

# Smart Ports Initiatives worldwide

Intermodal Europe

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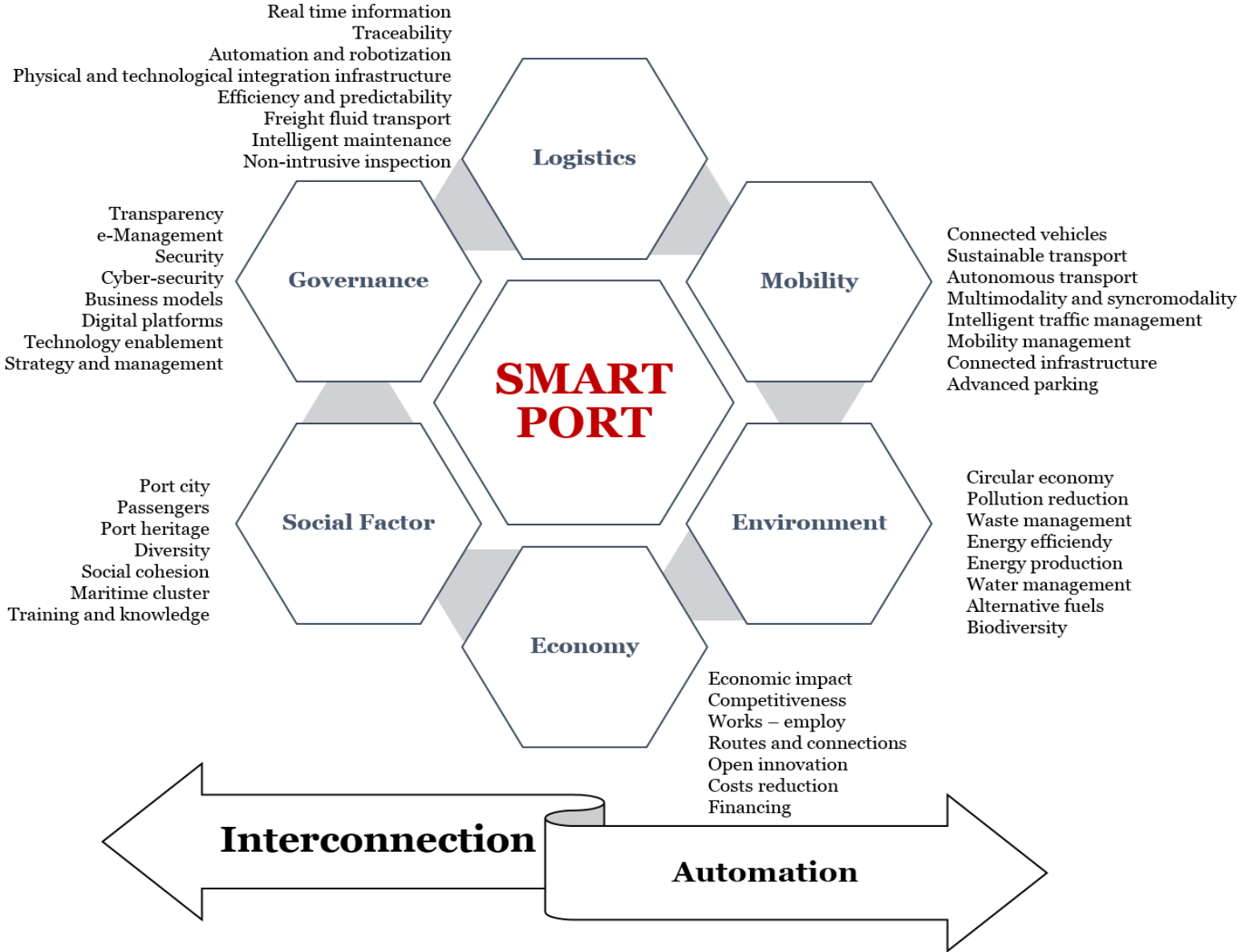
# 1. CONTEXT

“The term *Smart City* can mean anything today. For me it is about continue doing what Hamburg has always distinguished from others: the connection of technological and social progress”.

