Spain

Quality data drives Spanish traffic management growth

Jose F. Papi, on the success of the Spanish traffic management industry

Road traffic have always played a key role in the progress and economic growth of any nation, both through the direct impact of a higher mobility to citizens and goods and through the indirect benefits derived from building the infrastructures required. In the case of Spain, the development of a modern transport network coupled time-wise with a substantial increase of the socioeconomic conditions enjoyed by the citizenship, and this fact made the role played by road traffic self-evident to the Spanish society. Since then, the Spanish construction industry has grown exponentially and become a global leader, as it is transferring its knowledge and expertise in planning, building, equipping and operating road networks all across the world.

Most TEC readers will be familiar with the fact that, according to the 2011 ranking published by the specialised magazine Public Works Financing, five Spanish companies make it into the Top 10 in the ranking of the world's top infrastructure concession groups (ACS, Globalvia, Abertis, Ferrovial, OHL, Sacyr, Acciona), with four additional Spanish companies (Sacyr, Acciona, Isolux-Corsán, Itínere) joining the Top 40.

However, it must be noted that the Spanish traffic management industry - as its peers in the infrastructure sector - has also made a successful way to the international markets, combining both commercial dynamism and a passion for research, development and innovation.

Companies like Indra, Telvent, SICE or Grupo Etra are a flagship for the industry both in Spain and globally, being present in more than a 100 countries altogether. According to Enrique Belda, Deputy Director for Traffic at the Spanish National Directorate General for Traffic (DGT), 'the experience gathered by Spanish traffic companies in operating a modern road infrastructure like ours has been very relevant when the time has come to innovate and move abroad.'

In an effort that involved more than 50 organisations and 220 individual experts, the Spanish Road Technology Platform – a stakeholder forum promoted by the Spanish Ministry for Science & Innovation - recently mapped out a plethora of ITS R&D projects developed by the Spanish traffic management industry, to then build a Strategic Research Agenda for the period 2011-2025 which set up a detailed implementation plan for 32 priority R&D actions in the ITS field. As managing director at the Spanish Road Technology Platform, I think that through this review, the industry realised that most of the existing solutions gathered valuable data for the use of road public and private operators, but more effort was needed to secure the deployment of even more effective services at the service of the final users.

In order to secure a dynamic calculation of the ITS services' level in place, and following the mandate of the European Directive 2010/40/EU on the framework for the deployment of Intelligent Transport Systems, the Spanish industry believes that it is paramount to ameliorate the synergies between the data collected through different technologies. The aforementioned Directive establishes a framework in support of the coordinated and coherent deployment and use of ITS within the European Union, in particular across the borders between the Member States, and

Central control units are essential to managing data and traffic flow

provides for the development of specifications for actions within the following priority areas (as well as for the development, where appropriate, of necessary standards):

I Optimal use of road, traffic and travel data,
II Continuity of traffic and freight management ITS services,
III ITS road safety and security applications,
IV Linking the vehicle with the transport infrastructure.

Imanol Esteban, DGT Commercial Director at Indra, believes that 'the Directive's mandate is clear: users need high-quality and real-time information, a requirement that is fully aligned with our company`s quest for more safe, secure, efficient and sustainable traffic solutions.'

With more than 30,000 professionals and clients in over 100 countries, Indra is today the 2nd European company by market capitalization in the Information Technology sector, and was responsible for the technology deployment for the scrutiny of the Spanish general elections held last November 20th. The company integrates technologies that are available on the market into complete systems, marketing them throughout Spain and in Europe, Asia, and the Americas. Today Indra manages ITS for nearly 2,500 miles of Spanish highways and controls toll lanes and plazas in 15 countries. For instance, the company has been active in China since 1997 and is currently implementing the urban traffic management systems in the Chinese cities of Changde, Guilin, Korla (Bazhou) and Liaochen.

