



Smart Ports
Point of View

By Deloitte Port Services

Seaports are playing catch-up with the large transport & logistics players when it comes to developing insight driven solutions and IoT applications.

Contents

Introduction	3
Need for Smart Ports is driven by industry challenges	6
From digital to smart	10
Challenges ahead	16
About the authors	18

Introduction

Currently, a tidal wave of technological innovation & integration is pushing industries and businesses to transform themselves in an effort to become more data, and insight-driven. The port industry is no exception.

Being part of both larger transport and logistics (T&L) supply chains and in itself being a cluster of companies and businesses active in the T&L sector, ports are in a unique position to fully grasp the potential generated by these new high tech developments.

Within the wider T&L sector, companies have begun experimenting with a range of connectivity and data-enabled technologies. In aggregate, these technologies form the Internet of Things (IoT), which represents a convergence between the physical and digital worlds, ultimately using data as a source of value. These IoT technologies are being applied in diverse settings, from last mile transport optimization to warehouse and transport management systems. These developments have been accelerated by decentralized networks that rely on the rapid availability and analysis of information.

Seaports are playing catch-up with the large T&L players when it comes to developing insight driven solutions and IoT applications. The current landscape offers some initial attempts at enhancing value propositions through technologies like automation but overall these

projects remain isolated. At the moment, ports in Western Europe are leading the pack in these attempts. Although the Smart Port and IoT initiatives are commendable, there is still a long way to go before we can truly speak of fully integrated ports that fully capitalize on the potential of IoT and insight driven applications, in other words true "Smart Ports".

Becoming a Smart Port means developing solutions to address the current and future challenges faced by seaports including spatial constraints, pressure on productivity, fiscal limitations, safety and security risks and sustainability. Today's technological and business model innovations can be a driving force behind the Smart Port.

However, determining which technologies, how to implement them and the way in which they can support the overall digital strategy of the port remains the main challenge.

It stands to reason that ports are faced with a myriad of issues both technical and strategic. The diverse nature of a port, with a wide variety of companies and ecosystems, operating different kinds of

equipment and requiring different types of products and services creates a complicated environment with multiple stakeholders. In addition to heterogeneity of data, a fear of transparency also remains a major issue. Ports are typically comprised of a cluster of competing companies.

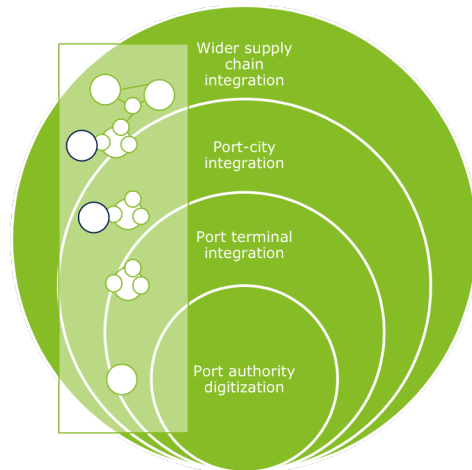
Thus, they are often very hesitant to share information with a central authority that has the ability to aggregate and distribute the data amongst the stakeholders involved. In addition the interaction with the surrounding environment, both ecological and social, adds an extra layer of complexity and opportunity to Smart Port development.

