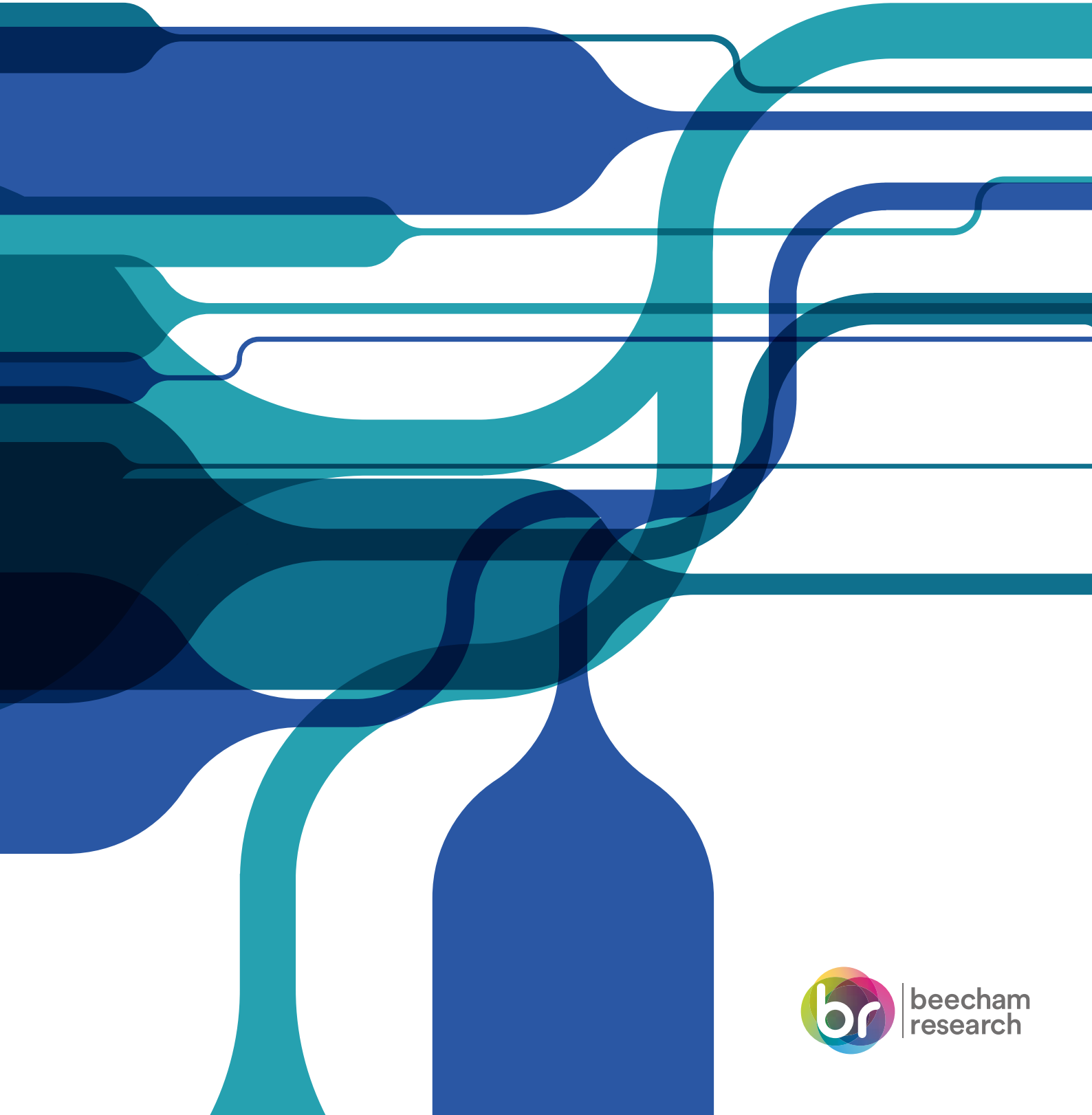
Shaping the IoT Future

The IoT Vision for Smart Ports.