Indra is one of a number of systems integrators (which include major international companies such as Telvent and SICE) which develop their own products in house while also integrating available technology to present a cities or regions with complete traffic management.

The Spanish Strategic Research Agenda 2011-2025 also highlights the urgent need to adapt road traffic to the new mobility models (i.e. electric and rechargeable hybrid vehicles), and at the same time calls for optimising the use of existing infrastructures and ameliorating the co-modality between transport modes.

Arturo Corbí, Global Business Development VP at Telvent Transportation, is of the opinion that 'traffic operators must make the right decisions today and put in place a more sustainable and environmentally-friendly urban and interurban mobility.'Telvent spends a significant portion of its revenue on R&D and develops its own proprietary technologies, for instance the SmartMobility™ Road Suite, an integration of Intelligent Transport Services that combines smart real-time information with advanced mobility management solutions through a centralised platform. Telvent supplies intelligent systems that control traffic at more than 9,000 intersections a day, and toll networks that handle 1.5 million vehicles annually; its clients include the New York State Department of Transportation and the Municipal Corporation of Greater Mumbai.

Just a few weeks ago the firm successfully launched a "511" Traveller Information Service for Maryland State Highway Administration in the U.S. Through this service, travellers now have access to real-time traffic and travel-related news to better plan trips and avoid traffic congestion. It also provides travellers with information on traffic jams, incidents, road construction and weather-related delays, together with links to the state's transit systems, airports and tourist attractions.

Field Operations Tests (FOTs) for ITS cooperative systems are also a trend that has been taken up remarkably by the Spanish traffic management industry. In 2011 a multinational consortiums led by Iridium (a Spanish concession operator 100% owned by ACS) put in motion FOTsis (European Field Operational Test on Safe, Intelligent and Sustainable Road Operation), an EU-funded large-scale field testing of the road infrastructure management systems needed for the operation of 7 close-to-market cooperative I2V, V2I & I2I technologies (the FOTsis Services), in order to assess in detail both their effectiveness and their potential for a full-scale deployment in European roads. FOTsis will test the road infrastructure's capability to incorporate the 7 services in 9 test-sites across four European countries (Spain, Portugal, Germany and Greece). Amongst its 23 partners, 9 Spanish organisations are present: Iridium, OHL, Indra, SICE, GMV Sistemas, the Polytechnic University of Madrid and the research centre CI3).

According to José Manuel Portilla, ITS product manager at SICE, one of the key partners in the FOTsis Consortium, 'the project represents a major step forward to better connect vehicles, infrastructures and traffic management centres, the main focus being placed on the responsibilities of the road operator.'

SICE was responsible for the tunnel integration of Madrid's Calle 30 (a world reference in urban tunnels) and holds extensive national and international experience in developing centralised urban traffic management systems in cities over 50,000 people. Very recently, a new traffic control centre installed by SICE opened up in Lima (Peru), while ACS has used the gantry technology integrated by SICE in free-flow toll roads in Santiago de Chile or Melbourne (Australia). SICE integrates complete highway solutions in Europe, Latin America, and North America, and at times operates highway road tolls as a concessionaire standing in for a public authority.

In order to promote a long-term solution to infrastructure financing and taxing, securing the recovery of the actual internal and external costs associated to road traffic is a must. The Spanish Strategic Research Agenda 2011-2025 emphasises the need for dynamic pay-per-use solutions that make the utmost use of the existing technologies. The Spanish traffic management industry believes that only collaborative environments that bring together road side units, in-vehicle/on-board equipment and traffic control centres

will be able to provide these charging services in an efficient manner.

Grupo Etra has been active in the Urban Mobility Solutions business since 1979. Javier Núñez, the company's Mobility Director, states that "clients are becoming more and more conscious of the need for viable and solid ITS solutions for traffic and demand management, especially in urban areas".

