# itransport engineering & consultancy magazine



ENGLISH EDITION

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### CLIMATE CHANGE 2015 PARIS CONFERENCE For a million reasons

INTERVIEW Susana Magro Andrade Director of the Spanish Office of Climate Change "The governments have to make commitments, but the fight against climate change is something we must all be involved in"

FOREST MANAGEMENT OF AIRPORTS Protecting forest for barrier-free flying

FEASIBILITY STUDY
A new tram in Pavlodar

AIRPORTS IN UGANDA More space to grow

URBAN CABLE CARS With panoramic views

### **BRAND SPAIN**

Spanish horse: fine breed



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# **Editorial**

limate change, the subject of this edition's front page, is a reality with which we are all faced, proof that we must change our behaviours, and an opportunity to manage our future from a new perspective. The 2015 Paris Conference represents a step forward in the commitment to finding alternatives to slowing down the global warming process by setting timescales with solid and reliable objectives.

**Engineering companies play an important role in this challenge** that Ineco has enthusiastically accepted. Our company has joined the campaign entitled "A million pledges for the climate", an initiative of the Spanish Ministry of Agriculture, Food and Environment which implicates society as a whole. At Ineco we are adamantly determined to tackle this challenge by developing sustainable infrastructure projects and by promoting technologies that can reduce pollution emissions. Some examples are the project reports that we publish here such as the Uganda National Airport Plan, Forest Management at Aena Airports, the Quito MetroCable, and the Pavlodar Tram.

As a Spanish public engineering company, we would like for the publication of these studies to enrich dialogue between our clients and readers, and together to help raise awareness within society regarding the importance of charting a new course.

Jesús Silva Fernández President of Ineco



It also pleases me to highlight the important international tender that Ineco was recently designated (in consortium with the Spanish company Técnicas Reunidas and the Arab Consulting Firm Dar al Handasah), to carry out the project management of the future Sultanate of Oman railway network. This is excellent news and a major project which will allow us to continue collaborating in a country where we have had a presence since 2010.



# Médecins **Sans Frontières =** Humanitarian Action



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Susana Magro Andrade

Director of the Spanish Office of Climate Change

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COVER IMAGE: NASA

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In gratitude to Mariano Serrano, art director of the magazine itransporte (2007-2015)

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# News

# Pastor presents the Commission to establish the BIM methodology

On 15 July, the minister of Public Works, Ana Pastor, presided over the Commission's inaugural meeting for establishment of BIM methodology (Building Information Modelling) in Spain. This project management tool uses a 3D digital model to reduce costs, cut down on design and production time, and improve the quality of



engineering, architecture and construction projects. Ineco supports the Ministry of Public Works in this initiative which strives to promote the implementation of BIM in Spain, encourage its use, and develop standards and a training plan for this methodology. In the image, to the left of the minister, Jesús Silva, president of Ineco, and Jorge Torrico, Ineco Project subdirector.

### OFFICIAL VISIT

### Spain-Panama agreement

ast June the minister of Public Works, Ana Pastor, signed a bilateral agreement concerning transport and infrastructures with the president of the Republic of Panama, Juan Carlos Varela, and the minister of the Presidency, Álvaro Alemán. The objective is to support the Panamanian government in a public investment plan regarding sectors such as water, sanitation, basic health care, comprehensive solid waste management, public transport and mobility, urban planning and tourism development. Jesús Silva, president of Ineco, formed part of the Spanish delegation.«

### Railway accreditation in the UK

Ineco has renewed its accreditation for the second year as a supplier of railway design services in the United Kingdom with Achilles RISQS, the registration and pre-qualification system for suppliers that work with the main clients of Great Britain's railway sector such as Network Rail and Transport for London. Ineco has been working on the HS2 high speed newtwork in the United Kingdom since 2012. 

### Saudi Arabia



### Preliminary testing on the Makkah-Madinah railway line

This past July dynamic testing on the first Talgo train began on the high speed line that is under construction between the cities of Makkah and Madinah in Saudi Arabia. During the first week of testing the train reached a speed of 120 km/h. The Talgo 350 train travelled on a delimited 60-kilometre stretch within section four, 110 kilometres long, and the longest section of the project. Static testing and manoeuvres with the train began in June on tracks 7 and 8 to access the assembly base 2 mini depot, located at kilometre point 192+000, approximately. Ineco is responsible for the engineering and consultancy of this project which is headed by a Spanish consortium that anticipates a transport volume of 166,000 passengers per day during peak pilgrimage times to the two holy cities. Transportation will make use of the latest technology while causing the least possible environmental impact. The 449-kilometre line will boast 35 trains that will travel at speeds of up to 320 km/h.

# European deployment of the ERTMS at TEN-T Days 2015 Silvia Domínguez (second in the photo), the European Union-hosted this event Depresenting the technical accesses. Its analysises the deviluement of the

**S**ilvia Domínguez (second in the photo), the European Union– hosted this event dedicated person in charge of the technical aspects to analysing the development of the Transof Ineco's project to supervise the deployment European Transport Network (TEN-T). In of the ERTMS in Europe, gave a conference on December 2014, Ineco was awarded the the advantages of carrying out a specialised technical supervision of the ERTMS at the TEN-T Days celebration on 22 June in Riga. The capital of Latvia –the country that held the rotating Presidency of the Council of the

contract to coordinate and supervise the deployment of the European Rail Traffic Management System (ERTMS) until 2020 in the nine corridors throughout European Union territory.«



### **O**man

### NFW PROJECTS

### Ineco, designated to carry out the project management of the new railway network

he Oman Ministry of Transport and Communications has designated Ineco, in consortium with the Spanish company Técnicas Reunidas and the Arab consulting firm Dar al Handasah, to carry out the comprehensive project management of the future Sultanate of Oman railway network. The railway network is intended for both passengers and cargo and will cover a distance of over 2,200 kilometres. The first stretch which is 207 km will connect Buraimi and the Port of Sohar -in the north of the Sultanate- to the United Arab Emirates. The network will also interconnect the ports, the capital, management and the subsequent Muscat, and other urban centres with

the rest of the neighbouring countries: Saudi Arabia, Bahrain, Qatar, Kuwait and Yemen. This new infrastructure boasts an international-gauge double track and will reduce large-vessel traffic in the Strait of Hormuz. A team will work with the public rail company, Oman Rail, and shall direct the bidding for the different sections as well as their subsequent management. The project includes review and approval

### **Bus Transport Master Plan**

Alternatively, the Oman National Transport Company (ONTC) has commissioned Ineco to draw up a Bus Transport Master Plan which will come to a close in 2016. The projects, with the Spanish operator Grupo Ruiz as a strategic partner, include the design of



of construction projects, construction maintenance. This is Ineco's first railway contract in Oman where the company started to work in 2010. In the aeronautical and airport sector the company has designed flight procedures and navigation charts for the country's main airports in addition to safety studies, easements, and a site analysis for the future Musandam airport. Ineco elaborated an Urban Transport Master Plan for Muscat (see it51 and it54), which was delivered in 2015.«

improved service and safety. technologies.«

expansion policies and strategies for The projects also involve improvement of intermodal connections, definition of operational costs and the introduction of new management and operations

### Jamaica



### New projects at the Sangster Airport in Montego Bay

BJ Airports, the concession company of Jamaica's leading tourist airport -Sangster International in Montego Bay- has commissioned Ineco with a new project: the design for pavement rehabilitation of the taxiways and apron areas. In 2009 the company executed the Airport Master Plan which analysed growth needs. Following the Master Plan, the company provided technical assistance services for improvement and expansion projects which included interventions such as extension of the runway by 400 metres, installation of RESAs (runway end safety areas), and runway repaving among others (see it24 and it39). The project was carried out in two phases: the first phase involved detail design, and the second concerned the control and supervision of project execution.«

# News



### Seminar on Ineco's experience in air navigation

On 10 July, Ineco conducted the ROCATSEA seminar (Republic of China Air Traffic Safety Electronics Associates) in Taiwan in collaboration with the client MiTAC Corporation. At the event which was attended by about thirty members of the Taiwanese Civil Aviation and Air Navigation Authority, Ineco's experience and noteworthy projects were presented in addition to the radio analysis tools they have developed such as NavTools suite,

HECCO and RUCCMAN. The company is currently conducting an aeronautical study to evaluate whether it is feasible to increase the size of the cranes at the Port of Kaohsiung next to the airport. For this study, instrumental flight procedures as well as obstacle limitation surfaces are being analysed; radio evaluation studies are also being elaborated and preliminary findings were presented at this seminar as well.

## International INTERNSHIPS AT THE CAMPUS INECO

### Ana Pastor announces an internship programme for Ibero-American engineers

ast September the minister of Public Ibero-American institutions collaborate Works, Ana Pastor, introduced the Campus Ineco internship programme for Ibero-American engineers within the framework of the International Transport Engineering Programme (PIIT, in Spanish). The programme seeks to strengthen the transport engineering sector in Ibero-American countries by selecting young engineers to work on projects in Spain, thus allowing them to acquire knowledge, methodologies and experience that can then be applied in their home countries. Owing to Ineco's 45 years of experience in planning and developing infrastructure projects, the Ministry of Public Works has appointed the public engineering company to coordinate this programme. The company will promote the insertion of graduates from other countries with the Campus Ineco programme through bilateral collaboration agreements that will encourage knowledge sharing within the transport engineering sector.

# with Campus Ineco

Rebeca Grynspan, secretary general of the Ibero-American Secretary General (SEGIB); Paulo Speller, secretary general of the Organization of Ibero-American States for Education and Science (OEI); and Félix García Lausín, secretary general of the Ibero-American University Council (CUIB), have signed a collaboration agreement with the minister Ana Pastor for the development of this ambitious programme

in Latin America. Valid for a period of four years, this agreement aims to reinforce bilateral cooperation on innovation and development between the Ministry of Public Works and other Ibero-American countries, as well as foster the exchange of knowledge and experiences. The Campus Ineco programme endeavours to expand its reach to a greater number of countries, not only in Latin America, but also to other geographical areas where Ineco carries out its international activity.«



### New appointments and office openings abroad

hroughout 2015 Ineco has continued to strengthen its international structure by appointing new delegates as well as by opening offices abroad. The new delegates are Félix Ortega for South America, headquartered at the new office in Lima; José Solorza for North and Central America, headquartered in Panama; Santiago Gómez de Olea

for the Middle East and the Arabian Gulf, headquartered in Abu Dhabi; Javier López-Villalta for Asia-Pacific, headquartered in Singapore; and Sergio Navarro for Europe, headquartered in Madrid.