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Towards the Smart Port Vision.

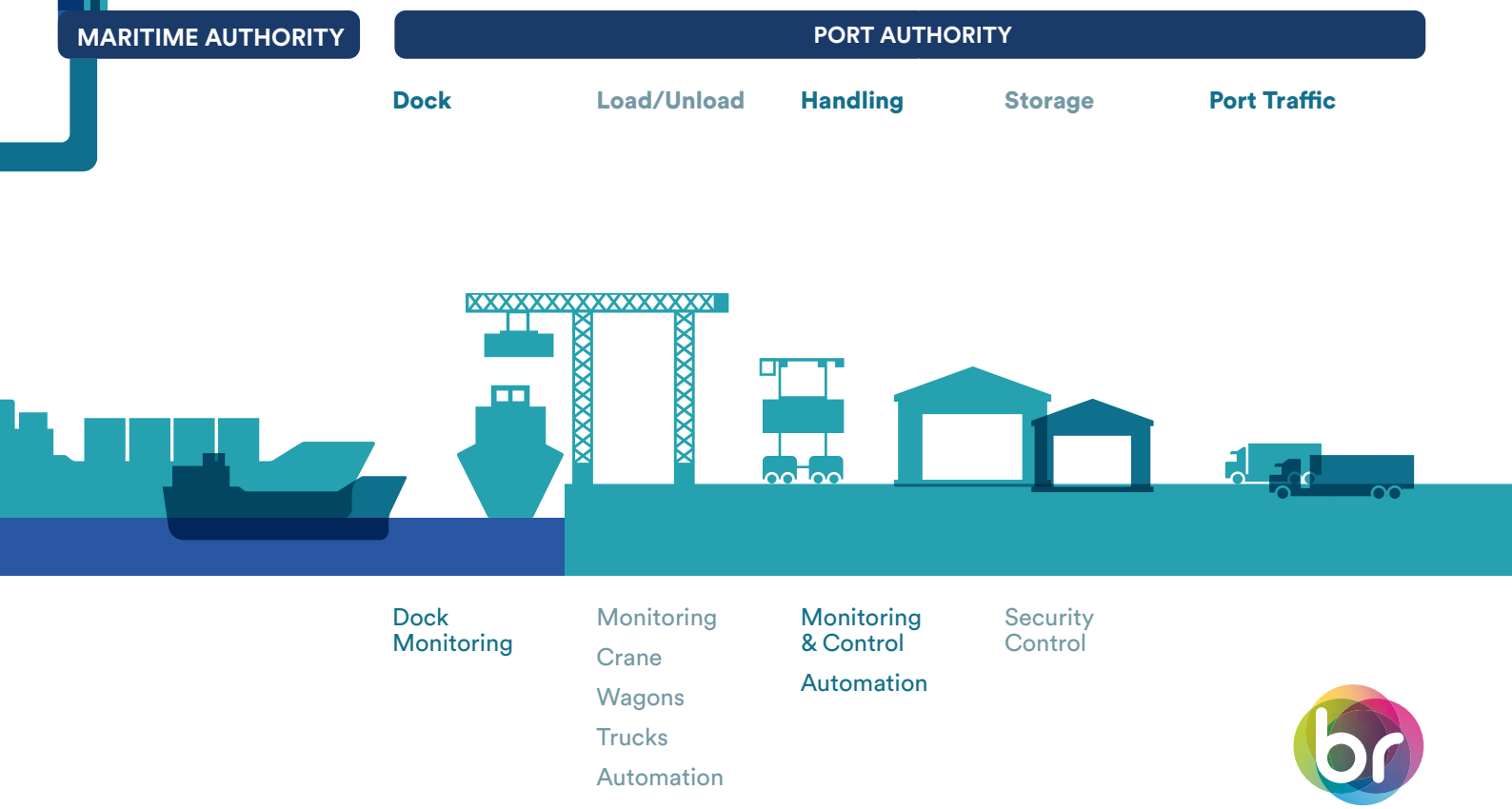
Defining the concept of Smart Port.

