Technical session - Envisioning the port of the future (II): Technologies, processes and capacity building actions

Chairman: Alexio Picco, Docks the Future Coordinator (Circle SpA)

PORTCDM – Mikael Lind
DIGITAL TWIN – Roberto Revetria
CUSTOMS IN 2030 – Frank Janssens
IMO GMN MTCC - Mohammed Asid Zullah
CLUSTERS 2.0 – Alice Benini
MidTerm Conference: Envisioning the Port of the Future: the 2030 horizon

4th of April 2019 – Port of Trieste

Collaboration and data sharing – towards a sustainable PortCDM future
TRANSFORMATION from AS-IS to Vision of PortCDM

THE VISION OF PortCDM

Actor 1
Actor 2
Actor 3
Actor D
Actor A
Actor B
Actor E
Actor C

AS - IS

TRANSFORMATION
PortCDM enables the transformation ...

From
- Fragmented situational awareness
- Low information quality
- Lacking planning horizons
- Unstructured information exchange
- Sub optimized operations
- Unnecessary waiting times
- Low IT maturity

To
- Common situational awareness
- High and reliable information quality
- Predictable operations
- Standardised data exchange
- Mature collaboration culture
- Just-in-time operations
- Enhanced IT-systems and third-party innovation opportunities
COMPONENTS FOR SUSTAINABLE TRANSFORMATION

PROJECT LEVEL

Standard for data sharing (PCMF)
PortCall Process Ontology and Metro Map
Living Lab Approach for Actor Collaboration
Digital Services for Situational Awareness

SUSTAINABILITY LEVEL

Standard For data Sharing (S-211)
PortCDM Maturity Model
International Governance (IPCDMC)
Low Barriers for 3rd party Innovation
Principles for Collaboration
Giving rise to …

- Reduced turn-around times
- Just-in-time departures, arrivals, and operations
- Reduced chasing
- Optimized resource utilization
Concluding remarks

PortCDM can provide a significant IMPROVEMENT in the overall performance of the maritime transportation chain ecosystem.

Port CDM and digital data sharing provides significant positive benefits by enabling port call actors to plan, coordinate and synchronise activities more efficiently giving rise to enhanced and more efficient overall port call performance; and

The basic doctrine, procedures and standards for PortCDM have reached a level of maturity that enables them to be used as the foundation for a GLOBAL IMPLEMENTATION of PortCDM.
Next step

- Put S-211 into use
- Establish data sharing capabilities within ports
- Connect ports using S-211
- Invite 3rd parties to contribute with innovations
- Empower International PortCDM Council as a centre of gravity for harmonizing port call operations
- Put the PortCDM maturity model into use to ensure continual development of data sharing capabilities
- Use means to develop the collaborative culture of ports

Practical steps for engaged actors:
- ensure interoperability with S-211
- discuss mutual benefits of PortCDM with collaboration partners and other actors
- help to establish a local “PortCDM community” to bring all the interested actors together
- participate in the IPCDMC either as a participant or an observer

among the ~3900 ports with its actors and the ~90 000 merchandize ships conducting ~20 million port calls yearly as a part of the maritime supply chain
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Join our efforts by becoming a member of the
International PortCDM Council (IPCDMC) - www.ipcdmc.org
A DIGITAL TWIN FOR COMPLEX ENERGY MANAGEMENT IN HARBORS

- Roberto Revetria, Università degli Studi di Genova
"A digital twin is a multi-physics, multiscale integrator, a probabilistic simulation of a vehicle or a built-in system that uses the best physical models available to reflect the life of its twin correspondent."

- NASA -
**DIGITAL TWIN USE**

**FORECAST**: to make predictions about the behavior of the product; they can be used to determine the cause of performance problems, to evaluate the results of different control strategies, to define optimal maintenance schemes, etc.

**EXPERIMENTAL**: to test operating conditions very different from standard ones and to explore new practices in a safe way, limiting costs and risks.

**PARALLEL**: by processing the same inputs to the virtual replica that are supplied to the real system.
A STS Crane is a mechanical structure that is composed by various plates, booms, ropes, bolts, etc. subject to mechanical stress during the operational time.
Strain gauges will be glued on the piece: these measuring instruments allow to detect small dimensional deformations of a body subjected to mechanical stresses. The upright must also be uniquely identified, for this it will be equipped with a QR Code. The QR Codes are an evolution of the traditional barcode.

