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INNOVATION Cityneco: Smart City

+ ARTICLES

Peru, in between the earth and sky Stations for barrier-free travel Lighthouses: A room with a view The Galileo constellation *si muove* Creating a good atmosphere Brand Spain: Camino de Santiago

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According to the most recent report from the DAVOS Economic Forum, Spain is the world's top country in tourism industry competitiveness. 80% of all tourists arrive thanks to our air infrastructures.

That's right:

Spain is the world's top country

ENAIRe =

We are Spain's air navigation service provider



EDITORIAL Cityneco: the smart city

he future is here. Technologies that were unthinkable a few decades ago now make it possible to travel long distances faster, more safely, and with less consumption. We can manage and centralize all of the transport and services of a large city or region, prevent or resolve traffic congestion before it occurs and control communications remotely. We've come a long way, but paradoxically, we're still far from where we want to go. But nothing can be achieved without a society with the capacity for change, commitment and transformation. Nothing without innovation.

Sustainability and innovative technology go hand in hand in modern engineering and are the keys to building a friendlier society. This issue's cover story addresses one of the very latest topical issues that largely represents this demand for progress: the application of information and communication technologies in cities, where more than half of the world's population is already concentrated. Ineco is responding to this challenge decisively through its commitment to ICTs applied to mobility, smart platforms that make it possible to manage integrated data in real time. An example of this process of digital transformation is Cityneco, the platform that will soon go into operation to help provide truly smart management of traffic in the city of Granada.

In the report on air transport in Peru, we cover the vision of the general manager of AdP, concessionaire of the Chiclayo International Airport, a project to which we are contributing our extensive experience in airport expansion. For years, we have also provided technology to serve citizens through cutting-edge projects like the Galileo satellite navigation system, in which we have participated since 2010 and which is covered once again in this issue.

Lastly, we have technology and sustainability in Renfe's Universal Accessibility Plan, on which we are collaborating to improve the Cercanías commuter rail stations; the Faros de España project, for which we also have the interview with the head of the Spanish Marine Aids to Navigation Service of Puertos del Estado and reports on ENAIRE's Flight Plan 2020 and environmental management. We hope our readers will find the contents of this issue interesting and informative.



The future is here, but nothing can be achieved without a society with the capacity for change, commitment and transformation. Nothing without innovation⁹⁹

> ISAAC MARTÍN-BARBERO Chairman of Ineco

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* International article



NEWS | CURRENT EVENTS

from Ineco

SPAIN

REALISTIC BUDGETS **TO FINALIZE** LARGE PROJECTS



The Ministry of Public Works has presented the budget for 2017, increasing the total by 3,336 billion Euros, or 24.2% in comparison with 2016.

The budget, which the Ministry describes as realistic, aims to protect the large projects that are underway, such as the Mediterranean Corridor and the high-speed railway network. In regard to roads, a large part of the budget will be allocated to upkeep and maintenance.

Connections to airports and ports will be improved and investment in air navigation systems and airports will be increased. These budgets are aimed at the real needs of the citizens, to improve the quality of life of the Spanish people and to guarantee the territorial backbone and social cohesion, contributing to economic development and job creation.

CIVIL ENGINEERING WEEK HELD IN MADRID

Last May, under the slogan city, including a floodgate public, such as the control Civil engineering to transform from the Panama Canal in centre of Metro de Madrid, the world, Madrid hosted the fourth Civil Engineering Week (SICMA). Ineco, along with other companies and institutions, sponsored the event, which hosted a wide range of activities such as with accelerometer on engineering in the face of exhibitions, workshops, conferences, etc. These stretch of rail tracks with included a series of volunteer-led guided visits to large engineering works installed in central locations

the Plaza de Colón, several the Torrespacio skyscraper water cycle pieces in the Plaza de Castilla, a tunnel boring machine at the San- round-table discussions tiago Bernabéu stadium, a were also held on various wave-measurement buoy topics, such as civil road the Paseo del Prado, and a sleepers and a rail truck next to the Reina Sofía Mu- by Ineco's chairman, Isaac seum.

distributed throughout the cilities were opened to the Sergio Navarro.

and the EMT Historical Bus Museum. Conferences and climate change, and the internationalization of the sector, with participation Martín-Barbero, and direc-In addition, various fa- tor of Internationalization,

UNITED STATES

7TH WORLD STRATEGIC FORUM

In April, the city of Miami hosted the 7th World Strategic Forum, with Ineco's chairman, Isaac Martín-Barbero (in the photo, second to the right) participating in the presentation of the plenary session on Infrastructure: Engine for Growthand in the round-table discussion Shaping the Agenda for

Sustainable Growth. Politicians and businessmen from around the world attend this forum -organized by a non-profit organization- which fosters dialogue between companies, governments and institutions on the development and evolution of the world economy.



SPAIN INECO TO DEVELOP THE INNOVATION PLAN FOR THE MINISTRY OF PUBLIC WORKS

The Innovation Plan for Transport and Infrastructure aims to achieve greater economic and social profitability of public and private investments in Spain, as well as attract foreign investment.

Ineco's recently-created General Management of Transformation, Internationalization and Innovation will be in charge of preparing the document, which aims to promote the digital economy in Spain. In the words of Íñigo de la Serna, minister of Public Works, "this plan will be a fundamental milestone in the government's commitment to smart technologies."

Boost for BIM at the **5th meeting of the Commission**

The Innovation Plan is in line with the government of Spain's support for the development of BIM, a work methodology that manages the entire life cycle of buildings and infrastructure using computer tools.

The Ministry of Public Works hosted the fifth meeting of the BIM Commission, led by Ineco, which aims to promote the use of BIM, increase awareness of public administrations of the establishment of BIM requirements in infrastructure tenders, set a timetable for adapting the regulations for widespread application of the requirements, develop national standards to allow uniform application, and implement an academic training plan for this methodology in Spain, as well as facilitate its incorporation





In the photo, from left to right: Rosana Navarro, undersecretary of Public Works, Íñigo de la Serna, minister of Public Works, Isaac Martín-Barbero, chairman of Ineco and Jorge Torrico, deputy general manager of BIM.

HUMAN CAPITAL AWARD 2017



Ineco has been awarded the Human Capital Award 2017 in the category of Comprehensive Human Resources Policy in Public Administrations. These awards, given by the consulting firm Wolters Kluwer, are known as the Oscars of Human Resources.

Concern for innovation, talent management, digital transformation and business orientation are some of the characteristics highlighted by the judges, made up of representatives from the top ten Spanish business schools: Comillas, Deusto Business School, EADA, EOI, EAE, Esade, ESIC, IE Business School, IESE and the International Institute of San Telmo. Created in 1997, the Human Capital Awards seek to highlight best practices in people management, foster the professionalization and enhance the management, organization and motivation of people. This award joins the other human re-

into programmes of study. The minister emphasized that the European Union has urged Spain to incorporate this methodology to try to bring about a regulatory change in procurement and tendering processes.

sources awards that the company has received, including Top Recruiter 2016 and the Top Five Employees received between 2008 and 2013. Ineco signed the Global Compact in 2007 and since then has worked to comply with the Ten Principles of the agreement, which include equal opportunities and the reconciliation of work and professional life of its approximately 2,400 employees. These objectives are embodied in various corporate programmes and action plans and are supplemented by ongoing training and social benefits as part of its commitment management policy.

SPAIN

NEW GENERAL MANAGER OF TRANSFORMATION



Eva Pulido Rodríguez has been named Ineco's new general manager of Transformation, Internationalization, and Innovation. She is an economist and a collaborator at the Massachusetts Institute of Technology (MIT) and the Universidad Menéndez Pelayo, through CECO. She previously held the post of deputy manager of Internationalization at the ICEX. Her responsibilities included designing the innovation and internationalization plans for mobility, transport, and infrastructure of the Ministry of Public Works.

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SPAIN DELEGATION FROM ABU DHABI AIRPORTS IN MADRID

Last April a delegation from Abu Dhabi Airports (ADAC) travelled to Spain to visit the Madrid-Barajas airport and Ineco's headquarters in Madrid. The company is conducting the comprehensive project management and supervision of the expansion of Fujairah Airport in the United Arab Emirates.

The works, awarded by ADAC, include the extension of the current runway, a new control tower, a taxiway, an electric substation and a fire-fighting building, as well as new navigation aids. In addition to this work, since 2014, Ineco has been in charge of the start-up (ORAT) of the Midfield Terminal Complex, the new terminal at the Abu Dhabi International Airport.

In the photo, Ineco's the Middle East Account manager, Javier Pérez Diestro, with the members of the delegation.



INTERNATIONAL CONGRESS ON HIGH-SPEED RAIL

From 4 to 6 October 2017, share their knowledge and the High-Speed Rail Con- experience. More than 50 gress will be held in Ciudad Real, organized by the University of Castilla La Man- 35 years since its start in made by Ineco (http://www. cha (UCM) in collaboration Europe, and 25 years since with the Spanish Railways Foundation (FFE), with Ineco in Spain, the Congress proparticipating with several presentations.

on socio-economic aspects, technological changes and impacts on territory and mobility, and will bring to- Association of Civil Engigether experts and stake- neers, and the City Councils holders in high speed to of Seville and Ciudad Real.

years after the start of highspeed rail in Japan in 1964, it was first implemented poses to discuss this railway system that has changed the The Congress will focus concept of mobility itself. In to Seville/Infrastructures of the addition to the FFE, the Congress is also sponsored by Renfe, Adif, the Professional

Ineco dedicated issue number 59 of its magazine to 25 years of high speed in Spain and the contribution revistaitransporte.com/25years-of-high-speed-in-spain/).

Ineco technicians and engineers also participated in the report titled: The AVE 92, broadcast on Saturday 22 of April 2017 at 21h on Canal Sur TV. You can watch it by clicking on the following link https://www.youtube. com/watch?v=db5YFBKZNFE.





INTERNATIONAL

Once again, Ineco was present at the Passenger Terminal Expo, (Amsterdam) and the World ATM Congress (Madrid). Both are important dates for the airport and air navigation sector, respectively.

The Passenger Terminal Expo, which this year celebrated its 20th anniversary, seeks to publicize the latest trends in the airport industry and enhance business relationships between the companies and entities that attend. The World ATM Congress celebrated its 5th edition in Madrid, bringing together the leading suppliers of air navigation services in the world and in the aeronautics industry.



The world's leading airport operator by number of passengers.*



ENAIRE's new strategy

ENAIRE, the manager of air navigation services in Spain, has developed a strategic plan for 2017-2020 that includes an investment of 300 million euros during that period. Traffic is expected to grow 16% over the next four years, which will translate into 2.2 million flights in 2020. The goals of the plan are to increase the system's safety and capacity, improve the quality of services, contribute to environmental sustainability, ensure economic and financial viability, and highlight the work of its professionals.

n 10 May, the minister of Public Works, Íñigo de la Serna, submitted the Air Navigation Plan for 2017-2020, as the culmination of a long and participative process, opening the way to the progressive implementation of the ENAIRE's new strategy. The strategic plan, known in ENAIRE as the Flight Plan 2020, is based on the predicted increase in traffic and the measures to be adopted to manage the expected demand for flights, with adequate capacity, efficiency and quality in regard to its customers and stakeholders.

ROUTE CHARGES WILL DROP 11.5% BETWEEN 2018 AND 2020, REDUCING COSTS FOR AIRLINES BY 184 **MILLION EUROS**

ENAIRE's ambition in its new strategy is "to lead the safe, efficient, quality and sustainable delivery of air navigation services in a competitive global environment, to be valued by customers and society, and depend on people as the main engine driving the company".

