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Linking oceans

KUWAIT INTERNATIONAL AIRPORT MASTER PLAN
KIA, desert hawk

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President of Civil Aviation of Kuwait

MEDITERRANEAN CORRIDOR
The new Via Augusta

HS2/HIGH SPEED IN THE UNITED KINGDOM
Queen Victoria's dream

RAILWAY COMMUNICATIONS
SPRING: a model for good signals

BRAND SPAIN
Automotive: a high-powered engine

Editorial

Today we face a time of needed change in which innovation, competitiveness and flexibility are keys to survival. Globalization is now a reality. Emerging countries have been steadily gaining undisputed prominence in the world order for some years. From South-East Asia and Latin America to the Middle East and Africa, the significant increase in economic activity is creating urgent demand for new infrastructure and modern and effective transport systems capable of meeting their needs for development and mobility.

The challenge is great, but so are the opportunities. Our organisation is honed to the reality of an increasingly international business, which is reflected in our new corporate image. We have the skill to offer the finest solutions to our domestic and international clients. The human resources and experience that we have amassed through over 40 years developing infrastructure in Spain are now the backbone and engine for developing and expanding our company. Ineco's rail, aeronautical and road projects enjoy the added value of our specialisation in air navigation systems, electromechanics and rolling stock, signalling and communications, structures, architecture and unique works, transport economics, planning and the environment and information technologies.

Our recent projects in the Mediterranean Corridor for the Ministry of Public Works, the Master Plan for Kuwait International Airport and projects in Mexico, Colombia, Nicaragua and Brazil, explained in detail on these pages, are a testament to our company's determination to put the expertise of our specialists at our clients' disposal throughout an infrastructure's whole life cycle.

The value of an engineering company lies in its knowledge. Ineco contributes experience not only in the planning and design phase, but also in operations and maintenance. This experience has crystallised into solid teams specialised in elaborating strategic plans in which feasibility studies, featuring intermodal solutions and designs enriched through learning, weave a rich tapestry of connectivity that stimulates sustainable local development. One example of this is the bi-oceanic corridors and their role in Latin America, a crucial matter and the subject of an extensive report in this issue.

We hope that you enjoy the content.

Berta Barrero

General Director of Strategy and Corporate Services

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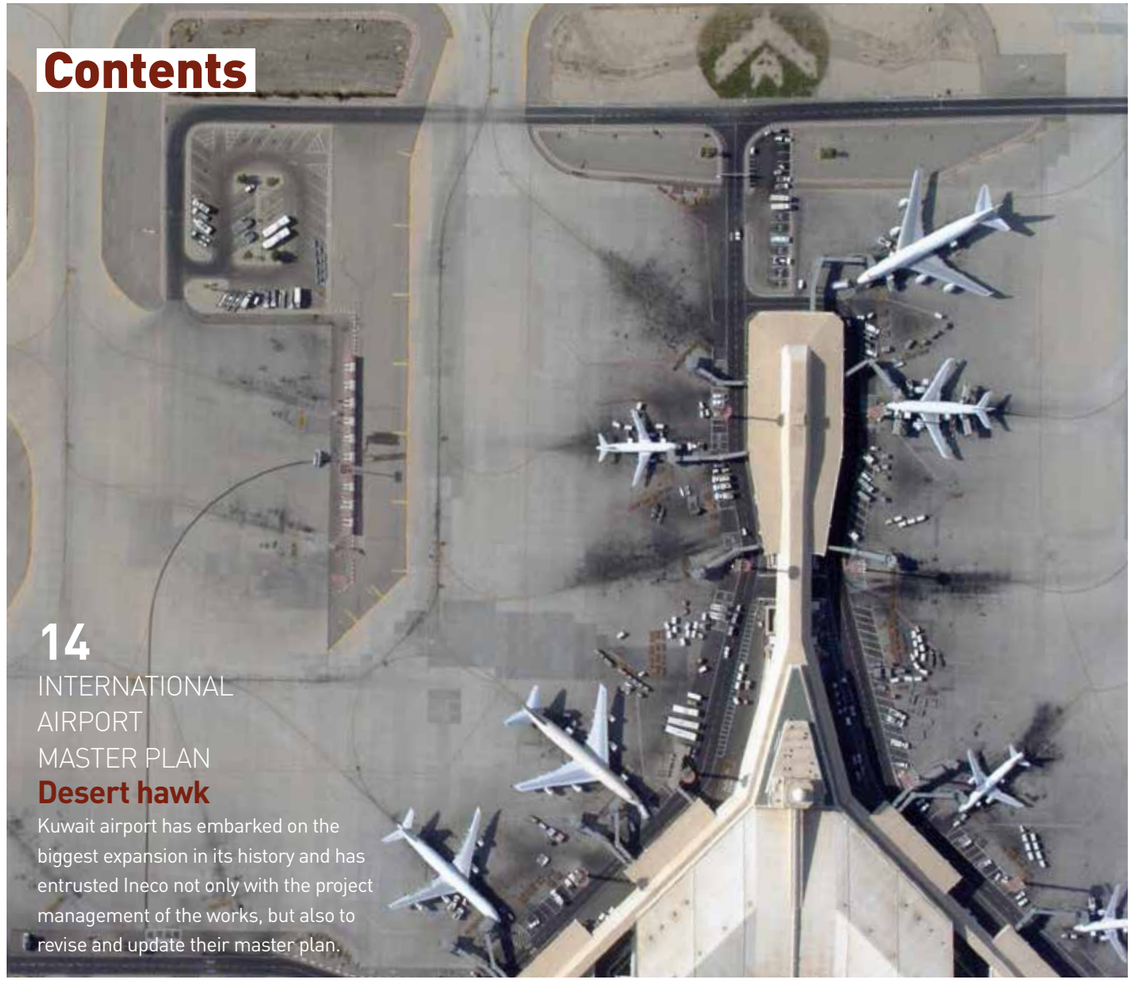

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News

Asia

New Ineco branch

With the inauguration of an office in Singapore, the company hopes to better serve its customers in Asia and Oceania. At the helm will be Alberto Fernández, an aeronautical engineer with a master in international project management. Ineco is thus strengthening its presence in a region with great potential for infrastructure and seeks to improve its ongoing work in Singapore itself, as well as in the Philippines, Nepal and India.

Egypt

Egyptian railways are brought up to speed

Egypt's Ministry of Transport and Egyptian National Railways (ENR) will receive the cooperation of Ineco, Renfe and Adif in improving their railway safety management. The contract includes collaboration in activities such as training staff in key positions, determining the criteria for defining the preparation of workshops and traffic control centres, the new level crossing regulations and implementing the main technical standards. It also involves improving operational safety procedures and rolling stock as well as the development of a plan of action for train drivers. This cooperation agreement is the result of an accord between Spain and Egypt as part of a twinning programme run by the European Commission.«

Brazil

CAF has manufactured trains for other metro and commuter rail lines in São Paulo; such as this one, delivered in 2011.

PHOTO: SERGIO ANDRADE/GOVERNO DO ESTADO DE SÃO PAULO

EXTENSION OF LINE 5

New trains for the São Paulo metro

Until 2016, Ineco, along with its local partner EBEI, will be in charge of supervising the project, design and commissioning for 26 new trains as part of the extension of line 5 of the São Paulo metro. The trains will be built by the Spanish firm CAF. Line 5, opened in 2002, is currently being extended 12 kilometres. In addition to the construction work, the project involves the purchase of new rolling stock, as well as communication systems and equipment, signalling systems, etc. The work is being financed with funds from the State government, the Inter-American Development Bank and the International Bank for Reconstruction and Development (IBRD). Ineco, which has been working in Brazil for over 20 years, is also participating, among other things, in the country's biggest road project, likewise in São Paulo: completing the city's ring road, the *North Section* of the Rodoanel Mário Covas (see pages 42 and 43).«

Italy

Safety in Fiumicino

Ineco and its local partner One Works, is rendering technical assistance services for airport safety to the Italian airport Leonardo da Vinci-Fiumicino, in Rome. The airport handles nearly 40 million passengers per year and has four terminals, making it the most important airport in the country. After studying and analysing safety procedures, the company is conducting a risk assessment for the airport manager (Aeroporti di Roma) that includes simulations.

Ecuador

IN COLLABORATION WITH CEDEX

Ineco to supervise the preparation of Ecuador's first National Water Plan

PHOTO: SECRETARÍA NACIONAL DEL AGUA (SENAGUA), ECUADOR

According to the Ecuadorian government it is "one of the most ambitious projects that this country will take on". This marks the first time that a "comprehensive" national plan to optimise the distribution, use and conservation of Ecuador's hydrological resources will be made. Ineco, with the cooperation of the Centre of Studies and Experimentation of Public Works, part of the Spanish Ministry of Public Works, will be in charge for the next two and a half years of the technical and methodological support for studies needed to execute the plan. Ecuador has 31 hydrological systems, spread throughout both sides of the Andes mountain range, which makes the distribution of water resources irregular. In addition to this, it has a tropical climate and is flood and drought-prone.«

Solidarity train

Ineco is also involved in social responsibility project run by the CODESPA Foundation to launch a tourist train in the province of Imbambura. The company signed an agreement with CODESPA in June 2013 and supports the project through the "Euro for Solidarity" programme, which consists of matching the voluntary contributions made by employees. The tourist train will benefit 169 underprivileged families.

Oman

Design of flight procedures

The Sultanate of Oman is to receive instrument flight procedures and approach charts designed and validated by Ineco and Aena Internacional.
Oman has two international airports, Muscat (shown in the photo above) and Salalah, as well as four regional airports. The work includes designing the procedures, performing validation flights and several training sessions in Spain for the technical and managing staff of the Public Authority for Civil Aviation (PACA) of Oman.
This contract will be extended until late 2015 and joins other Ineco projects in Oman, such as a study on navigation easements for the new control tower in Muscat and a location study and Master Plan for the future Musandam Airport. These projects are part of the airport network's expansion and modernisation process which the Sultanate has embarked upon in recent years.«

Linking oceans

Latin America seeks coast-to-coast transport solutions

By **Francisco Javier Vilches** and **Juan Ramón Hernández Barrera**, civil engineers

The creation of routes between the Pacific and Atlantic oceans to connect the ports on both coasts is a recurring theme among the countries of the American continent due to its potential impact on world trade. Ineco has worked on a series of studies and projects in both the South and Central America, where alternatives to the Panama canal are sought.

The economic growth of Asian nations has changed the map of world trade. There is evidence of this in the fact that nine of the ten largest sea ports in the world are located in China, Singapore, South Korea and the United Arab Emirates. These countries' interest in controlling the main interoceanic routes stems from two main issues: the need to connect their ports with the big producers of raw materials and petrol in South America (such as Brazil or Venezuela) and Africa, and the need to facilitate trade routes with the East Coast of the United States, Canada and Western Europe, all potential markets with high purchasing power to which their manufactured goods can be exported.

The example of China illustrates this phenomenon of attraction and generation of goods in the Asian region. With over 1,300 million inhabitants and economic growth rates approaching 10% in the last decade, China has been purchasing land in countries such as Nigeria, Australia, Kazakhstan and Brazil for some years now, in order to secure a steady supply of cereal, wood, minerals and fuel. For that matter, exportation is the bedrock of the Chinese economy.

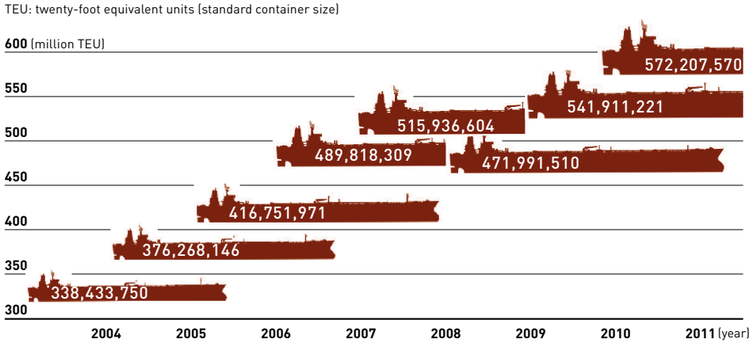
The might of China

China is the greatest exporter and second largest importer of goods in the world, so controlling trade routes has decisive strategic importance. To guarantee the foundations of their economies, countries such as China seek new, more efficient and manageable transport routes, allowing them to import and export their products throughout the world's continents and particularly through the passages between the Atlantic and Pacific Oceans (Panama) and the Mediterranean and Red Seas (Suez).

The opening of a new interoceanic corridor in Latin America would bring about a profound transformation of maritime trade. This is not a new concept. The opening of the Suez canal in 1869, financed by France and Egypt, had an unprecedented impact on world trade, allowing direct maritime transit between Europe and Asia without the need to circumnavigate Africa. 45 years later, ships traversing the risky passages of the strait of Magellan and the Beagle canal found similar relief with the opening of the Panama canal in 1914, a project controlled by the United States and which now, under the management of Panama, is in the process of expansion. The significance of the Panama canal to world maritime trade is exemplified by the acceptance of the Panamax, the maximum size of a ship capable of crossing the Panama canal, as the manufacturing standard for a large part of the merchant fleet for several decades.»

