



AENA, Barcelona El Prat Airport

Industry: Facilities Management



“The centralization of operations that we get with Wonderware helps manage around 700,000 signals and is essential for a critical infrastructure like this. We can now quickly respond to incidents and also be proactive in optimizing management.”

Jordi Asensi, Head of Systems and Database Management, AENA Barcelona Airport

Wonderware Software Facilitates a Decade of Integration and Growth for Unprecedented Spanish Airport Expansion

Goals

- Develop an integrated and centralized control platform to accommodate expansion for the airport, which would triple in size
- Ensure that the new platform in Barcelona would be replicable across the other airports in the AENA system
- Find a way to integrate, manage and optimize processes and systems coming from multiple vendors

Challenges

- Airport control systems handle thousands of signals simultaneously; this information needed to be presented simply and in context to enable operators to quickly and accurately interpret it
- The existing control platform required operators to learn up to 20 different technologies and tools, so training was difficult, operations were not smooth, stress was high and costs were rising

Solutions and Products

- Wonderware® System Platform
- Wonderware InTouch® HMI
- Wonderware Historian
- Wonderware Information Server

Results

- The Wonderware solution controls the processes throughout the airport that manage the terminal building and cooling and heating power plant as well as auxiliary buildings for luggage transport; additional systems are being deployed
- The system, which originally managed 35,000 signals, now handles 700,000 inputs through 80 servers that make up five control environments; in the final phase, signals are expected to increase to nearly one million

Success Story > AENA, Barcelona El Prat Airport



Barcelona, Spain – Spanish Airports and Air Navigation (AENA) is a public company in charge of civil air navigation and airports in Spain. Its subsidiary, AENA Aeropuertos SA, manages 47 airports and two heliports in Spain and participates directly in the management of 28 other terminals throughout the world. In passenger count, AENA is the world's leading airport operator with about 200 million passengers per year.

The Barcelona-El Prat airport, together with the port of Barcelona and the city's Zona Franca area, serves as a vital hub for the region's economy and is integral to tourism in the region. Recorded airport traffic in 2010 was 29,209,595 passengers, 277,832 operations and 104,280 tons of cargo.

To modernize the airport and prepare for future demands, major improvements to infrastructure and services have been made, including the construction of a new T1 terminal and a new runway. The aim is to turn Barcelona-El Prat into an essential European hub and a premier airport for southern Europe. To ensure this goal, plans also include a new satellite building, four additional boarding gates, an intermodal area, jet ways, a luggage transportation management plant, service and evacuation galleries and the refurbishment of the T2 terminal.

Problematic Process Management

In 2000, 15 to 20 integrators were engaged in supporting the airport control systems. Each vendor implemented a separate solution, resulting in a multiplicity of technologies. The airport's operators had to learn all of these different tools, which made it practically impossible for the facility to function smoothly. Personnel were under high stress. Management and workers were concerned that they would not be able to respond appropriately to incidents.

The budget was under pressure too. Contracts with multiple suppliers meant that maintenance costs were increasing. Plus, additional training was required to teach the staff the unique signal logistics for the proprietary systems from the various manufacturers' solutions.

The control system structure also created lags in response time and in resolving incidents. An integrator explains, "To control lighting the building, information would appear on a screen in the power control room and different data would be seen in the engineering room. This prevented handling the processes in a simple manner. It was also difficult to address other issues such as the environmental impact." And, although appropriate attention was paid to all incidents, another integrator added, "We had to analyze each subsystem to understand where a malfunction was located, which inevitably slowed down response times."

Barcelona-El Prat Airport had reached a critical point. Another integrator stated it clearly, "It was necessary to standardize communications and automation in order to create a control environment that was worthy of a large infrastructure like this."

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Management searched the market for a solution. They wanted a control architecture that would provide:

- Single platform, to unite the control systems of the existing facilities and the future expansions
- Reliability, to support efficient and safe airport operations and avoid downtime in airport services
- Scalability, to handle the addition of a second large terminal building and integrate the annex buildings and other systems into one infrastructure
- Economy, to meet the budget restrictions of a public project

When considering their goals and plans for expansion, the choice for AENA was Wonderware software. It met management's criteria, plus it offered the only non-proprietary solution, providing a better alternative to disparate systems and the high costs and operator challenges the airport had experienced in the past.