To achieve this leadership, the main pillars are a commitment to society in terms of safety and the environment; customer-orientation, with special emphasis on the quality of services; teams committed to a proactive approach and innovation and, as a public business entity, transparency and good governance.

CAPACITY AND EFFICIENCY

ENAIRE wants to respond adequately to the capacity requirements in an environment of increasing demand, while also improving airspace efficiency by helping users to optimise the distance flown.

The plan includes redesigning Spanish airspace to improve en-route operations and redesigning terminal areas, especially in Madrid, Barcelona and Palma, to improve operations in airports.

The Free Route concept (free route in the upper airspace), the flexible use of airspace thanks to civil-military coordination and the implementation of new procedures based on satellite technology will further contribute to the achievement of the capacity and efficiency objectives.

WHERE THE INVESTMENT IS GOING

ENAIRE is Europe's fourth largest supplier in terms of managed flights in its airspace, which is one of the most extensive in Europe, with 2.2 million square kilometres. The Single European Sky framework makes airspace an increasingly global and more competitive environment, and ENAIRE is focusing its investments, 300 million euros over the next four years, on upgrading and modernizing its air navigation system, incorporating research, development and innovation.

Investments (70.1 million euros in 2017, 73.3 million in 2018, 74.8 million in 2019 and 76.0 million euros in 2020) will be made, among many other aspects, in initiatives such as the following:

▶ Evolution of the Automated Air Traffic Control System (SACTA, as its acronym in Spanish) with advanced solutions and a new control position harmonized with the principal European suppliers (iTEC project).

► Modernization of voice communication systems between controllers and pilots, incorporating ground-to-air data links.

▶Upgrading of navigation and surveillance systems: new precision procedures, state-of-the-art radar (Mode S) and satellite technologies (EGNOS, ADS-B).

▶Deployment of a new high-performance data network for information exchange.

HOW WAS THE PLAN CONCEIVED?

The draft of the Flight Plan 2020 was nourished throughout the first quarter of the year by numerous and varied internal and external contributions

► In January, the professionals of ENAIRE participated in a survey on the necessary aspects to be included in the plan. The proposals that most interested ENAIRE employees were the organization and management of people, improvement of internal processes, communication, business development, management of the new company brand, and energy efficiency, among other aspects.

► In February, an updated version of the *Flight* Plan 2020 was presented to project managers, division heads, regional directors, trade union representatives and the Steering Committee.

▶In March, the authorities, clients and stakeholders made their contributions: the General Secretariat of Transport, the General Directorate of Civil Aviation. Aesa, Aena, the State Trade Union Coordinator, Control Convention unions, Aprocta, the airlines and the Air Force.

 Improvement of the maintenance model for infrastructure and air navigation systems.

MORE COMPETITIVE CHARGES

ENAIRE will reduce its route charges by 11.5% between 2018 and 2020 (3.0% in 2018, 4.0% in 2019 and 5.0% in 2020). After 2019, ENAIRE's route charge will be in the lowest of the major European suppliers. The savings for airlines and, therefore, the

improvement of the competitiveness of Spanish air transport, is expected to total 184 million euros.

The minister of Public Works, Iñigo de la Serna, at the presentation of the ENAIRE Flight Plan 2020.









ÁNGEL LUIS ARIAS General manager of ENAIRE.

ENVIRONMENTAL BENEFITS

The following environmental benefits will be achieved thanks to the improved efficiency of the 2017-2020 routes: savings of 5.5 million nautical miles, 60,000 tonnes of fuel and 190,000 tonnes of CO₂. The fuel cost savings in the period will exceed 25 million euros.

IN SPAIN AND IN THE WORLD

ENAIRE provides air traffic services in 22 control towers in Spain's airports, including the 5 airports with the largest traffic volume and in all airports that offer approach control. It has 307 radio aids, 54 surveillance systems, 130 communications centres, 100 REDAN nodes for voice and data. 94 control tower and approach positions, and 118 route positions.

Beyond Spain's borders, ENAIRE is actively involved in international consortiums and satellite navigation (ES-SP) and satellite surveillance (ADS-B) partnerships. It is also part of the Pan-European Digital Communications Service (NewPENS) until 2028, the European **ATM Information Management Service** (EAIMS) until 2030, and has opted for new opportunities in satellite data communications (IRIS) services.



For years, the term 'smart' has been used in all areas of political and industrial discourse more as a statement of intent than a reality, but cities are gradually changing, from cities that are merely connected into cities that are genuinely smart, with Ineco playing an important role in this development.

By Jesús Vázquez Galán, computer engineer

While there are still shortcomings in the communication and dissemination of all the initiatives that have been implemented thus far and all the work that has been done to promote the application of new technologies in the improvement of the efficiency of services, and ultimately, the quality of life of citizens, we are beginning to feel the transformation of our cities. Spain is a pioneer and an international point of reference in the development of smart cities thanks to its National Smart Cities Plan. This plan is based on three fundamental pillars: standardization, gov-

ernance and industry.

The standardization process is centred on the development of the industrial fabric, thanks to the concepts of reuse and interoperability of technological solutions. There are currently 20 UNE standards published within the sphere of Smart Cities, four of them recognised by the ITU as recommendations (Interoperability -ITU-T Y.SSCP, Open data - Y.ODI, Tourist Destinations - Y.STD and Development of Rural Environments - Y.SRC), and more than 20 new standards in progress. Regulatory development concerning smart cities is carried out by the Spanish Association of Standardization (UNE), specifically the Technical Committee for Spanish Standardization on Smart Cities CTN178. of which Ineco is a member. As a result, Spain has developed an important international presence thanks to the strong policy development in this area.

In regard to governance, Spain represents a unique model in the world thanks to the fact that all the agents involved have been part of the development of

ILLISTRATION INFCO

SPAIN IS A PIONEER AND AN INTERNATIONAL POINT OF REFERENCE IN THE DEVELOPMENT OF SMART CITIES THANKS TO ITS NATIONAL SMART CITIES' PLAN

smart cities. From an institutional point of view, there is coordination of the five ministries with competencies associated with smart cities: Ministry of Finance and Civil Service (MINHAFP), Ministry of Public Works (MFOM), Ministry of Energy, Tourism and the Digital Agenda (MINETAD), Ministry of Agriculture and Fisheries, Food and Environment (MAPAMA) and Ministry of Economy, Industry and Competitiveness (MINECO). To represent the cities, the Spanish Network of Smart Cities (RECI), is formed of 82 cities that account for 40% of the total Spanish population. Representing the industry point of view are the AMETIC (Association of Electronics. Information and Communications Technologies, Telecommunications and Digital Content Companies), CONETIC (Spanish Confederation of Information Technology, Communications and Electronics Companies), GICI (Smart Cities Interplatform Working Group) as well as the sector representatives.

Finally, as far as industry is concerned, both consolidated and emerging industries are available. Additionally, in order to speed up adoption on the part of industry, subsidies for smart city initiatives were announced in 2014 (15 million Euros), 2015 (63 million Euros) and for smart islands in 2015 (30 million Euros). Thanks to our National Smart Cities Plan, innovation and development of the industrial fabric have been made possible, providing realistic technological solutions for cities.

In this area, Ineco works with the Secretary of State for the Information Society and Digital Agenda (SESIAD) at the heart of the National Smart Cities' Plan through the coordination of public and private initiatives of smart cities and their modelling and dissemination at national and international levels, contributing its extensive experience in the field of smart cities through an expert team of consultants in information technologies and 'smart products'. In recent years, technological solutions have been implemented for different verticals, especially for the internal management systems of town halls, which often work behind the scenes without citizens being aware them. A vertical could be described as a technological solution aimed at a specific service in a city, such as the management of lighting. These solutions have traditionally been responsible for the control and monitoring of the associated devices.

Other more modern examples include smart car park solutions or traffic optimization solutions, such as the ones developed by Ineco for the mobility vertical in the Cityneco ecosystem, energy efficiency systems, smart irrigation, or measurements of pollutant emissions in the environment vertical, management indicator dashboards, citizen portals and mobile applications for interaction with citizens in the vertical of smart government, and a large variety of products deployed in our cities.

LOCAL INTELLIGENCE SERVING **GLOBAL MOBILITY**

Our cities are beginning to develop true intelligence. Cities such as Santander, Málaga, Madrid, Valencia, Barcelona and Valladolid have made very significant progress, but it is time to make the leap to the next level and this progress will require two concepts: the vision of the city as interconnected objects and interoperability of the city's different platforms.

T p to this point, cities have been viewed from the perspective of the services that city councils provided to the citizens. For this reason, the solutions that have been developed have focused on improving the efficiency of these services. But as the development of smart cities has evolved, it has been noted that urban environments have a number of elements that have their own entity, with their own characteristics and needs, and which, though they are not services that constitute a management vertical, do need to be integrated into the brain of the city that is the city platform.

Some examples are the stations, airports, ports and the smart buildings themselves. These elements have a high level of automation and are becoming increasingly intelligent thanks to the intensive use of ICT, but it is necessary to avoid their isolation within the city.

SMART BUILDINGS

Buildings are the main elements of the city and as such, they represent one of the greatest assets of smart cities. In addition to the increasing automation of the internal operation of buildings, work is also being done with the aim of turning them into some of the most important sensors in the city. Buildings have a lot of valuable information that can contribute to both the city and other buildings in terms of energy consumption, as well as alarms in the field of security, environment or sustainability.

Spain is committed to this comprehensive vision and already has a UNE standard for smart buildings. Also, work is being carried out with the industry to define a device to allow all the relevant information to be collected and transmitted to the city in a comprehensive manner.

SMART STATIONS AND AIRPORTS

Analysing smart stations in a similar manner to buildings, we find that they must manage their facilities properly in regard to maintenance and security,

as well as in regard to their commercial aspects, exploiting the characteristics of digital marketing and providing travellers with a user experience that makes them feel unique. But communication between the station and the city is essential in order to exchange the information that they both need.

Stations, like ports and airports, constitute a point of entry and, in that sense, are the traveller's first point of contact with the city. For this reason, they must provide relevant information about the



INECO AT THE SMART CITY EXPO WORLD CONGRESS Ineco's IT team at the Smart City Expo World Congress/16 in Barcelona. From left to right: Francisco Javier Carvajal, Eloy Cámara, Ignacio Martínez, deputy director of IT, and Jesús Vázquez, alongside them, Ana Olmeda and Natalia Díaz, Knowledge Management manager.

city, so that it can optimize its resources and services in different areas: public transport, mobility, security or tourism.

The use of information by the city, which is aggregated in order to avoid privacy issues, such as the number of travellers expected within a certain time range, can be made available to private

CITYNECO PREDICTS **FUTURE TRAFFIC** CONDITIONS FACILITATING OPTIMIZATION OF MOBILITY PARAMETERS VIRTUALLY IN REAL TIME

agents through a city's Open Data portals, allowing the development of new business models that improve the range services offered to users, for example, in the tourism sector.

SMART PORTS

In the case of the analysis of the ports, and to provide a more comprehensive view, we will focus our comments on the area of freight transport. In addition to being the point of arrival of travellers, ports constitute a point of entry of goods to the city. The predicted information regarding the arrival of these goods, as well as their characteristics, is of great value, allowing the city to adapt, taking into account logistical and security aspects based on the volume and types of goods.

infrastructure.



CITYNECO, A SMART PLATFORM

Cityneco is the smart platform developed by Ineco to integrate the different verticals in cities.

