PORTFORWARD

TOWARDS A GREEN AND SUSTAINABLE ECOSYSTEM FOR THE EU PORT OF THE FUTURE

Afshin Mansouri, Stefanos Kokkorikos, PortForward

The project PortForward is an investment of nearly $6 million by the European Union's Horizon 2020 Research and Innovation Programme to make the port of the future smarter, greener and more interconnected.

After formally commencing on July 1, 2018 for 42 months, the project is a response to the call made by the European Commission in 2015, which invited "modernization" for European trade hubs [1].

The project consortium is using a combination of optimisation, decision support, and information and communications technology (ICT) and internet of things (IoT) solutions to reduce environmental impacts of port operations while improving cost- and service-oriented key performance indicators (KPIs) and the facilitation of information flows between ports and port communities.

Members of the PortForward consortium include partners and stakeholders from seven European countries including: Germany (Fraunhofer IFF, Ubimax, and port of Magdeburg), UK (Brunel University London), Spain (Leitat, Acciona, and ports of Vigo and Balears (Palma, Alcúdia, Maó, Eivissa, and La Savina)), Italy (MAR.TE and ports of Livorno, Naples, and Salerno), Norway (port of Kristiansand), Belgium (IMEC), and Greece (Core Innovation).

The PortForward project will address the following challenges and needs:

- Lack of efficiency in operations with heterogeneous freights (roll-on/roll-off cargo, containers), such as inefficient land use, berth scheduling and quay crane allocation, quay crane scheduling and bay sequencing, yard configuration and stacking policies, and lack of monitoring of the depth of access channels and quays, which varies due to silting
- Need for real time monitoring of freight flows with end-to-end track-and-trace solutions in order to optimize port activities
- Need for remote monitoring and management of important port operations, such as maintenance scheduling, cargo and passenger traffic, especially for short sea shipping cases
- Interconnection with hinterland transportation with special focus on inland waterways
- Interface with the surrounding urban environment
- Experience sharing and transferability to other intermodal transport hubs
- Environmental impact reduction through the use of green technologies and energy solutions saving

THE PROJECT APPROACH

To meet the aforementioned challenges, PortForward proposes a holistic approach to develop new, and exploit existing

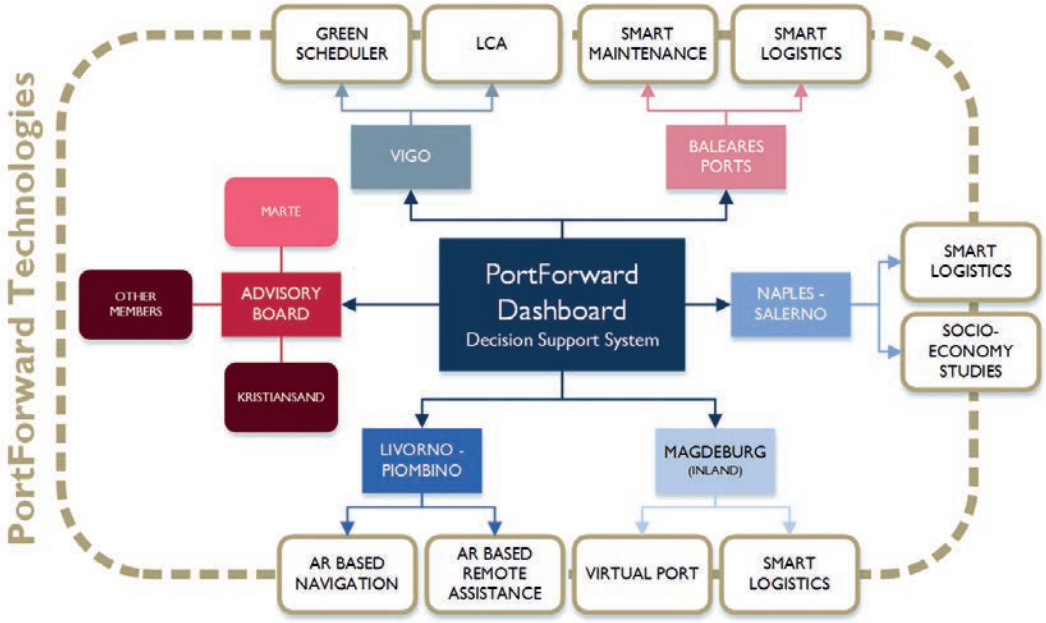

Figure 1: PortForward technologies

technologies (Figure 1) that will support transition to a smarter, greener and more sustainable port ecosystem, which will include the following features:

- The introduction of an IoT concept for port assets (infrastructure, vehicles, cargo, people and processes)
- Sensor deployment using equipment such as cameras and multi-modal tracking devices.
- Interconnection into one seamless, versatile and secure IoT network
- Remote management and intelligent maintenance tool
- Virtual Port tool embedded in the PortForward Dashboard providing centralized control and alternative visualisations
- Novel smart logistics platform with a decision support system (DSS)
- Environmental and energy monitoring/ optimization system using the novel concept of Green Scheduling (GS)
- Augmented reality (AR) for pilot assistance and remote assistance to workers/operators
- Information exchange layer with other stakeholders, such as city services
- The socio-economic analysis of the port interface with its surrounding area and the port city, as well as the rest of the logistics value chain.