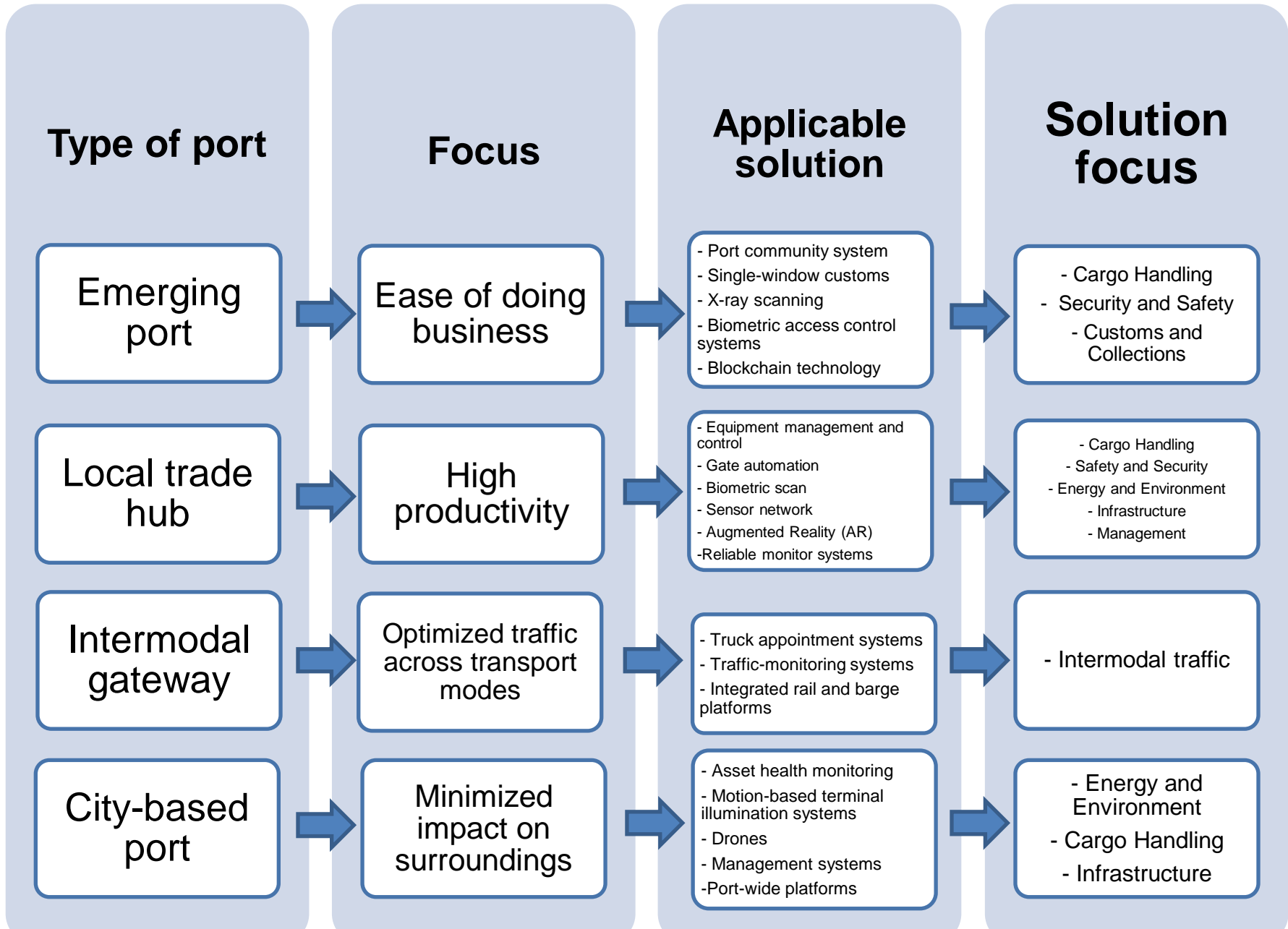
- Olaf Scholz, former lord mayor of Hamburg and currently finance minister of the Federal Republic of Germany.

- The smart port is generally related to the improvement of port productivity and efficiency and the reduction of impacts on the environment.
- The smart port concept entails the use of technologies to transform the different (public) services at ports into interactive systems with the purpose of meeting the needs of port users with a high level of efficiency, transparency and value
- Smart port pillars: interconnection and automation





# CLASSIFICATION



# OVERVIEW



## Infrastructure

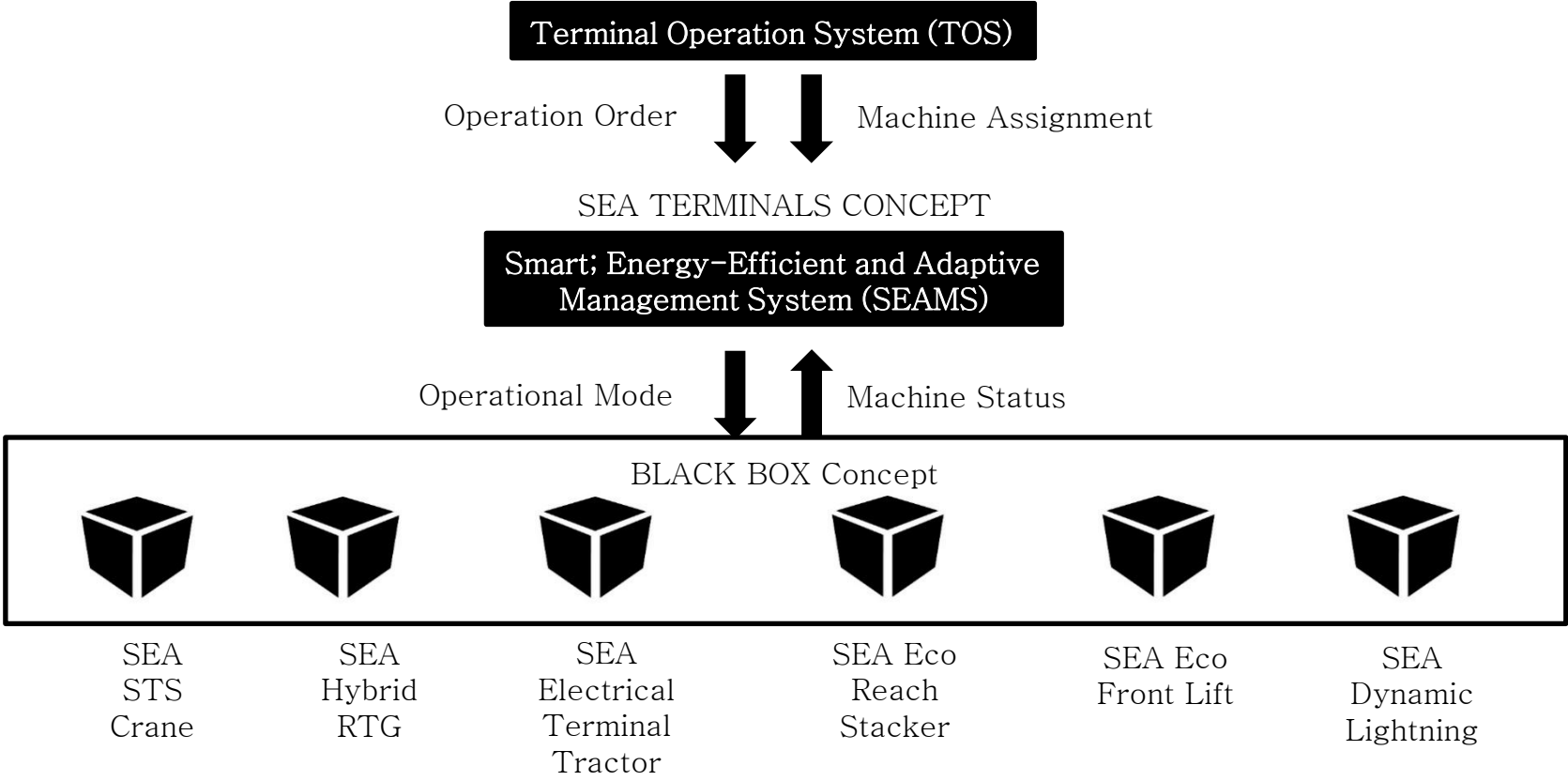
- Smart sensors



source/copyright: <http://www.portautomation.com/solutions/automatic-truck-identification/>