### Furthermore, the activity on the

American continent has been reinforced with the appointments of José María Llorente as director of Business in

South America, located in Quito; and Alberto Váscones, director of Business in North and Central America, based out of Mexico City. From the headquarters in Madrid, José María Urgoiti is the National Railways director; José Ángel Higueras is the National Aviation and AMEA director; and Casimiro Iglesias is the National Intermodal Transport and Europe director.«

### Egypt



### Cairo-Luxor high speed feasibility study

Ineco will conduct the feasibility study concerning the future high speed line which will connect the Egyptian cities of Cairo and Luxor. This corridor stretching more than 600 kilometres will join the country's two most important cities, thus strengthening its tourism infrastructure. A delegation from the company which was led by the president, Jesús Silva, travelled to the country in May to hold a meeting with senior infrastructure and transport leadership. Egypt, a country where Ineco has carried out several airport and air navigation projects, is also scheduled to improve underground lines 4, 5 and 6 in the capital, Cairo, just as was done in Alexandria. The project is part of the memorandum of understanding signed on May 1st in Madrid between the Spanish minister of Economy, Luis de Guindos, and the Egyptian minister of Transport.



directors.

### 2015 INNOVA AWARDS Ineco commits to innovation

Several Ineco professionals were granted the first internal Innova 2015 awards given out at the Annual Convention celebrated in June at the Casa de America in Madrid. In the image, those who received the award next to the president of Ineco, Jesús Silva, and company

### Spain **Public Procurement** of Innovation for anti-fog solutions on A-8

neco is collaborating with the Ministry of Public Works on the first Public Procurement of Innovation (PPI) in the field of road infrastructure to develop a system to protect against dense fog on the A-8 highway between Mondoñedo and A Xesta (Lugo). Despite the fact that this stretch of road is already equipped with virtually all of the measures available for roadways during adverse weather conditions (traffic guidance equipment, variable road signs, visibility sensors, etc.), the Directorate General of Roads wants to consider possible innovative solutions in order to resolve this issue. The initial phase of this process began in June 2015 with a Preliminary Market Consultation, an innovative procedure that



allows for the technical specifications of a subsequent procurement to be defined. If it can be justified by the conclusions reached, the project will continue on to the phases of Pre-commercial Procurement (PCP) -for the execution of field prototypesand Commercial Public Procurement, for implementation of the final solution.«

# For a million reasons

### Commitments to fighting global warming in view of the Paris Conference

By itransporte with the collaboration of Alicia Blázquez, geographer

In view of the Conference on Climate Change (COP21) that will take place in Paris in November, Spain presents the "1 millón por el clima" (1 million for the climate) campaign, a project of participation and awareness-raising amongst citizens developed by Ineco that aims to achieve that number of commitments from individuals and companies.

limate change, that is, the alteration of the earth's climate due to human acture of the Earth caused by the accumulation of greenhouse gases is the melting of the polar ice caps, increasing sea level and

threatening human occupation of coastal areas. It indirectly modifies wind and rain patterns all over the planet, with severe ecological and economic consequences. Since 1990, the United Nations has led actions to combat this phenomenon; countries have been seeking commitments to the planet for decades through many international meetings -the next is the Paris Conference- which will require certain emission reduction guotas to be achieved and clean energy sources to be promoted.

The 21st Conference of the Parties to the United Nations Framework Convention on Climate Change or COP21, which will take place from 30 November to 11 December tivity, is scientifically proven. The most 2015 in the French capital, can make hisnoticeable effect of the increased tempera- tory if at least one of its main objectives is achieved: a universal greenhouse gases emissions reduction agreement which will prevent global warming from exceeding 2°C

by 2020, and which, if not achieved, would have catastrophic consequences. To achieve it, 100 billion dollars per year is expected to be raised to help developing countries combat climate change. During the last few decades, the outreach and awarenessraising effort of the scientific community on the scale of the threat and the importance of collective action have left their mark on public opinion. Governments, NGOs, and international organisations –such as the European Union or the United Nations-promote citizen and company participation, through initiatives that combine and maximise the impact of the individual efforts of specific individuals and entities. Recycling and waste reduction, decreased water and energy consumption and using the car less in favour of public transport or non-motorised means (walking, cycling) also contribute to the fight against climate change.«

### All actions count: "1 million for the climate" campaign

nly collective and global action, as a result of the sum of individual actions, will be effective against climate change: this is the starting point of the campaign of the Spanish Ministry of Agriculture, Food and the Environment:

"1 million for the climate", with the special involvement of the Spanish Office Of Climate Change and the Biodiversity Foundation and Ecodes. The objective of the government is to present a million commitments in Paris. Ineco has developed this project where, through a website (www.unmillonporelclima.es), any citizen or entity can subscribe and share their commitments in the fight against climate change and choose from

a list of 80, or add their own. For this, a project of research, detection, definition and calculation of the reduction in emissions (online carbon calculator) for each commitment has been carried out. In addition to this work and developing the

Ineco commitments. Ineco has also joined the campaign in the framework of its general commitment to the environment. In 2008, it signed the ten principles of the United Nations Global Compact and since 2003 it has had an environmental management system for measuring and reducing its water and energy consumption, as well as its waste. As well as having recycling and water and light saving systems in its offices, it carries

web platform, Ineco is also responsib for the involvement in the project of eight infrastructure managers, urban and metropolitan transport companies of 15 cities and four interurban transport companies.«

out actions to offset the company's carbon footprint, such as the photovoltaic system in its headquarters in Madrid, the development of public transport, and carpooling, or videoconferencing systems and online meetings to reduce the number of journeys. Furthermore, in 2015 various innovation projects are being developed on climate change and an internal award will be created for the best environmental suggestion.

called to become aware of the need to make lifestyle, production and consumption changes to combat this warming or, at least, the human causes that produce it or accentuate it' Pope Francis, in the 2015 Laudato Si' encyclical-letter



"COP21 will be key to achieving a binding international agreement subsequent to 2020 that will ensure a reduction of emissions that prevents the worst ecological, economic and social impacts of climate change"

"1 million for the climate" campaign

### Transport engineering in the context of climate change

he generation of energy from fossil fuels (coal, oil and gas), industry and transport, agriculture and changes in the use of soil (particularly deforestation) are the main causes of artificial emissions of greenhouse gases. With regard to transport, the contribution of engineering to the global battle against climate change involves seeking the most sustainable technical solutions and new tools and technologies that allow the detection, quantification and mitigation of its effects.

This battle concerns the transport both of goods and passengers and every means of transport. It is a phenomenon that affects the whole life cycle of the engineering projects, from the planning phase and prior studies through the design and



### The expertise of Ineco's multidisciplinary environment

**professionals**, has allowed the environmental aspects, from their beginnings, and in collaboration with the other areas, to be an important part of the company's projects. Furthermore, it provides specific solutions and products linked to climate change, such as studies of adaptation to climate change, air quality, the calculation of carbon footprints, the design of energy saving and energy efficiency plans, as well as projects for implementing renewable energies. In the sphere of innovation, in 2015 a study was launched that will analyse the impact of Climate Change on infrastructure, and vice-versa. MinOx Street, within the European LIFE programme, studies the use of catalytic technology (materials that absorb pollutants) in urban areas; (CO)Trans is our own methodology for calculating more quickly and at a lower cost the economic and energy impact and the polluting emissions of transport actions.

During the last 20 years, the company has worked on many aspects related to the protection of the environment in the construction and improvement of Spanish transport infrastructure. This has given it a wealth of experience and knowledge that it now also applies in its international work. As such, for example, it has ensured the application of environmental regulations in the carrying out of many studies and evaluations on the environmental impact of important railway works, roads, and airport enlargements, as well as in the environmental management, supervision and control of works (waste management, natural heritage protection, etc.) in all of Spain, and in countries such as Ecuador, Mexico, Poland or Brazil (roads), Turkey or Saudi Arabia (high speed rail), amongst others. We should also highlight the expertise in environmental restoration and archaeological works related to the construction of the high speed network throughout Spain. The preparation of transport plans and strategies, whether it be at a national level (Ecuador, Algeria, Costa Rica or Spain, such as PITVI) or a local level (Logroño, A Coruña, Muscat in Oman, etc.), or the transport models for Croatia or Malta, in progress, have sustainability as one of their basic axes.

execution of the works, which must strictly adhere to environmental regulations, to operations and maintenance. From the point of view of making strategic decisions, the promotion of rail and short-distance sea transport, which would allow roads to be decongested, is one of the lines that the European Union has backed.

### A multimodal challenge

The transport infrastructure, which by definition is planned and built to have a long service life, must be designed taking into account the effects of climate change, such as the raising of the sea level, the increased temperatures or changes to the pattern of flooding, the latter having increasingly shorter recurrence intervals. These factors have a direct influence on the safety and longevity of a bridge, road or railway line, to give some examples.

will be required to in greenhouse gas Protocol (2/6/2009) Canada

Even air navigation, the management of airports and air space can be optimised to reduce the impact of the real time, as well as interaction with the effects resulting from climate change; and this is how it is actually done: the the smart city.«

Another important area of knowledge is airport operations

and air navigation: since 2006, Ineco, through Enaire, has participated in the European programme SESAR (Single European Sky ATM Research), which by 2020 aims to achieve a more rational use of European air space and eliminate its fragmentation, in addition reducing the environmental impact of each flight by 10%. Under the umbrella of SESAR, the company has been participating in research projects aimed at minimising CO<sub>2</sub> emissions and the consumption of fuel, such as OPTA-IN, which has just ended, on continuous descent operations (CDO) or "green landings". SMART (Shared Monitoring Alert and Reaction Tracking-Oceanic) focusses on the reduction of CO. emissions in aviation. The implementation of satellite-guided air navigation is another activity of the company that is linked to the optimisation of air transport and, therefore, the reduction of its environmental impact



*"Major changes to the* design, construction and use of these networks deliver large reductions emissions and ensure sufficient resilience to cope with foreseeable climate change impacts' **Civil Engineering and Climate Change** 



progressive implementation of satelliteguided navigation or large projects such as the "Single European Sky", are some examples.