Grupo Etra has been a key partner in a key EU-funded project such as TELEFOT (Field Operational Tests of Aftermarket and Nomadic Devices in Vehicles) and provides integral solutions for the mobility in the cities, having installed nearly 30 mobility management systems in the most important urban areas in Spain, including Madrid. Grupo Etra integrates intelligent traffic management with user information, parking information and public transport priority, contributing to the efficient movement of people and goods in those cities. In Madrid they have implemented a novel means of communicating with the public: the company has designed a system whereby riders can send a text message with the bus number and stop identifier, and immediately receive back a text with the arrival time of the approaching bus.

The experiences described above convey the good health of the Spanish traffic management industry, a vibrant sector that has obviously benefited from the extensive internationalisation of the Spanish construction industry, but that at the same time has been able to successfully open markets for public and private clients all across the globe on its own.

Our industry is very likely to hear more from the Spanish Conquistadors.

Indra free flow system in Mexico

EYP SCAP and the Spanish use of Doppler technology

Spanish success in the use of Doppler technology for speed control has been witnessed over the past few years, as Victor Perea reports.

In order to talk about technology applied to speed control in Spain, one must go back to 1959, when the Guardia Civil Traffic Enforcement Group ("Agrupación de Tráfico de la Guardia Civil" or ATGC) was created, being responsible since the very first moment for carrying out speeding controls. Initially, due to the lack of a reliable measurement system, the calculation of the speed it had to be done in a precarious way by comparison with the one of the police vehicle. It was not until 1968 when the first doppler radar arrived, equipment than worked exclusively with analog cameras and on a road side on a static mode.

During the 70s and 80s different technological improvements were gradually incorporated obtaining lighter and easier to handle equipment. This way, the first laser barrier radar arrived as well as those that allowed to be used in movement.

But the greatest technical advance comes without doubt during the year 2004, by adopting Spain the strategic lines in the field of road safety of the European Union, which among other things established the promotion of new ITS technologies. This alignment with EU policies occurred because the Spanish mortality rate from traffic accidents in 2003 was 50% above the EU average. This, coupled with the fact that speeding was the main factor in over 30% of the cases, made the Government to include in its 2003-2008 Road Safety Strategic Plan the installation of up to 500 new fixed radars.

At that time, EYP SCAP played an important role as the first national engineering company in obtaining the Type Approval of a speed radar device, an important milestone of the traffic control technologies in Spain.

EYP SCAP in use on the Spanish motorway

TYPES OF RADAR

In Spain you can find radars with different measurement principles: laser, spirals ... although the most common is by far the Doppler radar. These devices emit in the Ka band frequencies (ranging from 33.2 GHz to 36GHz). The operating principle is simple: the wave that the doppler sensor emits collides with the vehicle, bouncing back and returning to the sensor. But this wave has a different frequency. Due to the Doppler effect formulas is possible to determine the vehicle's speed through that phase difference:

$$v = \frac{f_d \lambda}{2 \cos \alpha}$$

Where,

v	is the speed
f_d	is the detected frequency difference
λ	It is the emitted radiation wavelength
α	Is the angle that forms the sensor with the motion vehicle

Once the vehicle is detected committing a speed violation, the system automatically takes a picture, being that an unequivocal proof of the infraction.

It is important to note that the management of the Spanish radar network is the direct responsibility of the Directorate General of Traffic (Dirección General de Tráfico or "DGT"), an independent agency under the Ministry of the Interior responsible for the implementation of the national road policy. The DGT requires that, in order for this picture to be used as an indisputable proof of a violation, it´s necessary that both the license plate and the vehicle brand and model can be recognized. Initially, this raised serious problems with night shots, as the flashes achieved to reveal the information of the license plate but not the model of the vehicle, when these were of dark colors. To solve this problem, EYP SCAP developed the RAI Flir® a new type of infrared flash that would capture both the license plate and the details of the vehicle under any light condition, obtaining a high quality of detail, and at the same time not dazzling the drivers avoiding the risk of a potential accident.