The opening of a new interoceanic corridor would bring about a profound transformation of maritime trade, as happened with Suez and Panama

Maritime container traffic
TEU: twenty-foot equivalent units (standard container size)



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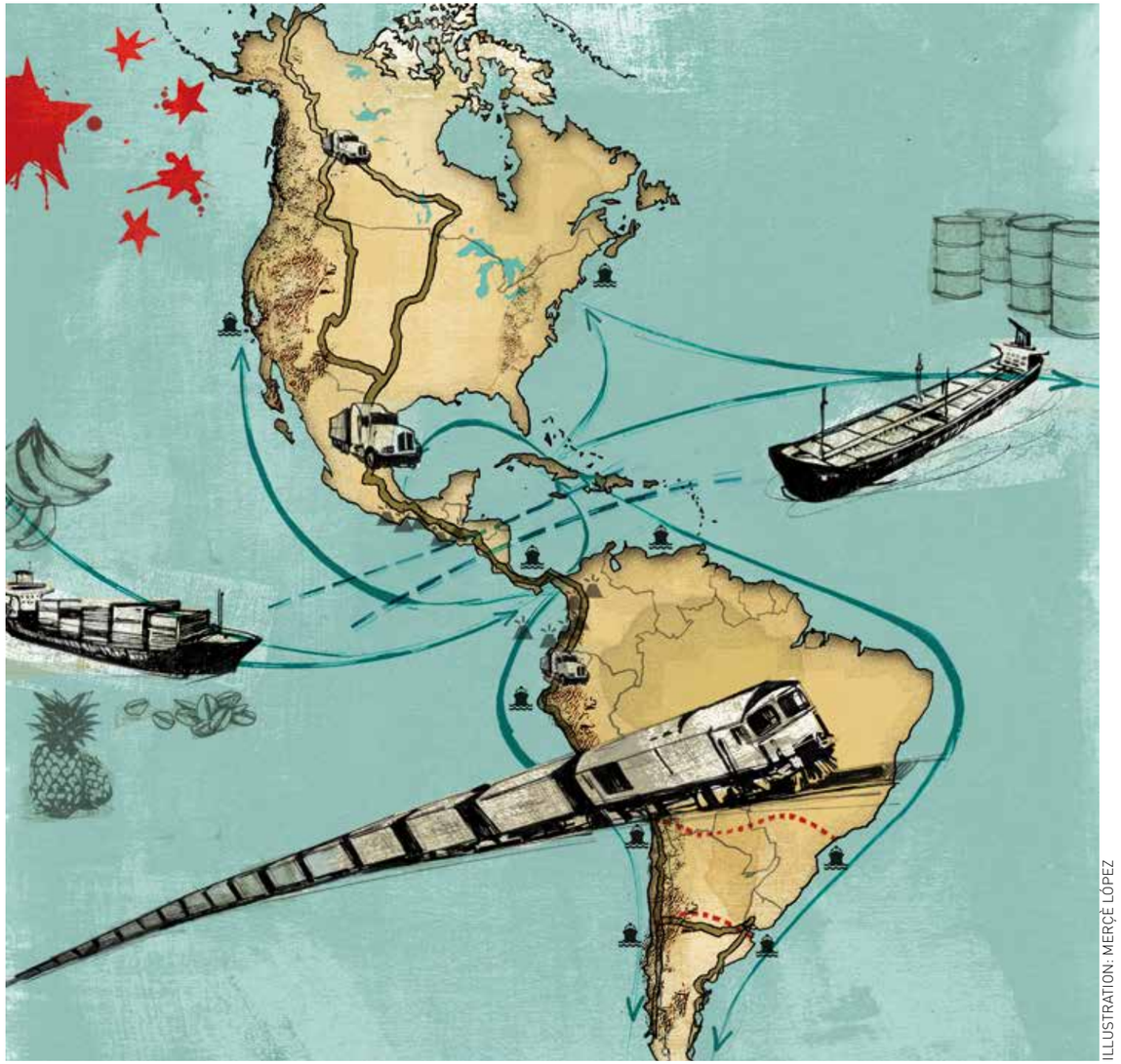


ILLUSTRATION: MERÇÈ LÓPEZ

Asia wishes to control the main interoceanic routes to connect its ports to producers of raw materials and oil in South America and Africa and to facilitate trade routes with the United States, Canada and Western Europe

Today, however, the Panama canal is saturated and the need to allow larger ships through led to the decision to expand it in 2007. A consortium headed by Spanish construction firm Sacyr Vallehermoso is responsible for expanding the canal, a mammoth task that should be completed by 2015. The expansion will increase the size limit on ships crossing the canal. Transit capacity will likewise see a significant boost by allowing the simultaneous passage of two 'New Panamax' ships in either direction.

Alternatives to the Panama canal

Other Latin American countries are now considering the construction of interoceanic corridors as an alternative to the Panama canal. Nicaragua is revisiting its old aspirations of having a canal or rail link for transporting containers between the ports on each of its coasts. This project was recommended as early as the late 19th century by American engineers as an alternative to the Panama canal, in view of the great difficulties encountered in the canal's construction (it is estimated that about 27,000 people died in the nearly 45-year-long construction of the canal).

The Nicaraguan interoceanic corridor study contemplates two possibilities. One would be a wet canal joining the Pacific and Caribbean coasts via a large waterway, taking advantage of the existence of the Great Lake of Nicaragua. The other would be a dry canal, joining the two coasts with a rail line and an oil pipe between the two main ports (Corinto and Monkey Point), which would allow goods to be shuttled between the two coasts. Ineco prepared the feasibility study for the dry canal, analysing and sizing the rail and intermodal infrastructures needed for the project to be viable.

Dry canals or 'landbridges'

Over a century ago, sea canals revolutionised the worldwide transport of goods, but their cost and volume limitations also created bottlenecks for international trade.

Many Latin American countries are currently studying the possibility of building interoceanic corridors to provide an alternative to the Panama canal

One of the main limitations of the Panama canal is the size of the ships that can travel through it. Large container ships such as Maersk Class E and Triple E ships, with capacities of up to 18,000 TEU, will be too large to traverse the canal even after the expansion is completed. The size cap on these ships, contrary to what one might expect, is not due to depth but rather breadth, which is limited to 55 metres by the size of the future locks of the canal (as opposed to the current limit of 33 metres).

In addition to this drawback, there is also an operability problem and thus a problem of transit time. Expanding the elephantine canal is an arduous proposition, making it difficult to adapt to changing conditions. The total length of the Panama canal is 82 kilometres. According to Port Authority statistics, in 2008 ships took about 13 hours to get from the first lock to the last. Real transit time, however –including the approach to the canal, waiting time before crossing, paperwork, etc.– was 35 hours. From 2008 to 2013 this transit time has increased, but it is expected that once the canal expansion works are complete it will drop to about 30 hours.

A matter of cost

In addition to the technical limitations of the canal and the limits on capacity, cost is another crucial factor when selecting a route. The Panama canal's fees have risen sharply in the last few years and they are expected to continue rising in order to amortise the massive investment in the expansion.

The combination of these factors means that shipping companies are constantly looking for faster alternative routes with lower costs, which is seen by neighbouring countries as a great business opportunity if they are able to successfully implement a project that can claim to be a realistic alternative to the canal. This reasoning is what led the Japanese in the 1980s to finance a landbridge across the United States, investing

The Panama canal's fees have risen in recent years, and they are expected to continue rising to amortise the massive investment in the expansion

in the renewal of railway infrastructure between the ports of the Pacific Coast (Los Angeles) and the Gulf of Mexico to allow for more efficient and higher-capacity double-stack container platforms so as to export their products to the US East Coast. In the Middle East, similar alternatives to the Suez canal are under consideration.«

Latin America's challenge

In Central and South America the aim of a bi-oceanic corridor has been a persistent challenge.
Many countries wish to have one. Mexico, Nicaragua, Guatemala, El Salvador, Honduras, Costa Rica and Colombia are all studying maritime, rail and road connections between their Pacific and Caribbean ports.
In the Southern hemisphere, Argentina and Chile have been working for years


Bi-oceanic Aconcagua corridor.

on a bi-oceanic corridor through the province of Mendoza. The remaining countries, such as Bolivia, Peru and Brazil, continue to invest in new railways and roads to link the two coasts.
The infrastructure's design must respect the environment and will have to overcome some substantial physical obstacles. Nothing less than the Andes mountains, the Amazon rainforest, volcanic regions and the plateau stand between one coast and the other.
The tropical climate and protection of biodiversity are other issues to consider when seeking to erect infrastructure in this region. Complex engineering studies and cutting-edge technology are required. Environmental protection is a key aspect and is increasingly required by public institutions, particularly by multilateral organisations requiring environmental and social studies that ensure project sustainability.

Governments include, as part of their strategic plans, safe, integrated and interconnected multimodal

transport systems with smart solutions that use national sources of energy. To accomplish this, they need an organisation for the domestic promotion of industrial development, bringing public and private sector efforts together. Financing is a key element and the main hurdle. It is closely related to political stability.«

Ineco has been preparing technical, economic and financial feasibility studies in South America for years, including studies on demand, defining the financial structure, environmental impact, alignment, port access, logistical centres and the design and construction of tunnels and viaducts

INECO'S EXPERIENCE

Libertadores, Colombia and Costa Rica

Ineco has collaborated for 25 years on different interoceanic connection projects in Latin America. One example is the work performed in the 90s on the Libertadores corridor in the Southern Cone, in which Ineco participated along with the Spanish rail operator Renfe. The project contemplated the creation of four large corridors involving seven countries in the region, linked by an international railway network some 16,000 kilometres long. In many cases, the stretches on some lines were the only transport alternative available and therefore an indispensable means for integrating and connecting the territory.

At the time, the concept of intermodal transport and 'containerisation' was already being developed as a basic strategy for the future, opening a path to the sea for landlocked countries such as Bolivia and Paraguay. The name of the project made reference to the Los Libertadores passage crossing –also known as Cristo Redentor– on the Argentina-Chile border in the Andes mountain range. Libertadores envisaged the construction of railway tunnels 23 kilometres in length at 2,500 metres above sea level. This is a macroproject that seeks an alternative to the slow and saturated road traffic on the border and the continual closures to traffic during winter snowstorms. As part of this corridor, in 2007, Ineco prepared the studies for renovating a 298-kilometre Argentine rail line between Salvador de Jujuy and La Quiaca, a town on the border with Bolivia at an altitude of 3,442 metres. This project was financed by the Andean Development Corporation. It is still in progress.

When Colombia, years later, was also considering the option of creating an

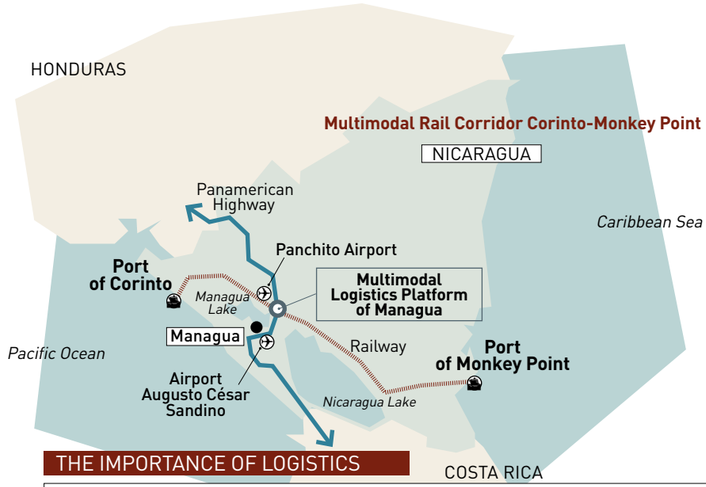
interoceanic corridor, Ineco prepared a study on freight transport for dispatching extracted minerals.
In 1992, the company carried out the pre-feasibility study for the Central American railway network, financed by the Ministry of Public Works and Transport of Spain. The study diagnosed the state of Central American railways and examined the supply and demand of other modes of transport. Different actions were proposed to create a Central American railway network and the pre-feasibility of a potential landbridge in the region was determined.

In Costa Rica, in 1999, the firm prepared the feasibility study for the railway network concession project for Renfe. 10 years later, in 2009-2010, technical assistance was provided for the current and future development of the national rail system. These studies ultimately led to the National Transport Plan in 2010-2012, which encompassed all modes, including air transport. This is a global study with a planning horizon of 2035 that prioritises actions according to transport mode, with proposals for financing them. As a result of this, the country will have a network grid in which the ports of Caldera in the Pacific and Limón in the Caribbean will be linked.

In 2013, Ineco completed a feasibility study for the government of Nicaragua on the Corinto–Monkey Point Multimodal Railway Corridor. Its main objective was to identify the most suitable and profitable intermodal transport system for attracting international traffic, linking the Pacific and Caribbean ports with a logistics centre in Managua. This project sought to convert a 486-kilometre-long multimodal railway corridor into an alternative to the Panama canal by providing the possibility of landbridge operations between the Pacific and the Atlantic. It was also meant to transform Nicaragua into the main logistics and distribution node for goods in Central America, following the construction of two large and important ports in the region and the multimodal logistics platform of Managua.
Ineco focused its studies on the region's area of influence and its socioeconomic variables. To define the most appropriate transport system and its cost, financial and operational calculations were performed for each mode. Comparative analysis allows the cost of transport for each tonne of goods to be estimated, depending on their presentation and the mode of transport used. Demand and modelling studies allow forecasts to be made and logistical and transport needs to be assessed, including for operation and maintenance. The engineering studies

The demand and modelling studies allow forecasts to be made and logistical and transport needs to be assessed, including for operation and maintenance

and the design of the infrastructure also allow investment costs to be anticipated, particularly considering the complex terrain.
Recently, Ineco signed a contract for a strategic environmental assessment of the central bi-oceanic corridor linking Peru, Bolivia and Brazil.«



THE IMPORTANCE OF LOGISTICS

Our experience in Nicaragua

Building this monumental interoceanic transport infrastructure does not, in and of itself, guarantee the economic and social development of a country. It is also necessary to invest in developing logistical infrastructure with which to provide added value to the goods passing through and increase economic activity and jobs. Otherwise, the infrastructure becomes a mere toll collection point that does not act as a tool for developing the region beyond generating some considerable revenue.

The feasibility study of the Corinto-Monkey Point Multimodal Railway Corridor prepared by Ineco for the Ministry of Transport and Infrastructure of Nicaragua, as well as the construction of the landbridge, included the building of a multimodal logistics platform near the city of Managua with a link to the railway landbridge, Panchito airport and the Panamerican highway. The total length of the infrastructure would exceed 25,000 kilometres, stretching along nearly the entire American continent, from Buenos Aires to Alaska.

This logistics platform associated with the landbridge in Nicaragua would enjoy a privileged location within the great East-West sea trade routes of the world, known as Round the World routes. Furthermore, it would be right next to the Panamerican highway, the backbone of the American continent running North-South. The Nicaragua Multimodal Platform would therefore be in a strategic position to become a great Central American logistical centre. This is just one of the many studies on logistics and intermodality that Ineco has done in recent years.

ENVIRONMENTAL CONTRACT

Bolivia hires Ineco for the bi-oceanic corridor

Ineco is performing the environmental assessment for the central bi-oceanic railway corridor. The work, awarded by the Vice-Minister of Transport and financed by the Inter-American Development Bank, involves the early assessment of the environmental impact of the corridor, which has 1,800 km of track. The main objective of the work is to promote the correct environmental and land-use decisions from the initial planning phases onward.

Desert hawk

Kuwait airport is being revamped in the face of higher than expected growth

With the collaboration of **Miguel de Bernardo,** project manager, and **Pablo Fuente**, aeronautical engineers


Ineco-KUD team with Mona-Al Mutairi (center), DGCA's project manager.


Amiri terminal.


Inside the Kuwait airport terminal.

Kuwait airport has embarked on the biggest expansion in its history and has entrusted Ineco not only with the project management of the works, but also to revise and update their master plan, which forecasts the airport's expansion needs for the next three decades.

It is the only civilian airport in the country and is located at the geographic crossroads of three continents: Europe, Asia and Africa. Kuwait International Airport (KIA) has become too small for a demand that will triple in the coming years to reach 25 million passengers annually by 2040. According to the DGCA, Kuwait's Directorate General of Civil Aviation, traffic volume had already reached 8.5 million passengers in 2011, four years ahead of the forecast made in the previous master plan, approved in 2005.

That same year the DGCA hired Ineco to carry out the project management of the biggest expansion in the airport's history, which will continue into 2016. Among the most remarkable works are the construction of a third runway, a new air cargo area known as Cargo City and a second terminal building designed by the architectural firm Foster & Partners, at 700,000 m^2 one of the largest in the world. The rapid growth of traffic has meant a comprehensive revision of the 2005 Master Plan is needed, a task the DGCA has likewise entrusted to Ineco and its local partner KUD (Kuwait United Development).