Urban transport is another crucial front in the battle against climate change. In cities, where more than half of the world's population is concentrated. having an efficient and sustainable collective public transport system is the alternative to using individual vehicles, with there being a considerable effect on the reduction of air-polluting emissions. The new technologies, which through the installation of sensors in all types of public facilities and spaces ("Internet of things") allow an enormous amount of information (Big Data) to be collected and managed in users, are the key of a new urban model:

Ineco has worked throughout its history on the planning and development of sustainable means in the urban environment. such as trams, the metro or commuter rail, with many studies and projects both in Spanish cities (Madrid, Barcelona, Bilbao, Valencia, León, Zaragoza, Alicante, Tenerife, Gran Canaria, etc.) and in those of other countries São Paulo, Mexico City, Tallinn (Estonia), Pavlodar (Kazakhstan), etc. It also has "smart products", aimed at implementing smart technologies, which are revolutionising the traditional way of managing urban mobility and public services in cities. Ineco, a member of the Aenor Smart Cities Committee -the Spanish body that certifies quality- is



developing new consultancy services, technological solutions, implementation of networks, and integration and management of data in this area, as well as in other new developments, such as waste management.

# Interview | SUSANA MAGRO ANDRADE Director of the Spanish Office of Climate Change

Ministry of Agriculture, Food and the Environment

# "The governments have to make commitments, but the fight against climate change is something we must all be involved in"

he Spanish Office of Climate Change is the public body in charge of formulating the national climate change policy and collaborating with the public and private sectors in the fight against this phenomenon. Furthermore, it is responsible for relations with European institutions and international bodies. Since January 2012 the Office has been directed by Susana Magro Andrade, a civil engineer who has dedicated her whole career to the environment. She previously worked in the regional government of Madrid and in a previous stage in the Ministry, she was advisor to the cabinet of the minister and technical advisor to the General Directorate of Coasts.

# What is Spain expecting from the Paris Conference and what will it contribute?

Spain is approaching the Conference with a very clear conviction: it is necessary to adopt a legally binding agreement to which all United Nation countries adhere. We actively participate in the whole international negotiation process, and as European partners, we already all have an agreed common position: by 2030, a commitment to reduce emissions by 40% from 1990 levels.

### As a country that is particularly vulnerable to climate change due to its geographic location, what are the priorities in this fight?

We have designed a Roadmap to fulfilour objectives of reducing emissions by2020 across many sectors. One of the<br/>main initiatives that we are developing is<br/>the Climate Projects, which promote the<br/>reduction of domestic emissions in sectorsWe<br/>with reduction with reduction of domestic emissions in sectors

such as transport, agriculture and waste,through purchasing reductions.

There are also the different Environment Promotion Plans (PIMA) that drive forward updating of the fleet of commercial vehicles, tractors, buses and lorries, as well as of hotel infrastructure. Furthermore, 200 companies have now obtained their certificate with the Carbon Footprint Project, and in 2013 the Work Programme on Adaptation to Climate Change 2014-2020 was approved for our coasts, national parks and water environment.

### What weight does dependence on energy have on climate change and how can it be reduced in the current context?

We must work to achieve a new pattern of growth, based on the pillars of efficient use of resources and promoting clean technologies. We cannot speak

### We must work to achieve a new pattern of growth, based on the pillars of efficient use of resources and promoting clean technologies

about economic and social progress if we compromise ecological principles to achieve it.

### What is Spain's position on emissions trading and what is its role at a European level?

We share the European Union's vision with regard to what we consider to be the

main instrument to achieving the reduction of emissions, particularly in industry and the electricity generation sector, which represent approximately 40% of total greenhouse gas emissions.

### As ordinary citizens, are we more aware of our individual responsibility with regard to climate change?

Spanish society has undoubtedly improved its environmental awareness. According to a 2013 study, nine out of

### We cannot speak about economic and social progress if we compromise ecological principles to achieve it

ten Spanish citizens believe that the phenomenon of climate change exists and that it is mainly caused by human factors, and six out of ten consider that it is a threat to which less importance is given than it is due. We have to directly relate our actions to their results, which cause greenhouse gases to be produced.

As governments we must make commitments and assume our responsibility but, when seeking solutions, it is essential to have "allies", both in companies and in citizens, since fighting against climate change is a common task for us all. As such, initiatives such as this are so important.

### In the actions against climate change, what role do you think engineering companies perform?

The transition to a low-carbon and resilient economy is only possible with the



active participation of all agents involved, both companies and citizens. As such, we have driven forward the creation of the Spanish Green Growth Group, which includes over 30 Spanish companies,

### Spanish society has improved its environmental awareness According to a 2013 study nine out of ten Spanish citizens believe that the phenomenon of climate change exists

which we hope engineering companies will also join.

# What other specific projects are related to the transport sector?

At the Spanish Office of Climate Change of the Ministry, we have promoted the Transport PIMA, which includes aid for the scrapping of buses and goods transportation vehicles that are older than eight years old. With this initiative, a significant reduction in  $CO_2$  emissions and fuel consumption of around 15% per scrapped vehicle is planned, as well as a major reduction in pollutants.«

14

The transition to a lowcarbon and resilient economy is only possible with the active participation of all agents involved, both companies and citizens

# **Protecting forests for barrier-free flying**

### A study analyses forested areas and how they are affected by take-offs and landings

By Marina Elsa Chao, biologist and Juan Fernández-Pampillón, forestry engineer Analysis by ArcGis and 3D illustrations by Laura Martín, geographer

Ineco has carried out an assessment of wooded areas for Aena in the surroundings of Barcelona-El Prat and San Sebastián airports, located adjacent to the protected areas of the Llobregat Delta and the mouth of the Bidasoa river and the Txingudi estuary.

ne environmental reports provide a detailed study of the situation of the wooded areas surrounding both airports, detecting the trees that interfere with the Obstacle Limitation Surfaces (OLS) established by Royal Decree

impact on them. The objective of the study is to achieve a sustainable balance when managing both environments. On the one hand, the protected areas belonging to the Natura 2000 network adjacent to both airports, and on the other, airport management, whose main duties include the monitoring of and compliance with air safety regulations. For Aena's Environment heads "this is

a pioneering study for us. The reports do not only aim to achieve compliance with current regulations on air safety, they also offer added value, providing innovative medium- and long-term solutions to conserve an area with special natural protection, harmoniously and coherently with the airport management". The project includes 862/2009, with the aim of avoiding their a 3D geospatial analysis to calculate the

plans marked out by the OLS, field studies, and the development of regular and detailed forest management guidelines on the arboreal elements in airport settings. The proposal involves sustainable management that meets the requirements of current legislation both in terms of air and environmental safety, allowing the sustainable coexistence of both spaces.«

This is a pioneering study in which we identify trees that infringe the Obstacle Limitation Surfaces (OLS) of Barcelona and San Sebastián airports



Snace

### A PLAN FOR FACH AIRPORT

Ineco has summarised all of the protective measures studied in a Forest Tree Management Plan. "Both for Aena and for the institutions in charge of environmental monitoring, such as for the Consortium for the Protection and Management of the Natural Areas of the Llobregat Delta, the assessment of these reports has been very positive" highlights Susana Gallart of Aena, and she adds that "this Forest Management model is a roadmap and a method applicable to the management of aeronautical easements in any airport located beside protected areas". The Forest Management Plan includes: Area, this action seeks to achieve »

### → Pruning programming in

the most sensitive zone. Most of the infringements detected occur in the zone of OLS heights from 10 to 15 metres. As such. the application PINEA2 has been used to obtain the growth prognosis, establishing both the maximum heights and the estimated period of time in which the pruning will have to be repeated.

 $\rightarrow$  Clearing mass in pruning areas. Although paradoxically it may seem like a measure that is contrary to the protection of the natural values of the Protected



Infringements of the OLS detected in San Sebastián airport Field studies and subsequent analysis reveal the infringements of the OLS at San Sebastián airport.



### Acquisition of LIDAR data Field data collected were compared with the LIDAR (Light Detection and

Ranging) data provided by the PNOA (National Air Orthophotography Plan) of the National Geographic Institute with the aim of detecting potential deviations.



### **Diagram showing penetration** of the laser pulse through vegetation

The first laser pulse returned is the most important and is associated with the largest entity in the panorama such as the canopy of a tree or the upper part of a building. The intermediate returns, in general, are used for the structure of vegetation, and the last return for models of bare soil terrain.

a density of the mass that provides greater lateral growth of the canopies, so that the percentage of leaves affected by the pruning is as low as possible, in turn minimising the impact on the tree. As such, a mature mass is achieved which, over time, will stagnate its growth and therefore avoid the need for permanent pruning.

→ Management of regenerated and specific trees surrounding the airport. With a view to shaping the structure of the canopy of each individual, we considered a comprehensive management of various stone

pine regeneration areas. This management includes treatments to reduce the density and shape canopies. As such, the effect on individuals is much lower than when treatment is carried out on adult specimens that have not been treated early. Once the analysis of the mass and the establishing of corrective and protective measures has been carried out. it is considered that the effect on the forested area belonging to the Natura 2000 network does not result in significant impacts or reductions provided that the planned measures are complied with.«

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To address the real impact of continuous pruning, fieldwork was carried out in which the height of over 1,500 trees of different species was measured



# BCN/ELPRAT

### The mouth of the Llobregat river

arcelona airport is located at Bernard an port of the Llobregat river. Various environmental protection areas have been declared in this deltaic system, including the SACs (Special Areas of Conservation) and SPAs (areas of special protection for birds) of the Llobregat Delta, which belong to the Natura 2000 network. These areas have a significant forest mass mainly consisting of stone pine (Pinus pinea) accompanied by Aleppo pine (Pinus halepensis) and black pine (Pinus nigra), introduced to determine the coastal dune between the airport and the Mediterranean Sea. To address the real impact of continuous pruning, fieldwork was carried out in which the heights of over 1,500 trees of different species were measured (mainly

stone pine), which are located in areas of maximum sensitivity with respect to OLS. Furthermore, and with a view to forest characterisation, 351 diameters of stone pine trees, a main species of the forest stand, were measured.