The platform makes it possible to connect the city's different sensors thanks to its IoT (Internet of Things) module, and in turn it can also integrate and process multiple sources of information, from social networks to video images.

► The platform is fully scalable and interoperable thanks to its layered structure, fully compliant with the standardization proposal in the standard. There is also a version that is offered in the form of Software as a Service (SaaS) that allows the development of mediumsized cities, making use of the platform without requiring the city to have its own

► With respect to the use of information, the platform can display dashboards based on real-time information as well as management indicators.

►Within the mobility vertical, Ineco's solution presents highly innovative features that set it apart from the other solutions available on the market. The platform monitors traffic thanks to the information that it receives from the non-conventional traffic detectors and sensors. The platform then processes the information, taking advantage of the integration with the simulation models, as well as the use of machine learning techniques (artificial intelligence). This makes it possible to predict future traffic conditions, facilitating optimization of mobility parameters virtually in real time. On the other hand, together with the information from the sensors, the platform's features allow information from mobile data, GPS and even social networks to be analysed, enriching the information on the status of mobility in the city.

►Ineco has signed a collaboration agreement with the city of Granada and is in the process of implementing the Cityneco platform, in order to allow the city to test the capabilities of the Ineco smart platform as well as the mobility vertical.

THE IMPORTANCE **OF INTEROPERABILITY**

All the objectives discussed so far for the elements of cities would be impossible without city platforms. It is in these platforms where the magic of transforming information into knowledge takes place. They allow information to be exchanged between the different services of a city and this combination generates significant added value.

e understand interoperability in different ways. First, cities must be able to evolve and change their platforms over time, if they want to, without affecting the other elements involved. Furthermore, this change may be a comprehensive change of the entire platform or may affect only one part of it.

The second concept of interoperability is centred on the fact that different platforms must be able to communicate with each other; station and airport platforms will need to talk to the city, and the platforms in different cities will in turn also need to talk to each other to exchange information.

The third concept of interoperability focuses on the business models that will be built on the city's platforms. Private agents are developing new business models, such as smart parking applications or tourist destinations, and there must be some assurance that the investment made to develop a product for a city will be recovered, with the possibility of implementing the same product in other cities.

To demonstrate the high degree of interoperability of Spanish platforms, SESIAD and Ineco are working on the implementation of virtual laboratories that allow the functional validation of the different solutions developed for smart cities. These laboratories, in turn, make it possible to verify the portability

of solutions between different platforms. Smart city platforms have currently been implemented in cities such as Málaga, Valencia or Barcelona, but they are not the only ones that have already taken the step.

For these reasons, Spain is a pioneer in the interoperability of smart city platforms. There is a UNE interoperability standard (UNE 178104) that has been proposed as an international standard through the ITU (International Telecommunication Union). Ineco has collaborated since the early stages as a member of the subcommittee that developed the standard, through to its international deployment, providing technical support to SESIAD. Cityneco complies with this standard, so it is completely interoperable.

Regarding all of the above, we can say that the interoperability of these platforms is vital to the development of both Spanish cities and Spanish industry. It is important to remember that our platforms can be exported to other countries.

THE NATIONAL PLATFORM

One thing to keep in mind is that the development of smart cities can lead to increased inequalities among cities, and one of the fundamental factors arising from this is the attraction and capturing of talent. The cities that are undergoing the greatest development in the field of smart cities are generating a pull effect



In these cases, it may make sense to services they provide to their citizens.

AERONAUTICAL | PERU

Airport expansion and modernization

Peru, in between the earth and sky

WORK PLANNED FOR THE CHICLAYO AIRPORT

• Runway and taxiways: extension of runway 19, widening of the runway strip to 150 meters on each side of the runway axis, shifting of both ends of the runway to the north, upgrading of the Instrument Landing System (ILS) and extension of the taxiways parallel to the runway, in both the military and civilian zones.

• Aprons: commercial terminal apron with seven parking stands for type C aircraft, four for type-E cargo aircraft, and seven for type-B general aviation aircraft and three helipads.

 New terminal building covering a total area of 41,000 m², 10 check-in counters, six security checkpoints in departures and five immigration checkpoints in arrivals; seven boarding lounges and four boarding bridges per contact; four baggage claim rooms and three customs control areas.

• Car parking: 476 spaces, including public parking, overnight parking and staff parking and 45 spaces for rental vehicles.

• New accesses to terminal buildings.

• New CORPAC facilities: 27-metre control tower. administration building, AIS/ ARO offices, power station, meteorological garden and antenna field.

• New category 9 Fire Extinguishing Services.

• New fuel plant.

• Cargo: new terminal with cold storage area with 1,800 m² and 3,600 m² of warehouse storage.

• Two handling buildings. • Hangars: one maintenance hangar for type-C aircraft and three hangars for general aviation

• Sanitation area: with treatment and sterilization units for hazardous waste, trash collection and waste water treatment

• Service area and police station



By Roberto Serrano, aeronautical engineer

n 2015, a total of 20.1 million passengers departed and arrived on domestic flights in Peru, an 11% increase from 2014, according to data from OSITRAN, Peru's public transportation infrastructure regulator. In terms of international flights, there were 6.3 million passengers, a 6.5% increase. In addition, more than 329.000 tons of cargo, including 270.000 tons of international cargo was moved. Despite the fact that this was slightly less than 2014, the trend for the last 10 years is clearly upward.

In response to this continuous increase in demand, the country's main airports, which are managed through concessions, have undertaken expansion and modernization processes. The Peruvian government began the airport concession process in 2000, entrusting the execution of the work to new managers under public supervision. Ineco, in a consortium with the Peruvian engineering firm CESEL, is currently involved in the expansion projects for two airports: the main international airport, the Jorge Chávez Airport in Lima, which was awarded to Lima Airport Partners (LAP) in 2001 (see IT53), and the Chiclayo Airport, in the north. The Chiclayo Airport is managed by Aeropuertos del Perú (AdP), which was granted the concession in 2006 as part of a package that also included the airfields in Anta, Cajamarca, Chachapoyas, Iquitos, Pisco, Piura, Pucallpa, Talara, Tarapoto, Truiillo and Tumbes (see IT58).

AEROPUERTOS DEL PERÚ (ADP) HAS CONTRACTED INFCO AND CESEL TO CARRY OUT THE PREINVESTMENT (PROFILE AND FEASIBILITY) STUDIES OF THE CHICLAYO AIRPORT

In 2011, the second package, of six airports, was awarded to another company, Aeropuertos Andinos del Perú, S.A., followed by the concession for the new Chinchero airport, to the Sociedad Aeroportuaria Kuntur Wasi S.A., in 2014. Lastly, the concession for the third group (Jauja, Huánuco and Jaén), is expected to be awarded soon, according to the Ministry of Transport and Communications.

THE EXPANSION

OF THE CHICLAYO AIRPORT Aeropuertos del Perú (AdP) has contracted Ineco to prepare the Profile Level Preinvestment and Feasibility Studies for the upgrade project of the FAP José Abelardo Quiñones Gonzales de Chiclayo International Airport (see IT58). On 09/01/17, it received approval for the 'Profile Level' preinvestment document from the Ministry of Transportation and Communications of Peru. The goal is to increase the airport's capacity from 451,000 passengers in 2014 to 2.6 million in 2038.



The continuous growth of air traffic in the Andean country has led to a process to expand and upgrade its airports, with Ineco participating in this work as part of a consortium with the Peruvian engineering firm, CESEL, with the projects to expand the airports in Lima and Chiclayo.

TOURISM AND EXPORTS

The key to the expansion of air transportation in Peru is the positive evolution of the economy, which, according to the International Monetary Fund, has the lowest average inflation in Latin America. with annual GDP growth of 5% for the last 15 years. Tourism and agribusiness are the sectors that most affect the increase in the demand for air transport, with exports of products such as asparagus, quinoa, grapes and, more recently, blueberries, increasing at a rate of between 18 and 20% per year and already representing the second largest source of revenue.

As these are perishable products, air is the method of transport that is in the greatest demand, which in turn requires airports to have adequate facilities for this type of cargo.

At the same time, tourism has started to increase at a healthy pace in recent years. In 2015, Peru rose to 58th (out of a total of 141 countries) in the World Economic Forum's Travel and Tourism Competitiveness Ranking, 15 higher than in the previous ranking just two years earlier. In 2015, the number of international tourists increased 7.5%, up to 3.5 million, according to the country's Ministry of Commerce and Tourism (MINCETUR), 60% of the visitors arrived by plane, according to figures from IATA, the world airline association. Tourists are attracted by the country's natural, archaeological and cultural wealth, with 12 UNESCO World Heritage sites, along with other attractions, as well as its gastronomy, which 40% of the total visitors cite as a reason for travelling.

EVANS AVENDAÑO TAPIA •Connectivity will be improved and agribusiness will be strengthened in northern Peru*

Since 2013, Evans Avendaño has headed Aeropuertos del Perú (AdP), which manages the concession of 12 of the country's regional airports. These include, the José Abelardo Quiñones airport in the city of Chiclayo, which is responding to the challenge to become a hub for the growth of international air traffic in northern Peru. Ineco is carrying out the pre-feasibility studies for its expansion.



A MANAGER FOR CHANGE

His degrees include a Master's in Economics and Master's in Finance from the University of the Pacific in Peru, a Master's in Economics from ILADES/Georgetown University and an MBA from the Universidad Católica in Chile.

What's your assessment of the current progress of the expansion work?

We believe that the solution implemented thus far meets all the needs and facilities required by an airport of this size. Not only because of the potential in terms of passenger traffic, but also in all aspects related to the potential cargo

that could be carried by this infrastructure.

What technical aspects of the project are most remarkable or unique?

One of the most important technical aspects is the expansion of the runway and the development of an entire

"The new cargo area is a distinctive feature of the project, and will provide the opportunity to decentralize operations⁹⁹

area dedicated to cargo, from the accesses to the platform Currently, we are not only looking for new international conto the development of the cargo terminal itself. This is an nections, but are also strengthening Copa's existing operaimportant element that sets us apart, since there is currently no such infrastructure.

What impact will the modernization of the airport have on the tourist and industrial activity of the Lambayeque region, and the country in general?

The impact revolves around two concepts: connectivity and airports to the Jorge Chávez Airport in Lima. What decentralization, not only in terms of passengers, but in might change in that relationship once the expansion is all aspects related to cargo. Chiclayo is located in northern completed? Peru, equidistant from important cities such as Piura and Indeed, Chiclayo is currently an alternative airport, but in Trujillo. This has made it an important centre of commercial the technical-operational area. The new airport would make activity. It is also the main point of land connectivity with Chiclayo an alternative airport on a commercial scale, not the mountains and jungles in the northeastern part of the only capturing international connectivity, but also decencountry. This creates the potential for the Chiclayo airport tralizing cargo. to become a regional hub for air connectivity. However, it has potential for connectivity not only in terms of domestic "Chiclayo's future growth passengers, but also in regard to all aspects related to interwill be based on the development national connections, because up until less than six months ago, the only international connection was through Lima. of regional aviation, as well as For a little more than six months, Copa has been connecting on the development of the north internationally, decentralizing the international international connectivity, connectivity of Lima.

In terms of cargo, the north is one of the country's main agro-industrial zones, with important agricultural projects that will increase the availability of land for future agribusi-What do you see, taking stock of the concession after a ness development, with products such as blueberries and decade? asparagus exported by air. This will also generate a positive With the initial investments now completed, in the last impact by placing a cargo terminal at the point of production for the export of these products.

