FUTURE PROOFING PORT INFRASTRUCTURE WITHIN THE PORT OF ROTTERDAM, CONNECTING THE DOTS

by

***Egbert van der Wal*[1]**

ABSTRACT

Together with the Smart-Port research institute, Port of Rotterdam uses all means from demand driven scientific research to pilots within infrastructure projects to enhance the capabilities of the Port Instructure and be ready for a more digital era.

The abstract will give an insight in the strategy and techniques which we have used so far to future proof our port infrastructure. Some first results from these techniques will be shared in the presentation. Most of the techniques can be used by other ports to improve the capabilities of their port infrastructure

1. THE MAIN CHALLENGES WITHIN THE PORT OF ROTTERDAM

The biggest challenge we are facing as a port are the following:

1. Increasing ship sizes in different parts of the port
2. Autonomous shipping
3. Changing cargo flows and a more circular economy
4. A large dependency on oil based products which will not last for another 30 years
5. Aging Port infrastructure which has surpassed the design life time but needs to cope with higher demands, changing functionality and customer needs.

2. THE MAIN CHALLENGES FOR PORT INFRASTRUCTURE

The Ports in Holland, of which the Port of Rotterdam is by far the biggest and most advanced port, have according to the World Economic Forum the best port infrastructure in the world. This is for us not a call to sit back and relax but instead to face our challenges head on and see how we can overcome our challenges by using our infrastructure network to the fullest.

We are focussing on infrastructure and the network because we believe that everything we do should contribute to the fact that our tenants can do their business by using our infrastructure network. We are achieving this by creating more time for the customers to use the infrastructure and using the (hidden) capacity of the quay walls.

The biggest challenges we face in infrastructure are:

- How to extend the lifetime of 50% of all quay walls in the port area
- How to cope with changing Customers requirements, functionalities and demand for more capacity on the existing aging quay walls
- How to shorten the realisation time for quay walls and limit required time for maintenance
- How do we bring conservative theory in line with practice and the actual use of infrastructure

To make it worthwhile we need to find a way to also incorporate the following goals:

- Substantially lower construction and maintenance costs (> 20%);
- Substantially shorter lead time for the realisation of the infrastructure;
- Create infrastructure without unexpected downtime;
- Timely anticipated and thus minimal scheduled downtime without impeding the customer process,
- Safely getting the most out of the (existing) infrastructure.

To come up with a solution we require the following two strategies:

1. Align theory and practice and validate assumptions through real data;
2. Creating a Digital Twin of the Port and its infrastructure.

[1], Port of Rotterdam Authority, Head of Engineering Department, PO Box 6622, 3002 AP Rotterdam, The Netherlands, Phone +31 10 252 1010, Mail: e.wal@portofrotterdam.com

For both strategies examples will be given how to use better defined starting points, assumptions or enhanced engineering practices and construction methods to prove that existing infrastructure is sometimes capable of life time extension and that future infrastructure can be built more economically. The Maritime Port infrastructure will be used as an example in these cases. Insight will be given in the techniques that are being used successfully by the Port of Rotterdam.

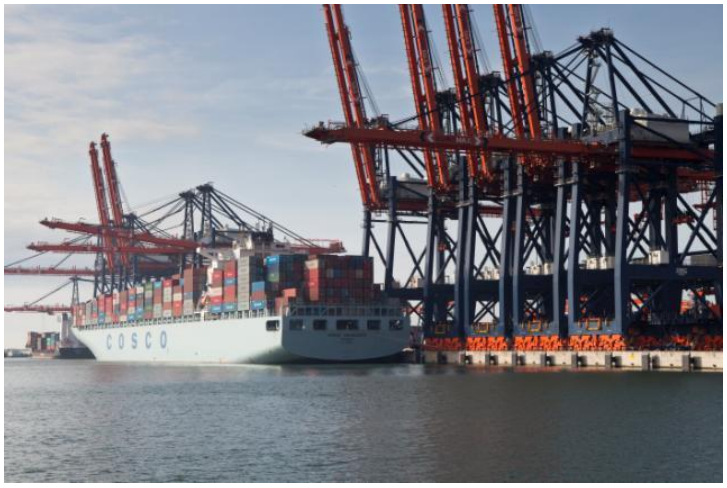

Figure 1: Euromax terminal smart quay wall, proven in Rotterdam

3. ALIGN THEORY AND PRACTICE AND VALIDATE ASSUMPTIONS BY USING REAL DATA

We are adapting a risk based approach in which we have identified the failure mechanisms for a Quay Wall and are created a method in which we are looking at the asset itself and the following for interactions:

- Ship to maritime structure (quay wall) interaction
- Ship to soil interaction
- Soil to maritime structure (quay wall) interaction
- Maritime structure to client operations interaction

These are the interaction on which more insight can turn risks in to rewards. By gathering more information the mean value of the loads and their standard deviations will become more certain. Using this information and putting it into a local perspective creates changes for the existing infrastructure.

In the presentation our vision will be shared and practices will be given on:

- The use of Reversed engineering of the Breakbulk LNG Quay Wall
- A New local guideline for berthing velocities and berthing angles based on data collection
- Creating a design guideline for Flexible Dolphins by full scale field testing
- Using GIS geotechnical data and full scale field testing to enhance pile foundations

4. CREATING A DIGITAL TWIN AND SMARTENING PORT INFRASTRUCTURE

With the expected arrival of autonomous vessels and to cope with further demands on infrastructure, we have to digitize our operation, our assets, the way we think. To stay digitally connected to the world around us we need to make a digital Port of Rotterdam and create infrastructure that will give us intelligent data. Even looking at a small percentage our port area we already see that thousands of potential digital twins are available like quay walls, buildings, vehicles, cranes, engines, etc . And not just objects with a fixed position, they are moving around in time and space!
We are currently starting to develop our digital twin and looking at how to smarten our infrastructure by using new technics that will fit in this digital world. We will give an insight in the challenges like :

- How to create a digital twin for the port of Rotterdam;
- Adopting the latest technologies in maritime infrastructure, such as remote sensing and robotics to enhance the capacity of the infrastructure and reduce downtime;

- Smart use of large amounts of available port data, such as hydrometeorology, sensor data quay walls and AIS data;
- Smart, real-time measurement of actual use vs capacity;
- Extending the service life of existing quay walls by combining owner and user data.

In the presentation our vision will be shared and practices will be given on:

- Our steps in creating a digital twin from GIS to Digital Twin System;
- The use of sensor in the Caland Canal Ship to Ship transfer berths;
- The analysis of the EMO Quay Wall Sensor Data;
- The creation of pilot on inland vessels berthing speed sensor system.

Figure 2: A first edition Smart Quay Wall in Rotterdam.

Within the Port of Rotterdam we are creating a living lab for all similar idea's and with data adapting the slogan "invented anywhere, Proven in Rotterdam". Revolutionary crazy ideas are always welcome.