## Cargo handling

- Reliable monitor systems:

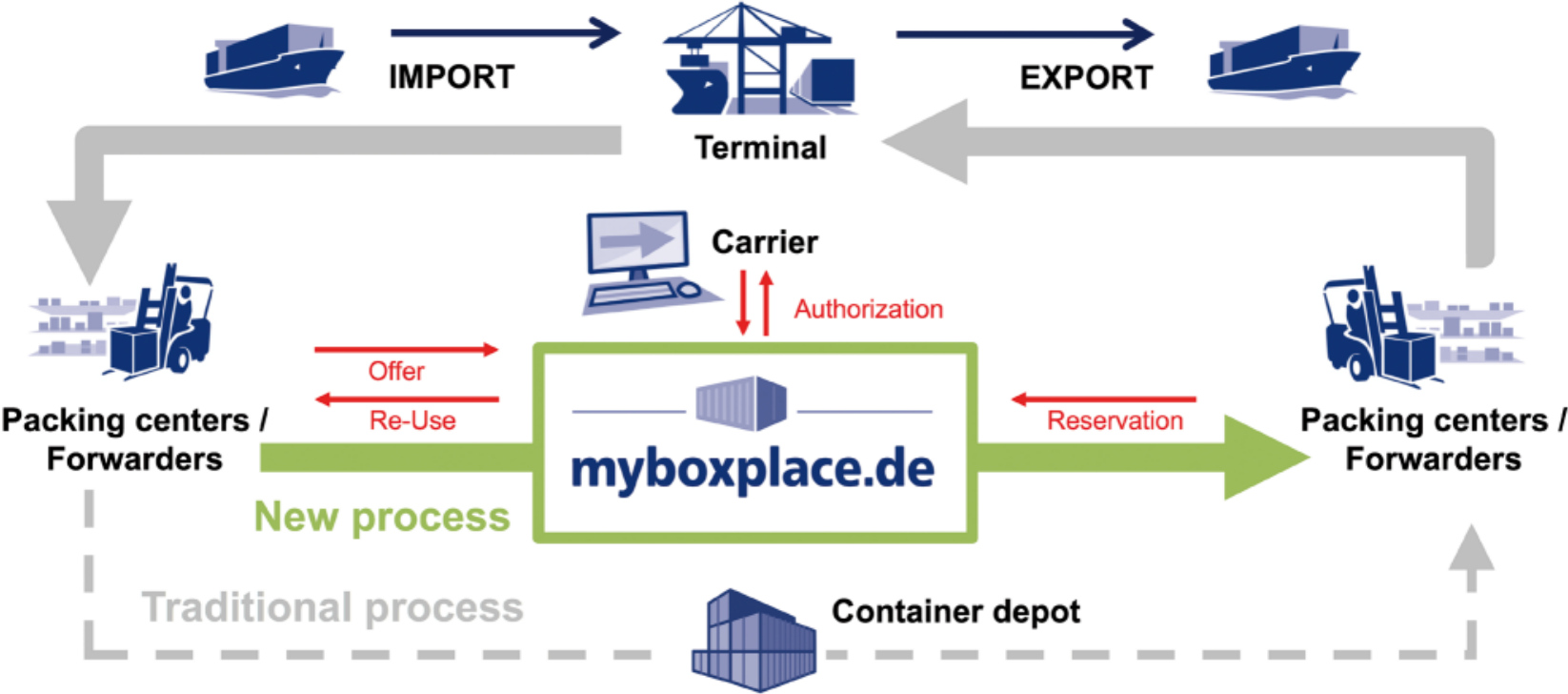


source/copyright: <http://www.seaterminals.eu>

# Overview

## Cargo handling

- Reliable monitor systems:



source/copyright: <https://www.dakosy.de/>

## Cargo handling

- Green AGVs



source/copyright: <https://www.hafen-hamburg.de/en/news/>

# Overview

## Intermodal traffic

- Terminal appointment systems



(a)



(b)

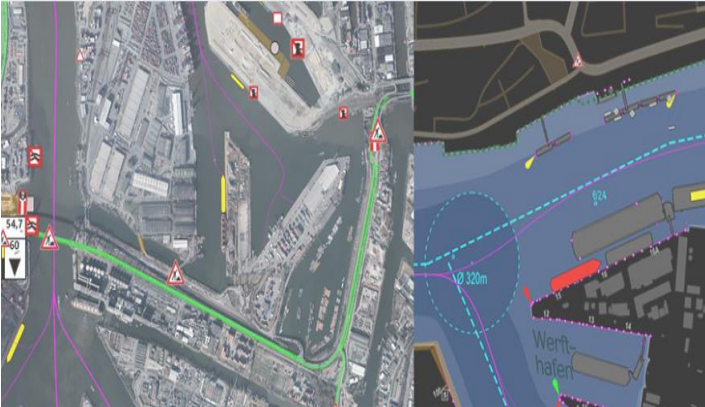
(a) C3 Solution TAS (b) GCT Bayonne's Drayage Truck Appointment System

source/copyright: <https://www.c3solutions.com>; <https://www.gctbayonne.com>



## Intermodal traffic

- Traffic-monitoring systems



(a)



(b)

