SuPort: Appraising Port Sustainability

Arup
Craig Covil
Agenda

- Intro to Arup
- Climate Change Risks: Implications to Maritime
- Plausible Futures for Ports in 2050
- SuPort: Port Sustainability Appraisal Tool

- Tomorrow – break out session

*Greening Port Facilities*
Sir Ove Arup founded his practice in London in 1946 based on a belief in ‘total design’

Today we understand this as a commitment to sustainability.
Worldwide Presence | Over 10,000 staff ✤ in more than 90 offices ✤ in over 30 countries
Costa Azul LNG, Baha California

- 700m long
- 25m water depth
- 100 year design wave condition
  - $H_s = 8.5m$
  - $T_p = 14.3s$
Acoustic consulting
- Advanced geometric design
- Advanced technology and research
- Airport planning
- Architecture
- Audio visual and multimedia
- Bridge design
- Building design
- Building modelling
- Building physics
- Civil engineering
- Cost management
- Economic planning
- Economics and planning
- Electrical engineering
- Energy strategy
- Environmental consulting
- Façade engineering
- Facilities management
- Fire
- Fluid dynamics
- Geotechnics
- Hydrogeology
- Infrastructure design
- Interchange design
- International development
- IT and communications systems
- Landscape architecture
- Lighting design
- Management consulting
- Maritime engineering
- Masterplanning
- Materials
- Mechanical engineering
- Oil and gas engineering
- Operations consulting
- Planning policy advice
- Power generation
- Product design
- Project management
- Public health engineering
- Quantity surveying
- Renewable energy
- Research
- Resilience, security and risk
- Seismic design
- Site development
- Software products
- Specialist technical services
- Sports architecture
- Structural engineering
- Sustainability consulting
- Sustainable buildings design
- Sustainable infrastructure design
- Theatre consulting
- Town planning
- Transaction advice
- Transport consulting
- Tunnel design
- Urban design
- Vertical transportation design
- Water engineering
- Wind engineering
- Drivers of Change  Oceans

- Slim City
  - World Economic Forum

www.driversofchange.com

http://www.driversofchange.com/docvis/slimcity/
- Copenhagen Communiqué
- Technical Advisor to the C40 Large Cities Climate Leadership Group
- TED
- Plausible Futures
Climate

Implications for maritime
Adaptation and Resilience to Coastal Changes

Spot the Difference

In a climate-changed world...

There is no competitive advantage to inaction
Increased Value Concentration: Increased Risk

Great Miami Hurricane: $157 billion economic loss (2005 dollar value)

Hurricane Andrew: $55 billion economic loss (2005 dollar value)

Source: Swiss Re. Sigma
Increasing Risk

The frequency of extreme events is increasing.

With it, the nature and structure of those events are changing.

Changing nature and structure of events: 1950-2001
- **Observed**

  Predicted Temperature 2080–2099 minus 1980–1999

  - **Heat waves**
  - **Frost days**

  - Models using only natural forcings
  - Models using both natural and anthropogenic forcings

  IPCC 2007: WG-AR4
### Observed

(WGBU, after Archer, 2006)

### Predicted

- Global Trends 1993-2008
- SLR Mechanisms
  - 1. Glaciers
  - 2. Thermal expansion
  - 3. Ice sheets

ARUP
How does the science inform coastal zone infrastructure?

1-meter sea level rise

Source: NASA
Observed

Predicted

Storms and other extreme events
How does the science inform coastal zone infrastructure?

Sources:
http://www.nasa.gov/images/content/161530main_surge_tide_lg.gif
10 foot (3 meter) sea level rise. Source: NYC Panel on Climate Change
Maritime Business Opportunities

**Arctic Circle**

**Arctic Bridge**

**Northern Sea Route**

**Northwest Passage**

**Transpolar Route**

4Futures

Plausible scenarios for global ports to 2050
Four Futures
Arctic passages open year-round

Increased reliance on engineered solutions

Infrastructure will become functionally obsolete before traditional design life
Increased focus on intermodal, land-based transportation hubs

Ports increasingly become unable to obtain insurance due to climate risks

Increased dependency on fossil fuel
High-efficiency ship design regulations and construction