The result is a new document, the 2012 Master Plan, which, while serving to structure KIA's growth until 2040, will also include the intermediate time horizons of 2020 and 2030. The plan is supplemented by ten detailed studies on different issues (see inset) such as business development opportunities, immediate improvements to the existing terminal, the development of Cargo City and even a location study for a future second airport in Kuwait with four runways and capacity for 100 million passengers and 15 million tonnes of cargo annually.«

The 2012 Master Plan provides a framework to guide KIA's growth until 2040

What is a master plan?

- **A master plan is a document that sets out the short, medium and long-term requirements of an airport until what the ICAO (International Civil Aviation Organization) calls its "ultimate development". While they compile and comprehensively analyse all aspects affecting airport activities, including environmental and non-aeronautical issues, master plans are not detailed studies but rather overall planning instruments that aim to set the course for an airport's future growth so that it happens in an orderly and efficient manner.**
- **While they start with a "snapshot", master plans are, by definition, dynamic documents that require updating whenever there are substantial changes that affect the development of the airport, such as in the case of KIA.**
- **Ineco has a great deal of experience: the firm has worked with Aena, the Spanish airport operator, for over a decade on the development and updating of the plans for its 47 airports. This experience has also been applied internationally with the master plans for Sangster Airport in Jamaica (2009) or the Colombian airports at Barranquilla (2008), Cali (2010) and Cartagena (2013). Also this year, Ineco has drawn up plans for 12 Mexican airports, as well as those of San Vicente, Praia, Sal and Boa Vista in Cape Verde.**

Supplementary studies

- **Strategic air transport study**
- **Study on investment opportunities at KIA**
- **Obstacle Limitation Surfaces (OLS) study**
- **Strategic Environmental Assessment of KIA Master Plan 2012**
- **Survey of the existing electrical network and proposals for the future**
- **Air navigation study**
- **Ground access study**
- **Cargo City development study**
- **Recommendations for enhancing the existing passenger terminal**
- **Kuwait second far future airport location study**

Aerial view of the existing Kuwait airport terminal.

The starting point for properly planning airport growth in the short, medium and long terms are traffic forecasts; these have been updated using the most modern calculation methods

A bird's eye view

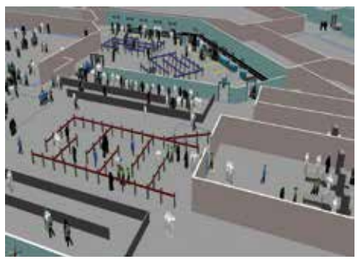
KIA is located in Farwaniyah, 16 kilometres south of the capital, Kuwait City. It began operation in 1961, coinciding with the country's declaration of independence. The airport is managed by the DGCA and is the base of operations for the two major domestic airlines: Kuwait Airways and Jazeera Airways. Other airlines from neighbouring countries, such as Emirates, Qatar Airways, Etihad, Saudi Arabian, Gulf Air and Oman Air, also operate at KIA. The Kuwaiti airline Wataniya Airways, which ceased operations in 2011, announced its intention to resume activity in 2013. KIA's main competitors are the airports of these neighbouring countries, including Doha, Dubai and Abu Dhabi.
KIA currently has a system of two parallel runways (one 3,400 metres long and the other 3,500 metres long), 11 aircraft parking aprons, a passenger terminal, a general aviation terminal opened in 2008, a military area and a restricted access area reserved for the Emir, the head of State, where Amiri terminal is located. KIA has two control towers: a main control tower, situated between the two runways, and a ground control tower, located on top of the existing passenger terminal building. There are two radar facilities, one of which is not yet in operation. The airport also has a category I ILS (Instrument Landing System). In addition to the two existing fire stations, two new ones are now nearing completion.«

Improvements to the existing terminal

The current terminal building, in the shape of a plane, was designed in 1979 by the renowned Japanese architect Kenzo Tange; it had to be rebuilt in 1991 after the Iraqi invasion. Since the terminal handles about 9 million passengers a year, it has already exceeded the capacity for which it was designed. During the preparation of the 2012 Master Plan, several aspects of the terminal that could be improved were detected, mainly related to waiting times at security controls and check-in areas and deficiencies in the baggage handling system.«

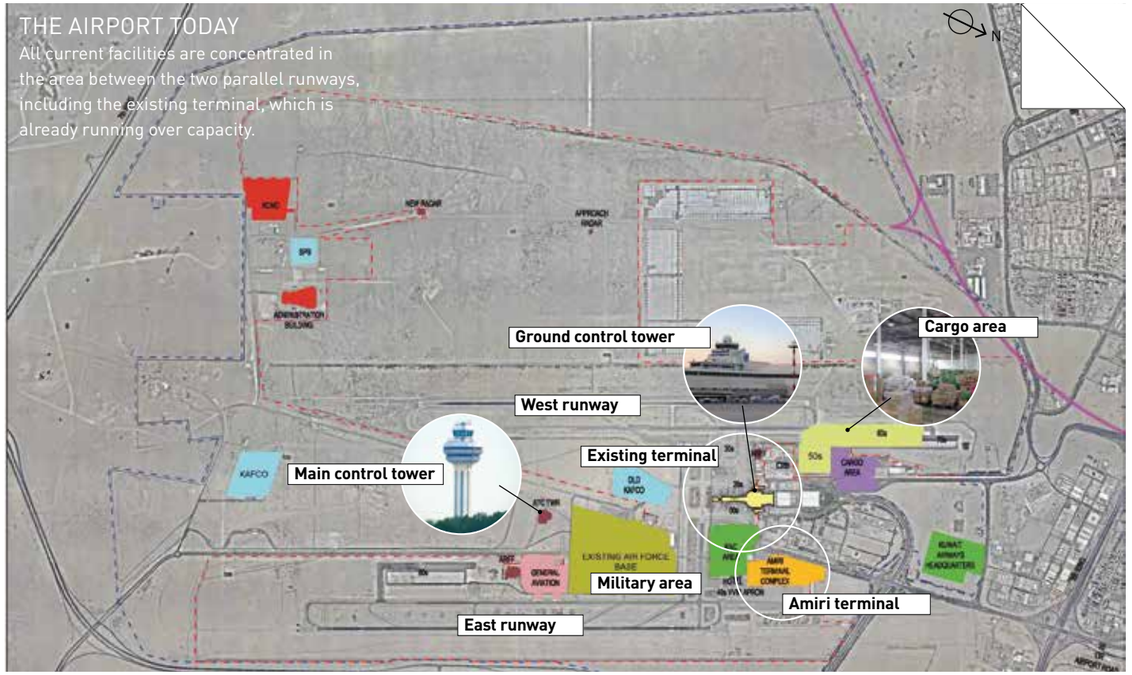
The future is in the data: air traffic forecasts

■ How do we know how much passenger volume will increase in the next 10 or 20 years? What about the increase in cargo volume? If the country continues to grow as a business centre, how will the number of private jets (general aviation) landing at or taking off from the airport evolve? What are the chances that new airlines will choose KIA as a base? The answers to these questions are the starting point for deciding what the airport will need to maintain an optimal level of service and when it will need it. This is why air traffic forecasts are made. In KIA's case, three possible demand scenarios have been taken into account: low, high and "base" for the main time horizons of 2020, 2030 and 2040.

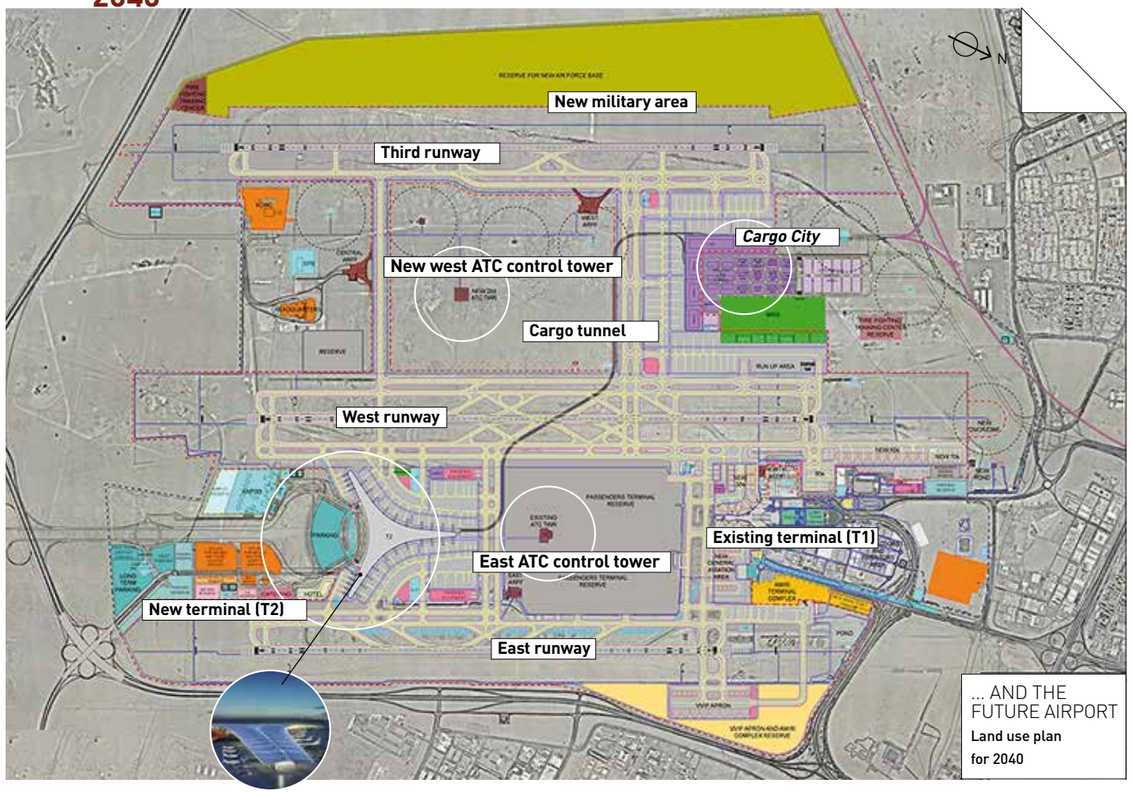


■ This approach uses current traffic data and an econometric model that takes different variables into account –from the country's GDP to airline results, as well as data specific to the airport– to obtain projections of the airport's future development. The most likely scenario, and the focus of the master plan's proposals, is the "base" or intermediate scenario, which returns a figure of 11.3 million passengers in 2020, 17.4 million passengers in 2030 and 25 million passengers by 2040.

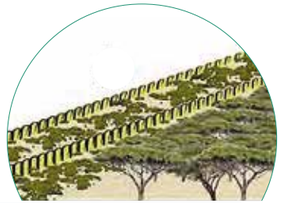
■ The statistics have been studied according to types of traffic; for example, Bombardier Aerospace forecasts were taken into account for the general aviation sector. They estimate fleet growth as a function of the economic development calculated by the International Monetary Fund in the whole Arabian Gulf region. Cargo is also trending upward, according to the ICAO forecasts for the region.



KUWAIT INTERNATIONAL AIRPORT (KIA)



The master plan takes the expansion projects already under way into account: the third runway, the new ATC control tower and the Cargo City, as well as the T2, which is executed through the Ministry of Public Works



Proposal for a "green belt" to protect against frequent sandstorms.

INECO IS MANAGING THE EXPANSION WORKS

Since 2011, Ineco has also been in charge of the KIA expansion project management, which includes the new T2, designed by Norman Foster's studio.

IMAGE: FOSTER&PARTNERS

The future T2, at over 700,000 m², will be one of the largest airport terminals in the world.

IMAGE: FOSTER&PARTNERS

The rise of air transport in Kuwait, as in other countries in the surrounding area, is supported by the prosperity of its nearly 2.7 million inhabitants, who enjoy one of the highest *per capita* incomes in the world. Kuwait, which has 10% of global oil reserves, has chosen in recent years to diversify its sources of income setting itself up as an international business centre. All these elements have contributed to the low impact of the economic crisis on the country, as shown by the vigour of the aviation market.

Air cargo.

View of the airfield and a passenger boarding bridge.

An expansion ongoing

Once the traffic forecasts have been drawn up, the next step is to "translate" them into facilities and equipment required to handle the expected demand. To do this, Ineco considered all the projects and works that are already in progress in this most ambitious expansion the airport has ever known, also directed and coordinated by Ineco since 2011. From the planning perspective, work will focus on two time horizons: 2020 and 2040. The master plan considers different scenarios that revolve around three major projects: the T2, which is executed through the Ministry of Public Works; the third runway (both already under way), and the construction of the new ATC control tower, which is necessary for the future enlarged airfield.
These three tasks and all associated facilities (aprons, car parks, taxiways and so on), as well as the new military area, are scheduled for completion between 2013 and 2020. Another major project currently in progress is Cargo City. The third runway will mainly serve the traffic generated by the military and cargo facilities, focusing the other two, which will be extended and overlaid for commercial passenger traffic. It is also anticipated that two new metro stations, one in each terminal, connecting the airport with the city center, will be ready by the same date. A vital concern is how to reduce the congestion that T1 is already suffering, which will continue until T2 is operational. The master plan proposes two solutions for this interim period, each with several alternatives: either to build a small support terminal or to expand the existing building.«

2040, horizon of the master plan

2040 is the planning horizon for the master plan. By then, KIA will be operating with three runways, two towers and the new T2. The existing terminal would be used for specific purposes, such as dealing with traffic peaks generated by the annual pilgrimage to Makkah. It is also anticipated that, by 2040, KIA will be linked to the future Kuwaiti rail network, currently in the feasibility study phase.«

More proposals from the 2012 Master Plan

- **Alternative locations for the general aviation terminal.**
- **Construction of a new maintenance, repair and overhaul (MRO) area; its recommended location is in the north-west, near Cargo City.**
- **Construction of a tunnel to transport air cargo carried on passenger flights between the future T2 and Cargo City, which will be about 4 kilometres apart.**
- **Installation of an anti-sand "green belt": to prevent sand infiltration, which causes significant maintenance problems, the plan proposes the location of a barrier of trees around the perimeter of the airport.**
- **Improvement of access roads.**
- **ULTIMATE VISION OF KIA DEVELOPMENT: the document briefly and broadly outlines how KIA could look beyond the long term planning horizon: it estimates that expansions of both the airport grounds and existing infrastructure will be required and that new infrastructure, such as a new satellite terminal or a People Mover, will have to be added. Groundside, it foresees the possible construction of flight school facilities, an aviation campus and various commercial developments, among other things.**
- **ORGANISATIONAL MEASURES: the creation of an Air Routes Development Committee, a Mobility and Quality Observatory, an Environmental Management Department and an area dedicated to the operation of the Geographic Information System (GIS).**

Plan, behind the scenes

- **To have updated information, an aerial survey was carried out to obtain high precision orthoimagery. A Geographic Information System was also developed.**
- **The most advanced tools available, such as ARCPort simulator, were used to test different airfield configurations. Simulators, including the INM (Integrated Noise Model), were also used to the study the noise impact due to aircraft operation and PTV Visum was used to study road access. In addition to these commercial products, the team also used ProEstop, proprietary Ineco software for defining the location of Rapid Exit Taxiways (RETs).**

Interview | FAWAZ A. AL-FARAH

President Directorate General of Civil Aviation State of Kuwait

“Airport development will enhance the position of the State of Kuwait as a major financial and economic hub in the region”

The president of DGCA, is interviewed by Carlos Amigo, Ineco’s project manager for Kuwait International Airport expansion.