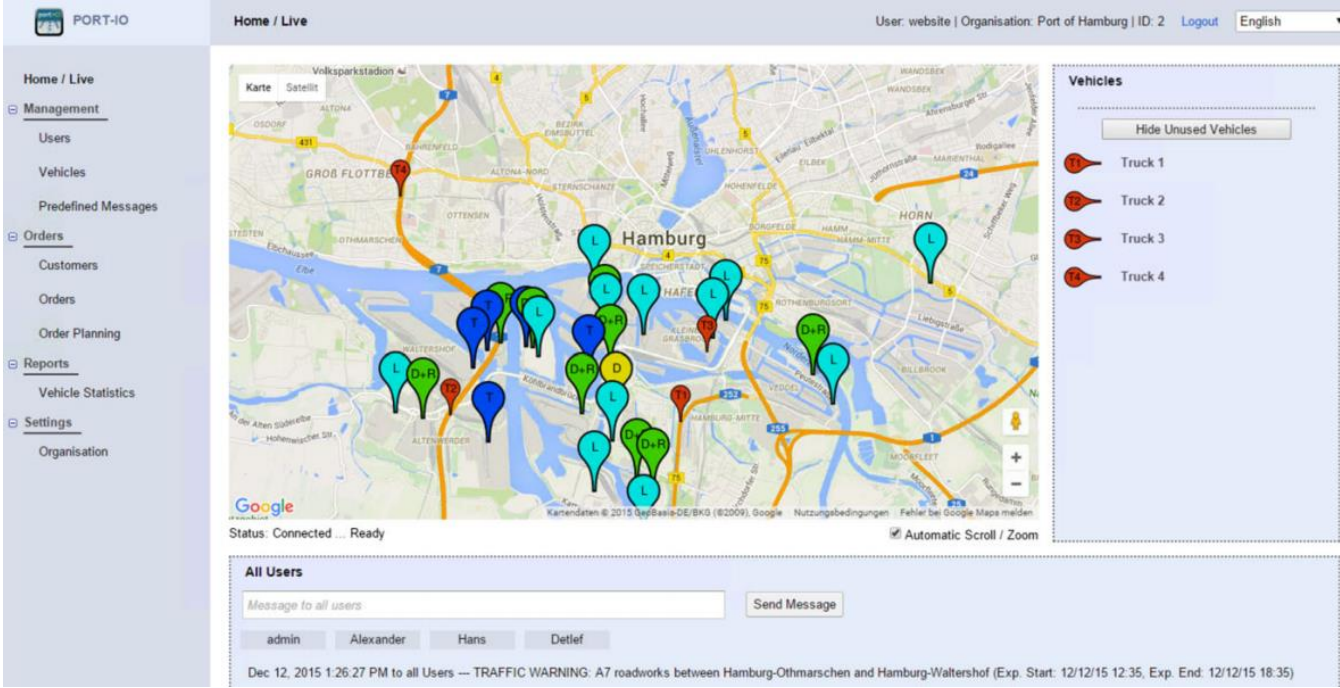
Port of Hamburg initiatives (WorkPlace Solutions): (a) PortMonitor and (b) Smart Sounding Table *source/copyright:* [www.wps.de](http://www.wps.de)



# Overview

## Intermodal traffic

- Traffic-monitoring systems

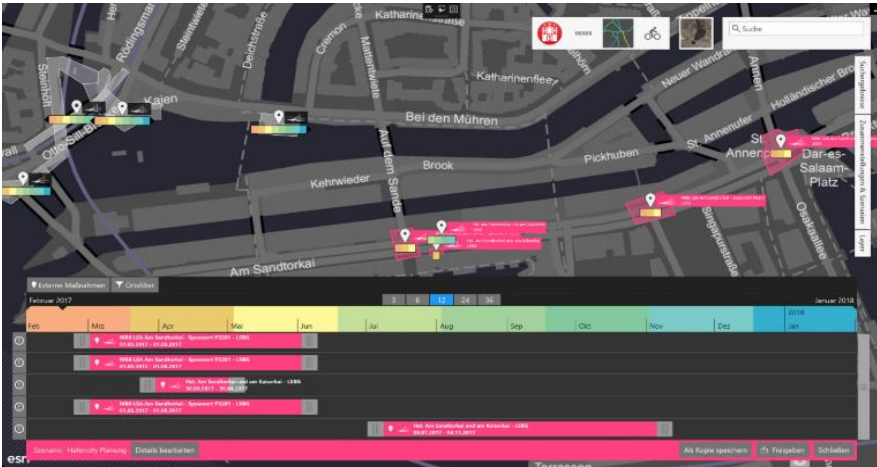


Port of Hamburg initiative port-IO

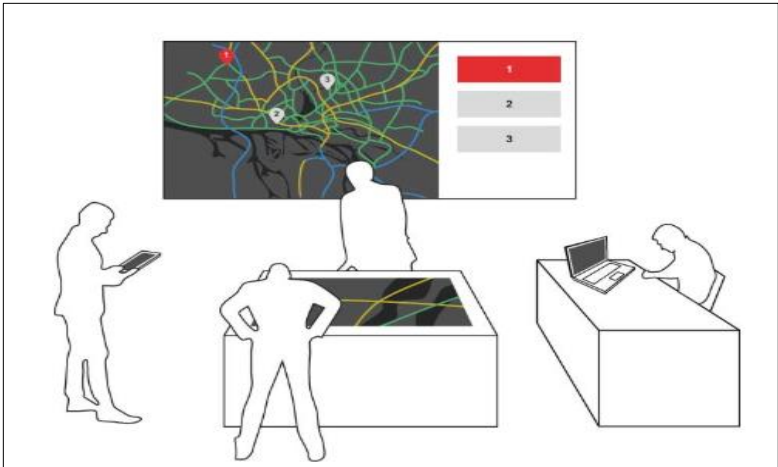
# Overview

## Intermodal traffic

- Traffic-monitoring sensors:



(a)

