes with a view to the future are developed.

Of these processes, the risk management system is the basic pillar for safety management. The analysis of potential consequences of the hazards (risks) measured in terms of probability and severity will allow for the determining of how the airport perceives these consequences so that they adopt the necessary measures accordingly to eliminate or mitigate them to the lowest level that is reasonably achievable.

When guaranteeing that this process is applied effectively, it is essential to involve in the identification of risks

Ineco is preparing Safety Studies based on data of incidents in the aeronautical industry

and hazards all the units involved in the operation of the airport (ATC, airport and air navigation maintenance, airport operations, airlines and ground assistance, etc.).



The design of the risk management procedure and its application require a thorough knowledge of risk analysis and experience with airport operation. It involves developing qualitative and quantitative methodologies for estimating the probability of risks and assigning their severity.

Preparing the aeronautical safety studies, which evaluate deviations from technical standards for airports and determine alternative measures that ensure operational safety, requires the application of the risk management processes. Ineco is preparing these Safety Studies, for which purpose it has developed a quantitative model for calculating probabilities for runway runoffs, based on data from accidents and incidents that have occurred in the aeronautical industry.

Other proactive tools for identifying potential hazards in airports are internal monitoring, Safety Committees, which gather airport operators, operational safety communications made by airport staff, and external provider monitoring.«

PANE_probabilities / severities

SEVERITY \ PROBABILITY	Very improbable	Improbable	Remote	Occasional	Frequent
Catastrophic	Tolerable	Unacceptable	Unacceptable	Unacceptable	Unacceptable
Dangerous	Acceptable	Tolerable	Unacceptable	Unacceptable	Unacceptable
Important /Major	Acceptable	Acceptable	Tolerable	Unacceptable	Unacceptable
Unimportant /Minor	Acceptable	Acceptable	Acceptable	Tolerable	Tolerable
Insignificant	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable

Acceptable · Tolerable · Unacceptable

PREDICTIVE PROCESSES

Identifying latent hazards

The purpose of analysing the daily activities of the staff is to gain knowledge on daily activities in airport operations. To this end, Operational Safety Indicators are a powerful predictive tool for evaluating

A powerful predictive tool to evaluate airport activities and avoid risks in the airport

airport activities with relevant impact on Operational Safety. Their design and analysis allow for the identification of latent hazards, which permits the taking of measures in order to solve deviations.

For example, an increase in the indicator regarding the number of non-routine activities of the airport Fauna Control Service shows that there has been an increase in the presence of birds or other animals in the airport premises, which may be due to hazards such as the existence of new areas near the airport that attract birds (ponds, dumps...) or improper maintenance of the peripheral fence that allows easy entry of animals into the airport, with the resulting hazards to aircraft operation.«

MPLS, high-speed technology

Data labelling provides speed and safety

By **Víctor Andrés Martín**, telecommunications engineer (Department of Signalling and Telecommunications)

The MLPS protocol is a data packet switching technology that was first developed in the 90's, and is currently the basis for railway telecommunications networks on high-speed lines.

To guarantee the effective operation of information systems on high-speed railways, communication must also take place at the maximum possible speed. Multiprotocol Label Switching (MPLS) consists in a communications protocol that transports information at high speeds with short failure recovery times, and constitutes the basis of current networking architectures in telecommunications networks on high-speed lines.«

The backbone of railway communications

The origins of MPLS communications technology date from the late 1990's. It was created in order to unify the benefits provided at the time by the IP protocol regarding information routing, and the ATM (Asynchronous Transfer Mode) technology for sending packages by consulting and exchanging labels.

After significant R&D developments in the 21st century, MPLS has become the backbone technology for railway telecommunication architectures on high-speed lines in Spain. An architecture known as the Data Exploitation Network (in Spanish, Red de Datos de Explotación, RDE), enabling a large switching capacity, long-distance links and high speeds; it has a Data Access Network (in Spanish, Red de Acceso de Datos, RAD) to allow transmit access to the different railway services. This allows for the development of a multi-tier networking topology that provides customers with a service that ensures quality, availability and scalability.

How does it work?