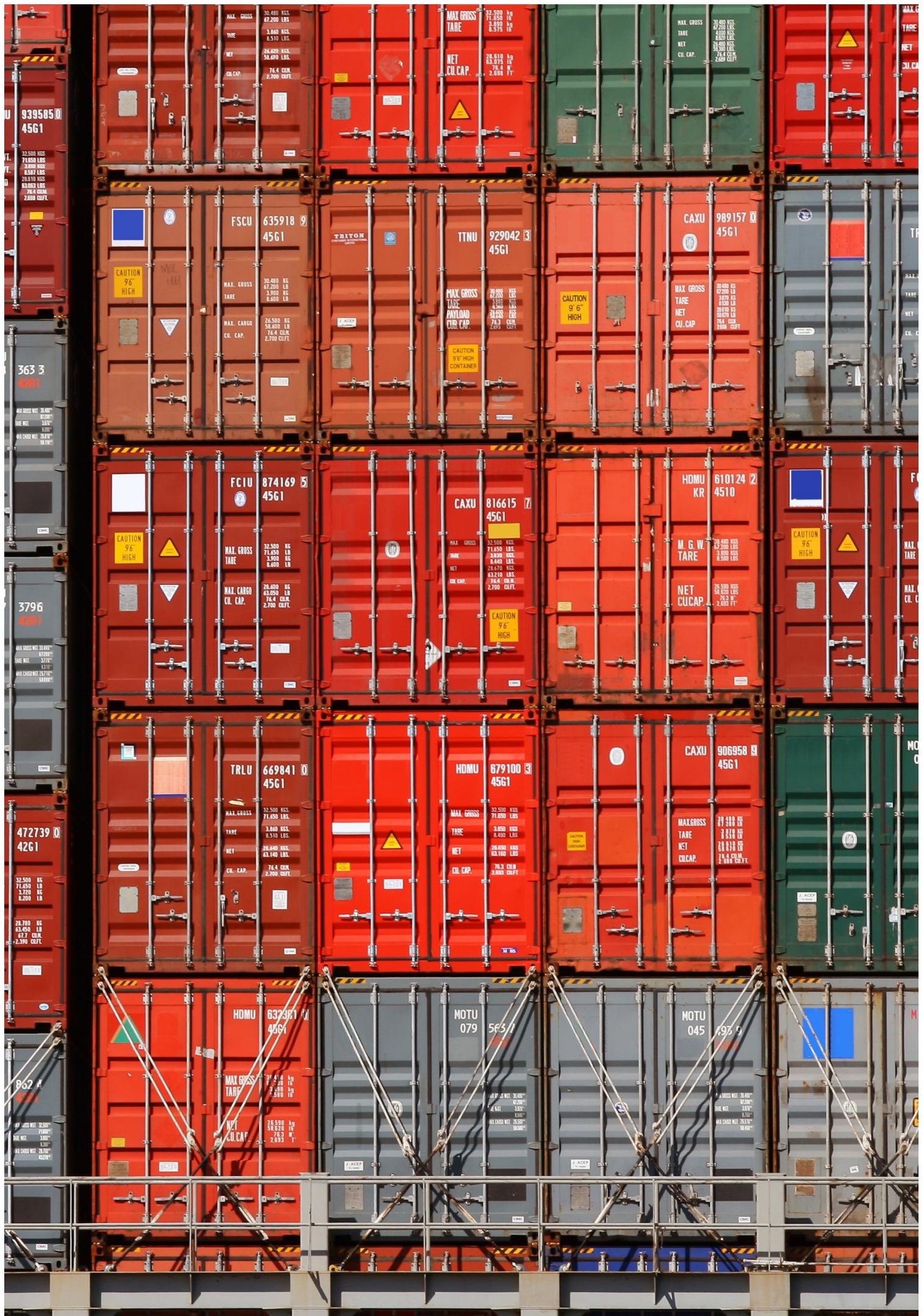


Transport management systems are currently the number one IoT application in ports.

One size fits all?

A fully developed smart port can use it gained insights for new business model generation. However not all ports have the potential to integrate fully with their surroundings. Some ports might lack infrastructure or physical integration with their surroundings or might simply not have the scale required to perform the necessary investments. The determination of which level of digitization that can be achieved should be performed on a case to case basis.





939585 0
45G1

363 3
4261

3796
4261

472739 0
4261

862 #

MAX. GROSS 30,400 KGS
67,200 LBS

TARE 3,840 KGS
8,510 LBS

NET 26,560 KGS
58,690 LBS

CU. CAP. 76.4 CBM
2,700 CU. FT.

FSCU 635918 9
45G1

CAUTION 9'6" HIGH

MAX. GROSS 30,400 KG
67,200 LB

TARE 3,840 KG
8,600 LB

MAX. CARGO 26,560 KG
58,250 LB

CU. CAP. 76.4 CBM
2,700 CU. FT.

FCIU 874169 5
45G1

CAUTION 9'6" HIGH

MAX. GROSS 32,500 KG
71,650 LB

TARE 3,840 KG
8,460 LB

MAX. CARGO 28,660 KG
63,190 LB

CU. CAP. 76.4 CBM
2,700 CU. FT.

TRLU 669841 0
45G1

MAX. GROSS 32,500 KGS
71,650 LBS

TARE 3,840 KGS
8,510 LBS

NET 28,660 KGS
63,140 LBS

CU. CAP. 76.4 CBM
2,700 CU. FT.

HDMU 832321 1
45G1

MAX. GROSS 32,500 KG
71,650 LB

TARE 3,840 KG
8,500 LB

NET 28,660 KG
63,150 LB

CU. CAP. 76.3 CBM
2,690 CU. FT.

MAX. GROSS 32,500 KGS
71,650 LBS

TARE 3,840 KGS
8,510 LBS

NET 28,660 KGS
63,140 LBS

CU. CAP. 76.4 CBM
2,700 CU. FT.

TRITON

TTNU 929042 3
45G1

MAX. GROSS 29,500 LBS
13,380 KGS

TARE 3,840 LBS
1,740 KGS

NET 25,660 LBS
11,640 KGS

CU. CAP. 76.3 CBM
2,690 CU. FT.

CAUTION 9'6" HIGH CONTAINER

MAX. GROSS 32,500 KGS
71,650 LBS

TARE 3,840 KGS
8,460 LB

NET 28,660 KGS
63,190 LB

CU. CAP. 76.4 CBM
2,700 CU. FT.

CAUTION 9'6" HIGH

HDMU 679100 3
45G1

MAX. GROSS 32,500 KGS
71,650 LBS

TARE 3,840 KGS
8,460 LBS

NET 28,660 KGS
63,190 LBS

CU. CAP. 76.3 CBM
2,690 CU. FT.

