



PIANC

Task Group 181 - 2018



THE STATE AND PERSPECTIVES OF WATERBORNE TRANSPORT INFRASTRUCTURE WORLDWIDE

The World Association for Waterborne Transport Infrastructure



PIANC
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Waterborne Transport Infrastructure

PIANC TASK GROUP 181
FINAL Report of Findings and Recommendations

**THE STATE AND PERSPECTIVES OF
WATERBORNE TRANSPORT
INFRASTRUCTURE WORLDWIDE**

2018

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PREFACE

At the 33rd PIANC World Congress in San Francisco, on 31 May 2014, the Annual General Assembly passed a resolution to form a task group on the 'State and Perspectives of Waterborne Transport Infrastructure Worldwide' (Appendix A). Task Group 181 was charged with gathering relevant information on the global needs for new or existing waterborne transport infrastructure, including investment levels and operation & maintenance costs as compared to other transport modes, and assimilating this information into a database that organises and presents it in a meaningful way.

The Task Group was also charged with investigating emerging trends and new technologies affecting the development of waterborne transport infrastructure worldwide. Appendix B provides the October 2014 Terms of Reference (ToR) and the work plan for TG 181.

TG 181's final product is intended to provide guidance on best practices for better design, financing and construction of waterborne transport infrastructure, which can lead to a gain in productivity in infrastructure delivery.

ACKNOWLEDGEMENT

This report was produced by an all-volunteer TG 181 team led by Nick Pansic (Stantec), Chair and a Commissioner of the US Section of PIANC. Team members included:

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- Mr Paul Scherrer, Council for Environment and Sustainable Development, France
- Mr Roberto Zanetti, Witteveen & Bos, the Netherlands

The team could not have produced this report without the excellent support and co-operation of PIANC leadership, including President Geoffroy Caude, previous Secretary-General Louis Van Schel, and Executive Committee (ExCom) members Edward Schmeltz and Ian White, through the various discussions, consultations, guidance and information provided.

The team would like to express its deep gratitude to the Chairs of the Technical Commissions – Dr. Philippe Rigo (InCom), Harald Köthe (EnviCom – previous Chairman), Francisco Esteban Lefler (MarCom) and Elio Ciralli (RecCom – previous Chairman) for their guidance and insights.

The team would also like to recognise the valuable contributions it received from the YP-Com workshop convened at their April 2016 Asian Seminar in Manila, especially YP-Com Co-Chairs Andrew Thomas (USA) and Pablo Arecco (Argentina – previous Co-Chairman), William Glamore (Australia), Hidenori Takahashi (Japan), Stanley Chuah (Malaysia), and Hann Jia Tan (Vietnam), as well as the other 75 workshop participants representing Australia, Iran, the Philippines and Singapore. Stantec young professionals Bella Chinbat and Puja Shinde also made meaningful contributions to the report and case studies, and their assistance is appreciated.

And, last but not least, the invaluable support of PIANC HQ staff members, An Van Schel, Sabine Van de Velde and Leen Weltens, is gratefully acknowledged.

1 INTRODUCTION

The TG 181 scope is broad and cuts across many aspects of waterborne transport infrastructure development. As such, it does not align uniquely with any of the traditional PIANC Technical Commissions. Therefore, oversight and sponsorship of TG 181 was at the Executive Committee (ExCom) level. However, the TG conducted outreach activities with each of the Technical Commissions, including a review of their Working Group reports, to help inform its work.

TG 181 members were solicited from all PIANC member countries, with 29 initial volunteers identified. The 'worldwide' scale of the TG's charter highlights the fact that the scope of the investigation goes beyond PIANC member countries, which are largely concentrated in Europe, Asia and the Americas. At the TG 181 kick-off meeting in February 2015, a work plan comprising four main thrusts was agreed:

- Collect data and information
- Assess the data and information
- Investigate emerging trends and technologies relevant to the sector
- Communicate results to stakeholders

This report presents the work and findings of TG 181 and provides recommendations for carrying forward its goals and objectives.

The report is organised as follows:

- The role of waterborne transport in the global economy (Chapter 2)
- A primer on waterborne transport infrastructure worldwide (Chapter 3)
- Summary of the data collection activities (Chapter 4)
- Analysis of the data and information obtained (Chapter 5)
- Case studies illustrating the significant emerging trends and technologies impacting the sector (Chapter 6)
- Case studies illustrating best practices for infrastructure design, financing and construction (Chapter 7)
- Observations on PIANC partnerships and stakeholder relations (Chapter 8)
- Presentation of key findings of the TG and its recommendations going forward (Chapter 9)

An FTP database was created to organise and house the wealth of data and information that exists on this topic. Appendix C to this report provides an overview of the database structure and its contents.

2 THE ROLE OF WATERBORNE TRANSPORT IN THE GLOBAL ECONOMY

The term 'global economy' can have multiple definitions, but it fundamentally speaks to the exchange of goods, services and commodities among businesses and nations on a global scale. Participants in the global economy continuously seek to gain competitive power and advantage by trading off costs of production (of which a major component is often labour) and transportation to maximise benefits and market share. Perhaps the defining example of a 'good' that illustrates today's global economy is the cell phone – with raw materials (e.g. from Africa) transported to locations where technology and labour advantages enable low production costs (e.g. China or other Asian countries), and the finished product transported from the manufacturing location to the demand centres (e.g. Europe and the Americas). A fundamental element of this value chain is reliable and efficient transportation – whether of raw materials or finished goods – of which much is by waterborne craft (maritime vessels) across the Pacific and Atlantic Oceans (Figure 1).

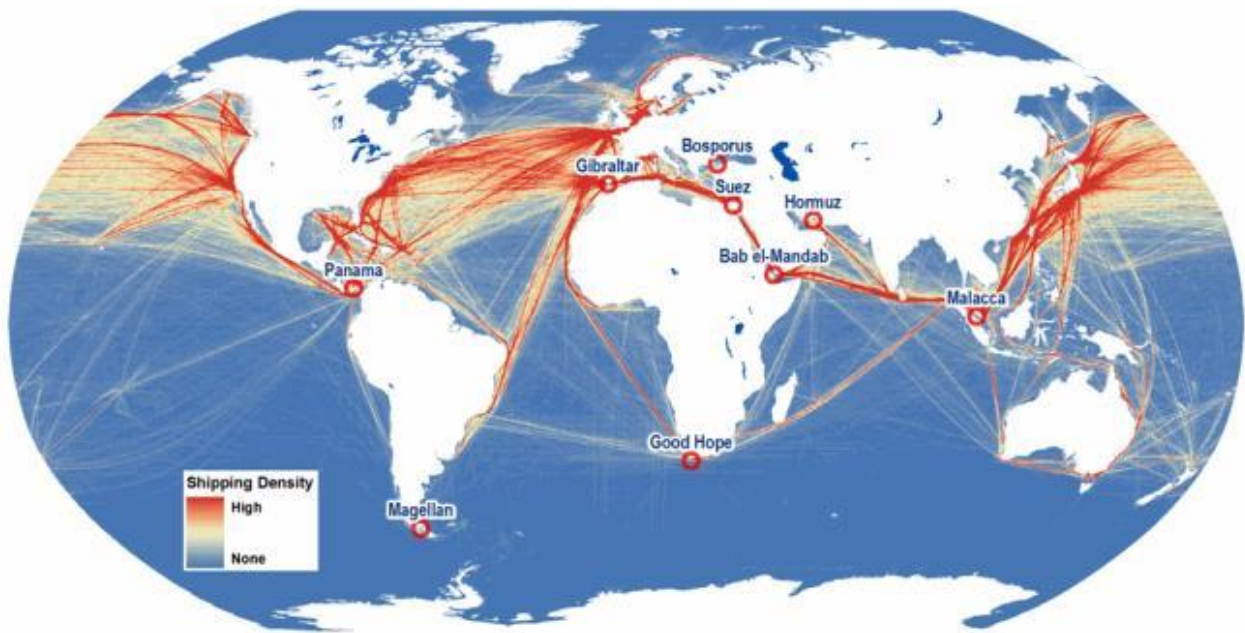


Figure 1: Map of Maritime Routes and Shipping Density [SeaNews, 2015]

Safe and efficient waterborne transport depends inherently upon the infrastructure – ports, waterways, navigation locks, etc. – that supports vessel operations. It is the physical built infrastructure that enables and governs the efficiency of the main logistical operations of the vessels – berthing, loading, unloading and transiting.

A broad definition of waterborne transport also includes passenger and recreation uses, and the International Council of Marine Industry Associations (ICOMIA) reports that recreational boating contributes significantly to world economies. According to ICOMIA's data, there are:

- 100,000 direct companies
- 1 million direct employees
- 30 million recreational boats
- 25,000 marinas
- More than € 45 billion in annual manufacturing turnover, with more than € 20 billion arising in the boatbuilding sector

The popularity of boating around the world remains evident – with:

- 142 million participants in the United States
- 36 million across Europe

- 12 million in Canada
- 5 million in Australia

However, much of the transport infrastructure is in support of freight or commodity movements. Inland freight transportation is often multi-modal, with rail and road modes serving as both complementary and competing alternatives. Shippers speak of the 'first and last mile' of any transport route as ultimately being by trucks on roads.

With world population growing rapidly, the demand for food, energy and consumer goods continues to increase and so does the need for waterborne transport. Waterborne transport has a global reach and offers significant opportunities for economic growth in the industrialised world and Countries in Transition. The facts are [UNCTAD, 2016]:

- World seaborne trade exceeds 10 billion tonnes yearly, and the volume of world merchandise trade continues to grow each year by about 2.5 percent.
- 3.5 billion tonnes of cargo travel through European seaports each year.
- Over 90 % of world trade is carried by the international shipping industry.
- Waterborne transport contributes 4-8 % of GDP and 2-4 % of the labour force in OECD countries.

Decisions regarding investment in transportation infrastructure – for all modes – are increasingly driven by economic, social, environmental or political factors, rather than by pure technical merit.

While all forms of transportation are vital and necessary, no other mode of transportation can match waterborne transport's environmental performance. At a time when policy-makers seek solutions to combat climate change without impacting economic growth, waterborne transport can increase global transport capacity with the lowest environmental impact per tonne transported, both in terms of energy consumption and atmospheric pollution.

According to a 2004 study by the World Business Council for Sustainable Development [WBCSD, 2004], road vehicles accounted for 77.3 % of the total energy consumption in the transport sector worldwide in 2000, vs 11.6 % for air transport and only 9.5 % for waterborne shipping. In 2006, the Stern Review on the Economics of Climate Change noted that waterborne shipping and rail transport produce only 1.75 % of greenhouse gas emissions, compared to 10.5 % for road transport alone. Similarly, the UK Greenhouse Gas Inventory 2006 [Choudrie et al., 2008] showed that despite significant increases in global trade flows between 1990 and 2004, CO₂ emissions from shipping went down 11 % during the same period.

The **challenge** to PIANC is that, as a recognised and respected organisation providing global guidance on waterborne transportation issues since 1885, PIANC has an obligation to bring its skills and expertise to inform sound decision-making on sustainable transport.

The **opportunity** for PIANC is to be a global source of thought leadership on the benefits of waterborne transport, thereby contributing meaningfully to the benefit and protection of society.

The beginning of the 21st century is seeing the implementation of a number of milestone infrastructure projects, including major port expansions across the world, the new lock system for the Panama Canal, and the construction of the Seine-Scheldt inland waterway connection in Europe. The technical recommendations defined and adopted by PIANC play a crucial role throughout the lifecycle of these projects, from the planning and design phases to the actual building and operation.

TG 181's efforts are directed at enlarging the role and effectiveness of PIANC as a source of technical expertise in the sustainable development of waterborne transport infrastructure globally.

3 WATERBORNE TRANSPORT INFRASTRUCTURE WORLDWIDE – A PRIMER

The World Economic Forum's Biennial Global Competitiveness Report assesses the economic competitiveness of over 100 countries worldwide on the basis of twelve criteria or 'pillars' of competitiveness [WEF, 2017]. One of these pillars is the quality of a country's infrastructure that supports its economy. Transportation infrastructure – airports, roads, rail, pipelines, seaports and inland waterways – represents a key component of the infrastructure that drives and supports the economies and competitiveness of countries participating in the global economy.

Research by the McKinsey Global Institute reported in June 2016 [MGI, 2016] that:

- Infrastructure provides a cornerstone for socioeconomic progress
- Infrastructure is a multitrillion-dollar market
- The current trajectory of investment will leave countries around the world facing major gaps
- Despite high-level attention and past commitments, investment rates have declined in many parts of the world
- The G20 economies have widely varying investment patterns and outcomes
- Disruptive technologies will change infrastructure needs in ways we cannot yet quantify

Figure 2 below, taken from the MGI report, presents an overview of global infrastructure investment by country/region and by sector.

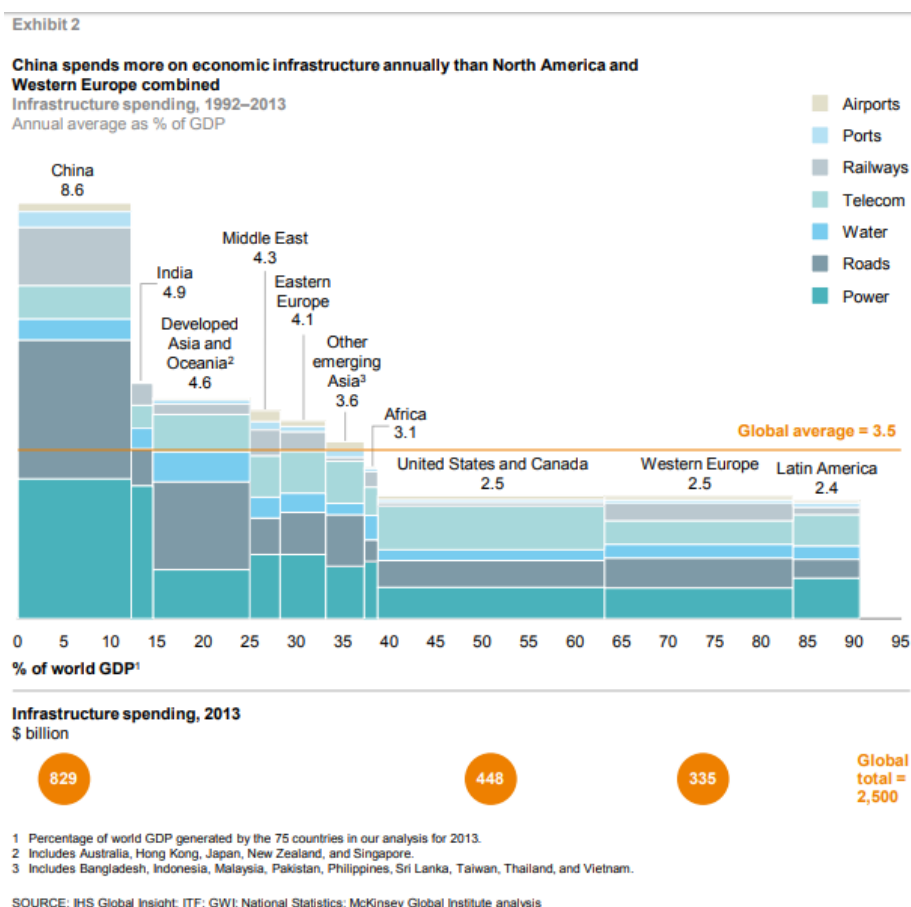


Figure 2: Global Infrastructure Investment as Percent of GDP [MGI, Exhibit 2, June 2016]

Investment in infrastructure, expressed as a percentage of GDP, is highly variable globally. Public sector (government) investment in infrastructure, in general, is globally less than that required to maintain the condition and level of service of existing assets, let alone expand or enhance it. Worldwide, such investment ranges from 2 percent to 8 percent of GDP annually, with Europe and North America at the low end, and China at the high end.

Of the US\$ 2.5 trillion in total annual global investment in economic infrastructure, approximately 46 percent (US\$ 1.15 trillion) is in the transportation sector, including road, rail, airports, seaports, and inland waterways [MGI, Exhibit 1, June 2016].

Investment in waterborne transport infrastructure is not easy or straightforward to break out, but it is a fraction (< 10 %) of the total amount of transport infrastructure spend (Ports = \$ 100M, out of total \$ 1150M; MGI, Exhibit 3, 2016).

Using the US inland waterway system as an example, this 60-year-old (average) system is valued at \$ 238 billion, has a backlog of \$ 140 billion of needed maintenance and refurbishment, yet the annual Federal allocation for operating and maintaining the entire system is less than \$5 billion, wholly inadequate.

The European Commission is fostering a host of transportation initiatives – across all modes – designed to improve economic, environmental, and social performance of the sector within the EU and globally [EC, 2017]. However, the McKinsey research shows that Western Europe infrastructure investment lags the global average – investing at 2.5 % of GDP versus 3.5 %.

The examples of the US and the EU above reinforce the point that most of the infrastructure investment – 60 % – is taking place in the emerging economies of the world, with the US (22 %), Europe (12 %), and Developed Asia (7 %) lagging behind significantly [MGI, Exhibit 4, June 2015].

On the maritime side, the picture is less bleak, because much of the investment in this infrastructure comes from the private sector, particularly private port operators with concessions to operate and maintain new or expanded facilities that enable them to recover such investment through their concession fee from the port authority. However, significant public investment in greenfield port development is occurring in Europe and the Middle East, with public agencies and national governments promoting and facilitating the private sector investment. Three examples are:

- In June 2007, the government of Qatar embarked upon the creation of one of the world's largest greenfield port developments. Strategically located south of Doha, the US\$ 7.4 billion megaproject, which includes a new port, a new base for the Qatar Navy, and the Qatar Economic Zone 3, spans a 26.5 square kilometre area. The port is fully operational as of December 2016 [Doha News, 2016].
- The Port of Rotterdam has expanded its footprint by 20 percent, with the completion of the 2,000 hectares Maasvlakte 2 expansion. At 20 square kilometres, Maasvlakte 2 will be as large as Amsterdam Airport Schiphol or Disneyland Paris. Half of the 2,000 ha will accommodate port infrastructure – seawall, waterways, rail and road access, and port basins. The remaining 1,000 ha will accommodate 'core business': industrial sites. The estimated cost of the entire Maasvlakte 2 project is € 2.9 billion. The Port of Rotterdam is making the Maasvlakte 2 investment at its own expense and risk [Port of Rotterdam, 2017].
- The Panama Canal expansion is a clear driver of change and investment in both maritime and inland facilities designed to capitalise on the benefits of larger vessels transiting the Canal (Figure 3). It also has led one of its chief competitors – the Suez Canal – to invest US\$ 8 billion in enhancements to improve its efficiency in the interests of maintaining its market share [The Guardian, 2015].



Figure 3: New Cocolí Locks at Pacific Entrance of Panama Canal [ACP, 2016]

Beyond the economics of investment, there are other factors and trends driving change in the waterborne transport sector. Examples include:

- Stagnant growth in global GDP is impacting the maritime shipping industry, leading to bankruptcies, divestitures and consolidation of carriers (Hanjin, Maersk)
- The Panama Canal Authority is using their increased revenues from the expanded Canal to fund their diversification strategy, with investments planned in a new container port (Corozal), RO-RO terminal, logistics park, and an LNG terminal; in parallel, they will be moving forward on obtaining additional water supplies to guarantee transits for the new third set of locks and (perhaps) an eventual 4th set
- China is making major investments in its 'New Maritime Silk Road' route through the Indian Ocean to facilitate imports and exports of strategic materials and products (Center for American Progress, 2015)

These are just a few of the myriad activities taking place globally that are impacting waterborne transport and driving change in the associated infrastructure.

The task of TG 181 is to provide perspectives and additional insights into the drivers, challenges, and outcomes of these and other trends impacting waterborne transport infrastructure, with the objective of branding PIANC more holistically as a source of information and knowledge for the broad and diverse group of stakeholders.

4 CHAPTER 4 DATA COLLECTION

Data collection activities were carried out along five main fronts:

- Preparation of PIANC member country profiles, presenting basic socioeconomic, geographic and transport infrastructure data
- 'Inreach' to PIANC technical commissions to obtain input and guidance on the TG 181 work
- Solicitation of objective (data and statistics) and subjective (opinions and perspectives) inputs from each of the 37 PIANC member countries via a 'long-form' questionnaire
- Solicitation of subjective inputs via a 4-question 'short-form' questionnaire
- Collection and compilation of literature, including newspaper, magazine and internet articles, technical publications and conference presentations and proceedings, that informed the TG 181 work

For purposes of organising the data collection and subsequent analysis, TG 181 structured the database around seven (7) world economic regions:

- Africa
- Asia
- Europe
- Middle East
- North America
- Pacific
- South America

Data on waterborne transport infrastructure was then gathered at the country level, with each country mapped to one of the seven regions. The country to region mapping is reflected in the file structure established in the FTP database.

For each country, the following information was solicited:

- Socioeconomics – General statistics defining population, size, economic factors, etc.
- Geography and Transport – Information on the country's existing transport systems, including road, rail and inland and maritime

Data and statistics for waterborne transport infrastructure – navigation locks, inland ports and maritime ports – were solicited with the intent to augment and update two existing PIANC databases:

- The list of locks in PIANC member countries, as presented in the 1986 PIANC 'Final Report of the International Commission for the Study of Locks'
- The Major Projects Database, resident on the PIANC website

A new working group designed to update the 1986 locks report is expected to convene in 2018.

Data for individual countries was supplemented by collection and compilation of published literature, including newspaper, magazine and internet articles, technical publications and conference presentations and proceedings. Over 200 such items were obtained and are posted on the TG 181 FTP site.

4.1 Country Profile Data

4.1.1 Socioeconomics

Each of the 37 PIANC member countries were mapped to the seven geographic regions and country profiles were developed for each country (mainly Europe & the Americas), based on the USA's CIA World Factbook (www.ciaworldfactbook.us). The resulting profiles reside in the FTP database. The country profiles were sent to each respective PIANC member country, along with the long-form questionnaire, for review and validation.

Appendix D provides an example country profile for Japan.

4.1.2 Geography and Transport

The production and consumption of goods and resources are key drivers of any country's economy, with direct implications for competitiveness and sustainability. The transportation of these goods (e.g. manufactured product) and resources (e.g. agricultural or mineral products) is a function of the geography of the country and its investment or exploitation of its geographic setting. For example, in his 2014 book 'The Accidental Superpower', Peter Zeihan argues that the United States' 17,600 miles of navigable waterways – more than the rest of the world combined and concentrated largely within the Mississippi River basin – gives it an outsized advantage in terms of capital generation and low-cost transport of both import and export goods [Zeihan, 2014].

4.2 Inreach to PIANC Technical Commissions

TG 181 leadership met with the Maritime (MarCom), Inland (InCom), Recreation (RecCom), Environment (EnviCom) and Young Professional (YP-Com) Commissions in February 2016. The twofold purpose of these meetings was to inform them of the TG 181 goals and objectives and to obtain their initial feedback on topics of most interest to the Commissions. In preparation for these meetings, TG 181 members carried out a review of each Commission's working group publications for the prior 5 years (2010-2015) and their individual action plans for implementing PIANC's 2014-2018 Strategic Plan.

Input received from each Commission was summarised and presented to ExCom, also in February 2016. Highlights of input received and relevant working groups for each Commission included:

MarCom

- Suggested a two-way approach:
 - Collect and analyse data
 - Identify the main trends and find evidence to support
- MarCom WG 161 – 'Interaction between Offshore Wind Farms and Maritime Navigation'

InCom

- Consider that navigation infrastructure is often part of a multi-purpose system
- InCom WG 129 – 'Asset Management'
- InCom WG 139 – 'Value of Inland Waterways'

RecCom

- Be aware of the complete picture of projects, not just the technical part
- Involve all recreational waterway stakeholders – beyond boaters
- RecCom WG 133 – 'Economic Aspects of Recreational Navigation'

EnviCom

- Who is the target audience, and what is the message?
- UN Sustainable Development Goals as drivers for investment [UNDP, 2015]
- EnviCom WG 178 – 'Climate Change Adaptation for Maritime & Inland Port & Navigation Infrastructure'

YP-Com

- Will start discussions and brainstorming on perspectives among YP's
- Conducted a TG 181 Workshop during the Asian Technical Meeting in Manila, April 2016
- YP-Com will contribute new TG members

These interactions with the Technical Commissions highlighted the value that a more holistic, forward-looking perspective can bring to the Commissions. While the Commissions own their areas of focus and

are best placed to identify a need for a working group to investigate a particular topic, there is benefit from a complementary approach that looks across the Commission boundaries for a broader view. As noted by the MarCom Chair, this perspective can serve as an 'early-warning system' or GPS of trends and forces in the global space for which PIANC should be prepared. Technical working groups convened at the Commission level can then bring these trends and forces into focus, for the benefit of PIANC's members and stakeholders.

Case studies highlighted in Chapters 6 and 7 of this report present some of the emerging trends and best practices that PIANC Technical Commissions might consider for working group topics and charters.

4.3 Questionnaire – Long-Form

A twenty-page, two-part questionnaire was developed as a basis for soliciting input from each of the PIANC member countries. It was reviewed, debated and edited by the TG 181 members, and then 'beta-tested' in Germany and the Netherlands. In February 2016, presentations were made to five technical commissions and to the country secretaries and the full Council to inform them of the TG 181 work and solicit their input and assistance.

The questionnaire was sent out in May 2016 to 20 country sections within PIANC (mostly Europe). There was very little response to this request – either no response or an indication that the section was too busy to complete the questionnaire. Possible reasons for this are:

- Despite having robust waterway networks, individual countries do not appear to have a single, comprehensive, database of current and historical data for their infrastructure; or
- The questions TG 181 is trying to answer have not been asked or answered previously in the context of 'What is the overall state of your infrastructure?' and 'Where are things headed?'; or
- Considerable effort required to collect, assimilate and interpret the available data to convert it to information and, ultimately, knowledge.

Although TG 181 piloted the data questionnaire in Germany and the Netherlands, with refinements and simplifications made as a result, at the end of the day the country sections did not provide the information in sufficient quantity or detail to enable a useful country-level, regional, or global assessment of the 'state and perspectives of waterborne transport infrastructure worldwide'.

Completed long-form questionnaires for France, Germany, Japan, the Netherlands and the United States were ultimately obtained. These completed questionnaires are provided in Appendix E to this report. Completed questionnaires for other countries, as they are obtained, will be posted on the TG 181 FTP site.

4.4 Questionnaire – Short-Form

Recognising the challenges faced with obtaining the detailed data and statistics solicited via the long-form questionnaire, a short-form questionnaire was developed and used to solicit subjective input on the following topics:

1. What new infrastructure is most needed to respond to the evolution of trade and market trends?
2. What emerging trends and technologies are affecting waterborne transport now and in the future?
3. How can project financing, construction, delivery and maintenance be improved?
4. How can waterborne transport infrastructure be designed/adapted in response to climate change and other environmental forces?
5. Other Comments & Inputs

This simplified short-form questionnaire was more successful in terms of gathering input from individual PIANC members and other industry stakeholders at various technical gatherings, including:

- PIANC YPG Asia Workshop (Manila, April 2016)
- PIANC AGA Meeting (Bruges, May 2016)
- ASCE/COPRI Ports 2016 PIANC Breakfast (New Orleans, June 2016)
- PIANC COPEDEC Meeting (Rio de Janeiro, October 2016)
- Other individual industry contacts by TG 181 members

Appendix F provides a summary of the responses received to the short-form questionnaire.

4.5 Literature Survey

TG 181 members have continuously surveyed technical and periodical literature that may have a bearing on the work of the group, and uploaded public-domain documents onto the FTP site. At this juncture, a total of 160 such documents are in the TG 181 library. Many of these documents have been useful in providing country-, region- or global-specific data and statistics. But they have primarily contributed to the identification of emerging trends and technologies, as well as best practices for infrastructure delivery, as described in Chapters 6 and 7 below. The literature has also informed the third-party data analyses presented in Chapter 5 below.

5 DATA ANALYSIS

5.1 PIANC Data Analysis

The data collected via the PIANC internal outreach and the long- and short-form questionnaires was analysed to inform the work of the group in assessing the state and perspectives of waterborne transport infrastructure worldwide. Due to the lack of response, the TG 181 analysis of this data was completed in only a limited number of countries – France, Germany, Japan, the Netherlands and the United States.

The country profile information, coupled with the long-form and short-form questionnaire responses, was analysed to develop country-specific ‘state and perspectives’ narratives. Appendix G provides an example of this narrative for the United States. Completed assessments and narratives for the other four countries are posted on the TG 181 FTP site. These country-level assessments will ultimately roll up and form the basis of a regional assessment for each of the seven geographic regions identified (see Chapter 4 above). The regional assessments will then form the basis of TG 181’s assessment of the global situation.

The questionnaire responses and published literature were analysed to identify emerging trends and technologies that are impacting waterborne transport infrastructure, and to obtain insights into best practices for infrastructure design, financing and construction. These analyses are presented in the form of case studies, in Chapters 6 and 7, respectively. An attempt was made to present case studies for a broad range of topics and over a global geographic footprint, so that a more complete picture of the ‘state and perspectives of waterborne transport’ could be presented.

5.2 Third-Party Data Analysis

TG 181 elected to augment the internal data analysis with relevant third-party data and analyses that could inform the work and intent of the TG 181 charter. Third-party data and analyses were sourced from the literature collected and reviewed by TG 181 members, with the following comparative analyses judged to be of interest:

- Modal Split of Freight Transport – Comparative analysis of the relative contributions of inland and maritime transport of freight versus road and rail
- Competitiveness – Biannual assessment by the World Economic Forum of country competitiveness based on 12 factors
- Sustainability – Annual ranking by [RobecoSAM](#), an investment specialist focused exclusively on sustainability investing, based on environmental, social and governance indicators

5.2.1 Modal Split of Freight Transport

Understanding the challenges and opportunities of waterborne transport requires an appreciation of where and how it relates to other competing or complementary modes. Figure 4 provides an overview of modal split of freight transport for major world economies.

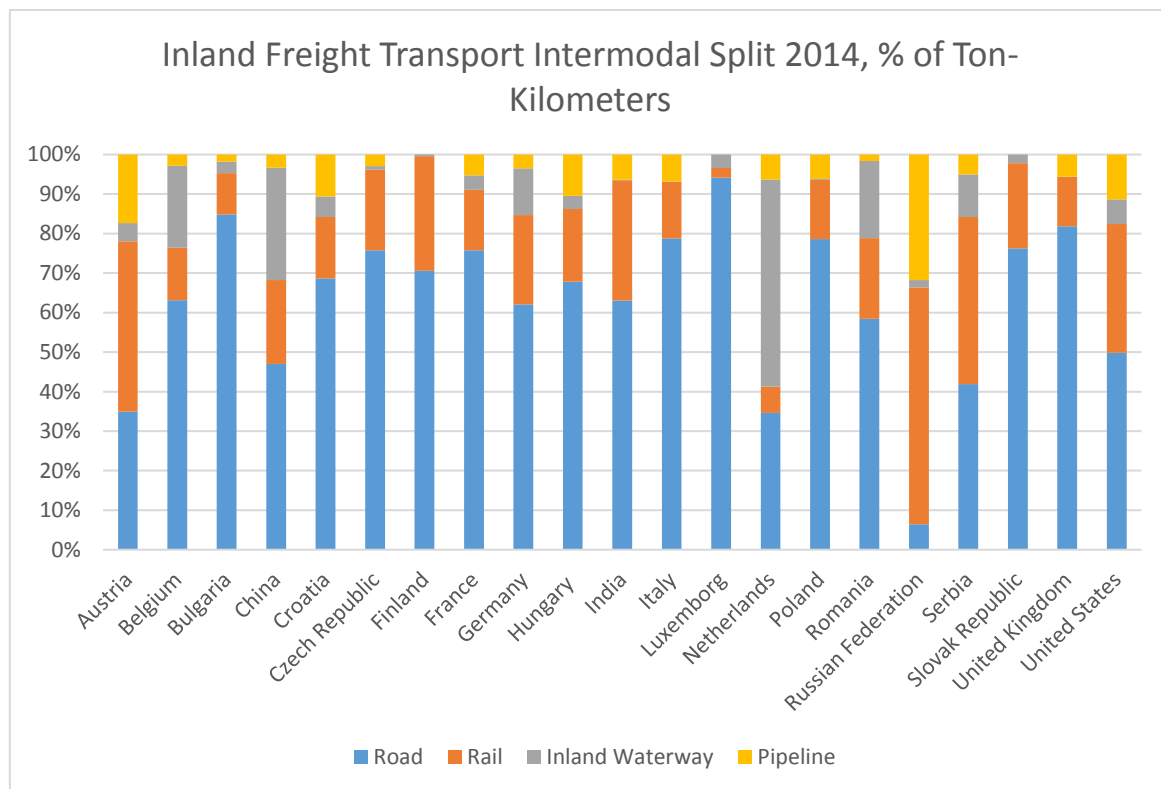


Figure 4: Comparison of Modal Split of Domestic Freight Transport [OECD/ITF, 2017]

The United Nations' Commission on Sustainable Development [United Nations, 2007] notes that "road transport is less energy-efficient and produces more emissions per tonne-kilometre than either rail or inland waterways transport. Therefore, the use of road for freight transport has greater environmental and social impacts, such as pollution, global warming, as well as a higher accident rate, than either rail or inland waterways transport."

See Appendix H for further details and background on the modal split topic.

5.2.2 Competitiveness

The World Economic Forum's 2017-2018 Global Competitiveness Report [WEF, 2017] assessed the economic competitiveness of 138 countries, in three stages of development, against its '12 Pillars of Competitiveness':

1. Institutions (quality of legal & administrative frameworks)
2. Infrastructure (extensive & efficient)
3. Macroeconomic environment (stability)
4. Health and primary education (workforce)
5. Higher education and training (mobility up the value chain)
6. Goods market efficiency (goods/services mix)
7. Labour market efficiency (meritocracy & gender equity)
8. Financial market development (risk awareness, transparency)
9. Technological readiness (agility & capacity to leverage ICT)
10. Market size (both domestic & foreign)
11. Business sophistication (networks & individual companies; clusters)
12. Innovation (technological foremost)

According to WEF, Pillars 1-4 represent 'basic requirements' that are key for factor-driven (Stage 1) economies. Pillars 5-10 represent 'efficiency enhancers' that are important for efficiency-driven (Stage 2) economies. Pillars 11 and 12 are 'innovation & sophistication' factors that define innovation-driven

(Stage 3) economies. However, all 12 pillars are interdependent – weakness in one area can impact others. Countries in different stages of development will tend to focus on different pillars (e.g. France vs. Cambodia).

The WEF then grouped the 138 countries into three stages of development, plus transitions between Stages 1 & 2 and 2 & 3, for a total of 5 categories. Figure 5 below shows the PIANC member countries, plus some others of interest, mapped to these five categories. Most PIANC member countries are innovation driven (Stage 3 – highest level) rather than efficiency-driven (Stage 2) or factor-driven (Stage 1).

While ‘infrastructure’ represents only one of the 12 pillars, and waterborne transport infrastructure is a sub-set of that, there does appear to be a correlation between competitiveness and the extent and efficiency of waterborne transport infrastructure in PIANC member countries (particularly Europe and the US).