•In the last ten years, we have obtained annual growth rates of 16% for passengers and 10% for operational areas?

How do you think passenger traffic will evolve in Chiclayo? And cargo traffic?

Pisco's experience has contributed to the improvement of the designs associated with the flow of passengers, not only in For the last ten years, the annual passenger traffic in Chiterms of operations and safety, but also from a commercial clayo has grown 16%, but this has been supported by a single perspective. The access routes to the airport terminal are route: Chiclayo-Lima. The future of Chiclayo's growth will also a key element for its development.

be based on the development of regional aviation, as well as the development of international connectivity.

For a few months now, Chiclayo has handled

international flights, specifically flights by Copa Airlines to Panama. What plans are there for the opening of new connections, and what impact do you think they will have on the airport's security?

tions. Regarding regional connections, one of the important destinations with potential for future development is the Chiclavo-Chachapovas route because of the tourist attractions it offers.

Chiclayo already operates as one of the alternative

ten years, we have obtained annual growth of 16% for passengers and 10% for operations. We have expanded and incorporated new routes throughout the 12 regional airports that we manage. We have reduced the co-financing granted by the government of Peru by 70%, and we have developed Master Plans to invest close to 1 billion USD in the expansion and modernisation of our terminals for the next five years.

The remodelling of the Pisco airport began in 2015. What do you think this experience can bring to the modernization of the Chiclayo airport?

Stations for barrier-free travel

Improving mobility for those who have difficulties is a reflection of developed societies with a keen sense of social justice. In Spain, equal access to public transport has been acknowledged as basic right, and companies like Renfe have been working for years to achieve this goal. One example of this is the improvement of accessibility in the Cercanías stations in Andalusia, a project on which Ineco has collaborated for years.

By Aránzazu Azcárraga, M^a del Mar Armenteros and Amparo Baena, architects and Francisco R. Montón, civil engineer, director of works

Reduced mobility may be permanent or temporary, and it affects a broad spectrum of the population. This may include wheelchair users, people carrying large or heavy packages, people who are blind or deaf, as well as the elderly, pregnant women, parents with children in strollers, or people who have other physical difficulties to move normally. When using public transportation, their quality of life can be greatly affected if the infrastructure and adequate means to overcome barriers is not available. For this reason, the European Community and Spain both

have laws that regulate the basic conditions of accessibility and non-discrimination in the access and use of means of transportation by people with disabilities.

In the case of Spain's public transportation services, both the Ministry of Public Works and Transport and the public companies Aena, Adif and Renfe have spent years designing and improving transportation systems so that people with disabilities or reduced mobility can access and use them safely and comfortably. As part of this effort, in 2007, Renfe Operadora created Atendo, a free service to provide assistance to passengers with disabilities or reduced mobility. Atendo is a cutting-edge initiative in Europe and currently serves more than 120 railway stations. At the same time, in 2007, the company launched a Universal Accessibility Plan, which was extended and improved in 2010 and includes the adaptation of stations and trains. and architecture teams, in the project phase, and the construction management team, have been working on conditioning and adapting mobility in more than 150 Cercanías stations since the start of this century. In order to ensure the improvement of station accessibility, Ineco has drawn up execution projects for each station

which was extended and improved in 2010 and includes the adaptation of stations and trains.
Ineco, as an engineering and public consultancy company, has extensive experience in the remodelling and modernization of railway stations and airport terminals, in which the accessibility is one of the key criteria. Both the engineering
In order to ensure the improvement of station accessibility is one of the key criteria. Both the engineering
In order to ensure the improvement of station accessibility is one of the key criteria. Both the engineering

EXPERIENCE IN ACCESSIBILITY

Ineco, as an engineering and public consultancy company, has extensive experience in the remodelling and modernization of railway stations and airport terminals, in which the accessibility is one of the keycriteria.





WHAT SHOULD AN ACCESSIBLE **STATION LOOK LIKE?**

▶ Articles 9.2, 10, 14 and 49 of the Spanish Constitution establish the principles of freedom, equality, participation and care for people with disabilities, ensuring minimum levels that extend to the entire country. Subsequently, Act 51/2003, dated 2 December, on equality of opportunity, non-discrimination and universal accessibility of people with disabilities, was enacted. Years later, and for the transportation sector, in addition to the European legislation in the field of technical specifications for interoperability (TSIS), Royal Decree 1544/2007, of 23 November, regulated the basic conditions of accessibility and non-discrimination for access to and use of, the modes of transport for people with disabilities. This decree stipulates that stations must follow general concepts of compliance with accessibility throughout the entire travel service for passengers in railway stations, from parking until they board the train. This adapted service must connect essential points of the station: ticket sales, information, toilets, cafeteria and platforms.

This involves the following actions throughout the service:

1. Minimum geometry to be respected in terms of width and height clearance of obstructions, maximum slopes on ramps, maximum heights of stairs and lift sizes. 2. Minimum conditions of non-slip flooring and the incorporation of tactile route guidance in floors.

3. At least one of the sales, information and customer service counters, toilets, vending machines and other interactive elements, such as public telephone booths, must be equipped with the necessary equipment for the correct service provided, from its geometry to the specific installations of visual and auditory support.

4. Information must be provided visually and audibly, in such a way that the information can be easily understood by people with disabilities (including magnetic loops in public address systems or Braille information on handrails, keypads and signage).

5. The platform edges must comply with the geometry and distances to the trains prescribed in the standard and must be equipped with the corresponding edge pieces, podotactile strips and photoluminescent strips.

IMPROVEMENT OF SIX COMMUTER **RAIL STATIONS IN ANDALUSIA**

Many Spanish stations are more than 80 years old and, although they have undergone constant improvements, their facilities need to be updated to conform to current regulations. In general, the scope of these actions includes the installation of lifts connecting to walkways under or over tracks to link the platforms to each other or to the other areas of the station, the adaptation of stairs to the width and number of flights established in the standard, improvements in lighting, in-

1. LOS BOLICHES STATION

The Los Boliches station forms part of the C-1 line in Málaga's commuter rail network, and it serves approximately 1,928 passengers per day.

The works carried out at this station have resolved the main problem: to allow accessibility for people with reduced mobility by installing a lift and improving access using stairs and a ramp.

The actions consisted of the installation of a panoramic lift; modification



cluding routing elements in flooring, changing flooring to comply with nonslip requirements, raising platforms or adapting the height of the edge of the platform, and the addition of signal bands and platform edge pieces, in accordance with the Royal Decree.

This report showcases the work and projects currently being carried out as part of the Renfe Station Plan in six Cercanías railway stations in the provinces of Seville and Málaga.



of the arrangement of stairs and ramps; widening the access walkway to the platform; replacement of flooring and railings; raising of the platform above the level of the track; adaptation of edges in accordance with Adif regulations regarding the installation of podotactile flooring and signalling bands; modification of the shelter and reinforcement of its lighting to comply with current regulations, and replacement of the lighting system with LEDs.





2. LORA DEL RÍO STATION

The Lora del Río station forms part of the C-1 line in Seville's commuter rail network, and it serves approximately 2,466 passengers per day.

The works at this station provided a solution to the existing accessibility limitations, adjusting the edges of platforms and installing lifts in the underpass, as well as raising the height of 31 metres of platform 2 in the direction of Córdoba, and extending platform 1, also approximately 31 metres long, in the same direction, giving both platforms a total length of 200 metres. Platforms 2 and 3 were also equipped with a shelter, over the stairs and as far as the lift access. The platform lighting was strengthened and replaced with an LED lighting system.

the underpass.



Another important addition was the installation of three new panoramic lifts that allow the movements of all passengers to the different platforms through

3. VIRGEN DEL ROCÍO STATION

The Virgen del Rocío station forms part of the C-1, C-4 and C-5 lines of Seville's commuter rail network. It serves approximately 6,758 passengers per day and is located in front of the Virgen del Rocío University Hospital in Seville.

The main actions at the station focused on inserting two lifts to allow accessibility between the lobby and the two platforms. The lifts were installed in this location due to the need to give priority to adequate functional distribution in the lobby as well as on the platforms. On the main platform, platform 2, the structure and layout of the ramp were modified to accommodate the lift. On platform 1. a panoramic lift was installed adjacent to the building, in the platform access area, and occupying part of the embankment.

In addition to the installation of lifts, a series of actions were carried out on the lobby, underpass and platforms to improve accessibility and appearance.



These included the relocation of the existing ticket office in the commercial space, currently unused, allowing the rest of the commercial space to be used as an entrance lobby area, the installation of podotactile route indicator and the arrangement of turnstiles in a single set located in the lobby. Over the course of the project, a Customer Service area, separate from the lobby, was also implemented before the turnstile area, facilitating adequate provision of passenger services.





4. FUENGIROLA STATION

The Fuengirola station forms part of the C-1 line, which covers the route between that station and Málaga-Centro Alameda. The Fuengirola and Los Boliches stations are the two stations in the municipality that provide this commuter rail service.

With the works carried out at the Fuengirola station corrected its accessibility and lighting shortcomings. The main action consisted of adapting the central platform and lighting. To do this,

both sides of the edge of the platforms on track 1 and track 2 were trimmed by between 5 and 15 cm to adapt them to the train's clearance and the new piece of platform edge that was installed, along with the podotactile strip and yellow safety strip, in accordance with current accessibility regulations.

Floor routing was installed, along with signs for stairs and platform lifts on platforms and in the lobby. In addition, lighting, which is required from the street level to the platform, was strengthened.

5. BELLAVISTA STATION

The Bellavista station forms part of C-1 line in Seville's commuter rail network (Lebrija-Utrera-Sevilla-Lora del Río), the network's longest line along with C-3, and one that receives the most passengers, with an approximate demand of 1,683 per day. It is located on the edge of the city, where the railway line marks the division between urban and agricultural land.

The works solved the station's main problem, which was to allow accessibility by people with reduced mobility by installing lifts. In addition, a series of actions were carried out on the underpass and the platforms to improve accessibility: installation of podotactile routing in the underpass; flooring to signal the location of lifts and stairs; and the replacement of the lighting system in the underpass with one with anti-glare LED technology. The works on the platforms involved the demolition and construction of new platform edges, following the guidelines for the improvement of accessibility to the railways stipulated in RD 1544/2007 and the Adif Accessibility Technical Manual.







6. BENALMÁDENA STATION

The Benalmádena station is located at KM 19.6 on the of the Málaga-Fuengirola Iberian-gauge railway line and forms part of the C-1 Line of the Málaga commuter rail network.

On platform 1 of the Benalmádena station, the markings of the platform edge had to be adapted. Two carborundum strips (silicon carbide) were constructed in situ on the existing platform edge, in addition to the with the installation of a 60-cm podotactile piece and the yellow approach strip.

The main work was done on platform 2, raising the height of the entire length of the train platform (80 metres in total) to 68 cm above top of the rail and installing a new platform edge in accordance with the regulations. The platform was raised by constructing a rough brick wall and a new reinforced concrete floor, with the new edge piece

installed on top, with a new 60-cm podotactile strip made of button tile, and the yellow warning strip. The new platform flooring was made of polished concrete.



Detailed view of the platform of the Benalmadena Station.

In the lobby, route indicators were

installed from the entrance door of the building to the passenger building, to the lifts and stairs that connect to the platforms, installing new signal flooring on them. The lighting on both platforms was renovated.