MOTU 079 563 1

MAX. GROSS 32,500 KGS
71,650 LBS

TARE 3,840 KGS
8,510 LBS

NET 28,660 KGS
63,140 LBS

CU. CAP. 76.3 CBM
2,690 CU. FT.

MAX. GROSS 30,400 KGS
67,200 LBS

TARE 3,840 KGS
8,510 LBS

NET 26,560 KGS
58,690 LBS

CU. CAP. 76.4 CBM
2,700 CU. FT.

CAXU 989157 0
45G1

CAUTION 9'6" HIGH

MAX. GROSS 30,400 KG
67,200 LB

TARE 3,840 KG
8,510 LB

NET 26,560 KG
58,670 LB

CU. CAP. 76.4 CBM
2,700 CU. FT.

HDMU 610124 2
4510

M. G. W. TARE 30,400 KGS
67,200 LBS

NET 26,560 KGS
58,690 LBS

NET CUCAP. 76.5 CBM
2,693 FT

CAXU 906958 8
45G1

MAX. GROSS 32,500 KG
71,650 LB

TARE 3,840 KG
8,460 LB

NET 28,660 KG
63,190 LB

CU. CAP. 76.4 CBM
2,700 CU. FT.

MOTU 045 192 5

MAX. GROSS 32,500 KGS
71,650 LBS

TARE 3,840 KGS
8,510 LBS

NET 28,660 KGS
63,140 LBS

CU. CAP. 76.3 CBM
2,690 CU. FT.

MAX. GROSS 30,400 KGS
67,200 LBS

TARE 3,840 KGS
8,510 LBS

NET 26,560 KGS
58,690 LBS

CU. CAP. 76.4 CBM
2,700 CU. FT.

TR

MAX. GROSS 30,400 KG
67,200 LB

TARE 3,840 KG
8,510 LB

NET 26,560 KG
58,670 LB

CU. CAP. 76.4 CBM
2,700 CU. FT.

MAX. GROSS 30,400 KGS
67,200 LBS

TARE 3,840 KGS
8,510 LB

NET 26,560 KGS
58,690 LBS

CU. CAP. 76.4 CBM
2,700 CU. FT.

CAUTION 9'6" HIGH

MAX. GROSS 30,400 KGS
67,200 LBS

TARE 3,840 KGS
8,510 LB

NET 26,560 KGS
58,690 LBS

CU. CAP. 76.4 CBM
2,700 CU. FT.

MC

Need for Smart Ports is driven by industry challenges

Ports operate within a supply demand model which is similar to the traditional T&L industry. On the supply side the Port Authority provides land for rent, services to clients as well as a regulatory framework.



The demand side is comprised of both logistics supply (warehouses, transport providers, terminal operators) and demand (industrial sites, stowage companies, etc.) and is therefore vastly different from the traditional T&L setup.

When assessing the availability of technology in seaports, one must understand the demand supply balance. Seaports are often 'landlords', their business model revolves on supplying land and services to demand parties like terminal operators and companies acting in the T&L sector. Therefore, there is an important distinction between technological innovation on a terminal level and on a port level. A full port based IoT implementation should benefit both the port users as well as the port authority itself.

There are three main challenges driving the need for smart ports:

1. Operational excellence
2. Migrating activities (challenging external market)
3. New business opportunities

These challenges stem from the tendency to measure success based on traditional parameters like size and throughput. However, Western ports are no longer only competing for the number one spot in global traffic figures. Ports in Western Europe are faced with a concentration of ports in a stagnating mature market where efficiency and protection of market share becomes central. This necessitates a strategic shift, where size is no longer the primary focus, but rather efficiency and smarter operations. It is no longer the largest port that will survive but the smartest port.

“Smart ports are the only ports that will survive.”

prof. dr. Olaf Merk

The three challenges can be countered by a set of solutions focused on automation and information services, such as IoT.

Operational excellence

The primary challenge driving IoT in seaports is operational excellence. From a supply side, namely port authorities, capacity, efficiency, reliability, support and costs are key drivers of value proposed to the clients (for e.g. terminal operators). On the demand side port users might want extra services like savings in time, security, traceability, etc. Improving these drivers for both sides is where the quick wins lie for ports. The importance of this challenge is mirrored in the current IoT implementations in ports. Today's digital port solutions focus on efficiency improvements like traffic management systems, improving flow throughout the port area, automation, reducing costs or digital invoicing (customs) by improving lead time.

However, the need for IoT and smart ports is not only driven from a business perspective. Today we also see other trends, which will force ports to be proactive and shape their environment instead of reacting to market fluctuations.

NxtPort

The port of Antwerp focuses its strategy of operational improvement on NxtPort, an information sharing platform for companies such as BASF, MSC, Katoen Natie, DP World and PSA. The objective is to become a self-sustaining data-commercialization company that will gather, centralize, store, analyse and exchange data from a wide variety of logistic actors. Other parties which can join the platform in due time include customs, food quality control, other governmental agencies and IT application developers.