A QR code is a two-dimensional bar code (or 2D code), that is a matrix, composed of black modules arranged within a square-shaped scheme.
INTRODUCTION

The price of electric energy is actually a key factor for the economic performance of high energy demanding logistics centers.

The complexity of planning operations and the availability of multiple markets allow to create synergic tools for simulation modelling of real scenarios with power consumption management tools.

The mix of energy consumption calculation through a system dynamics model and the predictive analysis on a short time period for best price buying on the electricity market represents a driving action for logistics planning operation.

This paper shows a real case implemented into an intermodal logistics center placed in Voltri (Italy), providing an overview of the harbor simulation and energy price forecasting models, and their role within the interaction among the decision-making personnel, aimed at electric energy purchase cost optimization.
THE HARBOR OBJECT OF STUDY

The **proposed terminal** is a container terminal with an annual capacity of 1.5 million TEU’s.

This terminal has 3 **berths** with 3 **vessels that can be served at once**, lifting containers from ship bays and unloading on trucks, which transfer it to the container yard. The container yard is equipped with working gantry cranes, which place containers in blocks in a container yard.

After discharging, containers wait until they are carried on a train, external truck or another vessel, or sent to custom inspection on import. The same procedure happens when container arrives with external transport and continue transportation by vessel.

Terminal operating time is 363 days/year, 24 h / 24 h (with the exception of December 25th and May 1st). 4 daily shifts of 6 hours each are provided:

- 1st shift 06:00 - 12:00,
- 2nd shift 12:00 - 18:00,
- 3rd shift 18:00 - 24:00,
- 4th shift 00:00 - 06:00.
ELECTRIC POWER MANAGEMENT

Recently, the harbor power source has been switched from an autonomous Diesel generator, to a connection with the national electric grid.

This choice has led to certain advantages in terms of local environmental impact; however, also economic advantages can arise whereas the energy acquired from the national electric grid is managed in an intelligent way.

Electric energy has a variable cost per kWh in function of time, so it is possible to design a buying strategy opportunely synchronized with the required harbor operations, in order to obtain advantages on the transported materials movement costs.
THE MANAGEMENT STRATEGY

The management strategy employed for the energy costs optimization is based on the interaction between harbour managers and simulation/forecasting tools made available to them. In particular, the actors of the decisional process are:

- The Harbour Manager, who is the main responsible for the good outcome of the decisional process. He obtains, as input data, the ships arrival time, by the Estimated Time of Arrival (ETA) document, and the amount of TEUs to be managed, appearing in the Manifest document.

- The Energy Manager, who is responsible for the power costs optimization; he receives data from the market, regarding the energy cost for each time slot.

- The Human Resources (HR) Manager, who has the data regarding the operative personnel availability, shifts and manpower costs.

- The Maintenance Manager, who is in charge for the maintenance exigencies and the availability of the loading-unloading equipment.
THE MANAGEMENT STRATEGY

The decisional process is supported by two informatics tools, namely:

- A **harbour simulation model**, which simulates the logistic operation of the harbour, predicting loading and unloading time.
- An **energy market cost forecasting model**, which forecasts the cost of the purchased kWh for each time slot thanks to market prevision models.

These two models are uploaded on a server, so that they are available to the decision managers.

The interaction among the decision managers is supported by a “**decisional chat tool**”, which is as well installed on the server, and helps the managers communicate the decisions related to their harbour management activity.
THE MANAGEMENT STRATEGY

Schematic view of the management interactions
HARBOUR DIGITAL TWIN

The model simulates the operation of the cranes which make unloading/discharging work and the manpower who works on cranes, influencing productivity of unloading/discharging operations.

The dynamic model is constructed using the SD formalism, which allows to build advanced dynamic simulation models of system.

The model consists of flows, levels, rates and constants.

Model of container terminal can be divided on 3 common parts:

- The first section is responsible for container ship coming and connected with it mooring and unloading procedures. First part can be divided also for 2 sections, on mooring and unloading sections.

- The second section is dedicated to unloading procedures. Common conditions of unloading are described by berths number, which define how many ships can be served in the same time and that number is stored in constant ‘Berths’.

- The third section is responsible for trains and trucks arrival, departure and loading/unloading.
MODELING MODELS

SEA SIDE LOGISTICS

LAND SIDE LOGISTICS
The embedded tool used behind the model has the aim of **calculating the simulated consumption of electric energy** due to the operation of the logistics center giving back information on costs owned by the logistics center.