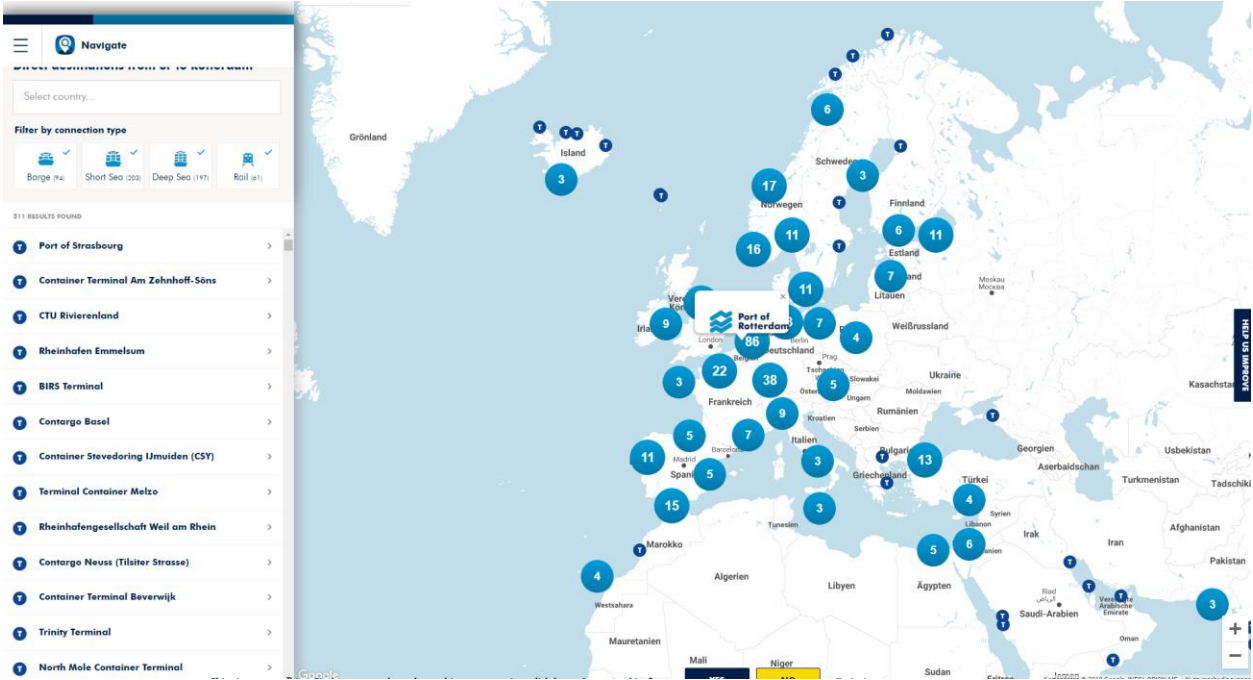


(b)

Port of Hamburg initiatives (WorkPlace Solutions): (a) Roads concept and (b) Sophisticated workplace concept  
*source/copyright: www.wps.de*

## Intermodal traffic

- Intermodal routing systems:



Port of Rotterdam initiatives: Navigate

source/copyright: <https://rotterdam.navigate-connections.com/>

## Intermodal traffic

- Car park management systems:

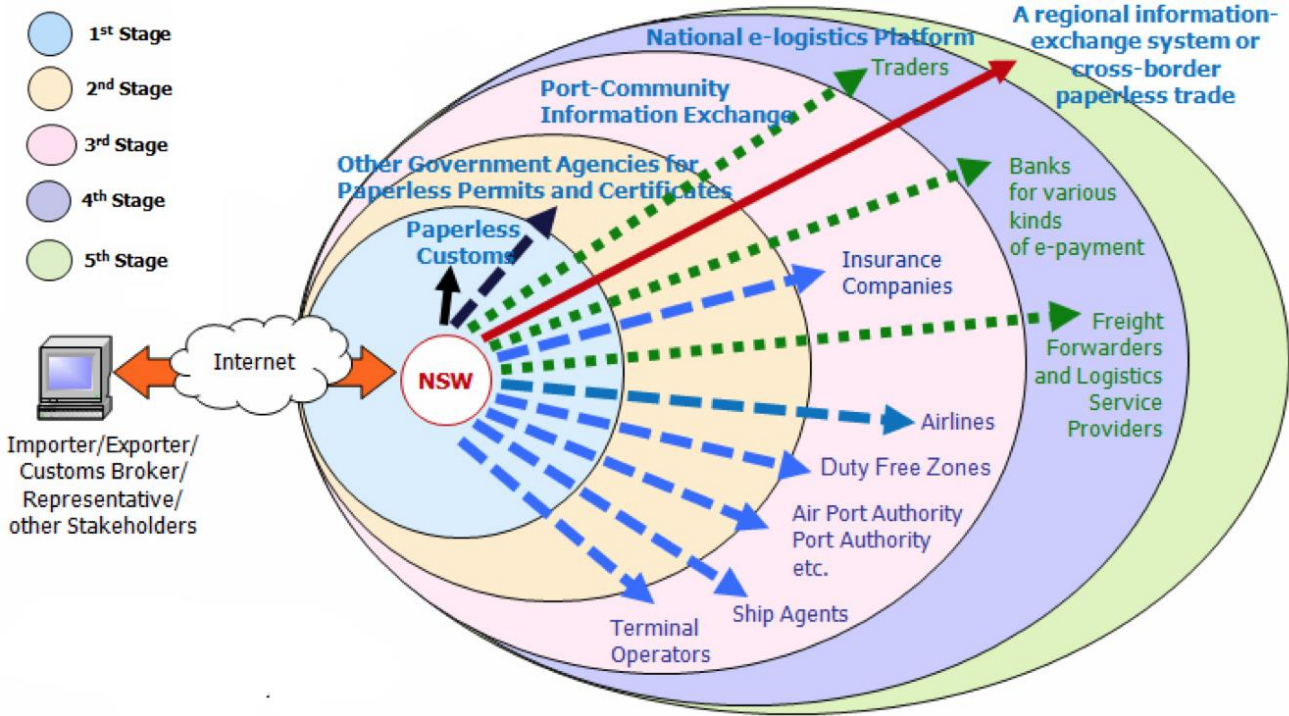


Floating car parks: MacGregor solution  
*source/copyright:* <https://www.macgregor.com>