	STAGE 1 – FACTOR DRIVEN	TRANSITION 1-2	STAGE 2 – EFFICIENCY DRIVEN	TRANSITION 2-3	STAGE 3 – INNOVATION DRIVEN
PIANC MEMBER COUNTRIES	India (40)	Iran (69), Philippines (56),	Colombia (66), Serbia (78), South Africa (61)	Argentina (92), Estonia (29), Poland (39),	Australia (21), Austria (18), Belgium (20), Denmark (12), Finland (10), France (22), Germany (5), Italy (43), Japan (9), Korea (26), Netherlands (4), Norway (11), Portugal (42), Spain (34), Sweden (7), Switzerland (1), UK (8), USA (2)
PIANC QUALIFYING MEMBERS		Morocco (71), Vietnam (55), Romania (68)	China (27), Indonesia (36)	Brazil (80), Czech Republic (31), Panama (50)	Canada (14), Iceland (28), Monaco (N/A), Singapore (3)
NON-PIANC COUNTRIES	Nicaragua (63)	Saudi Arabia (30), Sri Lanka (85)	Egypt (100)	Russia (38), Turkey (53)	Hong Kong (6), Luxembourg (19), Malaysia (23), New Zealand (13), Qatar (25), Taiwan (15), UAE (17)

Figure 5: PIANC Countries (Score) Against World Economic Forum’s Competitiveness Index
(1 = most competitive & 118 = least competitive) [WEF, 2017]

5.2.3 Sustainability

Investment advisor RobecoSAM (www.robecosam.com) monitors the sustainability performance of 22 developed and 40 emerging countries, as a basis for assessing investment risk.

The country sustainability score is based on 17 environmental, social and governance (ESG) indicators tied to the UN’s sustainable development goals. Each indicator receives a weight of 15 % (environmental), 25 % (social) and 60 % (governance) of the total score. The resulting country score, ranging from 1 to 10 with the highest grade being 10 and the lowest 1, provides a comparison on the basis of ESG indicators that are considered to be relevant for investors.

Their most recent ranking (October 2017) is provided in Figure 6 on the next page.

The Country Sustainability Ranking is updated semi-annually. Insights from ranking are then incorporated into the investment process for Robeco's Government Bond Strategies, and are used to determine the country weights in the S&P ESG Sovereign Bond Index Family.

As of October 2017

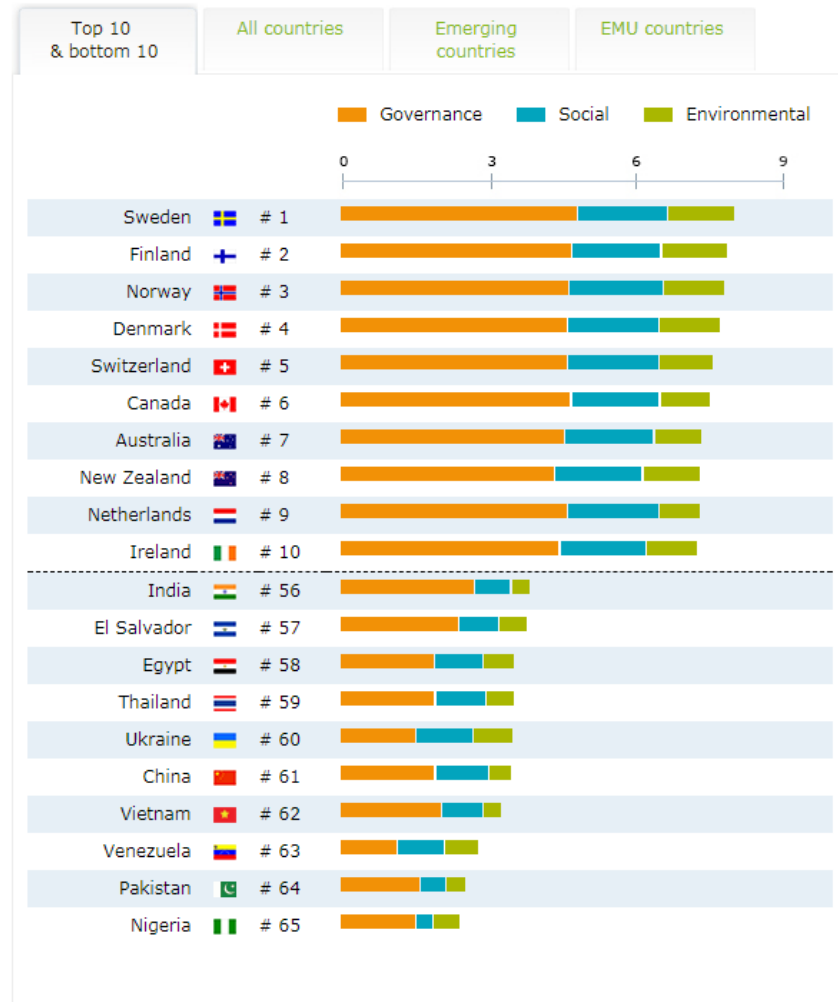


Figure 6: Country Sustainability Ranking [RobecoSAM, October 2017]

Note that the PIANC member countries tend to occupy the higher rankings.

6 EMERGING TRENDS AND TECHNOLOGIES

TG 181 collected and reviewed published literature in order to identify emerging trends and technologies that are impacting waterborne transport infrastructure, directly or indirectly.

6.1 Case Studies

An initial list of 15 topics, organised under 4 categories, was developed. Some topics were suggested by respondents to the short-form questionnaire, while others were developed by TG 181 members:

Vessels and Vessel Operation

- 6.1 Container Ship Size
- 6.2 Slow Steaming/LNG Fuelling/Clean Engines
- 6.3 Autonomous Vessels
- 6.4 Shipping Alliances
- 6.5 Container on Barge

Infrastructure

- 6.6 Intermodal Connectivity
- 6.7 China Belt and Road Initiative
- 6.8 Port Automation

Business Models/Drivers

- 6.9 Port Alliances
- 6.10 Blockchain Technology
- 6.11 Globalisation
- 6.12 Fourth Industrial Revolution

Environmental & Social

- 6.13 Green Ports
- 6.14 Arctic Navigation
- 6.15 Resilience and Anti-Fragility

Each of the identified topics was elaborated in a case study to illustrate its impact on waterborne transport infrastructure. Emerging trend case studies are provided in Appendix I to this report.

6.2 Assessment

The above case studies illustrate some of the trends in the local, regional and global transportation industry that are impacting waterborne transport infrastructure. While the full extent of these impacts may not yet be known, they are indicative of influences and factors of which PIANC, its partners and other stakeholders should be aware.

Relevant trends and infrastructure responses for US waterborne transport infrastructure are:

- The Panama Canal expansion is driving investment in East Coast ports to handle 50-ft draft container vessels – both on the waterside (deepening) and on-dock (larger container cranes)
- Environmental policy, as well as improved economics for renewable alternatives, is reducing US power producer demand for coal, with a corresponding reduction in inland waterway transport of coal
- Inland ports and waterway operators are progressing the use of container-on-barge as a means of capturing market share from rail and truck modes
- Public investment in the rehabilitation and refurbishment of the aging locks and dams continues to lag that required to restore the reliability and efficiency of the system

7 BEST PRACTICES FOR INFRASTRUCTURE DELIVERY- DESIGN, FINANCING AND CONSTRUCTION

7.1 Infrastructure Delivery

The challenges of infrastructure delivery are well-known and universal, encompassing economic, environmental and institutional aspects. Constraints in all three categories have, to some degree, led to the current situation of under-investment in infrastructure globally (see Figure 2 above). Different approaches to delivery have evolved in response to specific local conditions and the type of infrastructure. While sustainable infrastructure development must satisfy all three aspects, its success or failure often derives from a combination of economic and institutional factors. In the transportation sector in particular, public institutions (i.e. departments of transportation at local, state and federal levels) are often the prime movers for investment in new facilities, or rehabilitation of existing facilities. Yet they work within legal and financial constraints that define how the risks and rewards of road, rail or waterway infrastructure delivery are apportioned. Figure 7 below shows the range of options available within the US, for example, for managing delivery risks and rewards [ASCE/COPRI, 2017].



Figure 7: Spectrum of Infrastructure Delivery Options [ASCE/COPRI, 2017]

Under a 'traditional' delivery approach, public entities take the lead in financing the creation of the asset, as well as its life-cycle management. At the opposite extreme, 'privatisation', such as a concession or divestiture approach, gives primacy to the private sector for asset creation and management. Hybrid mechanisms – in the form of public-private partnerships – are also employed. In the end, however, it is the beneficiary or end-user who pays, whether through taxes (often on fuel for road infrastructure) or user fees (tolls paid to either public or private toll authorities).

The ASCE/COPRI work (2017) focused on chronic underinvestment in waterborne transport infrastructure in the US, highlighting the need for a new model that addresses comprehensive infrastructure delivery and management across the full life cycle. The task committee also examined the applicability of alternative finance and delivery to water resource activities within the U.S. Army Corps of Engineers (USACE) civil works programme. Recommendations were made for policy changes that would better leverage private capital in the financing of public infrastructure (ports and navigation locks).

The Canal Seine-Nord Europe is a priority European Union transportation link (part of the TEN-T program) to improve the connection between the Seine River in northeast France and the Belgian canal network leading to the Maas (Rhine) River and Central Europe. The 108-km waterway, including five locks and a 1.2-km long aqueduct, is currently configured as a € 3.3 billion public investment of the EU, the Federal government of France and the regional Picardy government. An earlier incarnation of the project, mooted in 2008, was programmed as a DBFM (design-build-finance-maintain) delivery, with private finance. However, the risk premium demanded by the private investors at that time made the project too expensive for the owner – VNF (Voies Navigable de France) – to proceed. The project was reconfigured to reduce its cost and re-programmed into the current, lower-cost, public investment scheme.

Maritime port investments are being made worldwide, in anticipation of, and in response to, the recent expansion of the Panama Canal. From the East Coast of the US (New York/New Jersey, Charleston, Savannah, and Miami), northern Europe (Rotterdam and Antwerp), the Middle East (Dubai UAE and

Doha Qatar), to south Asia (China's Maritime Silk Road), major port expansions are taking place to reduce costs and increase efficiency of operation for the larger Neo-Panamax (14,000 TEU) vessels transiting the Canal. The economics of these expansions varies, but most are a form of public-private partnership, with the public entity or 'landlord' of the port providing concession opportunities to specialised port operators who will invest in the expansion at risk, and take their return as operations fees for a specified time period.

7.2 Institutional and Legal Frameworks

The WEF's first pillar of competitiveness is the strength of a country's institutional and legal frameworks. Strong frameworks facilitate and promote both public sector and private investment in infrastructure. Most innovation-driven economies and, as shown above in Figure 5, most PIANC member countries have solid, transparent institutions and legal protections. However, there can be significant variations, particularly in the near-term, in political will to invest public resources for infrastructure investment. As PIANC directs its focus to potential members from factor-driven or efficiency-driven economies, we would do well to understand and appreciate the constraints imposed by weak institutions.

7.3 Key Roles and Responsibilities

Infrastructure delivery requires co-operation from many different participants, with different drivers and measures of success, whose objectives must align. Successful projects are configured in recognition of this fact. A brief summary of key roles and responsibilities of these participants follows.

- **Owner/Financier** – Often the same entity for a publicly-financed project, has authority and responsibility for creating new assets and managing existing assets. Examples might be the US Army Corps of Engineers, Rijkswaterstaat, etc.; key responsibility as owner is to assume and manage the legal, financial, social and environmental aspects of project delivery; under a design-build-finance-maintain (DBFM) model, the design-build entity also brings the financing and garners its return on the investment from a maintenance payment over the project life-cycle.
- **Designer/Engineer** – Can serve different roles, depending upon the delivery mechanism; often the Owner's Engineer for conventional design-bid-build delivery, or for design-build or DBFM; can also serve as the designer on a design-build or DBFM team; key responsibility is to assure public safety and project performance in accordance with the owner's technical requirements.
- **Contractor/Builder** – Responsible for constructing the works in accordance with the owner's requirements and specifications; in a design-bid-build model, implements the works as prescribed by the designer; under a design-build model, often has flexibility to deliver works that meet a specified performance objective, with fewer restraints on how the objective is met, but often takes on the schedule risk transferred from the owner.
- **Operator/End User** – In a design-bid-build or design-build scheme, the owner is often the operator and end user as well; under a design-build-operate (DBO) model, the owner retains ownership of the asset, but transfers operational responsibility to the design-builder; in many cases for maritime ports, a contract operator is retained to operate and maintain the constructed facility and pays a concession fee back to the owner.

A selection of case studies to illustrate these different delivery models, as well as the roles and responsibilities of the participants, has been developed.

7.4 Case Studies

TG 181 collected and reviewed published literature in order to identify examples of best practices that are being used to deliver waterborne transport infrastructure.

An initial list of 8 examples was developed:

Inland

- 7.1 P3 Pilot Project, USA
- 7.2 Canal Seine-Nord Europe, France
- 7.3 America's Central Port, USA
- 7.4 Ganga Waterway, India
- 7.5 IJmuiden Lock Expansion, the Netherlands

Maritime

- 7.6 Port of Doha, Qatar
- 7.7 Port of Miami, USA
- 7.8 Suez Canal Expansion, Egypt
- 7.9 Stad Ship Tunnel, Norway
- 7.10 Panama Canal Expansion, Panama

8 PARTNERS AND STAKEHOLDERS

The TG 181 scope addresses a dynamic topic. The state of waterborne transport infrastructure is ever-changing and evolving in response to local, regional, and global market stressors. Our findings indicate the need for more dialogue rather than more data. Because the market stressors impacting our sector extend beyond purely technical or economic considerations, a robust, continuing dialogue within PIANC, as well as with outside parties, is vital.

Waterborne transport is unique in that it sits at the confluence of two worlds – the transport world, and the water resources world (see Figure 8 below). And often waterborne transport struggles to compete in both of these worlds. Inland waterway transport in particular is a small but important mode of transport in many countries throughout the world. It is also a water use which at times competes with other uses, such as hydropower, municipal and industrial water supply, irrigation and recreation. And it impacts and interacts with environmental and ecosystem needs.

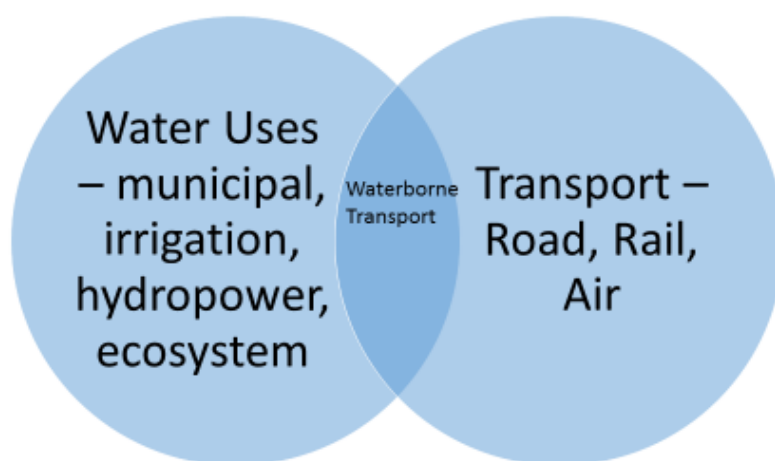


Figure 8: Waterborne Transport's Unique Position in the Infrastructure Space [TG 181, 2017]

In addition to the activities and relationships mentioned above, PIANC is cooperating more broadly with organisations whose missions may be tangential to PIANC's but where common interests still exist. An example is the participation of PIANC in the World Water Council's 7th World Water Forum in 2015.

Appendix K provides a presentation given by PIANC representatives at the 2015 WWF Congress in Daegu, Korea.

8.1 PIANC Sister Organisations

PIANC currently has eleven Sister Organisations (per the Website):

- IAPH – International Association of Ports and Harbors
- CCNR – Central Commission for Navigation on the Rhine
- ICOMIA – International Council of Marine Industry Associations
- IALA – International Association of Lighthouse Authorities
- TYHA – The Yacht Harbor Association
- IHMA – International Harbour Masters Association
- IAHR – International Association for Hydro-Environment Engineering and Research
- IMPA – International Maritime Pilots Association
- GMI – Global Marina Institute
- MedCruise – Association of Mediterranean Cruise Ports
- IADC – International Association of Dredging Companies

It is noted that there is no information on the PIANC website regarding joint activities or co-ordination with these entities.

8.2 PIANC Technical Commission Partners

As part of their Action Plans to implement the 2014-2018 PIANC strategy, Technical Commissions have identified strategic partnerships as follows:

MarCom

- IAPH, CIRIA, ICHCA

RecCom

- ICOMIA Marinas Group (IMG)

EnviCom

- Global – COPEDEC, IADC, IAPH, IMO, UNEP, UNESCO, World Water Forum
- Regional, Europe – CCNR, CEDA, ESPO, EU Com, EUDA, HelCom, INE, OSPAR, Paralia, SedNet
- Regional, US – COPRI, WEDA

While many of these organisations are PIANC sister organisations, several are not, and so should be considered for inclusion on that list.

8.3 US Section Partners

The US Section of PIANC has partnered with four organisations:

- American Society of Civil Engineers – Coasts, Oceans, Ports and Rivers Institute (COPRI)
- American Association of Port Authorities (AAPA)
- Organisation of American States – Inter-American Committee on Ports (OAS-CIP)
- Inland Rivers, Ports and Terminals, Inc. (IRPT)

Memoranda of Understanding have been signed with several of these entities to define the partnering relationship and promote joint sponsorship of conferences and other outreach and educational activities. These partnerships have been beneficial in promoting waterborne transport infrastructure in the US and the Americas.

8.4 Other Transportation Entities – Potential Partners

Other associations and organisations with which PIANC might consider engaging include:

8.4.1 AASHTO – American Association of State Highway Transportation Officials

AASHTO “...is a nonprofit, nonpartisan association representing highway and transportation departments in the 50 states, the District of Columbia and Puerto Rico. It represents all five transportation modes: air, highways, public transportation, rail, and water. Its primary goal is to foster the development, operation, and maintenance of an integrated national transportation system. AASHTO works to educate the public and key decision makers about the critical role that transportation plays in securing a good quality of life and sound economy for our nation. AASHTO serves as a liaison between state departments of transportation and the Federal government. AASHTO is an international leader in setting technical standards for all phases of highway system development. Standards are issued for design, construction of highways and bridges, materials, and many other technical areas.”
<https://www.transportation.org>

8.4.2 AAR – Association of American Railroads

“America’s freight railroads operate the safest, most efficient, cost-effective, and environmentally sound freight transportation system in the world — and the Association of American Railroads (AAR) is committed to keeping it that way. Founded in 1934, AAR is the world’s leading railroad policy, research, standard setting, and technology organisation that focuses on the safety and productivity of the U.S. freight rail industry. AAR full members include the major freight railroads in the United States, Canada and Mexico, as well as Amtrak. Associate members include non-Class I and commuter railroads, rail supply companies, engineering firms, signal and communications firms, and rail car owners.” <https://www.aar.org>

8.4.3 FIB – International Federation for Structural Concrete

FIB is a “not-for-profit association formed by 45 national member groups and approximately 1000 corporate and individual members.” FIB’s mission is to “develop at an international level the study of scientific and practical matters capable of advancing the technical, economic, aesthetic and environmental performance of concrete construction.” FIB has permanent commissions that focus on Marine Structures, Durability and Concrete Floating Structures, all of which are related to PIANC’s field of interest. <https://www.fib-international.org/>

8.4.4 ICOLD – International Commission on Large Dams

ICOLD is a “non-governmental International Organisation which provides a forum for the exchange of knowledge and experience in dam engineering. The Organisation leads the profession in ensuring that dams are built safely, efficiently, economically, and without detrimental effects on the environment. ICOLD’s mission is to lead the “profession in setting standards and guidelines to ensure that dams are built and operated safely, efficiently, economically, and are environmentally sustainable and socially equitable”, to be the “world’s leading professional organisation, dedicated to advancing the art and science of dam engineering and promoting the wise and sustainable development and management of world’s water and hydropower resources”, and to assist “nations to prepare to meet the challenges of the 21st century in the development and management of the world’s water and hydropower resources.” <http://www.icold-cigb.net/>

8.4.5 ITF – International Transport Forum

“The International Transport Forum at the OECD is an intergovernmental organisation with 59 member countries. It acts as a think tank for transport policy and organises the Annual Summit of transport ministers. ITF is the only global body that covers all transport modes. The ITF is administratively integrated with the OECD, yet politically autonomous. The ITF works for transport policies that improve peoples’ lives.” ITF’s mission is to “foster a deeper understanding of the role of transport in economic growth, environmental sustainability and social inclusion and to raise the public profile of transport policy.” ITF organises “global dialogue for better transport.” ITF also acts “as a platform for discussion and pre-negotiation of policy issues across all transport modes” and “analyse trends, share knowledge and promote exchange among transport decision-makers and civil society.” ITF’s Annual Summit is the “world’s largest gathering of transport ministers and the leading global platform for dialogue on transport policy.” <https://www.itf-oecd.org>

8.4.6 *Union Internationale de Chemins de fer (UIC)*, International Union of Railways

The mission of UIC, the Worldwide Railway Organisation, “is to: promote rail transport at the world level with the objective of optimally meeting current and future challenges of mobility and sustainable development; promote interoperability and, as a standard-setting organisation, create new world IRSs (International Railway Solutions) for railways, including common solutions with other transport modes; develop and facilitate all forms of international cooperation among members; facilitate the sharing of best practices (benchmarking); support members in their efforts to develop new business and new areas of activities; and propose new ways to improve technical and environmental performance of rail transport, improve competitiveness, reduce costs.” <https://uic.org>

8.4.7 PIARC – World Road Association

“The World Road Association is a non-profit association established more than 100 years ago to promote international cooperation on issues pertaining to roads and road transportation. It consists of a wide range of members from every part of the globe. The core members are road agencies representing over 120 countries.” PIARC’s mission is to serve all its members by “being a leading international forum for analysis and discussion of the full spectrum of transport issues related to roads and related transport; identifying, developing, and disseminating best practice and giving better access to international information; fully considering within its activities the needs of developing countries and countries in transition; and designing, producing, and promoting efficient tools for decision making on matters related to roads and related transport.” <https://www.piarc.org/en/>

8.4.8 TRB – Transportation Research Board

TRB is US organisation that “provides innovative, research-based solutions to improve transportation. TRB is a program unit of the National Academy of Sciences, Engineering and Medicine, a non-profit organisation that provides independent, objective, and interdisciplinary solutions. TRB manages transportation research by producing publications and online resources. It convenes experts that help to develop solutions to problems and issues facing transportation professionals. TRB also provides advice through its policy studies that tackle complex and often controversial issues of national significance.” www.trb.org

8.5 Building Stronger Relationships

Stronger relationships and more active engagement with PIANC’s Sister Organisations and Partners are needed and would strengthen PIANC itself. Memorandums of Understanding (MoUs) and partnership agreements are helpful – they lay the groundwork for collaboration and co-operation, but real engagement takes constant effort.

It is noted that most of the current sister organisations and partners fall in the waterborne transport arena. PIANC would benefit greatly by reaching out farther, to organisations that deal with transportation as a whole and even those that focus on specific modes like rail and road.

Engagement would be enhanced by taking specific actions, such as inviting representatives from these organisations to be keynote speakers at major PIANC conferences and congresses, inviting them to serve on ‘intermodal’ panel discussions at AGAs, and holding PIANC seminars or events in conjunction with the meetings or conferences held by these organisations, to promote interaction and networking among members of both organisations.

9 FINDINGS AND RECOMMENDATIONS

9.1 Key Findings

- **Finding 1 – *Intermodal connectivity*** to maritime and inland ports is a global challenge. Waterborne transport inevitably links to ‘first mile/last mile’ (road) and other intermediate transport (rail) modes. Intermodal connectivity is a challenge for both maritime and inland ports. PIANC’s Inland and Maritime Commissions have a shared interest, and so could also share resources to better address this industry need.
- **Finding 2 –** A wide range of project finance and delivery mechanisms are deployed globally for infrastructure construction and life extension. Transportation infrastructure is often publicly funded or subsidised to attract private finance. However, despite demonstrated economic and environmental advantages, ***funding for waterborne transport infrastructure lags*** significantly behind that of alternative, competing, yet complementary, modes of road and rail. PIANC has a role to play in documenting successful financing and delivery strategies that can be more widely employed to improve waterborne transport infrastructure development worldwide, so TG 181 has tried to shed more light on this fundamental challenge to the industry. Before we seek to speak authoritatively to external stakeholders on this topic, we have a need and obligation to discuss and debate it internally first.
- **Finding 3 –** PIANC’s concentration of membership in Europe and North America – largely ‘innovation-driven’ economies – coupled with the growth and investment in ‘factor-driven’ and ‘efficiency-driven’ economies, means that our ***CoCom and COPEDEC initiatives are mission-critical*** if PIANC is to expand its leadership role in the sector. Although PIANC recognises this and has initiatives via CoCom and COPEDEC directed at engaging with these regions, we have not added a significant number of new members from these regions. It may be that the financial and institutional requirements of joining PIANC are too high for these countries. Different approaches are needed.
- **Finding 4 –** Critical success factors to enhancing waterborne transport infrastructure are broader than and do not necessarily align with, PIANC’s technical commissions, nor is the topic a static one, pointing to the need for a ***cross-cutting, ongoing dialogue within PIANC and with a larger external stakeholder group*** to inform, communicate, and achieve PIANC’s vision, mission and goals. PIANC Sister Organisations are largely other waterborne-transport focused entities. Decisions to invest in such infrastructure are made by stakeholders that go far beyond this limited group. We can benefit by more and broader outreach to other entities. The list of stakeholders identified by EnviCom in their 2014-2018 Strategic Plan and in Chapter 8 of this report is a good start.
- **Finding 5 –** It is not unreasonable to expect that PIANC member country sections will have access to data and statistics concerning their waterborne transport infrastructure. They should also know how it relates to other, competing forms of freight transport (road, rail and pipeline). Likewise, they should be able to report on major infrastructure needs and investments of the country. Yet, TG 181 found it very difficult to obtain this information from the National Sections and, as a result, did not achieve its overarching goal of reporting on the ‘state and perspectives of waterborne transport infrastructure worldwide’. However, we were able to produce a number of work products that can serve as a ‘toolkit’ for continued efforts by country sections to build on TG 181’s work. Compiling and reporting such data and information is fundamental to achieving our strategic plan external goal #1 – *Achieve worldwide credibility and recognition of PIANC engineering, economic and environmental contributions to the development of sustainable waterborne transport infrastructure.*
- **Finding 6 –** It will be useful – both internally for PIANC and externally for our industry stakeholders – to have a continuing practice of identifying and observing emerging trends and technologies that

are impacting our space. This could be the responsibility of a Permanent Task Group, or ProCom, or a Headquarters staff person, and then reported in the AGA or the PIANC Yearbook.

- In short, TG 181 has identified strengths of PIANC and opportunities to deploy our resources to be more relevant and impactful in global development, which relies so heavily on our waterborne transport infrastructure.

9.2 Recommendations

Although TG 181 did not completely achieve its stated goals, it has identified opportunities for PIANC to do more to promote waterborne transport and the health of its infrastructure. PIANC's ongoing technical contributions fulfil an important niche, but market forces require broader thinking and stakeholder engagement on such a dynamic topic. These broader interests present both a challenge and an opportunity to PIANC.

- **Recommendation 1** – Form a joint InCom/MarCom ***intermodal connectivity working group***, with representatives from road and rail transport sectors on addition to IAPH and other sister Associations, to investigate measures to improve road and rail connectivity to inland and maritime ports. This will help us better achieve external strategic goal #2 – *Disseminate and transfer its expertise to the relevant decision making bodies, to the private sector involved, to the specialised press as well as to the interested trainees.*
- **Recommendation 2** – Allocate a one-hour session at each Annual General Assembly for a panel discussion of current topics related to the 'state and perspectives of waterborne transport infrastructure'. With such panels a part of the standing AGA agenda, we can maintain an ongoing dialogue to keep participants abreast of important developments in waterborne transport on a going-forward basis. Example topics can be drawn from the case studies presented in Chapters 6 and 7 above.

The 2017 Cairns, Australia AGA hosted the inaugural TG 181 panel designed to communicate directly with delegates and attendees on timely topics of both global and regional interest. These included:

- Australia's focus on improved intermodal rail connections to its major seaports (regional topic)
- The challenges of adequately funding the US inland and maritime systems O&M and capital replacement needs (global)
- Best practices for obtaining multi-lateral bank financing, as implemented for the Panama Canal expansion (global)
- Stakeholder co-operation and alignment to safely accommodate the upsurge in waterborne transport of petroleum products on the US inland waterway system driven by the 'fracking boom' (global)
- Major factors and trends that are impacting the waterborne transport sector and what PIANC can or should be doing to shape or cope with these

Appendix L provides a summary of the panellist presentations and audience contributions to the Cairns dialogue. It has been suggested that a panel focused on ***project finance and delivery*** be convened at the 2018 AGA in Panama.

These panel discussions can also be a vehicle for scoping and organizing regional events, pursuant to the strategic plan internal strategic goal # 4 – *Enhance the vitality of Qualifying Members and National Sections, e.g. by organising regional events.*

TG 181 also recommends that PIANC consider creating a Working Group to investigate and report on global best practices for project finance and delivery.

- **Recommendation 3** – Enhance focus on expanding PIANC membership to lesser-developed nations by investing further and implementing new approaches/strategies in our **CoCom and COPEDEC initiatives**. YP-Com should be engaged to help implement this recommendation, in line with our internal strategic goal # 5 – *Continue to give special attention to Young Professionals and Countries in Transition*.
- **Recommendation 4** – Charge ProCom with developing and implementing a plan for engagement with PIANC sister agencies and other stakeholders to open a **cross-cutting, ongoing dialogue within PIANC and with a larger stakeholder group** to promote PIANC as the leading authority on waterborne transport infrastructure. As part of this, they should review existing co-operation MoUs and identify where we are truly taking advantage of them to expand our reach. Co-operation with sister associations at a regional level could also bring additional benefits. In addition, we should consider adding new partners that go beyond the current crop. This is in line with our external strategic goal #4 – *Co-operate with international organisations through the existing agreements and/or mutual representation*. It is also conducive to achieving our internal strategic goal # 1 – *Increase all kinds of membership, including the target countries approach*.
- **Recommendation 5** – Prepare and distribute a ‘state and perspectives’ toolkit for use by each PIANC member country section to prepare a high-level, qualitative assessment of the ‘state and perspectives of waterborne transport infrastructure’ in their country. The toolkit would include the following templates:
 - Country geographic, demographic and economic profile
 - Transportation infrastructure asset database (road, rail, ports and waterways)
 - Short-form questionnaire on emerging trends and project delivery
 - Case study templates for emerging trends and project delivery approaches
 - Country narrative summarising the state of waterborne transport for public relations

The toolkit will also be useful for engaging with new member countries from emerging markets.

With a current database of waterborne transport data, statistics, competitive landscape with other modes, and infrastructure needs and investments, PIANC can readily communicate to media and stakeholder interests in each country, region or globally. This is fundamental to fulfilling PIANC’s stated vision: ***To be the leading international source of knowledge on waterborne transport infrastructure.***

The toolkit is available and provided under separate cover.

- **Recommendation 6** – Assign a PIANC resource to monitor and conduct ‘Technological Surveillance’ related to emerging trends and technologies. This should be reported periodically, at least annually, in the form of an AGA panel or published in the Yearbook.

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APPENDIX A

33rd PIANC WORLD CONGRESS RESOLUTION SAN FRANCISCO, CALIFORNIA 31 MAY 2014

Whereas:

- Waterborne transport infrastructure (for commercial and recreational purposes) supports the lifeblood of international trade and is basic to the functioning of the global economy;
- Around 80 percent of global trade is carried by sea and handled at ports [UNCTAD\RMT, 2013];
- PIANC has been providing global guidance on waterborne transportation issues since 1885;
- Investment in waterborne transport infrastructure supports stable and secure nations and communities, and stimulates economic development and growth;
- Environmentally-friendly, resilient and sustainable inland and maritime infrastructure investment and management is essential for human health and the well-being of communities;
- Use of alternative fuels and new technologies related to the construction, operation, and maintenance of waterborne transport infrastructure have the potential to transform the industry;
- Technological advances in ship design and port operations and the constant introduction of larger and more efficient vessels to the world fleet increase the demand for port infrastructure modernisation and expansions;
- Waterborne transport infrastructure faces the triple challenges of increasing needs, a changing climate, and limited funding; and
- Globalisation, new technologies, scarcity of nature areas, uncertain economic trends, increased government regulations and growing sector competitiveness are constantly influencing international shipping services and port systems [UNCTAD\TDR, 2013].

Therefore, The PIANC General Assembly resolves to form a task force on the State and Perspectives of Waterborne Transport Infrastructure Worldwide.

The goal is to create a worldwide inventory of the needs and their funding for the waterborne transport infrastructure in the coming years for the benefit and protection of society.

It is proposed to undertake the following actions:

- 1) investigate ongoing and emerging trends, technologies and new business models for the development of waterborne transport infrastructure which are both sustainable and efficient.
- 2) gather relevant information about the needs for new or existing waterborne transport infrastructure and comparable data about investment and maintenance costs of waterborne transport infrastructure by various nations, considering for instance the investment levels compared with other transport infrastructure investments, the ratio between investment level and GDP, and build a suitable method to collect and describe this information after having tested the proper way to proceed in a limited number of countries.

APPENDIX B

TERMS OF REFERENCE PIANC TASK GROUP – TG 181 THE STATE AND PERSPECTIVES OF WATERBORNE TRANSPORT INFRASTRUCTURE WORLDWIDE

Background

At the 33rd PIANC World Congress in San Francisco, 31 May 2014, the Annual General Assembly passed a resolution to form a task group on the 'State and Perspectives of Waterborne Transport Infrastructure Worldwide'. Observations which led to this resolution included:

- Waterborne transport infrastructure is the lifeblood of international trade and is basic to the functioning of the global economy;
- PIANC has been providing global guidance on waterborne transportation issues since 1885;
- Investment in waterborne transport infrastructure supports stable and secure nations and communities, and stimulates economic development and growth;
- Environmentally-friendly and sustainable inland and maritime infrastructure investment and management is essential for the well-being of communities;
- Major projects with worldwide impacts such as the expansion of the Panama Canal, are underway and will be completed soon, resulting in changing trade patterns;
- Use of alternative fuels and new technologies related to the construction, operation, and maintenance of waterborne transport infrastructure have the potential to transform the industry;
- Technological advances in ship design and port operations and the constant introduction of larger and more efficient vessels to the world fleet increase the demand for port infrastructure modernisation and expansions; and
- Waterborne transport infrastructure faces the triple challenges of increasing needs, a changing climate, and limited funding.

Objectives

The objectives of the Task Group will be to:

- 1) Gather relevant information about the needs for new or existing waterborne infrastructure and comparable data about investment and maintenance costs of waterborne transport infrastructure by various nations, considering for instance the investment levels compared with other transport infrastructure investments, the ratio between investment level and GDP, and build a suitable method to collect and describe this information after having tested the proper way to proceed in a limited number of countries; and
- 2) Investigate emerging trends and new technologies affecting the development of waterborne transport infrastructure.