Planning and Enforcing the Rules

Advance planning of the control system design and the specific features of the Wonderware software came together to help AENA meet their objectives.

The design stage began with the goal of making the change in technology, and also to take advantage of the Wonderware software's strengths by developing a new engineering routine. Each new device would be integrated into the Wonderware System Platform based on a set of common rules. And each supplier who was awarded a contract would be required to conform to these rules.

A data template was created for each element to be deployed in the terminal and each process that would connect to the airport's SCADA system. Wonderware enabled these objects and templates to be easily replicated, and soon AENA had a library that helped them to connect all field devices in a standardized manner. No matter the brand of the PLC or which supplier was installing it, it had a common interface to the system as defined in the overall plan. And while the control systems operated discretely at lower levels, at the SCADA level, processes were categorized and standardized. Since each vendor followed the contract specifications, the system integrated successfully.



According to the lead integrators and AENA, the project marks a change in how control systems are developed in Spain's airport sector because it overcomes two key challenges: it avoids duplication of engineering and, since the objects in the design have been pre-validated, their proper functioning is assured, which adds up to new facilities that can operate successfully.

Despite having multiple companies working on multiple projects, uniformity, full connectivity and efficiency was achieved. This also resulted in cost savings.

Five Stages to Optimized Management

The first project was to integrate the building control systems in the existing T2 terminal. The 35,000 signals in the lighting, climate control, passenger transport systems and entrances were brought over to the Wonderware platform.

Next, the control systems for services that would support the future T1 terminal were integrated. These included the fire brigade, civil guard, waste facilities, water control and pumping and other systems. With the addition of these signals, the Wonderware software was now helping AENA manage 80,000 total signals.

At this point, the monitoring infrastructure of the airport's power plants were also integrated.

Now it was time for the third project, which would be ground breaking: the deployment of the infrastructure for the newly constructed T1 terminal. This comprehensive, three-year project involved special challenges for the AENA team. They had to direct the many public sector contractors to work together and implement the new engineering routines and rules established at the beginning of the initiative.

Jordi Asensi, Head of Systems and Database Management at AENA Barcelona Airport, said, "If we had not decided from the beginning to create routines for each of the developments in order to be coupled naturally to Wonderware, we would have found ourselves in precisely the situation that we had wanted to avoid."

How did they do it? Prior to the construction of the terminal, processes were validated in the department responsible for defining user requirements, interface and design. Models were also tested to verify proper operation. Once the building was constructed and the field systems and control environment were deployed, an independent company tested each system in situ. At the end of the T1 project, 200,000 signals were added to the 80,000 existing ones.

The fourth project integrated the Automated Luggage Transport System (SATE), which included software to manage luggage movement, delivery and incident warning. By connecting SATE to Wonderware, Asensi says the airport has one of the lowest lost-luggage rates in Europe.

The final project integrated the New Terminal Area Power Plant (CENAT). This plant powers the airport and is the first facility to use AENA's "airport model." The company has set this standard for specific situations and platforms based on the Model View functions of the Wonderware System Platform.

Finally, in late 2010, the structure of the Energy Control System (SCE) was redesigned to bring together all of the electrical control systems into a single control point. This unified the controls for four separate power plants, including associated environmental monitoring for each (such as measuring groundwater levels or pumping systems using Archimedean screws to stabilize a portion of the runway built over a lagoon).

With the completion of these projects, the new system is managing 700,000 signals through 80 servers that make up five control environments.

700,000 Signals and Counting

The control environment for the Barcelona- El Prat Airport includes extensive operations systems. Once the full expansion is complete, the system will handle approximately one million signals.