## Customs and Collection

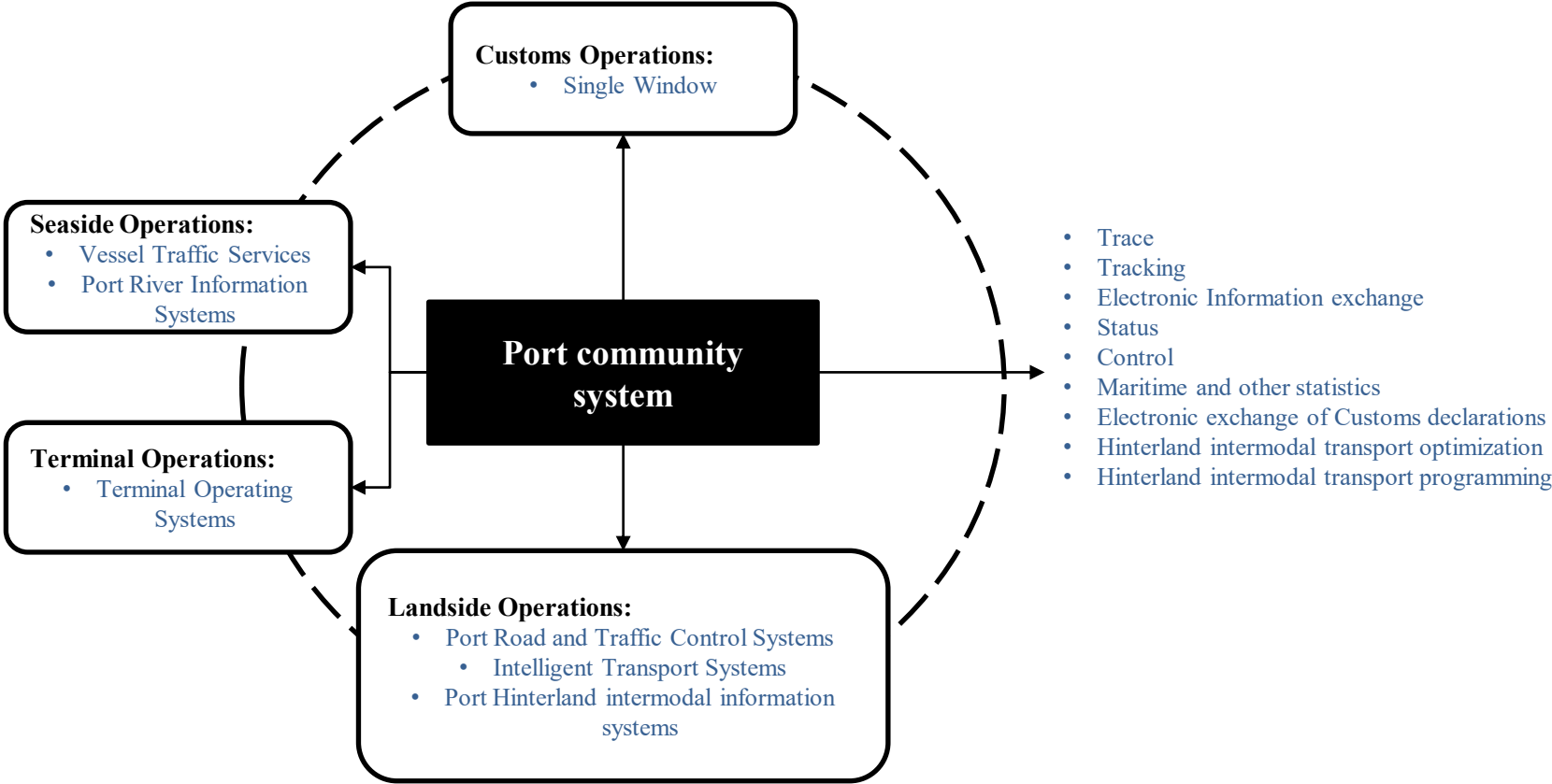
- Single windows:



Single window development stage

## Customs and Collection

- Port community systems (PCS):





## Customs and Collection

- Blockchain technology

## Safety and Security

- Biometric scan
- Sensor networks (alerts)
- Cargo scans



Cargo scan intelligent system

*source/copyright: <https://marsecoutlook.com/>*

## Energy and Environment

- Motion-based illumination system
- Drones (inspection, patrolling):