PORTS | SPAIN 'Faros de España' project

MORE THAN JUST LIGHTHOUSES

In 2014, the Ministry of Public Works, through Puertos del Estado and port authorities, launched the Faros de España project. This initiative takes advantage of the spaces left unoccupied in lighthouses as a result of automation, while the lighthouses continue to provide service. The photo shows the Cabo Vilán lighthouse in Camariñas (A Coruña), which has a 62 m² exhibit hall that is also available for events, an interpretation centre, a café, and a tourist information point

A hotel, restaurant, art gallery, interpretation centre, etc. In addition to aiding maritime navigation, more and more lighthouses are also being used for other additional activities. Aware of their exceptional location and the significant tourist interest that they generate, Puertos del Estado has launched an the public into closer contact with their and inventory of the lighthouses, in identifies the location as well as the uses and availability of each lighthouse.

initiative to promote lighthouses and bring use. Ineco collaborated on the cataloguing addition to launching of the website, which

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n addition to installations that form part of the maritime signalling system to provide assistance to sailors, Spanish lighthouses are also architectural constructions with great historic, technical and scenic value. Because they are located in areas that are remote and in some cases difficult to access, support buildings were originally built alongside them to provide the necessary maintenance, ranging from the lodgings of the lighthouse keepers -who today are called navigation assistance system technicians- to the storage, electrical and other buildings. The tourist interest generated by the lighthouses led to the creation of the Faros de España project in 2014, an initiative of the Ministry of Public Works, implemented through Puertos del Estado and

A room with a view

With the collaboration of civil engineer Enrique Herrero, architect Raquel Manglanos, and computer engineers Miguel Ángel Ponce and Alfredo R. Langa, and agricultural engineer Alberto Milanés

port authorities, with the goal of making the lighthouses "something more than lighthouses". The project aims to develop of the spaces that are no longer required for the service, in order to enhance the different activities of maritime signalling, including their use as hotels. In short, it is a question of promoting the development of cultural and social interest, enriching the tourist offerings in different areas and ensuring the sustainable conservation of lighthouses in a way that is respectful to the environment, without affecting their navigational assistance functions.

Although the Faros de España initiative includes developments other than hotel services, special focus has been placed on encouraging and promoting tourist

THE IDEA IS TO REUSE THE LODGINGS OF THE OLD LIGHTHOUSE **KEEPERS, FOR THEIR** ORIGINAL PURPOSE ACCOMMODATION, **BUT THIS TIME** FOR TOURISTS

accommodation, reusing the lodgings of the old lighthouse keepers. The project, which was carried out in 2015 and 2016 and for which Ineco provided technical assistance, seeks to promote the supplementary uses of lighthouses, using the spaces that are no longer necessary for the operation and maintenance of the lighthouse.

The idea is not to convert lighthouses into hotels, since they are still required to provide navigational aid. The idea is to reuse the lodgings of the old lighthouse keepers, for their original purpose, accommodation, but this time search centres, and 7 others have cafés for tourists.

There is already one lighthouse that is currently used as a hotel (the 187 LIGHTHOUSES Isla Pancha lighthouse, Lugo), and others, such as the lighthouses at Trafalgar (Cádiz), Cudillero (Asturias) and Punta Cumplida (Santa Cruz de Tenerife), are on track to become hotels. Furthermore, the process has already begun with the Pescador lighthouse (Cantabria) which is having its urban development frame-



work adapted, the Málaga lighthouse (Málaga), and the lighthouses of Higer, Santa Clara and Punta de Senokozulúa (Guipúzcoa).

With regard to other types of uses, 28 lighthouses have art and exhibition centres, 12 operate as cultural and training centres, 5 host activities such as reand restaurants.

AND ONE WEB PLATFORM

One fundamental part of the work performed by Ineco consisted of producing an inventory of 187 lighthouses that are currently managed by the port authorities. Each one has different characteristics in terms of facilities, location, access, urban and architectural features

of the buildings, as well as their administrative situation (some being subject to concessions) and the environmental sensitivity inherent to their location, making the collection and homogenization of this information a vital task to make it available to prospective future developers. The included information covers the legal situation, land ownership, easements, state buildings, uses and facilities. etc.

This exhaustive analysis culminated with the creation of a database that has been used as an initial step to launching the new website www.lighthousesofspain. es. Ineco developed the website, which increases exposure to the initiative and is the platform to host the inventory. The website aims to increase awareness of the project, give details of the lighthous-





requests to develop activities other than the activity of maritime signalling in the lighthouses. The activity is always developed through an administrative concession, for a period of years, in accordance with the existing legal framework and a business plan. In general, in addition to adapting the spaces, the developer must also renovate or consolidate the facilities based on their current state of conservation. The public concession is always be granted by the port authority to which the unit is attached.



OTHER LIGHTHOUSES 1 The Cabo de San Antonio lighthouse, in Jávea (Alicante). 2 The Cabo Trafalgar lighthouse, in Barbate (Cádiz). PHOTO IAVIER GUTIÉRREZ (FLICKR) 3 The Peñíscola lighthouse, in Castellón. PHOTO_AURELIANO (FLICKR)

GLIMPSES OF THE HISTORY OF THE SEA

► The beauty of the landscape of Spain's many capes and the history and originality of the lighthouses located on them, make these sites first-rate tourist destinations. The oldest is the Tower of Hercules, built on a hill on the coast of Galicia, which is thought to be 3,000 years old. The Welsh, Irish and Scottish all retain legends related to this lighthouse. It is generally accepted that it was built in the second century AD under Emperor Trajan.

► On the northern coast of the Iberian peninsula is the Peñas lighthouse, the first lighthouse built on the Asturian coast, perched on dangerous cliffs over 100 metres high. In addition to its magnificent views, history plays an important role in the Trafalgar lighthouse, to the south of the peninsula, surrounded by dunes and in the middle of the Bay of Cádiz. since it was there that the famous battle between Nelson's British fleet and the Villeneuve's Franco-Spanish fleet took place on 21 of October 1801.

► On the island of Alborán living conditions in its imposing lighthouse were not easy (1876). Isolated and built 14 metres above sea level, the life of the lighthouse keeper was the worst on the peninsula because of the isolation and scarcity of provisions. These days it is home to the scientific base of the Alborán Maritime Reserve. Also on a small island is the Alcanada lighthouse (1861) in Balearic Islands, whose last lighthouse keeper departed in 1960. The Calella lighthouse was built a few years earlier (1859, Barcelona). It dominates a wide panoramic view of the beach and the city of Calella, whose city council uses it as an exhibition hall. The Isla Pancha lighthouse stands out for the beauty of its location and it will be the first to be converted into a hotel, located on a small island connected to the mainland by a bridge, a similar location to that of the Isla Tapia lighthouse (1859) in Avilés, Asturias.

▶ Browsing the Faros de España website takes us to the ends of the earth, to the remote points of the landía and La Entallada lighthouses located on the island of Fuerteventura. The Entallada lighthouse is located on a 200-metre high cliff, at the closest point to Africa in the Canary Islands (100 kilometres away). It offers spectacular views, of sea and also of the Cuchillos de Vigán Natural Monument, a protected area of significant scientific interest.

INECO DEVELOPED THE WEBSITE, WHICH INCREASES EXPOSURE TO THE INITIATIVE AND PROVIDES THE PLATFORM TO HOST THE INVENTORY



JUAN-FRANCISCO REBOLLO

^{••}It is vital that we all work to ensure the conservation of the historical legacy of the lighthouses[•]

Born in Alcalá de Henares (1953), Juan-Francisco Rebollo has a Bachelor's Degree in Physical Sciences and a Master's Degree in Port Management and Intermodal Transport. He is currently the Head of the Spanish Marine Aids to Navigation Service of Puertos del Estado, under the Ministry of Public Works, and during the period 2014-2018 he is the President of the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA).

Is the future of lighthouses at risk?

Not at all. As a aid to navigation, they continue to serve as a unique point of reference for a large number of smaller vessels, as well as a verification point, and when necessary, a backup for electronic positioning systems.

Obviously, they are not as crucial as they were years ago, but advances in lighting technology and control, reducing consumption and monitoring their operation, make it viable to keep the lighthouse in service, and more efficiently than before.

With regard to the buildings that are not in use, normally the homes of the former lighthouse keepers, it is vital to create initiatives that ensure their conservation, and in many cases their refurbishment.

Have any new lighthouses been built in Spain?

The last one was put into service at the end of 1999, the Torredembarra lighthouse, which is attached to the Tarragona Port Authority. However, in the Canary Islands there are some lighthouses still to be built, as a result of the last review of the coastal

"I see no significant risk in opening up the lighthouses to the community, but there is a risk in inaction, such as vandalism or the degradation of the facilities" networks, and these have already been included, in one way or another, in the General Maritime Signalling Plan, 1985.

However, to answer your question, yes. Due to the expansion of the Port of Valencia, the Valencia lighthouse has beer replaced by a new one, made of *composite* (composite resin), of the new breakwater, with an LED optical system and hybris solar-wind power, designed to operate using clean energy.

What will the lighthouses of the future be like?

Understanding a lighthouse as a maritime light signal suppl mented by the landmark represented by the tower during th day, I don't believe that they will change much from the class image, although glass lenses and incandescent lamps will r longer be used. The lighthouses of the future, and already the present, will be supplemented with the broadcasting electronic information, using, for example, Automatic Ident fication System (AIS) technology.

It is important to remember that lighthouses are techn cal installations designed to provide a service, which will us the technology available at any given time, and which the us ers are capable of "seeing", either directly or with the help of instruments.

Similar initiatives are being successfully developed in nearby countries such as the United Kingdom, Ireland, Norway or, recently, Italy, with a new project for more than 50 lighthouses

Many lighthouses are over one hundred years old, is modern technology compatible with their design? Most are more than 150 years old. They date back to the first Maritime Signalling Plan of 1847, which marks its 170th ann versary this year. We just celebrated the 175th anniversary of the first session of the Spanish Lighthouse Commission (22 Februar 1842), which was created on 4 February of that year.

Their design is simple and that simplicity guarantees is validity. It involves placing a light at a certain height (depending on the height of the land) so that it can be seen by sailor from a distance of between 10-20 nautical miles. The tower the support and the lantern is the glassed space that protect the lens system (lamp and lens). The new lamp technolog does have to adapt to the requirements of large glass optic but it is possible, and desirable, to maintain the existing optic elements and upgrade the lamp to the technology availabl In most cases it is simple and inexpensive.

Are there still lighthouse keepers? What role do they play these days?