Matters to be Investigated

The task group will collect, on a worldwide basis, for each nation, the latest data along with historical trends where available, on waterborne transport infrastructure. This includes:

- Basic information on the inland waterways in each country, such as navigable length, depth, numbers of locks, etc.
- Basic information on the maritime ports and channels in each country, including capacity, depth, etc.
- Information on the condition and performance of both inland and maritime water transport infrastructure
- Information on historical and current investment in both inland and maritime water transport infrastructure in each country, including both capital spending and operations and maintenance spending.
- Information on the current and future investment needs for both inland waterways and maritime infrastructure in each country.

The task group will report on the findings from the above investigation, especially the comparability of the information collected.

The task group will investigate and report on ways to improve the waterborne transport infrastructure delivery system. This includes how to prioritise project selection, streamline delivery, and optimise performance of infrastructure.

The task group will investigate and report on ways to structure projects that are attractive to all stakeholders, and which include a clear allocation of risks and roles.

The task group will investigate ways to make construction of waterborne transport infrastructure faster and more cost-efficient. Possibilities are modularisation, standardisation of components, and other innovations which will increase productivity in the industry.

The task group will investigate how maintenance of aging infrastructure can be done more efficiently and effectively. Both preventive and reactive approaches will be investigated.

The task group will investigate and document emerging trends and technological advances in the industry which are likely to impact the delivery and operation of waterborne transport infrastructure, and report on how to best deal with these changes. This effort would include case studies on public private partnerships, emerging environmental issues, emerging fuels, new communication technologies, etc.

Suggested Products of the Task Group

One product would be a 'State of the Waterways and Ports' summarising current data on capacity, condition, and performance of both inland and maritime waterborne transport infrastructure in the world. *(Note – this may be split into two reports, one on inland waterways and one on ports)*

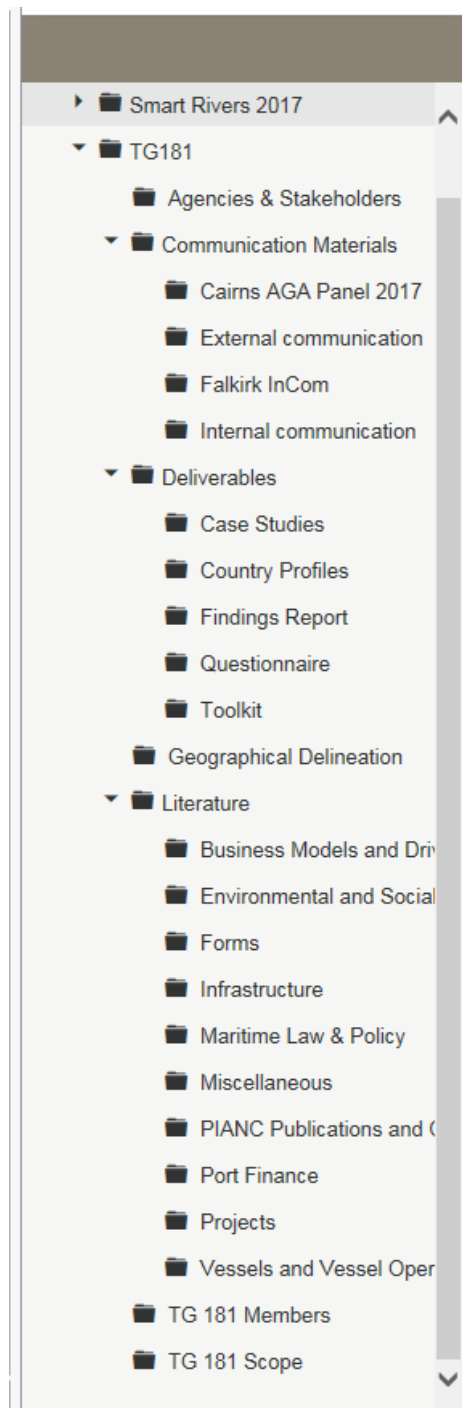
Another product would be a worldwide inventory of needs for the waterborne infrastructure in the coming years or decades and an assessment of the gap between these needs and current investment and the socio-economic benefits of closing this gap.

A third product would be guidance on how to best deal with emerging trends and technological advances in the waterborne transport infrastructure arena.

An Interim Progress Report should be prepared for the 2015 AGA in Portugal.

APPENDIX C

TASK GROUP 181 STATE AND PERSPECTIVES ON WATERBORNE TRANSPORT WORLDWIDE FTP SITE MAP



Link to Site: <https://projsftp.stantec.com>

Login: Username: smart0815

Password: 5832303

(Valid until 31/12/2018, afterwards new link will be added)

APPENDIX D

THE STATE AND PERSPECTIVES OF WATERBORNE TRANSPORT INFRASTRUCTURE WORLDWIDE

Country Profile – JAPAN

Completed By: N. Pansic

Date Completed: 23 March 2018

1. General/Geographic: INCLUDE A GOOD MAP OF THE COUNTRY

- a. Name: Japan
- b. Region or Sub-Region: Eastern Asia
- c. Capital: Tokyo
- d. Total Area: (sq. km) 377,915
- e. Remarks, sources: CIA World Factbook

2. Demographic

- a. Population (#, date, and source): 126,919,659
(July 2015 est.)
- b. Density (persons / sq. km) = 2a / 1d: 335.84
- c. Remarks, sources: CIA World Factbook

3. Economic

- a. Annual Gross Domestic Product (\$, year, source): \$4.658 trillion (2015 est.)
- b. Per Capita GDP (\$ / capita / year) = 3a / 2a: \$36,700.38 (2015 est.)
- c. Remarks, sources: GDP is in 2015 US \$, at purchasing power **parity**

4. Transport Network – Road & Rail

- a. Km of Roadway (total/unpaved/paved/expressway): 1,217,128/ 228,592/988,536/ 7,803
- b. Km of Railway (total/std/narrow): 27,155/ 4,343/ 96
- c. Responsible Agency or Agencies: Central and local governments, Private sectors (NEXCOs, JRs, etc.)
- d. Remarks, sources: CIA World Factbook



5. Transport Network – Maritime

- a. Number of Marine Terminals, Ports, Etc. (indicate major & minor, and how defined)
Ports: 2 (Strategic), 123 (Major), 808 (Minor)
- b. Identify largest terminals by capacity of major cargos in / out
Major container ports: Tokyo (4,894,511TEU), Yokohama (2,880,029TEU), Nagoya (2,738,241TEU), Kobe (2,616,537TEU), Osaka (2,437,550TEU), Hakata (975,244TEU)
Major ports: Nagoya (208Mton), Chiba (151Mton), Yokohama (119Mton), Tomakomai (104Mton), Kitakyusyu (101Mton), Kawasaki (99Mton), Kobe (88Mton), Osaka (87Mton), Tokyo (86Mton)
Major Oil terminal ports: Chiba (31,117kton), Kiire (25,532kton), Yokkaichi (16,189kton), Mizushima (14,910kton), Kawasaki (13,211kton)
Major LNG terminal ports: Chiba (27,860kton), Kisarazu (26,200kton), Nagoya (18,619kton), Himeji (17,580kton), Kawasaki (15,024kton)
- c. Responsible Agency or Agencies: Central and local governments, Private sectors (Electric and gas companies)
- d. Remarks, sources: Ports: Published data of Ministry of Land, Infrastructure, Transport and Tourism

6. Transport Network – Inland

- a. Km of Waterways (total):
- b. Km of Navigable Waterways (need a definition):
- c. Number of Inland Terminals, Ports, Etc. (indicate major & minor, and how defined)
- d. Responsible Agency or Agencies
- e. Remarks, sources

7. Freight and Passenger Data

- a. Annual Tonnes of Freight moved for most recent year with data (import and export, date, source): International: 989 Mton (Import), 287 Mton (Export), Domestic: 796 Mton (Import), 808 Mton (Export)
- b. Annual Passengers moved for most recent year with data (commuter and long- distance, date, source): International: 2,977,318, Domestic: 96,485,244
- c. Remarks, sources: Published data of Ministry of Land, Infrastructure, Transport and Tourism (2014)

8. Waterborne Recreation - Boating

- a. Total Number of Marinas: 570
- b. Total Number of Berths: 69,000
- c. Remarks, sources: Data of Japan Boating Industry Association

9. Global Competitiveness Index

Rank = 9, Score = 5.49

Global Competitiveness Index measures national competitiveness, defined as the set of institutions, policies, and factors that determine the level of productivity.
Rank is out of 138 nations. Scores range from 1 to 7.

Source: World Economic Forum at:

<https://www.weforum.org/reports/the-global-competitiveness-report-2017-2018>

10. Waterborne Recreation - Boating

- a. Total Number of Marinas: 570
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Rank is out of 138 nations. Scores range from 1 to 7.

Source: World Economic Forum at
<https://www.weforum.org/reports/the-global-competitiveness-report-2017-2018>

12. United Nations Sustainable Development Goals Index

Japan ranked 11th out of 157 nations on the U.N. Sustainable Development Goals Index, with a score of 80.2 (maximum possible is 100)

Source:
<http://www.sdgindex.org/assets/files/2017/2017-SDG-Index-and-Dashboards-Report-regions.pdf>

APPENDIX E

STATE AND PERSPECTIVES OF WATERBORNE TRANSPORT INFRASTRUCTURE LONG FORM QUESTIONNAIRE UNITED STATES

Introduction

The World Association for Waterborne Transport Infrastructure¹ (PIANC), has formed the Task Group 181. The goal of this Task Group is to investigate and report to industry on:

- ☐ Historical trends in infrastructure development;
- ☐ Need for new infrastructure to respond to the evolution of trade;
- ☐ Ways to improve project delivery;
- ☐ How to tackle the climate change challenge;
- ☐ How to structure project finance attractively;
- ☐ How to make construction faster and more cost-efficient;
- ☐ How to make infrastructure more environmentally-friendly and sustainable;
- ☐ How maintenance can be done more efficiently and effectively; and
- ☐ Emerging trends and technologies affecting waterborne transport.

For further information, please

- go to the PIANC website - <http://www.pianc.org>
- or
- contact our Chairperson – nicholas.pansic@stantec.com

Thank you for your time and interest!

¹ About PIANC:

PIANC is the forum where professionals around the world join forces to provide expert advice on cost-effective, reliable and sustainable infrastructures to facilitate the growth of waterborne transport. Established in 1885, PIANC continues to be the leading partner for government and the private sector in the design, development and maintenance of ports, waterways and coastal areas.

Goal of this questionnaire

Task Group 181 is reaching out to PIANC member countries, sister organizations, and inland and maritime transport stakeholders worldwide, to solicit data, reports, and industry knowledge that can inform the work of the group and lead to a useful dialogue on the future of this vital global enterprise.

This questionnaire is part of this data collection effort.

The goal of this questionnaire is to collect specific information on the state and perspectives of the waterborne transport infrastructure within the country and/or organization of the participant.

Structure of this questionnaire

This questionnaire is split in two parts:

Part I - 'Basic Data'.

Questions on existing transport patterns (e.g. modal split), infrastructure and financing.

Part II – 'Perspectives of Waterborne Transport Infrastructure'.

Questions on developments in shipping transport, project financing, environmental considerations, etc.

Notes to participant

We are happy to receive your feedback on this questionnaire. If you have any remarks or questions, please provide your findings to the Task Group member that you received it from.

We understand the questionnaire can be quite time-consuming. If you have relevant documentation in which we can find the answers to specific questions, we are most happy to analyze this information ourselves. In these cases, please provide us these documents, so you don't need to analyze them further.

Thank you for your participation!

Contents of questionnaire

Part I: Basic Data

1. Transport Data
2. Finance Data
3. Infrastructure Data
4. Historical trends and phases in infrastructure development

Part II: Perspectives of Waterborne Transport Infrastructure

1. Need for new infrastructure to respond to the evolution of trade
2. Emerging trends and technologies affecting waterborne transport:
3. How to structure project finance attractively
4. Ways to improve project delivery
5. How to make construction faster and more cost-efficient
6. How maintenance can be done more efficiently and effectively
7. How to make infrastructure more environmentally-friendly and sustainable:
8. How to tackle the climate change challenge

General information

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I would like to be kept informed by mail about the Task Group progress and its results	Yes	No
--	-----	----

Explanation of questionnaire

- Light green marked cells to be filled in Light green cell
- Cells can be filled with either values, explanation or a 'X' to tick the box.

Part I: Basic Data

1. Transport Data:

“Please provide information about the Modal Split (freight transport) in your country”²

1A. This table should show the Modal Split (in percent of the total transport performance [tons-kilometer]) of the past 25 years and upcoming 15 years.

Year \ Mode	- 25 (1989)	- 20 (1994)	- 15 (1999)	- 10 (2004)	-5 (2009)	2011	+5 (2019)	+10 (2024)	+15 (2029)
International Transport									
Road									
Rail									
Waterways									
Inland (Domestic) transport									
Road	36%	39%	42%	43%	45%	45%			
Rail	23%	24%	27%	30%	29%	29%			
Waterways	18%	16%	12%	11%	9%	8%			
Pipeline	23%	21%	18%	15%	17%	17%			

Source: U.S. Department of Transportation, Bureau of Transportation Statistics

² If you have relevant documentation in which we can find the answers to specific questions, we are most happy to analyze this information ourselves. In these cases, please provide us these documents, so you don't need to analyze them further.

- 1B: Prepare a table with National Freight Transport Volumes [tons] on waterways - Import and Export separately - for the same years as presented in the figures under Part A.

(Million Tons)

Year	International Waterway transport		Inland Waterway Transport		
	Import	Export	Import	Domestic	Export
-25 years (1989)					
-20 years (1994)					
-15 years (1999)					
-10 years (2004)					
-5 years (2009)					
now (2011)	869.1	610.4		887.9	
+5 years (2019)					
+10 years (2024)					
+25 years (2040)	1,653	1,667		990	

Source of 2011 numbers: Waterborne Freight Transport, AASHTO report, June 2013 Source of forecasts:

USDOT Freight Analysis Framework

2. Finance Data:

“Budgeting for infrastructure works and financing of the same”

- 2A. Please provide the following data:

Budget dedicated to transport (and water) infrastructure	2014	Currency [e.g. EUR, USD]
Capital investment in transport infrastructure	\$181 billion	USD
Maintenance investment in transport infrastructure	\$235 billion	USD

Note: Water transport spending is 40% capital and 60% O&M

- 2B. The division of the total annual budget (capital + maintenance) dedicated to the Transport Infrastructure: (Government Spending)

Transport infrastructure	percentage (%)
Roads	59%
Rail	1%
Waterways	4%
Mass Transit	23%
Aviation	13%
TOTAL	100%

2C. The division of the total annual budget (capital + maintenance) dedicated to the Waterways transport infrastructure:

Transport infrastructure	percentage (%)
Ports Infrastructure for Maritime Traffic	
Waterway Infrastructure for Maritime Traffic	
Ports infrastructure for Inland Shipping	
Waterway infrastructure for Inland Shipping	
TOTAL	100%

Source: www.cbo.gov/publication/49910, Congressional Budget Office, Public Spending on Transportation and Water Infrastructure 1956-2014, March 2015.

3. Infrastructure Data:

This question is about the infrastructure that your organization/institutions is responsible for or is part of your premises.

3A. Value of waterborne transport infrastructure

Item	Current replacement value (please specify currency)	Accumulated backlog* (as amount or in % of the current replacement value – please specify)
Sea ports		\$28.9 billion - AAPA
Maritime Waterways		
Inland ports		
Inland waterways	\$150 billion (check)	Estimated construction backlog for USACE navigation projects - \$20 billion

*: Shortfall in (re)investment and/or maintenance that should have been done but has been deferred due to financial, personnel or other restrictions.

3B. Age (years) and number (nos) of the main structures of your assets

Item	unit	Total	Age [years]				
			> 100	75- 100	50 - 75	25 - 50	0 - 25
locks	nos.	238					
weirs	nos.						
bridges	nos.						
movable bridges	nos.						
canals	length (m)						
dams (as part of navigation infrastructure)	length (m)						
canal Bridges	nos.						
quay walls	length (m)						
river training structures	nos.						
light houses	nos.						
culverts	nos.						
reservoirs	nos.						
...							

4. Historical trends and phases in infrastructure development:

“Where do you stand now, and where do you expect to be in 25 years?”

Regarding the development of transport infrastructure one can in general distinguish four consecutive phases:

1. Nation Building
(era's of predominantly isolated or local purpose projects)
2. Economic Efficiency
(progressivism & large public works, system building)
3. Environmental Enlightenment
(more integrated and holistic approaches)
4. Recapitalization, Resilience & Adaption

We assume that strategies, aims and limitations for building and maintaining transport infrastructure differ significantly from phase to phase. Therefore it would be interesting to know, what percentage of your transport infrastructure projects is in each of these phases.

Phase	Share of projects [%]
1 Nation Building	
2 Economic Efficiency	
3 Environmental Enlightenment	
4 Recapitalization, Resilience & Adaption	100%

Part II: Perspectives of Waterborne Transport Infrastructure

1. Need for new infrastructure to respond to the evolution of trade: “What are the demands of your clients?”

NOTE:

Various Clients will have different demands. Therefore, please provide an ‘average’ score based on your observations what the trade market demands from the infrastructure assets in your organization.

Items / value (0=none;10=very high)	0	1	2	3	4	5	6	7	8	9	10	Remarks
reliable infrastructure												
enabling quick operations												
better and more connections												
higher redundancy												
Resilience of infrastructure												
lower prices												
Safety - HSE												
more security (i.e. possible damage to vessels and/or cargo)												
improved draught												
better sailing predictions												
better clearance under bridges												
others:												
...												
...												

Issues identified in AASHTO Report

1. Basic waterway maintenance needs are not being met
2. Needed projects are often delayed for years, even decades
3. Funding for critical Marine Transport System expansion needs is inadequate and uncertain.
4. National investments in the Marine Transport System are not targeted to national needs and national benefit
5. No locus of responsibility for the well-being of the Marine Transport System and accountable for its failure or success.

2. Emerging trends and technologies affecting waterborne transport in your port or waterway: “Where to will transport develop?”

Please provide the top-5 trends in transport business you observe and how they impact your infrastructure (requirements). For reference, we have included some examples.

	Expected trends in the transport business	Complementary Trends & Technologies concerning infrastructure
Example	more LNG transport sailing on rivers and canals	increased safety measures on the fairways and ports
Example	Increase of ship size	Longer and/or wider locks, deepening of canals and rivers, increasing need for cargo handling facilities in ports
Example	Automatic sailing	Adapt pilotage and river information systems
1		
2		
3		
4		
5		

Key Trends and Challenges in Freight Transportation

The NFSP discusses six major trends affecting freight transportation and the challenges they present. If our freight transportation system is to continue to enable our way of life and serve as a competitive advantage for the U.S. economy, we must confront these challenges and seize on the resulting opportunities:

1. *Expected Growth in Freight Tonnage.* To support our projected population and economic growth, freight movements across all modes are expected to grow by roughly 42 percent by the year 2040. For example, container traffic at ports will increase steadily as the volume of imports and exports transported by our freight system more than doubles over this period.
2. *Underinvestment in the Freight System.* Numerous studies have identified the need for more and better directed investment in freight infrastructure. Freight projects can be costly to undertake. There are seldom public-sector funds dedicated to them and they do not compete well with non- freight projects because of the manner in which public investments are evaluated. As noted below, they often involve multiple transportation modes, jurisdictions, and stakeholders, each of which may have different objectives or operate under different investment timeframes. There may be adequate private sector financing to invest in privately owned freight railroad and pipeline infrastructure. These private sector investments may not include features to generate public benefits, however, unless the private sector believes its investments in these features will result in compensation through freight rates. Further, there is growing recognition that the workforce needed to build, maintain, and operate the system—including truck drivers, railroad engineers, skilled planners, and others—will be insufficient unless further investment is made in education, recruitment, and training.

3. *Difficulty in Planning and Implementing Freight Projects.* Most of our publicly owned freight system (apart from the waterway system) is planned and managed by State and local governments, as well as by Metropolitan Planning Organizations (MPOs). These agencies must work with each other and a broad array of Federal and private sector partners, including freight railroads, trucking companies, and pipeline companies. This decentralized approach has many benefits, including greater flexibility to identify and react to local needs. But when it comes to freight projects, especially those with national-level impacts, this approach presents a number of challenges such as fragmented decision-making.
4. *Continued Need to Address Safety, Security, and Resilience.* Recent trends show impressive improvements in freight safety. There was a 27 percent increase in freight ton-miles for all surface modes between 1990 and 2011, but freight-related fatalities across all modes declined by 33 percent over that same period. However, more progress must be made. In 2013, 543 people died in incidents associated with freight rail, vessel, and pipeline operations. In 2013, 3,964 people were killed in crashes involving large trucks. Specific risks associated with our physical and cyber infrastructures— ranging from transport of crude oil by rail to climate change—create vulnerabilities that must be addressed.
5. *Increased Global Economic Competition.* Our economy is increasingly reliant on international trade. Many imported goods or goods produced for export are carried overseas in ships that continue to grow in average size. Significant amounts of goods also move by air, truck, and train through land border crossings with Mexico and Canada. Ports must address congestion, dimensional, and equipment-shortage challenges generated by bigger, new-generation container ships as well as the larger bulk ships now able to transit the expanded Panama Canal with grain and energy exports. Port authorities are investing to modernize their facilities by dredging harbors, raising bridges, automating and expanding container yards, purchasing larger ship-to-shore cranes, and improving roads and rail connections to surface infrastructure. Where port congestion occurs, supply chains are increasingly able to react by changing supply sources, routes, and transportation modes. Even so, notable incidents of congestion (particularly at ports) have occurred over the last several years, most recently due to management-labor disputes on the U.S. West Coast. Land border crossings also face rising commercial traffic and congestion; from 1995 to 2012, surface trade between the U.S. and Mexico quadrupled from approximately \$100 billion to \$400 billion per year. Additionally, we have recently experienced a surge in domestic energy production and increased domestic manufacturing and assembly work. Ensuring that these products can efficiently reach both domestic and international markets is critical to the long-term success of these industries.
6. *Application and Deployment of New Technologies.* The freight industry is experiencing a technological revolution as information and communications technologies are applied to optimize global supply chains. Better data collection and analysis capabilities will enable faster and more accurate analysis of freight routes, travel times, and infrastructure capacity. Advanced automation will increase productivity in the freight industry and change the skill sets needed to work in freight, requiring skilled workers to maintain and operate new technologies. Technology will also automate and expedite inspection processes, improving safety and lowering costs. Growth in autonomous vehicle technologies may soon transform freight transportation, allowing for increased throughput and more reliable trips on existing capacity. Technologies such as positive train control and the Federal Aviation Administration's Next Generation air traffic control systems should also provide additional benefits.

Projections of these trends are subject to significant amounts of uncertainty. New technologies and products may be developed and deployed more quickly than expected; geopolitical events and recessions may suddenly alter growth, trade, and production patterns; and adverse effects of climate change on our coastal cities may arrive sooner. As demonstrated by recent fluctuations in oil and coal markets, even near-term freight projections made less than a decade ago can change dramatically. The recent severe economic recession upended many projections for both short-term and long-term growth at ports and facilities across the nation. Similarly, the ability of modern supply chain management to respond dynamically to building congestion at one location by using less congested ports or changing freight distribution patterns can alter

3. How to structure project finance attractively: “Do we implement PPP concepts or a landlord development (for ports) or just government investments out of national budgets?”

3A. How where your projects funded in the period 2000 – 2015? Source: AASHTO report

The Federal government, acting principally through the U.S. Army Corps of Engineers, has been primarily responsible for constructing and maintaining a set of Federally authorized navigation channels. Corps appropriations for navigation projects have, over the past decade, averaged \$1.5 to \$2 billion per year. Costs for deep-draft improvements are typically shared with local sponsors.

Multistate authorities, state agencies, regional authorities, and local governments have built marine terminals. Private industries have also built their own marine terminals. A survey by AAPA found that U.S. ports and their partners plan to invest \$46 billion in Marine Transport System infrastructure by 2017 (<http://www.aapa-ports.org/Press/PRdetail.cfm?itemnumber=18583>)

Local, regional, and state planners, recognizing the economic benefits of port operations as well as their potential impacts on transportation systems, communities, and the environment, have provided landside connections and made land use decisions affecting port development and expansion.

Railroads (private sector) have developed lines and services to connect marine terminals with inland and cross-country markets. The railroads compete with each other, but they also cooperate with each other and the public sector on projects of mutual benefit.

Ocean and waterway carriers select ports of call based on the particular port arrangements (location, accessibility, vessel size capacity, terminal operating cost structure, etc.) that allow them to profit from the customer services they provide.

Freight shippers and receivers have developed privately owned logistics infrastructure – warehouse/ distribution centers, manufacturing/processing plants, etc. either at ports or at inland locations connected to ports via rail and/or truck.

Description	Sea port (%)	Maritime Traffic (%)	Inland port (%)	Inland shipping (%)
Fully public (Government Budget)				Mostly federal
Public-Private-Partnership	A mix		A mix	
Fully Private/Industry		100		
Totals (%)	100%	100%	100%	100%

3B. Benefit for the investors /Reasons for investing:

Possible benefits	Importance in investment decision		
	low	medium	high
Macro-economic effects			X
Lower external costs	X		
Environment (CO2 neutral	X		
Environment : interaction port -city (surroundings)			X
Efficient operations			X
Improvement of competitiveness			X
achieve flexibility in future	X		
other			
...			
...			

4 How to design proposed projects to be successful and prosperous? (key success factors)

Name and list the last three infrastructure projects executed:

- when was it built?
- why was it built?
- what was the effect/result?
- why was it successful (or not)?

Success factors to be considered (examples):

1. Transport Infrastructure Plan
2. Project management Tools
3. Public Private Partnership
4. Legal initiation
5. Stakeholder involvement
6. Taking into account environment / working with nature from the beginning
7.

#	Project name	Year of construction	Reason for construction	Effect / result	Success factors for the project
1					
2					
3					

5. How to make construction faster and more cost-efficient.

In the U.S., initiation and planning of navigation projects typically involves the following steps:

- Local sponsors must initiate and request Corps studies
- The Corps must conduct studies (Feasibility, Environmental Impact) and make appropriate determinations of national economic development benefits to advance an alternative
- Responsible agencies must review and approve the Corps Final report and Environmental Impact Statement
- Congress must authorize the project
- The President's budget must fund the project, based on identified national priorities.

The process co-mingles technical, political, and budgetary considerations at different points. All of this must happen before construction can begin.

For typical projects in your field of expertise/competence list the projects and present the details in the following tables.

5A. Typical time-consumption during the construction implementation period of the infrastructure (in %)

Note: fill out the percentage in each column, for example for locks, canals, quay walls, bridges, etc.

Nos.	Planning Process	Planning Approval	Budgeting	Procurement	Realisation	Total
<i>Example</i>	15	20	15	10	40	100%
Locks						100%
Canals						100%
Quay walls						100%
Other:						
...						
...						

5B. Typical problems in projects and your strategy to deal with them

#	Typical Problems:	Strategy to deal with this problem
<i>Example</i>	<i>Permitting</i>	<i>increased efforts to communicate with institutions</i>
<i>Example</i>	<i>NIMBY ("not in my backyard"): "Ok, waterway transport is a good thing – in general. But the new port should not be in my direct vicinity! Build it somewhere else!"</i>	<i>Increased efforts to communicate with the civil society, early involvement, etc.</i>
1		

6. Which strategies are being developed in order to do the maintenance more efficiently and effectively and which items do govern your maintenance strategy:

Rank	STRATEGIES		Relevance
	Current strategies	Ideas and expected developments?	Affects ... % of your capital investment
<i>Example</i>	<i>Planned maintenance</i>	<i>Risk based budget maintenance</i>	70 %
<i>Example</i>	<i>(Re-)act only in case of impending breakdown</i>	<i>Implementing an asset management model (direction, governance, planning, delivery) for traffic-relevant assets</i>	40 %
1			
2			
3			
4			
5			

7. Environmental considerations in projects

7A: Name the top three environmental considerations underlying the projects that have been executed for the last 5 years, i.e. how to make infrastructure more environmentally- friendly and sustainable: "Working with Nature concepts?!"

Rank	Strategies
<i>Example</i>	<i>install fish-passes, implement "Working with Nature"-concepts</i>
1	
2	
3	

7B: Which percentage of your project budget do you spend (on average) for environmental considerations?

Environmental mitigation	About 50%
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8. How to tackle the climate change challenge: “What do you expect from it and how do you manage that?”

8A. Climate change in projects.

	Yes	No
Do you consider in your projects climate change?	Yes, sea level rise	

8B. If yes, then fill out the next table for the items listed (add or delete items that you find necessary/important)

#	Items	Explanation
1	Prognosis concerning the influence of climate change on your waterway system	Sea level rise
2	Your adaption strategy towards climate change	
3	What are the total costs (in % of GDP) of the climate change strategy in your projects	
4	What are the costs that cannot be recovered from the investments made in Climate change i.e not compensable drawbacks and their costs (in % of GDP)	
5	Are any projects specifically developed because of climate change (if yes: what -type of- projects?)	

STATE AND PERSPECTIVES OF WATERBORNE TRANSPORT INFRASTRUCTURE LONG FORM QUESTIONNAIRE FRANCE

Introduction

The World Association for Waterborne Transport Infrastructure¹ (PIANC), has formed the Task Group 181. The goal of this Task Group is to investigate and report to industry on:

- ☐ Historical trends in infrastructure development;
- ☐ Need for new infrastructure to respond to the evolution of trade;
- ☐ Ways to improve project delivery;
- ☐ How to tackle the climate change challenge;
- ☐ How to structure project finance attractively;
- ☐ How to make construction faster and more cost-efficient;
- ☐ How to make infrastructure more environmentally-friendly and sustainable;
- ☐ How maintenance can be done more efficiently and effectively; and
- ☐ Emerging trends and technologies affecting waterborne transport.

For further information, please

- go to the PIANC website - <http://www.pianc.org>
- or
- contact our Chairperson – nicholas.pansic@stantec.com

Thank you for your time and interest!

¹ About PIANC:

PIANC is the forum where professionals around the world join forces to provide expert advice on cost-effective, reliable and sustainable infrastructures to facilitate the growth of waterborne transport. Established in 1885, PIANC continues to be the leading partner for government and the private sector in the design, development and maintenance of ports, waterways and coastal areas.

Goal of this questionnaire

Task Group 181 is reaching out to PIANC member countries, sister organizations, and inland and maritime transport stakeholders worldwide, to solicit data, reports, and industry knowledge that can inform the work of the group and lead to a useful dialogue on the future of this vital global enterprise.

This questionnaire is part of this data collection effort.

The goal of this questionnaire is to collect specific information on the state and perspectives of the waterborne transport infrastructure within the country and/or organization of the participant.

Structure of this questionnaire

This questionnaire is split in two parts:

Part I - 'Basic Data'.

Questions on existing transport patterns (e.g. modal split), infrastructure and financing.

Part II – 'Perspectives of Waterborne Transport Infrastructure'.

Questions on developments in shipping transport, project financing, environmental considerations, etc.

Notes to participant

We are happy to receive your feedback on this questionnaire. If you have any remarks or questions, please provide your findings to the Working Group member that you received it from.

We understand the questionnaire can be quite time-consuming. If you have relevant documentation in which we can find the answers to specific questions, we are most happy to analyze this information ourselves. In these cases, please provide us these documents, so you don't need to analyze them further.

Thank you for your participation!

Contents of questionnaire

Part I: Basic Data

1. Transport Data
2. Finance Data
3. Infrastructure Data
4. Historical trends and phases in infrastructure development

Part II: Perspectives of Waterborne Transport Infrastructure

1. Need for new infrastructure to respond to the evolution of trade
2. Emerging trends and technologies affecting waterborne transport:
3. How to structure project finance attractively
4. Ways to improve project delivery
5. How to make construction faster and more cost-efficient
6. How maintenance can be done more efficiently and effectively
7. How to make infrastructure more environmentally-friendly and sustainable:
8. How to tackle the climate change challenge

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I would like to be kept informed by mail about the Task Group progress and its results	Yes	
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Explanation of questionnaire

- Light green marked cells to be filled in **Light green cell**
- Cells can be filled with either values, explanation or a 'X' to tick the box.

Part I: Basic Data

1. Transport Data:

“Please provide information about the Modal Split (freight transport) in your country”²

1A: This table should show the Modal Split (in percent of the total transport performance [tons-kilometer]) of the past 25 years and upcoming 15 years.

Year Mode	- 25 (1989)	- 20 (1994)	- 15 (1999)	- 10 (2004)	-5 (2009)	2014	+5 (2019)	+10 (2024)	+15 (2029)
International Transport									
Road									
Rail									
Waterways									
Inland transport									
Road									
Rail									
Waterways									

² If you have relevant documentation in which we can find the answers to specific questions, we are most happy to analyze this information ourselves. In these cases, please provide us these documents, so you don't need to analyze them further.

1B: Prepare a table with National Freight Transport Volumes [tons] on waterways - Import and Export separately - for the same years as presented in the figures under Part A.

Year	International Waterway transport		Inland Waterway Transport		
	Import	Export	Import	Internal	Export
-25 years (1989)					
-20 years (1994)					
-15 years (1999)					
-10 years (2004)					
-5 years (2009)					
now (2014)					
+5 years (2019)					
+10 years (2024)					
+15 years (2029)					

Transport Network – Road & Rail

- Km of Roadway (total /paved/expressway): 1,088,747/ 1,088,747 / 11,599
- Km of Railway (total/ std/narrow): 29,219/ 28,987/ 232
- Responsible Agency or Agencies: for roads : Interregional Directorates for Roads, Departmental Councils, Municipalities; for motorways: concessionaires; for railway: SNCF Réseau (std), Corsica Railways (narrow gauge)
- Remarks, sources: Ministry of Transport

Transport Network – Maritime

In France 7 large maritime State ports are operating and in 2015 they have handled 350 millions of tons of freight and serviced 32 millions of passengers.