MPLS is a package switching technology that establishes virtual paths between nodes, enabling bidirectional communication between two devices in the network along a 'dedicated path'. The ingress router to the MPLS domain that receives

Ineco participates in all the MPLS deployment stages on Spanish high-speed railway

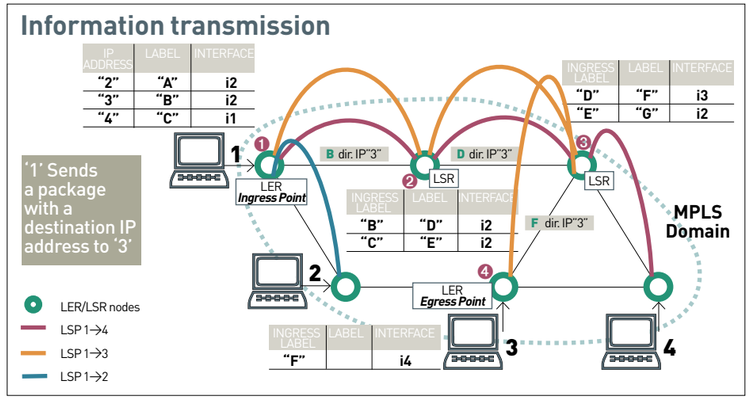
this information is known as the LER (Label Edge Router); depending on the destination IP address, a label will be added to its header, which is consulted, replaced and forwarded by the intermediate routers or LSRs (Label Switching Routers).

A table of labels guarantees greater transit speed, shorter transmission time between two devices (shorter latency) and therefore greater communication speeds. This association between labels creates a virtual circuit known as an LSP (Label Switched Path). This circuit simulates the construction of a communications tunnel.

Redundancy mechanisms

A basic premise is ensuring full service availability. Ring physical topologies or 1+1 redundancy are some of the design rules used to ensure this availability. The MPLS configuration has a primary tunnel and several backup tunnels for reaching a specific destination. These are protection paths that are switched among them if links are down, with convergence times of under 50 milliseconds.«

CARRIER CONSULTING



Ineco's experience in MPLS technology

■ **Ineco has participated in various projects where this technology is used, such as the Madrid-Albacete-Valencia and Ourense-Santiago high-speed lines, already in use, and the Albacete-Alicante line, currently under construction. Within these works Ineco has carried out engineering design and construction designs, consultancy, technical assistance and worksite control at the construction stage, as well as participating in maintenance.**

→DESIGN STAGE PHASE

Ineco plays an active role in the deployment of MPLS telecommunications infrastructures. The design phase defines the architecture of the Data Exploitation Network (in Spanish, Red de Datos de Explotación, RDE), the level that houses the MPLS routers and where the communications tunnels for providing services are designed.

→CONSTRUCTION PHASE

The construction phase involves a more intensive contribution of Ineco's accumulated experience. The design engineering is performed in collaboration with the customer and the technologist, and based on the topology defined in the design.
First the necessary services are analysed, configuring them as VPNs or VPLS, activating routing protocols and establishing LSPs to transmit the information in the most efficient manner.

→TESTING PHASE

The testing phase is used to debug the activated configurations, performing the field installation, and finishing with the system commissioning. Ineco collaborates throughout the lifetime of the project, providing its know-how obtained in the deployment of high-speed rail telecommunications networks.

A path that broadens horizons

Progress in the improvement and modernisation tasks

By **Daniel Esteban**, civil engineer (Department of Roads)


Office building in Sayula. 2


2 Teocuitatlán links.

The work continues after opening 29 new kilometres of four-lane carriageway this summer, leaving under 30 kilometres to double. Improvements on this road were also made at tolls, accesses and connections.

Ineco is in charge of project management for the expansion and modernisation work on the Guadalajara-Colima highway in Mexico. This work is one of many tasks envisaged in the agreement signed with Banobras to act up to 2025 as 'Administrator Agent and Supervisor' for the road (see box), which has a length of 148 kilometres. It alternates free access and toll sections, and comprises four lanes, with the exception of the 58 kilometre stretch on which the improvement work is underway. In August, 29 kilometres were inaugurated bringing the new four-lane carriageways into service, in addition to three connections: Ciudad Guzmán, Atoyac and Teocuitatlán, as well as several overpasses that allow the existing irregular accesses to be closed.«


The works have included the expansion of the carriageway and the construction of several overpasses at different levels. 1


1


1


1


In the image, a toll station. Bottom left: load test. Bottom right: carriageway expanded to four lanes. 2


2


The new links will eliminate the irregular accesses. The image shows the Ciudad Guzmán link. 2

Expansion to four lanes (1)

The lane doubling is about to be completed on the first 34 km section, as well as on the first phase of the second section of only 5 kilometres; there are another 19 kilometres left, which are somewhat separated from the current layout and travel over deep gorges. To overcome these, 11 overpasses and 17 bridges, three of these over 520 m in length, will be built. This last stretch will enter into service in early 2015.«

Links, tolls and accesses (2)

The modernisation work on the highway, which was built in 1983, consists in adapting six links, constructing three toll stations and building several non-level crossings. In addition to remodelling and expanding the two existing toll points (Acatlán and San Marcos), a third one has been built in Sayula. All are expected to be operative in 2013.«