It's not the case for lighthouse keepers, but there are lighthouses that are inhabited by a technician who is not exclusively dedicated to the maintenance of the lighthouse, but is also responsible for monitoring other aids to navigation in the vicinity, as well as inspecting third-party aids in the

01	"The lighthouses of the
n-	future will be supplemented
en	with electronic information
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id	broadcasting, using, for example,
	Automatic Identification
	System technology ⁹⁹
~	-)8)
he he	area. They are not civil servants: they belong to the staff of
sic	the port authority.
10	
in	How will the commercialization of these spaces contribute to
of	their conservation?
ti-	The existence of unused spaces creates two major problems: on
	the one hand, degradation in the harsh environment, and on the
11-	other, the risk of vandalism. Therefore, since it is not necessary
se	for technicians to be present at all times in the lighthouses, the
of	native to conserve them through the vital renovations required
01	to develop new uses.
	On the other hand, the income generated by these uses, which
	will never be significant in the port sector, will be a supplement
	to the revenues collected from the aid to navigation service fee
	and will allow the quality of the aid to navigation service, which
	will always be the goal of the lighthouses, to be improved.
	What are the risks and advantages?
	I think the advantages have already been discussed in the previ-
	ous questions, in addition to the fact that opening these light-
	house spaces, which are currently closed, to society in general,
	would maintain their function and exterior architecture, as a
	reflection of their historical legacy, which, among other things,
	has to be conserved.
	I don't see any significant risks or at least any that cannot
st	be managed with the proper measures. On the contrary, signif-
n- he	are not used since vandalism or degradation can leave them
rv	in ruins in no time at all, bearing in mind that the quality of
-)	the construction of the houses of the old lighthouse keepers
ts	is rather poor.
d-	All the neighbouring countries have successfully developed
rs	similar initiatives to make use of the unused spaces of their light-
is	houses for tourism, as a strategy to conserve them. These include,
ts	among others, the United Kingdom (England and Scotland), Ire-
gу	land, South Africa, Norway and, recently, Italy, with a new project
us, al	that covers initiatives with more than 50 lighthouses.
le.	How has Ineco's inventory contributed?
	Has it revealed anything new?
	The inventory done by Ineco, with the information provided
	by the port authorities, has meant, on the one hand, an update
	of the information of the unused spaces available in the light-
ıt-	houses and, on the other hand, the uses that are being developed
u-	in those spaces, revealing, in some cases, that the information
ut	neia by Fuertos dei Estado was not updated, either due to unre-
JII	ported uses (when it was not manuatory) or uses that were not

he ultimately implemented. ■

AIR NAVIGATION | EUROPE

The Galileo satellite naviaation system

The Galileo constellation si muove

In 2020, the 18 satellites initially deployed by the Galileo satellite navigation system, developed by the EU will be expanded to form a constellation of 30 satellites, making it one of the best performing satellite navigation systems in the world. Ineco leads the activities of the European Service Centre for users of the Galileo programme (GNSS Service Centre, GSC) located in Madrid. A nerve centre that serves users from all over the world.

With the collaboration of aeronautical engineers **Luis Chocano** and **Álvaro Morillo** and telecommunications engineer **Antonio Águila**

hen the Galileo satellite radio navigation and positioning system is fully operational, with its 30 satellites deployed, it will be possible to determine the location of people and objects with a precision and speed that are currently unattainable. In addition, it will provide Europe with a navigation system that is independent from the existing satellite positioning systems such as the North American GPS which operates using 31 satellites and Russia's GLONASS, which uses 24 satellites.

The North American and Russian systems, along with the Chinese BDS, operate under military control, making Galileo the only one designed for civilian purposes and completely open to commercial use. It will also provide Europeans with independence from the Russian and American systems, which is of strategic importance, taking into account that, if they were to be blocked, up to 10% of the European economic activity depends to a greater or lesser extent on satellite navigation.

The importance of these systems in the world economy and transport is growing, along with the range of uses. It is for this reason that, after more than ten years of work, the European space industry and institutions have been able to conduct a project to deliver the highly competitive performance that will finally give Europe its desired technological and strategic independence. It will also allow access to a market with great potential for growth. See https://www.gsc-europa.eu/.



GALILEO WILL PROVIDE SIGNALS FOR POSITIONING, NAVIGATION AND TIME MEASUREMENT THAT ARE MUCH MORE ACCURATE THAN THE OTHER SYSTEMS

When it is fully operational, Galileo, which was developed by the EU with the assistance of the European Space Agency (ESA) and whose services are operated by the European Global Satellite Agency (GSA), will provide signals for positioning, navigation and time measurement with much greater accuracy than the other systems, free of charge, for an unlimited number of users, and with the guarantee that the signals will be available anywhere in the world. It will be interoperable with the GPS system and will offer a paid commercial service that provides high precision and authentication.

Moreover, Galileo will offer a two other services: the PRS (Public Regulated Service) service which has highly robust signals that protect against malicious interference and which is intended for government use by security and civil protection organisations; and support for the SAR service (search and rescue), a European contribution to the international rescue service COSPAS-SARSAT. One of the biggest innovations is the incorporation of a return channel that informs those seeking assistance that their message has been received and that help is on the way. In addition, the Galileo technology makes it possible to reduce the search radius, and with it, the rescue

time, which is a critical factor in saving lives on these missions.

According to the European Global Satellite Agency (GSA), the market for applications based on satellite navigation systems will grow 11% per year in Europe over the next few years, reaching 165 billion Euros in 2020, just for activities directly related to the system (chips, maps or services), without taking into account the activities facilitated by this technology, such as mobile phones with satellite navigation capabilities (GNSS). Galileo will be key to the introduction of this technology to the market, to complement the GPS system (see IT44).

Galileo, in conjunction with GPS, will open a new era of satellite navigation through the introduction of the 'multiconstellation' concept. In the case of rail transport, aviation or road, this combined use will be very useful for fleet management, pinpointing the location of vehicles



NAMED AFTER THE GENIUS

The astronomer, physicist and mathematician Galileo Galilei, born in Pisa (Italy) in 1564, would certainly appreciate the progress of a project like the one that bears his name. He was found guilty by the Inquisition for maintaining, among other theories, that the Sun was the centre of the solar system and the Earth rotated on its own axis. Although there is no historical record, he is credited with the famous sentence spoken before the court: Epur si muove. Although he officially recanted his scientific assertions, thanks to which his prison sentence was commuted to lifelong house arrest, he continued researching them until his death in 1642, the same year in which Isaac Newton was born. The image shows, Galileo teaching the Doge of Venice how to use a telescope. Fresco de Giuseppe Bertini (1825-1898).





In the photo above, Ineco engineers Álvaro Morillo and Luis Chocano at the entrance of the GNSS Service Centre (GSC) in Torrejón de Ardoz, Madrid.

or vessels in real time, even in remote locations or in areas with poor visibility.

Satellite navigation is also an essential tool for scientists, astronomers, geologists and biologists who follow the movements of planets, the Earth and wildlife. For example, this type of positioning and location system allows animal tracking or drone monitoring. In addition, its time measurement, which is accurate to one billionth of a second, allows all kinds of measurements and scientific experiments to be performed with great accuracy.

1.5 BILLION FOR SATELLITE MANAGEMENT

In December 2016, the GSA, the organization responsible for operation of the Galileo system, awarded the contract for its operation and maintenance for the next 10 years to Spaceopal, a company formed by the Italian company Telespazio and the

In the photo above, a meeting at Ineco's headquarters in Madrid. From left to right: Vicente Giner, Ineco expert; Luis Chocano, Galileo project manager at Ineco; Giuseppe Lenzo, CEO of Spaceopal; Giuseppe Viriglio, advisor to Finmeccanica; Antonio Pozo, director of Southwest Europe Accounts at Ineco and Torcuato Battaglia, CCO of Telespazio Ibérica.

German company DLR GfR, which already managed the Galileo Control Centres (GCC) in Italy and Germany, respectively. Spaceopal's industrial team includes the participation of a Spanish group led by Ineco with the collaboration of INTA and Isdefe.

The contract, valued at 1.5 billion Euros, includes the operation and maintenance of the Galileo system:

▶ Operation of the Galileo satellites from the two main control centres located in Germany and Italy.

distribution network of Galileo.

system.

▶ Management of minor developments and support for major developments of the system. ■



▶ Service and information to the users, as well as activities for the evolution of services and applications from the GSC centre, located in Madrid, for the data

► Logistics and maintenance of the

GALILEO WILL BE MANAGED FROM MADRID

The GSC in Madrid is the international centre for support and assistance to the users of the Galileo system. Its management, operation and maintenance will be provided by Ineco with the collaboration of the Spanish entities INTA and Isdefe.

The main mission of the GNSS Service Centre (GSC), located at INTA's installations in Torrejón de Ardoz (Madrid), will be to serve as a link between the Galileo system and the users of its free as well as its commercial value-added services. The centre includes services such as:

►User support.

►System website.

►Electronic library for the distribution of documentation.

▶ Publication of professional products.

►Engineering Unit and GNSS 'expertise'.

► Management of commercial service users

Ineco's participation in this project began in 2010 when it carried out a study, funded by Aena under the supervision of the Ministry of Public Works, to define the scope of the GSC. Key Spanish space engineering companies also participated: Indra. GMV, Deimos, Hispasat, INSA and INTA. Since 2014, the company has been providing engineering services in the field of satellite navigation under various contracts signed with the European GNSS Agency (GSA).

Previously, the company has led a number of European projects and has participated in test flights and trials guided by the European satellite navigation system, EGNOS, a forerunner of Galileo. The EGNOS system improves the performance of GPS (and in the future, of Galileo) and facilitates aircraft guidance, increasing accuracy by up to half a metre. In addition, it allows aircraft to perform instrument approaches and landings at airports without the need for additional landbased infrastructure, thanks to the provision of signal integrity in space and the possibility of vertical guidance of the aircraft.

ENVIRONMENT | SPAIN

Environmental management in high-speed projects

"It is very satisfying for all the staff who form (or have formed) part of the team, to visit the places where they have worked years later and be unable to distinguish where the landfill was or where work was done on a river that appeared impossible to restore".

Ignacio Pandelet, technical forest engineer with Ineco

Creating a good atmosphere

For 15 years, an Ineco team has been working with Adif to minimize the environmental impact of large-scale high-speed works projects. Each project presents its own specific challenges, ranging from the management of different types of waste to the protection of flora, fauna and archaeological heritage, among others.

With the collaboration of **Sergio Mora**, biologist and environmental engineer, and **Ignacio Pandelet**, technical forest engineer

Il large works project inevitably have an impact on the environment: vegetation, fauna, water and relief are affected by the work during the execution of the project and also later, after the infrastructure is put into operation. Ensuring the prevention, elimination, or mitigation of this impact is the objective of environmental project management, which emerged in Spanish legislation in the 1990s, along with legislation requiring environmental assessment of plans and projects.

"Participating in the entire process, from evaluation to operation, has given us a comprehensive, integrated view of the implementation and deployment of linear infrastructure. The experience gained with the Spanish high-speed railway lines has been applied to other international railway and highway projects".

Sergio Mora, biologist and environmental engineer with Ineco

Ineco began developing its project environmental management departments in 1999, on the Madrid-Zaragoza-French Border high-speed railway line for the Gestor de Infraestructuras Ferroviarias (GIF), which later became Adif. Since then, it has continued to work on different high-speed lines throughout Spain, with a multi-disciplinary team made up of professionals from various fields: forest engineering, forestry, environmental sciences, biology, chemistry, geology, archaeology and cultural heritage.

The next section describes some of the team's more important projects.



A DINOSAUR UNDER THE TRACKS

'LO HUECO' PALAEONTOLOGICAL SITE Coordination: Pepa Ferrer, environmental engineer and Emilia de Aragón, archaeologist **Location:** Madrid-Levante high-speed line (Fuentes, Cuenca) **Subject area:** archaeology/palaeontology **Date:** 2007-2008

► CHALLENGE: in 2007, earthmoving for the construction of a cut-and-cover tunnel in Fuentes (Cuenca) for the high-speed line to Levante uncovered more than 8,000 fossils from the Late Campanian-Early Maastrichtian (Late Cretaceous) (see IT47) including 23 large sauropod specimens. 80 million-year-old flora and fauna were found in the palaeochannel.

"It was undoubtedly the most interesting palaeontological site we encountered during the construction of the high-speed lines in Spain. So much so that some of the 23 dinosaurs found have been presented in different international forums".