There are three different types of ports:

- the large maritime state seaport(s):
 - in metropolitan area 7: Bordeaux, Dunkerque, La Rochelle, Le Havre, Marseilles, Nantes-Saint Nazaire and Rouen
 - overseas 4 : Guyane, Martinique, Guadeloupe, Port-Réunion
- the largest maritime regional ports: Brest, Calais, Bayonne, Saint-Malo, Lorient, Sète, Nice
- River state port(s): Paris(Seine); Strasbourg (Rhine);
- the container traffics in the three main French ports expressed in TEUs throughput in 2015 follow:
 - Le Havre (2,56 MTeus)
 - Marseille (1,22 MTeus)
 - Dunkerque (0,318 MTeus)
- LNG terminal(s) (import): Fos-Cavaou, Fos-Tonkin, Montoir de Bretagne, Dunkerque

Transport Network – Inland

- Km of Waterways (total): 8,501 KM (2010) (CIA WF)
- Km of Navigable Waterways (need a definition): 5064 KM (in use EUROSTAT)
- Number of Inland Terminals, Ports, Etc. (indicate major & minor, and how defined): 20 main inland ports in the French association for inland ports :
Aproport, Arles; Avignon-Le Pontet, Châlons-en-Champagne, Colmar Centre- Alsace, Delta 3

Dourges, DPHP (Développement Portuaire de Haute-Picardie), Elbeuf, Givet , Lille ,Lyon Terminal, Mulhouse,Pagny Terminal, Paris, Reims, Moselle,Strasbourg ,Valence , Vienne Sud and Villefranche-sur-Saône

The largest ones are the ports of Paris and of Strasbourg

- Responsible Agency or Agencies: Voies Navigables de France, Compagnie Nationale du Rhône, EDF
- Remarks, sources

Freight and Passenger Data

- Annual Tons of Freight moved for most recent year with data (import and export, date, source): 350 Million Tons in 2015 (source DGITM/DST/PTF4)
- Annual Passengers moved for most recent year with data (commuter and long distance, date, source): 31,863 millions in 2015 (source SoeS CCTN 2016)
- Remarks, sources

Waterborne Recreation – Boating

- Number of marinas: 1029 recreational ports with 473 maritime ports and 556 inland ports
- Number of berths : approximately 200 000 berths of which 10% for inland recreational navigation

Nombre de poste et d'anneaux d'amarrage selon affectation

	Maritime	Fluvial
Bateaux de plaisance	180 600	18 600
Bateaux de commerce	1 700	600
Bateaux à passagers	1 600	150
Bateaux de pêche	3 700	
Total	187 600	19 350
Complément postes à sec	14 000	2 000

- Remarks, sources: Observatoire des ports de plaisance- rapport 2015- Direction des affaires maritimes-Mission de la navigation de plaisance et des loisirs nautiques

2. Finance Data:

“Budgeting for infrastructure works and financing of the same”

2A. Please provide the following data:

Budget dedicated to transport infrastructure	Average annual amount 2009 - 2014	Currency [e.g. EUR, USD]
Capital investment in transport infrastructure		
Maintenance investment in transport infrastructure		

2B. The division of the total annual budget (capital + maintenance) dedicated to the Transport Infrastructure:

Transport infrastructure	percentage (%)
Roads	
Rail	
Waterways	
TOTAL	100%

2C. The division of the total annual budget (capital + maintenance) dedicated to the Waterways transport infrastructure:

Transport infrastructure	percentage (%)
Ports Infrastructure for Maritime Traffic	
Waterway Infrastructure for Maritime Traffic	
Ports infrastructure for Inland Shipping	
Waterway infrastructure for Inland Shipping	
TOTAL	100%

3. Infrastructure Data:

This question is about the infrastructure that your organization/institutions is responsible for or is part of your premises.

3A. Value of waterborne transport infrastructure:

Item	Current replacement value (please specify currency)	Accumulated backlog* (as amount or in % of the current replacement value – please specify)	
Sea ports			
Maritime Waterways			
Inland ports			
Inland waterways			

3B. Age (years) and number (nos) of the main structures of your assets

Item	unit	Total	Age [years]				
			> 100	75- 100	50 - 75	25 - 50	0 - 25
locks	nos.						
weirs	nos.						
bridges	nos.						
movable bridges	nos.						
canals	length (m)						
dams (as part of navigation infrastructure)	length (m)						
canal Bridges	nos.						
quay walls	length (m)						
river training structures	nos.						
light houses	nos.						
culverts	nos.						
reservoirs	nos.						
Aquaduct	nos.						
Discharge locks / sluices	nos.						
Pumping stations***	nos.						
Storm surge barrier	nos.						

4. Historical trends and phases in infrastructure development: “Where do you stand now, and where do you expect to be in 25 years?”

Regarding the development of transport infrastructure one can in general distinguish four consecutive phases:

1. **Nation Building**
(era's of predominantly isolated or local purpose projects)
2. **Economic Efficiency**
(progressivism & large public works, system building)
3. **Environmental Enlightenment**
(more integrated and holistic approaches)
4. **Recapitalization, Resilience & Adaption**

We assume that strategies, aims and limitations for building and maintaining transport infrastructure differ significantly from phase to phase. Therefore it would be interesting to know, what percentage of your transport infrastructure projects is in each of these phases.

Phase	Share of projects [%]
1 Nation Building	
2 Economic Efficiency	
3 Environmental Enlightenment	
4 Recapitalization, Resilience & Adaption	

French contribution to part II

II-1 Need for new infrastructure to respond to the evolution of trade

National priorities for the transport sector up to 2030 were elaborated in 2013 by the Mobility 21 Commission, and are currently under revision in view of a multiannual programming Law for the transport sector to be adopted in 2018. Regarding seaports, the main recommendations of the Commission were to place at the heart of the funding priorities investments that contribute directly to better connections between European level port platforms (mainly Marseilles, Le Havre, Rouen and Dunkirk) and their hinterlands. In the case of Marseilles-Fos for instance, a 25 km long highway is required for linking the Fos-sur-Mer industrial port area and the A54 motorway at Salon-de-Provence, so as to create the conditions for a bypass of Fos- sur-Mer and a link with the motorway bypass of Martigues / Port-de-Bouc towards the Marseilles agglomeration. In the case of Le Havre, the main project deals with the electrification of the Serqueux-Gisors railway line for better rail connection of the port with the Paris area. Better connections with waterway network are also in the agenda of the port of Le Havre, through the extension of the Grand Canal du Havre to the Tancarville Canal.

Other priority projects listed by the Commission over the long term deal with the extension of container terminals, for instance Port 2000 third phase in Le Havre, Fos 3XL and Fos 4XL in Fos-Marseilles, and a new container and bulk terminal in Dunkirk. Multimodal platforms are also on top of the agenda, such as the creation of a new multimodal platform at Achères in the case of the Paris port, whereas Le Havre has created its own trimodal platform and Marseilles is developing a bimodal platform also for containers in Mourepiane. Most of these projects are cofunded by the State (through AFITF – the national transport infrastructure funding agency), by regional authorities and contributions of the ports.

II-2 Emerging trends and technologies affecting waterborne transport in France:

II-2-1 Maritime ports

The French maritime ports system has adapted its governance and moved to the landlord port model in 1992 and 2008. The investment in port infrastructure has also been adapted with Port 2000 (Le Havre), Fox XXL (Marseilles), Calais 2015, LNG terminal (Dunkirk), a.s.o. The environmental legislation has equally been unified although its application remains very strict at both European and State level.

The main emerging trends result from ecological and energy transition policies adopted in 2009 at national level (Grenelle Laws on Environment) and at European level (Directive 2009/28/EC on the promotion of the use of energy from renewable sources). Those policies will induce less fossile energies and a reduction in nuclear power plants use, which will affect the maritime ports. For maritime ports, they consist in improving the hinterland connection by mass transit systems, mainly by railway making use of local railway carriers for port access such as in Germany, through creation of multimodal terminals (e.g. Le Havre), modernization of existing railway links (e.g. Serqueux-Gisors line, between Le Havre and Paris).

As expressed by the French Prime Minister during “Assises de l’économie de la mer” in november 2017, France will adapt its rules and regulations to facilitate LNG bunkering in French ports. There will also be more investments for LNG bunkering and shore power supply. One big step towards more use of LNG as fuel was the decision by French CMACGM to power its 9 new 22 0000 Teu’s container ships with LNG.

Another main trend consists in developing marine renewable energy systems (e.g. offshore wind power plants in Saint Brieuc, Courseulles, Fécamp, Dunkirk, tidal stream generators at the Pointe du Raz in Brittany), resulting in new business opportunities for ports during construction and operation phases.

A closer cooperation is also taking place between the maritime and the inland ports on the three main gateways: between the ports of Le Havre, Rouen and Paris with HAROPA on the Seine gateway, between the ports of Dunkirk, Calais, Boulogne, Lille and Valenciennes with Norlink ports on the

Northern gateway and between between Marseilles, Lyon, Mâcon, Châlon and Sète along the Rhône-Saône rivers with Medlink ports.

II-2-2 Inland waterways

The inland waterways are mainly managed by Voies Navigables de France, public body which has recently absorbed the former State navigation services (4500 people). The infrastructure needs concern mainly the network infrastructure asset maintenance especially with the resilience of the main hydraulic structures (dams, locks and dykes or levees) to extreme climate events (droughts or floods), automation of locks on the secondary network and renewal of man-operated dams mainly on the river Aisne and Meuse together with small hydro-electricity equipments through a PPP.

Expansion or capacity improvement of the existing waterways network could be achieved with the extension of the river Seine eastward between Bray and Nogent or northward along the tributary Oise until Compiègne and also with the already mentioned major European investment Seine-Nord-Europe canal.

The vessels themselves have mainly to face the adaptation of their motors to new emission standards which approaches the lorry motors emission standards (Europa V) which means small particle filters and sulphur emission catalysts or moving to LNG motors.

II-3 How to structure project finance attractively?

II-3-1 Successful examples of projects (inland waterways)

1. **Project name** : Upper Rhone pleasure boating locks
2. **Year of construction:** 2010
3. **Reason for construction:** From request of the French state and to answer the public interest and local officials, CNR has decided to extend the navigation of the Upper Rhone river providing extended access to a river portion between two hydropower schemes.(Chautagne and Belley) by creating 2 couples of new locks.

Size of the locks: 40 m x 5.25 x 3 m

Hydraulic head: 16 m and 17 m (with two steps)

These locks open to pleasure-boating an uninterrupted 57 km waterway on the Upper Rhone, between Seyssel and Brégnier-cordon, with a connection to Lake du Bourget.

The partial navigation on the Upper Rhone is a key objective of the first plan of missions of general interest developed by CNR. It is in line with the tourism and economical development policy of the valley and allows officials, tourism professionals and Rhone riparians to highlight their natural heritage and reclaim the River



4. Effect / result

- River tourism development
- Territorial development
- Increase of turnover for hotels, restaurants, shipping companies

5. Success factors for the project

- Financing through the CNR model : multipurpose concession; navigation and other missions in the public interest financed by hydropower revenues
- Strong support from local and regional authorities thanks to CNR's local roots
- Ecological integration and good cooperation with authorities in charge of nature protection of Creation of natural habitat, biodiversity improvement



II-4 Ways to improve project delivery?

II-5 How to make construction faster and more cost-efficient?

In France, initiation and planning of navigation projects, like for instance building of a new port, typically involves the following main steps (only the main are mentioned, which means others aren't...):

- local sponsors and more precisely the Port Authority (we will call him the Owner) and his private partners (For all the port superstructures at least) must initiate first studies and get approval by central government to go on for studies, especially regarding environmental integration;
- owner must obtain agreement by "Commission Nationale du Débat Public" (National Commission for Public Debate) to accept all the supporting documents he presents and decide nomination of a Debate Committee and dates for Public Debate about the project;
- public Debate on the project takes place with many public meetings for at least 4 months and after that "Compte-Rendu" (Official Recording) by the nominated Committee and "Bilan" (Balanced Overview) by National Commission are issued. Those two documents will have to be attached to the future final consultation on the project by "Enquêtes Publiques" (Public Inquiry)

- after the Public Debate, owner has to officially decide to continue or to stop project and then to ask for “Prise en Considération” (Taking into consideration) by the Minister in charge of Transport and Environment;
- after that “Prise en Considération”, the owner and his private partners must then conduct many studies, economical, technical, environmental... to define more precisely the project and its feasibility, and all the environmental needs linked to it;
- after decision by the “Tribunal Administratif” (Local Administrative Court) designating a chairperson or a Enquiry Commission, project is subject to “Enquêtes Publiques” (Public Inquiry) with the Public Inquiry Files being available in all the Town Halls of the cities and villages concerned (Sometimes more than 50....). There are in fact two simultaneous enquiries, one general regarding law on water and another regarding immersion of dredged sediments;
- at the same time the project is examined by many different administrative commissions, often requiring specific files different from those for public enquiry....For example
- Commission for the River Basin, for migratory fishes, for the aquatic environment, National Committee for Water and if the project is near a Nature Reserve, also Scientific Committee of the Nature Reserve, National Committee for Nature Protection with its different Commissions (for Flora, Fauna...), local Commission for Protected Areas....;
- if the project can have an impact on a Europe designated Natura 2000 site, which is often the case for navigation projects, the French Central Government has to notify the project to the European Union, based on specific files prepared by the owner;
- after the end of the public enquiries and the agreement of the different commissions, the Préfet (local representative of National Government) gives Work Permit according to Water Law;
- at the same time, the different municipalities have to decide the modification of their “Spatial planning regulation” in order to make the project possible;
- at the same time also, the private partners have to go through all their own decision process (Executive Board, General assembly) and obtain the bank loans for their participation to the project. They can also have to get administrative authorizations with specific procedures like building permit or activities permit in case of specific risks;
- at the end of all this process, the Minister in charge of Ports and Environment has to authorize formally the work for the project and if there is State Money linked to it, open the budget resources for the project.

This process co-mingles technical, environmental, political, and budgetary considerations at different points. All of this must happen before any construction can begin. At quite all stages any individual or NGO having interest in the zone can file a law suite before the Administrative Tribunal, putting the project at risks.

There are many thoughts in France to modify and facilitate all those procedures by a “single desk” approach, for instance one desk for all environmental procedures and one desk for all land planning procedures. For the moment this approach was not conclusive. At the end of 2017, the French Minister in charge of Ecological Transition announced new types of procedures such as global license (“Permis Enveloppe”) to speed up administrative inquiries and building of offshore wind power fields that for the moment do last 10 years or even more. Those modifications will certainly also benefit more widely to all maritime and inland waterways projects.

But really, even much more than the length and complication of procedures, the worst situation for any project is “Stop and Go” in the process of designing and building. The stop, often by legal decision, can cost very large amount of money, especially when it occurs after awarding of work contract. Furthermore, it can be very difficult and lengthy to start again after such a stop as the jurisdictional process engages many different inputs coming from administration, politicians, NGO’s.

A good example of such stopping still pending after months and even years is in France the possible building of a new airport in the Nantes Region or in Germany the deepening of Elbe River for the access to Hamburg Port for ultra large Container Ships.

To minimize the risks of those “Stop and Go”, it appears important to have continuous dialogue with all the different stakeholders concerned by the project.

It is also of utmost importance to take into consideration from the very beginning of the project, the environment of the global zone concerned by the project.

In this way, Working with Nature developed by PIANC (See <http://www.pianc.org/workingwithnature.php>) is really a philosophy of design and development that certainly cannot make the construction faster, but by eliminating most risks of future stops, can provide a more cost efficient way of conducting projects. That approach was used for all the Port 2000 project of a new Container Port in Le Havre and also for the start of environmental rehabilitation of the Seine Estuary and in effect, this project was lengthy and sometimes difficult but never with "Stop and Go".

II-6 How maintenance can be done more efficiently and effectively?

Which strategies are being developed in order to do the maintenance more efficiently and effectively and which items do govern your maintenance strategy:

Rank	STRATEGIES		Relevance
	Current strategies	Ideas and expected developments?	Affects ... % of your capital investment
Example	Planned maintenance	Risk based budget maintenance	70 %
Example	(Re-)act only in case of impending breakdown	Implementing an asset management model (direction, governance, planning, delivery) for traffic-relevant assets	40 %
Waterways			
1	Curative maintenance Reparations when necessary	Budget priorities based on : - Risk analysis - state indicators Implementation of new ageing diagnostic technique	
2	Planned preventive maintenance In some waterways with a fixed interruption period (1week/year)	Generalization to the whole network Optimization and adaptation according to the expected reliability goal	60,00 %
3	CMMS software		40% (100 % in 2020)
4	Asset management Database With criticality indicators (state, security, use) Risk analysis and cost/risk approaches maintenance project based on objective technical criteria	Generalization and improvements to help decisions	70 %
5	5S methods for maintenance centers		
PORTS			
	1.		
	Asset management based on 2 indicators mechanical state and use		30 to 50 %
	Inspections base on 3 levels : 1 current (survey); 2 state assessment; 3 detailed		
	Risk analysis (risks indicators for safety, and for use) to define failure mechanisms and		
	Software helping for asset management decisions maintenance		

Waterways

VNF already use classic preventive maintenance methods but has a maintenance project on the 2010-2020 period in order to reach a new harmonized strategy generalized to the whole network, including mainly 4 groups of actions : strategy and politic, organization of means, improved technical methods (use of tools as CMMS,...), asset management (use of database and indicators).

CNR (Rhône river) has scheduled recurrent preventive maintenance mainly based on:

6. Return of experience and manufacturer's specifications
7. Availability of navigation locks (shut down 7 days/year)
8. Preliminary investigations (if possible not underwater) and expertises

Ports

Asset management and maintenance strategies are existing in some ports (for example Le Havre, Marseilles have specific methods) but not current everywhere. Therefore:

2. Expected developments would be that relevant methods are used in all ports
3. It's difficult to assess percentage of use without inquiry (probably from 30 to 50 %) mainly in big ports

II-7 How to make infrastructure more environmentally-friendly and sustainable?

7A: Name the top three environmental considerations underlying the projects that have been executed for the last 5 years, i.e. how to make infrastructure more environmentally friendly and sustainable: "Working with Nature concepts?!"

Rank	Strategies
<i>Example</i>	<i>install fish-passes, implement "Working with Nature"-concepts</i>
1	In France, we have to follow the regulation "Avoid, Mitigate, Compensate" which is not far from the "Working with nature" concept.
2	Regarding port projects, the preservation of wet areas, maintenance of the environmental functionality and preservation of protected species are the top three environmental considerations.
3	

7B: Which percentage of your project budget do you spend (on average) for environmental considerations?

Environmental mitigation	The percentage of the project budget spent for environmental considerations is depending of the impacts. The main objective is to have no lost from an environmental point of view. Due to
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II-8 How to tackle the climate change challenge?

8A. Climate change in projects.

	Yes	No
Do you consider in your projects climate change?	Yes, sea level rise	

8B. If yes, then fill out the next table for the items listed (add or delete items that you find necessary/important)

#	Items	Explanation
1	Prognosis concerning the influence of climate change on your waterway system	<p>For the major ongoing harbour project on Mediterranean coast (Port-La-Nouvelle), sea level rise is the only oceano-meteo parameter taken into account.</p> <p>No tendencies were highlighted for storms climate and ocean currents in project area and no data were available for future waves and storm surges in studies area (Artelia, 2013).</p> <p>Among metocean parameters SLR has the major influence on the project and reference hazard selected comes from coastal risk assessment recommendation (ONERC 2010) with 3 assumptions of elevation by 2100 :</p> <ul style="list-style-type: none"> - optimistic hypothesis : 40 cm ; - pessimistic hypothesis : 60 cm ; - extreme hypothesis : 100 cm. <p>Pessimistic hypothesis has been retained in the project.</p>
2	Your adaption strategy towards climate change	Dikes and platforms are the only buildings dimensioned with future climate hypothesis (no retreat strategy for current harbour structures).
3	What are the total costs (in % of GDP) of the climate change strategy in your projects	Not estimated, as climate change is taken into account from the beginning of the studies by harbour authorities.
4	What are the costs that cannot be recovered from the investments made in Climate change i.e not compensable drawbacks and their costs (in % of GDP)	id.
5	Are any projects specifically developed because of climate change (if yes: what -type of- projects?)	<p>None</p> <p>Nota: Platforms and dikes design with CC criteria must be linked with today's structure levels and need specifical works.</p>

STATE AND PERSPECTIVES OF WATERBORNE TRANSPORT INFRASTRUCTURE LONG FORM QUESTIONNAIRE GERMANY

Introduction

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- ☐ Historical trends in infrastructure development;
- ☐ Need for new infrastructure to respond to the evolution of trade;
- ☐ Ways to improve project delivery;
- ☐ How to tackle the climate change challenge;
- ☐ How to structure project finance attractively;
- ☐ How to make construction faster and more cost-efficient;
- ☐ How to make infrastructure more environmentally-friendly and sustainable;
- ☐ How maintenance can be done more efficiently and effectively; and
- ☐ Emerging trends and technologies affecting waterborne transport.

For further information, please

- go to the PIANC website - <http://www.pianc.org>
- or
- contact our Chairperson – nicholas.pansic@stantec.com

Thank you for your time and interest!

¹ About PIANC:

PIANC is the forum where professionals around the world join forces to provide expert advice on cost-effective, reliable and sustainable infrastructures to facilitate the growth of waterborne transport. Established in 1885, PIANC continues to be the leading partner for government and the private sector in the design, development and maintenance of ports, waterways and coastal areas.

Goal of this questionnaire

Task Group 181 is reaching out to PIANC member countries, sister organizations, and inland and maritime transport stakeholders worldwide, to solicit data, reports, and industry knowledge that can inform the work of the group and lead to a useful dialogue on the future of this vital global enterprise.

This questionnaire is part of this data collection effort.

The goal of this questionnaire is to collect specific information on the state and perspectives of the waterborne transport infrastructure within the country and/or organization of the participant.

Structure of this questionnaire

This questionnaire is split in two parts:

Part I - 'Basic Data'.

Questions on existing transport patterns (e.g. modal split), infrastructure and financing.

Part II – 'Perspectives of Waterborne Transport Infrastructure'.

Questions on developments in shipping transport, project financing, environmental considerations, etc.

Notes to participant

We are happy to receive your feedback on this questionnaire. If you have any remarks or questions, please provide your findings to the Task Group member that you received it from.

We understand the questionnaire can be quite time-consuming. If you have relevant documentation in which we can find the answers to specific questions, we are most happy to analyze this information ourselves. In these cases, please provide us these documents, so you don't need to analyze them further.

Thank you for your participation!

Contents of questionnaire

Part I: Basic Data

5. Transport Data
6. Finance Data
7. Infrastructure Data
8. Historical trends and phases in infrastructure development

Part II: Perspectives of Waterborne Transport Infrastructure

9. Need for new infrastructure to respond to the evolution of trade
10. Emerging trends and technologies affecting waterborne transport:
11. How to structure project finance attractively
12. Ways to improve project delivery
13. How to make construction faster and more cost-efficient
14. How maintenance can be done more efficiently and effectively
15. How to make infrastructure more environmentally-friendly and sustainable:
16. How to tackle the climate change challenge

General information

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I would like to be kept informed by mail about the Task Group progress and its results	Yes X	No
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Explanation of questionnaire

- Light green marked cells to be filled in **Light green cell**
- Cells can be filled with either values, explanation or a 'X' to tick the box.

Part I: Basic Data

1. Transport Data:

“Please provide information about the Modal Split (freight transport) in your country”²

1A: This table should show the Modal Split (in percent of the total transport performance [tons-kilometer]) of the past 25 years and upcoming 15 years.

Year \ Mode	- 25 (1989)	- 20 (1994)	- 15 (1999)	- 10 (2004)	-5 (2009)	2014	+5 (2019)	+10 (2024)	+15 (2029)
International Transport									
Road	41,1*	60,6	82,5	99,7	98,4	105,1**	tbd.	tbd.	tbd.
Rail	18,3*	24,0	29,4	37,6	36,9	43,6**	tbd.	tbd.	tbd.
Waterways (sea transport)	31,3*	34,7	35,3 1110,0	37,0 1481,0	32,7 1629,4	36,2** 1982,4**	tbd.	tbd.	tbd.
Inland transport									
Road	tbd.	tbd.	341,7	398,4	415,6	468,9**	tbd.	675,6	tbd.
Rail	tbd.	tbd.	76,8	91,9	95,8	117,4**	tbd.	151,9	tbd.
Waterways	31,4*	31,7	62,7	63,7	55,5	60,3**	tbd.	80,2	tbd.

Values are in 10⁹ tons-kilometer - *: 1990 **: 2013

1B: Prepare a table with National Freight Transport Volumes [tons] on waterways - Import and Export separately - for the same years as presented in the figures under Part A.

Year	International Waterway transport****		Inland Waterway Transport		
	Import	Export	Import	Internal	Export
-25 years (1989)	96,0*	44,0*	96,2*	tbd.	52,5*
-20 years (1994)	124,8	65,0	98,5	227,0***	47,9
-15 years (1999)	137,8	73,9	100,5	229,1	44,7
-10 years (2004)	163,8	99,7	105,1	235,9	51,4
-5 years (2009)	155,9	100,1	83,7	203,9	49,1
now (2014)	171,4**	119,2**	104,5**	226,9**	47,8**
+5 years (2019)	tbd.	tbd.	tbd.	tbd.	tbd.
+10 years (2024)	tbd.	tbd.	tbd.	tbd.	tbd.
+15 years (2029)	tbd.	tbd.	tbd.	tbd.	tbd.

Values are in 10⁶ tons - *: 1990 **: 2013 ***: 1996 ****: by seagoing vessels

² If you have relevant documentation in which we can find the answers to specific questions, we are most happy to analyze this information ourselves. In these cases, please provide us these documents, so you don't need to analyze them further.

2. Finance Data:

“Budgeting for infrastructure works and financing of the same”

Remark:

Figures in 2A to 2C show only those parts of the budget on Germany's federal governments level. Which is more or less 100% of the budget for rail, but does not comprise the budget for non-federal roads (we do have a lot of them) and ports (inland and maritime). It is possible to get those figures too, but that will take some time.

2A. Please provide the following data:

Budget dedicated to transport infrastructure*	Average annual amount 2009 – 2014**	Currency [e.g. EUR, USD]
Capital investment in transport infrastructure	2.812.431	thousand €
Maintenance investment in transport infrastructure	3.093.677	thousand €

*: only road and waterways

*: only 2014

2B. The division of the total annual budget (capital + maintenance) dedicated to the Transport Infrastructure:

Transport infrastructure	percentage (%)
Roads	37,2
Rail	52,8
Waterways	10
TOTAL	100%

2C. The division of the total annual budget (capital + maintenance) dedicated to the Waterways transport infrastructure:

Transport infrastructure	percentage (%)
Ports Infrastructure for Maritime Traffic	tbd.
Waterway Infrastructure for Maritime Traffic	tbd.
Ports infrastructure for Inland Shipping	tbd.
Waterway infrastructure for Inland Shipping	tbd.
TOTAL	100%

3. Infrastructure Data:

This question is about the infrastructure that your organization/institutions is responsible for or is part of your premises.

3A. Value of waterborne transport infrastructure

Item	Current replacement value (please specify currency)	Accumulated backlog* (as amount or in % of the current replacement value – please specify)	
Sea ports	tbd.		
Maritime and Inland Waterways	52,6 * 10 ⁹ €	9,5 * 10 ⁹ €	18 %
Inland ports	tbd.		
Inland waterways	tbd.		

*: Shortfall in (re)investment and/or maintenance that should have been done but has been deferred due to financial, personnel or other restrictions.

3B. Age (years) and number (nos) of the main structures of your assets

Item	unit	Total	Age [years]				
			> 100	75- 100	50 - 75	25 - 50	0 - 25
locks	nos.	326	81	98	66	48	33
weirs	nos.	337	50	85	84	67	51
bridges	nos.	1354					
movable bridges	nos.	0					
canals	Length (km)	3.853					
dams (as part of navigation infrastructure)	length (m)	tbd.					
canal Bridges	nos.	10					
quay walls	length (m)	tbd.					
river training structures	nos.	4359					
light houses	nos.	120					
culverts	nos.	352	18	88	35	105	106
reservoirs	nos.	2					
...							

4. Historical trends and phases in infrastructure development: “Where do you stand now, and where do you expect to be in 25 years?”

Regarding the development of transport infrastructure one can in general distinguish four consecutive phases:

1. **Nation Building**
(era's of predominantly isolated or local purpose projects)
2. **Economic Efficiency**
(progressivism & large public works, system building)
3. **Environmental Enlightenment**
(more integrated and holistic approaches)
4. **Recapitalization, Resilience & Adaption**

We assume that strategies, aims and limitations for building and maintaining transport infrastructure differ significantly from phase to phase. Therefore it would be interesting to know, what percentage of your transport infrastructure is in each of these phases.

Phase	Share of projects [%]
1 Nation Building	0
2 Economic Efficiency	
3 Environmental Enlightenment	10
4 Recapitalization, Resilience & Adaption	90

Part II: Perspectives of Waterborne Transport Infrastructure

1. Need for new infrastructure to respond to the evolution of trade: “What are the demands of your clients?”

NOTE:

Various Clients will have different demands. Therefore, please provide an ‘average’ score based on your observations what the trade market demands from the infrastructure assets in your organization.

Items / value (0=none;10=very high)	0	1	2	3	4	5	6	7	8	9	10	Remarks
reliable infrastructure											X	
enabling quick operations									X			
better and more connections						X						
higher redundancy											X	
Resilience of infrastructure											X	
lower prices			X									
Safety - HSE			X									
more security (i.e. possible damage to vessels and/or cargo)			X									
improved draught									X			
better sailing predictions							X					
better clearance under bridges										X		
others:												
...												
...												

2. Emerging trends and technologies affecting waterborne transport in your port or waterway: „Whereto will transport develop?”

Please provide the top-5 trends in transport business you observe and how they impact your infrastructure (requirements). For reference, we have included some examples.

	Expected trends in the transport business	Complementary Trends & Technologies concerning infrastructure
Example	more LNG transport sailing on rivers and canals	increased safety measures on the fairways and ports
Example	Increase of ship size	Longer and/or wider locks, deepening of canals and rivers, increasing need for cargo handling facilities in ports
Example	Automatic sailing	Adapt pilotage and river information systems
1	Increase of ship size (seagoing vessels)	Deepening of rivers, increasing need for cargo handling facilities in ports, better hinterland connections
2	increasing transport of containers by inland vessels	Better clearance under bridges
3	Lowering ship emissions	research programme
4	LNG driven ships	Providing sufficient bunker infrastructure
5		

3. How to structure project finance attractively: “Do we implement PPP concepts or a landlord development (for ports) or just government investments out of national budgets?”

3A. How where your projects funded in the period 2000 – 2015?

Description	Sea port (%)	Maritime Traffic (%)	Inland port (%)	Inland shipping (%)
Fully public (Government Budget)		100		100
Public-Private-Partnership				
Fully Private/Industry				
Totals (%)	100%	100%	100%	100%

3B. Benefit for the investors /Reasons for investing:

Possible benefits	Importance in investment decision		
	low	medium	high
Macro-economic effects			X
Lower external costs		X	
Environment (CO2 neutral)		X	
Environment : interaction port -city (surroundings)	X		
Efficient operations		X	
Improvement of competitiveness		X	
achieve flexibility in future		X	
other			
...			
...			

4. How to design proposed projects to be successful and prosperous? (key success factors)

Name and list the last three infrastructure projects executed:

- **when was it built?**
- **why was it built?**
- **what was the effect/result?**
- **why was it successful (or not)?**

Success factors to be considered (examples):

1. Transport Infrastructure Plan
2. Project management Tools
3. Public Private Partnership
4. Legal initiation
5. Stakeholder involvement
6. Taking into account environment / working with nature from the beginning
7.

#	Project name	Year of construction	Reason for construction	Effect / result	Success factors for the project
1	Shiplift Niederfinow	Still under construction	End of lifespan for old shiplift, prognosis of increasing number of ships	Prognosis not fulfilled	
2	Deepening of rivers Elbe and Weser (seaward access to ports of Hamburg and Bremen/Bremerhaven)	Planning phase	Growing ship size	Project delayed (for years) because of lawsuit (environmental protection)	
3	Building second lock chambers at the river Mosel locks	Two locks completed, next ones to follow	Increasing number of ships, long queue times	Lesser queue times	Regional acceptance, no use of third parties property

5. How to make construction faster and more cost-efficient.

For typical projects in your field of expertise/competence list the projects and present the details in the following tables.

5A. Typical time-consumption during the construction implementation period of the infrastructure (in %)

Note: fill out the percentage in each column, for example for locks, canals, quay walls, bridges, etc.

Nos.	Planning Process	Planning Approval	Budgeting	Procurement	Realisation	Total
<i>Example</i>	15	20	15	10	40	100%
Locks						100%
Canals						100%
Quay walls						100%
Other:						
...						
...						

5B. Typical problems in projects and your strategy to deal with them

#	Typical Problems:	Strategy to deal with this problem
<i>Example</i>	<i>Permitting</i>	<i>increased efforts to communicate with institutions</i>
<i>Example</i>	<i>NIMBY ("not in my backyard"): "Ok, waterway transport is a good thing – in general. But the new port should not be in my direct vicinity! Build it somewhere else!"</i>	<i>Increased efforts to communicate with the civil society, early involvement, etc.</i>
1		
2		
3		
4		
5		

6. Which strategies are being developed in order to do the maintenance more efficiently and effectively and which items do govern your maintenance strategy:

Rank	STRATEGIES		Relevance
	Current strategies	Ideas and expected developments?	Affects ... % of your capital investment
<i>Example</i>	<i>Planned maintenance</i>	<i>Risk based budget maintenance</i>	<i>70 %</i>
<i>Example</i>	<i>(Re-)act only in case of impending breakdown</i>	<i>Implementing an asset management model (direction, governance, planning, delivery) for traffic-relevant assets</i>	<i>40 %</i>
1			
2			
3			
4			
5			

7. Environmental considerations in projects

7A: Name the top three environmental considerations underlying the projects that have been executed for the last 5 years, i.e. how to make infrastructure more environmentally-friendly and sustainable: „Working with Nature concepts?!“

Rank	Strategies
<i>Example</i>	<i>install fish-passes, implement "Working with Nature"-concepts</i>
1	
2	
3	

7B: Which percentage of your project budget do you spend (on average) for environmental considerations?

	%	
--	---	--

8. How to tackle the climate change challenge: “What do you expect from it and how do you manage that?”

8A. Climate change in projects.

	Yes	No
Do you consider in your projects climate change?	X	

8B. If yes, then fill out the next table for the items listed (add or delete items that you find necessary/important)

#	Items	Explanation
1	Prognosis concerning the influence of climate change on your waterway system	
2	Your adaption strategy towards climate change	
3	What are the total costs (in % of GDP) of the climate change strategy in your projects	
4	What are the costs that cannot be recovered from the investments made in Climate change i.e not compensable drawbacks and their costs (in % of GDP)	
5	Are any projects specifically developed because of climate change (if yes: what -type of- projects?)	

STATE AND PERSPECTIVES OF WATERBORNE TRANSPORT INFRASTRUCTURE LONG FORM QUESTIONNAIRE JAPAN

Introduction

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- ☐ Ways to improve project delivery;
- ☐ How to tackle the climate change challenge;
- ☐ How to structure project finance attractively;
- ☐ How to make construction faster and more cost-efficient;
- ☐ How to make infrastructure more environmentally-friendly and sustainable;
- ☐ How maintenance can be done more efficiently and effectively; and
- ☐ Emerging trends and technologies affecting waterborne transport.

For further information, please

- go to the PIANC website - <http://www.pianc.org>
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This questionnaire is split in two parts:

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Questions on existing transport patterns (e.g. modal split), infrastructure and financing.

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Thank you for your participation!

General information

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I would like to be kept informed by email about the Task Group progress and its results	Yes	
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Part I: Basic Data on Waterborne Transport Infrastructure

1. Freight Transport Modal Split - in tonne-kilometers or other units (define)

1.1. Domestic Freight

Current situation:

What PERCENTAGE of the freight transported within your country moves by the various modes – (please provide the most recent information available).