There is an increasing use of the term "digital transformation". This implies the use of digital technologies for improving operation efficiencies, introducing agile and sustainable modi operandi, and enabling creativity and innovation. Those objectives are achievable if activities are measured and spaces are monitored. The Internet of Things vision is an important enabler for "digital transformation" creating connections between physical spaces and the Internet. Data flows in those connections. The analysis of data enables a better understanding of contexts, situations, and people moving within them. That understanding enables actions that make operations more efficient, optimize resources, and improve life and work conditions. Thus, the space is called smart space. And, as we have smart cities, we could think about smart ports.

Smart port is a relatively new concept. From an Internet of Things point of view, the smart port is a context with different machineries, different interactions among machineries, interactions between machineries and people, that can be improved as any other smart spaces using sensed data. The next evolution of a smart port is then the automation of those interactions. **Figure 1** shows an illustration of smart port activities.

This paper will explore two elements of the smart port: Port Logistics and Port Management.

Figure 1. Illustration of the Smart Port Concept.



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Smart Port Logistics.

Logistics depend upon the concept of optimising the product value chain; the shorter and more efficient the value chain, the more effective is the logistics operation. Logistics operations for physical products include all the tasks associated with material and resources handling, packaging, inventory management, transportation, storing and warehouse management, and delivering to the end-customer. In its wider definition, logistics deals not only with physical products but with the services as well, under the same concept of managing the efficient delivery of a service from "producer" to the end-customer. This includes the management and optimisation of materials, products and information flow as well as the respective coordination of the human factor. It goes without saying that the seamless communication of all the stakeholders involved in the logistics management is key for its success.

And this is the primary reason why IoT is so relevant for Logistics, because it constitutes a key enabler for the achievement of ubiquitous connectivity among people, machines, devices, products and other entities. Logistics is basically a series of communication among people and machines in transit.

Second, the IoT and the data it generates is widely used for the optimisation of any kind of processes, because analysis of IoT-generated data produces the insights regarding the way the processes work and how they can be optimised, that are so highly needed throughout the function of products or services. Analytics suites and features are already widely deployed in the Logistics area, making it very easy for someone to integrate device and product-generated data as well as data transmitted from moving vehicles, which represent traditional applications for the IoT.

Third, it is quite interesting that both Logistics and the IoT rely upon networks, logistics its operation of disruption networks, IoT its network of connected things. The logic of how a communications network, that is highly reliant on smart features for its operation, such as the IoT, can be optimised, is of additional value when we are seeking ways to optimise the operation of the distribution network.

Fourth, there is an increasing tendency in the logistics area for automation of processes through the use of intelligent features and machines, e.g. robotics in the warehouse, automated guided vehicles for order-picking processes, the collaboration of manufacturing robots with identification technologies used on semi-finished goods, etc. are all areas where IoT has already made significant leaps and delivered valuable results.

Fifth, the fundamental purpose of logistics management is to shorten the value chain and bring the desired outcome (delivery of product or a service, information, etc.) to the correct recipient (end-user, end-customer, retail store, etc.) in the most economical and optimised way. The core principle of IoT throughout the enterprise sector, namely industry, retail, energy, logistics, etc. is to enable the convergence of separate worlds, for example IoT can enable the mass customisation of products bringing the consumer closer than ever to the production process. Another example if the bi-directional communication between disparate energy production units to coordinate the desired energy output across different locations and different time frames etc. In logistics, IoT is the enabler to bring together the worlds of production and retail, or the consumer needs closer to the production capabilities and so on. Therefore, IoT by its nature, can help the very fundamental purpose of logistical operations management.

