



System), ERP and so forth. There are also very different business needs and orientations in the Smart Port domain: road/rail traffic monitoring, vessel movements, energy efficiency, access control, supply automation, automatic metering, pollution minimising, maintenance processes, people's location, operations optimising, cargo tracking, and better information exchange.

Creating a new Smart Port project trying to connect all sensors and devices into a single platform and covering all business needs of the different agents into a common environment will likely lead to a very limited scope, an extremely costly implementation or to a complete disaster.

### A SYSTEM OF SYSTEMS

We envision future Smart Port platforms as a system of systems in which each agent can integrate a smart infrastructure at various levels with a common central Smart Port system. Different agents will have private IoT platforms and other IT systems with their own sensors controlled in their own way. Terminals will have their own systems for accessing and managing sensors, the Port Authority will have its own platform and the rest of agents will have private platforms as well.

A Smart Port platform will integrate with existing agents' systems rather than connecting directly to sensors or specific data stores. No more n-to-m connections need to be implemented. Interoperability and integration will be the enablers of this system of system approach.

Such configuration reduces investments, allows a faster commissioning and eases the maintenance and evolution of the Smart Port. New agents can be incorporated quickly, new sensors and data can simply be accessed, and new services can easily be created and integrated.

But this system of systems approach is not trivial at all. There are different standards around the IoT and Smart domain, and dozens of platforms that compete to be the prominent one. Interoperability among all these standards and platforms is not a reality so far. Thus, this lack of integration and interoperability is a technical problem to solve if we want to deploy effective Smart Port systems.

### COLLABORATION

In order to achieve such an ambitious integration of disparate systems, specific tools and methodologies should be used. The Port of Valencia and Prodevelop are engaged on a European research project under H2020-ICT program named INTER-IoT which is aimed at the design, implementation and experimentation of an open cross-layer framework, an associated methodology and tools to enable voluntary



interoperability among heterogeneous Internet of Things (IoT) platforms.

It will allow an effective and efficient development of adaptive, smart IoT applications and services, atop different heterogeneous IoT platforms. This will allow integration at different levels: device, networking, middleware, application services and data and semantics. A set of tools and methodologies will also be available to enable a seamless and easy integration among all IoT and Smart platforms in the port.

This integration mustn't be based just in accessing sensors. It should also allow for the integration among IT systems at different levels. For instance, the Smart Port platform may detect when a truck is entering any terminal, or may find out that a berthing is going to be delayed with respect to the ETA; and the applications of affected agents may be notified of these events, launching the specific business processes in order to handle these situations properly.

Therefore, the Smart Port will become

a central node where the different platforms of all the stakeholders in the port community can share its information coming from sensors and IT processes and receive raw or processed data, events or information to make it possible the definition of new processes aimed at the digitalisation of its core business.

### CONCLUSION

We believe that this system of systems approach is the most effective way to exploit the full IT infrastructure in the whole port area for optimising the overall port procedures and help to achieve a more efficient management of the information for the full logistic chain.

The final driver of these innovating processes is to make the resources available for defining new digital businesses that can help a port authority to create strategic value for its socioeconomic environment. It will be the trigger that addresses the shift from the automation era towards the digitalisation era.

### ABOUT THE AUTHORS

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Jose Garcia de la Guia is CIO at the Port Authority of Valencia. Previously he was the Port Community System Manager in ValenciaPort and Vice President of Infoport Valencia. He has developed PCS and EDI systems throughout his 20 years in the industry, working for companies such as Infoport Valencia, ValenciaPort Foundation and Portel.

Miguel Montesinos is a partner and CTO of the Spanish IT firm Prodevelop where he has been responsible for IT projects in the maritime sector for the last 20 years. He is also responsible for R&D and applying technology transfer to the company's products and projects in the sector.

### ABOUT THE ORGANISATIONS

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Port Authority of Valencia  
The Port Authority of Valencia (PAV), which trades under the name of VALENCIAPORT, is the public body responsible for running and managing three state-owned ports,

Valencia, Sagunto and Gandia, along an 80 kilometre stretch of the Mediterranean coast in Eastern Spain.

### Prodevelop

Prodevelop is a company highly specialised in ICT application for the maritime industry, which prides itself on its ability to offer innovative and flexible solutions, specially designed to meet the requirements of each and every one of its clients. It offers comprehensive port information system platforms, which focus mainly on meeting the needs of port authorities. The portfolio of Prodevelop covers Port Management Systems to Integrated Port Operation Management Systems, as well as Port Community Systems, Safety and Security, Environmental Management Systems, Space Management and Mobile Workforce.

### ENQUIRIES

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Prodevelop  
Tel: +34 963510612  
Fax: +34 963510968  
www.prodevelop.es