The KIA 2012 Master Plan shows a fully developed and sophisticated airport to be implemented within 7-8 years from now, and that will serve the country for the future decades. What is, in your opinion, the role of Kuwait International Airport in the future of Kuwait?

Kuwait International Airport (KIA) is the front gate of the State of Kuwait. According to our statistics, the airport handled 8,877,883 passengers, 181,412,943 kg of cargo, and 85,567 aircraft in 2012. We expect that the volume of international passenger traffic and aircraft movement will increase during the next decade and, certainly, KIA development, as projected in our 2012 Master Plan, will facilitate this growth. Kuwait’s aviation industry will continue to play an important role in the economic well-being of the country. It will enhance the position of the State of Kuwait as a major financial and economic hub in the region.

The strategic location of KIA between Europe, Asia and Africa makes it appealing for the global aviation industry, both in passenger and cargo business. Do you foresee Kuwait as a competitor with the successful cases of other Middle East airports?

Serving more than 85 destinations through an extensive network of air services offered by 54 airlines, Kuwait International Airport (KIA) is a main gateway in the region. It aims to attain its own rank. The airport will achieve complete success when it meets the demand of both passenger and cargo traffic with higher capacity and more efficient services. The implementation of the new master plan will transform KIA into a state-of-art 21st century aviation hub in the Middle East.

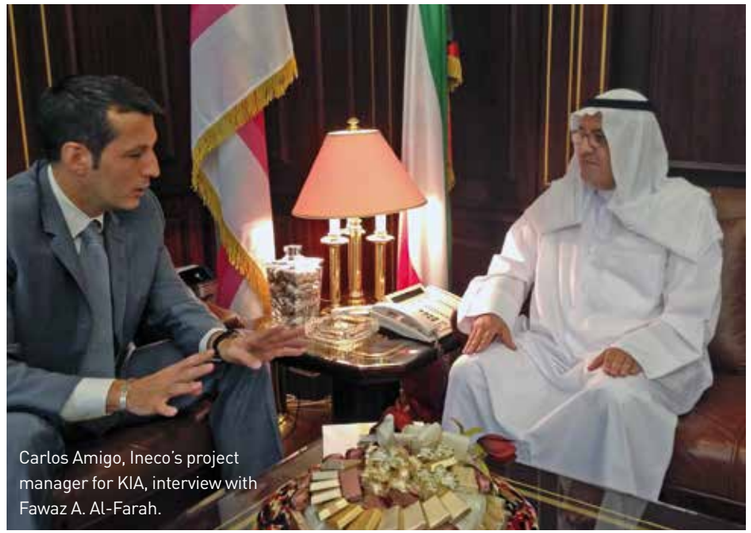
“The implementation of the new master plan will transform the airport into a state-of-art 21st century aviation hub in the Middle East”

In a few years KIA will have one of the largest aviation cargo facilities in the region, and some major players have shown interest in it, as per the master plan studies. What do you expect from this Cargo City?

Cargo City is under construction on a 2 million square meter land. The City will comprise of cargo and logistics facilities, vast aprons capable of handling up to 66 aircraft, and Customer Care Center. The Cargo City will be available for airlines, cargo agents, freight forwarders and other logistics operators to build their own dedicated facilities including cargo terminals, warehouses and office buildings. Several courier companies, logistics firms, cargo operators, and airlines have all expressed interest in the on-airport location. Multi-modality will be a key element for the success of the Cargo City being linked through highways with the port and the main land ways. The new cargo facility is expected to take air freight at KIA to new levels.

The new KIA will require more staff, new procedures, and no more ‘business as usual’. How is DGCA facing this challenge?

The general performance of Kuwait International Airport is governed by the rules, standards, and recommended practices adopted by the International Civil Aviation Organization (ICAO). However, this is only a takeoff point for us. We strive to keep up with the latest airport technology. Now, we are executing several projects to upgrade and integrate air navigation and IT systems, resulting in better performance. Our staffing process is ongoing. Our manpower comprises of 2,200 employees now. Every year, we send our employees for specialized training to academies and institutions accredited by ICAO in different countries. We also find solutions in outsourcing which can also cover the provision of different services, administration, operation, and maintenance.



Carlos Amigo, Ineco’s project manager for KIA, interview with Fawaz A. Al-Farah.

“Ineco has been delivering DGCA with work in project management of top quality. Ineco’s extensive and diverse experiences in different aviation fields make them distinguished”

What investment opportunities will come along with the new terminal building designed by Norman Foster?

The construction of the new terminal (T2) at Kuwait International Airport will avail excellent investment opportunities for aviation innovators,architects, system developers, equipment manufacturers, suppliers and vendors to participate in this monumental project. Another investment opportunities will be availed in this project for Operational Readiness And Transfer (ORAT) service providers as well as passengers terminal operators. The new terminal (T2) will be the largest development project in Kuwait International Airport history.

“Multi-modality will be a key element for the success of the Cargo City being linked through highways with the port and the main land ways”

Ineco has been working for two years in KIA, using project management systems and procedures specially tailored for the airport. How do you value this work?

Ineco has been delivering DGCA with work in project management of top quality. Ineco’s extensive and diverse experiences in different aviation fields make them distinguished. The work done by Ineco at KIA has been completely efficient and satisfactory to DGCA in both projects, the master plan and the project management. We highly value this work.«

Into the depths of the 'Infiernillo'

Ineco to monitor the structure, which was damaged by a flash flood

By **Justo Carretero**, civil engineer, **Jorge Navío**, forest engineer and **Sara Solanas**, industrial engineer
Photos: **Jorge Navío**

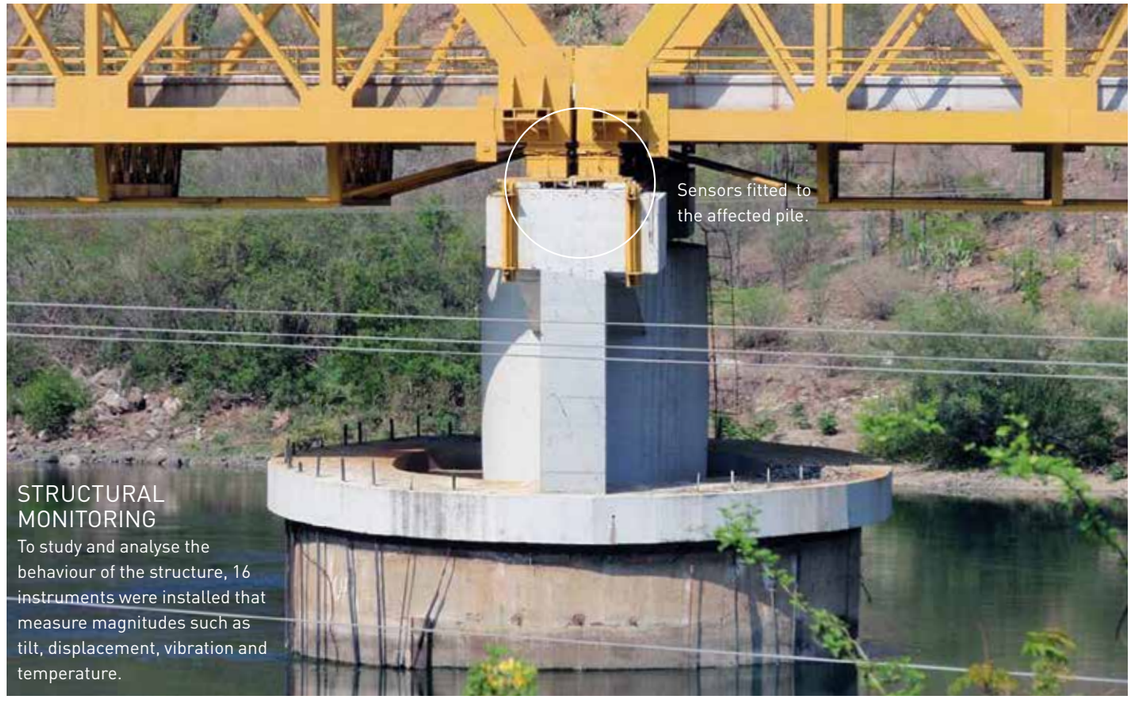
For one year, Ineco will monitor the Infiernillo "0" bridge (in English, Little Hell "0") on the Pátzcuaro-Lázaro Cárdenas highway, in the Mexican State of Michoacán.

The "0" road bridge crosses the Balsas River in the state of Michoacán. In mid-2012, this river suffered a major swell after a discharge at one of Mexico's largest dams, the Infiernillo Dam, with a capacity of 12 billion cubic metres of water. As a result of the flash flood, one of the bridge piles supporting the Pátzcuaro-Lázaro Cárdenas highway scoured and became tilted. The company Apia Ingenieros Consultores Mexicanos entrusted Ineco with the task of fitting instruments to the bridge and monitoring it to determine its status.

An Ineco team, with the assistance of work at height specialists, thus installed sensors on both sections of the metal bridge, each 100 metres long. 16 instruments were installed in total that measure magnitudes such as tilt, displacement, vibration and temperature. For one year, these instruments will automatically gather and store thousands of data items to monitor the pile's tilt and other parameters. This will allow for study and analysis of the structure's behaviour to determine whether it is safe. The continuously fed data obtained from each sensor are automatically uploaded to an Ineco server through a mobile communications system. The data can then be consulted and analysed over the internet and the entire installation controlled remotely.«

Sensor close-up.

High-voltage wiring.



Sensors fitted to the affected pile.

STRUCTURAL MONITORING

To study and analyse the behaviour of the structure, 16 instruments were installed that measure magnitudes such as tilt, displacement, vibration and temperature.

Work at height specialists installing solar panels.

Experts in "listening" to bridges

The system installed on the Infiernillo is the same one Ineco has used previously to equip and monitor another big Mexican viaduct, the 140-metre high El Beltrán bridge in Jalisco (see *it46*), which is part of the Guadalajara-Colima highway. Ineco's own methodology has been applied to the work as well as the vast experience gained over the past 25 years in Spain, where other unique large structures have also been monitored, such as the high speed rail viaducts of Arroyo del Valle and Arroyo de las Piedras, among others.

Queen Victoria's dream

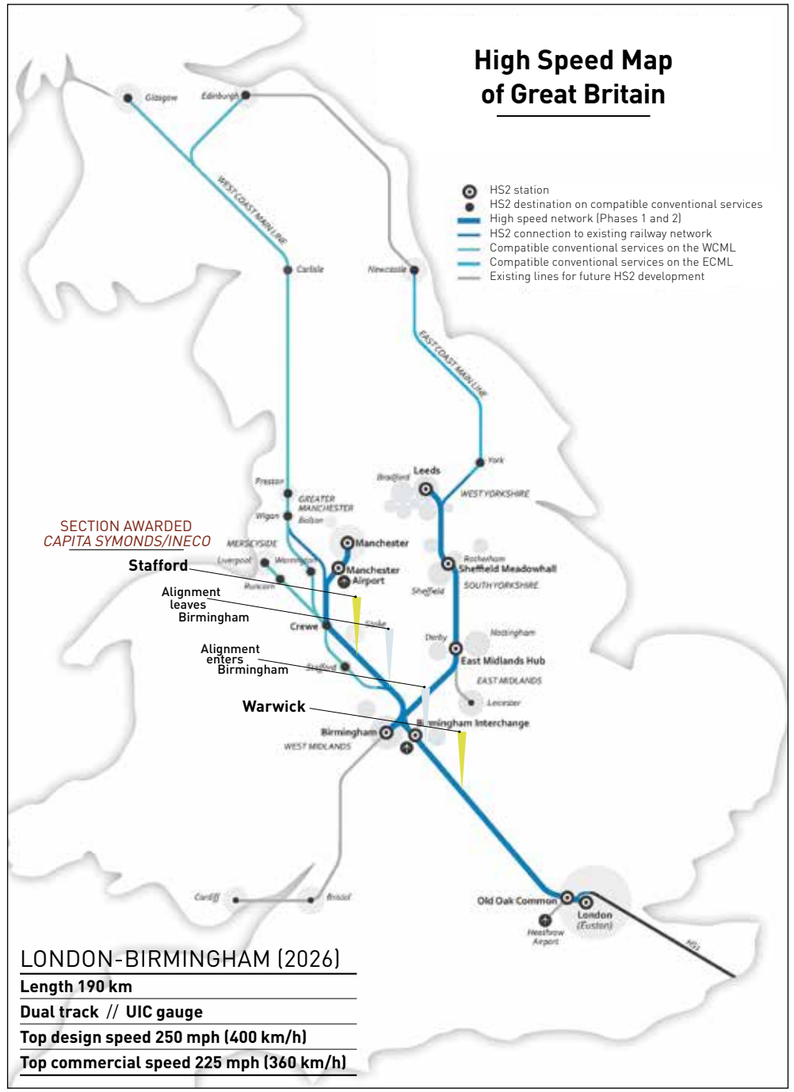
Ineco participates in Phase One of the London-West Midlands line

With the collaboration of **Pablo Ramos**, civil engineer (Deputy Director of the HS2 Project)

The HS2 network is an unprecedented technological investment in the UK. It is expected that some 400 million trips will be made by 2020, improving connections, trip times and service between the most populated regions in the north and the city of London. This is an ambitious project that places the UK at the forefront of high speed rail. Ineco is taking part with the consulting firm Capita Symonds.

The new high speed rail network launched by the UK government in 2012, *High Speed Two* (HS2), is a crucial step forward in the modernisation of its busy nineteenth-century railway infrastructure. In 2026, the current infrastructure –construction of which began during the industrial revolution, in Victorian times– will find itself accompanied by a modern high speed rail network equipped with cutting-edge technology: trains up to 400 metres long, able to carry up to one thousand passengers and with a design speed of 400 km/h transporting thousands of inhabitants from the northern, central and southern UK, all with reduced journey times, intelligent ticketing systems and optimal comfort. In Phase One, it is anticipated that eventually a total of 18 trains per hour will run in each direction.

This enterprising plan shows a clear commitment by the UK government to ease crowding on the railways, improve connections between its biggest cities, while acting as an engine for economic growth. In the nation that pioneered the »



THE HS2 PROJECT
The image shows a computer rendering of the Birmingham and Fazeley canal viaduct. The bottom images show the exterior and interior of Euston station.