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Smart Port – Port Management.

There is a significant number of tasks that need to be executed in the context of Port Management that render IoT quite relevant and in many cases essential to be deployed in this context.

Large ports need to deal with many disparate activities: the movement of ships, containers, and other cargo, the loading and unloading of ships and containers, customs activities. As well as human resources, anchorages, channels, lighters, tugs, berths, warehouse, and other storage spaces should be allocated and released. The efficient management of a port involves managing these activities and resources, managing the flow of money involved between the agents providing and using these resources, and providing management information. It is a typical logistics challenge, obviously having its unique characteristics and challenges due to the very specific desired outcomes and the given area of operation, which is the environment of a port along with all the elements that this includes.

Some typical examples of how IoT is used in the context of the Port Management include:

- Geolocation and tracking of vehicles, need for a communications network to be in place. There is a high probability that a mixture of connectivity types will be needed, namely starting from Short Range communication for product tracking and identification, to LWPA for asset management and satellite-based geolocation processes for vehicles.
- Address security and maintenance needs of assets, e.g. machinery, tools and equipment, and vehicles that operate in the port, well in advance to save downtime and additional costs.
- Seamless flow of information to travellers about routes, destinations, real-time information sharing, etc.

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Examples of Smart Ports

There is a growing number of implemented "Smart Port" projects as well as others currently underway, where IoT is an essential part of the overall solution.

The Port of Barcelona

The Port of Barcelona has led the way in applying technological solutions in its various areas: commercial, public and logistics, to create transparent and efficient services providing value to customers, while furthering the Port's commitment to protecting the environment and providing quality areas and services to the public. The Port of Barcelona's smart way of working involves: using technology to transform public services into interactive services; an environmental commitment to become a sustainable port; and orienting port activity towards the needs of customers and the public.

As for the IoT related project, that involved Cisco, Actility, etc., the plan was to use the LPWA network to track security and maintenance vehicles and personnel around the port area.

Vendors who contributed: **Cisco, Actility, Abeeway, Tracktio,** and others

Benefits

- The target for network-based geolocation is to achieve an accuracy of better than 100m, which is all that's necessary in many use cases, such as determining whether a vehicle is in one depot or another, for example, or geofencing to detect when an animal strays outside boundaries.
- Automatic lighting management and automated terminal entry and exit controls - due to come on stream soon – removing the need for paper documents in container deliveries and collection.
- Monitoring queues of lorries at the entrance to the terminals as a way of planning the internal traffic flow within the Port.
- The PortIC telematics platform serves the entire port community; the Port Management System project, located in the Control Tower, which provides coordinated management for all the services provided in Port waters - pilots, tugs, berths, supplies, etc.
- On the environmental side, the Port performs systematic controls on all its facilities and promotes actions to minimise the environmental impact of its activities. It has placed atmospheric sensors all around the precinct to monitor the air quality in the various areas of the Port. Such data are shared with Barcelona City Council and the Government of Catalonia to help them draw up a map of emissions and act if necessary. It also checks the emissions from ships when they are within the Port itself.
- Private operators and CILSA have installed solar power generation complexes on the roofs of warehouses and parking areas at the ZAL (Logistics Activities Area), comprising one more example of the Port's environmental commitment to promoting a management model that is energy-efficient, sustainable and respectful of the natural and social environment.
- Finally, the Port is working on an agreement with car manufacturer SEAT to conduct short-term tests of two prototypes: one electric car and one hybrid. These vehicles, which will be charged via the mains, will send telemetric signals to SEAT providing real-time information on the vehicle - its position, speed, and battery charge - and the Port will assess the possibility of including this type of vehicles in its fleet in the future.

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The Port of Hamburg

The smart Port of Hamburg faces a daunting challenge, it should move an increasing volume of lorries, trains, people, and containers in a limited space that cannot grow beyond its current size because it is in the middle of the city. 9 billion containers and 10,000 ships should be assigned to docking piers, unloaded, and moved out of the port while trailers or trains receive the shipments.