At the same time, the tool is able to **connect to the market exchange** in order to analyze price trends on different markets, to do predictive analysis for the best market in the next 1-2 days and to show comparison between forecasted and real costs due to market choice.
In general, the results are good, and the forecasts particularly different from reality can be explained by phenomena unpredictable with the only market data. Electricity prices depend on many factors such as, atmospheric data; gas prices of the previous days; environmental temperature; hour of the day; day of the week; demand of the day before; season; festivity; level of water basins.

The forecasting model has been successfully employed in previous papers to forecast the price of electric kWh in steelworks.
DIGITAL TWIN FOR PLANNING

The simulation of port operations allows to identify the best layout configuration in terms of number of berths, number of cranes and number of equipment.

The simulation lets you validate economically solutions considering many elaborate scenarios in virtual reality.
CONCLUSIONS

• This work has addressed the problem of energy supply during the planning phase of an intermodal logistics center.
• The problem is typical of each highly energy demanding site or plant in which the price of energy greatly influences the economics of the owner and the price of the service.
• The study of statistical models was of fundamental importance for the analysis of market data and for forecasting future prices.
• Starting from these bases, a platform for decision support has been developed in order to guide who manages logistics planning to select the best plan in terms of bill expenditure.
• Several other uses of digital twins have been presented.
Mid-Term Conference
http://www.docksthefuture.eu/
Triest 04 April 2019

DOCKS THE FUTURE
defining the concept of "Port of the Future"

Vision on customs in 2030

Frank Janssens
International Customs and Trade Facilitation expert
1 Future Landscape: Be ready for the unforeseen!
1 Future Landscape

- Multi-Modal transport with integrated on-line data flow
- IoT bringing interconnected vessels, means of transportation, terminals, tools, etc.
- Increased forecasting capacity by availability of Big Data and Analytics
- Artificial Intelligence (AI) bringing automated optimal decision making
- New threats and risks
2 Trade Facilitation as a driver for progress

WTO ‘Trade Facilitation Agreement’ provides support for customs & border services to achieve trade facilitation. Therefore in 2030 the Customs environment will profit from:

Single submission of information
Information requirements will be digital and respect international standards
Online mobile secured access to information
Optimal Cross-Border Process Management
Full use of ‘Trusted Trader’ principle:
• Authorised Economic Operator & AEO Mutual Recognition
• Personalised simplified procedures in line with needs
• Single electronic automated Risk Management valid for all border services
2 Trade Facilitation as a driver for progress

WTO ‘Trade Facilitation Agreement’ provides support for customs & border services to achieve trade facilitation:

In 2030 there should be as much as possible (continued):

• Single inspection at border crossing using non-intrusive Inspection methods enabling the targeting of real risks safety, security and revenue collection risks
• Optimised cross border processes implementing digitalisation services
• Increased us of Trade Single Window services, with increase of Regional Single Windows, exchange of information between SW (including PCS)
3. Integrated approach to the Supply Chain and its supervision

‘Trade Facilitation’ is no longer opposed to ‘fighting non-compliance’,
But Trade facilitation & fight against non-compliance go hand in hand and reinforce one another! How?

• Single electronic submission of information prior to arrival of the goods
• This allows automated integrated risk analysis and selection for controls
• Safety, security and revenue documentary inspections are done prior to arrival of the goods
In 2030 ‘integrated cross border handling’ will ensure in a complementary way trade facilitation & necessary controls!

Integrated approach for quick release of goods separated from duty & tax collection:

✓ Cross border officials will have full online access to financial and transport information on import/export transactions

✓ Multi-disciplinary inspection teams (customs, phytosanitary, veterinary, etc.) will use non-intrusive inspection methods.

✓ Extended use of ‘tailor made’ on-line simplified procedures, such as comprehensive guarantees with on-line checking of balance available for future actions, approved locations, etc.

✓ Electronic post-release controls /audits will ensure correct collection of duties and taxes and application of commercial policies
Connected machines and robotics

- Production and transport can be largely automated
- Human intervention will diminish drastically
- Compliance to rules will be very important (drugs, trafficking, environment, safety, etc.).
- For cross border authorities access to information will be crucial for supervision and risk management
- Identification of and accessibility to persons in charge is crucial.
Why Is Big Data Important?

**Big data** refers to the large volume of data – both structured and unstructured available to a business and/or public organisation on a day-to-day basis.