In parallel, in GIS a 3D model of a closed volume demarcated by the OLS plans was built. Once the fieldwork data

Various environmental protection areas have been declared in this deltaic system, including the SAC and SPA of the Llobregat Delta

were obtained, they were implemented in the model and they were analysed through geoprocessing tools, which allowed the three main objectives to be achieved: determine which individuals were included within this volume (noninfringement), which were exceeding the limits (infringement) and, of the latter, guantify the degree of infringement. The GIS analysis allowed precise quantitative and qualitative results to be obtained that helped design the appropriate protective and corrective measures. In the total trees measured, various infringements were found, mainly located in the zones of La Ricarda and Toro Bravo, of which 14% are below the 20cm of OLS infringement, and since this is the maximum error of the hypsometer

infringements".

### Subsequently, the same procedure was

repeated for the LIDAR data provided by the National Geographic Institute with the aim of validating the model and detecting potential variations in places where it would not have been possible to collect field data. For the El Prat airport, 21 native LIDAR files (.las) were processed with a total of 90,496,306 points, from which the area of tree forest mass that infringes the OLS was obtained, that is, the results obtained refer to areas of the canopy and cannot be interpreted as differentiated individuals. LIDAR has been very valuable in its use as a quality control tool and for validating the data model, as well as for

used, they are considered to be "possible establishing forecasts about the potential growth of individuals in accordance with statistics.

### To comply with the environmental

requirements of conservation, as well as the environmental values of the SAC and SPA of the Llobregat Delta, and ensure that this protected area can continue to coexist with the Barcelona-El Prat airport, protective and corrective measures have been planned that are aimed at both eliminating the infringement of the OLS and enhancing the natural mechanisms that the mass itself possesses in order to resist the pruning without there being a gradual loss of vigour of the trees and, as a result, a general decline of the mass affected.«



BARCELONA AIRPORT, STUDY SETTING Protocol for forest management of the mass of trees in the areas belonging to the Natura 2000 network of Barcelona airport.





possible, the natural shape of the individual's canopy, and as such, it is necessary to adjust the cutting of branches so that the resulting structure remains as constant as possible. Furthermore, to cut them, branches with the smallest diameters will always be chosen. The cuts carried out will be clean. close to the stem and will not affect the collar with tearing, will not damage the branch collar and will not leave a stump, as shown in the images.

The corrective measures include pruning in line with criteria and best practices that ensure the minimum weakening of the tree and that, in turn, promote greater lateral growth in the trees affected



# EAS / SAN SEBASTIÁN



SAN SEBASTIÁN AIRPORT. STUDY SCOPE Actions on trees that infringe the easements in San Sebastián airport.

### A special conservation area beside the Bidasoa river

Can Sebastián airport is located next to the mouth of the Bidasoa river and the Txingudi estuary, which conserves important natural values, and as such, it is protected by various environmental protection figures, amongst which are the special conservation area (SAC) "Txingudi-Bidasoa" and the special area of protection for birds (SPA) "Txingudi", belonging to the Natura 2000 network. Furthermore, the Bidasoa estuary is designated as a Ramsar wetland and is inventoried by SEO/BirdLife as an important bird area (IBA). Lastly, the 1994 plan for special protection and management of the natural resources of the Txingudi area classifies the lagoon of the airport as having the

status of special protection. The lagoon, located within the airport grounds, has a fringe of vegetation of around ten metres wide in its margins.

The main supply of water comes from the underlying aquifer and the collection of rainwater, since the supply from the estuary at high tide is very limited. Aena, through an agreement with the Basque Government, has developed guidelines for managing the water regime and

As a protective measure, a lagoon tree management plan within the airport was prepared vegetation of the lagoon to achieve better conservation and quality of the habitats.

The overall results obtained were the measuring of 489 heights and locations of different individuals, mainly of black locust (Robinia pseudoacacia) and white mulberry (Morus alba), although measurements were also taken of French Tamarisk (Tamarix gallica), different species of willow (Salix spp.), palm trees (Washingtonia robusta), laurels (Laurus nobilis), birch (Betula alba), poplars (Populus spp.), and other hardwoods. Once the field data were obtained, each individual inventoried was analysed using GIS tools, identifying the infringements of the OLS, of which several are included in the Natura 2000 network space.«

# **Corrective and protective measures**

■ The corrective measures include the execution of pruning in line with criteria and good practices that ensure the minimal weakening of the trees and, in turn, promote better lateral growth of the trees affected so that, in the shortest time possible, they can replenish the loss of leaf area.

■ Lastly, and as a protective measure, a lagoon tree management plan within the airport was prepared. This management is aimed at achieving the main study objectives: the establishing of a tree mass that maintains carrying capacity and, as far as possible, improves its environmental values by replacing exotic species with a high colonising power with other native species in order to comply with the regulations on air safety that San Sebastián airport is required to abide by.

### THE ENVIRONMENT AND AENA AIRPORTS

The extensive network of Aena airports with 46 airports and 2 heliports in Spain has brought the company much experience in the conservation of natural resources, environmental protection, and the maintenance of quality of life of the surrounding population.

**Given the large expansions of land** in which its facilities are located and their different locations, the diversity and type of ecosystems that can be found therein varies greatly, with them housing different habitats in which Aena works to maintain and conserve over time, providing the ecological niches necessary for the establishing of different populations of animal species.

With this objective in mind, each airport has a **fauna control service** that works to guarantee the safety of aeronautical operations while respecting the biodiversity of the surrounding environment, carrying out various actions and initiatives that promote the conservation of various animal and vegetable species both within and in the areas surrounding the airports.«

# Getting all of the facts

### Independent technical consultancy for financial institutions

By Carlos Sánchez, civil engineer

Since 2009 a team of experts from Ineco has advised financial institutions on concessions regarding three sections of L9 of the Barcelona underground. It will be the longest automatic underground line in Europe.

will become the longest suburban ine with automatic train operation in Europe, and is the first non-radial line of the metropolitan rail service in the city. The line spans a total distance of 47.8 kilometres and has trains circulating at two different levels for the majority of its course. The line will boast a total of 52 stations, some of which will be located 60 metres below around. These stations will serve as connection points with the rest of the underground lines, regional railways (FGC and Renfe) and the tram. The line will travel around the centre of Barcelona, thus notably enhancing the efficiency of the current metropolitan transport network.

### From the beginning to future outlook

The transfer began in autumn of 2009 in the area called Besòs with 11 stations in section IV where development took place over several stages until September 2011. The underground is expected to officially coming into service at the beginning of 2016. All of section I will open (with the exception of two stations), in addition to 4 stations in section II which will connect the city of Barcelona with the Barcelona-El Prat airport for the first time ever. The line will connect cities such as El Prat de Llobregat, L'Hospitalet de Llobregat, Barcelona, Badalona and Santa Coloma finance. de Gramanet.

The Railway Infrastructures of Catalonia (IFERCAT, currently infraestructures. cat) launched the concession process in 2008 to construct and operate the stations. Concessions were granted in 2008 for sections I and IV, and in 2010 for ine 9 of the Barcelona underground section II. Since March of 2009, Ineco has offered independent technical consultancy to the group of entities that partici-

pated in concession financing for stations in sections I, II and IV using project

The most important Spanish and European institutions involved in infrastructure financing that participated are La Caixa,

Line 9 of the Barcelona underground will become the longest suburban line with automatic train operation in Europe



BBVA, Banco Santander, Bankia, Banco Sabadell, Instituto de Crédito Oficial (ICO), Natixis, WestLB, and the European Investment Bank, which financed another tranche of the project. The main focus of Ineco's work has been on providing the institutions with all of the studies they need to award project funding during the previous phase. Their work is also aimed at monitoring the construction process -with projects valued at close to 2 billion euros- as well as during the exploitation and operational phases.«

# Ineco's work on L9

With their team of experts in contract drafting, construction supervision and maintenance, budgetary control, financial and legal analysis and investment assessment. Ineco has carried out the following functions:

- Entrance to Can Peixauet sta
- eridiana station platform



- Due Diligence of project's technical and contractual assessments and its risks
- Monthly reports for validation of loan drawdowns
- Quarterly monitoring reports of the evolution of investments
- Final reports on each of the stations
- Technical report for financial commissioning
- Due Diligence of contract modifications
- Studies on economic and financial readjustments that have occurred
- Reports on waivers of changes to services rendered

# A new tram in the old Cossack city

Ineco's analysis includes proposals for a comprehensive renovation

With the collaboration of Roberto López, civil engineer

The city of Pavlodar, an old Cossack settlement and an important industrial hub in Kazakhstan since the middle of last century, wants to modernise its tram. Ineco and Deloitte have elaborated a feasibility study for the EBRD which will finance the project.

n May of 2015 the European Bank for Reconstruction and Development (EBRD) signed a finance contract with the tram company in Pavlodar. The purpose of this finance contract for ten million euros is the modernisation of the city's tram. Ineco, in consortium with Deloitte, has elaborated a feasibility study for the EBRD in which quidelines for the project were defined such as the purchase of 25 new trams, infrastructure renovation and implementation of a public service contract between the City Council and the company, among others. All of these guidelines involve updating the infrastructure and management of Pavlodar's tram, which together with the bus system provides vital service to the 330,000 inhabitants of this industrial city located to the northeast of Astana, the capital of Kazakhstan.