Vendors who contributed: **SAP, Telefonica, Cisco**

Benefits

- Better communication between harbour port authority and ships, telling them where to dock, raising drawbridges in time to let ships pass through while cutting traffic to the bridges and at the same time indicating to lorries which parking spaces or cranes have been allotted to them, in order to have them loaded and leaving the harbour area in the shortest time possible.
- Better coordination for truck loading, among truck drivers, traffic management systems, cranes and containers loaders, resulting in quicker delivery of products to the stores.
- Streamlining processes that result in saving money for shipping and logistics companies.
- Less waiting times for ships, vehicles, employees, that result in better coordination and traffic management, which is key for busy ports.

Other Examples

Other interesting examples are port of Santos in Brazil, port of Valencia in Spain, and port of Southampton in the UK. There are also ports moving further and exploring the role of blockchain in a smart port vision. The port of Tallin and the port of Antwerp are working in these directions. The port of Rotterdam has been even more proactive establishing a blockchain for port logistics incubator called “Blocklab”.

Blockchain for Ports & Maritime Logistics

Blockchain is a new concept, perhaps difficult to grasp, but it can open new opportunities for secure transaction of data. Historically, when performing a transaction between two entities, the exchange of goods, services, etc. is handled and verified by a middleman. A blockchain transaction removes the middleman. The process of verification is carried out by members of the network called ‘miners’, who check the trade against all past records held within the network to ensure that what is being traded actually exists and is owned by the respective parties. This makes it very hard to simply create something out of mid-air. Every few minutes the miner creates a verified file which holds a copied record of all transactions that have occurred in the network over the time frame, called a ‘block’. As each transaction in every block is made at a specific time, each block is linked to the previous block of transactions. By grouping these blocks we get what is referred to as the blockchain. Therefore, the concept of blockchain is very well suited to track a transaction from one point to another in a trustless manner. There are several companies working on the use of blockchain for port logistics such as T-Mining, Circle, and Blockfreight.