Mode	%	billion tonne-km	Source
Road	50.9	214	Data of Ministry
Rail	5.0	21	Data of Ministry
Waterway	44.0	185	Data of Ministry
Air	0.02	0.1	Data of Ministry
Pipeline	0	Small	-
Intermodal	0	Small	-

Recent trends:

What are the recent historical trends in these modal splits? I.e., is transport on the waterways increasing or decreasing as a percentage of all freight?
Transports on the road and the rail are increasing and decreasing, respectively. Transport on the waterway almost remains stable. The percentage of the waterway is slightly decreasing. In the future the share might decrease for road because of shortage of truck drivers or consideration for CO ₂ emissions.
See also (Cite agency or relevant reference, if known.)

Future outlook:

What is the outlook for the future? Is the historical trend expected to continue? What is likely to change?
Basically, the trend is expected to continue. The terminal for the intermodal is being constructed in some ports including Port of Tokyo. It might change the percentage.
See also (Cite agency or relevant reference, if known.)

1.2. International Freight

What PERCENTAGE of the international freight entering and leaving your country moves by the various modes?

Mode	%	million ton	Source
Road	0	0	-
Rail	0	0	-
Waterway or Port	99.9	1291	Data of Ministry
Air	0.1	1.4	Data of Ministry
Pipeline	0	0	-

Recent trends

What are the recent historical trends in these modal splits? I.e., is transport on the waterways increasing or decreasing as a percentage of all freight?
As Japan is an island, the modes are limited only to waterway and air.
See also (Cite agency or relevant reference, if known.)

Future outlook

What is the outlook for the future? Is the historical trend expected to continue? What is likely to change?
The trend will continue. Although there is an idea to build a pipeline from the continent, it would be difficult.
See also (Cite agency or relevant reference, if known.)

1.3. How much freight (volume and TEUs) moves by water in your country?

Waterborne Freight Transport Volumes (most recent data available)

Inland Waterways Information

Length of Navigable Waterways (specify units)

-

Annual Volume of Bulk Freight Transport (units & year)

-

Annual Container Transport (TEUs & year)

-

Maritime (Deep Draft) Port Information

Number of Ports	2(Strategic), 123 (Major) ,808 (Minor)
Annual Volume of Bulk Freight Moved (units & year)	1,950 million tons, 2014
Annual Number of Containers Moved (TEUs and year)	21,717,563 TEUs, 2014

Inland Trends – What is the recent historical trend of freight moved via inland waterways? Is it increasing, decreasing, or staying the same? What are the future expectations?

-

See also (Cite agency or relevant reference, if known.)

Maritime Trends - What is the recent historical trend of freight moved through deep draft ports? Is it increasing, decreasing, or staying the same? What are the future expectations?

Both bulk freight and container are slightly increasing. This trend will continue.

See also (Cite agency or relevant reference, if known.)

2. Finance Data: How much money is spent on transport infrastructure in your country?

Total Spend – All transport infrastructure.

Budget Dedicated to All Transport Infrastructure	Average Annual Amount	Currency and Year	Source
Capital Investment (New Infrastructure)	**	**	**
Operations, Maintenance & Repair (Existing Infrastructure)	**	**	**

Modal Split - How is this spending divided among the transport modes?

Mode	Percentage (%) of Total Transport Spending	Source
Roads	79.5 (1,048 Billion Yen)	Data of Ministry
Rail	7.3 (96 Billion Yen)	Data of Ministry
Waterways and Ports	13.2 (173 Billion Yen)	Data of Ministry
TOTAL	100%	

The above values are only government budgets.

Waterborne Transport Only - How is spending on WATER transport infrastructure divided between capital (i.e. new construction) vs. Operations and Maintenance (taking care of existing infrastructure)?

Type of Waterborne Transport	% of Budget Spent on Capital Investment (New Infrastructure)	% of Budget Spent on Operations, Maintenance & Repair
Inland Waterways	-	-
Maritime Sea Ports	**	**

Public vs. Private - How is spending on water transport infrastructure divided between public (government) and private sector?

Type of Waterborne Transport	% Government-Sector Spending	% Private-Sector Spending
Inland Waterways	-	-
Maritime Sea Ports	**	**

FUTURE OUTLOOK for Spending and Needs:

What is the trend in the Capital vs. OM&R spending? More spending on O& M?
A number of infrastructure on transport are aging, and the budget of repair is gradually increasing. In near future, the budget needed for repair will dramatically increase.
See also (Cite agency or relevant reference, if known.)
What is the trend in public vs. private spending?
The percentage of them will remain stable.
See also (Cite agency or relevant reference, if known.)
What is the greater need for your country - new infrastructure or more maintenance and repair of aging infrastructure?
New infrastructure is needed for sustainable development of the country. On the other hand, the budget for repair will increase because a number of infrastructure in the country were constructed in the period of high growth of 1954-1973. The policy of selection and concentration is needed.
See also (Cite agency or relevant reference, if known.)

To what extent is dredging, disposal, or deepening of navigation channels a need in your country?
Regular dredging will be needed. Disposal sites need to be constructed in future. Regarding navigation channel at the sea, expansion is necessary to accommodate bigger vessels.
See also (Cite agency or relevant reference, if known.)

3. Assets - Infrastructure Data: How much water transport infrastructure do you have, and how old is it?

Number and age (years) of your main waterborne transport assets.

Item	Unit	Total No.	Age [years]				Total
			0-30	30-40	40-50	50>	
Locks	Number	10000	38%	22%	16%	24%	100%
Dams (as part of navigation infrastructure)	length (m)	0	-	-	-	-	-
Quay walls	Number	5000	44%	27%	22%	7%	100%
Road bridges (15m>)	Number	157000	47%	25%	19%	9%	100%
See also (Cite agency or relevant reference, if known.)							

Part II: Perspectives on Waterborne Transport Infrastructure

1. Need for new infrastructure to respond to the evolution of trade:

Who are your clients? What are they demanding of your organization/business? What are your customers' needs and expectations, and how do you see them evolving within the next 5, 10 or 20 years?

Key Customers/Clients: Port users (carriers, shippers, port operators, stevedoring companies, truckers, etc.)
Customer demands, expectations: Appropriate service levels (short lead-times, reliability, visibility, etc.) with proper costs.
How their needs will evolve over time: As Japan is a matured country, our customers are becoming more and more demanding on services.

What customer expectations most impact your operations and infrastructure investment decisions? For example: reliable infrastructure; quick operations; lower prices; improved facility, other...

No. 1 Expectation of Your Customers: Cost reduction
How it impacts your investment decisions: We need to accommodate bigger vessels and we are expected to decrease land transport costs as well by provision of good hinterland access.
No. 2 Expectation of Your Customers: Reliability of services even under emergency situations such as natural disaster.
How it impacts your investment decisions: Concept of business continuity/resiliency needs to be introduced.

2. Emerging trends or technological advances affecting waterborne transport in your country's ports and waterways – where is transport headed?

Please provide the top trends or technological advances in waterborne transport – or its alternatives – that you observe, and the associated impact(s) on your infrastructure requirements. Some examples are provided for reference.

Trend No.	Emerging Trends or Technologies in Transport	Comments
Example	more LNG transport sailing on rivers and canals	Leading to increased safety measures on the fairways and ports
Example	Increase of ship size	Larger locks, deepening of canals and rivers, increasing need for cargo handling facilities in ports
Example	Automatic sailing	Adaptation of pilotage and river information systems
1	Bigger vessel sizes	Development of larger port facilities
2	Panama/ Suez Canal expansion	Change of vessel sizes/dimensions Change of shipping routes
3	Business continuity management at ports	Good preparation for natural disasters, resilient port facilities
4	Smart port system	Introduction of ICT for more smooth connection or visibility
5	Short sea shipping within Asia	Frequent and fast maritime transport services in ASIA
6	Automated terminal operation	Safer terminal operation
7	Better hinterland access	Use of rail/vessels, inland container depots
8	Modal shift	Shortage of truck drivers, awareness on climate change
9	NSR (Northern Shipping Route)	Decrease of transport time/cost between Europe and Asia
10	LNG fuel vessels	Better air quality in port areas

3. Enhancing the value of your waterborne transport infrastructure – what drives investment and what inhibits or constrains it?

- 3A. What are the main triggers for your waterborne infrastructure investments? (e.g., aging infrastructure, legal compliance, increased demand, etc.).

Drivers of investment:

Steady increase of cargo volume due to growing Asian economies Growth of vessel sizes

- 3B. How are your projects funded (public, private, partnerships)? What are the main hurdles to securing funding?

Funding strategies & constraints:

Basis structure or main facilities are funded mainly by the public. Budget for public works has been gradually decreased which is one of the significant hurdles.

- 3C. What are the major problems your organization faces in getting projects executed (e.g., funding availability, real estate availability, divergent stakeholder needs, complex procedures and regulations, lack of resources, long delays from planning to approval to execution, evolving technology, other)

Project execution challenges:

As is stated in 3B shortage of funding is a significant issue. In addition sometimes we have troubles in gaining agreements by local stakeholders.

- 3D. Please provide some examples of recent investments in your organization. How were the investments prioritized (return on investment, regulatory compliance, improved competitiveness, other)? How is the success of the investment measured?

Example recent investment:

The Government selected strategic ports (container/bulk) on which major investments are concentrated.

- 3E. What would you need moving forward to support your infrastructure asset management strategies (risk based maintenance planning, asset management system/tools to optimize value driven capital investment, commercial frameworks, other)

Keys to managing your assets:

Introduction of LCC(Life Cycle Cost), Facility Maintenance Plan, Port Maintenance and Management Plan

4. Environmental considerations in projects

- 4A: To what extent do you consider climate change and environmental impact in your projects? Does your organization have a formal strategy concerning climate change?

Environmental drivers:

In order to reduce CO₂ emission, efforts for modal-shift has been conducted. Also it is recognized that accepting larger vessels will contribute to reduce of CO₂ emission.
In construction of port facilities such as breakwaters or dykes, we carefully monitor tide levels and wave. We have a formal policy directions on climate change.

- 4B: Which percentage of your project portfolio budget do you spend on average for environmental considerations? Are these costs recoverable?

Percent of total spend on environmental aspects:

Very roughly, 1% has been spent. This budget is regarded as public spending.

- 4B: Please give examples of how environmental considerations factor into your projects (fish passage, environment mitigation, sustainability requirements in new construction, degradable oils, etc.). Have some projects been specifically developed because of climate change?

Key environmental considerations:

instance, we create tidelands at port areas.

- 4D: How do you see climate change and environmental considerations affecting your organization in the future?

Outlook for environmental / climate change considerations:

In the long run we will have to continue to monitor the actual situations regarding climate change and environment at ports, and react adequately to such trends.

STATE AND PERSPECTIVES OF WATERBORNE TRANSPORT INFRASTRUCTURE LONG FORM QUESTIONNAIRE NETHERLANDS

Introduction

The World Association for Waterborne Transport Infrastructure¹ (PIANC), has formed the Task Group 181. The goal of this Task Group is to investigate and report to industry on:

- ☐ Historical trends in infrastructure development;
- ☐ Need for new infrastructure to respond to the evolution of trade;
- ☐ Ways to improve project delivery;
- ☐ How to tackle the climate change challenge;
- ☐ How to structure project finance attractively;
- ☐ How to make construction faster and more cost-efficient;
- ☐ How to make infrastructure more environmentally-friendly and sustainable;
- ☐ How maintenance can be done more efficiently and effectively; and
- ☐ Emerging trends and technologies affecting waterborne transport.

For further information, please

- go to the PIANC website - <http://www.pianc.org>
- or
- contact our Chairperson – nicholas.pansic@stantec.com

Thank you for your time and interest!

¹ About PIANC:

PIANC is the forum where professionals around the world join forces to provide expert advice on cost-effective, reliable and sustainable infrastructures to facilitate the growth of waterborne transport. Established in 1885, PIANC continues to be the leading partner for government and the private sector in the design, development and maintenance of ports, waterways and coastal areas.

Goal of this questionnaire

Task Group 181 is reaching out to PIANC member countries, sister organizations, and inland and maritime transport stakeholders worldwide, to solicit data, reports, and industry knowledge that can inform the work of the group and lead to a useful dialogue on the future of this vital global enterprise.

This questionnaire is part of this data collection effort.

The goal of this questionnaire is to collect specific information on the state and perspectives of the waterborne transport infrastructure within the country and/or organization of the participant.

Structure of this questionnaire

This questionnaire is split in two parts:

Part I - 'Basic Data'.

Questions on existing transport patterns (e.g. modal split), infrastructure and financing.

Part II – 'Perspectives of Waterborne Transport Infrastructure'.

Questions on developments in shipping transport, project financing, environmental considerations, etc.

Notes to participant

We are happy to receive your feedback on this questionnaire. If you have any remarks or questions, please provide your findings to the Task Group member that you received it from.

We understand the questionnaire can be quite time-consuming. If you have relevant documentation in which we can find the answers to specific questions, we are most happy to analyze this information ourselves. In these cases, please provide us these documents, so you don't need to analyze them further.

Thank you for your participation!

Contents of questionnaire

Part I: Basic Data

- 9. Transport Data
- 10. Finance Data
- 11. Infrastructure Data
- 12. Historical trends and phases in infrastructure development

Part II: Perspectives of Waterborne Transport Infrastructure

- 17. Need for new infrastructure to respond to the evolution of trade
- 18. Emerging trends and technologies affecting waterborne transport:
- 19. How to structure project finance attractively
- 20. Ways to improve project delivery
- 21. How to make construction faster and more cost-efficient
- 22. How maintenance can be done more efficiently and effectively
- 23. How to make infrastructure more environmentally-friendly and sustainable:
- 24. How to tackle the climate change challenge

General information

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I would like to be kept informed by mail about the Task Group progress and its results	Yes	
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Explanation of questionnaire

- Light green marked cells to be filled in Light green cell
- Cells can be filled with either values, explanation or a 'X' to tick the box.

Part I: Basic Data

1. Transport Data:

“Please provide information about the Modal Split (freight transport) in your country”²

1A: This table should show the Modal Split (in percent of the total transport performance [tons-kilometer]) of the past 25 years and upcoming 15 years.

Year \ Mode	- 25 (1989)	- 20 (1994)	- 15 (1999)	- 10 (2004)	- 5 (2009)	2014	+5 (2019)	+10 (2024)	+15 (2029)
International Transport									
Road									
Rail									
Waterways									
Inland transport									
Road									
Rail									
Waterways									

Please refer to these sources for your information. Future scenarios cannot be translated into the table above.

Source: Eurostat and CBS 1998 – 2010:

<http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=81914NED&D1=a&D2=0-5&D3=a&HDR=T&STB=G1,G2&VW=T>

http://ec.europa.eu/eurostat/statistics-explained/index.php/Freight_transport_statistics_-_modal_split#Modal_split_in_the_EU_and_the_countries

Source 2 : Mobiliteitsbeeld 2014

http://www.kimnet.nl/sites/kimnet.nl/subsites/mobiliteitsbeeld-2014/3_4.html#tab-2

Source 3 : TLC – Transport in Cijfers (TIC, 2014)

Source 4: Monitoring modal shift (IenM/Panteia, 2011).

http://www.modularsystem.eu/download/facts_and_figures/3839492_rapport_shift_lzv_eng.PDF

² If you have relevant documentation in which we can find the answers to specific questions, we are most happy to analyze this information ourselves. In these cases, please provide us these documents, so you don't need to analyze them further.

- 1B: Prepare a table with National Freight Transport Volumes [tons] on waterways - Import and Export separately - for the same years as presented in the figures under Part A.

Year	International Waterway transport		Inland Waterway Transport		
	Import	Export	Import	Internal	Export
-25 years (1989)					
-20 years (1994)					
-15 years (1999)					
-10 years (2004)					
-5 years (2009)					
now (2014)					
+5 years (2019)					
+10 years (2024)					
+15 years (2029)					

Please refer to these sources if you want to compare data of the Netherlands on transport volumes.

Source CBS 2010 – 2014 (older data on request)

<http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=82514NED&D1=a&D2=a&D3=0&D4=a&HDR=T&STB=G1,G2,G3&VW=T>

2. Finance Data:

“Budgeting for infrastructure works and financing of the same“

- 2A. Please provide the following data:

Budget dedicated to transport infrastructure	Average annual amount 2009 - 2014	Currency [e.g. EUR, USD]
Capital investment in transport infrastructure	2,23 mld*	eur
Maintenance investment in transport infrastructure	2 mld**	eur

* Gemiddelde van de jaren 2015-2028, OB2015 artikelen aanleg en geïntegreerde contracten. Betreft HWN, HVWN en spoor

** Gemiddelde van de jaren 2015-2028, OB 2016, bijlage BenO, VM en V&R

- 2B. The division of the total annual budget (capital + maintenance) dedicated to the Transport Infrastructure:

Transport infrastructure	percentage (%)
Roads	50%
Rail	37%
Waterways	13%
TOTAL	100%

- 2C. The division of the total annual budget (capital + maintenance) dedicated to the Waterways transport infrastructure: **Not available because we register it differently. Only obtainable by adding the price of all the individual projects.**

Transport infrastructure	percentage (%)
Ports Infrastructure for Maritime Traffic	
Waterway Infrastructure for Maritime Traffic	
Ports infrastructure for Inland Shipping	
Waterway infrastructure for Inland Shipping	
TOTAL	100%

3. Infrastructure Data:

This question is about the infrastructure that your organization/institutions is responsible for or is part of your premises.

- 3A. Value of waterborne transport infrastructure: **not available**

Item	Current replacement value (please specify currency)	Accumulated backlog* (as amount or in % of the current replacement value – please specify)
Sea ports		
Maritime Waterways		
Inland ports		
Inland waterways		

*: Shortfall in (re)investment and/or maintenance that should have been done but has been deferred due to financial, personnel or other restrictions.

- 3B. Age (years) and number (nos) of the main structures of your assets

Item	unit	Total	Age [years]				
			> 100	75- 100	50 - 75	25 - 50	0 - 25
locks	nos.	133	17	42	28	33	13
weirs	nos.	10		7	2	1	
bridges	nos.	904*	6	87	122	449	240
movable bridges	nos.	177**	8	22	71	50	26
canals	length (m)						
dams (as part of navigation infrastructure)	length (m)						
canal Bridges	nos.						
quay walls	length (m)						
river training structures	nos.						
light houses	nos.						
culverts	nos.	99	5	44	11	29	10
reservoirs	nos.						
Aquaduct	nos.	12			1	4	7
Discharge locks / sluices	nos.	92	4	28	29	21	10
Pumping stations***	nos.	17		8		7	2
Storm surge barrier	nos.	5			1	1	3

*704 bridges are part of the motorway / highway network. 200 bridges are part of local / regional road networks

**56 movable bridges are part of the motorway / highway network. 121 bridges are part of local / regional road networks

*** pumpings stations may be used for water management purposes (i.e. discharge of water) but also to maintain waterlevels for navigational purposes

4. Historical trends and phases in infrastructure development: “Where do you stand now, and where do you expect to be in 25 years?”

Regarding the development of transport infrastructure one can in general distinguish four consecutive phases:

1. **Nation Building**
(era's of predominantly isolated or local purpose projects)
2. **Economic Efficiency**
(progressivism & large public works, system building)
3. **Environmental Enlightenment**
(more integrated and holistic approaches)
4. **Recapitalization, Resilience & Adaption**

We assume that strategies, aims and limitations for building and maintaining transport infrastructure differ significantly from phase to phase. Therefore it would be interesting to know, what percentage of your transport infrastructure projects is in each of these phases.

Phase	Share of projects [%]
1 Nation Building	No current phase
2 Economic Efficiency	No current phase
3 Environmental Enlightenment	No figures available
4 Recapitalization, Resilience & Adaption	No figures available

Part II: Perspectives of Waterborne Transport Infrastructure

1. Need for new infrastructure to respond to the evolution of trade: “What are the demands of your clients?”

NOTE:

Various Clients will have different demands. Therefore, please provide an 'average' score based on your observations what the trade market demands from the infrastructure assets in your organization.

	% first rate	% second rate	% third rate
Quality waterway	33	31	19
Safety waterway	32	30	17
Execution activities on waterway	26	18	17
Controlling bridges and locks	6	14	20
Information and traffic signs traffic posts	3	7	22

Note: question asked was which importance clients attached to certain aspects of inland waterways. The aspects where:

- Quality inland waterway
- Safety inland waterway
- Execution activities on waterway
- Controlling bridges and locks
- Information and traffic signs from traffic posts

2. Emerging trends and technologies affecting waterborne transport in your port or waterway: “Whereto will transport develop?”

Please provide the top-5 trends in transport business you observe and how they impact your infrastructure (requirements). For reference, we have included some examples.

	Expected trends in the transport business	Complementary Trends & Technologies concerning infrastructure
Example	more LNG transport sailing on rivers and canals	increased safety measures on the fairways and ports
Example	Increase of ship size	Longer and/or wider locks, deepening of canals and rivers, increasing need for cargo handling facilities in ports
Example	Automatic sailing	Adapt pilotage and river information systems
1	More LNG transport overseas.	- Increased safety measures in relevant parts of ports - Adaptions in inland bunkering stations.
2	Ongoing process of enlargement of the average dimensions of inland vessels (aandeel klasse V en VI stijgt, aandeel lagere klassen daalt)	Depending on the distribution of the fleet related to the size of locks, it might lead to a decreasing capacity of certain locks and subsequently to the need of extension.
3	Development of traffic management on corridors (VCM, CoRISma, Pianc WG 125)	- Extended construction of extra lock capacity - More flexibility in use of berthing places.
4	Increasing share of high cube containers (30 cm higher then standard TUE)	Depending on nations policy, the possible need for higher bridges over canals.
5	More information (systems) on board of inland vessels.	Possible decrease in the need of VTS-guidance and systems.

3. How to structure project finance attractively: “Do we implement PPP concepts or a landlord development (for ports) or just government investments out of national budgets?”

3A. How where your projects funded in the period 2000 – 2015?

Hans de Kievit (RWS-GPO) has information as financial manager Locks program Hier nog aanvulling verwijzingslinkje financiering MIRT:

http://mirt2016.mirtoverzicht.nl/financien/financiele_uitwerking/inzet_van_de_middelen/

Helaas is na 2013 niet meer (vindbaar?) bijgehouden hoe de uitgaven tot stand komen (geld van derden/ van lagere overheden/ EU-subs/ rijk).

Op de projectbladen zelf is dit echter wel te vinden (zowel voorfinanciering als bijdrage).

Description	Sea port (%)	Maritime Traffic (%)	Inland port (%)	Inland shipping (%)
Fully public (Government Budget)				
Public-Private-Partnership				
Fully Private/Industry				
Totals (%)	100%	100%	100%	100%

3B. Benefit for the investors /Reasons for investing:

Possible benefits	Importance in investment decision		
	low	medium	high
Macro-economic effects			
Lower external costs			
Environment (CO2 neutral			
Environment : interaction port -city (surroundings)			
Efficient operations			
Improvement of competitiveness			
achieve flexibility in future			
other			
...			
...			

Not available, depends on the project

4. How to design proposed projects to be successful and prosperous? (key success factors)

Name and list the last three infrastructure projects executed:

- **when was it built?**
- **why was it built?**
- **what was the effect/result?**
- **why was it successful (or not)?**

Success factors to be considered (examples):

1. Transport Infrastructure Plan
2. Project management Tools
3. Public Private Partnership
4. Legal initiation
5. Stakeholder involvement
6. Taking into account environment / working with nature from the beginning
7.

#	Project name	Year of construction	Reason for construction	Effect / result	Success factors for the project
1					
2					
3					

5. How to make construction faster and more cost-efficient:

Figures possibly available in the project “multi waterwerk” via Arjan Hijdra, RWS.

For typical projects in your field of expertise/competence list the projects and present the details in the following tables.

5A. Typical time-consumption during the construction implementation period of the infrastructure (in %)

Note: fill out the percentage in each column, for example for locks, canals, quay walls, bridges, etc.

Nos.	Planning Process	Planning Approval	Budgeting	Procurement	Realisation	Total
<i>Example</i>	15	20	15	10	40	100%
Locks						100%
Canals						100%
Quay walls						100%
Other:						
...						
...						

5B. Typical problems in projects and your strategy to deal with them

#	Typical Problems:	Strategy to deal with this problem
<i>Example</i>	<i>Permitting</i>	<i>increased efforts to communicate with institutions</i>
<i>Example</i>	<i>NIMBY (“not in my backyard”): “Ok, waterway transport is a good thing – in general. But the new port should not be in my direct vicinity! Build it somewhere else!”</i>	<i>Increased efforts to communicate with the civil society, early involvement, etc.</i>
1		
2		
3		
4		
5		

6. Which strategies are being developed in order to do the maintenance more efficiently and effectively and which items do govern your maintenance strategy:

Rank	STRATEGIES		Relevance
	Current strategies	Ideas and expected developments?	Affects ... % of your capital investment
<i>Example</i>	<i>Planned maintenance</i>	<i>Risk based budget maintenance</i>	70 %
<i>Example</i>	<i>(Re-)act only in case of impending breakdown</i>	<i>Implementing an asset management model (direction, governance, planning, delivery) for traffic-relevant assets</i>	40 %
1	Risk based maintenance	Increased use of quantitative methods (RCM based) to get a better understanding of performance level. <small>Note: this is an evolvement of the current strategy (using RCMII / FMECA etc.)</small>	20% ³
2	Separate approaches for maintenance and replacement	Moving towards a more integrated assessment of both maintenance and replacement needs (using lifecycle costing)	40% ⁴
3	Preventive maintenance	Increased use of Life Cycle Costing and risk analysis as tools to optimize maintenance strategies	50% ⁵
4			
5			

³ Based on the premise that it's executed for only a few objects

⁴ Also a rough premise - ⁵ See note 4

7. Environmental considerations in projects

7A: Name the top three environmental considerations underlying the projects that have been executed for the last 5 years, i.e. how to make infrastructure more environmentally-friendly and sustainable: "Working with Nature concepts?!"

Rank	Strategies
<i>Example</i>	<i>install fish-passes, implement "Working with Nature"-concepts</i>
1	Room for the River
2	Water framework directive
3	Environment and nature maintenance

7B: Which percentage of your project budget do you spend (on average) for environmental considerations?

	%
--	---

8. How to tackle the climate change challenge: "What do you expect from it and how do you manage that?"

8A. Climate change in projects.

	Yes	No
Do you consider in your projects climate change?	In the road and waterway projects climate is now considered in an implicit way. Four projects currently treat climate explicitly, as part of a climate pilot investigation. It is the aim that all projects consider climate after completion of the climate pilots and no later than 2017.	

8B. If yes, then fill out the next table for the items listed (add or delete items that you find necessary/important)

#	Items	Explanation
1	Prognosis concerning the influence of climate change on your waterway system	Climate change can affect inland shipping transport (~ 1/3 of transport of goods in NL) and our waterways in several ways, the most important being too shallow waters (for inland shipping) due to drought, and high river discharge due to excessive rain (not enough clearance at bridges, functioning of sluices). Other effects are more heat (bridges stuck), more severe storms and winds, change in river bed erosion and (less) ice formation. These problems are now addressed in a NAS program (national adaptation strategy) and the national Delta program, but climate change is often already incorporated in maintenance, repair and renovation activities.
2	Your adaption strategy towards climate change	The adaptation strategy for our water security and fresh water supplies has been developed and is now implemented in the Delta program. For the other sectors, the NAS program now develops aims, strategies and actions. For infrastructure, these are developed for roads, waterways, rail and aviation.
3	What are the total costs (in % of GDP) of the climate change strategy in your projects	The costs of incorporating climate change into road and waterway projects is currently investigated in the 4 pilot projects. The costs of the Delta program amount to ~ € 1 milliard annually (? % of GDP?
4	What are the costs that cannot be recovered from the investments made in Climate change i.e not compensable drawbacks and their costs (in % of GDP)	currently investigated in the pilot projects
5	Are any projects specifically developed because of climate change (if yes: what -type of- projects?)	Yes, within the Delta program, f.i "room for the river" projects, fortification of levees..

APPENDIX F

SUMMARY OF RESPONSES TO TG 181 SHORT QUESTIONNAIRE

Region	Q1: What new waterborne transport infrastructure is most needed to respond to the evolution of trade and market trends?
Asia/Oceania (input from Philippines, Malaysia, Vietnam, India, Japan, Singapore)	<ul style="list-style-type: none"> - Better inland/hinterland connections (rail linkages and port access road upgrades, inland waterways and Ro-Ro routes, dry ports) - Ways to relieve port congestion, such as Off-dock logistic facility (e.g. Manila gas plant 500 m away from MICT) - Dredging for deeper channels and berths, also more maintenance to sustain these depths - Updating port terminals, esp. container terminals, to accommodate larger ships - Technology hub for knowledge transfer Infrastructure to handle LNG - Rivers need improvements to ensure year-round navigation Bridges over inland waterways need to be raised Hydropower plants in the river impact current and flow - Logistics system infrastructure to optimize utilization of existing ports - Cost effective and efficient coastal and inland waterway infrastructure with minimal environmental impact. - More reliable infrastructure to ensure business continuity/resiliency
Europe (input from Germany, the Netherlands, Finland, Spain)	<ul style="list-style-type: none"> - Better hinterland connections with all modes (rail, road, inland waterways) More reliable and safer infrastructure - Redundancy and resilience in infrastructure Better clearance under bridges - More efficient operations (e.g. High performance cargo handling operations) - Strengthening quays and yards for higher payloads - Alternative fuel and charging facilities for both marine vessels and landside vehicles (more use of natural gas, solar) - Deeper channels and berths - Better forecasts of traffic, volumes of cargo to enable better planning for infrastructure to handle it.
Middle East (input from Iran)	<ul style="list-style-type: none"> - Better hinterland connections (more rail, less trucks) Deeper channels and berths - More efficient port operations
North America (input from U.S.)	<ul style="list-style-type: none"> - Larger locks on the inland waterways, updates of aging locks and dams Better hinterland connections with all modes (rail, road, inland waterways) Connect inland industries to waterways - More and better barges for container shipping - Systems approach to marine highways, including policy and legal changes to facilitate waterborne transport - Deeper channels and berths to accommodate larger ships More LNG port development - Better communication with market industry to predict future needs and adapt
Pacific (input from Australia)	<ul style="list-style-type: none"> - Landside access infrastructure to better connect ports with the hinterland. Development and maintenance of shipping channels – need to be considered critical infrastructure. - Other comments: - Opportunities for waterborne transport infrastructure to be designed in a way that mitigates noise emissions from shipping, terminal operations and road/rail access and egress should be explored. The encroachment onto port operational lands by non-port uses eg. Residential and other sensitive uses is increasing and generates significant land use conflict which can constrain port capabilities and capacities through restrictions on use.

Latin America (input from Brazil,	<ul style="list-style-type: none"> - Locks are needed on rivers - Better hinterland connections, multi-modal terminals (less road, more rail and inland waterways) - Political agreements to resolve border problems – international river basin issue - Development of ports/terminals on river systems, also depots and storage facilities - Deeper channels and berths - Couple navigation improvements of rivers with hydropower development Modernization/automation of port equipment - A multi-modal integrated transportation system
Africa	No response.

Region	Q2: What emerging trends and technologies are affecting waterborne transport now and in the future?
Asia/Oceania (input from Philippines, Malaysia, Vietnam, India, Japan, Singapore)	<ul style="list-style-type: none"> - Changing/shifting shipping routes, i.e. Northern Shipping Route between Europe and Asia - Panama/Suez expansion Price of fuel - New fuels – LNG, even solar Underground storage of fuel - Floating platforms for containers, where land is limited Offshore handling and storage - Multi-national alliances create joint ventures (foreign corporations) Labor shortages due to aging workforce - Increasing importance of environmental aspects (green issues and GHGs) Aging infrastructure - Regulations, and differences in regulations across nations (double hull vessels, water ballast management) - Bigger and bigger vessels, with consequent infrastructure needs Protected waters (accommodating vessels without AIS) - Traffic management, TABS (Terminal Appointment Booking System) Population around ports limits growth and expansion - Very strong competition among ports Problems with hinterland connections - More energy-efficient transport – use of lighter weight, hull design, increase fuel efficiency - Increasing automation, reduction in jobs - Resistance to automation in some areas because labor is less expensive. Road congestion - Need more preparation for natural disasters, resilient port facilities Automated terminal operation - More short sea shipping in Asia
Europe (input from Germany, the Netherlands, Finland, Spain)	<ul style="list-style-type: none"> - New fuels, LNG, related bunkering and supplies Ports must supply energy for ships (cold ironing) Automation of terminals - Increasing ship size, with consequent infrastructure needs Increased safety measures in ports - Adaptations in inland bunkering stations to accommodate larger inland vessels - Development of traffic management on corridors Construction of larger lock capacity - More information systems onboard inland vessels, possible decrease in the need of VTS-guidance and systems. - Need for higher permissible loads on quay areas, to reduce turnaround time at ports - Outreach requirements for lifting gear – this deep sea trend will be experienced also in short sea shipping terminals. - Demands to reduce emissions - Intelligent fairway and virtual Aids to Navigation Autonomous shipping (unmanned SmartShip) IT and big data - Holistic concept of the logistics chain

Middle East (input from Iran)	<ul style="list-style-type: none"> - Connect with countries across the Caspian Sea, and generally increased connectivity with rest of the world
North America (input from USA)	<ul style="list-style-type: none"> - Asset management and use of GIS - More private financing - Increasing ship size – mega ships - Climate change, impacts of sea level rise and increased storm intensities/frequencies - New fuels – LNG - Volatility of oil and gas prices - Greater use of waterways for domestic goods transportation - Greater leverage of intermodal capabilities - More investment in containership capabilities at coastal ports - More demand and shift toward cleaner transport methods - Better technologies in ports to handle goods effectively
Pacific (input from Australia)	<ul style="list-style-type: none"> - Automation of container terminals - Larger vessels - Smarter methods of reducing emissions and management of ballast water - Application of smart technology to deliver efficiency and transparency to supply chains - Application of smart technology in managing large vessels and their interfaces with tugs, VTS, etc.
Latin America (input from Brazil)	<ul style="list-style-type: none"> - The Green Concept - Increasing environmental concern and pressure, cleaner fuels - Increasing ship size - Increasing traffic - Containerization – need for specialized vessels and infrastructure - LNG engine technologies - New dredging technologies - Regional agreements and national development policies - Hydropower dams without locks are barriers to inland navigation
Africa	No response.
Region	Q3: How can project financing, construction, delivery, and maintenance be improved?
Asia/Oceania (input from Philippines, Malaysia, Vietnam, India, Japan, Singapore)	<ul style="list-style-type: none"> - Develop a robust maintenance management system, including upgrades as well as repairs and preventative maintenance - Smart sensors that will detect deterioration - Life cycle approach – include maintenance as part of the construction contract - New WG on maintenance of port infrastructure - Improve linkage between operations and stakeholders - Early contractor involvement (this is a new WG) - Open to foreign players for partnerships - Integrate broader improved practices in the region, not just the port PPP, but cautiously - Standards sharing of chassis among countries (Japan, Korea, China) - Upgrading safety - Involvement of private companies/developers to improve efficiency of capital investment in waterborne transport infrastructure - Innovation can improve productivity, i.e. automation - Good understanding of baseline conditions can improve design, maintenance - Outreach and involvement of stakeholders for project development/expansion - Share best management practices via organizations like PIANC - Challenges are getting different agencies to work together, politics, short terms of office inhibit long term vision/planning - Need more urban planning - More long-term funding for socio-economic oriented project with an average IRR (financing) - Reduced noise pollution in construction process in developing countries (construction) - Prevent avoidable delays with better communication between stakeholders - Maintenance costs are seldom included beyond 3/5 years for projects with 30-50 year life cycle. - In Japan, the Government selected strategic ports (container/bulk) on which major investments are concentrated. - Move beyond existing old/outdated legislation - Improve transparency in approvals - Consider local population's aspirations

	Source of employment? Port-based economic engines model?
Europe (input from Germany, the Netherlands, Finland, Spain)	<ul style="list-style-type: none"> - Political will, assignment of budget lines - PPP - Risk based maintenance Increased use of quantitative methods (RCM based) to get a better understanding of performance level. - Separate approaches for maintenance and replacement - Life cycle management - Moving towards a more integrated assessment of both maintenance and replacement needs - Preventative maintenance - In Finland, Trend to Privatization of waterborne transport infrastructure, which will also allow and encourage the users and/or regional governments to be more involved in development project and in efforts to seek the project financing funds. - Open market principle and out-sourcing of construction and maintenance services - By developing new financial frameworks adapted to the risks of the different phases of the infrastructure life cycle, from early planning to design, construction, operation and renovation. Financial sources should be adapted to the different risks and payback Expectations of each one of them. - Public financing should be limited to those elements that have an influence on the general welfare and competitiveness or have a clear social impact but their costs are difficult to link to the revenues directly generated by the infrastructure (access channels, breakwaters, berthing facilities in isolated areas, etc.)
Middle East (input from Iran)	No response.
North America (input from USA)	<ul style="list-style-type: none"> - In government contracting, encourage an ongoing relationship between the entities owning the contracts and the engineers and contractors involved in delivering those contracts. Minimize the adversarial relationship to facilitate efficient project delivery. - Maintenance can be improved with greater recognition of life cycle costing in the design process. - Use of full-funding up front to construct locks, not year by year (projects get stalled and take too long) - Better funding source for the IWTF (taxes, tolls, or other) and better use of the funds - P3 and P4 Resilient design - Green considerations where possible - Constructing and maintaining undersized urban port areas appears costly. It would appear targeting new port areas (outside cities) would help. - Younger generations may want less port/industry occupying waterfront in urban areas.
Pacific (input from Australia)	<ul style="list-style-type: none"> - More efficient mobilization of savings including superannuation funds. Adaptation of master planning and sustainability planning frameworks which provides robust strategic approach to investment requirements and engages other stakeholders to take some ownership. - Ports now adopting improved preventative maintenance programs as distinct from reactive "it needs fixing" approach and sophisticated asset management tools.