Limited Arctic passage creates bottlenecks at Panama / Suez Canals

Extreme social pressure for environmental protection
Global and bilateral intergovernmental agreements, global price of carbon

Stricter environmental regulations for ports and shipping companies

Emergence of mega ports shifts trade power
Solutions

Pathways to Sustainable & Resilient Ports
Climate Change mitigation and adaptation

- **Mitigation:** proactively tackling the causes
  - Limited window of opportunity

- **Adaptation:** reactively adjusting to the impacts
  - Reducing vulnerability
  - Finding opportunity
  - Phasing

If we **act today**

**Cost**

~1% global GDP each year

If we **do nothing**

**Like losing**

~ 5% – 20% global GDP each year, every year
Solutions for Maritime Stakeholders

Port expansion, contraction, relocation
Risk and Contingency Planning
Regulatory Compliance and Foresight
Adaptation to Physical Impacts of Climate Change
Supply chain management

Life-cycle cost and durability analysis
Green Ships and Green Facilities
LEED and other sustainability certification
Coastal defenses
Multi-modal transport hubs and strategic planning

Public Infrastructure Adaptation
P3 Transaction Advice
Waterfront redevelopment and regeneration
Port masterplanning
Tourism and recreation infrastructure

Fuel switching, Cold-ironing
Arctic Navigation
Carbon emissions accounting and mitigation
Infrastructure adaptation to new vessels
Environmental assessment and remediation

ARUP
Arup SuPort Tool: Appraising Port Sustainability
New situation: economical, social and of relationship with the environment

New obligations and opportunities for the Ports

Commitment to go beyond legislative compliance

Evaluation, Management and Implementation of Sustainability as a Development Framework
Arup and the Port of Santander in Spain reached an agreement to develop a tool to appraise a port sustainability: **SuPort**.

This initiative rose from a joint R&D project, which built upon the current activity of the Port of Santander to adapt this tool and test it on a real case.

SuPort has been developed with the input from experts on a wide range of areas of expertise: logistics, infrastructures, economics, social science, environment, etc.
SuPort is a sustainability evaluation and diagnosis tool for existing maritime transport related facilities:

• SuPort deals not only with environmental issues → it evaluates the sustainability triple bottom line (allocating weight to economic and social issues).

• SuPort is oriented to existing operations → it provides a snapshot of their current or future performance in terms of sustainability.

• Provides a quick SWOT analysis by identifying strengths, weaknesses, opportunities and challenges
SuPort synthesizes the indicators to provide a comprehensive view of the sustainability of the port activities.

### Categories

<table>
<thead>
<tr>
<th>Environment</th>
<th>Society</th>
<th>Economics</th>
</tr>
</thead>
<tbody>
<tr>
<td>AQUATIC ENVIRONMENT</td>
<td>LOCATION AND CONNECTIVITY</td>
<td>BUSINESS MODEL</td>
</tr>
<tr>
<td>POTABLE WATER</td>
<td>STAKEHOLDERS</td>
<td>BUSINESS MANAGEMENT</td>
</tr>
<tr>
<td>AIR AND ATMOSPHERE</td>
<td>ATTRACTIVE AND LIVABLE WATERFRONT</td>
<td>ASSETS SUSTAINABILITY</td>
</tr>
<tr>
<td>ENERGY</td>
<td>CULTURE AND IDENTITY</td>
<td>FINANCIAL PERFORMANCE</td>
</tr>
<tr>
<td>SOLID WASTE</td>
<td>LABOUR AND EDUCATION</td>
<td>TRANSPORT CHAIN</td>
</tr>
<tr>
<td>NATURAL ENVIRONMENT AND SOILS</td>
<td>CORPORATE SOCIAL RESPONSIBILITY</td>
<td>REGIONAL ECONOMIC IMPACTS</td>
</tr>
</tbody>
</table>