Ineco on the Guadalajara-Colima highway

- **Banobras, the National Bank of Public Works and Services of Mexico, implemented in 2010 a new highway management and operation model. In 2011, Ineco won a contract worth 37 million euros to act until 2025 as 'Administrator Agent and Supervisor' on the Guadalajara–Colima highway. It currently has a team of 24 employees at its Guadalajara and Mexico City offices, as well as support staff onsite in work places.**
- **Ineco is also a majority shareholder of the Mexican company Inecomex, with which it collaborates in this project and in all other work carried out in Mexico.**

Bridges ready

Viaduct load tests, inspections and monitoring

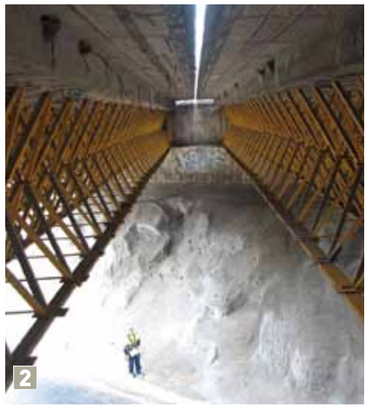
By **Justo Carretero** and **Pablo S. Gareta** (Department of Architecture, Structures and Instrumentation) and **Daniel Esteban** (Department of Roads), civil engineers

Work at height to install displacement measurement instruments on pile 2.

Ineco is conducting a series of inspection, monitoring and load testing activities for several bridges on the Guadalajara–Colima highway in Mexico. The company, which won a contract in 2011 to supervise the concession for 14 years, provides its 25-year experience in Spain and its own modern methodology.

The works are being carried out throughout 2012 and form part of the contract that Banobras (the National Bank of Public Works and Services of Mexico) awarded to Ineco in 2011. They will provide a substantial improvement in road safety and knowledge of the conditions and behaviour of some of the structures on the section, some of which have unique features. The Mexican government is expanding this 148 kilometres highway built in 1983, which is part of an important road axis: Manzanillo-Tampico.«

Load train, formed by three lorries with a total weight of 35 tonnes, during the static load test.



View of the bottom structure of the bridge (tested concrete and replaced metal).

An inspector examines the metallic structure joined to the top concrete slab.

At 140 metres, the Beltrán bridge, built in 1992, is the highest bridge in the state of Jalisco.

Equipment used to gather data during the load test. Above: displacement transducer installed on one of the sections.

Load test on the El Nuevo bridge (1)

This viaduct, located very near the city of Colima, has a length of 145.4 metres distributed in three spans. The terrain required the bridge to be instrumented by the work of specialists in work at heights. The test involved three lorries with a total weight of 35 tonnes, performing 6 static load tests. The load tests make it possible to check the behaviour of bridges and viaducts over time, regarding both potential variations in operation conditions and those due to rehabilitation, expansion or reinforcement work. They are performed for rail and road structures, both new and in use, simulating service overloads.«

Main inspection (2)

In addition to this test, throughout the year a main inspection was performed for a three-slab bridge known as PSV Carretera Federal 68+720. The inspection work included a general check of the structure data and an evaluation of its condition: search for possible damage and existing pathologies. After the inspection the required repair and maintenance work was performed.«

Instrumentation and monitorisation (3)

The system installed on the El Beltrán bridge, near Colima, uses fibre optic technology, from its sensors, amplifiers and connections to the control and recording system. For this reason, in some cases teams specialised in work at heights have been employed to install the measurement devices or the solar power supply installations.«

Solar panels for autonomous power supply, situated at a height on the pile for protection against vandalism.

The world wears Zara

A Zara shop in Tokyo.

Spain's fashion exports keep growing: not only clothing, accessories or footwear, but also something less tangible but increasingly in demand: design and quality products.

Design, value-for-money and an innovative and flexible business model are the distinctive signs of a sector of the Spanish economy that already reaps an average of 44% of its revenue from the international market. Fashion is the sixth sector by exports, with a total value of 13.5 billion euros in 2011 according to data from the Spanish Foreign Trade Institute (Instituto Español de Comercio Exterior, ICEX). It continues to grow in all of its segments: women's, men's and children's fashion, leather goods, footwear, faux jewellery and jewellery. Only in the first half of 2012 foreign turnover grew by 15.7% with respect to the same period in the previous year.

However, this business of ephemeral elegance is based on the creativity of the designers, who each season reveal the keys to dressing well: Balenciaga is a clear reference, as well as other important names such as Pertegaz, Elio Berhanyer, Paco Rabanne, Loewe, Pedro del Hierro, Jesús del Pozo or Victorio & Lucchino. A few more have turned their names into international brands, such as Custo Barcelona, Adolfo Domínguez, Purificación García, Agatha Ruiz de la Prada or the famous shoe designer Manolo Blahnik.

