



 **SUSTAINABLE DEVELOPMENT GOALS**



Fact sheets

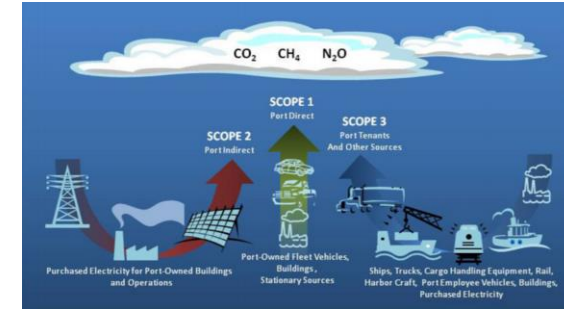


Measure and account the carbon footprint of port activities

DESCRIPTION

According to **World Port Sustainability Program (IAPH)** : "Carbon foot printing is used by ports to determine emissions sources, track emission trends, and provides data that allows ports to focus efforts to reduce their greenhouse gas (GHG) emissions. A carbon footprint is the given amount of GHG emissions an individual, organization or event directly or indirectly releases over a measured period of time".

<https://sustainableworldports.org/carbon-footprinting/>



Capacity building



Standard & code of practice

IAPH worked together with a number of ports to develop guidance for carbon foot printing in terms of inventory methods and measurement. A document was developed following a collaborative process which had a common interest in sharing knowledge and methods related to the planning and development of carbon footprint inventories.

In addition to the Guidance document, an online tool is available to ports interested in making their own carbon inventory calculation

The IAPH proposes a guide for port wanting to develop the inventory of its greenhouse gas (GHG).

OPPORTUNITIES AND BARRIERS

The IAPH international organization provide tools and user community to share experience and continuously improve the process. IAPH also provides a Carbon footprint calculator tool for ports willing to measure carbon footprint.

Initiating this measure should rather be done with IAPH network support.

COST

0.5 full time equivalent within MPA organization with yearly wage for :
- 0.5 x Senior engineer - Rs 50,000

Case Study - Carbon Footprinting of Container Terminal Ports in Mumbai.

The study aimed at analyzing the CO₂ emissions from the port by analyzing the four container terminals in Mumbai. The data related to sources emitting GHG were collected & categorized into on-site fuel consuming sources (Scope 1), electricity consuming sources (Scope 2) and other sources usually rented by the ports (Scope 3).

The results showed that RTGs accounted for 75% of Scope 1 total emissions followed by trailer trucks. Refrigerated containers accounted for about 50% of Scope 2 total emissions. For Scope 3, the auxiliary engines of the berthed ships contributed the most to the carbon footprint.

Improvement ideas arose from the study :

Instead of using diesel powered RTGs, electrification of RTGs can potentially save up to 45% of CO₂ emissions. Similarly, the use of LNG tanks can reduce carbon emissions by up to 24%. To run auxiliary engines when ships are at berth, using LNG tanks instead of residual oil can reduce 50% of the carbon emissions.

Ranking



Efficiency



Cost



Planning



Benefits

Setting up this measure and associated analysis can be easily initiated and improved over time. Measuring and accounting are the first steps to turn the port and its organization into a « green attitude » mind-set.

The port and neighbourhood can highly benefit from such a measure, and even more from the measures to reduce carbon emissions.

Adapt operational procedures

DESCRIPTION

Adapting operational procedures is a response to climate hazards to maximize port productivity and performance while keeping the same level of security. It is best addressed by identifying operations which may continue despite certain climate hazards (i.e. not closing the entire port when only part of the operations is impacted).



Capacity building

★ ★ ★ ★ ★

Standard & code of practice

The following international standards may act as a reference for operational procedures :

- ISO 14001 : Environmental Management
- ISO 45001 : Occupational Health and Safety
- ISO 50001 : International Energy Management Standard
- ISO 31000:2009 - Risk management — Principles and guidelines

Regarding code of practice & guidelines, it is worth mentioning the following :

- EcoPorts Ports Environmental Review System (PERS)
- PIANC - EnviCom WG Report n° 178 - 2020

OPPORTUNITIES AND BARRIERS

In addition to international ISO standards, the Ecoport is providing the access of a broad port community network willing to exchange experience on environmental issues. EcoPorts Self Diagnosis Methodology (SDM) provides an efficient starting toolkit for self evaluation and performance comparison against the sector's benchmark.

Being still a theoretical approach, turning the concept into practical change can be complex if not assisted by experts.

COST

1.5 full time equivalent within MPA organization with yearly wage for :

- 0.5 x Senior engineer - Rs 50,000
- 1 x Junior engineer - Rs 40,000

Case Study – UNCTAD Research – Port Industry survey on climate change impact and adaptation.