Migrating activities

The second challenge driving IoT in seaports is migrating activities. The need to be smart is also driven by challenging external market environments. Focusing on Europe, we observe a shift of spending power away from the traditional Western regions, GDP growth is stronger in Eastern Europe while cost of living is lower. Many of the EDCs, traditionally located in Northwest Europe, are moving their activities further east. This could result in a subsequent shift in local shipping networks, putting added pressure on the ports which are currently market leader (Rotterdam, Hamburg, Antwerp and Amsterdam).

On a global scale, shifting transport networks also endanger traditional port leaders. Developments like the China- Africa route reducing transshipment needs in Western Europe, the growth of transshipment hubs in the Middle East, the one belt, one road project or even the Arctic route might cause cargo shifts. This increases competition and renders the value propositions generated by IoT like cost reductions and increased efficiency ever more important.

Finally more indirect developments drive the need for Smart ports. These include the increased focus on sustainability, generated from a stronger interaction between port and city, by regulations based on sustainability and environmental targets and by social pressure.

New business opportunities

The third challenge driving IoT in seaports is the development of new (data-driven) business models. IoT applications provide more added value than only updating existing frameworks and streamlining established business models. In order to maximize potential of insight driven solutions, port authorities must rethink their orthodoxies about value creation and value capture. The three strategies described by Porter, differentiation, cost leadership, and focus are no longer mutually exclusive but rather mutually reinforcing. Next to the physical flows more emphasis will be put on (data-driven) models like value-added services, subscriptions, apps and anything as a service (XaaS).

Portbase and automated terminal

Within the port of Rotterdam two main technological feats have been accomplished, aimed at locking cargo streams to the port. First, the nationwide Portbase initiative, in existence since 2009. Portbase Port Community System is the digital connection to smart Dutch ports. It is a combination of an application layer, platform and information database. The system promises concrete savings in time and money through bilateral connections and information exchange.

A second technical feature in the port of Rotterdam is the state-of-the-art fully automated deep sea terminal with automated guided vehicles.

Port apps

The port of Amsterdam for example, has launched multiple apps. The I Am Port app offers real time information on ships locations and itineraries in the port. In addition you can find information on arrivals and departures, size, draft and berth of each ship in the port.

A second app, the Port Data app shows the historical market shares of the throughput of cargo of eleven ports in the Le Havre – Hamburg range in order to promote the idea of data sharing. Finally a third app allows you to tour the port in a VR environment and aims to increase local support for the seaport.



From digital to smart

Ports have gone through a structural and functional evolution over the past decades.



Simply put, there are three generations in port development:

1. The first generation port is a loading and unloading port (until the 1960s)
2. The second generation port is an industrial port (until 1980s)
3. The third generation port is a logistics / supply chain port (post 1980s)

Each generation comes with a new function and focus. In the third generation traditional views held that a ports function was less service and regulator oriented and more landlord and facilitator (or cluster manager) focused. What we see today with the increased need for digital integration is that a port is increasing its focus as a service provider, albeit not in physical services like towage and crane operations but more by becoming a data service provider. This means that phase three is actually followed by phase four, a digitalization of port activities where new services either replace or augment traditional port services.

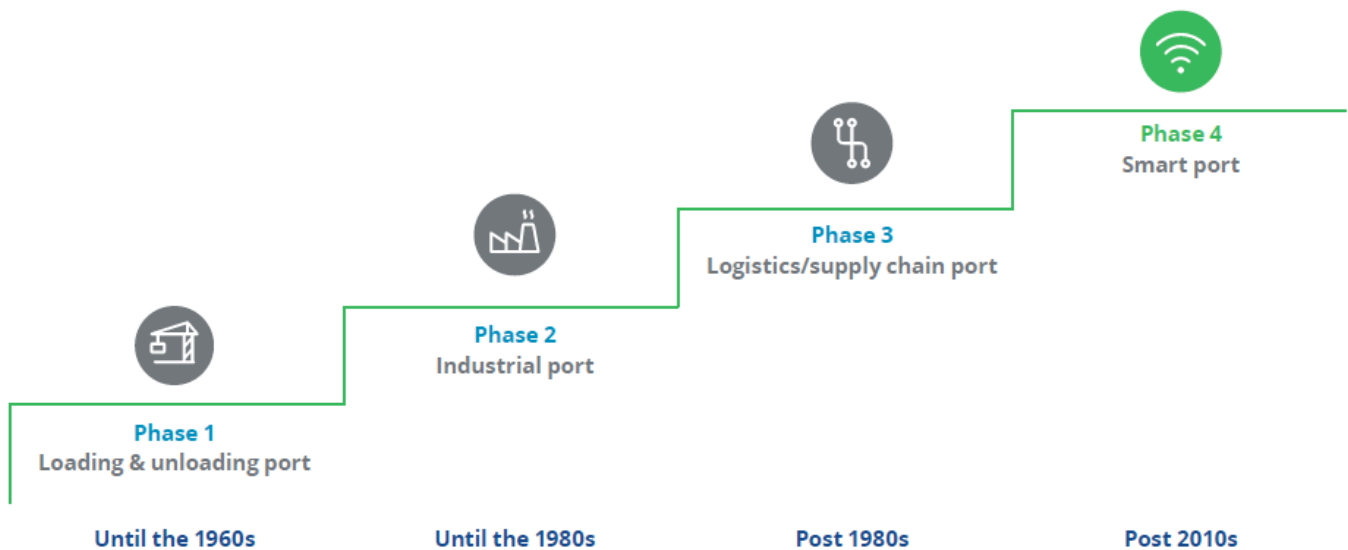
Moving towards a true Smart Port, one which uses the full potential of an IoT network and smart data solutions means that a port must be able to identify and take advantage of new business models within the larger ecosystem. The nature of the business makes this challenging, since it requires integration between the supply and demand side from the T&L sector, assimilating not only logistics firms and suppliers and distributors but also their clients like industrial producers.