The DGT dictates the protocols that all equipment must follow as well as the format that the traffic report must have, so that they are all standardize all across the country.

Cameras are deployed in a variety of locations

TECHNOLOGICAL EVOLUTION

One of the main technical advances that the Road Safety Strategic Plan brought was the replacement of the obsolete analogical cameras by new HD digital cameras. These new cameras not needed to change the film in order to produce the traffic violation, which made possible that the radar could be installed in fixed cabins, operating in an autonomous way without any operator supervision. From this moment its installation increased in a considerable way, rising from about only 10 radars installed in 2005 to around 300 installed in late 2010. To these radars it is necessary to add those installed in Catalonia (160) and the Basque Country (36), Autonomous regions that have their own jurisdiction on traffic enforcement.

EYP SCAP conducted the installation and commissioning of its 1st RAI 2002® Doppler radar during 2005 in the M40 motorway, a major ring road in Madrid. It should be noted that since this very first installation, the use of the RAI Flir® flash was contemplated for night detection. Since then, we have successfully carried out more than 150 installations throughout Spain, in all kinds of emplacements, both fixed and mobile. One of the most special projects was the one we developed for the Madrid City Hall in 2008 after being awarded the installation and commissioning of several radars to be placed inside the M30 tunnels, one of the biggest urban tunnels systems in the world, with 43km of total length.

During this time we have done advance the Doppler technology, getting approve at the end of 2009 our 2nd generation of radars, the RAI Plus® family, the only model in Spain capable of being installed in any type of emplacement: both for a static use (gantry, half-gantry armpole, road side, tunnel, or tripod) and dynamic (onboard a patrol car). Additionally, it is the 1st equipment in Spain that complies with the Welmec 7.2 Guide of software protection, in accordance with the 2004/22/EC European Directive of Measuring Instruments.

Without doubt, the technical development of speed radars in Spain has been continuous, which has placed manufacturers, system integrator and authorities at the international forefront.

As an example, it should be noted that in recent years innovative equipment has been installed that work exclusively with solar energy and GPRS, allowing it to be located on sites where it was impossible before due to the lack of energy or communications, something especially useful in Spain with many roads with high accident rates. The RAI Plus® model, thanks to its low consumption of only 22w, allows this type of installation, guaranteeing a continuous operation with favorable climatic conditions and having autonomy of up to one week in adverse conditions.

Also, in December 2010 came into operation the first Average Speed Radars, installed in the tunnels of Guadarrama (Madrid) and Torrox (Malaga), taking part EYP SCAP in this market through the development of its own MetraMed® technology.

The MetraMed® performs a control of the average speed on a section of a road, measuring the travel time of the on-road vehicles.

The speed measurement section is defined by two reference points: "the Entrance Point" that detects the instant when the vehicle enters the section and "The Infraction Point" that detects the instant when the vehicle leaves the section. In both cases the vehicle images are captured, an OCR engine analyzes the license plate and all the informa-

tion is stored in a local data base. Through a comparison of the calculated speed and the maximum allowed speed it is determined and recorded if there is a violation, leaving them stored in order to be sent to a Control Center for processing.

Also during this same year, EYP SCAP performs the installation on the A52 motorway of a new gantry radar, unique in Spain, designed to transmit through a real-time satellite link the speed record to a car patrol placed further down on the same road. This system was specially designed to sanction foreign drivers, who up to that moment were escaping from the traffic ticket due to the lack of a joint European agreement.

Finally, another innovation being under development is the installation of special radars onboard helicopters, being Spain the first country in the world that is starting to apply this system of military origin for civil traffic control.

A radar measuring speed

RESULTS

With a gradual decrease in road accidents since 2004 today Spain is on par with the European countries with the most advanced safety plans.

Thanks to initiatives like the introduction of the new Driving License by Points, decreased alcohol rate and particularly thanks to the improvement in speed control, the death rate has fallen about 30% in the last 8 years (source: Statistical Yearbook DGT, 2010, www.dgt.es)

The greatest Spanish contribution has undoubtedly been the continuous promotion between authorities, manufacturers and integrators of the development and implementation of new technologies with the goal of eliminating excessive speeds.