In 2018, UNCTAD conducted a survey on almost 50 ports in 29 countries on climate change impact and adaptation. The survey illustrated that the main indirect socio-economic impacts of CC were related to the supply chain. Port respondents also indicated that implemented or planned adaptation measures consisted of emergency management plans and processes (50 %), or appropriate changes in port operations (32 %) and management (29 %).

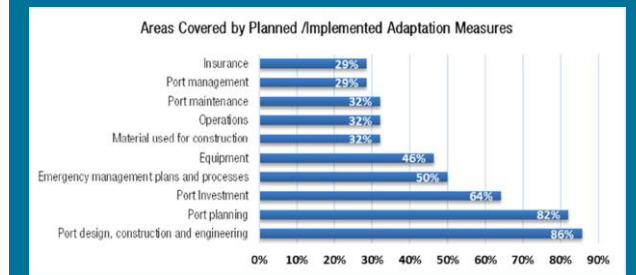


Figure 3-10. Areas covered by implemented or planned adaptation measures [0-37]

Ranking ★★★★★

Efficiency [Bar chart]

Cost \$ \$ \$ \$ \$

Planning 2020 → 2100

Benefits

By using appropriate standards (ISO) and recommendations (PERS, PIANC), the procedures will be set through an environmental prism and will be guided by it.

The port community and its vicinity will directly benefit from the new procedures on various themes (noise, pollution, safety, health...).

Port procedures may also encourage or even force external parties to “turn green”.

Promote the use of electric equipment

DESCRIPTION

Switching to electric equipment is a "must be" for any port willing to fight climate change. Operators can access this technology either by acquiring new equipment or by retrofitting its equipment into hybrid or full electric power supply. Hybrid RTGs can reduce CO2 emissions by 60% and NOX emissions by 90%, fuel consumption can be lowered by 60%. Recent technology even allows RTGs to use regenerative braking energy when a container is lowered. Straddle carriers, stackers and most other handling equipment can be powered electrically.



Capacity building



Standard & code of practice

All cranes are designed based on common and international standards. The International standard "ISO 53.020.20 - MATERIALS HANDLING EQUIPMENT – LIFTING EQUIPMENT – Cranes » is considered as a reference standard, and more specifically :

- ISO 4301-1:2016 - Cranes — Classification — Part 1: General
- ISO 4301-2:2009 - Cranes — Classification — Part 2: Mobile cranes
- ISO/FDIS 4301-2 - Cranes — Classification — Part 2: Mobile cranes
- ISO 4301-5:1991 - Cranes — Classification — Part 5: Overhead travelling and portal bridge cranes

OPPORTUNITIES AND BARRIERS

Most equipment companies are now developing electrical equipment or propose retrofitting solutions.

For electricity supply, port operators and the landlord shall focus on the 5 pillars of energy management : Resilience, Availability, Reliability, Efficiency and Sustainability.

COST

Retrofitting equipment, when feasible is often the cheapest option to be considered. Upfront payment for retrofitting or purchasing new equipment will allow cost energy savings during the lifespan of the equipment.

Case Study - Electrification of Yard Operation (Rubber Tyred Gantry) in TPKS Semarang, Indonesia

The project involves the modification of rubber-tyred gantry (RTG) which are used for stacking containers, from diesel power to electricity. Electricity is significantly cheaper per unit than diesel fuel, it is then a preferred option, provided that there is a consistently reliable supply. Two systems of RTG electrification were considered for this study: Cable Reel System and Conductor Bar System.

In order to meet the technical and operational requirements of the project, the study recommended the implementation of the cable reel system on the equipment.

The conclusion of the study demonstrated that the electrification of RTGs in the terminal is financially feasible with a five year payback.



Ranking



Efficiency



Cost



Planning



Benefits

Hybrid RTGs can reduce its CO2 emission by 60% and NOX emission by 90%, fuel consumption can be lowered by 60%. Recent technology even allows RTG to produce technology using regenerative braking energy when a container is lowered.

Electric equipment lowers air pollution and noise.

Furthermore, electric equipment can be powered by renewable energy equipment (solar panel, wind turbine etc);

Promote the use of IAPH sustainability standards

DESCRIPTION

The International Association of Port Harbour (IAPH) set up in 2017 the World Port Sustainability Program (WPSP). The goals are to enhance the sustainability of the ports and encourage the participation of supply chain members. The Program is based on the 17 UN Sustainable Development Goals (<https://sustainabledevelopment.un.org/>) and addresses five main topics: Climate and Energy, Community outreach and port-city dialogue, Governance and Ethics, Resilient Infrastructure, Safety and Security. WPSP works as a think tank and can provide various tools and share experience on port sustainability projects.



Capacity building



Standard & code of practice

IAPH publishes on a regular basis journals, newsletter and technical reports that are available to members and provide useful information to port related businesses and associations.