Latin America (input from Brazil)	<ul style="list-style-type: none"> - PPP - Involve all stakeholders for better solutions - Include social and environmental impacts in the cost/benefit analysis of projects - Less bureaucracy, i.e. Simplify license/regulatory procedures and the number of government institutions to deal with - Accommodate regional differences in a large country like Brazil - Partnership with universities to develop solutions, acquire data - Adoption of reliability-centered maintenance programs for ports. - More resources and public and private support from banks and agencies would improve the market which is almost close and basically driven by foreign companies
Africa	No response.

Region	Q4: How can waterborne transport infrastructure be designed/adapted in response to climate change and other environmental forces?
Asia/Oceania (input from Philippines, Malaysia, Vietnam, India, Japan, Singapore)	<ul style="list-style-type: none"> - Accommodate natural disasters within new infrastructure through engineering design - Better typhoon and storm surge protections, especially for the Philippines - Focus on water shortage, heat - Consider sediment changes (dredging needs) - Population changes and shifts due to climate can influence port operations/growth, locations - Better warning systems for severe weather - Subsidence can be reduced by restricting groundwater withdrawal – using alternative sources like desalinization - Begin now to accommodate/adapt to sea level rise, i.e. higher piers, refurbishment, redevelopment of existing infrastructure, floating structures. - Modal shift to water will reduce GHG emissions - Monitor changes and adapt as needed
Europe (input from Germany, the Netherlands, Finland, Spain)	<ul style="list-style-type: none"> - Need to mitigate climate change with new fuels, more efficiency - Need to adapt to sea level rise and increasing frequency and intensity of storms, more fluctuations in river flows - Address climate change in all project plans - Best option is design and build resilient structures, prepared for adaptation to climate change effects in the future whenever reasonably possible. - Need to deal with inland waterway impacts the most important being too shallow waters (for inland shipping) due to drought, and high river discharge due to excessive rain (not enough clearance at bridges, functioning of sluices). Other effects are more heat (bridges stuck), more severe storms and winds, change in river bed erosion and (less) ice formation. In Netherlands these problems are dealt with in a National Adaptation Strategy, room for the river, fortification of levees - In Finland, so far the ports have not been badly affected by the Jet stream wind and ports have coped with standard operational procedures (by relying the imposed wind limitations, securing the SSG's and re- stowing/securing the stacks of boxes). However, as these extreme conditions do occur more frequently and there are more experienced based information available, the design standards will be reshaped accordingly. - Harder winds and sea level rising has to be taken into account in design standards and principles. - Ice conditions and moving ice is a permanent factor to be considered in Finland (climate change is predicted to decrease the amount of ice, but to increase windiness, which increases the amount of moving ice (packed ice), which causes problems to the sea traffic.

Middle East	No response.
North America (input from USA)	<ul style="list-style-type: none"> - Be proactive, not just reactive to the problems, build resiliency and sustainability into initial designs as well as rehabilitation. - More flood protection and flood warning and operations systems. Focus on life cycle vs. initial capital costs. - Address risk and sustainability of waterborne systems - Better prediction of water level changes in the future and a system to identify ports that may become insufficient.
Pacific (input from Australia)	<ul style="list-style-type: none"> - Cater for more frequent/ higher intensity storm events through: <ul style="list-style-type: none"> Terminals - storm moorings for vessels, crane capabilities, container stack configurations, operational protocols Infrastructure – adaptation of existing breakwaters / revetment structures for protections, flood protections, landside access/egress during flood events. Shipping – operational protocols. - Sea level rise – suitable pavement levels, stormwater drainage design, implications of landside access/egress. - Air Emissions – improved vessel emissions through fuel type / vessel technology, cold ironing/shorepower, diesel vs electric terminal equipment (noting Australia’s primary source of energy is coal fired power), opportunities for solar / wind energy.
Latin America (input from Brazil)	<ul style="list-style-type: none"> - Apply Integrated Water Resource Management in multi-use river basins, so that the needs of navigation are balanced with hydropower, flood control, environmental, etc. - Better predictions of the impacts of climate change. - Climate change, as well as erosion, sedimentation, should be considered in port design, prepare to adapt as needed. - More use of waterways would contribute to mitigation.
Africa	No response.

APPENDIX G

THE FUTURE OF GLOBAL WATERBORNE TRANSPORTATION INFRASTRUCTURE UNITED STATES PERSPECTIVE

04 MAR 2018

Historical Trends in Infrastructure Development

The continental United States of America is blessed with some 900 commercial seaports and 12,000 miles of navigable waterways that, since its founding in the late 18th century, have fostered, promoted and sustained the economic and social development of the country (USACE, 2009). By all metrics, the US economy is the largest and most robust in the world, due in no small measure to its waterborne transport infrastructure.

Maritime. Maritime facilities along the US Atlantic, Gulf of Mexico, and Pacific coasts underpin much of the US import and export economy, as indicated in Figure 1 below.

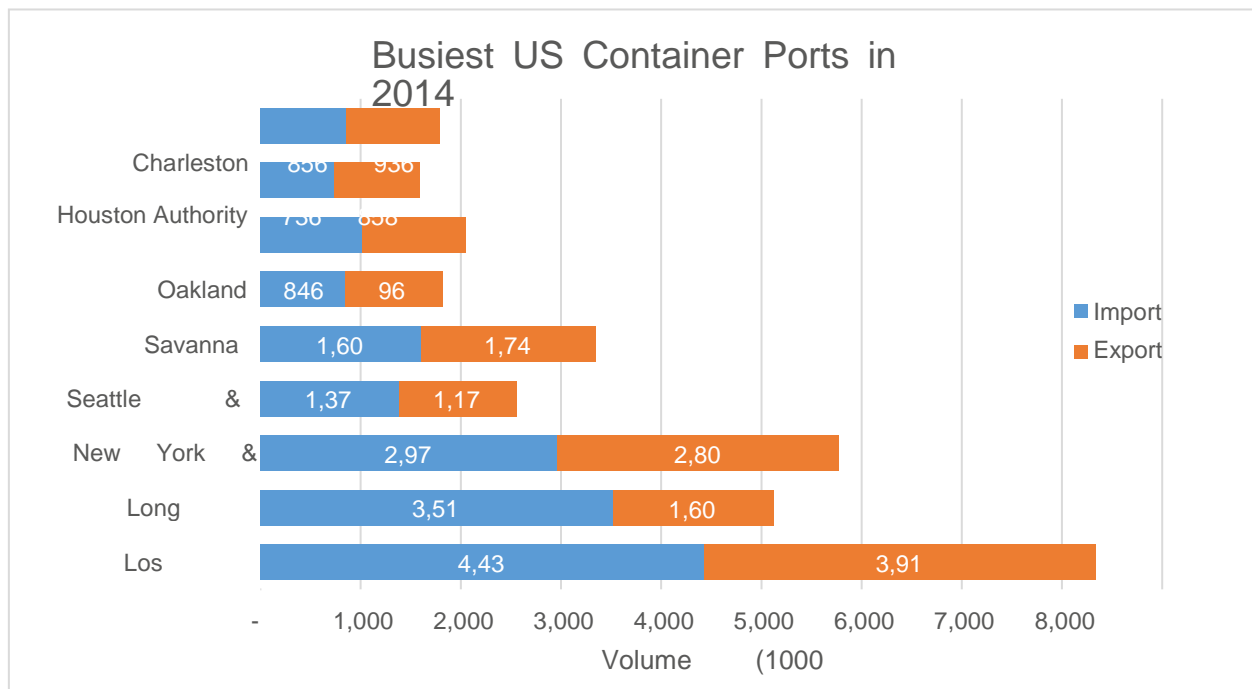


Figure 1: Busiest Container Ports in the US by 2014 Volume (Inbound Logistics, 2015)

US maritime facilities have evolved over time, with much of the current infrastructure built or expanded within the past 70 years since the end of WW II. Recognizing that a port is in fact an interface, infrastructure facilities can be considered in three categories: waterside; on-dock; and landside. Most of the major US ports are publicly owned, under the auspices of a State- chartered port authority. These authorities often function as “landlord” entities, whereby the actual port facilities (on-dock, primarily) are operated by a private entity under terms of a lease or concession agreement that obligates the operator to build, operate, and maintain facilities necessary to conduct its business. The landlord authority often partners with the US Federal government to provide and maintain waterside access to the port, and with State or local agencies to provide and maintain landside access. One of the major challenges facing US ports is the provision of

efficient, sustainable (environmentally, socially, and economically) landside access and intermodal connectivity. The Port of Miami has made a significant investment in this regard, in response to the expansion of the Panama Canal and its interest in capturing market share from larger vessels transiting the Canal.

Waterside access depends upon regular maintenance dredging of approach channels, fairways, and berths to provide the required safe navigable depths for vessels calling on the port. The importance of this aspect is underscored by the Federal-Local partnership for funding under the nationwide Harbor Maintenance Trust Fund (Congress.gov, 2016).

Similar to global port facilities, US ports continue to experience evolutionary change with the advent of containerization of cargoes and globalization of the world economy. According to the American Association of Port Authorities, its US member ports and their private-sector partners plan to spend \$154.8 on port-related freight and passenger infrastructure over the next five years. However, that figure stands in stark contrast to what it believes is the “best-case” scenario for investments by the Federal government into U.S. ports, including their land- and water-side connections, through 2020 of just \$24.825 billion. The vast difference between the two investment numbers poses tangible concerns, particularly considering the need to increase government investment in America’s federal navigation channels and the “first-and-last mile” connections with ports (AAPA 2016). While private sector investors – infrastructure funds, teachers’ retirement funds and the like –are willing to close the gap, but only if returns are adequate and risks are relatively low.

Inland. From the inland navigation perspective, much of the early US commercial navigation infrastructure (e.g., the Erie Canal circa 1825) is no longer viable or relevant for the current era. However, navigation locks on the Upper Mississippi, Ohio, and Columbia Rivers, and along the Gulf Intracoastal Waterway, are important elements in the current system. Figure 2 shows the US inland navigation system.



Figure 2: Map of US Maritime and Inland Ports (USACE, 2013)

Of the total 12,000 mile-long inland waterway system, over half relies upon navigation locks to facilitate reliable year-round service for freight transport. As seen in the above Figure 2, many of these are concentrated on the Upper Mississippi, Ohio, and Columbia Rivers.

The Great Lakes and St. Lawrence River navigation system is a cooperative entity between the US and Canada. It is primarily a maritime system, with access to ocean-going vessels from the Atlantic, but also supports a robust intra-Lake trade. Both are limited, however, by the seasonal availability of the system for navigation, as it often closes for 3 to 4 winter months each season.

The average age of US navigation locks is in the 50 to 70 year range, with some nearly 100 years old (USACE, 2013). As such, there is a backlog of deferred maintenance work that is required to maintain the reliability and functionality of the system. With an estimated replacement value of US\$ 238 billion, the backlog of necessary maintenance and refurbishment is estimated at US\$ 140 billion, while annual Federal appropriations for managing the entire asset is less than US\$ 5 billion (ASCE, 2016).

Intermodal. The US inland waterway system is often in competition with the extensive US road and rail network for efficient long-distance transport of certain cargoes. While all three modes are necessary, such competition is to be expected and is ultimately of value to the consumer or shipper, and it presents challenges to the viability of the waterborne transport network.

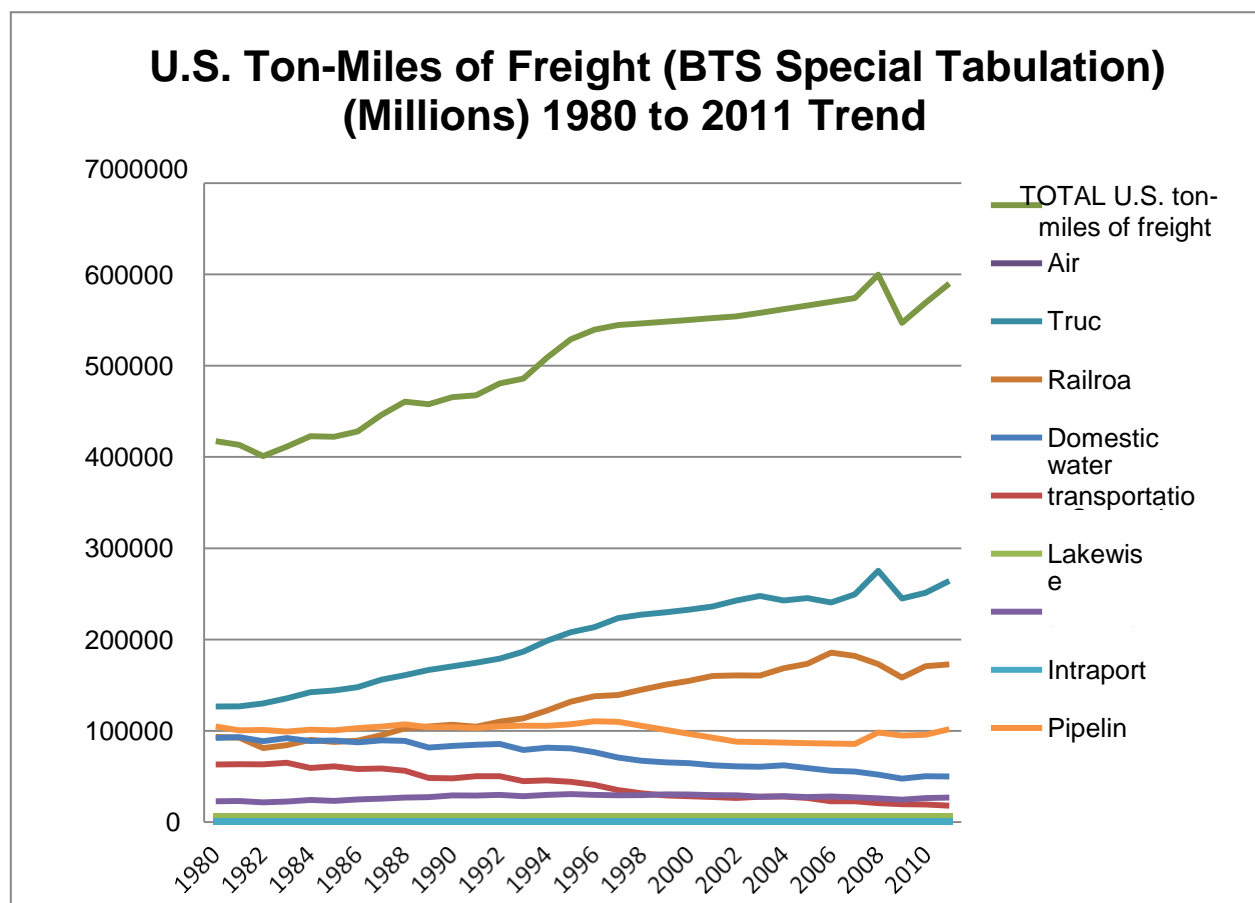


Figure 3: Historical Trends in US Freight Transport by Mode

As shown in Figure 3, total freight movement has increased dramatically over the past 30 years, but virtually all of this increase has been in road and rail transport modes. In fact, the ton-miles of domestic waterborne freight have declined, mainly due to the drop in coastwise transport.

Internal water transport has remained largely the same. Reasons for this decline cannot be attributed to any one source, but there are indications that decreasing reliability and efficiency of the inland navigation infrastructure have played a role. System downtime – both scheduled and unscheduled outages – has tripled over the 20-year period from 1992 (50,000 hours/yr) to 2012 (140,000 hours/yr) (Smart Rivers 2015).

Political, economic and institutional alignment of the different transportation modes (e.g., rail in the US is principally private industry with Federal government regulation, whereas road and water transportation rely more heavily upon public finance) present challenges to fully integrating the transport systems to take best advantage of all modes.

Figure 4 shows the institutional alignment of the US Federal transportation system. Cross-modal coordination is via the Committee on Marine Transportation Systems (CMTS), housed within the Maritime Administration.

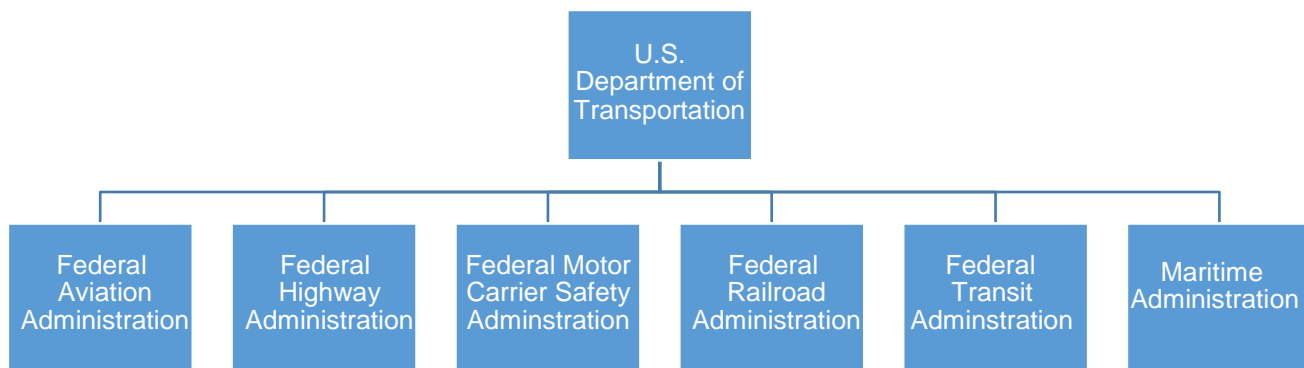


Figure 4: Institutional Alignment of the US Federal Transportation System (USDOT, 2016)

Because of the strategic value of the inland waterway system, the US Army Corps of Engineers, with the advice and consent of the US Congress, is largely responsible for the operation and maintenance of locks and associated waterways infrastructure. It coordinates its activities with USDOT via the Maritime Administration. However, because of the Corps' historical stewardship, a false public perception has arisen that US waterways support only the navigation industry, and that investments in the system represent a subsidy to a narrow segment of US business.

In fact, waterways serve and benefit multiple stakeholders and interests, including municipal and industrial water supply, environmental habitat, flood control, and recreation. With rare exception, none of these beneficiaries contribute to the operation, maintenance or enhancement of the system. Only the navigation industry, by virtue of the self-imposed barge fuel tax (which the industry voluntarily increased by 45% - from 20 cents to 29 cents per gallon in 2014), contributes non-public funds to the inland waterway system. Still, the chronic underinvestment in the system has enabled a continued deterioration in system reliability, with increased delays for both scheduled and unscheduled outages to conduct needed maintenance, which has measurable adverse consequences on cost and efficiency of transported goods. The net effect is to decrease US global competitiveness.

In summary, the dependency of the US inland navigation system on public funding, and the perception that it serves a limited sector of the US economy, has led to a sub-optimal system that is struggling to maintain its market share let alone thrive and grow to meet future needs.

The recent expansion of the Panama Canal, which counts the US, Japan, and China as its top customers, presents opportunities and challenges for the US ports and inland navigation systems to take full advantage of the potential benefits of the expansion.

Need For New Infrastructure to Respond to the Evolution of Trade

World trade continues to evolve as population growth and the associated increased demand for goods dictates, as illustrated in Figure 5 below. The global economy has mostly recovered from the 2008-2009 recession (with exceptions of course) such that transport of raw materials and finished goods are approaching record levels.

World merchandise trade and trade in commercial services, 1995-2014

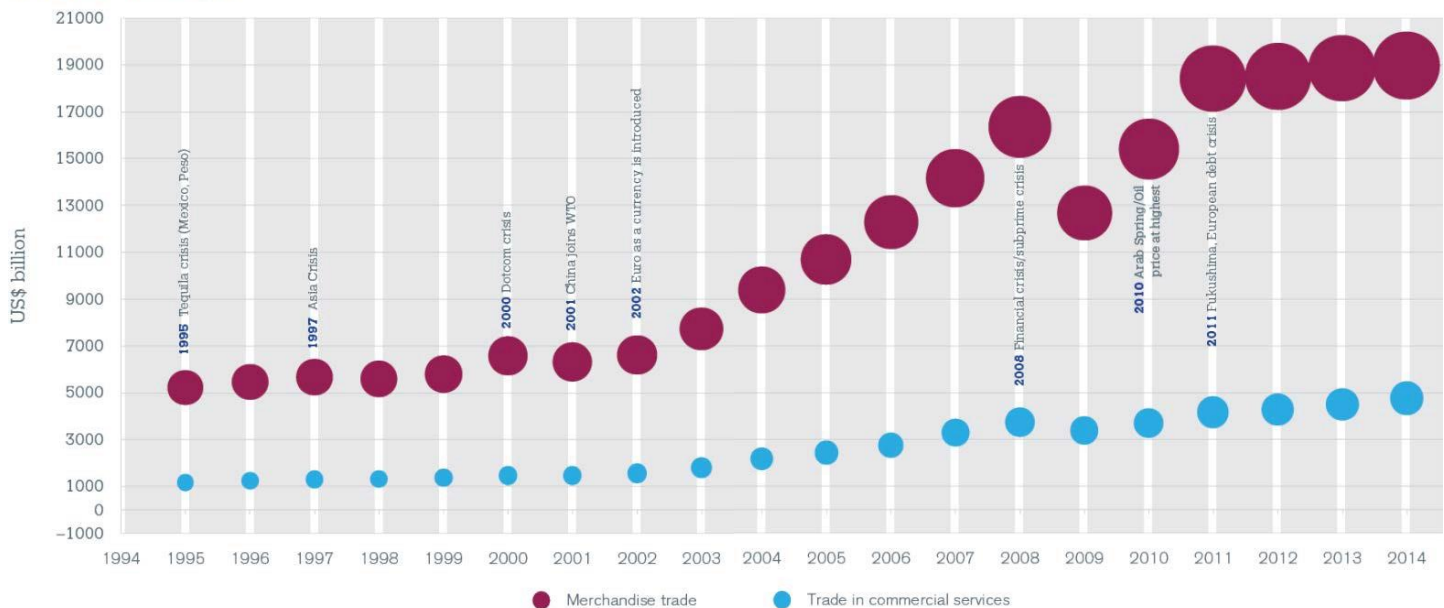


Figure 5: World Merchandise Trade – 1995 to 2014 (World Trade Organization, 2015)

The transport infrastructure that supports and sustains this trade growth is likewise required to grow and adapt accordingly. Key factors – both positive and negative – impacting global transport (and therefore US transport) are:

- Continued increase in container ship size to achieve economies of scale in the cost of transporting freight;
- Increased awareness and public demand for environmentally and socially responsible business practices, across the entire value chain;
- Over-capacity of the world's maritime fleet arising from the time lag in ship deliveries after the global recession;
- Population growth and increased consumerism in emerging and developing regions;
- Shifting of US oil and gas industry from a net importer to a net exporter; and
- Expansions of the Panama and Suez Canals to accommodate larger, more economical vessels and capture market share.

Because of the complexity and inter-relationships of the global economy, there is often not a linear, unique cause-and-effect relationship between a factor or driver and a market response. An illustrative example of this reality is the increase in container vessel size:

Larger and larger container ships =>

Expansion of the Panama Canal =>

Deepening/expansion of US East Coast port facilities =>

Upgrade of US West Coast ports and “landbridge” rail connections to increase efficiency and remain competitive =>

Upgrade of Suez Canal to increase efficiency and remain competitive with the Panama Canal all-water route =>

Etc., etc.

In light of the above, some clear signals for US waterborne transport infrastructure response to this trade evolution are apparent:

- The US ports and inland waterways systems will make investments in infrastructure – both new-build and refurbishment – that improves their competitive situation;
- These investments will be directed at facilities and situations where projects maximize return on the investment;
- Competition for investment will drive efficiencies in how transport infrastructure projects are designed, delivered, and operated/maintained;
- While continuing to be a net importer of commodities, goods and materials, the US will increase its exports of coal, agricultural products, and oil, gas and petrochemical products to meet global demands; and
- Political objectives such as increased US manufacturing (and jobs), investment of public funds in infrastructure rehabilitation, and economic stimulus via tax relief have the potential to drive investment and improvements in US waterborne transport infrastructure. However, they are likely to have only limited, short-term impacts that are not sustainable beyond one or two (two-year) election cycles.

Alternative Project Finance and Delivery

There is a clear gap between available public resources and the cost of needed waterborne transport infrastructure investment in the US. To bridge this gap, and to deliver projects as efficiently and cost-effectively as possible, public authorities across the world are turning to Public-Private-Partnerships (P3), Public-Public-Private-Partnerships (P4), and other strategies for alternative project finance and delivery. Through an infusion of private capital and management, P3s can ease fiscal restraints and boost efficiency in the project delivery process. Despite their potential, however, P3s are highly complex policy instruments.

While P3s have been beneficial in bringing about improvements in the delivery of public infrastructure projects through shorter delivery times, better value for money and increased innovation across a range of sectors, this does not mean that implementing a P3 program or project is easy. A recent assessment of alternative delivery opportunities for the US waterborne transport infrastructure system (ASCE, 2016) identified significant political, legal, regulatory and institutional hurdles that must be overcome in order to

move from a traditional, public sector model of project delivery to one in which public and private sectors work together.

Through a series of technical workshops held in New Orleans, New York City, St. Paul, and San Francisco, the ASCE explored the serious state of decline of our nation's water resources infrastructure and the need for new tools to address those needs given the paucity of public funding in today's environment.

As it sought to avail itself of the opportunities presented by the Panama Canal expansion, the Port of Miami conceived and implemented an innovative project financing mechanism to fund needed improvements. The port moved aggressively to be ready to take advantage of the potential for larger vessels to transit the expanded Panama Canal, investing over US\$ 1 billion in land, waterside, and inside-the-fence improvements, using a combination of financing and delivery strategies best suited to the project components. As a result, the Port is fully ready to take the new larger ships, and is seeing other efficiency and operational improvements (reduced congestion, zero impacts to Miami-Dade residents) as well. Intent of the improvements is to double the Port's cargo business by 2020 and triple it by 2035, creating 33,000 permanent jobs.

A major impediment in the timely and cost-effective upgrading of the US inland waterway system is the use of annual funding, rather than full capability funding, of priority projects. Major navigation lock replacements or upgrades have traditionally be funding constrained, with funding allocated via an annual appropriation that is below what efficient construction progress would dictate. This has the doubly-negative impact of extending the completion schedule and driving up costs due to inflation and multiple start/stop cycles. More recently, this approach has been modified to provide sufficient funding for the top priority lock projects, so that they can be completed efficiently. This modified approach is a win-win and should become the new standard for public financing of lock upgrades and replacements.

But the fact remains that the investment needs continue to outstrip the available public finance resources.

Environment and Climate Change

The US continues to lag the rest of the world in acknowledging and responding to the challenges of climate change. However, notable extreme weather events such as the October 2012 Superstorm Sandy have provided impetus to a change in attitude. Owners and asset managers of public infrastructure facilities in general, and port facilities in particular, have recent, documented evidence of the consequences of not planning for resilient facilities. For example, at the Port of New York / New Jersey, Sandy revealed the vulnerabilities of the Port's electrical facilities and the consequences of critical system outages on their ability to respond to and recover from the event.

In the wake of events such as the 2001 9/11 terrorist attacks and Superstorm Sandy, the City of New York determined that waterborne transportation is a key element for effective emergency management (New York City Hazard Mitigation Team, 2014). New York Harbor provides alternative options for evacuating residents during major emergencies and for moving people safely when other modes of transportation experience shutdowns, such as during power outages. After the 9/11 attacks, ferries safely evacuated hundreds of thousands of people from Lower Manhattan and were used in the following days for transportation of emergency personnel, vehicles, and equipment to and from Ground Zero. Therefore, properly maintained piers, landings and vessels are imperative for both the economic development of New York City and redundancy in transportation systems to support emergency evacuations.

On the West Coast, a heightened environmental and social sensibility has led the Port of Los Angeles to take a leadership role in "greening" of their facilities and operations. A key driver, beyond environmental regulatory compliance, is the recognition that local residents around the Port are key stakeholders who will not accept adverse impacts to their quality of life as a condition or byproduct of the economic benefits derived from the Port (Port of Los Angeles, 2014; Chow, 2016).

PIANC has taken a lead role in addressing the challenges of climate change, through formation of a Permanent Technical Group on Climate Change in 2008. The role of the PTGCC is to inform PIANC and its sister agencies on the adverse effects of climate change on navigation infrastructure, and provide guidance on appropriate adaptation or mitigation actions and investments that can be done proactively to minimize these effects.

Project Sustainability

Infrastructure asset managers across many sectors are realizing the benefits of “total cost of ownership” as a fundamental metric governing project feasibility and optimization. Inherent in this concept is a life-cycle approach to project planning, which in turn ordains a sustainability mindset. The US engineering community is taking a leadership role in this regard, with initiatives such as ASCE’s “Envision” protocol.

Sustainable infrastructure was the focus of Envision, introduced in 2012 as a new rating system to promote best practices in planning, designing, building and maintaining public roads, bridges, tunnels, water systems and other civic entities. The program was created by the aptly named Institute for Sustainable Infrastructure (ISI), a nonprofit organization jointly founded a year earlier by the American Consulting Engineers Council (ACEC), the American Society of Civil Engineers (ASCE) and the American Public Works Association (APWA). ISI also collaborated with the Zofnass Program for Sustainable Infrastructure at the Harvard University Graduate School of Design to develop Envision (ACEC, 2016).

Short-Form Questionnaire Responses

To provide context for the state and perspectives of US waterborne transport infrastructure, PIANC Task Group 181 circulated a two-page questionnaire to individuals and stakeholders of the system. The questions posed and the responses obtained are summarized below.

Q1: What new waterborne transport infrastructure is most needed to respond to the evolution of trade and market trends?

- Larger locks on the inland waterways, updates of aging locks and dams
- Better hinterland connections with all modes (rail, road, inland waterways)
- Connect inland industries to waterways
- More and better barges for container shipping
- Systems approach to marine highways, including policy and legal changes to facilitate waterborne transport
- Deeper channels and berths to accommodate larger ships
- More LNG port development
- Better communication with market industry to predict future needs and adapt

Q2: What emerging trends and technologies are affecting waterborne transport now and in the future?

- Asset management and use of GIS
- More private financing
- Increasing ship size – mega ships
- Climate change, impacts of sea level rise and increased storm intensities/frequencies
- New fuels – LNG
- Volatility of oil and gas prices
- Greater use of waterways for domestic goods transportation
- Greater leverage of intermodal capabilities
- More investment in containership capabilities at coastal ports

- More demand and shift toward cleaner transport methods
- Better technologies in ports to handle goods effectively

Q3: How can project financing, construction, delivery, and maintenance be improved?

- In government contracting, encourage an ongoing relationship between the entities owning the contracts and the engineers and contractors involved in delivering those contracts; Minimize the adversarial relationship to facilitate efficient project delivery
- Maintenance can be improved with greater recognition of life cycle costing in the design process
- Use of full-funding up front to construct locks, not year by year (projects get stalled and take too long)
- Better funding source for the IWTF (taxes, tolls, or other) and better use of the funds
- P3 and P4 delivery mechanisms
- Resilient design
- Green considerations where possible
- Constructing and maintaining undersized urban port areas appears costly; It would appear targeting new port areas (outside cities) would help; Younger generations may want less port/industry occupying waterfront in urban areas

Q4: How can waterborne transport infrastructure be designed/adapted in response to climate change and other environmental forces?

- Be proactive, not just reactive to the problems, build resiliency and sustainability into initial designs as well as rehabilitation
- More flood protection and flood warning and operations systems
- Focus on life cycle vs. initial capital costs
- Address risk and sustainability of waterborne systems
- Better prediction of water level changes in the future and a system to identify ports that may become insufficient

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Appendix H

MODAL SPLIT OF FREIGHT TRANSPORT GLOBALLY

Context

The United Nations' Conference on Environment and Development (Rio 1992) recognized the importance of indicators in helping countries make informed decisions about sustainable development. An updated set of 50 core indicators were published by the UN's Commission on Sustainable Development in December 2007. These core indicators encompassed 14 themes:

• Poverty	• Natural Hazards	• Biodiversity
• Governance	• Atmosphere	• Economic Development
• Health	• Land	• Global Economic Partnership
• Education	• Oceans, Seas and Coasts	• Consumption and Production Patterns
• Demographics	• Freshwater	

Within the Consumption and Production Patterns theme, four sub-themes are identified:

- Material consumption
- Energy Use;
- Waste generation and management; and
- Transportation.

A “core indicator” of the transportation sub-theme is Modal Split of Passenger Transport, while two other indicators are “Modal Split of Freight Transport” and “Energy Intensity of Transport.”