Ports have already positioned themselves in the supply chain as a place for supply and demand to meet. In other words, they represent a physical manifestation of a platform business model.

While it is likely common to think in traditional strategic terms – those examples from Porter mentioned before, the strategic application of this business model goes beyond these perspectives. Ports must focus on the ecosystem they have created, a platform - where two

parties meet in order to create value. In a platform world, this often means that the availability of supply on one side of the market affects the volume of transactions on the other side of the market. In the context of a port, the platform business performs a sidestep from the traditional supply and demand balance mentioned above, where the port is a landowner and service provider for both incoming and outgoing logistics. A port platform model would be represented by three parties:

1. Supply: this side of the market includes inbound logistics companies, ship owners, terminal operators, maritime service providers, etc.
2. Platform: this is represented by the platform itself. The Port Authority provides the physical / business platform for supply and demand to meet.
3. Demand: this side of the market includes outbound logistics companies, manufacturers both inside and outside the port, and distributors seeking to meet materials and products further down the value chain.



Smart port is the fourth generation in port development.

A true Smart Port will need to take advantage of its position in the supply chain to add value with the improved use of the data generated by the embedded IoT infrastructure. While the data in itself does not add value, aggregating different data sources and setting the right business rules for analysis can turn it into real insight. At Deloitte, we refer to this as the Information Value Loop, which is further explained on the next page. All of this data can be gathered in a digital IoT platform. It is at this point that the physical (business) platform and digital (IoT) platform begin to merge.

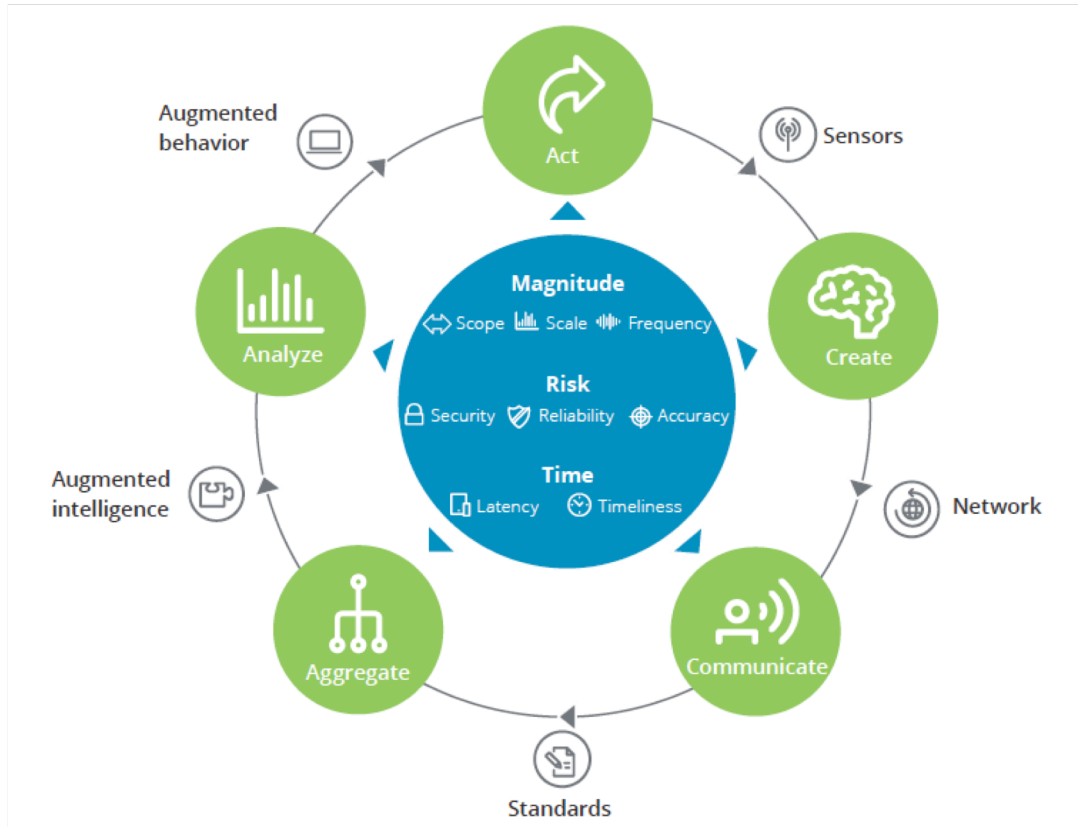
While some of the same parties may remain involved on the supply and demand side of the market, they now increasingly interact digitally. Furthermore, this new digital environment creates opportunities for new, non-traditional parties (e.g. technology companies, individual developers, etc.) to create applications and solutions for stakeholders targeted at improving performance or enhancing the business model of port stakeholders or the port itself.