The Port Authority can base its reflection and strategy on the following reference documents :

UN 2030 AGENDA AND SDGS

UNFCCC PARIS AGREEMENT

IMO STRATEGIC PLAN 2018-2023

OPPORTUNITIES AND BARRIERS

MPA is already a regular member of IAPH and can actively benefit from its expertise, network and regular conferences and meetings. IAPH members have the opportunity to benefit from each other's experiences, tools and feedbacks.

IAPH sustainability standards and processes may be difficult to apprehend and handle on a daily basis and on its own. Regular support and monitoring may be needed for an efficient setup and day to day management.

COST

1 full time equivalent within MPA organization with yearly wage for :
 - 0.5 x HSE - Director - Rs 150,000
 - 0.5 x Senior engineer - Rs 50,000

Case Study - Sustainability Governance

Port of Vancouver (Canada)

The Vancouver Fraser Port Authority engaged with stakeholders over a two-year period to identify the long-term future vision of the port.

It is now actively integrating sustainability throughout the port's business and processes with strong supporting measurement tools to ensure ambitions to deliver the vision are met. These are apparent in the governance structure as well as in its detailed annual reports.



Practical monitoring tools are also available to the public online such as the port dashboard covering all aspects of the supply chain and live monitoring of the environment in and around the port.

Ranking



Efficiency



Cost



Planning



Benefits

IAPH standards encouraging the participation of supply chain members, a large amount of companies and people directly or indirectly connected to port activity can take advantage from the program.

Climate being part of the 1st theme, the community will benefit from the program.

The Community outreach theme will encourage the neighbouring population to actively participate to enhance sustainability.

Diversify trade into climate-resilient commodities

DESCRIPTION

Port Louis is organized to handle a wide mix of products and volumes that slightly change from year to year. Climate Change may change the product mix and lead to a decrease in volume to be handled or a mismatch between demand (products) and supply (services). Supply being driven by assets (infrastructures and equipment) and knowledge (operation processes, expertise), the sustainability and competitiveness of the port on the medium to long term relies on its capacity to adapt to the supply. On the other hand, the port can also prepare the future by putting incentives on trade diversification. This diversification will have to be driven by climate change effects. This reflexion will have to be taken for both import and export products and considering the port as part of an overall supply chain.



Capacity building



Standard & code of practice

Even though no formal standards or code of practice have been published on the subject, it can be instructive to follow the OXFAM - **PREP Value Chain Climate Resilience** documentation. This guide provides useful information on managing climate impacts in companies and communities. It introduces the Business ADAPT (Analyze, Develop, Assess, Prioritize, and Tackle) tool that follows a step-by-step climate resilience framework inspired by existing good practice risk management models.

OPPORTUNITIES AND BARRIERS

Being at the heart of the logistic chain, the port has a major role to play within the diversification strategy. The port can become an active participant to the diversification and proactively trigger profound transformation within its organization.

MPA has the opportunity to become a change driver through new processes, tools and services and increase its role and activity within the logistic chain.

COST

0.5 full time equivalent within MPA organization with yearly wage for :
- 0.5 x Director - Rs 150,000

Case Study – Coffee farms in Highlands (Vietnam).

Coffee production has a huge economic benefit for this northern region of the country. It is also a major carbon producer through fertilizer, water and energy use. This plantation type is also very sensitive to climate change. Low water and drought recently had serious impact on coffee output.

An answer to the economic and climatic threat was to diversify the crops and a better use of fertilizer and water. Multi-crops farms turned out to be more economically resilient as they were not depending on a single product. Farms also became carbon sink due to crop diversification, biomass production, resulting in sequestering more CO₂ than they were producing.

These successful adaptation methods were synthesized to make them more practical and scalable in order to respond to climate change.



Ranking



Efficiency



Cost



Planning



Benefits

Diversifying trade is a major path to increase the resilience to climate change. It involves switching from a vulnerable economy having a negative impact on the climate to low carbon and climate-adapting goods.

This strategic turn, named "Green Industrial Strategy" will benefit to the local communities and will anticipate and prevent the damage caused by climate change on the social fabric and the local economy.

Implement a climate adaptation capacity building program

DESCRIPTION

Capacity building (or capacity development) is the process by which individuals and organizations obtain, improve, and retain the skills, knowledge, tools, equipment and other resources needed to do their jobs competently. It also allows individuals and organizations perform at a greater capacity (larger scale, larger audience, larger impact, etc.). “Capacity building” and “capacity development” are often used interchangeably.



Capacity building



Standard & code of practice

There is no international standard on capacity building, however international organizations have developed some methodologies that can be used and followed or adapted depending on the situation. Among all available methodologies, one can mention :

- UNDP Approach on capacity development - www.undp.org/capacity
- UNCTAD – Technical cooperation – Building capacity on trade & development

OPPORTUNITIES AND BARRIERS

A capacity building program has the main advantage to gather people from a same organization around a climate adaptation reflection and foster communication between participants.