> Pepa Ferrer and Emilia de Aragón, coordinators

► SOLUTION: due to the infrastructure's requirements, more than 60 archaeologists and palaeontologists and 40 assistants had to carry out the excavation in shifts, working day and night. An emergency excavation was done to meet the project's tight deadlines and also protect the site, which covered more than 10,000 m².

INTENSIVE CARE

WATER MANAGEMENT AND HANDLING IN THE PAJARES TUNNELS Coordination: David Luengo, environmental engineer biologist Location: Pajares bypass Subject area: wastewater management Date: 2004-present

► CHALLENGE: the excavation of the Pajares tunnels represents one of the biggest civil engineering challenges in Spain. It is also challenging in terms of the environment, since the project is located inside the Las Ubiñas-La Mesa Natural Park, a Biosphere Reserve, a brown bear habitation area, and the Peña Ubiña SCI in the Natura 2000 network.

As a result of the difficult geography and geotechnical conditions of the Cantabrian mountain range, during the tunnel excavation (twin-tube tunnel 25 km long), the volume of water generated during the excavation with the tunnel boring machines exceeded the predicted amounts. In addition, due to the environmental importance of the Huerna River where the water is discharged, the Hydrographic Confederation of Cantabria requires very strict discharge parameters. Another difficulty is the limited space and lack of definition of the construction plans to determine the placement of treatment facilities.

► SOLUTION: new hydrogeological studies were carried out during the execution of the work (see IT16 and IT24). These indicated that the water supply inside the tunnels would be higher than initially estimated, and that extraordinary measures should be taken to protect the hydrological system, and treat the water from the tunnel excavations. The project's environmental management department is coordinating the improvement of the original measures included in the construction project, and several industrial wastewater treatment plants (IWWTP) will be constructed, with successive expansions to treat 100% of the flow from the tunnels and ensure that the treated water discharged to the river complies with the parameters required by the Confederation in the discharge authorizations. A monitoring and analytical control program is also being implemented and coordinated to verify that effluents comply with the specified values.





RISING TO THE OCCASION

ENVIRONMENTAL INTEGRATION OF THE VIADUCT OVER THE ULLA RIVER (OURENSE-SANTIAGO LINE) Coordination: Luis Álvarez-Pardiñas, biologist Location: Madrid-Galicia high-speed line. Ourense-Santiago Axis. Silleda (Dornelas)-Vedra-Boqueixón section Subject area: environmental integration and restoration Date: 2008-2011

► CHALLENGE: of the 38 viaducts that were built on the high-performance axis between Ourense and Santiago, in service since 2011, the Ulla river viaduct stands above the rest. The construction of the viaduct, 117 metres high, 168 metres long and with pillars more than 90 metres high, was a major challenge, both technically and environmentally (see IT18 and IT44) due to the high risk of erosion and the extreme difficulty of environmental integration and restoration of the area. The bridge is located in an area of high ecological value, protected as a Special Protection Zone of the Natural Values of the "Ullla-Deza River System", whose well-conserved banks provide a magnificent example of Atlantic riverbank habitats, with alders, willows and ash trees, and a wide abundance of fish species, such as Atlantic salmon, sea lamprey, and trout living in its waters.

"The result was a model integration that received the 'Aqueduct of Segovia' award for the high level of environmental protection achieved during its construction, among other achievements".

Luis Álvarez-Pardiñas, coordinator

► SOLUTION: the Ineco team coordinated all the preventive, protective and corrective measures established in the Environmental Impact Statement (EIS) in regard to earthworks, occupation of space, construction waste, noise and impact on vegetation, and general actions to protect the historical and cultural heritage, before, during and after the viaduct work, in addition to the final replanting and landscape restoration work.

BETWEEN THE RIVER AND THE MOUNTAINS

RENOVATION OF THE RONDA-ALGECIRAS TRACK Coordination: Iñaki G. Seoane, mountain engineer Location: Ronda-Algeciras railway line Subject area: impact on protected natural areas Date: 2009-2010

► CHALLENGE: the railway line between Ronda and Algeciras is a conventional line that is strategically important for freight transport in Spain as it provides the only rail outlet from the country's largest port in Algeciras. It is also unique from the environmental point of view, as it crosses steep and mountainous terrain, enclosed in the canyon of the Guadiaro River, passing through the Natural Parks of Sierra de Grazalema and Los Alcornocales. The renovation work (see IT22 and IT32) therefore had to be carried out as quickly as possible, but at the same time, had to be compatible with the environmental protection of these valuable natural spaces. Numerous protected species, such as the imperial eagle (Aquila adalberti), vulture (Neophron percnopterus), griffon vulture (Gyps fulvus) and mountain goat (Capra pyrenaica) are native to the area.

"The biggest challenge was working with the platform access limitations associated with the geography in the vicinity of the Guadiaro River and the restrictions of the Natural Parks through which the track passes. Coordination between the people in charge of these spaces and the project managers was essential to avoid irreparable impacts on the environment".

Iñaki García Seoane, coordinator

► SOLUTION: the management of both natural parks was involved in the handling and resolution of incidents and incompatibilities between the use of the land and the works. Biological stoppages, the location of auxiliary facilities and accesses were defined based on the actual data on the species present and the needs of the agencies responsible for the parks. Railway service was shut down during most of the work, which affected freight transport, but allowed compliance with the EIS.



ENVIRONMENT | SPAIN

ON DANGEROUS GROUND

MANAGEMENT OF CONTAMINATED SOIL FROM THE PLOTS OF THE NEW HIGH-SPEED STATION IN MEDINA DEL CAMPO Coordination: Sergio Mora Alonso, biologist and environmental engineer Location: Medina del Campo, Madrid-Galicia high-speed line

Subject area: waste management Date: 2015-2016

CHALLENGE: during the initial phase of the works, the area chosen for the station was found to be contaminated by illegally-dumped debris. According to the official documentation pertaining to this land, the expropriated plots were involved in sanctions proceedings as a result of the dumping of hazardous wastes containing mercury (Hg) prior to the work. In addition, to make matters worse, large areas with fibre-cement sheets containing asbestos were also discovered. Asbestos is a fibrous mineral that was widely used for many years in construction for its high flame-retardant and insulating properties. It was later found to be highly carcinogenic through the inhalation of the fibres.



"Once the surplus earth containing mercury or asbestos had been identified and classified, it was taken to safe dump sites, controlled or inert landfills, by an authorized waste management company".

Sergio Mora, coordinator

► **SOLUTION:** the biggest challenge was to adequately classify and manage the surplus earth coming from the works, to ensure proper traceability and separation of the soil based on hazard levels, and also, to make this work compatible with the current work plan. The problem was approached with caution, carrying out representative analyses of the affected area to detect the possible presence of both mercury and asbestos.



CONTAMINATION CAUSED BY THE USE OF ANFO FOR BLASTING

Coordination: Esther Izquierdo, biologist / Enrique Martínez Agüera, forest engineer Location: La Canda tunnels, (Ourense) Subject area: water quality management Date: 2014

► CHALLENGE: during the excavation of the railway tunnel (see IT53), blasting of rocky terrain was required to loosen the rock and facilitate drilling. One of the explosives used in this process was ANFO, an explosive that combines ammonium nitrate and petroleum-derived fuel oil. It was discovered that the traces of this toxic compound would eventually end up in the waters of nearby rivers, posing a risk for both aquatic wildlife and humans.

►SOLUTION: the first step was to inform and educate all workers in order to avoid unnecessary dumping on the land that would eventually reach the waterways. They also began to use cartridge (instead of granular) explosives to facilitate handling. Water monitoring and treatment measures were strengthened, and aerators were installed in the settling ponds, in order to promote denitrification and removal of ammonium ions from the water.

SAFE GARDENS

RESTORATION OF AGRICULTURAL LAND IN THE AGRICULTURAL PARK OF CATALONIA

Coordination: Martí Segret, environmental engineer Location: Madrid-Zaragoza-Barcelona-French Border highspeed line (Sant Boi and El Prat de Llobregat, Barcelona) Subject area: landscape integration and restoration of agricultural land Date: 2006-2008



"Some of the more important actions carried out included ► CHALLENGE: the Baix Llobregat is one of Catalonia's oldest and most fertile agricultural areas, with a climate that is the naturalization of the rockfill riverbank protection, well-suited for vegetable cultivation, outdoor fruit trees and the expansion of the Aiguamolls of Molins de Rei, the protected crops, particularly in the delta and lower river basin construction of fish ladders and other actions, such as the of the Llobregat River. The construction of a 1,740 metre unconstruction of access roads and a riverbank road". derground section as part of a cut-and-cover tunnel affected this agricultural area with its significant cultural, economic and Rubén Segura, coordinator ecological value: the Agricultural Park of Baix Llobregat.

"The agricultural land was restored by spreading and levelling layers of sand, silt and topsoil taken previously from the farmlands themselves".

Martí Segret, coordinator

► **SOLUTION:** the work consisted of levelling the ground with sand and conditioning to the surface level of the ground with two layers of assimilable silts and topsoil. previously taken from the property affected by the track.



GETTING BACK ON TRACK

ECOLOGICAL AND LANDSCAPE INTEGRATION ALONG THE LLOBREGAT RIVER AND THE SURROUNDING AREA Coordination: Rubén Segura, biologist Location: Madrid-Barcelona-French Border high-speed line Subject area: landscape integration-corrective /compensatory measures Date: 2003-2010

► CHALLENGE: the construction of the platforms for the Papiol-Sant Vicenc dels Horts and Sant Vicenc dels Horts-Santa Coloma de Cervella sections of the high-speed line affected the necessary measures be taken.

area surrounding the Llobregat River. Both the Environmental Impact Statement (EIS) and local regulations required that the ► **SOLUTION** one of the more important actions carried out was the naturalization of the rockfill protection along the banks of the river by adding topsoil followed by revegetation with hydroseeding and planting, the expansion of the Aiguamolls (wetlands) of Molins de Rei and the construction of fish ladders. In addition, works were undertaken to maintain and enhance the river's morpho-hydrodynamic conditions, as well as others aimed at ensuring longitudinal connectivity, such as the construction of access roads and a road along the riverbank.

ROCK-SOLID STABILITY

WATERPROOFING AND REVEGETATION OF EXCAVATED EMBANKMENTS WITH GEOTEXTILE AND GEOCELLS Coordination: Javier Cáceres Martín, biologist Location: Córdoba-Málaga high-speed line; Puente Genil and Herrera Subject area: stability and revegetation on embankments for line infrastructure Date: 2006

► CHALLENGE: in one of the hillside clearings for the Cordoba-Malaga high-speed line, near the towns of Puente Genil and Herrera, the clayey slopes were in danger of collapsing. It was essential to avoid the gradual deterioration of the slope, which could generate risks for the railroad traffic and high costs during the maintenance.

"In addition to the stabilization of the entire slope, a three-layer coating was installed every 200 metres: a waterproofing bentonite sheet, and over that, two geotextile support elements to secure a middle layer of sodium bentonite".

Javier Cáceres, coordinator

► SOLUTION: in addition to stabilizing the entire slope, a threelayer coating was installed every 200 metres: a waterproofing bentonite sheet, and over that, two geotextile support elements to secure a middle layer of sodium bentonite. A polyester voided geocomposite structure 10 cm thick was then laid over that, with the hexagonal cells filled with topsoil. This made it possible to carry out the planned hydroseeding treatment to ensure the germination and maintenance of the vegetation.



Level test

Ineco's experience with ERTMS, the European rail signalling system, supports the development of an innovative method to study how its implementation affects railway line capacity.