We observe six distinct data driven opportunity models based on the level of cooperation and the type of data used.

	Business model opportunity	Example
1	Product innovators enhance their products and services with data	Incorporating smart lighting networks in ports through using data from motion sensors
2	Systems Innovators use data to integrate multiple product types	Creating a transport management system using diverse sources of data (weather sensors, motion sensors, etc.) and applying insights to multiple devices like bridges, quays, etc.
3	Data Providers gather and sell raw data without adding too much value to it	Data services like the Automatic identification System linked to GPS which offers insights in multiple aspects of ship movements like origin, destination, cargo, etc.
4	Data Brokers gather and combine data from multiple sources, create additional value with analytics and sell insights	Create market reports using multiple sources like order books and scrapping forecasts
5	Value Chain Integrators share data with system-integrator partners to extend product offerings or reduce costs	Improve the internal port supply chain with data shared by the port users
6	Delivery Network Collaborators share data to drive deal making, foster marketplaces and enable advertising	Foster the marketplace and drive deal making to a new level through novel insight driven business models

Information value loop

The suite of technologies that enables the Internet of Things promises to turn almost any object into a source of information about that object. This creates both a new way to differentiate products and services and a new source of value that can be managed in its own right. Realizing the IoT's full potential motivates a framework that captures the series and sequence of activities by which organizations create value from information: the Information Value Loop



For information to complete the loop and create value, it passes through the loop's stages, each enabled by specific technologies. An act is monitored by a *sensor* that *creates* information, that information passes through a *network* so that it can be *communicated*, and *standards*—be they technical, legal, regulatory, or social—allow that information to be aggregated across time and space.

Augmented intelligence is a generic term meant to capture all manner of analytical support, collectively used to analyze information. The loop is completed via *augmented behavior* technologies that either enable automated autonomous action or shape human decisions in a manner leading to improved action.

Getting information around the Value Loop allows an organization to create value; how much value is created is a function of the *value drivers*, which capture the characteristics of the information that makes its way around the value loop. The drivers of information value can be captured and sorted into the three categories: *magnitude, risk, and time*.

Although most ports are aware of the need for digital integration only few have been acting proactively towards becoming a smart port. Even the European ports with the highest level of IoT implementation today use the technology primarily for adaptive analytics. The leap towards new businesses and new revenue streams remains unexplored at this point.

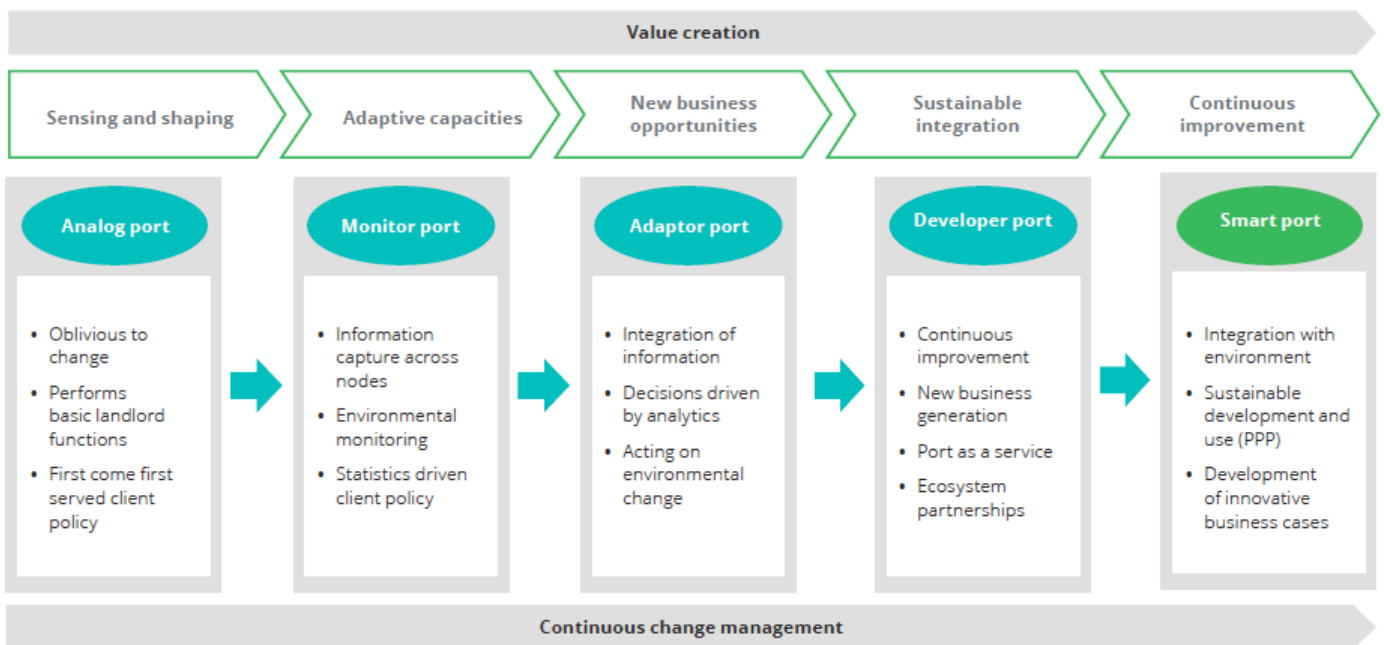
The development of a Smart Port should be something that stems from a strategy. A port should have a clear business case in mind when planning its IoT implementation, because the applications are endless and value can be created in a myriad of different improvements. This also means that a Smart Port is not necessarily the final step in port development. Within a platform world driven by insights cooperation increases the value proposition so one could argue that the next phase would be a Smart Port network, where different platforms connect and share information across geographical borders.