Capacity building can appear very theoretical at first sight and be seen as unproductive or inefficient for some members of the organization. This first barrier must be overcome for a successful implementation.

COST

The costs and required efforts depend on the material and skills already available for capacity building, education and training.

Within MPA, 0.5 full time engineer may be needed for organization.

Case Study – Red Cross - Climate Training Kit

The Red Cross has developed a Climate Training Kit to support capacity building on climate risk management and policy dialogue.

The kit aims at providing a general and adaptable tool to trainers and facilitators and help them set up a training event or workshop. The kit includes five modules, each of them split into sub-modules.

Depending on the topic and the purpose of the training, the trainer can pick and choose the sub modules that better fit the program. Each module and sub-module must be customized and tailored to the local context and audience.



Ranking



Efficiency



Cost



Planning



Benefits

A capacity building program is one of the first steps to turn an organization into a climate change thinking philosophy. This climate change awareness will go beyond the port for each participant and will most probably be put into practice on a daily basis.

The program will engage each participant regarding climate change and its impact on daily life. The social environment may indirectly benefit from the program.

Build a breakwater to reduce wave action at the MCT and oil jetties

DESCRIPTION

Breakwaters are pretty much the standard engineering solution to protect a port against wave action, for navigation, mooring and wave overtopping on the quay.



Capacity building

★ ★ ★ ★ ★

Standard & code of practice

The main guidelines for this measure would be the Rock Manual: the Use of Rock in Hydraulic Engineering. CIRIA/CUR produced the Manual on the use of rock in coastal and shoreline engineering, in dams, fluvial engineering and construction (2007). Breakwaters have to be tested on a physical model before construction.

Among other guidelines, one can also note the World Association for Waterborne Transport Infrastructure (PIANC) and its useful guides (i.e - MarCom WG 40 State-of-the-Art of designing and constructing berm breakwater).

OPPORTUNITIES AND BARRIERS

When possible, the infrastructure can be complemented by logistical and port operations infrastructure and equipment. Many sea ports have seen breakwater construction as an opportunity to further extend berthing and sea side operation offers.

Environmental barriers and construction costs for are the two main barriers for such infrastructure project.

COST

Based on the pre-feasibility study, typical costs (2020) per linear km are as follow:

- 40m\$ from 0 to -10m MSL
- 80m\$ from -10 to -15m MSL
- 120m\$ from -15 to -20m MSL
- 170m\$ from -20 to -25m MSL
- 250m\$ from -25 to -30m MSL
- 370m\$ from -30 to -35m MSL

Case Study – Port of Constanta (Romania) – construction of a breakwater

The Port of Constanta is located in Romania, on the western coast of the Black Sea. It is the largest port of the Black Sea. Directly facing the Black Sea, the port is highly exposed to waves coming from the East that could severely impact ship navigation and berthing hence, decreasing port productivity and operability.

The construction of two breakwaters, one in the Northern side of the port and one in the Southern side of the port significantly decreased wave agitation within the basin.

In 2015, ARTELIA participated in the extension of the northern breakwater (1,050m) further reducing the wave disturbance inside the port. The ARTELIA ACCROPODE™ technology was successfully installed and has proven its reliability.



Benefits

Environmental benefits mostly concern soft protection measures. Though hard engineering solutions are hardly seen as an environmentally friendly solution, they are designed and built following environmental standards and rules (Environmental and Social Impact Assessment). Breakwaters would provide direct economical benefits for the population with the downtime decrease. However, a particular attention shall be given to the social and environmental impact of the new construction itself.

Build coastal defences such as dikes or sea walls

DESCRIPTION

Various types of coastal defences exist, depending on the objective. Seawalls and levees are typical hard protection measures to protect against overtopping. Soft measures such as reefs, mangroves, dunes, and salt marshes are often preferred for coastal protection due to their "building with nature" aspect, but such solutions are not easily applicable in a port environment. Alternatively, retractable seawalls, of temporary nature and raised following an extreme event warning, are cheaper and integrate better in the urban environment. Such a solution would be particularly suitable for the Caudan waterfront, and a similar solution has been installed on the MCT.



Standard & code of practice

The main guideline for this measure would be the Rock Manual: the Use of Rock in Hydraulic Engineering. CIRIA/CUR produced the Manual on the use of rock in coastal and shoreline engineering, in dams, fluvial engineering and construction (2007).

Among other guidelines, one can also note the World Association for Waterborne Transport Infrastructure (PIANC) and its useful guides (i.e - MarCom WG 40 State-of-the-Art of designing and constructing berm breakwater).