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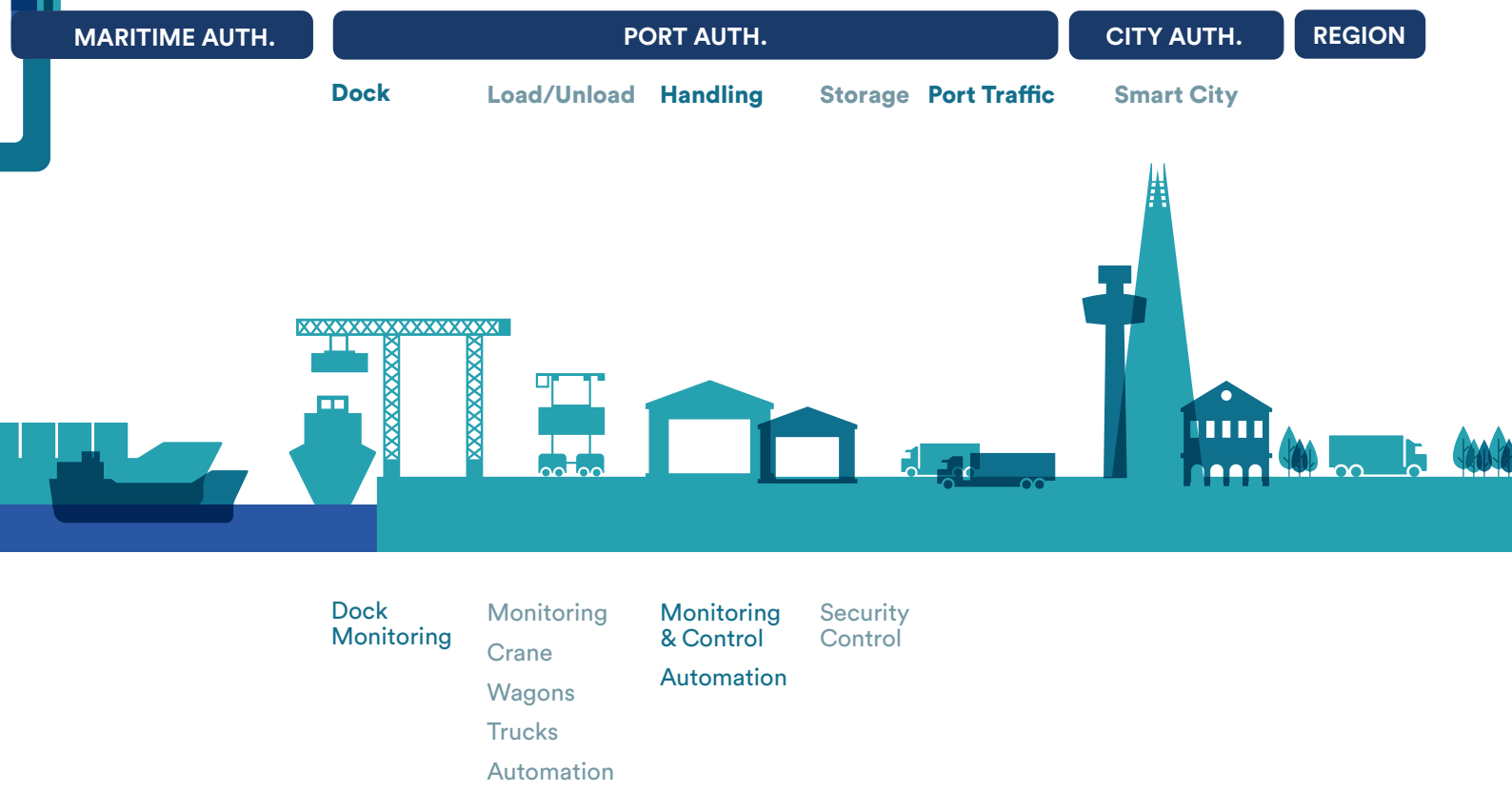
Linking Smart Ports to Smart Cities & Smart Regions.

This paper has briefly explored the concept of the smart port illustrating activities, technologies used and highlighting some examples of smart port projects. However, there is another important consideration to make. The smart port needs to be thought in the context of the area in which it is located and which serves.

Therefore, the link between smart port and smart city and, further, with the smart region is an important one to build. The link is the data gathered along the axis port-city-region as shown in **Figure 2.** The analysis and use of that data is crucial for making that axis and the nodes of that axis more efficient.

Figure 2. The Smart Axis Port-City-Region.



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Beecham Research

Beecham Research s a leading technology market research, analysis and consulting firm established in 1991. We have specialized in the development of the rapidly-growing Connected Devices market, often referred to as M2M and IoT, worldwide since 2001. We are internationally recognised as thought leaders in this market and have deep knowledge of the market dynamics at every level in the value chain.

Our clients include component and hardware vendors, major network/connectivity suppliers, system integrators, application developers, distributors and enterprise users in both B2B and B2C markets.

We are experts in M2M/IoT services and platforms and also in IoT solution security, where we have extensive technical knowledge.

Chief Research Officer **Saverio Romeo** runs research in the areas of M2M, IoT, IoT policy, and wearable technologies. He also publishes studies, advises vendors & adopters on these topics, and frequently contributes to IoT conferences. He is a Visiting Fellow at the Centre for Innovation Management Research and guest lecturer on the IoT at the Department of Informatics at Birkbeck University, London. Previous to Beecham Research, he worked at Frost & Sullivan, Technopolis Group and the European Commission. He holds three MSc in Telecommunications Engineering, Information Technology, Innovation Management & Technology Policy. He is native Italian, fluent in English, intermediate in Modern Greek.

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