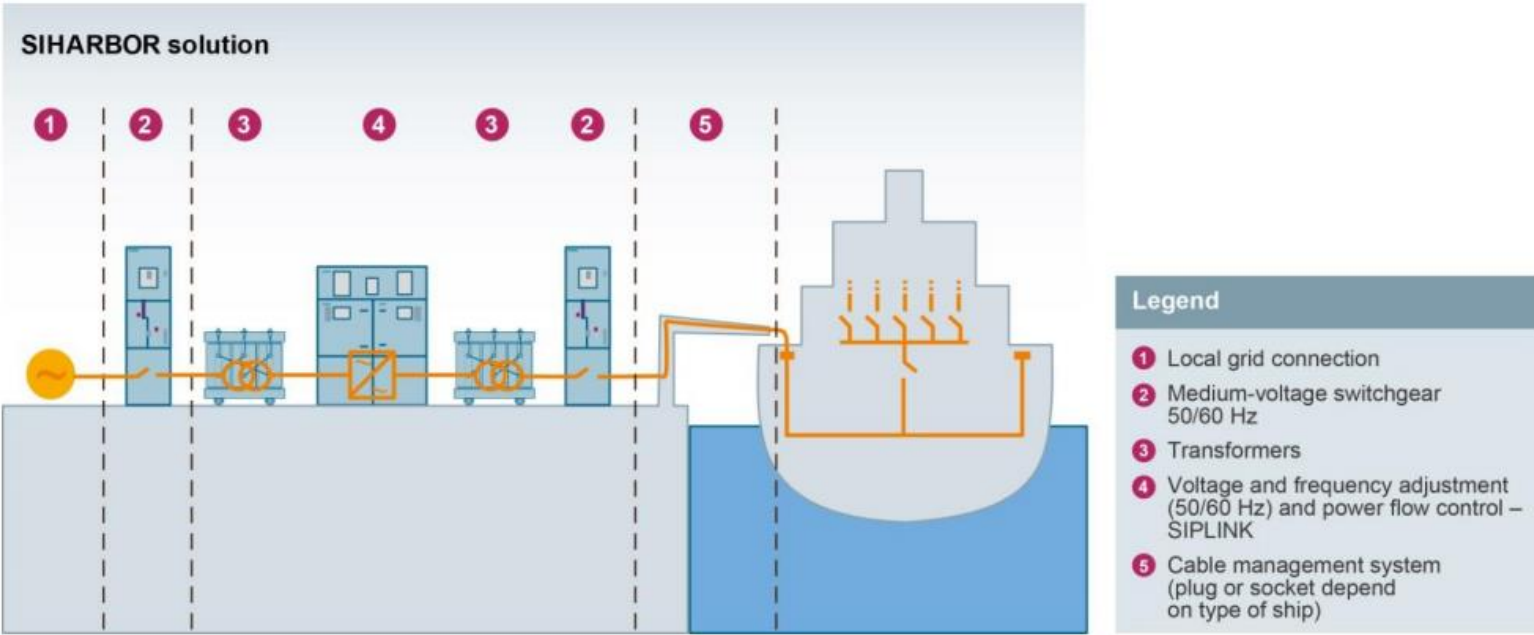


Drones as cargo transporters

*source/copyright:* <https://www.bairdmaritime.com>

## Energy and Environment

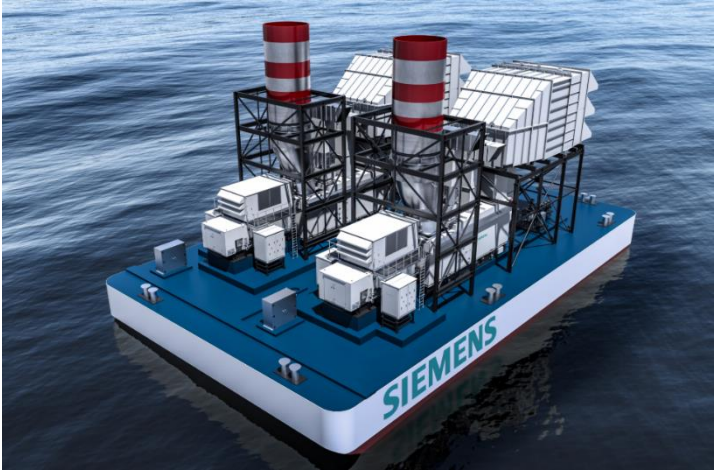
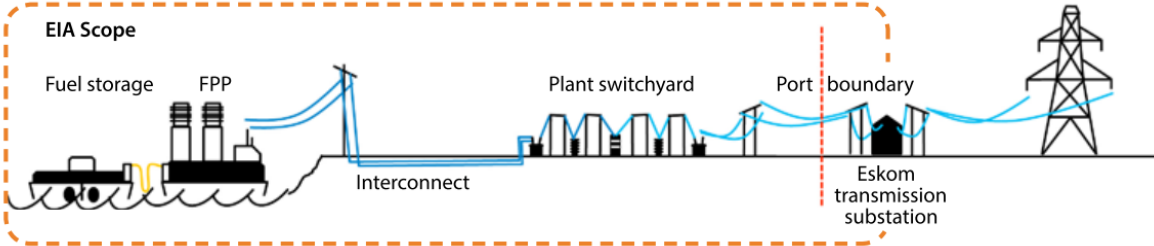
- Shore-side electricity:



Shore-side electricity: SIHARBOR by Siemens  
*source/copyright:* <https://new.siemens.com>

## Energy and Environment

- Floating power plant:



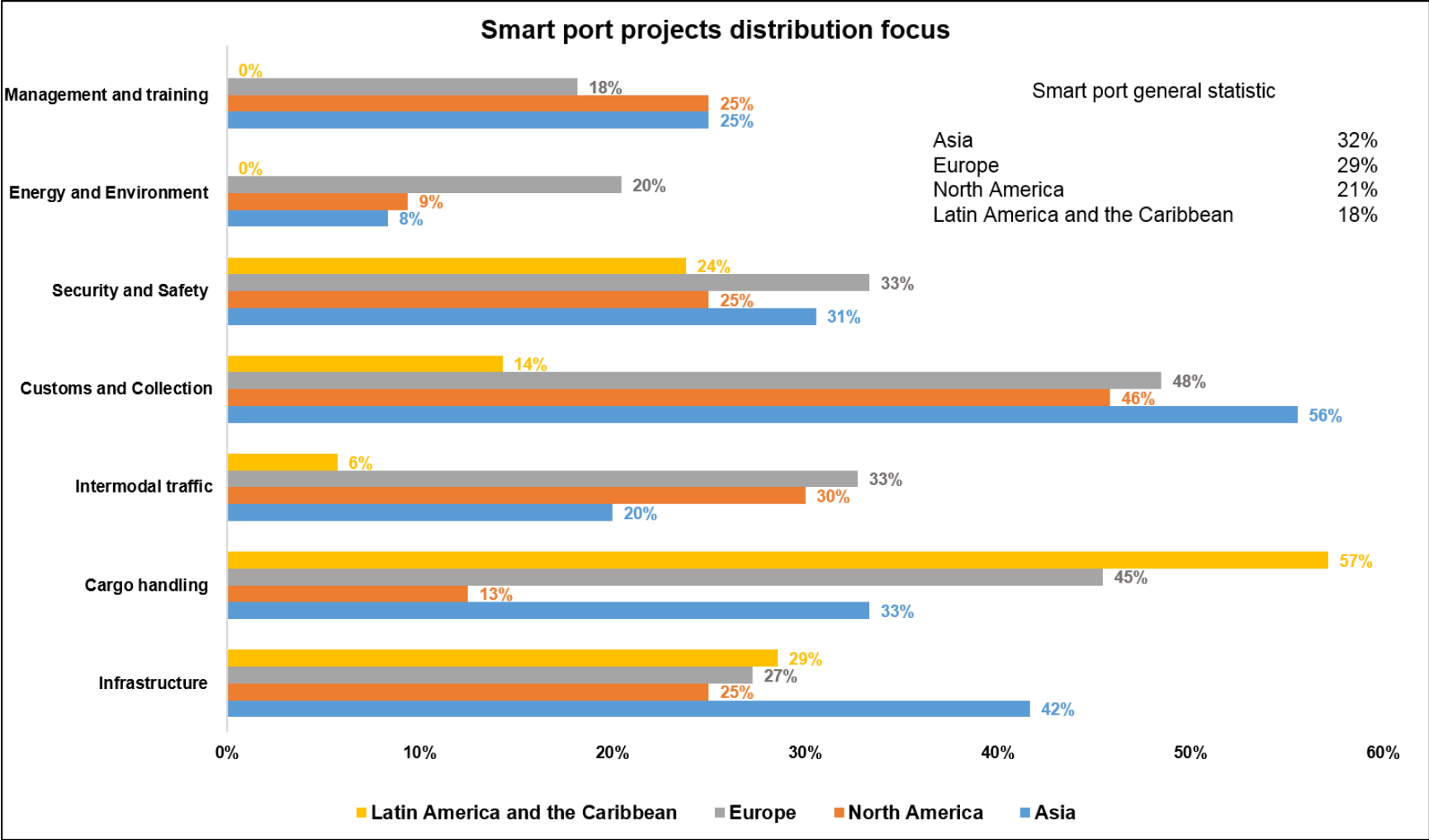
Floating power plant example by Siemens  
*source/copyright:* <https://new.siemens.com>