OPPORTUNITIES AND BARRIERS

Sea walls are mainly built on high value lands because of its long term sustainability approach. However, less advanced designs can be implemented at a local level to protect the coast from erosion and sea level rise.

The main barriers for the construction of sea walls are the cost, and data accuracy to design an effective protection.

COST

Sea Wall - from 0.5 to 36m\$ per km per meter elevation (2020). (average – 3.4m\$)

Dikes – from 1.2 to 37m\$ per km per meter elevation (2020). (Developed country 10m\$)

Case Study – Tourist resort – Newcastle (United Kingdom).

Co Down tourist resort, located on the sea side of Newcastle, is regularly facing storm surges causing flooding along the resort and the neighboring streets.

The local government has been implementing various coastal defenses solution over the last century to fight against storm surges, namely wooden groynes and gabions (late 20th century) then more recently sea walls .

Coastal defenses have proven to work efficiently against storm surges. The sea wall was designed to provide a walkway while protecting the seafront landscape.

However, the sea required a lot of construction work and affected the natural habitat of the area. It may also cause coastal erosion further along the coast.



Ranking

Efficiency

Cost

Planning

Benefits

The local economy can highly benefit from a sea wall as the construction can preserve high value areas (city centres, touristic areas) on a long term basis. Coastal defences are by nature incompatible with a managed retreat (coastal setback).

Sea walls, and more generally, coastal defences can also be combined to a beach nourishment. The latter will provide a buffer zone to prevent flood and erosion.

Consider floating developments for future infrastructure

DESCRIPTION

Floating platform solutions are still at R&D level, but are considered for a few projects around the world. Chittagong port is considering this solution as a response to the current port congestion, inability to extend operations overland and the necessity to reduce the excessive dredging maintenance costs that the port is currently facing. In French Guyana, the port authority is also considering this solution for a deep sea port offshore, in order to create a regional hub complementing the existing low draught port. Floating developments naturally adapt to a rising sea level rise.



Capacity building



Standard & code of practice

Floating infrastructure is still a recent solution that has not been implemented yet on a large scale.

As a consequence, there are no standards nor code of practice related to such design and construction.

OPPORTUNITIES AND BARRIERS

Floating infrastructure may be faster to implement than traditional extension (dredging, land reclamation) and can be further extended when needed. The technology being duplicable, the construction can be standardized.

However, being a pioneer technology, there is a high range of uncertainty regarding cost, sustainability, reliability and safety...

COST

Being at R&D level, it is not possible to estimate the cost of implementing such a solution.

Upcoming projects in Guyana and Bangladesh may provide a cost range when implemented.

Case Study – Floating port – Chittagong (Bangladesh)

Bangladesh has a yearly economic growth of 7%. The port of Chittagong, the main port of the country, is suffering from congestion and has no possibilities to further extend to cope with current and forecasted traffic. Port authorities have the ambition to enlarge the current port capacity and offer a deep sea access.

The Port Authority has received a proposition for the creation of a deep sea floating terminal to be used as a “transshipment port”. Feeding vessels will load/unload on the floating terminal and brown water vessels will ensure the connection to Chittagong port.



The new floating infrastructure will allow the transshipment of 1m TEU per year and can be further extended if needed for container or any other product type (bulk).

Ranking



Efficiency



Cost



Planning



Benefits

Floating developments are an innovative response to economic growth when infrastructure development or extension isn't feasible. It also grows with the sea level rise.

Building such infrastructure has a lower environmental impact on the coast than a traditional port (no reclamation, dredging). However, feedback is still non-existent.

Dry-proof construction of critical infrastructure

DESCRIPTION

Dry proofing is a construction method consisting of making a building watertight. Dry proofing techniques include putting sealants to the walls, shields to any sensitive openings (doors, ventilation...) and installing a water pumping system to remove the water that would still enter inside the building. According to current analysis and projected climate hazards on the port, there does not seem to be any critical infrastructure affected in the short to middle term. The MCT terminal, logistics areas as well as the Indian Oil and the bulk terminals seem to be the most exposed areas for which such an approach may make sense, where applicable (electrical stations, etc).



Capacity building



Standard & code of practice

Construction standards are mostly national or regional and may differ in terms of obligations and restrictions. Among all organizations and standards, one can mention :

- BS 85500:2015 : Flood resistant and resilient construction.
- ANSI - FM 2510 : American National Flood Barrier Test Program.
- ASCE/SEI 7, Minimum Design Loads for Buildings and Other Structures
- ASCE/SEI 24 Flood Resistant Design and Construction
- Massport - Floodproofing design guide

OPPORTUNITIES AND BARRIERS

Dry proofing construction or refurbishment allows land owners to use areas subject to a water surge. Flood proofing is often a much more cost effective option than relocation. For dry proofing, in case design loads are exceeded, buildings may collapse and cause damage. Advanced flood proofing installations can be costly and will need to be associated with flood hazard mapping.