Pavlodar, located on the banks of the large, navigable Irtysh River, was originally a settlement associated with the exploitation of salt, and later on a *Stanitsa*, or a Cossack military village. Around the middle of the 20th century, Pavlodar became a nucleus for several metallurgical and chemical industries, including a tank factory. The tram came into use primarily to transport workers to the industrial plants, a service that still continues today albeit in different

circumstances. The passage of time, competition with the bus and the increased use of private vehicles has caused a continuous fall in the number of tram users since 2007. Of the city's 200,000 daily public transport users, only 32% opt for the tram compared to 68% that prefer the bus or the minibus a situation trying to be reversed with a comprehensive modernisation plan. Ineco has analysed the condition of the tracks and the rolling stock, as well as the management system. With this information a series of proposals have been elaborated. Starting in 2016, the aim is to progressively recover 50% of the almost 10 million passengers lost since 2007.«

### **Different forecasts**

On the premise that the quality of service influences mobility demand and that it is also directly linked to population growth –which in the case of Paylodar is not expected to exceed an average of 0.9% per year-, demand forecasts for three different scenarios have been drawn up. The most optimistic forecast predicts that the tram will boast 19.9 million passengers in 2016, 26.6 million in 2020 and 31.1 million in 2028. This increase would go hand in hand with implementation of the of the improvements proposed.

The most conservative forecast estimates that the tram would not reach 20 million passengers until 2028. In a scenario with no changes, the tendency would be just the opposite with a loss of users until only 11.6 million passengers would be using the tram in 2028. On the basis of these forecasts, the study includes a risk assessment, a costbenefit analysis and an economic-financial analysis of the proposed actions.





### DIAGNOSIS AND SOLUTIONS

### **NEW TRAMS**

Pavlodar's public transport system is based on two modes of transport: buses and minibuses (these are more expensive but offer higher quality), and trams. The tramway network measures 89.2 kilometres and has 76 stops over a total of nine routes. The fleet consists of 112 units, eight of which do not transport passengers (they are used for maintenance work and other tasks), and are very outdated. 68% of the trams have been used for an average of 30.5 years, which have surpassed their expected 16-18 years' lifespan.



As a result, the number of breakdowns has increased by more than 15% over the last few years, from 3.6 daily breakdowns to 5.5 in 2013. This has increased maintenance costs in addition to provoking frequent delays. This decrease in service reliability comes in addition to increased fares -more expensive than bus fare- to help offset rising costs. These factors have led to an increased loss of passengers.

After comparing the costs of repairing the fleet with the costs of acquiring 25 new trams, the study **proposal** opts for the latter option: the new rolling stock will not only consume less energy, but will also reduce maintenance costs

as well as minimise the incidence of malfunction. Route optimisation has also been given some close attention, estimating that the total fleet would not need more than 74 units.

city centre where the ballast is covered with a layer of asphalt, in junctions with traffic road. The track also has drainage problems, especially in the winter. About half of the alignment (46.19 kilometres) was either improved or renovated in INFRASTRUCTURE RENOVATION the 1990s. The rest of the alignment, The track's geometry is irregular due to however, has been in service since 1971, alterations over its many years in use, thus requiring a more urgent renovation. the traffic, insufficient maintenance and In terms of electrification, the network the harsh climate. The gauge is 1,524 has nine traction substations of 10.6 mm with a minimum separation between kV/600V and overhead contact lines; the the axes of the tracks measuring 3.68 cabling and connections have been in metres. There are four different types use for between 30 and 50 years. of rails and two types of sleepers, made The proposal is to eliminate all of from concrete or wood. It is mounted on these shortcomings and to rectify the ballast except for some stretches in the alignment in order to improve passenger

## The study proposes purchasing 25 trams, completely renovating the infrastructure, redesigning and optimising the transport network and implementing a public service contract with the municipality

comfort. Infrastructure restoration includes renovating and repairing the track, substituting overhead contact lines, updating the electric substations and improving 21 junctions. It also includes remodelling two stations to convert them into terminals, as well as updating another three stations so that they can be used as exchange stations. Four work phases have been established between the years 2018 and 2027 for sections measuring between 14 and 24 kilometres per phase. The feasibility study includes general technical guidelines for carrying out the work. It also includes references to international standards as well as considerations regarding guality assurance and track maintenance implementation plans.

### **NETWORK OPTIMISATION**

The distances between tram stops are very short (between 260 and 600 metres), hence slowing down commercial speed to about 18 km/h. Many of the stops are not properly segregated from the tram tracks with elevated platforms for passengers. Furthermore, many do not provide shelter nor or are they accessible to people with reduced mobility. The network, with two north-south lines, is designed to connect the city's industrial areas. However, other areas are left unconnected to tram service, such as the eastern part of the city or the Irtysh River banks. Several tram routes overlap each other, and some even overlap bus routes. To date, no combined fares exist with the exception of a monthly pass valid for the bus and tram, but its price is high compared to that of a single ticket. Moreover, its use is minimal.



The proposals are to modernise the tram stops, increase service on certain lines (lines 5 and 3) and reduce service on others (lines 1, 6 and 8). The proposal also implements a ticket which includes a transfer. It also recommends eliminating the bus lines which overlap tram lines. In the longterm, tariff and fare integration should be implemented for both modes of transport (travelcard).

### PUBLIC SERVICE CONTRACT

The tram company in Pavlodar belongs to SPK which is dependent on the regional Government. SPK has a contract with the municipality that was renewed in 2014

nor does it include requirements for quality of services: punctuality, safety, etc. The contract is very open, it also fails to regulate the relationship between the owner of the infrastructure and the operator. The proposal is to establish a public service contract between the municipality and the company. The municipality would assume the demand risk; in other words, they would have the capacity to make decisions regarding the offer as well as the level of quality that the operator should be providing. The tram company, however, would be responsible for the operational risk: meeting service requirements while keeping costs to a minimum. The company would be reimbursed for subsidised tickets (for groups such as senior citizens, students. individuals with disabilities, etc.), and for vehicles per kilometres (VKM). The contract would include a system of incentives and penalties dependent on compliance with quality service standards (punctuality, etc.). On the other hand, it is anticipated that current compensation coming from the industries which receive tram service around the city should be transferred to the municipality, given that these are loss-making routes. It is also recommended that ,in a few years, tram infrastructure ownership be transferred to the municipality, given that this entity has investment capacity. In many cities a fee is charged for its use. If the company continued to manage tram maintenance, it could receive compensation that would be included in

the contract.«

and is valid until 2018. The contract does

not specify geographic coverage or routes,

# TRANSPORT THINKING

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STRATEGIC MOBILITY PLAN, ECUADOR | AIRPORT EXPANSION PROJECT MANAGEMENT, KUWAIT | HSZ HIGH-SPEED, UK | HARAMAIN HIGH SPEED TRAIN MAKKAH-MADINAH, SAUDI ARABIA MODERNISATION OF AIRPORT NETWORK AND REORGANISATION OF AIRSPACE, SPAIN CPTM LINES, BRAZIL | HIGH SPEED RAIL NETWORK: INFRASTRUCTURES: SPAIN | HIGH SPEED RAIL NETWORK: TRAIN CONTROL SYSTEMS: SPAIN | SUPERVISING AGENT GUADALAJARA - COLIMA HIGHWAY, MEXICO | OPERATIONAL READINESS AND AIRPORT TRANSFER OF THE MTC OF ABU DHABI INTERNATIONAL AIRPOR

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INTERMODAL | SPAIN | Public transport management

# Madrid in real time

All public transport in the Region of Madrid is coordinated by CITRAM

By itransporte



Technological innovation in this centre allows for real time coordination of the region's entire transport system. A smart mobility service for five million daily trips that is attracting the attention of several major cities from various continents.

e Integrated Public Transport Management Centre of Madrid, CITRAM, was inaugurated in 2013 after intense preliminary work that had been started six years earlier. Just as the creation of a single transport authority in Madrid was ground-breaking in its day – The

Madrid Transport Consortium- so is CIT-RAM, which depends on said Consortium. If the Consortium is the brain of Spain's most populated region public transport system, then CITRAM is its eyes and ears. Thanks to a network of 20,000 cameras (city cameras, cameras in the metro, traffic cameras, etc.), and 6,000 informative panels spread throughout the transport network, information from five thousand vehicles from 40 different public and private operators is received and exchanged in real time. CIT-RAM is also connected to "112" Emergency Services, the Directorate General of Traffic (DGT) Control Centre and the Madrid City Council, all while functioning 24 hours a day, seven days a week.

This amount of information not only serves to coordinate the largest transport system in Spain during major events, but also transfers this information directly to users to improve their travel experience.

### CITRAM integrates all transport data from around the region of Madrid. It is especially useful during major events in public spaces as well as for monitoring all kinds of incidents



Consortium's data reveals that two thirds of the millions of daily travellers utilise more than one mode of transport. This means that knowing ahead of time about any type of incident in the transport chain is extremely helpful. The information that reaches the informative panels in the metro and at bus stops originates in CITRAM, and is also available via a mobile app. Users can choose an alternative route or mode of transport to arrive at their destination, allowing them to save time and money. In this light, the CITRAM represents tremendous progress in the development of "smart" public transport, and its creation is transport management.«

### **Experts in integrated transport management**

The Regional Transport Consortium was created in 1985 to unify the Community of Madrid's regular public transport with that of associated cities. Its Board of Directors is formed by representatives from the Community of Madrid, from associated cities and from the State's General Administration in addition to several social organisations: private transport operators, consumer and users' associations and unions. Even though the Consortium does not have authority in the scope of commuter rail trains, there is an agreement with Renfe allowing for use of a step forward in intermodal and integrated an integrated ticket. Transport Passes were established in 1987 which introduced the

concept of a "unique ticket" for the first time. These monthly or year-long passes allowed for unlimited travel within specific zones. The old magnetic ticket has recently been substituted for contact-less card technology which ensures greater security and better features, a technology that already has 2.5 million users in Madrid. The Consortium's primary mission involves infrastructure planning and programme coordination for the development of the different modes of transport.

This integrated management model has proven its usefulness over the last 30 years and is used today among Spain's major cities. It is also a reference model for other metropolitan The creation of CITRAM represents tremendous progress in the development of "smart" public transport and its creation is a step forward in intermodal and integrated transport management



areas around the world, as is demonstrated by the constant flow of visitors from international delegations, close to 50 in 2014. Among these international visitors was the Muscat Delegation, capital of Oman, where Ineco has just finished a public transport master plan for the city.