The UN notes that the “[modal split] indicator is based on inland transport only. Due to their predominantly international nature, there are conceptual difficulties in dealing with air and sea transport in a manner consistent with the inland modes.”

The core passenger transport indicator measures the share of each mode (passenger cars, buses and coaches, and trains) in total inland passenger transport, measured in passenger-km. It ignores waterborne passenger transport, which is often a minor component of total (inland) passenger transportation.

The freight transport indicator measures the share of each mode (road, rail and inland waterways) in total inland freight transport, measured in tonne-km. The UN notes that “road transport is less energy-efficient and produces more emissions per tonne-kilometer than either rail or inland waterways transport. Therefore, the use of road for freight transport has greater environmental and social impacts, such as pollution, global warming, as well as a higher accident rate, than either rail or inland waterways transport.”

Further, the UN points out that the energy intensity indicator, defined as fuel used per unit of freight-kilometer (km) hauled and per unit of passenger-km traveled by mode, measures how much energy is used for moving both goods and people. As transport is a major user of energy, mostly in the form of oil products, it is the most important driver behind growth in global oil demand. Energy use for transport therefore contributes to the depletion of natural resources, to air pollution and to climate change. Reducing energy intensity in transport can reduce the environmental impacts of this sector while maintaining its economic and social benefits.

In summary, waterborne freight transport brings significant benefits in achieving sustainable development goals, both in terms of reduced air emissions and reduced energy consumption, both on a tonne-km basis.

Modal Split by Major Regions and Countries

TG181 has characterized the modal split of freight transport for countries where such data exists.

Figure E-1 below shows that, despite the extensive waterway network of the European Union, the vast majority of inland freight transport is by road (75.3%), with rail (18.3%) and waterborne (6.4%) well behind.

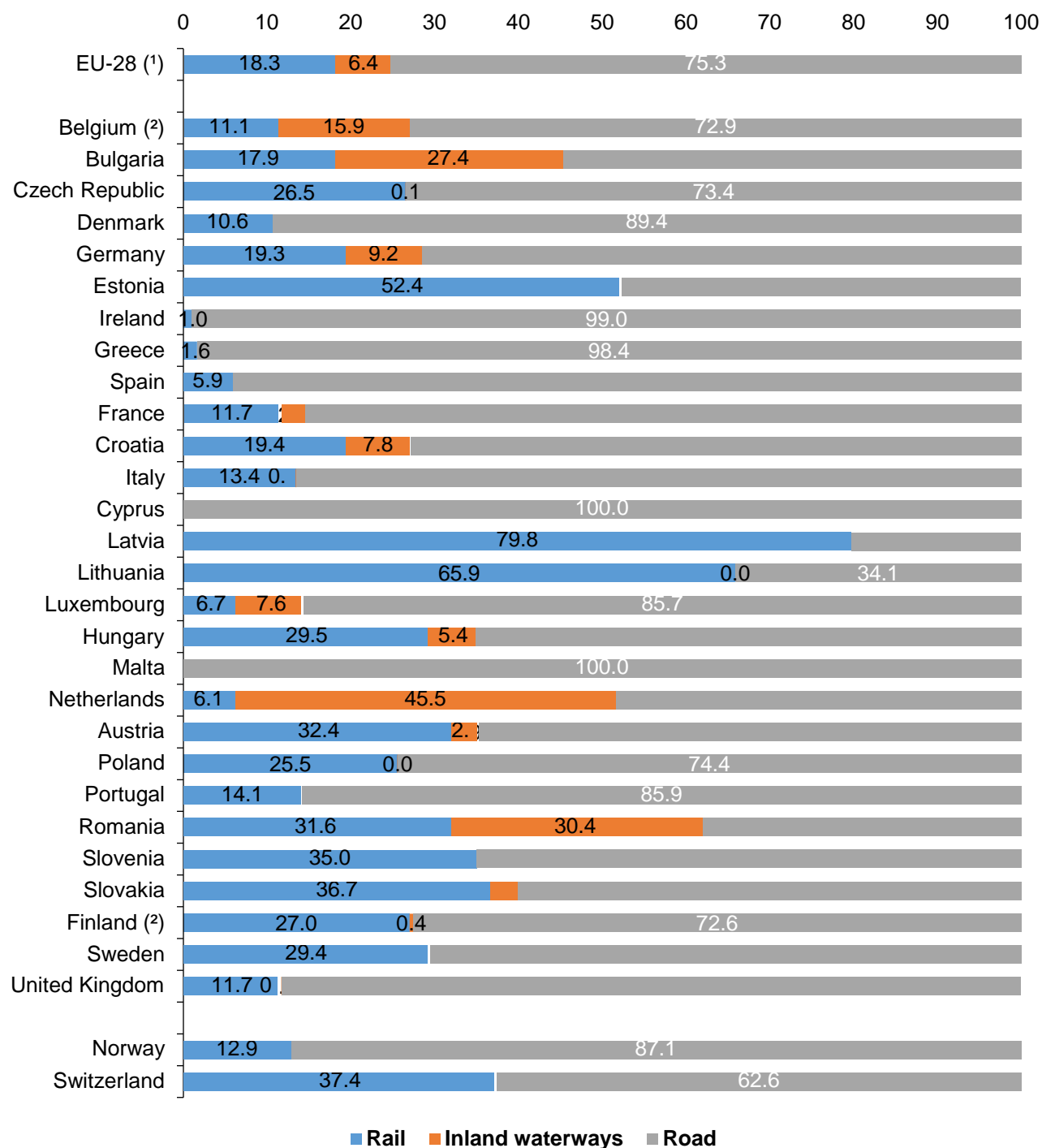
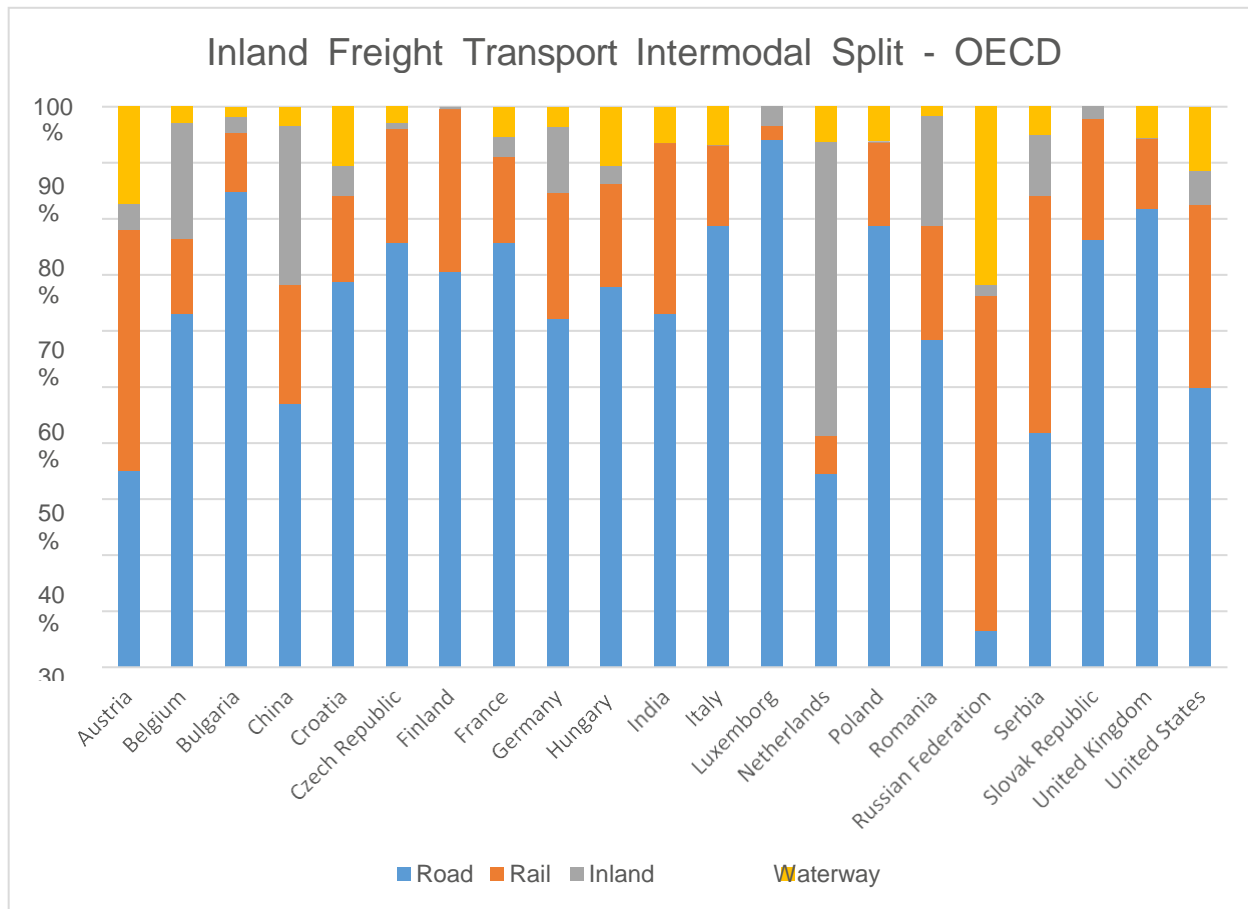


Figure E-1: Modal Split of inland freight transport in Europe, 2015 (% of total tonne-km)

(¹) EU-28 includes rail transport estimates for Belgium, inland waterways transport estimates for Finland and does not include road freight transport for Malta (negligible). Figures may not add up to 100% due to rounding.

(²) Estimated values.

Source: Eurostat (online data code : rail_go_typeall (rail), iww_go_atygo (inland waterways), road_go_ta_tott (national road transport), road_go_ca_c (road cabotage transport) and Eurostat computations (international road transport).



Source: Source: OECD/ITF (2017), ITF Transport Outlook 2017, OECD Publishing, Paris.
<http://dx.doi.org/10.1787/9789282108000-en>

The picture looks the same, if not worse, for the US, where waterborne transport's share has diminished over time – dropping from a 16% share in 1994 to half that (8%) by 2011.

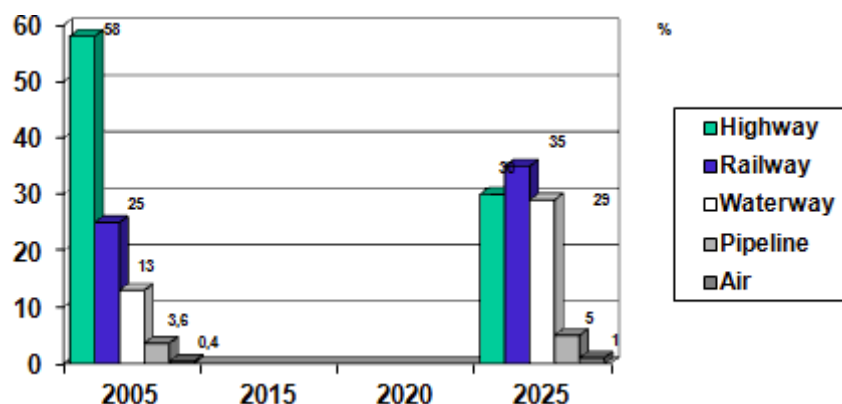
U.S. Modal Split (in percent of the total transport performance [ton-miles])

Year \ Mode	- 25 (1989)	- 20 (1994)	- 15 (1999)	- 10 (2004)	- 5 (2009)	2011	+5 (2019)	+10 (2024)	+15 (2029)
Inland (Domestic) Transport									
Road	36%	39%	42%	43%	45%	45%			
Rail	23%	24%	27%	30%	29%	29%			
Waterways	18%	16%	12%	11%	9%	8%			
Pipeline	23%	21%	18%	15%	17%	17%			

Source: U.S. Department of Transportation, Bureau of Transportation Statistics

Brazil, on the other hand, is projecting a doubling of waterborne transport by 2025, as compared to its 2005 share (13%).

Brazil Intermodal Split in 2005, and Forecast for 2025 (waterways 13% in 2005, forecast to be 29% in 2025)



Source: Presentation by Luiz Carlos R. Ribeiro, Ministerio dos Transportes, Secretaria de Política Nacional de Transportes, Brazil, on the Paraguay-Parana Inland Waterway at the Inland Waterway Transport in Times of Globalization Preparatory Workshop and Side Event, Marseille, France, 13 March 2012.

The differences illustrated above may be explained by the level of investment. The EU has recognized the value of waterborne transport, and is implementing policies and programs to maintain and increase its use. The US has continued to under-fund its navigation infrastructure, both for capital investment/replacement and for operation, maintenance and rehabilitation (OMR).

Brazil, on the other hand, completed a strategic plan for its inland waterway system that identified a program of **17 billion reais** (US\$5.1B; €4.3B) investment to upgrade and expand its inland waterways, as a primary means of improving its efficiency and global competitiveness, particularly for agricultural and mineral resource exports. **[Brazil Inland Waterways Strategic Plan, Arcadis, 2013]**

APPENDIX I CASE STUDIES – EMERGING TRENDS

TG 181 EMERGING TRENDS CASE STUDY

March 2018

PIANC Task Group 181 on “The State and Perspectives of Waterborne Transport Infrastructure” presents the following case study for an emerging trend or technology that is impacting waterborne transport and/or its infrastructure.

CASE STUDY NAME: 6.1 Container Ship Size

CASE STUDY CATEGORY: Vessels and Vessel Operations

PREPARED BY: Bella Chinbat, Stantec



Source: ACEC Engineering Inc., 2016

1. Trend Description

Due to economies of scale and the growing global demand, container ship sizes continue to increase. As of 2017, container ship sizes are up to 19,000 TEU and projected to be even greater in coming years. Although there are certain benefits to this trend, such as reduced transport costs per container unit, it does require capital-intensive infrastructure improvements for ports and waterways to keep pace.

2. How is this trend impacting waterborne transport?

There are three main incentives for larger vessel sizes. Because the shipping industry is very competitive with small financial margins, operating efficiency and cost containment are imperative for profit. Since the container ship's largest operating cost is fuel, anything that improves the efficiency and reduces the cost of fuel is the primary focus. Although savings can be seen from slow-steaming that consumes less fuel, "larger ships are more energy efficient per container transported, and thus their use is economically inevitable."

In addition to economic factors, another main driver is environmental. According to the World Shipping Council (WSC 2015), environmental regulations are also encouraging and rewarding larger vessel sizes. Regulations designed to reduce vessel air emissions (including emission control areas requiring low sulfur fuel, additional global low sulfur fuel regulatory requirements scheduled for 2020/2025, and efforts to monitor and reduce vessels' CO₂ emissions) have imposed higher cost fuels on the industry, and will incentivize further emission reductions and energy efficiency from vessels. These factors incentivize the industry to move toward larger and more efficient ships. The environmental benefit of such ships is that they produce fewer emissions per TEU of cargo transported. This environmental regulatory dynamic is unlikely to diminish, and in fact is likely to become stronger.

3. What are the short- or long-term implications of this trend?

According to the World Shipping Council, the growth in container ship sizes has affected Asian and European routes the most. The largest ships, on a scale of 18,000+ TEUs, only travel on those routes. The US, on the other hand, has only recently started to see 12,000-14,000 TEU ships at its California coasts. Since the opening of the new locks of Panama Canal in 2016, this rate is expected to increase, as the Canal expansion will enable ships of up to 14,000 TEU capacity to transit.

4. How can/should the waterborne transport industry respond to this trend?

Due to this growing trend in vessel sizes, ports around the world are pressured to expand. There are already prominent port congestion issues independent of larger incoming vessels. Insufficient investment for maritime infrastructure has been a problem worldwide for many years (WSC 2015).

On the other hand, some ports, like the Port of Miami, have already taken steps to modernize to take advantage of the Panama Canal's expansion. Further information on Port of Miami's finance and infrastructure improvements can be seen in its own case study file. According to ACEC's *Engineering Inc* (2016), other ports that are modernizing include Baltimore, New York/New Jersey, Los Angeles, Seattle, Oakland, and Charleston. Infrastructure investments for ports like Charleston and Miami alone are \$1.3 billion and \$1 billion, respectively.

5. References: Provide source(s) for this case study.

Engineering Inc. (2016, December). Large Post-Panamax Cargo Ships Along with Larger Locks on the Panama Canal are Prompting U.S. Ports to Undergo Modernization Projects. *Engineering Inc*, 13- 15.

World Shipping Council (WSC). (2015, July). Some Observations on Port Congestion, Vessel Size and Vessel Sharing Agreements. Retrieved from: http://www.worldshipping.org/industry-issues/transportation-infrastructure/Observations_on_Port_Congestion_Vessel_Size_and_VSAs_Updated_July_6_2015.pdf

TG 181 EMERGING TRENDS CASE STUDY

March 2018

PIANC Task Group 181 on “The State and Perspectives of Waterborne Transport Infrastructure” presents the following case study for an emerging trend or technology that is impacting waterborne transport and/or its infrastructure.

CASE STUDY NAME: 6.2 Slow Steaming / LNG Fueling / Clean Engines

CASE STUDY CATEGORY: Vessels and Vessel Operations

PREPARED BY: Nick Pansic, Stantec



Source: MFAME, 2016

1. Trend Description

Regulations governing vessel emissions, coupled with dramatically increased natural gas production due to the US “fracking boom,” have led vessel operators to begin investing in “clean engine” technology and shifting to natural gas as fuel. Overcapacity of vessels, due to the 2008/2009 global recession, is also incentivizing “slow steaming” of vessels to use excess vessel capacity while still managing operating (fuel) costs, and positioning to comply with expected IMO and port emissions regulations. Operators are also seeking brand enhancement by operating cleaner vessels.

2. How is this trend impacting waterborne transport?

- Increased use of LNG carriers to transport gas from production centers (e.g., US) to demand centers (e.g., Pakistan (GreenPort, 2015))
- Construction of liquification and regasification facilities at or near marine ports
- Construction of new, and retrofitting of existing, vessels with cleaner engines that burn natural gas instead of bunker fuel
- One of the major segments now using the expanded Panama Canal is the LNG carrier segment, and ACP is investigating offering LNG fueling as a service to vessels transiting the Canal (MFAME, 2016)
- Slow steaming of vessels in response to excess of capacity in the system reduces fuel consumption and associated emissions (World Shipping Council, 2015)

3. What are the short- or long-term implications of this trend?

In the short-term, carriers will take advantage of relatively cheap natural gas to reduce their costs of doing business. Building new liquification and regasification facilities will be economically attractive to serve the market.

- In the longer term, shifting to cleaner engine and fuel technologies will enhance the maritime sector overall in terms of its sustainability and social acceptance.

4. How can/should the waterborne transport industry respond to this trend?

The industry will invest – both in vessels and port infrastructure – to take advantage of the current market economies of using and transporting natural gas.

5. References: Provide source(s) for this case study.

GreenPort. (2015, April 08). Pakistan Opens First LNG Terminal. *GreenPort*. Retrieved from: www.greenport.com/news101/lng/pakistan-opens-first-lng-terminal?SQ_DESIGN

Marine Fuels and Marine Engine (MFAME). (2016, July 27). 1st & 2nd LNG Carriers Successfully Transits the New Panama Canal. *Marine Fuels and Marine Engine*. Retrieved from: <http://mfame.guru/1st-2nd-lng-carriers-successfully-transits-new-panama-canal/>

World Shipping Council (WSC). (2015, July). Some Observations on Port Congestion, Vessel Size and Vessel Sharing Agreements. Retrieved from: http://www.worldshipping.org/industry-issues/transportation-infrastructure/Observations_on_Port_Congestion_Vessel_Size_and_VSAs_Updated_July_6_2015.pdf

TG 181 EMERGING TRENDS CASE STUDY

March 2018

PIANC Task Group 181 on “The State and Perspectives of Waterborne Transport Infrastructure” presents the following case study for an emerging trend or technology that is impacting waterborne transport and/or its infrastructure.

CASE STUDY NAME: 6.3 Autonomous Vessels
CASE STUDY CATEGORY: Vessels and Vessel Operations
PREPARED BY: Nick Pansic, Stantec



Autonomous Ship, Yara Birkeland (Source: WSJ, 2017)

1. Trend Description

Two Norwegian companies – Yara International and Kongsberg Gruppen - are developing the world's first crewless, autonomously operated ship. Dubbed the “Tesla of the Seas,” the Yara Birkeland is scheduled to enter service in late 2018, carrying fertilizer 37 miles down a fjord. It will use GPS, radar, cameras and sensors to maneuver and dock on its own (WSJ, 2017).

2. How is this trend impacting waterborne transport?

Although the 100-container capacity vessel will cost \$25 million, about three times as much as a conventional ship of its size, operating without fuel or crew is expected to cut annual operating costs by as much as 90%.

The Norwegians aren't alone in looking into autonomous shipping. British manufacturer Rolls-Royce Holding PLC is also investing in this technology, and plans to launch robotic ships by 2020.

3. What are the short- or long-term implications of this trend?

Autonomous ships have the potential to revolutionize inland and maritime shipping, by eliminating or at least greatly reducing the need for on-board crews to operate and maintain the vessel.

Use of electric motors and batteries also eliminates need for petroleum-based fuels, making the vessels potentially safer and more efficient.

In addition to reducing fuel and labor costs, the Birkeland project is being pitched as a way to cut emissions. The ship is expected to replace 40,000 truck journeys a year through urban areas in southern Norway.

New regulations for operating autonomous ships will be needed. IMO says likely won't have legislation governing crewless ships in place before 2020.

4. How can/should the waterborne transport industry respond to this trend?

- Pace of adoption will depend upon the safety, reliability, and cost-effectiveness of these vessels.
- Will likely be adopted for dry bulk cargoes before higher-risk or higher-value cargoes
- An infrastructure for electric power supply and storage for charging the vessel batteries will require investment and increased efficiency

5. References: Provide source(s) for this case study.

The Wall Street Journal (WSJ). (2017, July 22). Norway Takes Lead in Race to Build Autonomous Cargo Ships. *The Wall Street Journal*. Retrieved from: <https://www.wsj.com/articles/norway-takes-lead-in-race-to-build-autonomous-cargo-ships-1500721202>

TG 181 EMERGING TRENDS CASE STUDY

March 2018

PIANC Task Group 181 on “The State and Perspectives of Waterborne Transport Infrastructure” presents the following case study for an emerging trend or technology that is impacting waterborne transport and/or its infrastructure.

CASE STUDY NAME: 6.4 Shipping Alliances
CASE STUDY CATEGORY: Vessels and Vessel Operations
PREPARED BY: Nick Pansic, Stantec



Source: WSJ, 2015

1. Trend Description

Vessel sharing agreements (VSAs) allow ocean carriers to reap the efficiency benefits of larger vessels by sharing space. As early as 1988, when Sea-Land first deployed the then gigantic 4,000 TEU “Econ” ships in the Trans-Atlantic, it did so based on a VSA structure with two other ocean carriers -- P&O Container Line and Nedlloyd. VSAs today continue to enable lines to capture the efficiency benefits of scale by enabling large vessels to be efficiently used by customers of more than one line.

The ability of larger vessels to deliver efficiency gains depends, however, on the efficient utilization of vessel capacity to carry cargo. A 14,000 TEU ship burns less fuel on a per-unit basis than a 7,000 TEU ship, but it still burns more fuel overall. Thus, a 14,000 TEU ship that is half full is less efficient than a 7,000 TEU ship that is full. The utilization rate is critical to realizing the designed efficiency of the larger vessels, and vessel sharing arrangements are an important tool in attaining efficient utilization rates. In many cases a single carrier simply does not have enough customers or cargo to fill ships of this size on its own in the framework of a weekly service, which is the norm in the industry and what is required by customers.

2. How is this trend impacting waterborne transport?

In addition to allowing carriers to more efficiently use the cargo carrying space of larger, more efficient vessels, VSA cooperation allows participating carriers to offer and provide greater service scope. By sharing multiple loops, each carrier in a VSA is able to offer its customers a much broader scope of service offering than it could on its own, which is pro-competitive. There are carriers in VSAs that would simply not be able to make the investments required to serve every port they cover pursuant to VSA space sharing arrangements if they had to serve that network with their own assets (World Shipping Council, 2015).

3. What are the short- or long-term implications of this trend?

In short, with multiple carriers using more efficient vessels in larger networks with greater service scope, VSAs allow each carrier to offer a broader scope of more frequent, more efficient services.

Two highly respected, independent international business consultants (Boston Consulting Group and McKinsey & Company) have recently issued reports discussing how much greater potential transportation efficiency gains may be obtainable by VSAs expanding their cooperative efforts from traditional vessel sharing operations to landside operations.

Vessel sharing arrangements can become more formal in terms of alliances or even mergers. In late 2015, the Wall Street Journal reported that a US \$10 – 20 billion merger of China's two largest shipping companies - state-owned COSCO and China Shipping Group Co. – would create the 4th largest shipping line in the world.

Lisa Chee, an Erasmus University researcher, has analyzed the business drivers and market conditions impacting vessel utilization under various business models.

4. How can/should the waterborne transport industry respond to this trend?

More efficient use of existing vessels will require that port facilities increase their operational efficiency as well. Investments in automation, increased crane capacity, and improved intermodal connections can be expected.

International trade protection organizations, such as the WTO, may determine that certain alliances create anti-competitive monopolies and rule against them, limiting the potential impact of this trend.

5. References: Provide source(s) for this case study.

Boston Consulting Group (BCG). (2015, March 19). The Transformation Imperative in Container Shipping. Retrieved from: https://www.bcgperspectives.com/content/articles/transportation_travel_tourism_transformation_imperative_container_shipping/

Chee, L. (2016). *Reasons for mergers and acquisitions in the container shipping sector; A qualitative analysis of structural factors and market behavior* (Unpublished master's thesis). Erasmus Universiteit Rotterdam. Retrieved from <https://thesis.eur.nl/pub/33920/BA-scriptie-Lisa-Chee.pdf>

McKinsey & Company. (2015, April). Landside operations: The next frontier for container-shipping alliances. McKinsey & Company. Retrieved from: <https://www.mckinsey.com/industries/travel-transport-and-logistics/our-insights/landside-operations-the-next-frontier-for-container-shipping-alliances>

Wall Street Journal (WSJ). (2015, December 11). China Approves Merger of Cosco, China Shipping. *The Wall Street Journal*. Retrieved from <https://www.wsj.com/articles/china-approves-merger-of-cosco-china-shipping-1449834748>

World Shipping Council (WSC). (2015, July). Some Observations on Port Congestion, Vessel Size and Vessel Sharing Agreements. Retrieved from http://www.worldshipping.org/industry-issues/transportation-infrastructure/Observations_on_Port_Congestion_Vessel_Size_and_VSAs_Updated_July_6_2015.pdf

TG 181 EMERGING TRENDS CASE STUDY

March 2018

PIANC Task Group 181 on “The State and Perspectives of Waterborne Transport Infrastructure” presents the following case study for an emerging trend or technology that is impacting waterborne transport and/or its infrastructure.

CASE STUDY NAME: 6.5 Container on Barge
CASE STUDY CATEGORY: Vessels and Vessel Operations
PREPARED BY: Nick Pansic, Stantec



Source: American Patriot Holdings, 2017

1. Trend Description

Transport of freight on US inland waterways has traditionally been done by bulk (dry or liquid) barges. Intermodal transport of containers from US maritime ports to inland destinations has a mature business with rail and road transport. While transport of containers by barge has been done successfully in Europe for some time, it has been trialed in the US but so far has not materialized into a viable business model.

In March 29, 2017, Plaquemines Port Harbor & Terminal District (PPHTD) and American Patriot Holdings LLC (APH) announced plans to jointly develop a new gateway container terminal on the lower Mississippi River. The 4200-acre facility will be capable of trans-shipping containers from ocean-going vessels (up to 20,000 TEU) to purpose-built, shallow-draft container vessels as an alternative to rail or road transport.

The proposed 12,700-14,800 DWT vessel would be 592 ft in length, with a beam of 134 ft, and a laden draft of 9-10 ft, capable of carrying 2500 conventional TEUs or 500 reefers. The so-called liner vessel would transit open rivers and serve upriver ports at Memphis and St. Louis. An integrated tug-barge version, 570 ft in length with an 85-ft beam, would further extend container transport through the Ohio River, Upper Mississippi River, and Illinois Waterway locks (110-ft wide by 600-ft long).

2. How is this trend impacting waterborne transport?

Intermodal transport of containers by barge would compete with intermodal rail and road transport, bringing competitive advantages from lower cost, reduced emissions, and lower energy consumption that pertain to waterborne transport. Increased safety and reduced road and rail congestion are additional benefits.

3. What are the short- or long-term implications of this trend?

Increased penetration of both import and export cargos into the Midwestern US would compete with existing intermodal rail services via US East and West Coast ports, providing a cost-competitive alternative.

Conventional container-on-barge service, using a standard 10-barge tow of hopper barges, would only carry 300 TEUs. The more efficient purpose-built APH vessels would increase this capacity dramatically – by eight-fold.

4. How can/should the waterborne transport industry respond to this trend?

Existing inland river ports that rely primarily on bulk cargo handling will be incentivized to invest in berthing and container-handling facilities that can accommodate these new vessels. This will drive more capacity and throughput, increasing port revenue and expanding economic reach further east and west of the Mississippi.

5. References: Provide source(s) for this case study.

American Patriot Holdings LLC and Plaquemines Port Harbor and Terminal District. (2017, November 10). Creating Inland Marine Innovation. Retrieved from: <http://waterwayscouncil.org/wp-content/uploads/2017/11/Bob-McCormack.pdf>

MarineLink. (2017, June). Public-Private Project Promises to Revive America's Marine Highway. Retrieved from <https://www.marinelink.com/news/publicprivate-promises426628>

TG 181 EMERGING TRENDS CASE STUDY

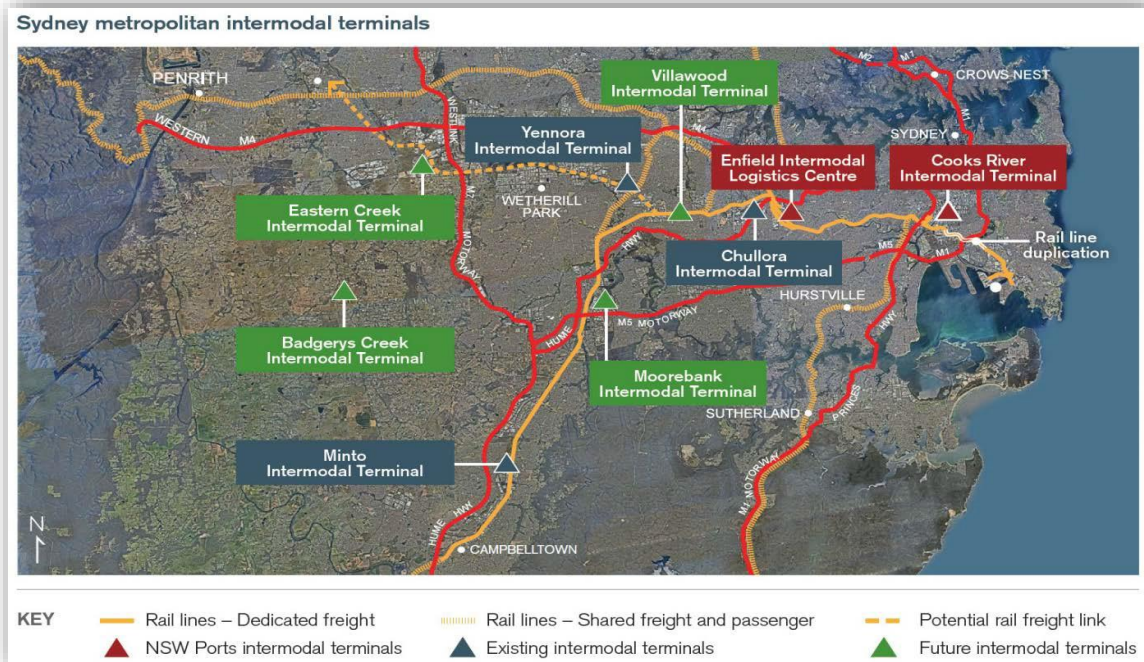
March 2018

PIANC Task Group 181 on “The State and Perspectives of Waterborne Transport Infrastructure” presents the following case study for an emerging trend or technology that is impacting waterborne transport and/or its infrastructure.

CASE STUDY NAME: 6.6 Intermodal Connectivity

CASE STUDY CATEGORY: Infrastructure

PREPARED BY: Anne Cann, USACE and Marika Calfas, New South Wales Ports, Australia



1. Trend Description

Ports rarely are the final destination of goods; therefore intermodal connectivity is critical, and is currently a global challenge. Improving intermodal connections actually increases port capacity. And in Australia, efforts are increasingly focussed on short-haul rail for containers. Australia imports a significant amount of goods in containers as its manufacturing base is declining. Population is centred around key cities and most containerised goods are destined for these cities. Also, in Australia, ports don't compete with each other for containers due to large separation distances between cities. These factors, combined with increased road congestion, have led to the development of short-haul rail as a solution.

In Port Botany (Sydney metro area), containers move straight from the port to an Intermodal Terminal via rail. Port Botany is NSW's largest container handling facility, servicing a vital role in the NSW economy. It handles 2.3M TEU per year.

80% of import containers travel no further than 40km from the port. The rail mode share is 18% - likely to hit 400,000 TEUs in 2017. The target is to move 3 million TEUs by rail. Similar efforts are going on in other Australian ports.

2. How is this trend impacting waterborne transport?

Ports are only as good as their landside connections. Every one million TEU moved by rail reduces the number of trucks on the roads around Port Botany by more than 900 trucks each day. This increases capacity at the port.

3. What are the short- or long-term implications of this trend?

The Australia experience shows that short-haul rail can work and can be effective. The projects identified in Australia generally were financed with some combination of public/private funding. Due to the alleviation of road congestion, benefits to the broader public are achieved as well as faster movement of goods through the port and to the final destination.

4. How can/should the waterborne transport industry respond to this trend?

Building short range rail to take the containers/cargo out of ports and to distribution centers located on the outskirts of metropolitan areas has been shown to be viable in Australia. Perhaps other PIANC countries, which previously thought that short haul rail was not economical, will revisit this intermodal strategy.

5. References: Provide source(s) for this case study.

Calfas, Marika. (2017, June). The Intermodal Challenge: How to improve port connectivity with rail. Presented at PIANC AGA, Cairns, Australia.

TG 181 EMERGING TRENDS CASE STUDY

March 2018

PIANC Task Group 181 on “The State and Perspectives of Waterborne Transport Infrastructure” presents the following case study for an emerging trend or technology that is impacting waterborne transport and/or its infrastructure.

CASE STUDY NAME: 6.7 China Belt and Road Initiative

CASE STUDY CATEGORY: Infrastructure

PREPARED BY: James McCarville, US Section PIANC



Source: MarineLink, 2015

1. Trend Description

China's emergence as a major trading partner is altering 21st Century global logistics and navigation patterns, including significant infrastructure investment in ports, channels and intermodal connections. The Chinese emergence includes the "Silk Belt" railway through Central Asia to Europe; and a "Maritime Silk Road" including roadway improvements to ports inside and outside of China in East and South Asia (such as the China -Pakistan and Bangladesh-China-India-Myanmar corridors); a string of ports (dubbed the "String of Pearls" by the west) flowing from the South China Sea, the Strait of Malacca, the Indian Ocean, the Arabian Sea, East Africa and the Persian Gulf; and even the purchase of a controlling interest in the Port of Piraeus, Greece. See above figure.