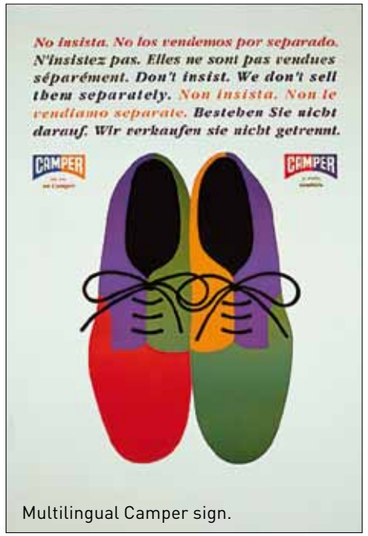
A new business model

In debt with these great names in fashion and the Spanish textile tradition, Spanish prêt-à-porter firms have developed an innovative business model that arose in the 90's and has now adapted successfully to a globalised market in constant evolution. Firms such as the Inditex group, led by Zara, the Catalonian firm Mango or the Cortefiel group, which includes Cortefiel, Pedro del Hierro, Women´s Secret and Springfield, are examples of this paradigm of success.

The growth in casual fashion, the fact that price is the main driving factor for purchases and the increased demand for children's fashion, among other factors, have transformed the market and consumer demand. Spanish fashion companies have found a way to respond to these changes, such as applying new technologies to the transport and distribution of their products, so that a new design can be developed, manufactured and distributed to sales points worldwide within one month. Speed of reaction is also essential in the design phase: teams of several hundred people continuously analyse consumer preferences to offer the products that they demand. Efficient logistics also allows quick product turnover at reasonable prices, that are optimised by the strategic distribution of production centres.

The flagship

Zara, which opened its first shop in 1975, is the emblematic brand of Inditex and the seed of the group, integrated by eight different brands (Pull&Bear, Massimo Dutti, Bershka, Stradivarius, Oysho, Zara Home and Uterqüe). In July 2012 Inditex had 5,683 shops in 85 countries. In 2011 its profits amounted to 1,932 million euros, with sales of 13,793 million euros, 10% more than in 2010. Of its total turnover, 20% originates from the Asian market.



Multilingual Camper sign.

Sketch by Custo for the 2012 New York Fashion Week.

A growing market

The main Spanish fashion customer is the European Union, responsible for three quarters of exports, mainly France, followed by Italy, Portugal and Germany. Outside of Europe, in addition to Morocco, which is next on the list, the United States and Russia stand out in places 9 and 14 respectively.

The Middle East is one of the markets that has grown the most, with 24% in 2011 according to ICEX data. Internet sales on the international market increased by over 89% only in the first quarter of 2012, amounting to 49.2 million euros according to the latest official data.

Mischa Burton with a bridal dress by Rosa Clará.

Mango design centre.

Children wearing Mayoral.

Committed to technology

Internet sales represent the main commitment of Mango, created in 1984. It received a turnover of 1,408 million euros in 2011, 82% abroad, and expects to close 2012 with 70 million only from online sales, twice as much as the previous year. The company currently has 2,521 shops in 108 countries and three product lines (Mango, Mango Touch and He by Mango). It has developed its own logistical system able to classify and distribute 40,000 items per hour.

Brides, children and furs

Within the international market of Spanish fashion there are some particularly strong segments. This is the case of bridal fashion, in which Spain is the second worldwide exporter, with firms such as Pronovias providing 90% of exports, or Rosa Clará. Another strong subsector is children's fashion, which in the past two years has increased its sales by 50%, with firms such as Mayoral, Neck & Neck, Star Textil (Bóboli), Tuc Tuc, Tutto Piccolo, AKR Kids, Cóndor, Losan, Barcarola or Pili Carrera.

The Spanish footwear industry exports 70% of the 94 million pairs of high-quality shoes it manufactures each year

The fur, leather and footwear industry has a centuries old tradition in Spain, and is currently a big exporting sector: shoes by Ursula Mascaró, Lotusse or Yanko, or the striking designs of the Majorcan firm Camper are available everywhere in the world. In the 60's, Loewe was one of the first firms to reach out to foreign markets, where it conserves its prestige and international presence. On the other hand, the creations of Elena Benarroch, José Gómez Benet or Álvarez Valls should also be mentioned in the fur market.

Swiss? No, Spanish

Spain is the fourth European manufacturer of jewellery and watches after Italy, the UK and Switzerland. In addition, the latter country is its main foreign customer. Names with important international presence are Carrera y Carrera –which exports up to 80% of its production–; the Catalan firm Tous; or watch and jewellery groups such as Festina, Munreco –with brands such as Viceroy or Sandoz– and Valentín, which markets the brand Time Force. In jewellery, it is worth citing the work of designers such as Joaquín Berao, with shops in Italy and Japan, Vicente Gracia, Chus Burés, Helena Rohner or Enric Mayoral«

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