By Silvia Domínguez, telecommunications engineer



here is a generally accepted idea that capacity increases with the application levels of the ERTMS (European Rail Traffic Management System) signalling system; in other words, ERTMS Level 2 allows for greater capacity than Level 1, which in turn has greater capacity than a line with a traditional signalling system such as ASFA, which is deployed in the Spanish network.

However, there is currently no harmonized method in European or international regulations for assessing the impact of ERTMS deployment on railway line capacity: for this reason, Ineco, with its extensive experience and expertise in this field (see IT32 and 46), carried out an innovation project in 2016 with the aim of developing one. The conclusions reached in this project make it possible to propose improvements across the entire network or on specific lines in order to optimise capacity.

WHY?

This qualitative and quantitative assessment method will serve as a basis for the development of different types of technical studies. First, as part of strategic railway plans to define which infrastructure actions are most appropriate, how to deploy or not to deploy ERTMS, and at which level, implications for rolling stock, etc.

The method is also useful for optimizing the detailed design of the ERTMS

THIS METHOD MAKES IT POSSIBLE TO ASSESS THE IMPACT OF THE DEPLOYMENT OF ERTMS ON THE CAPACITY OF A **RAILWAY LINE**

functions of a railway line or network, taking into account aspects such as the network's capacity and regularity. Lastly, this method can be used to calculate the capacity of a section after the deployment of the ERTMS system. In addition, it could be considered as a basis for the future development of a specific module in a tool for complete calculation of railway network capacity data.

RESULTS

For the initial application of the method, the values of a typical high-speed network with a homogeneous fleet of passenger trains were taken as a starting point.

The data was divided into three categories: fixed data that cannot be changed in the network being studied, semi-fixed data that corresponds to the aspects of ERTMS functions common to most ERTMS projects, and



ERTMS IMPLEMENTATION ERTMS implementation brings a variety of improvements to railway operations, ranging from interoperability of different types of trains

variable design data within capacity analysis.

It should be noted that this classification may vary depending on the type of study performed. For example, line block sections may be fixed in cases in which only ERTMS will be installed, or variable in cases where some action on the line, in addition to ERTMS deployment, is allowed.

The variable data used in the study was: movement authority, the ERTMS braking algorithm, speed restrictions and gradient. The conclusions generated by the study included an improvement of 9.67% in time between trains by installing ERTMS Level 2 instead of Level 1 on the same section of line. However, applying the qualitative analysis, it is unlikely that this improvement would occur on a network with different characteristics. Some conclusions were also reached

regarding the impact on capacity with

Analysis

respect to other much more detailed characteristics of ERTMS, such as inhibition of the service brake in the ERTMS braking curve algorithm which results in an improvement of 0.51% in time between trains in this network.

The number of trains per hour is one of the most important characteristics to take into account in most railway opera-

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on different infrastructures to increased safety and capacity.

ITS APPLICATION HELPS TO FORMULATE STRATEGIC PLANS TO **DEFINE WHICH ACTIONS** ARE MOST APPROPRIATE. HOW TO DEPLOY OR NOT TO DEPLOY ERTMS, AND AT WHICH | EVEL

ERTMS, EUROPE'S **RAILWAY LANGUAGE**

ERTMS is a railway signalling standard supported by the European Union, which promotes its implementation on the EU's core network. Ineco is in charge of the control and monitoring of the deployment plan until 2021 (see *IT53*).

It is an automatic system consisting of information exchange between trains and infrastructure, and is based on cab signalling and continuous monitoring of speed. It can be deployed with different application levels, which differ in the way that the information is transmitted: sporadic transmission between the track and train for Level 1 or continuous, two-way transmission in Level 2.

The implementation of ERTMS brings a variety of improvements to railway operations, such as interoperability of different types of trains on different infrastructures and increased safety and capacity. This capacity is calculated based on the number of trains with specified characteristics that can travel on a railway line or network during a certain period of time. In addition, the benefit of ERTMS in railway digitisation programmes has been demonstrated through its deployment as part of the modernization processes of numerous railway networks around the world.

tions, on both new and upgraded lines: the greater the number of trains that can circulate, the more profitable the infrastructure will be. This calculation is important in different project phases: in the strategic decision stage (which sections of the network to upgrade, which ERTMS levels to install, etc.) as well as in more detailed phases, in which it is necessary to know the exact number of trains per hour to include in the business case or design ERTMS functionality to optimise this capacity.

Finally, it was also possible to identify some scenarios in which the ERTMS deployment reduces capacity, for example, the large impact that temporary speed restrictions in Level 1 can have. This demonstrates the need to carry out technical studies based on this method of assessing the impact of ERTMS on capacity before defining the actions required to upgrade a railway network.

BRAND SPAIN | CAMINO DE SANTIAGO

REBIRTH AND RENEWAL

Many pilgrims extend their journey to Finisterre, the Roman Finis Terrae, the westernmost geographical point of Europe. Reviving customs that date back to the pre-Christian era, pilgrims leave behind their boots or an item of clothing in a symbolic gesture of rebirth and renewal.

The route of the stars

Today, well into the 21st century, the Camino de Santiago, a World Heritage Site, is a cultural, touristic and spiritual phenomenon that is more global now than it was in the Middle Ages, when it was consolidated as one of Christianity's great pilgrimage routes along with the routes of Rome and Jerusalem.

By ITRANSPORTE

ccording to data from the Santiago de Compostela Tourist Office, almost 263,000 pilgrims come to the city each year (in jubilee years, that number doubles to half a million). Of these, half are foreigners from across all continents. 85% are European, half of whom are Spanish, from every region, but mainly from Madrid, Andalusia and Catalonia. More than 90% go on foot, with the rest going by bicycle (9.6%, around 25,000 people), on horseback (326 people), and a small number in wheelchairs (71 in 2015). They all get their "compostela" or accreditation, for reaching their goal, which is issued by the Pilgrim's Office. To get their certificate, pilgrims must travel the last 100 kilometres on foot or horse, or 200 kilometres by bike, and prove their achievement with the stamps that they receive for each stage, the only requirements needed to consider their journey complete.

This journey started in the Middle Ages, when the remains of St. James the Greater were discovered in the 9th century near the city. According to history and legend, this follower of Jesus preached in the land that we now know as Spain -a fact highlighted by scholars such as Beatus de Liébana- and then subsequently travelled to Palestine, where he was martyred, with his remains finally arriving in Galicia at the campus stellae, or field of the stars -whose name comes from the mysterious lights that attracted its discoverers-which, it is believed, gave 'Compostela' its name. When the Muslims invaded the peninsula, with the exception of the Kingdom of Asturias, the devotion to the Apostle quickly grew, and he was soon considered the patron saint of Spain.

Together with Rome and Jerusalem, Santiago became a great centre of Christian spirituality. The rise of pilgrimages, journeys with a sense of penance, the atonement for sin, fit with the medieval mindset in which spirituality was present in all areas of daily life. This was also in line with the concept of homo viator, human beings as "pilgrims" in earthly life, in transition to a spiritual and internal life that can only be attained by the cleansing of sin. So much so that forcing prisoners and criminals to go on the Camino de Santiago became a standard sentence in some European courts of the Middle Ages, although the pilgrimage was made by people of all social classes, including nobles, some of whom commissioned others to walk the route on their behalf.

These days the profile of the travellers is much more varied, and ranges from true pilgrims who more than anything are seeking an inner experience, to tourists, adventurers, and curious types, as well as every other possible combination. As a result, although participation in the Camino is free, there are many companies that offer all kinds of services –transport and storage of backpacks, suitcases and bicycles– and tourist packages that, in addition to walking sections, also include guided tours, airport, bus or train transfers, riding on horseback and even donkeys, hotels, gastronomy, etc.

And as was the case centuries ago, the Camino itself is an economic engine and cultural itinerary of the highest order, offering boundless artistic and natural riches. Although, in many cases, the routes leading to Santiago already existed before the discovery of the tomb of the Apostle, they prompted the entry and dissemination of cultural currents from the rest of Europe. After reaching its peak in the 12th and 13th centuries, the Camino went into decline, and it was not until the 1980's that it started to regain its value, going on to become the huge phenomenon that it is today.

While the "French Route", which crosses the Pyrenees through Roncesvalles, is the most popular route to reach Compostela from Europe, chosen by more than 66% of the pilgrims, there are more than a dozen routes throughout Spain. Virtually every region has its Jacobean route, many of which were

forgotten and have been rediscovered thanks to the work of associations and scholars. In 2015, UNESCO expanded its 'Heritage of Humanity' classification, which the French Route had held since 1993, to include four other routes to the north of the country: the Coastal Route; the Inland Route of the Basque Country and La Rioja; the Liébana Route and the Camino Primitivo, which together total 1,500 kilometres.

At the same time, Spanish associations of friends on the Camino de Santiago –34 in total–, have studied, revived, and marked 12,000 kilometres of routes with yellow arrows, throughout Spain since the late 1980s, in addition to recruiting 700 volunteers known as "hospitaleros", to work in around 40 free hostels, which were referred to in the past as "hospitales". The pilgrims also have a further 400 places of paid accommodation managed by parishes, municipalities and other entities and institutions.







2. Churches: such as the Santa María de Eunate church (Navarra), an architectural rarity with an octagonal floor and connections to the Order of the Templars, or the Virgen Blanca Church (Palencia). The oldest churches are the Asturian Pre-Romanesque churches of San Miguel de Lillo and Santa María del Naranco.
3. Monasteries: like the San Juan de la Peña monastery (Huesca), half-



The following are just a sample of the myriad artistic, scenic and cultural treasures scattered throughout all of the Jacobean routes:

1. Romanesque and Gothic cathedrals:

such the one in Santiago -a Romanesque jewel with the spectacular Pórtico de la Gloria and the Baroque Fachada del Obradoiro-, Jaca, León, Burgos, Palencia, Oviedo and Lugo.



3. Monasteries: like the San Juan de la Peña monastery (Huesca), halfexcavated into the rock in a spectacular natural location; and San Juan de Ortega



(Burgos), where twice a year the phenomenon of equinoctial light (a ray of light that illuminates a Romanesque capital) takes place, and which can also be seen in the Santa María de Tera church in Zamora. Other important monasteries are Santo Domingo de la Calzada and San Millán de la Cogolla (La Rioja), Leyre (Navarra), etc.

4. Bridges: Trinidad Bridge (Arre, Navarra) from the 12th century, the Paso Honroso Bridge or the Caballeros Bridge over the Órbigo River, (León), where a knight fought for 30 days to win the favour of his beloved; Puente La Reina (Navarra) over the Arga River, etc.

5. Stone Crosses: such as the Ligonde cross (Lugo).



These carved stone crosses were placed at the crossroads and were used as guides for the pilgrims. They are frequently seen in Galicia and Portugal, although they can also be found in the area of Cantabria and some parts of Castilla-León. In popular Galician mythology, they served as protection against a chance encounter between pilgrims and the Santa Compaña (ghostly procession of the dead).

6. Fountains: these are vital for all pilgrims, for example the peculiar Fuente de los Moros de



Monjardín, an old water cistern (rainwater tank) with gabled roof and a deep access stairway; the thermal springs in Ourense, known as "As Burgas", and Fonsagrada fountains (Lugo), the Wine Fountain, near Estella (Navarra), dedicated to pilgrims and built in 1991 by a group of local wineries, and which also includes a fountain with water.

Basic information to do the Camino:

a) www.santiagoturismo.com/ camino-de-santiago b) www.caminosantiago.org/ cpperegrino/comun/inicio.asp c) www.catedraldesantiago.es/en

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