Building Management Systems at Terminal 1 and Terminal 2

- Passenger transport: escalators, elevators, conveyor belts and entrances
- Lighting
- Air conditioning
- Fire safety
- Low voltage

Flight Operations Support

- Time register of planes at jet ways for subsequent billing

Control and Monitoring of Terminal Annex Services

- Police station and fire brigade
- Waste management
- Water control (groundwater level management)

Power Plant Management

- CELT: Earth-side power plant
- CELA: Air-side power plant
- CENAT: New terminal area power plant
- CEREM: Plant in protected El Remolar area
- CEN: Cooling and heating power plant integrated into T1

Luggage Handling

- Monitoring support of Automated Luggage Transport System (SATE)

Future Projects

- Beacon Presentation Command System (SMPB)
- Platform control tower management
- Satellite terminal

A Benchmark for Automated Building Projects

The Wonderware technology in Terminal 1 processes a multitude of signals across the many processes operating there:

Climate: 33 technical climate rooms, 1,000 fan coil units and 650 fans. The system handles aspects ranging from the generation of cooling and heating to subsequent distribution, controlling all elements (cooling towers, air conditioning rooms, valves, fan coil units, room controls, etc.).

Mechanical Transport: 250 items (escalators, ramps, elevators, moving walkways, etc.).

Plumbing and Sanitation: 247 items corresponding to wells and pumps and motorized infiltrations, deposits, pressure group and valves.

Lighting: 10,000 regulators, sensors, lines and other items are supervised in all terminal areas; in addition, Wonderware technology helps to manage the facility's lighting output.

Pneumatic Waste System: Waste room and distributed containers that enable automatic selective waste collection at the terminal; waste is carried through pipes by a vacuum system to a discharge point where it is collected and transported by trucks for further treatment.

Low Voltage: 26 transformation centers (including 300 panels that can be fully modified within the system and have control priority) and 1,300 secondary panels each containing one of the processes for the terminal's power input; this system also includes uninterruptible power systems (UPS).

Fire Detection: With 30,000 controlled items (detectors, CCFs, etc.), this is a unique system because of its high specificity; it reports real-time information on fire-risk locations at the control center, significantly reducing response times and directing operators to precise alarm locations. "You can find out where there is a possible fire in two clicks," notes Oscar Saco of Abantia Sistemas & Telecom.

Technical Highlights

AENA feels the architecture of the T1 monitoring systems is especially outstanding because of its structural logic, robustness and transparency. It consists of a development server and 19 other servers running Wonderware System Platform. Of these, one acts as a repository, running Wonderware Historian software and containing the full configuration for all servers. The remaining servers are structured around four pairs of redundant object servers that contain the logic for each of the infrastructure management parts, three pairs of independent communications servers that communicate with field PLCs, and two pairs of terminal servers, which are redundant servers with Wonderware InTouch HMI that allow clients to connect and use applications.

The airport has two data processing centers that are geographically separated. Redundant servers are located in each of these centers and connected through the fiber optic network. In the event of a power failure in one center, the other takes over. The only server that is not redundant, the repository, uses SAN technology to continuously replicate its disk arrays locally and remotely. So if this server fails, the disks have a hot back up or distance mirror.

The integrators used the Wonderware software to create a special object to address potential conflicts in this redundant system. Called “control of communications,” it continuously assesses all elements in a particular process and makes decisions based on the data, communicating the optimal path for all objects that operate through it. In this way, it avoids loading the system by defining communications paths in a more organized manner.

An important safety aspect is the connection between the monitoring system and the closed circuit TV system. When there is an alarm, the Wonderware software enables operators in the control center to see images and locations of incidents, so they can quickly make accurate decisions to resolve the situation. Despite the independence of the two systems, they are perfectly integrated.

The Benefits of a Single Control Environment

After ten years of work, the control environment of the airport is almost completely integrated and AENA's commitment to Wonderware software as their standard for handling the 47 airports they operate in Spain is stronger than ever.

Unified Platform

According to the AENA team, the most outstanding benefit so far is that the solution enables them to manage a large number of processes in an integrated and simultaneous manner under a single platform — even with so many devices and signals with distinct technological languages.

“It would be impossible to have the management model we have today with other solutions,” says Asensi. “The centralization offered by Wonderware technology is essential. It allows us to respond to incidents rapidly and be proactive in making process improvements, because now we have real-time unified information available to us for analysis.”