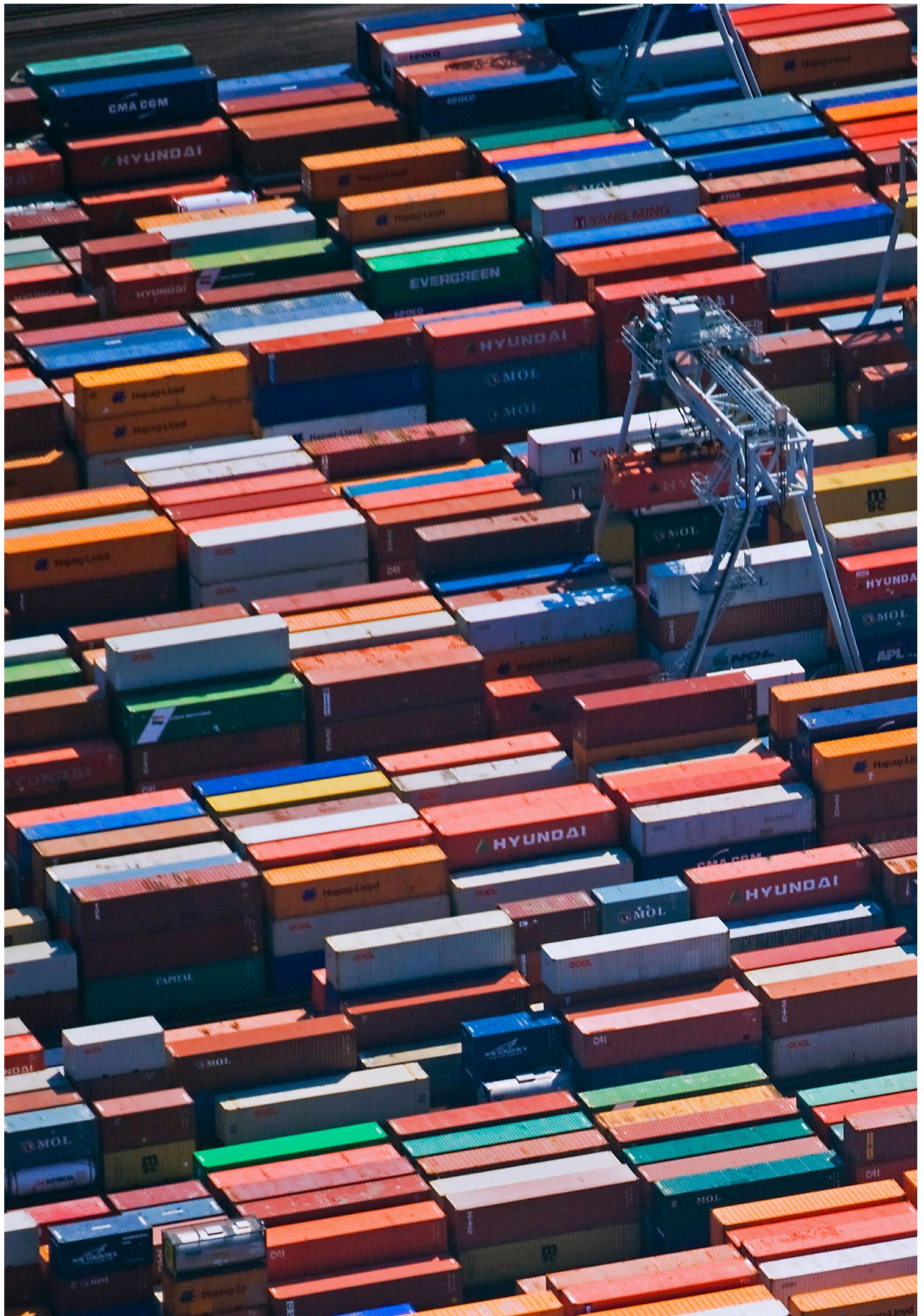
IoT in ports

The port of Hamburg is one of the busiest ports of Europe and a large driver for the regional economy with one-tenth of the total area of Hamburg City. Furthermore, it employs over 260 thousand people and generates over € 750 million in yearly tax revenue for the city of Hamburg. The port has opted for an IoT platform to counter the expected rise in traffic and increasing negative externalities (e.g. traffic congestion, pollution, and road safety) caused by the seaport's activities. The platform is based on three pillars, Smart Port infrastructure, intelligent traffic flows and intelligent trade flows.