Implementing a sole transport authority is the cornerstone of the plan which is following the model utilised in Madrid which has received multiple acknowledgements. Among the most recent awards was the "Best Public Works Project" granted to the Consortium in 2014 by the Association of Civil Engineers. This award was presented to the Consortium on account of CITRAM's cutting-edge work and contribution to quality service in public transport.«

### The cornerstones of CITRAM

- Fully operational 24 hours a day, 365 days a year.
- It coordinates the work of 40 public and private operators that handle the region's public transport.
- It encompasses the region's 179 City Councils, including the capital, Madrid.
- It allows for the visualisation of 20,000 security cameras observing the different modes of transport.
- It monitors the 5,000 vehicles which provide services.
- Access to 6,000 informative panels.
- Connections to the Directorate General of Traffic Control Centres, the Madrid City Council and "112" Emergency Services.
- Geo-referenced facilities.
- Integration of CCTV systems both onboard vehicles and at facilities.
- A web-based incident manager: alarms, conditions, complaints and suggestions.
- App for notifying clients in real time.



### Apps for stops with low demand and other personalised services

CITRAM's smart transport service offers a

wide range of applications. At present there are two fully operational applications, both of which are free of charge. One application is for the public transport card and is available on the computer, smart phone and tablet. It allows users to check their card expiration date, card balance and authorised card recharging locations. Also available to users is the "My Transport" application which offers real time information for the whole transport system.

The Consortium is also working on a pilot programme called "Order Your Bus". It involves an on-demand stop service in the



town of Valdemorillo in the Region of Madrid. Users are able to request service at low demand stops via their mobile phones. The system contacts the closest vehicle and then notifies the user as to how long the vehicle

will take to arrive. This way, operators can optimise routes while travellers can make plans according to the time they have without having to wait unnecessarily. **Another consolidated app is one which** allows for system inspection. Not only does it oversee whether or not service is correct, but it also supervises the quality of services in addition to facilities maintenance (stops, glass windows, signs, maps, etc.). Ticket payment via mobile phones, online transport card recharging and cultural/leisure information available via the apps are just some of the many developments underway in the pilot programme.«

## More space to grow

### The ICAO awards Uganda's National Airport Plan to Ineco

In collaboration with Pablo Fuente and Paloma González, aeronautical engineers

The Uganda Civil Aviation Authority (CAA) plans to construct three international, three regional and six local airports, as well as expand the

e aim is for the airport infrastructures, which Ineco are reviewing and planning for the Uganda Civil Aviation Authority (CAA), to be completed by 2033 and their goal is ultimately to encourage the growth and consolidation of the tourism industry, as well as to earn significant financial returns for the country. Given its geographical location in the centre-east of the African continent and the fact it is landlocked, air transport is vitally important to the country which borders the Democratic Republic of Congo to the west. South Sudan to the north. Kenva to the east and Rwanda and Tanzania to

### The aim is for the airport infrastructures, which Ineco are reviewing and planning for the Uganda CAA, to be completed by 2033

the south. It is part of the East African Community (EAC) along with neighbours Kenya, Tanzania, Rwanda and Burundi. With its 10 national parks and exceptional flora and fauna, Uganda is a growing tourist destination. The Rift and Nile valleys, its great lakes, waterfalls and wild fauna mean it deserves to be considered one of the most stunning destinations in the world. The country has high-quality tourist facilities, an extensive road network and an established tourism industry that

political stability will allow to develop further.

Its more than 36 million inhabitants have English as their official language and their most important activity is agriculture; with existing Entebbe International Airport. its tropical climate and abundant natural resources, its main exports are coffee, cotton and sugar. The products exported by air are fish, flowers and other fresh products such as fruit and vegetables. The country also has large copper and cobalt deposits and it has begun to exploit gas and petrol. Battling poverty, increasing per capita income and developing the local economy and industry are the challenges the current government is tackling by investing in the improvement of its airport infrastructures.

The Entebbe International Airport, which is for both civilian and military use, is the country's main airport. It is situated near the city of the same name, on the banks of Lake Victoria, some 35 kilometres from Kampala, the capital of Uganda, and it is the country's main passenger and cargo entry

### ANNUAL PASSENGER FORECASTS

	COMMERCIAL	MONUSCO*	TRANSIT	TOTALS
2015	1,507,000	171,000	114,100	1,792,100
2016	1,638,000	184,000	126,300	1,948,300
2017	1,785,000	197,000	140,000	2,122,000
2018	2,007,000	210,000	160,100	2,377,100
2019	2,258,000	222,000	183,200	2,663,200
2020	2,538,000	235,000	209,400	2,982,400
2021	2,793,000	248,000	234,200	3,275,200
2022	3,059,000	260,000	260,600	3,579,600
2023	3,256,000	273,000	281,700	3,810,700
2024	3,507,000	286,000	308,200	4,101,200
2025	3,779,000	298,000	337,200	4,414,200
2033	6,607,000	400,000	660,700	7,667,700
*MONUSCO: UNITED NATIONS STABILIZATION MISSION				SOURCE: INECO

airway. 19 airlines operate in the airport, which offer good links to Europe, Africa and the Middle East. The airport also houses a major United Nations logistics base for missions in other countries in the region.

According to traffic forecasts, the 1.5 million passengers transported in 2013 will

### The improvement of airport infrastructures will help to develop tourism, the economy and local industry

rise to 7.7 million in 2033. It is predicted that there will also be a notable increase in cargo, from 56,000 to 172,000 tonnes. This is enough of a reason for the Ugandan government to prioritize the expansion and modernization of its infrastructures in order to improve passenger and cargo services, promote tourism and exports, and achieve economic growth and an increased quality of life for the region and its inhabitants.«



### UGANDA, A GROWING TOURIST DESTINATION

With its 10 national parks and exceptional flora and fauna, Uganda is a growing tourist destination. The Rift and Nile valleys, its great lakes, waterfalls and wild fauna mean it deserves to be considered one of the most stunning destinations in the world. The country has high-quality tourist facilities, an extensive road network and an established tourism industry that political stability will allow to develop further

## **Uganda's National Airports Plan** drawn up by Ineco includes traffic forecasts and everything the airport infrastructures will need until 2033

### A comprehensive study of Ugandan air transport

he International Civil Aviation Organization (ICAO), which supports and advises the CAA in civil aviation development, has commissioned Ineco to conduct strategic, financial and economic impact studies. The work includes the National Airport Plan, the Entebbe airport Master Plan, the modernisation plan for air navigation services and designing a route map for the implementation of air security management systems.

The master plan includes all the Entebbe airport's short, medium and long-term needs, up to its foreseeable maximum growth capacity. The study also suggests phases of development to keep interference to the airport's normal operations to a minimum during the construction process. Among other aspects, the study also sets out what is required to acquire new areas and alternative proposals for the location of the new facilities, both on the ground and in the air, including control towers, terminals, cargo areas, auxiliary buildings and associated facilities such as aprons, taxiways, car parks, access roads, etc. Environmental aspects are also considered with sustainable future development in mind. This includes drawing up plans for noise, air quality control, energy consumption, water, waste, etc.«



### AIRPORT NATIONAL PLAN AND MASTER PLAN

As well as this expansion, Ineco, as a consultancy, has integrated the master plan into a wider study -the National Airports Plan- which includes the development of 12 small existing airports to develop three international, three regional and six local airports. The three international airports are located in Arua, Kasese and Pakuba. The discovery of petroleum and gas deposits in the west of the country has accelerated the need to build a new one in the Hoima region, together with the future refinery in Kabaale. The planned regional airports, where tourism and chartered operations play an important

role, are in Soroti, Gulu and Kidepo. Lastly, the development of six local airports is also being considered: Moroto, Lira, Tororo, Jinja, Mbarara and Kisoro.

Some of the airports that provide access to Uganda's main national parks are:  $\rightarrow$  **Pakuba** / Murchison Falls National Park  $\rightarrow$  Kasese / Queen Elizabeth National Park → **Kidepo** / Kidepo National Park  $\rightarrow$  Jinja / The source of the Nile

- $\rightarrow$  Kisoro / Bwindi Impenetrable
  - National Park



35

>>

The proposal for the Entebbe airport includes the expansion of the airfield and commercial apron, a heliport and a new control tower



### PRESENTATION OF THE NATIONAL AIRPORT PLAN IN KAMPALA

Uganda's Civil Aviation Authority presented the National Plan, devised by Ineco, to institutions and the media on 29 January, 2015. It was attended by Abraham Byandala, the Transport minister and W. Rama Makuza, director of Uganda's Civil Aviation Authority, in the centre of the image. On the right is Pablo Fuente, an aeronautical engineer at Ineco and project manager.

### GROWTH AND ENVIRONMENTAL ASPECTS

Uganda has 62,000 km<sup>2</sup> of protected zones in 732 areas, which comprise 26% of the country's territory. The increase in demand, expansion of the Entebbe airport and construction of new airport facilities all have an impact on the environment, which is why preliminary studies have to be conducted. Ineco draws up environmental impact assessment reports which take into account territorial balance, habitat and the local flora and fauna. In other studies and environmental impact assessments, Ineco needs to draw up noise footprints and forecasts for 2033. The image shows a noise map of the Entebbe area during the day.





Elephants in the Queen Elizabeth national park.



# UGANDA: ONE OF THE MOST STUNNING DESTINATIONS IN THE WORLD

Kampala, the capital of Uganda, is the country's main destination, accounting for 54% of its tourist activity. The Entebbe airport is 35 kilometres from the city. Murchison Falls National Park. Situated in the northeast of the country, near the Congolese border, it is 50 kilometres from the Kasese airport. Murchison, known for its enormous crocodiles, is one of the most visited destinations, along with the Queen Elizabeth national park and those on the Ssese islands, an archipelago of 84 islands in the north-east of Lake Victoria. Ineco's study forecasts that the environmental impact on protected zones will be kept to a minimum. HOTO: ROD WADDINGTON (FLICK

### RAFTING

Rafting enthusiasts encounter rapids to enjoy the sport in rivers close to the city of Jinja, a colonial enclave next to the source of the Nile, one of the country's most beautiful and most often visited places.