COST

The Federal Emergency Management Agency (FEMA) provided in 2009 approximate costs.

ie : Elevation cost from \$30 to 100\$ per square foot (2009 data)

Case Study – Floodwall System in Lourdes Hospital – Binghamton (USA)

In 2006, a flooding in Binghamton forced the city hospital to close for 2 weeks and caused 20m\$ in damage. As relocation was not possible, the hospital invested in a 7m\$ flood proof system that would provide the necessary protection.

The system consists of a floodwall surrounding the hospital and 11 flood gates as entry points. The gate automatically rises during a flood event and lowers after the flood episode.



In 2011, a tropical storm hit the city and the main river overflow more than during the 2006 flood. The hospital did not suffer any damage from the flood and kept operating during the event.

Ranking



Efficiency



Cost



Planning



Benefits

Dry proofing infrastructure can be considered through refurbishment work within areas subject to a water surge. A refurbishment solution avoids the need for relocation with all its related environmental issues (new construction, land...), even more for sea port services where infrastructures need to be near the sea.

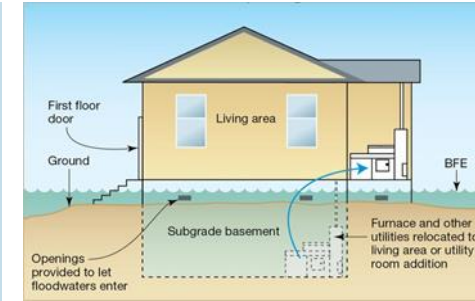
Dry proofing refurbishment methods and design can be duplicated on the island, hence benefiting to a larger part of the community.

Wet-proof construction of critical infrastructure

DESCRIPTION

By contrast to dryproofing, wetproofing allows water to enter the building or the structure. Infrastructure is designed to resist flooding (resistant materials, elevated storage, etc) until water drains. Wetproofing is a cheaper solution than dryproofing but can be more problematic in case of serious or recurrent flooding of a building. Like for dryproofing, the MCT terminal, logistics areas as well as the Indian Oil and the bulk terminals seem to be the most exposed areas for which such an approach may make sense, where applicable (storehouses, administrative buildings).

<https://www.dewberry.com/news/blog/post/blog/2018/10/18/five-prominent-flood-resistant-building-techniques>



Capacity building



Standard & code of practice

Construction standards are mostly national or regional and may differ in terms of obligations and restrictions. Among all organizations and standards, one can be mention :

- BS 85500:2015 : Flood resistant and resilient construction.
- ANSI - FM 2510 : American National Flood Barrier Test Program.
- ASCE/SEI 7, Minimum Design Loads for Buildings and Other Structures
- ASCE/SEI 24 Flood Resistant Design and Construction
- Massport - Floodproofing design guide
- FEMA TB 7-93. Wet Flood proofing Requirements-Structures Located in Special Flood Hazard Areas.

OPPORTUNITIES AND BARRIERS

Wet proofing construction or refurbishment allows land owners to use areas prone to a water surge and avoids the need for relocation. Wet proofing is cheaper than dry proofing and can be as efficient. Wet proofing is not recommended if the building is facing rapidly rising flood water, high velocity and a short flood warning time. In this case, elevation or relocation are more preferable solutions.

COST

The Federal Emergency Management Agency (FEMA) provided in 2009 approximate costs for flooding buildings.

le : Wet flood proofing goes up to 17\$ per square foot of house (2009 data)

Case Study – Climate adaptation Strategy for the port of Rotterdam (Netherlands)

The Port of Rotterdam is situated in the outer-dike area and is directly linked to the river and the sea. This makes it vulnerable to high river levels and especially to storm surges. The port has developed a climate adaptation strategy that combines several measures including **wet proofing** for areas where floodable ground floor was possible as well as internal moving of goods to higher floor.

The port based its strategy on the following questions ; Which climate adaptive measures are appropriate for the port and who will take the first steps?

What added value is generated by the combined measures for the environment, for society, for the economy and for the ecology and who will benefit?

Ranking



Efficiency



Cost



Planning



Benefits

Wet proofing infrastructure can be considered through refurbishment work within areas subject to water surge. Refurbishment solution avoids the need for relocation with all its related environmental issues (new construction, land...), even more for sea port services where infrastructures need to be near the sea.

Wet proofing refurbishment methods and design are easily duplicable and can be done in rural areas where urgent measures are needed.

Automate logistics procedures

DESCRIPTION

Automating logistics processes increases the competitiveness and reliability of port operations. Automating (fully or not) a port has to be strongly weighted and prepared in order to reach expected objectives (higher productivity, lower OPEX) to cover a rather high investment cost. Major barriers to successfully switch to automation are capability, data quality, siloed operations and the handling of exceptions (source : Mc Kinsey study - 2018).