When you combine big data with high-powered analytics, border crossing agencies can accomplish important tasks such as:

- Optimising risk portfolios in near real time.
- Detecting fraud before it affects the organization.
- Determining root causes of failures, issues and problems.
- Discovering new trends and enabling smart decision making.
- Allowing time gains to optimise staff deployment
- Achieve cost reductions.
Why is Artificial Intelligence relevant for Customs?

Tracking fraudulent activity: Cross border authorities will have adopted predictive analytics to help track fraudulent activity and assess the likelihood of criminals to reoffend.

Because AI can process much more data, and faster, than humans, it can analyse more efficiently leading to the faster apprehension of criminals.

These processes include learning, reasoning and selfcorrection.
Thank you for your attention!

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MidTerm Conference: Envisioning the Port of the Future: the 2030 horizon

4th of April 2019 – Port of Trieste

Green Pacific Ports - A Future Regional Initiative
Green Pacific Ports - A Future Regional Initiative

Green Pacific Ports
Flexibility, Innovation, Adaptation

Operations
Improving port operations efficiency
- Quality Management
- Legal Framework
- Climate Resilience

Energy
Reducing port carbon footprint
- Energy Management
- Energy audits
- Energy Conservation

Environment
Preventing port marine pollution
- Environmental Management
- Waste Management
- Pollution Response
PORT OPERATIONAL & ENERGY MANAGEMENT

Reducing port carbon footprint
## Port Operational Management

<table>
<thead>
<tr>
<th>Component</th>
<th>Expected result</th>
<th>Approach/activities</th>
<th>Expected Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improving Port Operations Efficiency</td>
<td>PICTs have a strategy and a Quality Management System (QMS) in maritime ports improving efficiency and sustainability of port operations as well as discharging country responsibilities regarding international conventions</td>
<td>Conduct a port function review and outline a consistent and integrated strategy that includes all aspect of sustainability and efficiency of port operation. Review relevant ports legislative and regulatory frameworks, including to implement international conventions. Develop QMS in ports to improve sustainability and efficiency of port operations ensuring safety and security, facilitating trade. Collect relevant information to assess climate resilience and disaster risk of port infrastructure and outline a response plan.</td>
<td>Port review and recommend strategies for improved port efficiency and sustainability. Legislation reviewed and Gaps identified with recommendations. Quality Management System is developed and implemented. Response plan/BCP developed for a more resilient and Ports are better prepared to recover after a Disaster.</td>
</tr>
</tbody>
</table>
## Port Energy Management

<table>
<thead>
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<th>Approach/activities</th>
<th>Expected Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reducing port carbon footprint</td>
<td>PICTs have and implement a programme of assessment and management of energy efficiency, carbon footprint in their ports</td>
<td>Conduct energy audits in maritime ports</td>
<td>Recommendations are provided to reduce GHG from port infrastructure and operations including GHG baseline data</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Develop an Energy Management Policy and plan</td>
<td>Energy Policy and Management Plan is developed</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Implement low-cost energy conservation measures (incl. mentoring/coaching)</td>
<td>Low-cost energy conservation implementation report provided including emissions reduction</td>
</tr>
</tbody>
</table>
Port Energy Audits

Results
Solomon Islands Ports Authority (SIPA)

<table>
<thead>
<tr>
<th>Change process (How)</th>
<th>Results and impact (So what)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Yard lighting control strategy in Honiara— switching off yard lights when they aren’t needed.</td>
<td>• “Switch the light” new policy at the main berth saved around 7,800 kWh/ SB$40,358.20 and 6.7 tonnes of GHG in 2 months in 2017.</td>
</tr>
<tr>
<td>• Refurbished the board room and corridor leading to the boardroom, including the</td>
<td>• A simple comparison with previous year, annualised, based on between 6 to 12 months of savings data indicates a reduction of 190,000</td>
</tr>
<tr>
<td>• Installation of a new air conditioner and changing lighting to LED.</td>
<td>electricity usage with the cost saving of $900,000SBD and a total of <strong>160 tonnes of GHG emission_reduction</strong></td>
</tr>
<tr>
<td>• Installation of LED yard lighting on the new wharf</td>
<td></td>
</tr>
<tr>
<td>• Rationalized vehicle yard movements with a TOS and changed modes of transport</td>
<td></td>
</tr>
<tr>
<td>• Appointed a energy manager to overlook data collection and commercial energy efficiency project</td>
<td></td>
</tr>
</tbody>
</table>