TO: YOTUT (FLICKF

S: DAVE PROFFER (FLICKA

# The sky is the limit

### 11 European countries participate in the project

By Laura Serrano, aeronautical engineer

One of the biggest European air navigation projects finishes at the end of the year: ANSPs IDP. With a budget of more than 200 million euros and co-financed by the EU, European air navigation heads are aiming to deploy the Single European Sky's technology.

NSPs IDP is a European project that brings together the main European air navigation service providers (ANSPs), and the Spanish engineering company Ineco, to implement the bases for the future deployment of SESAR in a coordinated manner. The project is part of the European transport network improvement programme, TEN-T and

it aims to improve airspace management (making the way aircraft currently fly more flexible), the decision-making processes in airports (in order to improve aircraft punctuality, the turnaround time, etc.), communication between aircraft and control centres, the tools that support air traffic management and landing procedures in the main European airports.

### The participation of a consortium

The work, which affects 11 member states (Cyprus, Estonia, Finland, France, Germany, Italy, Lithuania, Malta, Portugal, Spain and the UK) has counted on the participation of a consortium made up of the air navigation heads ENAV (Italy), project coordinator, Enaire (Spain), DFS (Germany), DSNA (France), MATS (Malta), NATS (UK), NAV PORTUGAL, FI- NAVIA (Finland), LGS (Lithuania), DCAC (Cyprus) and EANS (Estonia). The involvement of the members of this consortium guarantees it will be far-reaching from a geographical perspective, which will enable the internal deployment programme (IDP) to be implemented correctly across Europe.

Ineco was involved in the consortium. supporting both the Italian coordinator, ENAV, and the rest of the partners

Ineco was involved in the consortium. supporting both the Italian coordinator. ENAV, and the rest of the partners in management activities

in management activities. Since 2013, a team of the company's air navigation experts has provided a transversal technical support service with the aim of guaranteeing the planned deadlines, costs and quality levels would be met.

### Implementing SESAR

Since the project started in 2013, different deployment initiatives have been launched for SESAR, which was designed to develop the future European air traffic management system through the development, validation and launch of a new ATM (air traffic management) infrastructure. Its development will enable air space capacity to increase, safety and interoperability to be reinforced and air traffic's environmental impact to be reduced, accompanying its growth up to



### 5 MAJOR AREAS OF IMPROVEMENT

The main objective of this internal deployment programme (IDP) is to improve the way the ATM network works in a synchronized and coordinated manner, to the benefit of its end users, with the involvement of the main European ANSPs and the support of the European Commission.

Development of ASM / ATFCM processes / Free routing / Development of technical enablers that make it possible to operate with free

Area3 Improvement to the operations in an airport, paying particular attention to the aircraft turnaround and the pre-departure sequence process ACDM

### Area4 Air-ground datalink Improvement to ATS systems / Improvement to communication infrastructure /

and dialoque



### Area2 Airspace management improvements and data sharing

Improvement to data links

### Area5 Automated assistance to controllers for seamless coordinated transfer

OLDI migration from X.25 to IP / Supplementary OLDI messages

### Area6 High-precision RNP approaches

National deployment of APV in several European countries

# With panoramic views

### Ineco is working in conjunction with the Quito city hall on the Metrocable project

By Manuel Francisco Herranz, civil engineer and Carlota Serrano, economist

Since the 1970s, cable cars have been incorporated little by little into cities' public transport networks as an additional mode of transport, and the figure currently stands at a considerable 20 urban cable car lines.

ne capital of Ecuador, like many cities in the world, has had a tourist cable car since 2005. During its 10-minute, 2.5-kilometre journey, it climbs from an altitude of 2,950 metres above sea level up to more than 4,000. providing a spectacular panoramic view of the city. However, this type of cable-based transport is already completely integrated in the urban transport network in cities such as Medellín. La Paz. Caracas. São Paulo, Oregon, London and New York.

Quito, with 2.2 million inhabitants (including its metropolitan area) is situated

in a 50 kilometre-long by just 8 km-wide Andean valley, at an altitude of over 2,800 metres. Therefore, the city has expanded across the valley and up its sides, creating an urban area with sheer inclines, which is why an "aerial lift" is such an appropriate transport system. Hence the city has launched a four-line "metrocable" project,

In addition to its low cost, speed of installation and low levels of contamination. the metrocable will make it easier for the inhabitants of isolated districts to integrate, thus improving the quality of life in the surrounding area

The metrocable, a unifying mode of transport

The metrocable is an aerial transport **system** consisting of cabins, cables, pulleys, poles and stations. During planning, it is important to take into account -in addition to how mountainous the area is that it is being installed in- the demand it will generate and the opportunities to integrate districts which, due to their location, have been poorly connected to the rest of the city. With their limited impact on urban links when they are being constructed, cable-based transport systems can carry more than 200 people in their gondolas

and reach operating speeds of up to 21 km/h. Although they do not reach the levels of traffic of other mass modes of transport, when sheer inclines have to be negotiated, they become very competitive in comparison to other transport options. Installing them is also a viable option in places where conventional machines cannot be used due to land being inaccessible or in order to reduce heavy investment in the construction of roads and railways. In addition to its low cost, speed of installation and low levels of contamination, the metrocable

has shown that it makes it easier for inhabitants of isolated districts to integrate, improving quality of life in the surrounding area.

In order to operate the system public private participation methods can be formulated to facilitate financing for the development and subsequent management of the infrastructures. One of the advantages of the metrocables is their significantly lower cost compared to the investment requirements for other transport systems such as buses and trams.«

which Ineco has conducted preliminary feasibility studies for.

### Aim of the first system

In the mid-20th century, cable cars began to be used systematically in winter seasons for winter sports and recreational use to travel up to raised areas with good views of the surroundings. The latter was the aim of the first cable-based transport system built by the Spanish civil engineer, Leonardo Torres Quevedo (1852-1936), who was the director of the laboratory of applied mechanics, president of the Royal Academy of Exact Sciences, member of the Royal Spanish Academy and an associated member of the Paris Academy of Science. One of Torres Quevedo's many contributions was the construction of the Aerial Tramway for San Sebastián in the Basque Country, which connected Mount Ulloa with San Sebastián, becoming the first cable car in the world designed to carry people.«



### Most successful case: the Medellín Metrocable



Of all the cable-based transport systems that operate in the world, the case of the Medellín Metrocable was undoubtedly the most successful: with three lines in service and two more under construction, the first line, K, launched in August 2004, was used by 12 million passengers in 2013. The second line, J, reached 5 million users. Both are connected with the rest of the public transport network. The three current lines run across a total of 9.37 kilometres and have eight stations, all of which are adapted for people with reduced mobility.

But the truly revealing fact is not just the figures: its installation has been a decisive factor for the population of marginalised and low-income districts to have access to the city's mass transport network, and thus integrate with the rest of the community.

The inhabitants of the most isolated and troubled areas have not only been able to reach the city centre in a reduced journey time, but this exchange has reduced levels of social and cultural isolation and, ultimately, guality of life has improved.«

In 2015, Ineco conducted the preliminary cable-based transport system feasibility study for the Municipality of **Quito's Department of Transport** 

INTERVIEW | DARÍO TAPIA

# Metropolitan District of Quito's Secretary for Transport "Metrocable is not a tourist project, but a mass public transport system"

# FEASIBILITY STUDIES [ Quito Cables Project, Ecuador ] INECO

In 2015, Ineco conducted the preliminary cable-based transport system feasibility study for the Municipality of Quito's Department of Transport. The project includes financial and management models for the four lines of the system named Quito Cables. It is forecast that these four circuits will be integrated into the metropolitan public transport system and serve a total of 120,000 people. The work carried out by the company includes:

 $\rightarrow$  Analysis and authorization of the documentation provided by the Municipality of Quito.

→ Preliminary economic-financial profitability study for the project.  $\rightarrow$  Analysis of the potential management model and contracting the Quito Cables service.

→ Distance learning/training on the economic-financial assessment process.«



MAP OF THE FOUR LINES PLANNED FOR QUITO The project includes financial and management models for the four lines of the system named Quito Cables.

## **Visual impact on districts**

The stations' architecture makes a visual impression on the user and the surrounding environment. Its design, function and cost can vary greatly. The image shows the Medellín metrocable.



neco interviews Darío Tapia, the Metropolitan District of Quito's Secretary for Transport, Metrocable's lead project manager.

### What does Quito's Metrocable project involve?

It is important to underline that it is not a tourist project, but a mass public transport project, which will afford people the opportunity to avoid Quito's congested traffic. We are launching a project which will not only serve the longitudinal northsouth axis but also the districts located to the east and west.

### How will the project be integrated into the city's transport system?

Metrocable is part of an Integrated Transport System, which is why the northern lines. Pisulí and La Ofelia. for instance, terminate in a transfer terminal, where people will be able to access the rest of the system from districts in

raised areas. Meanwhile, we believe nonmotorized transport, such as the bicycle, could complement the metrocable system both in the centre and the south of the city. We are also already planning for the metrocables to reach the city's metro stations, with the possibility of not just operational but also priced integration.





### Who will this new system serve?

We estimate that in the first phase, no fewer than 100,000 people, plus another 70,000 additional people from Quito's satellite cities, such as Tumbaco and Cumbayá.

### What are your predictions for when the different lines come into service?

One of our main predictions is that the sections of the city with metrocable stations will be regenerated, with street lighting, roads in a good condition and parks and gardens that will bring the project to life. Then, by virtue of being part of an integrated transport system, the raised areas of the city will have connecting services to transfer people directly to metrocable stations.«

### Ineco's vast experience

Ineco has worked on various phases of the entire infrastructure development cycle (planning, design, construction and operation) in similar projects in Spain and Mexico. The company has vast experience in feasibility studies for urban and commuter train network enlargement in Spain (Madrid, Málaga, Barcelona, A Coruña, Biscay, etc), as well as Mexico, Kuwait, Costa Rica, Colombia, Nicaragua and Ecuador itself.