3 Dimensions

18 Categories

82 Indicators
## Indicators

### Environment and Natural Resources

<table>
<thead>
<tr>
<th>Environment</th>
<th>Indicators</th>
</tr>
</thead>
</table>
| N1 Aquatic Environment | N1.1 Port water quality  
| N1.2 Hardscape and stormwater management  
| N1.3 Foul water management  
| N1.4 Flood risk management  
| N1.5 Ship liquid waste management - MARPOL I-II-IV |
| N2 Potable Water | N2.1 Potable water network efficiency  
| N2.2 Potable water use  
| N2.3 Use of non-potable water (grey, sea and storm water) |
| N3 Air and Atmosphere | N3.1 Dust and air quality  
| N3.2 Greenhouse gases emissions reporting  
| N3.3 Noise  
| N3.4 Light Pollution  
| N3.5 Odours  
| N3.6 Ship air emissions – MARPOL VI |
| N4 Energy | N4.1 Energy efficiency of installations  
| N4.2 Lighting efficiency  
| N4.3 Renewable energy use  
| N4.4 Clean fuel supply (ships and port equipment)  
| N4.5 Onshore power supply |
| N5 Solid Waste | N5.1 Non-dangerous waste management  
| N5.2 Hazardous waste management  
| N5.3 Ship solid waste – MARPOL III – V |
| N6 Land Natural Environment | N6.1 Contaminated soils  
| N6.2 Habitat restoration and protection and biodiversity management  
| N6.3 Plague control (ballast water and ship sediments)  
| N6.4 Dredging and land reclamation management  
| N6.5 Landscaping and visual impact  
| N6.6 Climate change provision |

### Society

<table>
<thead>
<tr>
<th>Society</th>
<th>Indicators</th>
</tr>
</thead>
</table>
| S1 Proximity and Accessibility | S1.1 Accessibility (internal)  
| S1.2 Accessibility (external)  
| S1.3 Information accessibility  
| S1.4 Accessibility to the shoreline  
| S1.5 Citizen proximity to port industry activity |
| S2 Stakeholders | S2.1 Stakeholder relations  
| S2.2 Improved positive community  
| S2.3 Port community social contributions |
| S3 Culture and Identity | S3.1 Social identity and heritage preservation  
| S3.2 Social and economical interaction and diversity  
| S3.3 Community relationship development  
| S3.4 Cultural program |
| S4 Labour and Education | S4.1 Entrepreneurship and creativity (education)  
| S4.2 Employment (quality and diversity issues)  
| S4.3 Employee retention  
| S4.4 Trade union relationships |
| S5 Corporate Social Responsibility | S5.1 Management Systems  
| S5.2 Internal and External Reporting  
| S5.3 Supply Chain  
| S5.4 Social Footprint |
| S6 Attractiveness and Livability | S6.1 Amenities and services  
| S6.2 Local environmental quality  
| S6.3 Health  
| S6.4 Safety  
| S6.5 Security and contingency plans (ISPS compliance)  
| S6.6 Comfort  
| S6.7 Walkable and open waterfront |

### Economics

<table>
<thead>
<tr>
<th>Economics</th>
<th>Indicators</th>
</tr>
</thead>
</table>
| E1 Business Model | E1.1 Workforce age  
| E1.2 R&D+I (investing on)  
| E1.3 Private investment  
| E1.4 Split of incomes sources  
| E1.5 Clients diversity |
| E2 Business Management | E2.1 Service quality / Performance audit results  
| E2.2 Service delivery unit costs compared with peers  
| E2.3 Quay utilization rate (congestion)  
| E2.4 Storage area utilization rate  
| E2.5 Land use |
| E3 Assets Sustainability | E3.1 Maintenance of assets  
| E3.2 Asset flexibility  
| E3.3 Ability to expand  
| E3.4 New construction sustainability plan  
| E3.5 Sustainable procurement and materials |
| E4 Financial Performance | E4.1 Debt service coverage ratio (DSCR)  
| E4.2 Return on assets  
| E4.3 Efficient pricing (road, parking, insurance, fuel, etc) |
| E5 Transport Chain | E5.1 Sustainable traffic mix  
| E5.2 Modal share sustainability  
| E5.3 Inland transport external costs  
| E5.4 the port as a total transport hub |
| E6 Regional Economic Impacts | E6.1 Direct Employment  
| E6.2 Indirect Employment  
| E6.3 Contribution to the regional GDP  
| E6.4 Support for local industries  
| E6.5 Gross Added Value |
Dust and air quality

Dust causes a threat not only to human health and the environment, but also to facilities maintenance due to its corrosive properties. The main source of air dust is bulk handling and storing. Other air pollutants may be generated by these activities (PM, COx, SOx, NOx, VOCs, heavy metals, etc). The port entity must limit the harmful effects of these substances by means of preventive measures. Besides, the port entity should control the pollutant capacity of ships at berth.