PROJECT OBJECTIVES

The specific objectives of the PortForward project can be summarized under the following 10 items:

- 1: To develop a novel smart logistics platform for ports that will improve cargo real time traceability, positioning precision, and stowage plan optimization for both Ro-Ro and container traffic, in order to increase revenues from cargo handling through the improvement of related operational indicators such as waiting and service times, and tonnes of cargo handled per ship-hours in port. Moreover, the tool will facilitate the interconnection of the port operations with hinterland transport modes, including short sea shipping operations and inland waterways.
- 2: To develop a remote management and maintenance platform for ports that provides seamless access and insight into port KPIs and alerts, by integrating novel monitoring and communication technologies with already existing port management subsystems, using innovative virtual reality (VR) visualization of processes, objects and parameters. The platform will constitute a DSS that will help increase the sustainability of the management and maintenance strategies implemented at the port by visualizing interrelations and non-linear dependencies between objects, processes and parameters.
- 3: To develop an IoT middleware that facilitates the deployment, discovery and management and unifies the interaction with (i) heterogeneous connected sensors/actuators, (ii) tracking devices and (iii) connected workers, thereby making use of both short, medium and long range wireless connectivity and leveraging on open IoT standards such as LWM2M/IPSO.
- 4: To develop a novel green yard scheduler (GYS) for container terminals as a core component of the DSS by considering energy consumption and fuel emissions by trucks, ships, cranes, etc. as explicit objectives besides service and cost-oriented KPIs. This will be achieved through (i) developing a new multi-objective mathematical model of yard operations incorporating cost- and service-oriented KPIs as well as sustainability-oriented measures; (ii) developing a fast and scalable GYS module for PortForward DSS; and (iii) evaluating the impact of the GYS on sustainability of port operations using life cycle assessment (LCA) and life cycle costing (LCC) methodologies in comparison with the current practice.
- 5: To develop AR solutions to support fast maintenance, remote decision making, and safe navigation of vessels within the port. This requires (i) the development of a remote assistance (RA) tool for on-site maintenance of critical infrastructure and fast problem solving to enable port workers inspect incidents with support from important decisive stakeholders and identify fast solutions and actions; (ii) the development of an AR-based

pilot-assistance system that support vessels' manoeuvring, when entering/leaving the harbour and berthing, in a secure and safe way. With this tool ship captains will get access to visual data, such as traffic and bathymetry measurements within the port even when visibility is low or weather conditions are critical.

- 6: To develop and demonstrate a Virtual Port Tool for VR- and AR-based visualization of port operations and process status. The tool will visualise the port related data assessed by the PortForward DSS and Dashboard. Virtual objects of the tool will also be used in other PortForward applications like the AR-based maintenance assistance tool.
- 7: To trigger stakeholder engagement for the whole port-related supply chain including actors, for instance port authorities, terminal operators, shipping companies, customs, security forces, and city authorities for issues regarding the environmental footprint of the port to the port city, the interoperability of the PortForward solutions, the intermodality with the rest of the logistics value chain and transferability to other types of terminals (rail, freight, air, etc.).
- 8: To study the socioeconomic effect of the port emissions to the surrounding area and the impact to the port city logistics and transport operations, including the hinterland transport network, short sea shipping, and inland waterways.
- 9: To develop the PortForward Dashboard to integrate all separate PortForward tools and provide real time monitoring to the port operators. The Dashboard will be complementary as a visualization option, with the Virtual Port module.
- 10: To validate the PortForward solution in five relevant use cases focusing on implementing the technologies in port environments, with a focus on short sea, intermodal transportation (especially rail) and inland waterways.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 769267

REFERENCES

[1] European Commission, 2015, MG-7-3-2017 The Port of the Future, 14 October 2015: http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/mg-7-3-2017.html

ABOUT THE AUTHORS

Afshin Mansouri is Professor of Operations and Supply Chain Management, and Director of Research at Brunel Business School and member of the Institute of Energy Futures at Brunel University London. He is a pioneer in the area of green scheduling and its applications in maritime as well as manufacturing sectors. As Brunel's Principal Investigator in the PortForward project, Afshin is leading a work package on Green Scheduling and Sustainability of Operations for the development of a novel green yard scheduler for container terminals. He has contributed to more than 90 papers and presentations in academic as well as practitioners forums and received funding in excess of two million Euros from EU and UK funding bodies in six projects.

Stefanos Kokkorikos is an Electrical and Computer Engineer, MSc, and the Co-founder and Managing Partner of Core Innovation, which generates, secures and shares innovation, through innovative concepts, business models, and technology and conducting innovation management approach with respective communication actions. In PortForward, Stefanos is acting as the Dissemination, Exploitation and Communication Manager of the project. Through PortForward, he aims to contribute to the building of an EU-wide Port of the Future community.

ENQUIRIES

Tel: +44-1895-265361
Email: Afshin.Mansouri@brunel.ac.uk