Port automation has five components that can be implemented individually : 1 – Automated equipment ; 2 – Equipment control system ; 3 – Terminal control tower ; 4 – Human machine interaction ; 5 – Interaction with the port community.



Standard & code of practice

There is no defined standards on logistics procedures automation, however the general principles identified by a Mc.Kinsey study can be applied for a successful transition :

1. Build automation-ready capabilities :
2. Set up a strong project-governance and communication plan—and execute with discipline
3. Define a road map to realize value from automation
4. Build and continually refresh your technology ecosystem
5. Incorporate external data into your automation system

OPPORTUNITIES AND BARRIERS

Automated ports are safer and port operations are becoming uniform meaning performance is more predictable. Major barriers to successfully switch to automation are likely to be the port capability, the data quality, the compartmentalized operations and the handling of operation exceptions. Last but not least, implementation costs may also be a major barrier.

COST

Although it is difficult to estimate the cost of a fully automated terminal, an automation service provider estimates that labour costs may drop by up to 60%, maintenance by 20% and power & fuel costs up to 25%.

Case Study – Qianwan Container Terminal automation transformation, Qingdao (China)

Qingdao container terminal is the first fully automated terminal in Asia. The port has an annual capacity of 5.2m TEUs and can operate 24,000 TEU container vessels. The system allows for example automatic container operation in complete darkness. Fully autonomous automatic guided vehicles are using artificial intelligence to operate and recharge when needed.

Since its automation, Qingdao container terminal (China) saw its productivity rise significantly (crane productivity : 39.6 move/hour, +30% throughput capacity) while saving 70% of its labor and is now capable of operating 24/7, fully automated on the whole logistic process (mooring, ship loading / unloading, storage, transfer).



Ranking



Efficiency



Cost



Planning



Benefits

Port automation can increase environmental sustainability. Automation process can save up to 25% on fuel cost and more generally save energy by optimising the performance of the equipment. Automation leads to predictability, precise scheduling which in turn can decrease traffic jam and related environmental pressure.

However, switching to automated operations must go hand in hand with user training and change management.

Install active motion damping systems for moored ships

DESCRIPTION

Active motion damping systems for moored ship are an example of a smart port application. Among other mooring operation and safety benefits, this system increases ship accessibility and operability (mooring, loading/unloading) when the port is facing severe weather conditions. Three different technologies are now available : Vacuum/suction, magnetic, tension cable, each technology having its own advantages and drawbacks.

The vacuum/suction technology seems to be the most advanced technology and currently the most used. Tension cable systems are less documented and do not seem to have reached recognition among port operators.



Capacity building



Standard & code of practice

Active motion damping systems are quite a recent technology and only a few companies can provide such equipment. There is no standard nor code of practice for “active motion” technology. However, and more generally, fendering and mooring are designed and installed according to the following guides and standards :

- BS 6349-4 :2014 “Maritime works, Code of practice for design of fendering and mooring systems”
- Oil Companies International Marine Forum (OCIMF) guidelines
- The World Association for Waterborne Transport Infrastructure (PIANC) guidelines

OPPORTUNITIES AND BARRIERS

Active motion damping can be monitored from the quay, the vessel or, to further extent, be part of an overall automated logistical process.

Being a recent technology, there is little feedback on active motion damping technology, and equipment manufacturers promises are yet to be confirmed from an operational point of view.

COST

Being a recent technology and with only a few players in the market, it is difficult to estimate the cost of an installation. Based on Cavotec (equipment manufacturer) data, a single mooring system costs approximately 500k\$

Case Study –Rope free mooring system Port of Melbourne (Australia)

The port of Melbourne has recently equipped its ferry quays with vacuum technology auto mooring equipment. The new installation minimizes the use of operators, reducing the human error and improving the general mooring and unmooring operation safety.

The system significantly dampens the vessels motion and extends the range of conditions in which quay operations can be done.



The system reduces vessel idling time and reduces the time tug boats are required alongside the vessel until the mooring operation is complete, cutting CO2 emissions.

Ranking



Efficiency



Cost



Planning



Benefits

With this technology, vessel mooring is achieved within a minute, freeing up tugs and manpower early. Carbon emissions during a mooring cycle can be reduced by up to 90%.

This solution may also be seen as a cheaper and more environmentally friendly alternative to a breakwater to reduce wave and surge impacts.

Automatic mooring systems reduce ship and shore crew operation risks.

Install cranes that can safely operate under strong winds

DESCRIPTION

Under strong wind, cranes can face serious issues to efficiently and safely operate. Strong waves being often combined with vessel movements, operating under these specific conditions appears to be problematic. Wind is a capital element to take into account as wind loads increase exponentially – each time wind speed is doubled, loads become 4 times higher.