Measurement

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>There is an air quality management plan put in place, which deals with both dust and air pollutants emissions. As part of this plan, preventive active measures are taken such as providing systems to prevent pollutants dispersion during the loading or unloading of vessels (such as covered conveyor belts) or covering stacking areas, and providing them with special systems to catch dust in each transfer point. The port entity checks the Environmental Ship Index (ESI) of incoming ships.</td>
</tr>
<tr>
<td>0</td>
<td>National/Local air emissions regulations are met (European Ambient Air Quality Directive 1999/EC/30 or equivalent). The port entity has never received a fine/complaint regarding dust/air contamination issues. Ships berthing into the port entity comply with Marpol convention Annex VI.</td>
</tr>
<tr>
<td>-3</td>
<td>National/Local air emissions regulations are not met on a regular basis. The port entity has received a fine/complaint regarding dust/air contamination issues, and no action was taken. Ships berthing into the port entity do not comply with Marpol convention Annex VI.</td>
</tr>
</tbody>
</table>
Questions

- Has the port entity got an air quality management plan? If so, what does it include?
- What measures is the port entity implementing in order to avoid air quality issues?
- Has the port entity ever received community complaints for low air quality? If so, has any action been taken?
- Has the port entity ever received fines for not complying with national/local air quality regulations? If so, has any action been taken?
- Are the incoming ships checked by the port entity in terms of its air quality performance? (i.e. compliance with Marpol convention Annex VI, ESI)

References

- Marpol convention Annex VI: Prevention of Air Pollution from Ships. Entry into force: 19 May 2005
- IAPH tool box for port clean air programs (iaphtoolbox.wpci.nl)
  - http://www.porttechnology.org/fa_terminal_handling/
  - Environmentally-friendly-dust-control-solutions/4471.html

Correlation to other indicators

- BREEAM - Europe Industrial: Pol4
- ESPO - Environmental Code of Practice: Issue 7 (Port area)
- Green Port Guidelines: EM2
- (Spain) Indaport: Indicator #1
- SPeAR: air quality indicators
- Santander: C51, P44, P39

Notes

Picture source: Arup photo library
According to ESPO, air quality is the second most important environmental consideration for European ports (first one for large ports handling >25 million tons). Dust takes up the eighth positions on the same ranking.
S1.5 Citizen proximity to port industrial activity

The proximity of the urban cities to the waterfront area defines the linkages of these with the sea, benefiting from the economic advantages that imply a privileged geographical location at the time of receiving and shipping goods by sea. Port facilities have been enriching the cities, but sometimes make it hard to enjoy the coast due to industrial port activity. Given this, new initiatives have foreseen displacement of the main port activities to areas more distant with less interference with daily life and neighborhoods.

Land previously suitable for use of operations of port industrial activities has become unusable (due to restrictions in legislation) presenting an excellent opportunity to introduce new attractors in areas of high centrality, related to landscape and shoreline.

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<tr>
<td>3</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>-3</td>
</tr>
</tbody>
</table>
Questions

- How many people live nearby and are affected by industrial port activities?
- How far is the industrial port area to the neighbors?
- Is there any complaint by the proximity of port activity?