Advisory services to companies and public administrations for financing infrastructure projects.

- Economic-financial feasibility studies.
- Structuring public-private joint ventures.
- Risk assessment.
- Traffic analysis and stated preference surveys.
- Planning commercial management for regions and buildings.

### URBAN TRANSPORT | **BRAZIL** | São Paulo underground

MAL

# Energy 12 metres above ground Power supply systems for the new São Paulo monorail

with the city centre.

he engineering company Isolux has relied on Ineco to carry out the manufacturing and installation construction projects for the low voltage power supply systems and auxiliary systems on line 15 of the São Paulo underground. This is the first monorail line to be constructed in the city, and once finished, it will boast 17 stations spanning approximately 25 kilometres. The monorail will connect São Paulo's

Ineco has begun construction work for the manufacturing and assembly of upply systems in 15 stations, including nergency signalling auxiliary systems, \_\_\_\_\_\_security locks.« conditioning, lighting, hydraulic pumps, fire extinguishing system,

By Enrique Monfort, industrial engineer

electric/solar water heating system for workshops, etc.

The monorail moves along a concrete beam which is 690 millimetres wide and situated at a height between 12 and 15 metres off the ground 11 is electricpowered and utilises low noise tyres, making it an environmentally-friendly addition to the city. Once complete, the Prata Line (Silver Line in English), will span a total length of 24.6 kilometres and will provide service to an estimated 550,000 people/day. The line's 54 trains will operate without drivers, and each extremely populated districts in the east train will be formed by 7 cars equipped with air conditioning and a holding capacity of 1,000 passengers. Stations will be furnished with platform door systems, ticket windows and armoured

# **Flying microrobots**

### Ineco tests out microdrones and prepares pilots to inspect structures

By Leendert de Haan and Joaquín Muñoz, civil engineers

Field tests carried out on the different models that Ineco has acquired allow for drone behaviour in adverse weather conditions to be evaluated. Testing also allows for control of maximum flight duration as well as image quality obtained from the different drones.

With the incorporation of microdrone technology, Ineco's structural inspection services enter into a new dimension. Tests carried out for Adif break new ground in advanced applications in civil engineering.

ystem downscaling and cost reduction means that the development of new applications for this technology within the civil sector is taking giant leaps. The world of microdrones is in full swing, and the possible market applications of these little flying spies are infinite. Drones are not just designed for military use anymore. Many organisations and companies depend on them to complement their work with fewer risks and lower costs. This is possible given their ability to move quickly over rugged or uneven terrain, overcome any type of obstacle and offer bird's-eye view images along with information gathered by sensors.

### Safe and legal inspections

Enthusiasm for using this technology has made it necessary to establish legal limits on both its use and its possible infringement on personal privacy. For these reasons, governments and civil aviation authorities of different countries have begun to regulate these new unmanned flying objects. On 15 October 2014 Spain implemented Law 18/2014 which currently regulates the commercial use of drones in Spain. Among other obligations, it requires pilots to have certificates guaranteeing remote piloting of civil aircrafts.

The new drones are more stable, sturdier and easier to manage. They are equipped with more precise positioning software, different kinds of cameras and, thanks to technological advances, are lighter, have greater autonomy in the air and can offer stable and vibration-free images. From an operating position on the ground, drones can be controlled with just a joystick to obtain real time images via flight control equipped with GPS.

Their versatility allows for diverse applications such as studying the movement of people and wildlife in enclosed areas or natural parks, or inspecting the condition of electric power networks and thermo-voltaic facilities, etc. There are many applications in civil engineering including work monitoring, inspection of overhead contact lines, topography, etc. The new, more flexible and versatile models make it possible to detect deterioration on the outside of buildings and road surfaces, as well as possible cracks in the walls, pillars, abutments and foundations of major infrastructures such as bridges, tunnels and viaducts.«

Ineco has carried out a market analysis in addition to an assessment of the legal aspects that should be taken into account. Moreover, a multidisciplinary team is making the final preparations to safely and legally integrate this high-added-value technology into regular inspection services. Knowledge gained from another innovation project, Arid Lap, has been put to use. In said project, drones were tested to study sand transport, high temperatures and extreme temperature gradients on railways [see article from *itransporte 53].*«



### Field Tests

By using these remote-controlled aircrafts we can quickly inspect an area after an accident or weather event. Among their infinite applications, drones can help with train and traffic circulation given that they allow for the supervision of bridges,

embankments, trenches and overhead contact lines, as well as allowing for the detection of obstacles or vegetation on roads and tracks. Drones are another tool for mapping different points along road and rail networks.



neco engineers Joaquín Muñoz and Leendert de Haan carrying out field tests at the Lozoya River aduct. Using drones makes it possible to quickly perform inspections without interrupting rail traffic.

# Marca España\* | SPANISH HORSE

De casta fina (fine breed)

Spanish Thoroughbred horses or PRE (in its Spanish acronym) have been globetrotting for nine centuries and are now bred in more than 60 countries.

Bv itransporte

oble, spirited, a good nature, and a great ability to learn are some of the most appreciated on the appreciated qualities in the Spanish Thoroughbred horse or PRE that make it suitable for all types of riders and dressage events: classic, cowboy, rejoneo (bullfighting on horseback), etc. If centuries ago they were used as war horses, nowadays due to their docility and calm temperament, they are used by the police and other Spanish security forces, which have around 1,800 horses. They are also the stars of the shows of the Royal Andalusian School of Equestrian Art of Jerez or that of the Royal Stables of Córdoba, created by King Philip II of Spain.

Also popularly known as "Andalusian horses" around 42% of these horses, some 220,000. are found in Andalusia. According to experts,

Nobility, strength, a good nature, and a good ability to learn are the qualities that are most appreciated in the Spanish Thoroughbred horse

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the PRE is a descendant of the Andalusian horse called "de casta fina" (fine breed) to distinguish it from the Castilian "de casta basta" (stock breed). At the end of the 15th century, the Royal Stud of the Carthusian monastery in Jerez was created, where the monks carefully worked to improve, select and breed the horses, developing the basis of modern breed. Between the 12th and 17th centuries, it moved throughout the Americas and Europe, where it improved the breed of local horses, such as the Lipizzan horse, the Palomino, the Friesian, the Neapolitan, the Orlov Trotter, the Hanoverian and the English purebred horse.

EXPORTS AROUND THE WORLD\_According to the National Association of Spanish Horse Breeders (ANCCE), although 75% of the horses are found in Spain, they are nowadays bred in more than 60 countries from New Zealand to Costa Rica, but particularly in the United States and Mexico. In total, of the 27,668 breeders registered worldwide, 5,463 are international and the rest are Spanish, mainly from Andalusia,

Image courtesy of the Royal Andalusia School of Equestrian Art (www.realescuela.org/es/exhibiciones.cfm

Valencia and Castilla-La Mancha. Exports have increased in recent years, particularly to countries such as China, Russia and Arab countries.

### The horse industry in Spain

Economic activity linked to the horse industry in Spain each year moves more than 5.3 billion euros, the equivalent of 0.51% of the GDP, a similar figure, for example, to that of the publishing industry. However, it generates double the amount of jobs, more than 60,000. These are data from a report by the Royal Spanish Equestrian Federation, published in 2013. Notable among the many activities analysed are livestock breeding, with more than 80,000 breeders throughout Spain, and trading,

one of the sectors that generates the most financial resources, accounting for 403 million euros in 2012. In terms of the practice and teaching of horse riding, a notable increase in the number of federated riding clubs has been registered, with there currently being around 800 in existence. Other notable data include the 112 million euros generated by the seven Spanish racecourses, where over 500 races a year are held, or the 132,000 spectators that attend more than 330 horse shows each year. carried out more than 5,000 of these reviews.«







for an average price of 40,000 euros, although some have been sold for 700,000. In Spain, the prices vary between 2,000 and 10,000 euros. The

### **FQUESTRIAN EVENTS**

FAIRS Particularly focussed on the Spanish Thoroughbred horse, we should highlight events such as the Seville Horse Show (SICAB) or the Valencia Horse Show.

### EQUESTRIAN EVENTS WITH PRE HORSES In

Jerez de la Frontera: Roval Andalusian School of Equestrian Art. exhibition "Como Bailan los Caballos Andaluces" (How Andalusian Horses Dance) (www. realescuela.org/es/ exhibiciones.cfm); and in the Royal Stables of Córdoba: "Pasión y Duende del Caballo Andaluz" (Passion and Spirit of the Andalusian Horse) (www.turismodecordoba.org/seccion/ espectaculoecuestre-encordoba).

**POPULAR FESTIVALS** Apart from bullfighting festivals, we must mention the "Feria de Abril" (April fair) of Seville, the pilgrimage of "El Rocío" (Huelva), the "curros" (enclosed which retain horses) and "rapas das bestas" (The Capture of the Beasts) in Galicia, the races on the beach of Sanlúcar de Barrameda, in Cádiz, or the festivals of Sant Joan in Menorca, amongst many others.

HORSE RIDING Fans of active ecotourism have 36 equestrian activities approved by the **Royal Spanish Equestrian Federation. They** can be consulted in an Official Guide (www. turismo-ecuestre.es/html/ guiaoficialie.html).



National Association of Breeders is responsible for controlling and certifying the origin of the foals born all over the world, more than 10,000 alone in 2014. On behalf of the Ministry of Agriculture. Food and the Environment. ANCCE manages the Herd Book of the PRE, the official digital registry that must include the records of each horse. The process begins at the moment of birth, when a sample of blood is taken, a profile is prepared and a microchip is implanted. Once the sample arrives in Spain, it is analysed to verify the declared ancestry of the animal, to which a "passport" is issued, which certifies it as PRE. Another key function of the ANCCE is the issuance of the "Basic Fitness for Reproduction" certificate, which rates the quality of the horse for breeding, for three years of age. In 2014, they

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Thanks to our technical specialisation, our activity has diversified into new markets and we have reinforced our presence in those where we are already established.

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

1 O D y www.ineco.com

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