Capacity building



Standard & code of practice

All cranes are designed based on common and international standards. The International standard “ISO 53.020.20 - MATERIALS HANDLING EQUIPMENT – LIFTING EQUIPMENT – Cranes » is considered as a reference standard.

Among all standards applicable for STS cranes, the following standards are directly related to strong wind operation capacity

- ISO 4302:2016 - Cranes — Wind load assessment
- ISO 4305:2014 - Mobile cranes — Determination of stability
- ISO 4310:2009 - Cranes — Test code and procedures
- ISO 12210-1:1998 - Cranes — Anchoring devices for in-service and out-of-service conditions

OPPORTUNITIES AND BARRIERS

Modern cranes are now proposed with automated or semi-automated operation system. Acquiring new equipment would participate to the automation of logistics processes and ultimately turn the port into a smart port.

With a rather high acquisition cost, the return on investment for climate change hazards only may be difficult to achieve based on the productivity gain (and safety increase).

COST

The cost of a new STS crane ranges from 10m\$ to 15m\$ per unit. The latest technology provides better design and automation systems, improving operation under stronger wind .

Case Study – Liebherr Cranes

Liebherr is continuously improving its Ship to Shore crane to provide a more secure and efficient equipment to port operators.

New designs result in more rigidity and a reduction of crane deflection and structural sway.

The crane can be equipped with automation / semi automation systems that may improve productivity and enable the connection for an overall logistic automation process.



Ranking



Efficiency



Cost



Planning



Benefits

This adaptation strategy is a solution to the climate change impact on port operations and in particular against the wind impact.

From a social point of view, equipment automation can be seen as a threat for port operators.

It is essential not to neglect the workers fear of change and work adaptation.

Lastly, modern equipment generally provide a high safety level.

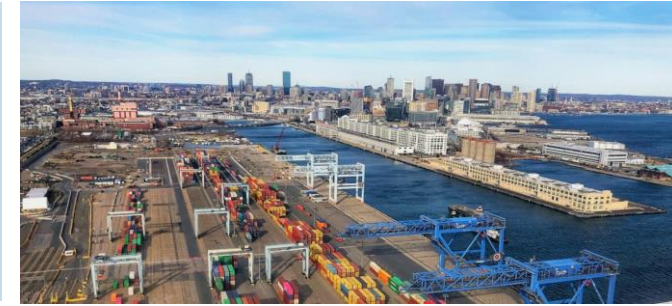
Manage the costs of climate change risks through insurance contracts

DESCRIPTION

Climate change will affect the port on many levels (operations, efficiency, wear and tear, damage ...). Refining knowledge on climate change and impacts is a major step for the port authority to understand the future risks and assess the insurance coverage and cost associated.

Regarding insurance, it is important for the port to focus on two directions :

- making sure all climate change related risks are insured at a correct level;
- setting up a climate change related policy that will decrease insurance costs.



Capacity building



Standard & code of practice

The first step to manage climate change risks is to identify them. The following guides and recommendations may provide support for the port authority :

- ISO 31000:2009 Risk management — Principles and guidelines
- EcoPorts Ports Environmental Review System (PERS)
- PIANC - EnviCom WG Report n° 178 – 2020

Once climate risks are identified, each specific measure (protection, accommodation ...) presented in the fact sheets is a potential measure to be added in the climate change policy, and may participate in decreasing the insurance cost (See related standard and code of practice for each measure).

OPPORTUNITIES AND BARRIERS

The climate change risk assessment and consequent actions taken by the port authority (see the other fact sheets) can be leveraged to improve insurance policies.

However, insurers tend to reveal that, as knowledge of climate change impacts increases, the terms and conditions of insurance contracts will likely change, even more for exposed areas such as Mauritius.

COST

There is no particular cost associated with such a measure other than the cost of the insurance itself.

Case Study – Terminal Marítimo Muelles el Bosque (MEB) - Cartagena (Colombia)

MEB is facing increasing risks due to climate change that could impact both its business (revenue loss) and assets (damages). MEB insurance didn't include the connection road, that was identified as highly at risk regarding climate change. MEB insurance didn't include contingent business interruption due to most climate related hazards on the access to/from the port. MEB took action to raise the causeway connecting the port to the land, reducing the risk of operation interruption due to flooding.

Discussions with insurers conducted for this study indicated that some insurers would consider reducing

insurance premiums, or offering more favorable insurance terms, to customers who have undertaken similar actions.



Ranking



Efficiency



Cost



Planning



Benefits

Assessing climate change risks through insurance allows the user to have an analysis from another perspective. It can outline hidden risks that weren't necessarily identified through other methodologies.

Environmental and social impacts are quite limited for this measure. But measures following from the analysis can have a positive environmental and social impact.



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