TWO-PHASE PROJECT

From the capital to the north

The HS2 project is divided into two phases, comprising about 530 kilometres of track. Phase One will link London and the West Midlands with a 190 kilometres stretch. Phase Two will link Birmingham to the cities of Leeds and Manchester. Future phases may connect Euston station in London to the Heathrow airport spur. The decision on this has been postponed till a review of aviation capacity that is due to be published in 2015. Subsequently, the line may also be extended to Scotland.

Once Phase One is complete, the nation's capital will be a short 49 minutes hop from Birmingham, the UK's second most populated city and one of its main economic and industrial centres. From there, two spurs will branch off the line and link to Manchester and Leeds, with intermediate stops, providing service to a prosperous urban areas with a significant economic footprint in the UK. In broad terms, this new line will reach up to embrace the north in a larger Y-shape, forming part of a network that, when complete, is expected to link seven major cities: London, Birmingham, Nottingham, Derby, Sheffield, Manchester and Leeds. The high speed trains can then run on to Newcastle, Glasgow and Edinburgh on the current rail network.«

Ineco is working with the British consulting firm Capita Symonds on the third stretch, a complex alignment some 75 km long with two tunnels, 60 viaducts and three rail junctions

» rail industry, the HS2 project will employ the latest 21st century technology to provide an effective solution to the growing passenger demand of the coming decades. Not only that, but it will provide better international connections as well, via Birmingham and Manchester airports and by train or road into continental Europe through the Channel Tunnel. Project development is being coordinated by HS2 Ltd., a company wholly owned funded by the Department for Transport. Its initials establish continuity with the HS1 line, operated by Eurostar since 1994, which links London to Paris by tunnel and on to Brussels via Lille.

Environmental impact assessment

All studies and projects are put out to public consultation before being approved by parliament. Concern for the

Environmental concerns, including noise pollution and landscape, are core priorities for the project

environment is a priority goal of the project, which crosses through small rural villages, farmland and forests. The Environmental Impact Assessment (EIA) takes account of construction using the most environmentally friendly and sustainable methods, including mitigation of noise pollution and landscape impact. Thus, in Phase One, about 91 kilometres will be concealed in tunnels or cut-and-cover tunnels.«

WEST COAST MAIN LINE
Conventional train travelling on the West Coast Main Line along the M1 highway.

A team of 14 Ineco technicians have been working at the HS2 offices in London since 2012.

High speed rail experience

Ineco's involvement in this project is testament to its experience in the design, construction and commissioning of the Spanish high speed rail network, which is currently over 3,000 kilometres in length. Ineco is also participating in the construction of the high speed rail lines between Makkah and Madinah (Saudi Arabia) and between Ankara and Istanbul (Turkey),as well as in the consortium bidding for the line from São Paulo to Río de Janeiro in Brazil.

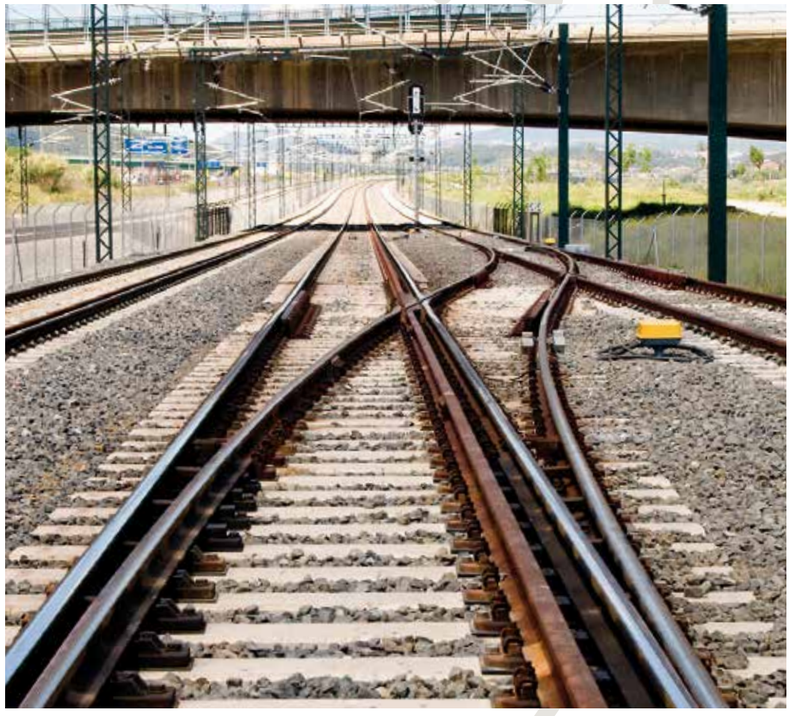
The new Via Augusta

Ineco is working with the Ministry of Public Works on this complex project

By **Francisco Cifuentes**, **Sonia Ferrero** and **Carlos Cubillo**, (project management team for the Mediterranean Corridor)

Possessing a high-capacity international gauge railway corridor along the entire Mediterranean coast, from Murcia to France, is a strategic transport goal in Spain.

From Roman times to the present day the Spanish Mediterranean coast has always been one of the most populous areas of the Iberian Peninsula and one of the central arteries of the Spanish economy. What is now known as the 'Mediterranean Rail Corridor' follows the path of an ancient Roman road, the Via Augusta, one of the most important trade routes of antiquity. Since then, in each new age the transport technology of the day has been applied to optimise the capacity of a trunk line that has not lost one bit of importance. In modern 21st century, Spain the main challenge is to provide a high-capacity rail link for both passengers and freight that can get round the difference in track gauge with Europe.



FORD ESPAÑA

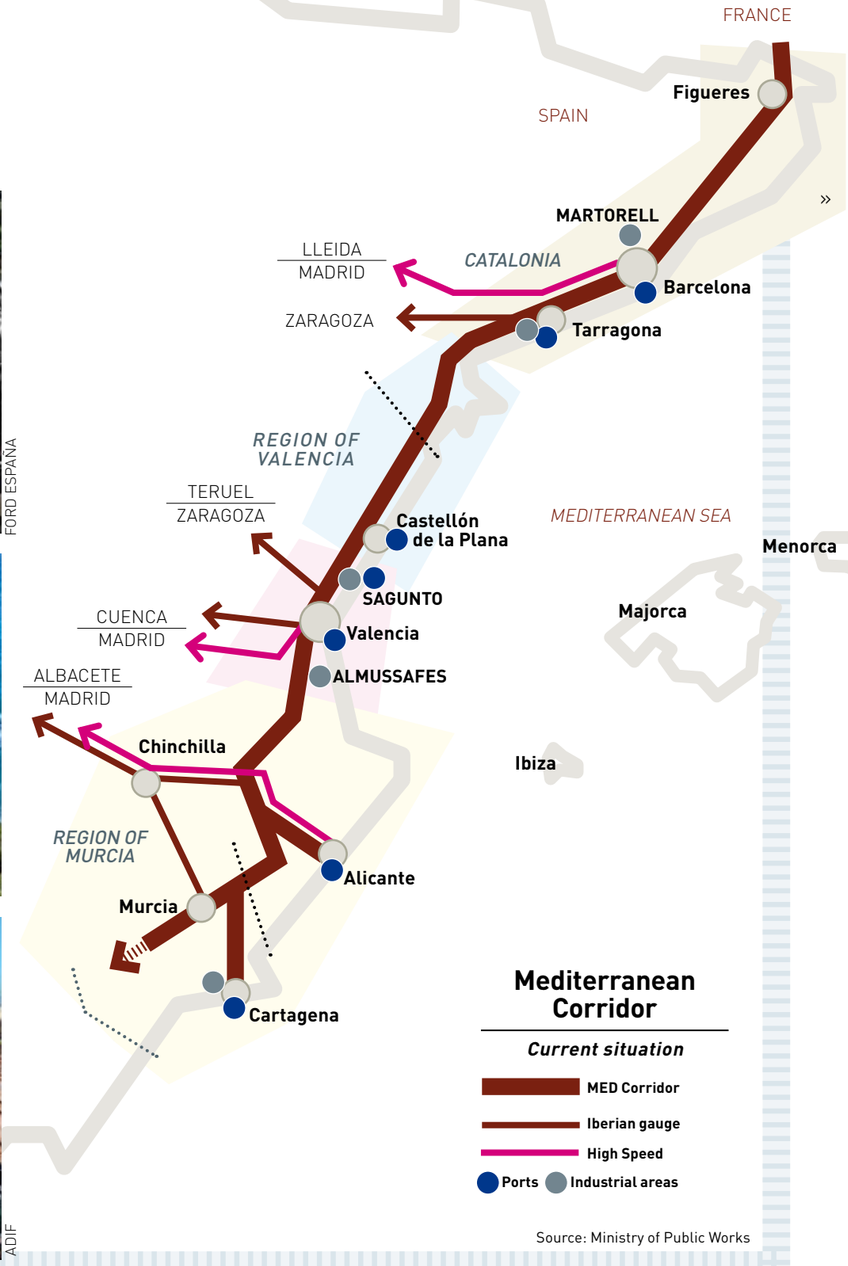
ADIF

A vital transit axis

The Mediterranean Corridor is now consolidated as the industrial and economic backbone of the country with the longest coastline in Europe, at over 8,000 kilometres, 45% of Spain's gross domestic product and almost half of its 47.1 million inhabitants are concentrated along the Mediterranean strip. Along this route, stretching from southern Andalusia to the Pyrenees, we find some of the most important hubs of the main Spanish industries. Such is the case for automobiles, with factories such as Seat in Martorell (Catalonia) and Ford in Almussafes (Valencia). Other strategic industrial sectors, such as chemicals in Tarragona (Catalonia) and steel in Sagunto (Valencia), are likewise of note.

The big challenge is to provide a high-capacity railway connection for passengers and freight that can get round the difference in track gauge with Europe

The manufacturing output of all these sectors is largely export-oriented, hence the vital importance of the ports as transport nodes. 60% of products sent abroad and 85% of imports pass through these ports. It is no accident that Spain's most important ports are on the Mediterranean strip. The port of Valencia is the second largest in the country after Algeciras and the busiest in the country and fifth busiest in Europe in container traffic. The ports of Barcelona and Tarragona are third and fourth, respectively. There are »



Source: Ministry of Public Works

The objective of the Ministry of Public Works is to overcome the limitations of the infrastructure as soon as possible and at the lowest possible cost and make railway freight transport more efficient and profitable

also other significant ports, such as Castellón and Sagunto, in Valencia, Cartagena-Escombreras, in Murcia, or the port of Alicante, all of which are linked to industrial, sporting or leisure activities. For the 46 Spanish ports taken as a whole, the percentage of freight carried by rail remains low in comparison with other European nations. Stakeholders from the sector agree that increasing this share would improve the general competitiveness and environmental sustainability of Spanish transport, where road continues to dominate by a considerable margin.

Goal: an effective and interoperable network

To improve this panorama the goal is to achieve interoperability with the rest of Europe. The existing rail network, save for a few dual-gauge stretches and the high speed lines, is all built to 'Iberian' gauge. Moreover, infrastructure, tracks and sidings in the Mediterranean Corridor only allow for the use of freight trains 450 metres and, in some cases, 600 metres in length. Now the plan is to raise capacity with longer trains –up to 750 metres– which will allow operating costs to be reduced by about 40%, according to calculations made by the Ministry of Public Works. Such a change will make railway freight transport efficient and profitable.

One case in point is the freight route from the port of Barcelona to the French city of Lyon, in service since 2011, which can already handle this type of train. To create this route, part of the North-East High Speed Line's alignment was used, as well as some conventional sections which have been fitted with a third rail, also known as dual-gauge. This made the first international railway connection in standard gauge a reality through the cross-border passage between the Catalonian town of Figueres and the French town of Perpignan, operated by the Spanish-French private consortium TP Ferro.

ADIF

Adapting track gauge and train capacity to European standards will make rail freight transport efficient and profitable

In addition to the general issues related to track gauge, the Mediterranean railway network has breaks between Barcelona and Murcia, with local peculiarities for which specific technical solutions have been planned to improve freight traffic flow. Ineco is currently working with the General Directorate of Railways of the Ministry of Public Works on the preparation of several studies and construction projects for the implementation of standard gauge in the Mediterranean Corridor. At the same time, the company's experience with the Spanish railway network encompasses a wide variety of work throughout the last few decades (see 'Ineco and the Mediterranean Corridor'.«

PABLO NEUSTADT

The project to create a homogeneous and interoperable railway corridor for international traffic on the Mediterranean coast dates back to the late 1980s. In the past 23 years it has evolved, with different proposals and solutions brought to the table. The objective of the current Ministry of Public Works team is to overcome the limitations of the infrastructure as soon as possible and at the lowest possible cost, to make passenger traffic compatible with freight traffic.

Ineco and the Mediterranean Corridor

Ineco is working with the Ministry of Public Works to implement standard gauge on rail as well as road connections to the main ports of the Mediterranean coast. These connections are essential to the development of the Corridor. In this regard, of particular note is the recent agreement for the construction of a new rail access to the port of Barcelona, designed by Ineco and signed last September by the Spanish minister of Public Works, Ana Pastor, and the president of the Generalitat (regional Government) of Catalonia, Artur Mas.

Since 2005 Ineco has been assisting the national public body Puertos del Estado, along with individual port authorities, to reorganise the internal rail networks of Spanish ports, such as those of Barcelona, Tarragona, Valencia and Castellón, which have all launched projects to improve their rail and road access and to adapt their tracks to standard gauge.

Regarding civil works, Ineco has participated throughout the development of the high speed line Madrid-Zaragoza-Barcelona-French border. In 2011, the first standard gauge freight corridor between the port of Barcelona and France opened. This was made possible by using part of the high speed alignment and some stretches of the conventional 'Iberian' gauge line that have been retrofitted with a third rail (likewise with the participation of Ineco). Ineco had previously also worked on the Barcelona-Castellbisbal-Can Tunis freight branch, which now has rails adapted to standard gauge.«

Novel solutions

The Mediterranean Corridor project contains two new elements: the implementation of 'dual-gauge' and the gauge conversion of lines that are in service, something which has never been done before.Dual-gauge makes it possible for both Iberian and standard gauge trains to run on a track through the installation of a third rail. This technical solution had hitherto only been performed on small sections and is now being extended to several longer stretches with heavier traffic. This, coupled with having to work on operational lines, has made it necessary to search for novel solutions.

The projects can be categorised into four types of actions:

- Implementation of dual-gauge (third rail): a highly complex solution limited to sections where the continuity of Iberian gauge traffic must be guaranteed along with standard gauge traffic.
- Converting Iberian gauge to standard gauge on stretches where the prevailing traffic can run on the new gauge.
- Adaptation of sidings for trains up to 750 metres length and homogenisation of clearance per the interoperable European standard.
- Adaptation of electrification, safety and signalling facilities and, if needed, new electrification.«

The Mediterranean Corridor has been divided into several work sections between Castellbisbal and Cartagena. They comprise 600 kilometres of track in total and are part of the Trans-European Transport Networks (TEN-T)

MEDITERRANEAN CORRIDOR

Section by section

The corridor has been divided into several work sections, between Castellbisbal, in Barcelona, and Cartagena, in Murcia. They comprise 600 kilometres of track in total and are part of the Trans-European Transport Networks (TEN-T).