Solomon Islands Ports Authority (SIPA)
Fiji Ports Authority Limited (FPCL)

<table>
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<tr>
<th>Change process (How)</th>
<th>Results and impact (So what)</th>
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<tbody>
<tr>
<td>• Port of Suva have reduced electricity consumption at their building upgrading the lighting system to LED</td>
<td>• For LED upgrades, an annual reduction of 40 tonnes of GHG emissions was reported</td>
</tr>
<tr>
<td>• Port of Suva installed a new power switch board (Power correction factor)</td>
<td>• 70,000 power board installation (for power factor correction) has saved $26,000 for September which is expected to provide a total of $300,000 savings annually</td>
</tr>
<tr>
<td>• Port of Suva : change in the behaviour to eco-driving</td>
<td></td>
</tr>
<tr>
<td>• Port of Suva: appointed a young women as energy manager that has now been selected through SPC WIM network to a training in port management</td>
<td></td>
</tr>
</tbody>
</table>
Thank you for your kind attention

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MidTerm Conference: Envisioning the Port of the Future: the 2030 horizon

4th of April 2019 – Port of Trieste

CLUSTERS 2.0_Consorzio IB Innovation_Alice Benini

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 770064.
CLUSTERS 2.0 and the Cluster Community System

Agenda:

• Clusters 2.0 objectives and activities

• The Cluster Community System (CluCS):
  - Concept
  - Design
  - Communication infrastructure
Cluster 2.0 objectives and activities

Open network of hyper connected logistics clusters towards Physical Internet

DOCKS THE FUTURE

Co-funded by the Horizon 2020 programme of the European Union
The main aim of Clusters 2.0 project is to leverage the full potential of European Logistics Clusters for an efficient and fully integrated transport system in Europe, while keeping neutral the environmental and local impacts.

The European logistics hubs involved in the project are: PLAZA (Zaragoza), Duisport (Duisburg), Dourges (Lille), Interporto Bologna/Port of Trieste (Bologna-Trieste), BruCargo (Bruxelles), Heathrow (London), PCT (Pireaus), Port (Trelleborg).
Clusters 2.0 Work Plan

WP1 - Innovation Management (O6)

WP2 - Collaboration and synergies within a Cluster (O1-C1)

WP3 - Symbiotic Network of Logistic Clusters (O2-C2)

WP4 - New Modular Load Units (NMLU) and Automatized Transhipment (O3, O4, O5-C3, C4, C5)

WP6 - Evaluation and Impact Assessment (All Objectives – All Challenges)

WP5 - Living Labs (O5, O6)

WP7 - Communication and Engagement (All Objectives – All Challenges)
Cluster Community System (CluCS) platform

Concept, design and communication infrastructure
CluCS concept

- IT platform supporting the governance of PTN (Proximity Terminal Network)* and their aggregation (Clusters)
  *The Proximity Terminal Network is the regional terminal network
- Enables efficient management of information (cargo flows and assets)
- Allows coordinated management of multiple hubs with different specializations
- Enables involvement of manufacturing and value added service providers
- Creates synergies and allows to link Clusters to TEN-T corridors
- Permits the coordination and collaboration between neighbouring and regional terminals
CluCS platform and its stakeholders (pilot)

Users:
- Shippers
- Terminal operators
- Logistics Service Providers
- MTO

Cluster Community Manager
CluCS components

➢ Communications infrastructure (allows)
  ▪ Secure Message Exchange between Cluster participants establishing Trust
  ▪ Easy user’s back-end integration through development of Connectors

➢ Web Interface (allows)
  ▪ Planned Cargo Flows – paths & time tables (by train, road and maritime - pilot)
  ▪ Intermodal Logistic Services – free slots & booking (e.g. train slot booking and real-time availability update - pilot)
  ▪ Identification of Cargo Consolidation (goal: reduce road traffic in benefit of rail traffic)
  ▪ Identification of Cargo Pooling
CluCS communication infrastructure

Digital Certificates: Trust is established using digital certificates. This can be implemented through a mutual exchange of certificates.

Access Point: The access points implement a standardized message exchange protocol (based on AS4) which ensures secure and reliable data exchange within the system.

Backend Integration / Connector: The Connector enables and facilitates the interaction between the Access Point and the Backend Systems.
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