References

- Environmental Impact Assessment
- The WHO European Healthy Cities Network
- Urban Planning Lows
- Sustainable port and urban planning

Correlation to other indicators

- SPeAR; Transport (Ec), Transport (En), Form and Space
- LEED-ND; NPDC11

Notes

http://www.bahiadialghero.it/public/images/org/alghero/panorami-125.jpg
**SuPort: How does it work?**

**Values:** each indicator will have a value between -3 and +3.

<table>
<thead>
<tr>
<th>Category/Indicator</th>
<th>Values</th>
<th>Weights</th>
<th>Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>N1 AQUATIC ENVIRONMENT</td>
<td>3 2 1 0 1 2 3</td>
<td>1 12.5% 0.38</td>
<td></td>
</tr>
<tr>
<td>N1.1 Port water quality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N1.2 Hardscape and stormwater management</td>
<td></td>
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<td>N1.5 Ship liquid waste management - Marpol HI-IV</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

**Weight:** each indicator will have a weight, which will enable the particularisation of the tool for each application.

In this example, indicator N1.4 represents the most critical issue. Indicators N1.1, N1.2 and N1.3 are the relatively least important.
SuPort: How does it work?

Scores:

<table>
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<th>Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N1 ENVIRONMENTAL QUALITY</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N1.1 Port sea/river water quality</td>
<td>3</td>
<td>12.5%</td>
<td>0.38</td>
</tr>
<tr>
<td>N1.2 Air quality</td>
<td>2</td>
<td>12.5%</td>
<td>0.25</td>
</tr>
<tr>
<td>N1.3 Noise</td>
<td>1</td>
<td>12.5%</td>
<td>0.13</td>
</tr>
<tr>
<td>N1.4 Light pollution (impact on land and water)</td>
<td>3</td>
<td>37.5%</td>
<td>0.76</td>
</tr>
<tr>
<td>N1.5 Odour</td>
<td>2</td>
<td>25.0%</td>
<td>0.50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>100.0%</td>
<td>1.25</td>
</tr>
</tbody>
</table>

Indicator score = Value x Weigh(%)  
Example: 3 x 12.5% = 0.38

Category score = \( \sum \) Indicators score

Accordingly, SuPort has flexibility enough to add a weight to the Categories within a Dimension

<table>
<thead>
<tr>
<th>Dimension/Category</th>
<th>Values</th>
<th>Weighs</th>
<th>Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ENVIRONMENT &amp; NATURAL RESOURCES</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N1 ENVIRONMENTAL QUALITY</td>
<td>1.25</td>
<td>11%</td>
<td>0.14</td>
</tr>
<tr>
<td>N2 ENVIRONMENTAL IMPACT</td>
<td></td>
<td>22%</td>
<td>-0.06</td>
</tr>
<tr>
<td>N3 ENERGY AND ATMOSPHERE</td>
<td>0.52</td>
<td>11%</td>
<td>0.00</td>
</tr>
<tr>
<td>N4 WASTE MANAGEMENT</td>
<td>1.00</td>
<td>33%</td>
<td>1.91</td>
</tr>
<tr>
<td>N5 WATER USE</td>
<td>-0.70</td>
<td>11%</td>
<td>0.09</td>
</tr>
<tr>
<td>N6 ENVIRONMENTAL MANAGEMENT</td>
<td>-2.20</td>
<td>11%</td>
<td>0.24</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>100%</td>
<td>0.88</td>
</tr>
</tbody>
</table>

The scheme of application is the same: Score for each Dimension is the aggregate of the weigh-up scores of its categories
SuPort provides a framework which enables ports and terminals operators and maritime facility owners to:

- Engage in communication and awareness
- Help in management and planning
- Identify strengths and weakness
- Promote best practice
- Allow monitoring
- Demonstrate a contribution to sustainable development

<table>
<thead>
<tr>
<th>Potential Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engage in communication and awareness</td>
</tr>
<tr>
<td>Help in management and planning</td>
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<td>Identify strengths and weakness</td>
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<tr>
<td>Allow monitoring</td>
</tr>
<tr>
<td>Demonstrate a contribution to sustainable development</td>
</tr>
</tbody>
</table>

- Analyse their current performance
- Identify areas for improvement
- Go beyond detached solutions to isolated problems in order to provide a strategic integrated solution.
- Evaluate how the performance would be if the actions were taken successfully.
Environment and natural resources
Questions

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Thank You

Land based facilities:

- Refrigeration storage
- Admin & offices
- Energy storage / supply
- Cold ironing
- LNG facilities
- Data Centers
- Maintenance facilities
- Dry/wet docks
- Tug Facilities
- Laboratories

CapEx vs OpEx
Holistic Integrated
whole system approach