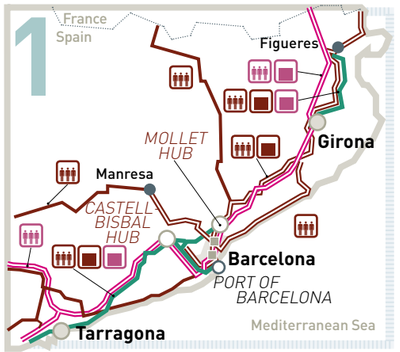
1
→Castellbisbal–Tarragona Section

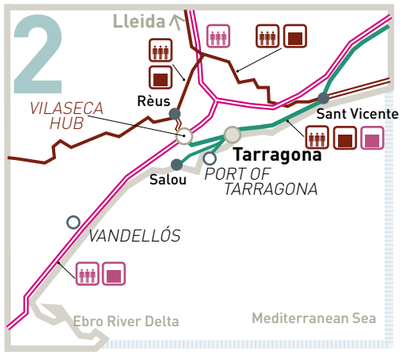
■ In this 97-kilometre section, dual-gauge is employed to link the port of Tarragona, the area's chemical industries (BASF and Bayer, among others), the Seat automobile factory in Martorell and other factories, such as Celsa, Gonvauto, Gonvarri and Solvay, many of which are already anticipating international traffic.

The goal with these sections is to ensure that the works do not disrupt commuter traffic, with a particular focus on the section between Martorell and Castellbisbal, where the gradient has been reduced in some tunnels to guarantee compliance with interoperable clearance for both gauges. Furthermore, the asymmetrical nature of tracks with a third rail creates the need for a highly specific analysis of the side of the track where the platforms, junctions, sidings, etc., are to be installed.«

TRAFFIC

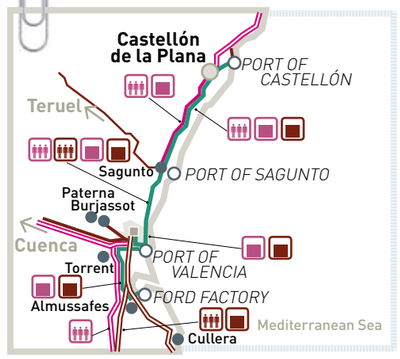
- **Passengers** (Standard gauge)
- **Passengers** (Iberian gauge)
- **Freight** (Standard gauge)
- **Freight** (Iberian gauge)





2
→Tarragona–Vandellós Section

■ This 30-kilometre section was already under construction before the project began. A new double-track, standard gauge bypass is being built that, when completed, will save trains from having to pass through the towns of Cambrils and Salou, thereby improving quality of life in these developed areas. Starting from this section, the alignment will be operated with only standard gauge.«



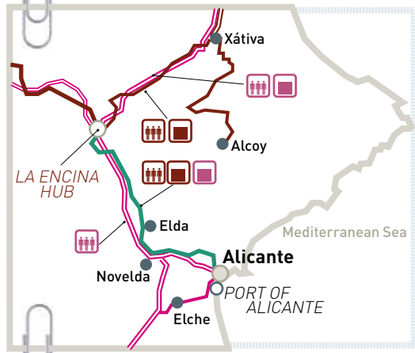
3
→Vandellós–Almussafes Section

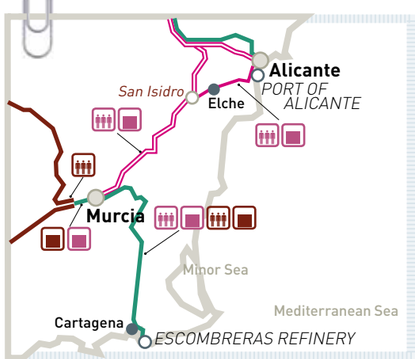
■ For this 279-kilometre section several solutions have been considered: from Vandellós to Castellón (159 kilometres), the gauge of a conventional line changes to standard to reduce the costs involved in installing third rail technology. This section is mainly for passenger traffic, adapted along nearly its full length for high speeds (200 km/h).

In the section running from Castellón to Valencia, a dual-gauge is implemented to make the different types of traffic compatible. In this region, a significant amount of that traffic is intra-peninsular, so the Iberian gauge must be preserved.

TYPES OF TRACK

- **Standard gauge**
- **Iberian gauge** (double track)
- **Iberian gauge** (single track)
- **Third rail**





4
→Valencia–Alicante / Alicante– Murcia

■ On this section work is performed on 194 kilometres of the line. Work is already in progress between Valencia and the railway hub of La Encina and on the high speed access to Murcia. The object is mainly to connect the ports of Alicante and the Escombreras dock in the port of Cartagena, as well as to incorporate the Murcia–Freight terminal at the end of the corridor section currently under construction.

The technical solutions are mixed: dual-gauge from La Encina to Alicante on the conventional line and conversion to standard gauge between Alicante-San Gabriel and Murcia (with electrification of sections where needed). The dual-gauge and electrification extend to Escombreras, in Cartagena, thereby paving the way for the future arrival of high speed rail.«

From Sagunto to Castellón the gauge is changed on one track and dual-gauge is installed on the other, so that the port of Castellón has railway access available in both gauges.

From Sagunto to Valencia two dual-gauge tracks are used due to heavy traffic from Iberian gauge rolling stock.
Lastly, from Valencia-Fuente de San Luis to Almussafes, where the Ford automobile factory is located, a dual-gauge track is being laid over a pre-existing trackbed. It will serve as a bypass for access to Valencia from Silla.
In addition, a track providing direct access to the factory is also being built. This will facilitate both the entry of supplies from the rest of Europe and the exporting of finished vehicles.
Standard gauge access is also to be provided for the ports of Castellón (currently in the study phase), Valencia and Sagunto and to the industries near Sagunto.«

Waterways

Preliminary project to expand the capacity of Príncipe Felipe freight terminal

With the collaboration of the **Consulting and Operation team**

Ineco has completed the preliminary project for remodelling the Príncipe Felipe railway terminal at the port of Valencia. The goal is to increase the functional length of the tracks from 450 to 750 metres, which will allow the use of longer and more efficient trains.

The port of Valencia is Spain's leading port and the fifth-busiest in Europe in terms of container traffic. It has two freight terminals. In addition to Renfe, private railway companies such as Logitren and Continental Rail operate in the terminals. The Port Authority hired Ineco in 2012 to prepare the preliminary project for remodelling the railway terminal located on Príncipe Felipe pier. Of the six alternatives considered, the one selected proposes to extend the five existing tracks to 750 metres of functional length, typical in Europe, and to install a third rail on three of them, allowing the coexistence of the Iberian and international gauges.

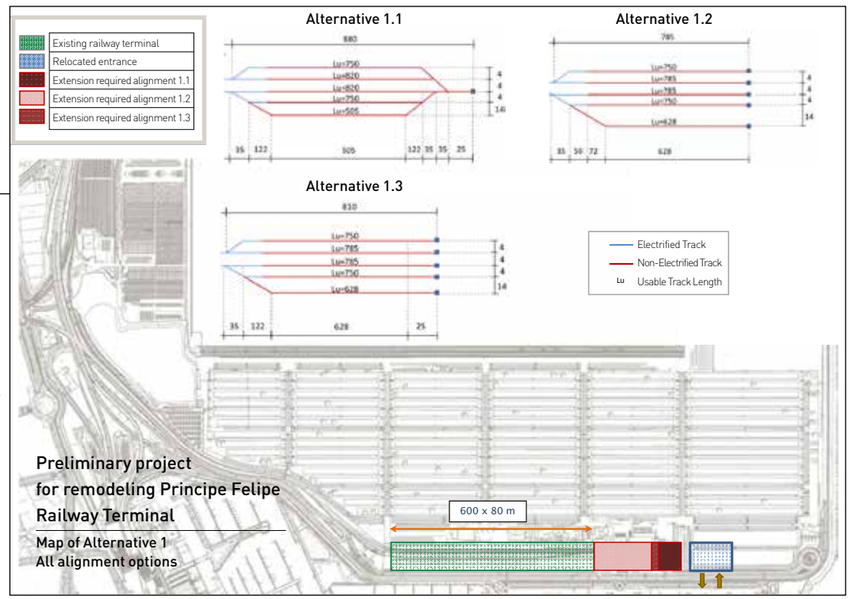
This initiative is just one more step in the development of the port of Valencia's railway links. In 2006, the South Access was inaugurated, which connects the port to the logistical centre of Fuente de San Luis. In 2008, trains with a length of 600 metres began travelling between the port of Valencia and Madrid. In 2011, tests were performed with 750-metre trains.«

Rise in freight volume

The Madrid-Valencia freight corridor is one of the busiest in the nation. The improvement to infrastructure that has allowed 750-metre-long trains to travel on this line has raised transported freight volume.
The commissioning of the Madrid-Levante high speed line (first to Valencia in 2011, then to Alicante in 2013) has helped matters by absorbing passenger traffic, freeing the conventional corridor for freight use.

INTERMODAL COMMITMENT

The port of Valencia, considered the maritime gate to the heart of the Iberian Peninsula, and Ineco's preliminary project are committed to intermodal transport. Part of the project team is shown above in the lower image.



First, line 1

Renovation of Caracas metro line 1

By **Jorge García Morales**, industrial electronics engineer, responsible for the project
and **Álvaro García Tapia**, telecommunications engineer, international expert in signalling

CAF SUPPLIES THE TRAINS

The 48 trains provided by Spanish manufacturer CAF can carry up to 2,170 passengers and are the first to include gangway connections, allowing for better passenger distribution. Boasting a modern design and the latest technological advances in safety and comfort, the units come equipped with passenger information systems and recording centres for any eventualities that may arise.

Ineco is participating in the renovation of Caracas metro line 1, which sees 1.2 million users daily. The work consists of technical assistance, integration, coordination and planning for the Spanish consortium formed by CAF, Dimetronic, Cobra and Assignia.

With a population of some 4 million people, Caracas has four metro lines and 24 metrobus routes that provide service to approximately 1.7 million passengers each day. Of these, almost 1.2 million normally use line 1 on working days, as it connects densely populated suburbs, such as Petare and Catia, spanning the whole city from east to west. Since its inauguration in 1983, line 1 has transported about 8 billion passengers. It has an approximate length of 22 kilometres, 22 passenger stations and electrical trains that run daily linking the two ends of Caracas. The city's population growth and the rise in the number of metro users has led to the saturation of this line. This problem is particularly acute in the centre of the city, on the busy section between Capitolio and Plaza de Venezuela.

After almost 27 years of service, this line's equipment and systems were showing clear signs of wear as they were approaching the end of their useful life. The time had come to renew them. The public corporation Metro de Caracas initiated a renovation process in 2009, creating several expansion plans meant to provide Greater Caracas with an efficient and safe public transport system.

Different expansion projects

In addition to the renovation and re-outfitting of line 1, C.A. Metro de Caracas is carrying out other expansion projects on its lines. Some of these include the projects on line 5 and on the Caracas-Guarenas-Guatire system, as well as complementary projects to support the metro system such as Metrocable Mariche and Cabletren Bolivariano. Other initiatives undertaken by Metro de Caracas to increase passenger comfort include installing new air conditioning systems, fixing escalators and cleaning graffiti.

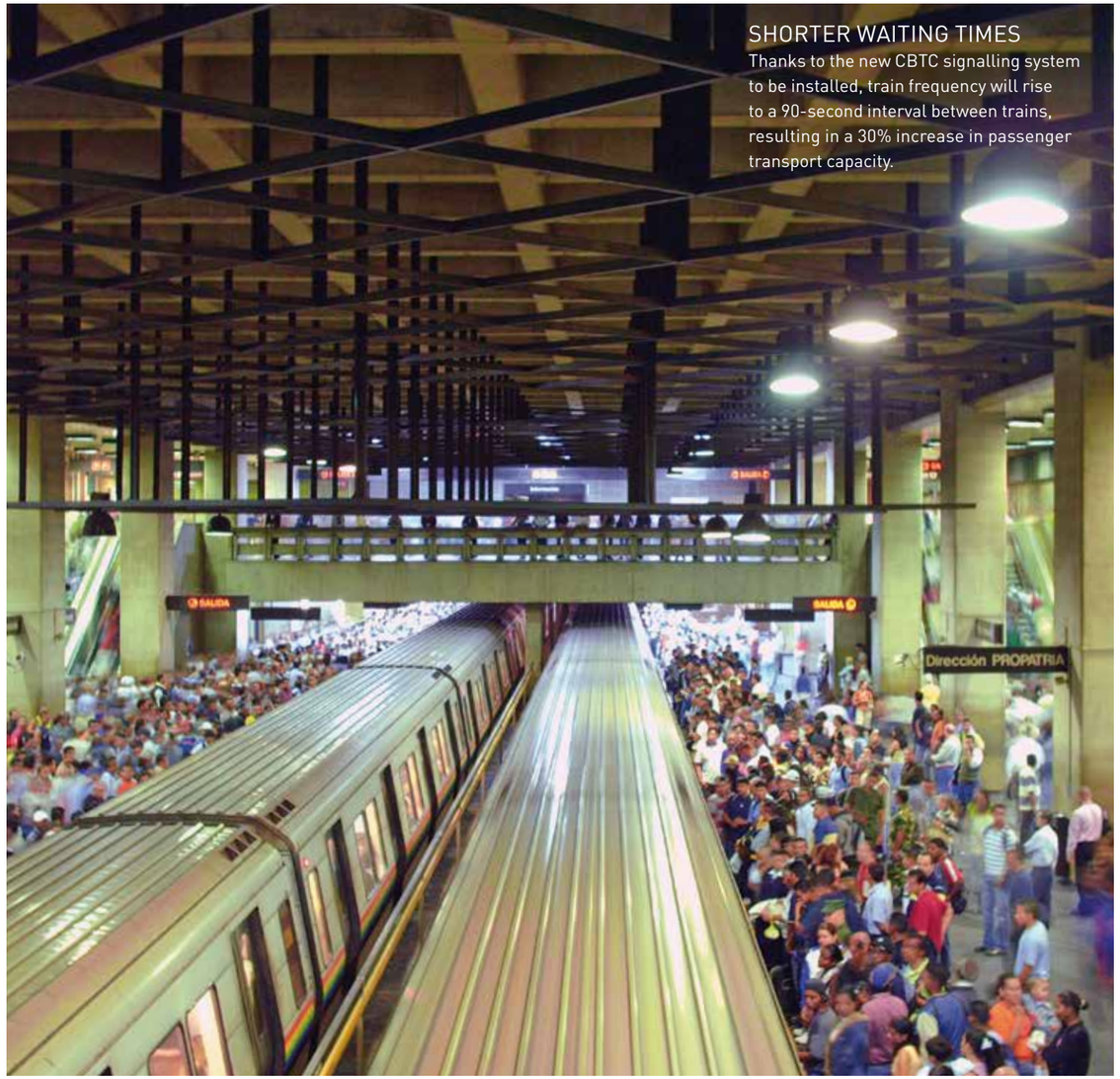
Ineco has been working with the Spanish consortium responsible for line 1's renovation since 2009, when work began, and will continue to do so until its coming completion in late 2014. The consortium is comprised of CAF (the manufacturer of the new trains), Assignia Infraestructuras (track renewal), Cobra Instalaciones y Servicios Internacional S.L. (renovation of traction substations) and Dimetronic, from the Siemens group (CBTC signalling system).«

The main challenge in this renovation has been to undertake the work without interrupting commercial train operation, to avoid inconveniencing metro users.