In the same vein, integrators EMTE Sistemas and Abantia Sistemas & Telecom agree that — despite the complexity of managing the facilities — there is a fluid control dynamic. “Now, all terminals are handled within a common environment. Each system below still works with the logic of its systems, but Wonderware has created an extraction and intercommunication layer that makes it possible to handle a great number of signals in a unified manner,” they state.

Open Architecture

From the business management perspective, AENA Head of Systems and Database Management Asensi reiterates the Wonderware solution's open architecture, "We are free to contract maintenance services for the control platform to any company specializing in Wonderware solutions." And, since Wonderware has a network of 170 systems integrators in Spain, many of whom specialize in serving large facilities, AENA can set out competitive criteria for potential vendors.

Reliable, Real-Time Data Prompts Continuous Improvement

Rafael Cortés of EMTE Sistemas, the integrator responsible for maintaining the control platform, cites a positive effect of the solution between the airport departments. Because they can obtain data reporting and trending with the Wonderware Historian, he says, "After T2, when additional application integration began, there was significant demand for capabilities that had not originally been planned, such as environmental management. Graphs and historical reports, for example, were highly valued tools. Wonderware prompted an internal process of continuous improvement that still remains alive today."

Another significant benefit is that department heads now have access to overall process information. "The data was separated before and it was difficult to understand and respond to an incident. We were more reactive and it was a more unstable infrastructure. Now, the system provides the reliability that is required of an airport in the class of Barcelona, which is considered to be among the best in the world."

Central Alarm Management

The software also provides real-time distributed alarm management through an alarm filter in each facility. "For an airport, it is impossible to think of central alarm management, although this is the most common way to handle alarms by the majority of commercially available technologies. If a serious event occurs, there is a flood of alarm information. Wonderware provides an alarm absorption, management and distribution system that helps us to manage a huge number of events, even thousands of alarms in seconds," explains Cortés.

Ease of Use, Flexibility for Changes, Reduced Development Costs

The solution's templates and objects have significantly streamlined engineering efforts throughout the project, according to Oscar Saco of integrator Abantia Sistemas & Telecom. "In the design stage, templates were defined above each group of objects, covering up to four levels and allowing for changes without modifying each element. Template scripts defined behavior for all objects, so system modifications can be made safely and easily. Navigation is hierarchical by area, plant and facilities, even covering highly detailed facilities within each zone. In addition, all communications with PLCs and servers are performed in real time, as is the creation of graphics requested by users. And a search tool facilitates the location of objects."

Carlos Rivas from EMTE Sistemas agrees, "It is a great benefit to be able to normalize and standardize the control platform and reuse many of the developments in the logical behavior of the devices. Without Wonderware, It definitely would have been more difficult to obtain the level of integration that we have today, so that a process, whichever airport it is for, is handled in the same way and work is not duplicated."

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Jordi Oliva of integrator Abantia Sistemas & Telecom adds that the models, templates and objects have “significantly reduced development costs and subsequent maintenance, while at the same time fully ensuring the integration of all operations.”

Scalability and Compatibility

Beginning in 2000 with Wonderware InTouch HMI, over the course of the expansion project, AENA has migrated to Wonderware Application Server and now to Wonderware System Platform. Each new technology release supported the advancement of the airport project.

Continuing High Efficiency and Progress

Today, AENA is achieving operations excellence and the Barcelona-El Prat airport boasts a dynamic, high-functioning infrastructure. Approximately 15 systems integrators work simultaneously within a completely standardized process. The airport has 30 licenses for concurrent operators, although they explain that the infrastructure can be managed “with only eight operators in non-peak hours.”

About 30 live projects are currently underway, including the integration of the Beacon Presentation Command System (SMPB) which will manage the runway lights, a platform control tower, and the construction of a new satellite terminal. All told, when the projects are finalized, nearly one million signals will be controlled under the unified platform. With Wonderware technology and the vision and teamwork of numerous executives and integrators, the Barcelona-El Prat airport is one of the most emblematic projects for AENA to date.