## Management and training

- Augmented Reality (AR):



# SMART PORTS INITIATIVES AROUND THE WORLD



# CASE STUDY: HAMBURG

Type	Initiative	Port/Terminal	Initiative name/project
		Port of Hamburg	
Infrastructure	Smart sensors	x	IoT in the Port of Hamburg
	Port Property management	x	smartPort
Cargo handling	Reliable monitor systems		myboxplace.de
Intermodal traffic	Terminal appointment systems	x	
	Traffic-monitoring systems	x	PortMonitor, port-IO
	Traffic-monitoring sensors	x	Roads concept
	Intermodal routing systems		
	Car park management system	x	Parking space management
Customs and Collection	Single Windows	x	Dakosy
	Port Community Systems	x	
	Blockchain technology		
Security and Safety	Biometric scan	x	
	Sensor network	x	Sensor networks to monitor transport
	Cargo scans	x	
	Motion-based terminal illumination system	x	
Energy and Environment	Drones		
	Shore-side electricity	x	Shore-side power system
	Floating power plants	x	Port Feeder Barge concept
Management and training	Augmented reality (AR)		

# NEW RESEARCH FOCUS

Type	Trend challenges	Scientific problems	Trend in the literature
Infrastructure	<ul style="list-style-type: none"> <li>*Smart sensors: a large number of sensor and actuator devices</li> <li>*Frequency bands</li> <li>*Deployment and coverage</li> <li>* Costs to build and buy</li> <li>*Device support</li> <li>*Security and privacy</li> </ul>	<ul style="list-style-type: none"> <li>*External power provision infrastructure would be non-economic, inflexible, and therefore infeasible.</li> <li>*Connecting common cyber-physical system devices to the Internet requires additional infrastructure and thus complexity due to the need for gateways.</li> <li>*Force cloud-based and data virtualisation services to be as airtight as possible to protect user data and privacy</li> </ul>	<ul style="list-style-type: none"> <li>*WiFi-Enabled and Solar-Powered Sensors for Smart Ports</li> <li>*Device-to-network that integrate 5G, Multi-access Edge Computing (MEC), vehicle-to-pedestrian communication</li> <li>*Augmented reality (AR)</li> </ul>
	<ul style="list-style-type: none"> <li>*To work at the minimum cost point</li> </ul>	<ul style="list-style-type: none"> <li>*The sum of operative and energy cost are too high</li> </ul>	<ul style="list-style-type: none"> <li>*Smart, Energy Efficient and Adaptive ECO-RTG crane (SEA-EcoRTG)</li> </ul>



# New research focus

Type	Trend challenges	Scientific problems	Trend in the literature
Cargo handling	*Real-time reaction	*Multiples and unconnected systems	Reliable monitor systems *Augmented reality (AR)
Intermodal traffic	*Manage gate operations in order to control the arrival of any type of transportation mode	*High congestion, gate idling time, and greenhouse gas emissions (GHG).	Terminal appointment systems by non-stationary queueing model and genetic algorithm
			Traffic-monitoring systems with data suppression techniques
			Traffic-monitoring sensors + IoT
	Manage multimodal transport while applying synchronization		Intermodal routing systems

Type	Trend challenges	Scientific problems	Trend in the literature
Customs and Collection	Automation of processes while ensuring data security *Counterfeiting *Decentralized IoT platforms	*Provide vertical collaboration	Single Windows
		*Ensure and secure transactions	Port Community Systems
Security and Safety	*Cargo security	*Overflowing growth of cargo	Blockchain technology
			Biometric scan
Energy and Environment	*Reduce electrical illumination consumption (high energy cost) *Energy awarness	*Reduce energy cost	Sensor network
			Cargo scans
			WiFi-Enabled and Solar-Powered Sensors for Smart Ports * Smart, Energy Efficient and Adaptive Terminal Dynamic Illumination (SEA-Light) *Shore-side electricity *Floating power plants
	Security (environmental digitalized ecosystems)	*Ensure securiy in unreached or unsafe areas	Drones

Thank you

**Questions ...**



IWI: [bwl.uni-hamburg.de/iwi](http://bwl.uni-hamburg.de/iwi)