CARACAS METRO

Ineco's responsibilities

- **Verification of compatibility, rehabilitation and interface troubleshooting.**
- **Work programmes and progress reports. Processing technical documentation.**
- **Work progress supervision. Supervision and monitoring of compliance with company specifications.**
- **Monitoring of studies and documentation. Preparation of full or partial work deliveries.**
- **Verification of works or goods upon receipt by the contractor.**
- **Coordination of the testing programme.**
- **Compliance with safety regulations.**



SHORTER WAITING TIMES

Thanks to the new CBTC signalling system to be installed, train frequency will rise to a 90-second interval between trains, resulting in a 30% increase in passenger transport capacity.

Ineco has been working on different projects in Venezuela for over 20 years. In 2012, it performed the refit of the Caracas metro's workshops for CAF

Valencia metro station.


Train on test track.


Rail junction assembly.


Rail replacement.


Inside of a workshop.

New project in the Valencia metro

Ineco is also providing technical assistance to the same Spanish consortium in the expansion of the Valencia metro, which will gain 6 new stations.

Located 172 kilometres west of Caracas, Valencia is the most important industrial city in Venezuela and its metropolitan area has a population of almost 3 million. Valencia's metro system currently has 7 stations in operation (6.3 kilometres) on an initial stretch in the south of the city, between Monumental (next to the bullring) and Cedeño. The Spanish consortium for the Valencia metro has the same members as the consortium for the Caracas metro (CAF, Cobra, Assignia and Dimetronic). Its purpose is to extend the line by adding six new stations, from Rafael Urdaneta to Tacarigua. This will involve placing an additional 4.3 kilometres of track.«

WORKING IN VENEZUELA SINCE THE 80S

Over 20 years of experience

Ineco has been working on different projects in Venezuela for more than 20 years now. Back in 1987 it prepared the plan of action for Venezuelan railways for the Spanish operator Renfe within the scope its international cooperation with IFE, a study promoted by the Spanish Ministry of Foreign Affairs. In the 90s, the company did a study on alternative freight transport from the south-eastern region of Venezuela. This project was carried out for CGV Ferrominera Orinoco and the Corporación Venezolana de Guayana. The purpose of the study was to solve the problems generated by mineral exports and the flow of merchandise between the south-eastern region and the centre of the country. Between 1992-1993 the Technical and Economic Feasibility Study of the Santo Domingo-Acarigua-Puerto Cabello Railway Project was conducted for the Corporación Venezolana del Suroeste-CVS. From 2006 to 2009 technical assistance was provided to the Spanish consortium formed by OHL-Obrascon-Huarte-Lain to expand the Venezuelan rail network, which involved several studies between Barquisimeto-Maracaibo and Yaracal-Coro-Punto Fijo. Alignment and geotechnical studies were also done, as well as preliminary reports on the possibility of creating a rail connection on the Caracas-La Guaira stretch.
In 2007, work was performed on the National Plan for Water, Air and Land Transport, Phases I and II. This was a joint effort by the consortium formed by Ineco and the companies Incostas, Insurbeca, Modelística, Calzadilla, Pardo and Sully for the Venezuelan Ministry of Infrastructure.
In 2012, Ineco adapted the Caracas metro's workshops, where the 48 trains supplied by the Spanish manufacturer CAF are maintained. Among other tasks, this construction project was designed to implement a range of equipment in the Propatria workshop. It also involved the functional study and the alignment and track details for positioning a painting booth, a wheel lathe and two wheel mounting and demounting presses.«

CARACAS METRO

Step by step guide to line 1's renovation

- 48 new trains with seven cars each.
- Supply, installation and commissioning of new signalling systems (CBTC), automated operation, centralised control and communications.
- Track renewal by replacing rails, rail junctions, sleepers and fastening system elements, as well as elastomers and third rail components in determined areas.
- Supply and commissioning of vehicles for track inspection, transport and maintenance.
- Modernisation of the traction power supply system for trains along with auxiliary and emergency power systems for stations, stabling yard and OCC on line 1, through renovation work on the 30kV subtransmission system and the 12.47 kV and 750 V power supply systems.
- Supply and commissioning of new units and monitoring systems for the electrical traction substations, power centres and SEDE system equipment.
- Supply of special tools, measuring devices, diagnostic equipment and test benches, as well as implementation of workstations for maintaining the new trains and equipment that will be incorporated into the Integral line 1 system.

VALENCIA METRO

Renewal of line 1

- Repowering substations, overhead contact line feeder and 13.8kV cabling.
- Replacing signalling.
- Supply of on-board ATP-CBTC units for existing trains.
- Main communications network, Tetra radio and remote power control.
- Intercom and anti-intruder equipment.
- Refit of rolling stock workshops.

Comprehensive line 2 project

- 36 train units with two cars per unit.
- Three traction and auxiliary substations and three auxiliary substations.
- One main 115/13.8 kV substation.
- Track length of 4.3 km.
- Signal replacement.
- New overhead contact line.
- Supply of on-board ATP-CBTC equipment for the new CAF trains.
- Main communications network, Tetra radio, remote power control, telephony and ticketing.
- On-board video and Wi-Fi.
- Intercom, anti-intruder, CCTV, timekeeping, information displays, fire detection and remote control of auxiliary installations.
- Refit of rolling stock workshops.

A model for good signals

Project SPRING: improvement of radio-electric coverage in tunnels

By **Rafael Gutiérrez** responsible for the project, **Alberto Trujillo**, **César Díez** and **Sergio Breso**, telecommunications engineers

Ineco has completed the first phase of SPRING, a novel project to optimise radio coverage inside tunnels. The goal is to obtain the best signal quality with the fewest transmitters, thereby reducing infrastructural and maintenance costs.


Burata Tunnel between Ourense and Santiago.

Maintaining radio communications at all times between the train and the traffic control centre is essential. Insufficient radio-electric coverage may result in temporary signal or communication loss, leaving the control system "deaf and blind". To avoid this risk, it is imperative that the location of the equipment that retransmit the radio-electric signal along the line is properly planned during construction. This can be easier said than done on certain kinds of terrain or certain points on the alignment, especially in tunnels.

Because tunnels run underground and are greatly heterogeneous, there are not to date commercially available computer tools for simulating radio coverage that can be used to find the optimal location of transmitters within tunnels. While simulators were used for outdoor coverage, the formula used to size and plan the equipment was purely theoretical. It was in this context that Ineco sought out an innovative solution: SPRING (Radio-electric Planning in Tunnels for GSM-R Software), a project that began in 2012 and has now reached its second phase. It all started with the need for a radio planning tool in the project design phase and the company's experience with prior radio-electric studies performed on different high speed and conventional rail lines.

The tests performed in a real-world project on the Makkah-Madinah line were a success

Studies results

These studies revealed that the distances between units (repeaters and base stations) responsible for transmitting the radio signal can be much greater than previously believed without signal loss or deterioration. It was thus determined, for example, that two successive repeaters could be separated a maximun of 3,100 metres, instead of the usual 1,800 metres, and by up to 4,800 metres for base stations.

It was concluded that fewer units were needed to guarantee the best radio-electric coverage than previously thought. In other words, savings could be achieved by installing fewer transmission units. The next step was to confirm this finding. To this end, the project SPRING team designed and built a radio transmitter to perform various measurement campaigns. In January 2013, the transmitter was ready to be tested in an actual project. The SPRING team travelled to Saudi Arabia, where Ineco is working on one of the most significant railway projects in the world: the second phase of construction of the 444-kilometre-long high speed line between Makkah and Madinah. The most cutting-edge technology available is being installed for this project, making it ideally suited for conducting these tests. The tests were completed successfully.«

TESTING ON THE MAKKAH-MADINAH LINE

In the top left image, Ineco engineer, Alberto Trujillo, with a signal strength meter; bottom left, the radio transmitter designed by the SPRING team. To the right, an antenna on a crane.

Unveiling

Ineco will present several articles on this project at the 10th World Congress on Railway Research (WCRR), to be held from 25th to 28th November 2013 in Sydney, Australia. The WCRR is the biggest forum on innovative railway technology in the world. These same articles, along with the modelling tool, will also be presented in the Transport Research Arena 2014, a conference devoted to research and innovation in transport, to be held next year in Paris La Défense from 14th to 17th April.

Second phase: a multipurpose tool

Currently, project SPRING is in its second phase of development, focused on the implementation of a specific software program for the GSM-R band. One of the main difficulties is that there is no model that can be used as a guide, so one must be built from the ground up. Once again, field testing is needed. In this case, tests are performed in tunnels on both conventional and high speed Spanish lines, for which Ineco has been able to rely on the cooperation of Adif, the Spanish railway infrastructure administrator.

The plan is to place a radiofrequency transmitter at several points throughout the tunnel and then measure the signal strength using a moving radiofrequency scanner. These measurements are taken with different configurations of the transmitter and different types of antenna. Thus, a computer modelling that will show how radio waves propagate inside a tunnel will be obtained, which can then be used to plan the most economical and efficient option for radioelectric facilities.

The SPRING system developed by Ineco also provides another advantage: it is not only valid for analysing GSM-R railway mobile telephony frequencies, but also those of any other communications system: TETRA, LTE, UMTS, train-ground, etc.«

Coming full circle

Ineco is coordinating the works for the final section of Brazil's largest road infrastructure

José Luis Pancorbo, Coordinator of the Rodoanel North Consortium,
José Isidro Díaz, civil engineers and **Alejandro Rodríguez**, IT engineer

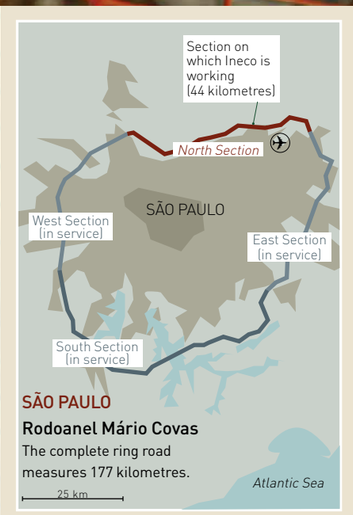
Photo: **André Lemes**

This ambitious megaproject is the largest investment in South America by the IDB (Inter-American Development Bank) and is part of the most complex road works in Brazil. Once completed, it will reduce traffic congestion in the São Paulo metropolitan region –home to 19 million people– by means of a full ring road. Over 65,000 vehicles daily are already using the finished sections, many of them heavy and long-distance vehicles.

The work on the last section of the São Paulo Ring Road, called the Rodoanel Mário Covas, will close the 177 kilometres loop encircling the metropolitan area. Known as the *North Section*, it is a highly complex 44-kilometre stretch of highway with three to four lanes in each direction and will require the construction of seven twin-bore tunnels (mainly to preserve natural spaces), 111 bridges and viaducts and an access road to Guarulhos International Airport. Furthermore, along with the other delicate preliminary tasks, some 4,000 families will have to be resettled.

A consortium led by Ineco, in conjunction with Brazilian engineering firm EBEI, is supporting the public-private joint venture DERSA (Desenvolvimento Rodoviário S.A, partly owned by the State of São Paulo). One of Ineco's roles is to monitor the work of the six construction groups and the companies and institutions participating in the works, which began in March 2013 and are scheduled for completion in 2016.

Infrastructure of this size requires the handling of immense volumes of information on a myriad of media platforms: drawings, charts, photographs, progress reports, incident reports and technical data, on issues ranging from compulsory purchases, the environment, interference with other infrastructures, work performed and administrative and economic matters. The SIOS (Singular Works Information System), which was developed by Ineco, is providing support for analysing information and monitoring the works with the help of DERSA computer systems. SIOS combines an array of works data in a single application, accessible both via the web and in real time.«



SÃO PAULO
Rodoanel Mário Covas
The complete ring road measures 177 kilometres.

In this image, Ineco engineers, José Luis Pancorbo and José Isidro Díaz at the worksite of the North Section of the São Paulo Ring Road

Numbers and flowers

Technical, legal and financial structuring of the Flandes airport

With the collaboration of the Economics and Planning team

Mirroring the enterprising spirit of Santiago Vila when he began construction of this airfield in 1948, the airport's current managers and regional leaders intend to invest in a project that will generate wealth and promote the development of the entire area in the future. Ineco has carried out the financial consultancy with funding from Fondecun.

Located in the town of Flandes, in the Department of Tolima, about 134 kilometres from Eldorado international airport, in Bogotá, Santiago Vila airport has considerable potential for development and economic growth as it is located in a prosperous urban area formed by the towns of Flandes, Girardot and Ricaurte.

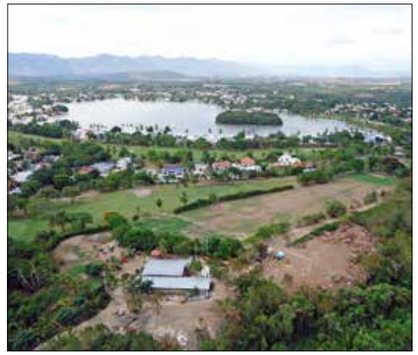
The history of this region in central Colombia is closely tied to the strategic location of Girardot, the adjacent municipality. Flandes witnessed the birth of aviation in Colombia. The first flights in the country happened there and, not long after, Santiago Vila, a local businessman, built the Flandes airport.

The airport modernisation project is part of the geopolitical and strategic plan for the region of Cundinamarca and Tolima, meant to make it the key logistical hub of Colombia. This initiative is joined by projects such as the divided highway to Bogotá, La Línea tunnel within the Coffee-Growers Axis, the promotion of the Magdalena River's navigability and the restoration of the railway. The governments of Cundinamarca and Tolima reached agreements with Aerocivil –Colombia's civil aviation authority– and Fondecun (Cundinamarca Fund for Project Development) to encourage the modernisation of the airport so that it can gradually reach at least category 4D, complying with the international standards set by the ICAO. One of the goals was to convert it into an international cargo airport with a significant complementary role in the National Airport Network.