The port of Hamburg works with a variety of local, regional and national partners on the project. These partners include the city of Hamburg, which is moving to the smart city model by implementing e.g. smart lighting, bridges, parking lots, etc., the state of Hamburg as well as the Federal Ministry of Transport. Building and Urban Development also play a pivotal role through the maintenance and expansion of inland transport infrastructure. On the private side Hamburg is teaming with IT solutions providers.

Phase 4 Smart port





Challenges ahead

Even though some ports today are starting to come to terms with the importance and need for digitalization and IoT, there is still a long road ahead to get to relatively mature Smart Port concepts.



First of all the real question remains what the port wants to achieve by becoming smart – in other words what is the strategic imperative. This strategic goal should go beyond mere efficiency improvements and focus on a holistic, long term strategy, where insights are distilled from smart applications enabling a transition towards an insight driven company.

This challenge is amplified by the large variety that exists between ports for e.g. a pure bulk port versus a container port. Defining where the quick wins and long term added value lie must be done in cooperation with the respective clients.

A second challenge is the increased focus on cyber security. Companies active in the ports industry, are responsible not just for customer data (which is already extremely valuable), but for physical goods. In addition many of the stored goods can be regarded as strategic stockpiles for the countries and regions increasing the need for a robust security system. Right now port security is limited to the global ISPS code, which focusses on physical threats. Port authority ecosystems must be aware that the digital threat is just as important, certainly if ports continue on their path towards further digitalization.

The need for cooperation between ports, in order to truly share data and insights is something that is unexplored. This third challenge, driven by a certain form of protectionism of the port authorities on their own data is a major hurdle in the development of a true Smart Port strategy.

Finally the dichotomy between the port authority and terminal operator adds a level of complexity. Operational implementations cannot be forced by the port authority on terminal level. This could create a port with a highly integrated infrastructure network but with lacking superstructure integration.

The role of the port authority within a Smart Port strategy includes development and facilitation for its users. The final level of integration will be the result of the stakeholder management and determination shown by the port authority. The issues drivers and challenges above help port authorities to determine where to play and find the right strategy to win. It is our strong belief that becoming a Smart Port, driven by smart technology like IoT is a fundamental part of every seaport game plan.

About the authors

Sjors Berns is a senior manager at Deloitte Financial Advisory Services in the Netherlands and works in the service line Real Estate & Partnerships. He primarily works in the corporate real estate industry and Sjors leads the Deloitte Port Services group in the Netherlands. Sjors is an experienced consultant for port operators and authorities.

Indra Vonck is a consultant at Deloitte Financial Advisory Services in the Netherlands and works in the service line Real Estate Advisory. He primarily works in the corporate real estate industry with a specific focus on seaport and maritime development. Indra recently completed his PhD on Port Resilience and Port Development.

Rob Dickson is a Senior Consultant in Deloitte Consulting's Technology practice and part of the Dutch High Tech Competence Center (HTCC). Rob focuses primarily on product development, Internet of Things (IoT) and Industry 4.0, data-enabled business models and business platforms.

Jochem Dragt is a director at Monitor Deloitte Consulting and works in the Strategy service line of Deloitte's Strategy and Operations practice in the Netherlands. He is part of Deloitte's Maritime Cluster and has worked extensively for various shipping and ports clients, next to clients in consumer business.

Deloitte.

Deloitte refers to one or more of Deloitte Touche Tohmatsu Limited, a UK private company limited by guarantee ("DTTL"), its network of member firms, and their related entities. DTTL and each of its member firms are legally separate and independent entities. DTTL (also referred to as "Deloitte Global") does not provide services to clients. Please see www.deloitte.nl/about for a more detailed description of DTTL and its member firms.

Deloitte provides audit, consulting, financial advisory, risk management, tax and related services to public and private clients spanning multiple industries. With a globally connected network of member firms in more than 150 countries and territories, Deloitte brings world-class capabilities and high-quality service to clients, delivering the insights they need to address their most complex business challenges. Deloitte's more than 210,000 professionals are committed to becoming the standard of excellence.

This communication contains general information only, and none of Deloitte Touche Tohmatsu Limited, its member firms, or their related entities (collectively, the "Deloitte network") is, by means of this communication, rendering professional advice or services. No entity in the Deloitte network shall be responsible for any loss whatsoever sustained by any person who relies on this communication.