Capacity building workshop on sustainable port development and improving port productivity among ESCAP member countries

Natural Disaster and Ports Resilience

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I. Trends and Prospects of Climate Change

- Global temperatures increased by 0.85 degrees over the past 133 years (1880~2012)
- Sea level rose 19cm over the past 110 years (1901~2010)
- IPCC expects temperature and sea level to rise by 3.7 degrees and 63cm in 2100

Prospects average temperature

Prospects sea level

I. Trends and Prospects of Climate Change

- Total anthropogenic GHG emissions continued to increase between 1970 to 2010
- CO₂ emissions from fossil fuel combustion and industrial processes contributed about 78% of the total GHG emission increase from 1970 to 2010

Source: IPCC, Climate Change 2014.
I. Trends and Prospects of Climate Change

- Various local risks such as natural disaster (earthquake, tsunami, flood), avian influenza, radioactive effluent occur
- The effect of local risks expand to global risks due to international division of labor and logistics network expansion
- Manufacturer focus on logistics resilience by diversifying procurement sources and increase safety stock

Global Logistics Issues - Globalization of Local Risk

- **Natural phenomenon**
  - **Natural disaster**: flood, earthquake, tsunami
  - **Disease, epidemic**: SARS
  - **Forest fire, etc.**

- **Political system**
  - **War, Terrorism**: Iraq(1991, 2001), Libya(2011)
  - **Strike**: Europe(frequently), Singapore(2013)
  - **Regulation, Custom**: Japan, US(Super 301)

- **Productivity**
  - Production cost
  - Financial/insurance
  - Production capacity increases
  - Supplier bankruptcy

- **Operation**
  - Discordance of prediction
  - Quality, on-time delivery
  - Maintenance, safety, bullwhip effect, flexibility

- **Information system**
  - Failure of information system
  - Distortion of information
  - System integration
  - Virus/bug/hacking

Source: Olson, Supply Chain Risk Management, 2011.
II. Climate Change and Natural Disaster Impacts on Ports
Climate Change & Natural Disaster Factors on Ports

- Ports are many interacting components that can be stressed by multiple socio-economic factors
- Ports are under the threat of climate change & natural disasters such as earthquakes, hurricanes, high waves etc.

II. Climate Change and Natural Disaster Impacts on Ports

Interacting critical socio-economic factors in port

Climate Change Impacts on Ports

- Sea level rise, storm surges and waves impact on coastal transport hubs and networks including seaports and connecting coastal roads and rail lines

<table>
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<tr>
<th>Major climatic factor</th>
<th>Impacts on ports</th>
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| **Sea level**               | ✓ Damages in port infrastructure and cargo from incremental and catastrophic inundation and wave regime changes  
                               | ✓ Higher port construction and maintenance costs                                                        
                               | ✓ Potential modulation of tides causing sedimentation and dredging in port channels and operational time table changes  
                               | ✓ Effects on key transit points                                                                        
                               | ✓ Increased risks for coastal road and railway links                                                    
                               | ✓ Relocation of people and businesses                                                                   
                               | ✓ Insurance issues                                                                                     |
| **Temperature**             | ✓ Damage to infrastructure, equipment, cargo and asset lifetime reduction                              
                               | ✓ Increases in the staff health risk                                                                    
                               | ✓ Higher energy consumption for cooling terminals and cargo                                             
                               | ✓ Restrictions for inland navigation that may affect estuarine port competitiveness (e.g. port of Rotterdam) 
                               | ✓ Reductions in snow and ice removal costs                                                              
                               | ✓ Extension of changes in transport demand                                                              |
| **Precipitation and Fog**   | ✓ Land infrastructure inundation; damage to cargo and equipment                                        
                               | ✓ Navigation restrictions in inland waterways                                                           
                               | ✓ Network inundation and vital node damage                                                              
                               | ✓ Problems in port equipment operations                                                                |
| **Wind**                    | ✓ Problems in seaport navigation and berthing                                                          
                               | ✓ Operational disruptions due to inability to load/unload                                               |

Source: UNCTAD, Port Industry Survey on Climate Change Impacts and Adaptation, 2017.
Damage to ports by natural disaster which will result not only in monetary losses attributed to replacement cost of the structures, but will also result in losses due to down-time (disruption to domestic/global supply chains).

- The East Japan earthquake & tsunami (2011.3.11) devastated 15 major ports, disrupting distribution systems of the region as well as global supply chains.


Source: Hankyoreh, http://www.hani.co.kr/interactive/typhoon/, 2019.3.29
III. Case Study

- Policies to Prevent Damages from Disasters
The Port of Long Beach developed a CRP to manage the direct and indirect risks associated with climate change and coastal hazards

- **Project Goals**: 1) Manage risks associated with climate change, 2) Identify Port assets that are most vulnerable, 3) Identify potential adaptation strategies to protect the Port

### Steps to Developing the CRP

1. **Climate Science Review**
2. **Inventory Mapping**
3. **Vulnerability Profiles**
4. **Development of Adaptation Strategies & Port Workshop**
5. **Final CRP**

Source: Port of Long Beach, Climate Adaptation and Coastal Resiliency Plan, 2016.

### CRP’s Five strategies

1. **Strategy 1** Addressing climate change impacts through Port policies, plans, and guidelines (Governance)
2. **Strategy 2** Adding sea level rise analysis to the Harbor Development Permit (Governance)
3. **Strategy 3** Piers A & B Study – Combined impacts of riverine and coastal flooding (Initiative)
4. **Strategy 4** Adding sea level rise analysis to the Harbor Development Permit (Infrastructure)
5. **Strategy 5** Pier S substation protection – Evaluation of multiple strategies (Infrastructure)

Source: Port of Long Beach, http://www.polb.com/, 2019.3.29
The Port of Rotterdam to work on fresh water supply, protection against flooding, pilot project ‘Botlek’, flood risk assessment

Source: Port of Rotterdam, Climate Change Adaptation in the Port of Rotterdam, 2016

Source: Port of Rotterdam, Climate Change Adaptation in the Port of Rotterdam, 2016
The Port of Tokyo continued to work on the development of shoreline protection facilities including levees, embankments, flood gates, and draining pumping sites.

After the East Japan earthquake, the Port of Tokyo drafted a new development plan for all shoreline preservation facilities in 2012.
IV. How to Prevent Port Damages from Disasters
IV. How to Prevent Port Damages from Disasters

**Strengthen the installation of disaster prevention facilities**

- Large scale damage areas are selected as disaster vulnerable areas
- Infrastructure installation of disaster prevention such as disaster prevention hill, sea water inflow blocking facilities
- Breakwater reinforcement, flood prevention facility installed in the damaged area

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**Pier sea level rise and storm surge maps (Port of Long Beach)**

Source: Port of Long Beach, Climate Adaptation and Coastal Resiliency Plan, 2016.

**Breakwater subsections wave model (Port of Long Beach)**

Source: Port of Long Beach, Climate Adaptation and Coastal Resiliency Plan, 2016.
IV. How to Prevent Port Damages from Disasters

- **Reinforcement of seismic design and maintenance**
  - Prioritize reinforcement project for passenger terminals and its facilities

- **Securing the avoidable condition of ports for fishing vessel against the increased risks of typhoon**
  - Securing the avoidable conditions by Designating port of major islands as the National Management Coastal Port
  - Expansion of offshore facilities such as breakwater in order to secure avoidable condition of ports

Source: https://www.tokyo-international-cruise-terminal.jp/, 2019.3.29
※ Construction expected to be complete at the end of June 2020

Source: https://www.mori-group.jp/, 2019.3.29