Agreement between several parties

As a preliminary step before reaching these goals, in 2011 Fondecun entrusted Ineco with the task of providing *International consultancy for the financial structuring of the concession project for the Santiago Vila airport in Flandes-Tolima.* To execute this task, in 2012 Ineco consulted the project's stakeholders, which include Fondecun, Aerocivil, the governments of Cundinamarca and Tolima, the town councils of Flandes and other towns near the airport, chambers of commerce, entrepreneurial associations, Asocolflores, airline associations such as Atac and Alaico, Avianca, Tampa Cargo, Aerosucre, the National Infrastructure Agency, Cormagdalena and Asecarga.«

The main goal is to make Santiago Vila airport the engine that drives the competitiveness and exports of central Colombia



ON THE MAGDALENA RIVER

The airport is located at a strategic crossroads, in a region with a great potential for growth.

The key points of the financial and economic study

- In-depth analysis of existing infrastructure and future growth.
  - Analysis of runway orientation and length and extension alternatives.
  - Apron and terminal building layout, control tower, supply area, fire station, etc.
  - Equipments and electrical instalattions neccesities and the need for environmental protection measures.
  - Calculation of investments over the whole concession period (CAPEX).
- Design specifications: airport profile, capacity, type and category of aircraft, operation, etc.
- Consultation, opinion and expectations of the stakeholders.
- Analysis of the project's zoning, territorial and urban planning approach. Accessibility, affected areas, land use and the free trade zone, among other aspects.
- Studies traffic forecast on the evolution of domestic, international and cargo traffic. Traffic studies include forecasts until 2036.
- The Operating Plan for the Concessionaire.
- Definition and projection of operating costs (OPEX).
- Airport´s fee structure. What are the fees for each activity? Fee proposals.
- Management alternatives and management model recommendation. The different scenarios and their risks.
- Legal issues. National regulations and adaptation to ICAO rules. Contractual scheme for the Public Private Partnership.

Flandes is a strategic spot for the development of an attractive free trade area for private investors, as this multimodal hub will be an important point in the Colombian freight transport network

FOSTERING NEW BUSINESS

Flower power

Colombia is one of the world's top flower producers with an annual volume on the order of 220,000 tonnes. The most important plantations are in the Savannah of Bogotá, which exports 95% if its flower production by air. The main destinations are the US, via Miami, with the lion's share of 75%, followed by Europe and, to a lesser extent, Japan. 80-82% of these exports, however, go through Eldorado airport, much closer to the Savannah area. If the average travel time from the Savannah to Eldorado airport is about 30 minutes, the use of Santiago Vila would imply an increase in distance of some 140 kilometres, representing 3-4 more hours of transport, which would affect the costs, delivery times and refrigeration chain.

Ineco has done a study of the minimum cost overrun for transporting flowers to fill a cargo aircraft in the new Flandes airport. For flowers, the limiting factor for transport is volume, not weight. The cargo aircraft considered were the Boeing 727-200 and the Boeing 737-200, with maximum cargo volumes of approximately 100 cubic metres, similar to that of a tractor-trailer.
The added cost for transport (fuel, time, tolls, etc.) to the Flandes location is greater than the potential savings in airport fees. There is no possibility of compensating the added cost by reducing airport fees. Moreover, after holding meetings with several associations, it was determined that the weather conditions of Santiago Vila airport do not ensure that the cold chain required for the logistics of transporting cut flowers can be maintained.

ASOCOLFLORES

Both the Chamber of Commerce of Ibagué and the ANDI (National Entrepreneurs Association of Colombia), Tolima-Huila section, are considering the opportunity to change their bi-annual crops (which are losing their competitiveness due to the Free Trade Agreement) in favour of exportable crops, such as fruit and cocoa. These crops are better adapted to warm climates and require less irrigation. They are also considering the production of cotton by agribusiness, particularly in the region of Tolima, the second-largest cotton producer in Colombia, to export top quality thread. Fish farming in Huila, gold, fertilised eggs, new fruit crops and cosmetics are other potentially exportable products.«

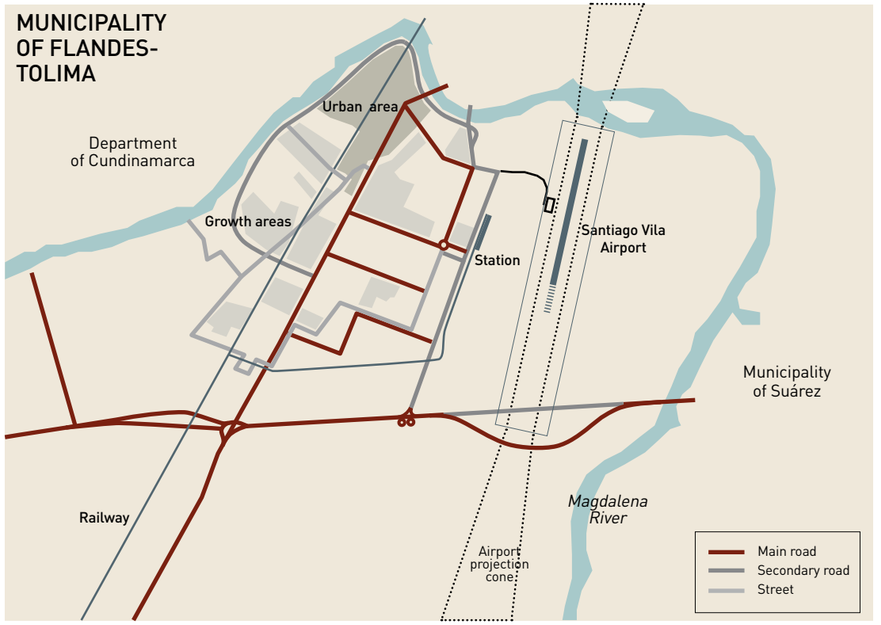
Aircraft maintenance

These days the main aircraft maintenance, repair and overhaul (MRO) centres are in the US, Europe and Asia. There are also some centres in Latin America, the Middle East and Africa. Colombia's location gives it considerable potential as a headquarters for aircraft MRO companies.

The Flandes airport has the space needed for modern, competitive and efficient facilities. The creation of free trade zones would facilitate all the processes and reduce costs, as the maintenance business needs spare parts to be imported.«

A FAVOURABLE LOCATION

The airport is located in a strategic area in Latin America and has land available.



A new free trade zone

Flandes is a strategic location as it is destined to become a multimodal hub due to the confluence of a divided highway linking Bogotá to the Pacific coast, a road to the Caribbean and the navigability of the Magdalena river, a project that will allow goods to be carried to Barranquilla. The convergence of these three links make the creation of a free trade zone highly attractive to private investors, as this multimodal hub will become an important point for freight transport in Colombia. Free trade zones generally promote domestic and international investment and create jobs and new investment opportunities. Colombia would benefit by competing with other countries in the region that have developed efficient logistical facilities.«

Conclusions

- **All the conclusions reached following the meetings with stakeholders reveal that the freight traffic linked to the operation of Eldorado airport as a hub and the use of the cargo holds of passenger flights to carry freight generate reluctance to start new business at Santiago Vila airport. At this time there is not enough freight exported by air to generate a volume that would allow the private sector to operate and recoup the initial investment.**
- **The meetings held with chambers of commerce and entrepreneurs of the region have led to the conclusion that the volume of exportable goods produced is insufficient in and of itself to justify a new cargo airport. Nonetheless, the airport is located in a strategic area in Latin America and has land available. The navigability of the Magdalena river and the trackbed reaching Neiva and Facatativá do favour the creation of a new intermodal hub. Implementation of a free trade zone beside the airport and the pursuit of aeronautical activities, such as aircraft maintenance are also new lines of business to consider.**
- **Lastly, the technical, legal and financial structuring shows that, given that this is a greenfield project, it is difficult to find developers willing to assume a pronounced demand risk in the project launch stage in addition to an investment risk. As an alternative, a public-private partnership (PPP) was proposed to transfer the risk of availability and payment for the works and services by the Administration, such that the Administration pay a percentage of the cost of the works and an annual amount in accordance with the option selected.**

PHOTO: IRIZAR

Irizar is the largest independent Spanish coachbuilder.

A high-powered engine

Spain is not just one of the world's biggest car manufacturers. A local industry of components and equipment has grown up around the big brands that arrived in the fifties and its reach extends beyond Spanish borders.

Spain is the second largest automobile manufacturer in Europe –the first for industrial vehicles– and the ninth worldwide, according to ANFAC, the Spanish automobile manufacturers' association that groups together all the large corporations operating in the country: Ford, General Motors, Iveco, Mercedes Benz, Nissan Motor Ibérica, Peugeot, Citroën, Porsche, Renault, Seat, Toyota, Lexus, Volkswagen and Audi.

It should be noted that Spain is the only country where nearly all of the big automobile brands are present. They began arriving in the 50s, attracted by the competitive advantages offered by the country. Among these were lower wages than in other European countries and a highly qualified labour force. These advantages remain today and result in high productivity: of the 17 factories present in Spain, 10 are typically included among the most productive for their corresponding brands. This added value is in addition to the presence of a world class components industry and ten regional clusters with dynamic R&D&i activity.

The automotive sector is one of Spain's biggest industries. It represents 10% of the country's GDP and generates 300,000 direct jobs and 2 million indirect jobs, according to data from the Ministry of the Economy. Vehicles –passenger cars, trucks and buses– comprise 17.7% of all Spanish exports and are distributed to 130 countries. In fact, nine out of every ten vehicles made in Spain are intended for the foreign market, which comes to 2.2 million by the end of 2013.

A LEADING AUXILIARY INDUSTRY. The 61 million vehicles made in Spain in the last 25 years attest to this long-standing industrial tradition, generating an automotive sector that is the eighth-largest in the world and involves a thousand companies, some of which are global pioneers. The sector encompasses a wide range of products, from whole systems to replacement parts and accessories: engine and transmission equipment, electrical and electronic components, tyres and wheels, bearings, rubber components and chassis and bodies, among others. It has a turnover of 27,000 million euros, 60% from foreign sales, and employs about 200,000 people, according to data compiled by the trade association SERNAUTO.

Almost all automotive manufacturers operate in Spain, which possesses the eighth largest parts and components industry in the world

CUSTOM BUSES. One of the leading sub-sectors worldwide is the manufacture and design of custom bodies for cars and buses. According to the Spanish coachbuilders' association, ASCABUS, this activity generates about 3,600 direct jobs and another 6,000 indirect jobs. Almost half of its production is exported to 70 different countries. Spain is the European nation with the most independent coachbuilders, thanks to technological innovation, speed and cost containment.

PHOTO: GOING GREEN

Less is more

Sales of electric motorcycles double those of cars. In 2013, the Madrid-based distributor Going Green opened the first Spanish factory exclusively dedicated to electric motorcycles. Located in the Catalonian town of L'Hospitalet, it will manufacture 5,000 units per year, 70% of which to be sold in the European market. In addition to international brands, Spanish companies such as Helectra, Ecoter, Bereco, Ecoscooter, Kyoto, Vmoto, EMO Internacional and BSG electrics assemble and market electric motorcycles.

PHOTO: ANTOLÍN GROUP

Spanish multinationals such as Ficosa and Grupo Antolín (shown in the photo) are world leaders in parts and components.

The 'custom' products are adapted to all needs, including urban and long-distance transport, tourism, and high-end luxury. All configurations are covered: single and double-decker, articulated, low-floor, accessible for persons with reduced mobility, minibuses, buses specially sized for narrow streets or made-to-order products such as mobile offices, clinics or libraries.

The largest one in a field made up of little more than ten companies –most of them small and medium– is the Basque corporate group Irizar, with a turnover of 500 million euros, 2,900 employees and manufacturing operations in seven countries: Spain, Brazil, Mexico, Morocco, China, India and South Africa. The Galician company Castrosúa comes in second, with sales amounting to 40 million euros, four plants in Spain and 500 employees. In 2008, Castrosúa launched the first petrol-electric hybrid bus with a fully Spanish design and body.

Manufacturers outsource 75% of vehicle components. This photo shows the Seat plant in Martorell.

PHOTO: SEAT

Another Galician firm, UNVI, manufactures in Spain and Portugal and exports 88% of its products to 19 countries. The Catalonian company Indcar, founded in 1888, specialises in bodies for passenger minibuses and the adaptation of vans. It sells its products in eleven countries and just opened a factory in Romania. Indcar exports 85% of its products. So does Ferqui, a company hailing from the Asturias region that, like Indcar, was originally a family business and is now focused on the foreign market.

SPANISH PARTS. Another leading sub-sector is the supply of automobile parts. Gestamp Automoción (bodies, chassis and mechanisms) had a turnover of 5,757 million euros in 2012 with 94 production plants and 12 R&D centres spread throughout five continents. CIE Automotive manufactures engine and transmission components, among other items, and has over 16,000 employees worldwide.

The Catalonian firm Ficosa, a worldwide leader in rear-view mirrors, has factories, engineering centres and sales branches in 19 countries. Grupo Antolín manufactures roofs, seats and doors. It was founded in the 50s in Burgos as a family-run workshop crafting improved truck parts. It has since grown to 10,000 employees in 22 countries and invoices 1,580 million euros annually. For its part, 30% of the Basque cooperative Mondragón's economic activity is centred on the automobile business, which employs a total of 11,000 people throughout 44 plants in Spain and a further 21 in other countries.«

Renault manufactures the Twizy in Valladolid.

PHOTO: RENAULT

Do drivers dream of electric cars?

Within the vehicle manufacturing sector, which is strategic for Spain, the hybrid and electric vehicle segment offers significant growth potential worldwide. The diverse hybrids are currently in the lead, while 'pure' electric vehicles still represent a very small share of the market. Spanish factories manufacture several hybrid vehicles, such as the Citroën Berlingo, in Vigo (Galicia), and the Nissan e-NV200, in Martorell (Catalonia), both vans, as well as Ford's C-Max hybrid SUV in Almussafes (Valencia). Since 2011, Renault manufactures one of its four electric models in its Valladolid plant: the Twizy two-seater. The Spanish automotive industry is currently involved in many lines of technological research aimed at improving a variety of issues, such as range (which remains under 200 km), the deployment of recharging infrastructure and battery performance.Different research projects have been developed in recent years with these goals in mind.

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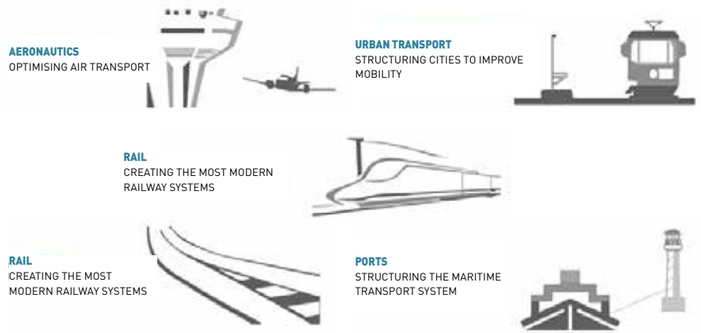

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