EYP SCAP has helped to meet these objectives by providing innovation and technology as well as by working closely with both state and local authorities to improve road safety in Spain.

TSS solution drives MARTA project

Nadia Feddo on TSS's contribution to a major Spanish transport research project

TSS-Transport Simulation Systems was an important contributor to Project MARTA ("Mobility & Automotion through Advanced Transport Networks"), which was unveiled in spring 2011 after three years of development. MARTA is one of 16 projects that form part of the Spanish Government's 35-million-Euro initiative to promote investigation and development in transport issues, one of the largest public-private initiatives in the history of Spanish research.

MARTA aims to foster research and development in vehicle-to-vehicle communication and also between vehicles and the infrastructure. These intelligent systems of the future will contribute to the reduction of traffic congestion, accidents and pollution and reinforce incident management strategies. In general terms MARTA will cover communication protocols, vehicle and infrastructure equipment, human-machine interface (HMI), end-user services and methodologies to increase efficiency in the traffic infrastructure as it relates to the motor vehicle.

MARTA is the combined effort of 18 companies from different industries including telephone operators, vehicle producers, infrastructure and service providers, software developers, and automotive suppliers. These companies have subcontracted 19 research and development centres across Spain to work on the project. The results, after four years of work, were presented in February 2011 in Barcelona by the Minister of Science and Innovation, Cristina Garmendia. 'This project is all about offering a great great service to all citizens,' said Ms Garmendia at the presentation ceremony, who also stressed that, through this project, a group of Spanish companies now leads product niches in the global security market and efficiency in transport. 'We not just talking about patents or business expectations, but also marketed products that are already generating wealth and jobs,' she added.

TSS, who markets and develops Aimsun traffic simulation software, was closely involved in the area of IT and

A map of Valencia using Aimsun software

mobility, particularly the study of accidents, automatic incident detection and strategic planning. TSS actively participated in the Working Group 5 research and development activities and, among other innovations, demonstrated the benefits of coupling the Aimsun traffic simulator with a centralised traffic control centre to optimize traffic flows in urban areas. A pioneer in this area, TSS also developed the anticipatory route guidance concept within the MARTA framework, aiming to offer centralised dynamic route guidance based on equilibrium oriented traffic assignment. This route guidance system is capable of taking real-time incidents into account and providing different alternative routes to individual navigation users.

Using microsimulation in the analysis of road safety, TSS improved the behavioural models of vehicles in the Aimsun microscopic model, refining the models of vehicle tracking and lane changes based on video analysis of vehicle trajectory. This improvement has been made possible by the decoupling of the reaction time of the passage of vehicles made at the beginning of the simulation project. Obtaining accurate models has been fundamental to the use of simulation as a tool for evaluating strategies to improve road safety.

Another major contribution was the preparation of the simulator for event management: TSS prepared a mesoscopic traffic model which was the ideal compromise between the microscopic level of simulation (which has a high level of granularity but correspondingly high calibration requirements) and macroscopic (which is static rather than dynamic and lacks detail). This enabled TSS to simulate networks the size of entire major cities faster than real time. Furthermore, TSS developed a Dynamic User Equilibrium (DUE) traffic allocation that calculates the optimal distribution of vehicle flows on a road network where capacity has dropped due to an incident or any other event. This tool has been instrumental in the preparation of the concept of the anticipatory guidance system, shown in the final demonstration of the project.

TSS also worked closely with ETRA Group to forge a real-time connection between the microscopic simulation and the strategic control centre. This connection has demonstrated how taking microscopic simulation as a tool for prognosis greatly improves the positive impact of strategic control. To test and validate the interactive system, TSS developed a simulation model of Valencia city centre and it was this model that was used during the final demonstration project.