2. How is this trend impacting waterborne transport?

According to the Center for American Progress, Belt and Road initiative projects accounted for more than 40 percent of China's overseas construction projects in the first half of 2015, with returns to be realized over a period of 10 years or more. The Belt and Road initiative has announced more than 1,400 contracted projects related to high-speed rail, electricity upgrades, port development and enhancements, as well as coal power plants. Chinese enterprises have signed \$7.06 billion worth of contracts with more than 60 countries involved in the Belt and Road initiative - a year-on-year increase of 17 percent.

China has specified five types of Belt and Road initiative projects: policy coordination, facilities connectivity, unimpeded trade, financial integration, and strengthening people-to-people bonds. China's gross domestic product, or GDP, growth is expected to fall below 7 percent as early as 2015, making Silk Road connections more important for private-sector growth outside of China, as well as for excess manufacturing capacity such as building new markets overseas.

The Maritime Silk Road connects the largest ports in the world – China and Northern Europe. As such, it can be expected to have a large impact on global shipping (Vickerman, 2016).

3. What are the short- or long-term implications of this trend?

This "super-regional" initiative will create efficient transport routes that will ultimately facilitate not only increased exports from China, but also increased imports to China as it develops its own consumer economy, and moves from a factor-driven economy to a more developed, efficiency-driven one.

4. How can/should the waterborne transport industry respond to this trend?

The success of the initiative depends, in part, on the cooperation of countries where major port and rail infrastructure investments are programmed. But with China providing the financing, this cooperation is all but assured. Example projects include:

- The \$1.4 billion "Colombo Port City" in Sri Lanka will encompass 233 hectares (576 acres) of reclaimed land, with offices, hotels, apartments and shopping centers drawing up to \$20 billion in investment over 15 years;
- The Pakistan Port of Gwadar, less than 400 kilometers from the Strait of Hormuz, will be linked by rail and road to the Chinese city of Kashgar; and
- In Malaysia, China plans to spend nearly \$2 billion upgrading the port of Kuantan.

5. References: Provide source(s) for this case study.

Center for American Progress. (2015, September 22). Understanding China's Belt and Road Initiative. Retrieved from: <https://cdn.americanprogress.org/wp-content/uploads/2015/09/22064156/SilkRoad-brief.pdf>

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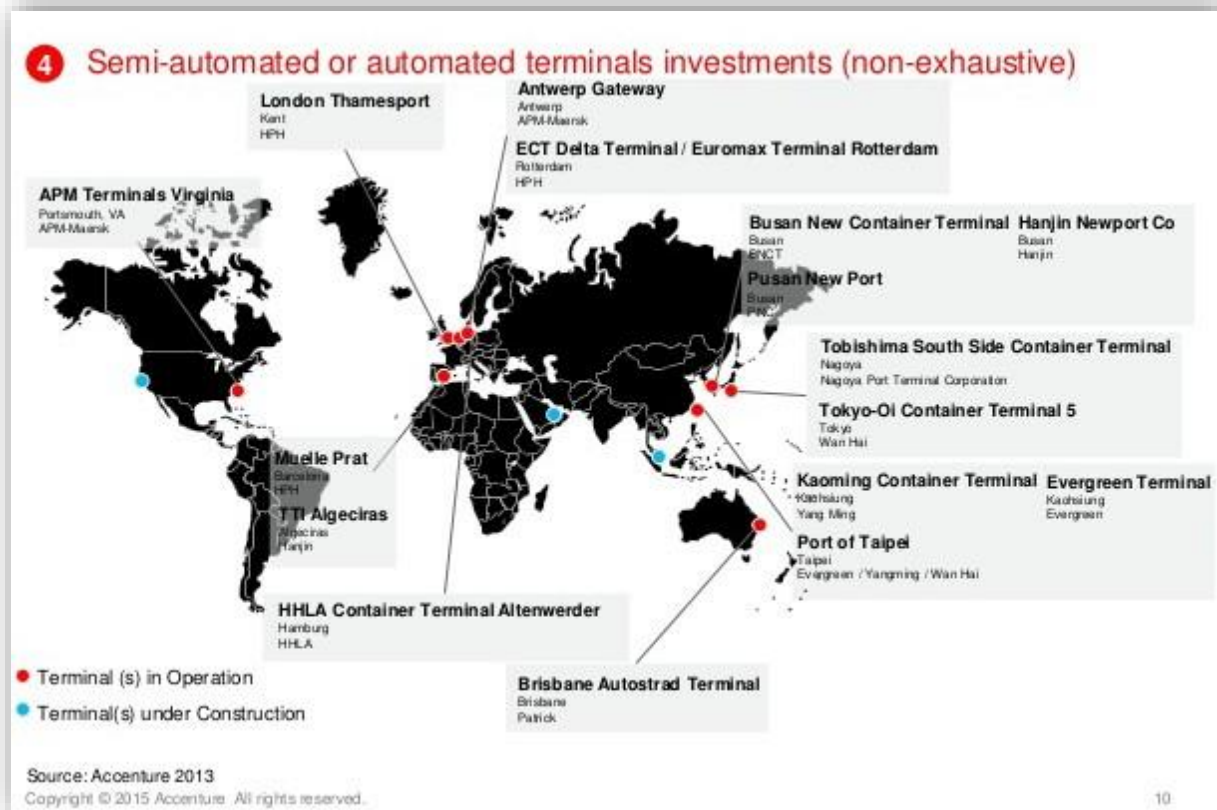
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March 2018

PIANC Task Group 181 on “The State and Perspectives of Waterborne Transport Infrastructure” presents the following case study for an emerging trend or technology that is impacting waterborne transport and/or its infrastructure.

CASE STUDY NAME: 6.8 Port Automation
CASE STUDY CATEGORY: Infrastructure
PREPARED BY: Nick Pansic, Stantec



1. Trend Description

A collateral effect of increased container vessel size is the need for ports to increase their throughput to handle the larger vessels without excessive dwell times. Many large ports are looking to increased automation as a means to achieve this improvement. Due to a higher demand and traffic patterns, ports in China, Singapore and Rotterdam are foremost in port automation deployments in the world (Flexport, 2015).

Although fully automated port terminals currently account for only a small fraction - some four to five percent of container volume was handled by fully automated terminals in 2016 – of world terminal capacity, competitive pressure has driven ports to invest and automate, and the number of automated terminals is increasing.

By the end of 2018, ultra large container vessels (ULCVs) are expected to gain a 61% share of total vessel capacity, pushing established hubs like Singapore to automate its terminals to stay relevant. The port's volume growth of 6.4 percent for the first half of 2017 indicates that its investments in modernized berths and joint ventures with liners are paying off (The Maritime Executive, 2017).

Australian ports have the highest percentage of automated terminals for a multiple major container port country in the world.

2. How is this trend impacting waterborne transport?

By definition, automation of port terminals reduces the need for labor and therefore threatens thousands of lucrative dockworker jobs. The push over the last decade by international maritime ports to fully automate operations has sparked the ire of many U.S. longshoremen whose high-paying jobs and way of life are at stake. The trend also sets up a battle between labor unions and companies and governments who see automation as a cleaner, more efficient and less costly alternative to the current system.

By digitizing and automating activities once handled by human crane operators and cargo haulers, seaports can reduce the amount of time ships sit in port and otherwise boost port productivity by up to 30% by some estimates (Fortune, 2018).

3. What are the short- or long-term implications of this trend?

One implication of port automation is an increased vulnerability to cyber threats. The "NotPetya" cyber attack in June 2017 interrupted terminal operations at multiple terminals worldwide, costing Maersk an estimated \$300 million.

Since 2016, the International Maritime Organization (IMO) has put forward voluntary guidelines regarding cyber risks. Only after 2021 does the IMO plan to enforce a set of binding regulations on cyber security.

4. How can/should the waterborne transport industry respond to this trend?

Increased throughput capacity on the dock can expose other weaknesses or inefficiencies at the port. For instance, the Australian ports have highlighted the need to improve intermodal rail connections to their high-capacity Sydney area ports, so that import and export freight movements can be further optimized.

5. References: Provide source(s) for this case study.

Flexport. (2015, September 22). Why is the port of Rotterdam more automated than the port of Oakland. Retrieved from <https://www.flexport.com/blog/port-automation-oakland-rotterdam/>

Fortune. (2018, January 30). U.S. Ports Take Baby Steps in Automation as Rest of the World Sprints. Retrieved from <http://fortune.com/2018/01/30/port-automation-robots-container-ships/>

The Maritime Executive. (2017, December 27). Port Automation and Cyber Risks. Retrieved from <https://www.maritime-executive.com/editorials/port-automation-and-cyber-risk#gs.pYh6SGc>

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March 2018

PIANC Task Group 181 on “The State and Perspectives of Waterborne Transport Infrastructure” presents the following case study for an emerging trend or technology that is impacting waterborne transport and/or its infrastructure.

CASE STUDY NAME: 6.9 Port Alliances

CASE STUDY CATEGORY: Business Models/Drivers

PREPARED BY: Puja Shinde, Stantec



Source: Canadian Geographic, 2009

1. Trend Description

The introduction of mega-ships within the world fleet is driving investment in major deepwater ports to take advantage of the economies of scale of handling the larger vessels. However, other ports have physical and financial constraints that prevent them from vying for these larger vessels. Instead, their business model is focused on taking advantage of the “cascade effect,” whereby vessels that formerly called on large mega-ports are shifting to second-tier ports where they can be accommodated without significant investment in port infrastructure (More Than Shipping, 2016).

According to article from the Canadian Geographic, the US and Canada’s Great Lakes and St. Lawrence Seaway system, first opened in 1959, has transported more than 2.5 billion tonnes of cargo, worth in excess of \$375 billion, between Canada’s “fourth coast” and ports principally in the United States, Europe, the Middle East and Africa.

However, the system is constrained by lock and riverine dimensions that limit the size of vessels that can service their ports. Rather than competing among themselves for scarce traffic, the Great Lakes and St. Lawrence Seaway ports have entered into a joint marketing agreement called “Highway H2O.”

2. How is this trend impacting waterborne transport?

As infrastructure requirements for large ports to handle mega-ships becomes greater, secondary ports are at increased risk of losing business. Yet these secondary ports remain vital economic engines for the regions they serve. A 2011 study by Martin Associates examined the economic impacts of the Great Lakes

St. Lawrence Seaway System and concluded that:

- 226,833 jobs in Canada and the U.S. are supported by cargo moving on the system;
- Maritime activity supports C\$ 14.5 billion in personal income and expenditures in Canada and the US;
- North American farmers, steel producers, construction firms, food manufacturers and power generators depend on the 164 million metric tonnes of iron ore, coal, stone, salt, sugar, grain, steel, wind turbines and machinery that are delivered by ships every year to keep their businesses running; and
- The Great Lakes - St. Lawrence Seaway System has saved shippers US\$ 2.7 billion annually in transportation costs.

3. What are the short- or long-term implications of this trend?

The Highway H2O alliance markets itself as “offering shippers direct access to the commercial, industrial and agricultural heartland of North America. We are a reliable and cost-competitive gateway, driving sustainable infrastructure advancement, while connecting you to your market.” (Highway H2O, 2017).

Strategic advantages in cost competitiveness, reliability, access, and sustainability are promoted as benefits to users of the member ports.

4. How can/should the waterborne transport industry respond to this trend?

Navigation locks on the Canadian Seaway are investing in improvements – such as hands-free mooring – to improve operational safety and efficiency and reduce costs of transiting vessels, as a means of improving their competitive position.

5. References: Provide source(s) for this case study.

D'arcy Jenish. (2009, August). Inland Superhighway. *Canadian Geographic*. Retrieved from http://www.greatlakes-seaway.com/en/pdf/resources_article1.pdf

Highway H2O. (2017). About HWY H2O. Retrieved from <http://hwyh2o.com/about-hwy-h2o/>

Martin Associates. (2011, October 18). The Economic Impacts of the Great Lakes – St. Lawrence Seaway System. Retrieved from <https://www.seaway.dot.gov/publications/economic-impact-study-0>

More Than Shipping. (2016, November 25). The Impact of Shipping Consolidation and Alliances. Retrieved from <https://www.morethanshipping.com/impact-shipping-consolidation-alliances/>

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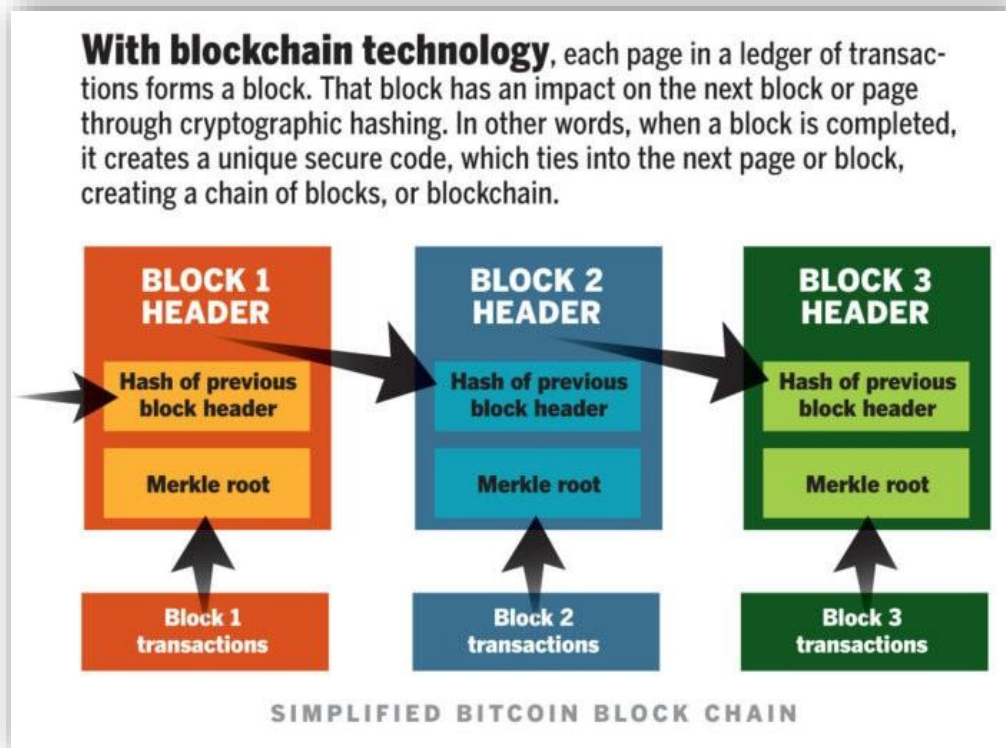
March 2018

PIANC Task Group 181 on “The State and Perspectives of Waterborne Transport Infrastructure” presents the following case study for an emerging trend or technology that is impacting waterborne transport and/or its infrastructure.

CASE STUDY NAME: 6.10 Blockchain Technology

CASE STUDY CATEGORY: Business Models/Drivers

PREPARED BY: Nick Pansic, Stantec



Source: Computerworld, 2018

1. Trend Description

Blockchain represents a new paradigm for the way information is shared and companies are rushing to figure out how they can use the distributed ledger technology to save time and administrative costs. Numerous companies in 2017 began rolling out pilot programs and real-world projects across a variety of industries - everything from financial services to healthcare to mobile payments and even global shipping (Computerworld, 2018).

In January 2018, Maersk and IBM announced a joint venture to deploy a blockchain-based electronic shipping system that will digitize supply chains and track international cargo in real time (WSJ, 2018). The new platform could save the global shipping industry billions of dollars a year by replacing the current electronic data interchange (EDI)- and paper-based system, outdated systems for tracking cargo and getting approval from customs and port authorities, which can leave containers in receiving yards for weeks (Computerworld, 2018).

2. How is this trend impacting waterborne transport?

Maersk says that the cost of documentation to process and administer many of the goods shipped each year can amount to as much as one-fifth of the physical transportation costs. IBM and Maersk say that blockchain is ideal for organizing large networks with different partners like the shipping industry, which transports more than \$4 trillion worth of goods annually.

All players across the supply chain stand to benefit from the neutral, open digital platform for safe and easy ways of exchanging information. Customs authorities in Singapore and Peru are exploring collaborating with the platform to facilitate trade flows and enhance supply-chain security.

3. What are the short- or long-term implications of this trend?

Maersk is looking to move beyond its traditional maritime shipping business model to become a global supply-chain major like UPS and FedEx by integrating its transport and logistics business and spinning off its oil business.

4. How can/should the waterborne transport industry respond to this trend?

It is still early days, but the potential for streamlining shipping and enhancing the security of freight is high.

5. References: Provide source(s) for this case study.

Computerworld. (2018, January 18). Blockchain will be the killer app for supply chain management in 2018. Retrieved from <https://www.computerworld.com/article/3249252/emerging-technology/blockchain-will-be-the-killer-app-for-supply-chain-management-in-2018.html>

Computerworld. (2018, January 18). What is blockchain? The most disruptive tech in decades. Retrieved from <https://www.computerworld.com/article/3191077/security/what-is-blockchain-the-most-disruptive-tech-in-decades.html>

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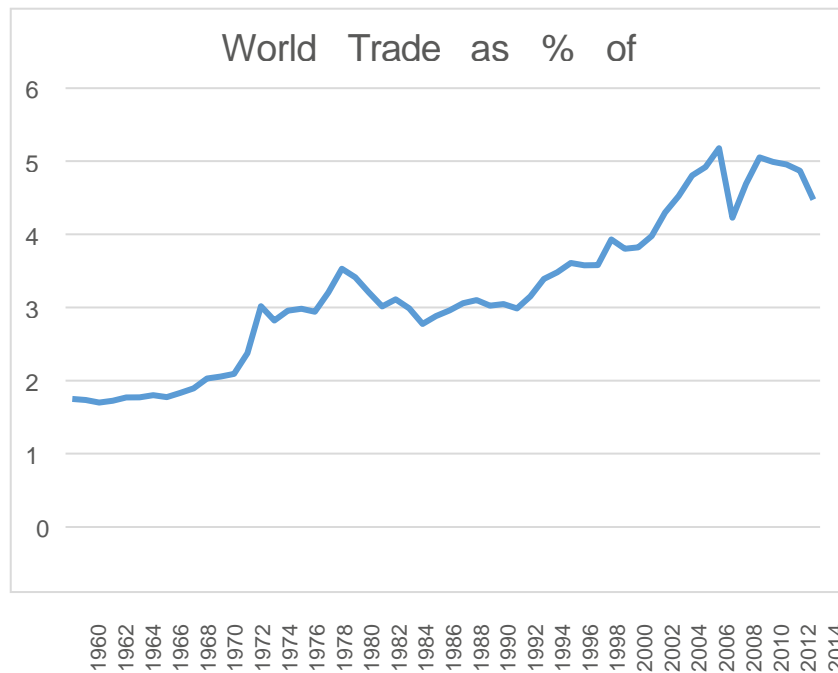
March 2018

PIANC Task Group 181 on “The State and Perspectives of Waterborne Transport Infrastructure” presents the following case study for an emerging trend or technology that is impacting waterborne transport and/or its infrastructure.

CASE STUDY NAME: 6.11 Globalization

CASE STUDY CATEGORY: Business Models/Drivers

PREPARED BY: Anne Cann, US Army Corps of Engineers, Institute for Water Resources



World Trade as Percent of Global GDP (Source: World Bank)

1. Trend Description

There are signs that globalization is slowing and may even be ending. A recent article in the Wall Street Journal (“Globalization Backers Face End of an Era”, March 30, 2017) provides information on several new trends. One trend with potentially long term implications for seaborne trade and shipping is weakening of the trade/GDP growth ratio. For the past several decades, trade has been growing faster than GDP, but recent data indicate a reversal in this. The world trade/GDP ratio was 1.4 in 2013, 0.94 in 2014, and 0.62 in 2015. World trade as a percentage of global GDP is shown in the figure above, and an inflection point is evident in the last few years.

Nations, corporations, and institutions are figuring out how to adapt to a world with bigger barriers to trade and finance. Big banks are reducing their global footprints. Industries are developing strategies for a more localized world. Major international shipping companies are losing money, with some struggling for survival, while the business of dismantling large container ships for scrap is booming in Pakistan, Bangladesh, and India.

2. How is this trend impacting waterborne transport?
Demand for waterborne transport, and associated need for supporting infrastructure, is tied directly to global trade. To the extent that globalization retreats, a corresponding reduction in waterborne transport can be expected.
3. What are the short- or long-term implications of this trend?
It is not a given that globalization trends will continue along a sustained, uni-directional path. It could be cyclical, depending upon economic and trade policy considerations.
4. How can/should the waterborne transport industry respond to this trend?
Public and private entities responsible for waterborne transport and its infrastructure will develop and implement strategies and tactics designed to respond appropriately to upward or downward trends in global trade. However, this response will likely not be perfect, and may not be timely, so some economic disruptions are inevitable.
5. References: Provide source(s) for this case study.
<p>Wall Street Journal (WSJ). (2017, March 30). Globalization Backers Face End of an Era. <i>The Wall Street Journal</i>.</p> <p>World Bank. (2018). Trade (% of GDP). Retrieved from: https://data.worldbank.org/indicator/NE.TRD.GNFS.ZS</p>

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PIANC Task Group 181 on “The State and Perspectives of Waterborne Transport Infrastructure” presents the following case study for an emerging trend or technology that is impacting waterborne transport and/or its infrastructure.

CASE STUDY NAME: 6.12 Fourth Industrial Revolution

CASE STUDY CATEGORY: Business Models/Drivers

PREPARED BY: Puja Shinde, Stantec



Source: Maritime Reporter & Engineering News, 2017

1. Trend Description

Today's era of technological advances are on par with a new type of industrial revolution. Recent developments in artificial intelligence, 3-D printing, the Internet of Things and other technologies and systems have inspired organizations with an historical bent to paint today's digital disruption as the Fourth Industrial Revolution, or Industry 4.0 (WSJ, 2017).

The first, starting in the last third of the 18th century, introduced new tools and manufacturing processes based on steam and water power. The second brought steel, cars, and electricity, and with it, mass production. The third, following World War II, saw the advent of computers and the automation of process in just about all industries. But while there's general agreement that today's Industry 4.0, is primarily driven by technologies integrating the physical and digital worlds, there's a spectrum of opinions as to the scope of its impact.

2. How is this trend impacting waterborne transport?

Both positive and negative impacts on maritime transport are possible. On the positive side, the marine industry is working towards solutions for propulsion, environmental regulations, safety standards and global trade by embracing these technological advancements currently reshaping the industrial world. On the other hand, technologies such as 3D printing have the potential to reduce demand for offshore manufacturing and transport of both raw materials and finished goods.

According to the Maritime Reporter & Engineering News, technological innovations currently underway include:

Electrically powered car ferry taking vehicles and people four miles across the Sognefjord in Norway with zero emissions;

Optimized ship operation and performance via a common digital platform to collect and consolidate ship data from different system suppliers and in different data formats;

Automated commercial fishing vessels able to catch, process and package fresh cod on-board like an Industry 4.0 factory on the seas;

Product lifecycle software used to design the most highly complex of ships, such as the prototype fully autonomous ship (ReVolt concept - unmanned and battery-powered) that will cross the Atlantic next year.

3. What are the short- or long-term implications of this trend?

According to in Maritime Forecast 2050, potential implications include:

Digitalization can reduce the cost of shipping while improving safety;

Operators will generate cost savings through advanced data analytics, process digitalization, robotic process automation and connecting and sensing technology;

Changes to maritime law will be needed to address autonomous vessels; and

Enabling of new business models and better ship operations with a positive impact on energy use.

4. How can/should the waterborne transport industry respond to this trend?

The fourth industrial revolution is happening now. It is the integration of digital, physical, and biological systems, and no one really knows exactly how it will unfold. But it has the potential to literally change how we live in the world. It has the potential to reduce the demand for maritime transport services by cutting the length of supply chains with 3-D printing and robotics, the circular/shared economy, and other unforeseen mechanisms.

5. References: Provide source(s) for this case study.

Maritime Forecast 2050. (2016). Marine Transport and the Fourth Industrial Revolution. *Maritime Forecast 2050*, 70.

Maritime Reporter & Engineering News. (2017, February). Industry 4.0 on the High Seas. Retrieved from: <https://magazines.marinelink.com/Magazines/MaritimeReporter/201702/content/industry-high-seas-522738>

Wall Street Journal (WSJ). (2017, December 15). Digital Disruptors of the World Unite: Interpreting the Fourth Industrial Revolution. Retrieved from: <https://blogs.wsj.com/cio/2017/12/15/digital-disruptors-of-the-world-unite-interpreting-the-fourth-industrial-revolution/>

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PIANC Task Group 181 on “The State and Perspectives of Waterborne Transport Infrastructure” presents the following case study for an emerging trend or technology that is impacting waterborne transport and/or its infrastructure.

CASE STUDY NAME: 6.13 Green Ports

CASE STUDY CATEGORY: Environmental & Social

PREPARED BY: Thijs de Boer, Royal Haskoning DHV



View on Mombasa port (Source: The East African, 2017)

1. Trend Description

Sustainability of shipping and related infrastructure is a hot topic nowadays. Over the past 10 years, ports worldwide are increasingly taking measures to reduce and mitigate environmental and social impact of their operations. This trend, often related to as ‘Green Ports’, has so far focused on developed countries in the America’s, Europe and Asia. These countries have large ports with big interlinking cities, a well- educated population that is aware of port impacts and often an active stakeholder involvement.

However, for the next 10 to 20 years, most environmental and social issues related to port development are expected in less developed countries in South America and specifically Africa and Asia. Strong population growth, urbanization and economic growth will increase the pressure on the ports and the port-city interaction in these countries.

In anticipation of this, the measures currently taken by Kenya Ports Authority (KPA) in the port of Mombasa are interesting. KPA has developed a Green Port policy and is implementing subsequent actions (cold ironing, solar power, semi-electric cranes) in the port of Mombasa. A policy is being implemented to require specific visiting vessels to switch of diesel engines in favor of an electrical shore power connection. This is beneficial for the local air quality, whereas it also contributes to the global reduction of carbon emissions (The East African, 2017).

Another example of such a development can be found in Tanzania, where the Tanzania Ports Authority under the Dar es Salaam Maritime Gateway Program (supported by World Bank and UK DFID funding) is developing a Green Port policy and implementation action plan. Objective of this policy and action plan is to increase the sustainability of regional trade by improving climate resilience and environmental performance of Tanzanian ports (World Bank, 2017).

These two examples are reflections of an emerging trend of sustainable port development in developing countries. So far, these efforts have been relatively limited compared to the efforts worldwide and are encouraged by international donor support. However, considering the forecasted external developments (population, economic growth), this trend is expected to strengthen and continue – as it has done in other parts of the world.

2. How is this trend impacting waterborne transport?

This trend will impact all players active in the waterborne transport in the respective regions. Ships visiting these countries will need to be adjusted to match e.g. shore power requirements. Port authorities will develop and professionalize waste management procedures and facilities. Private terminal operators will increasingly play a role in mitigating environmental and social impact of their operations. Port authorities together with national governmental bodies will need to increase collaboration to for example improve oil spill response and fight international waste crime. This requires international collaboration between neighboring countries as well. Private and public companies operating in the port, and especially port authorities, will be more and more involved in port-city interactions and stakeholder management.

3. What are the short- or long-term implications of this trend?

In the short term (0-5 years), the implications are expected to be limited. Some ports might require vessels to use shore power, for which these need to be equipped. Designs of new port infrastructure will need to take into account a shift towards electrical power instead of diesel (e.g. for cranes, terminal equipment and shore power). This requires a more elaborated electrical system with more medium-voltage electrical connections, substations, etc.

On the mid- and long term (>5 years) there will be more serious implications. Stakeholders in and around the port will be more influential and have a stronger voice (e.g. City Councils of port-cities). Ports and port authorities will shift focus from technical and operational efficiency to organizational skills (e.g. oil spill response), new procedures (waste management), accreditation and inspection (e.g. ISO 14001), institutional aspects (awareness, commitment top management), stakeholder management (port-city interaction), compliance (to international conventions such as MARPOL 73/78) and competitiveness on sustainability (e.g. clients require sustainability in whole logistic chain). Terminal operators will need to follow this shift. New jobs are created, for employees with different skills than purely operational or technical, to suit these requirements.

4. How can/should the waterborne transport industry respond to this trend?

The 'Green Port' topic isn't new and the industry therefore has a fair experience on how to respond to this trend. However, developing countries have their own challenges. The industry can perform a stimulating role, promoting sustainable shipping and sustainable port development. For example, large private terminal operators or shipping lines that use their own social and environmental standards in all countries. Consultants and contractors developing new infrastructure can proactively take sustainable design measures into account. International conventions are demanding and developing countries are not always able to fully comply. International regulatory bodies should acknowledge this challenge and provide guidance on how developing countries can move in steps / levels towards full compliance of international regulations. Port authorities should set-up policies to improve environmental and social performance of the ports.

5. References: Provide source(s) for this case study.

The East African. (2017, November 14). Mombasa port going green in global drive. Retrieved from: <http://www.theeastafrican.co.ke/business/Mombasa-port-going-green-in-global-drive/2560-4187024-6legtjz/index.html>

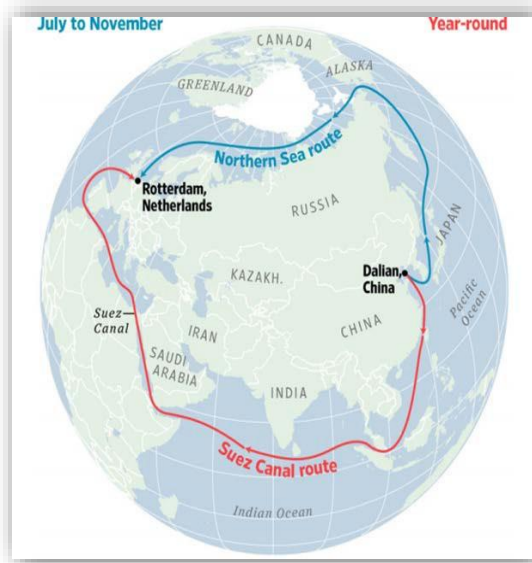
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PIANC Task Group 181 on “The State and Perspectives of Waterborne Transport Infrastructure” presents the following case study for an emerging trend or technology that is impacting waterborne transport and/or its infrastructure.

CASE STUDY NAME: 6.14 Arctic Navigation
CASE STUDY CATEGORY: Environmental & Social
PREPARED BY: Bella Chinbat, Stantec



Source: WSJ, 2015

1. Trend Description

As sea ice continues to recede in the Arctic, maritime infrastructure investment in the north becomes a serious potential as vessel traffic increases. Abundant, high-value mineral reserves also pose valid economic reasons for development. Currently, the availability of nautical charts, aids to navigation, communication, scientific research, emergency response, and rescue capabilities are quite limited, making navigation difficult and dangerous. With this, organizations such as the USDOT and other bordering countries consider further infrastructure investment that improves the navigability and safety of the arctic waterways.

2. How is this trend impacting waterborne transport?

Waterborne transport in the arctic fall into two general categories:

Transiting – navigation through the arctic, via the Northern Sea Route or the Northwest Passage, as part of global maritime logistics; or

Destination – Navigation to and from specific arctic locations as part of resource extraction (oil, gas, minerals) activities.

According to an arctic economics report, shipping through the Arctic region is 7,400 km shorter and could reduce transit times from East to West by 40 percent compared to the Suez Canal, reducing fuel consumption and carbon emission as a result (CSIS, 2013).

According to the CSIS report, development of the Northwest Passage will reduce a trip from London to Tokyo to “4,350 miles and 3,050 miles shorter than using the Panama or Suez Canals, respectively.”

In December 2017, one of the largest Russian private natural gas companies, Novatek, launched the production of liquefied gas at the first LNG train of Yamal LNG plant, located above the Arctic circle. The initial capacity of the first train is 5.5 million metric tons per year, while the ultimate production will reach

16.5 million metric tons per year. China is a 20 percent investor in the project, as the “Ice Silk Road” component of its Road and Belt Initiative (The Diplomat, 2018).

3. What are the short- or long-term implications of this trend?

Besides shorter and cheaper shipping routes, other economic benefits to developing the Arctic include minerals, fish, fresh water, and ecotourism. According to a 2014 World Economic Forum report, critical resources like natural gas, condensate, and oil are abundant in the arctic. Significant issues around sovereignty, environmental protection, and operational reliability are yet to be addressed and resolved.

4. How can/should the waterborne transport industry respond to this trend?

The prospect of increased transiting and destination use of the arctic passages portends a need for increased investment in infrastructure and operational capabilities (e.g., icebreaking), as well as improved surveillance, search and rescue preparedness, and environmental response capacities (United States Coast Guard, 2013). Because the cost of such infrastructure likely exceeds available government funds, public-private partnerships will be crucial in developing the Arctic (The US Committee on the Marine Transportation System and the Arctic Marine Integrated Action Team, 2016).

5. References: Provide source(s) for this case study.

Center for Strategic & International Studies (CSIS). (2013, July). Arctic Economics in the 21st Century—the Benefits and Costs of Cold. Retrieved from <https://www.csis.org/analysis/arctic-economics-21st-century>

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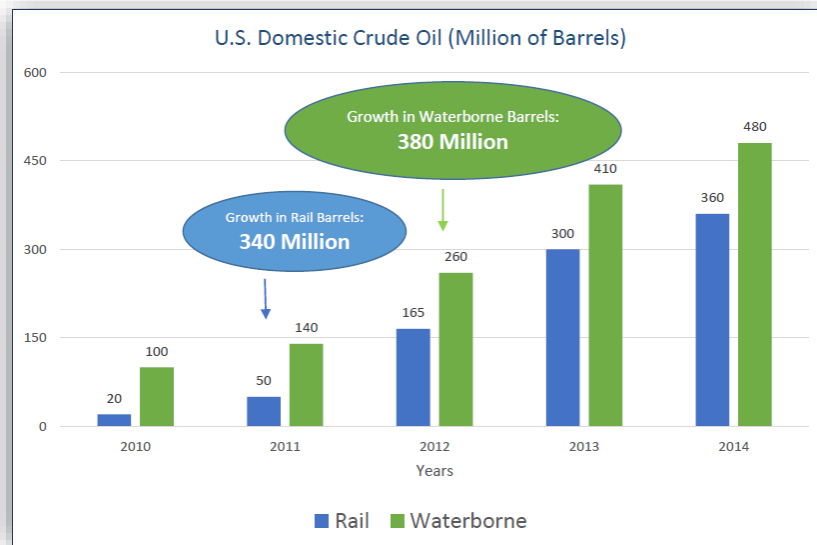
March 2018

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CASE STUDY NAME: 6.15 Resilience and Anti-Fragility

CASE STUDY CATEGORY: Environmental & Social

PREPARED BY: Dr. Craig Philip, Vanderbilt University and Anne Cann, USACE



Source: Philip, 2017

1. Trend Description

Today, there are real concerns that the U.S. waterway system may no longer be sustainable (i.e. able to satisfy system demands over time and in the future). Its role in economic vitality and growth is underappreciated. There is increasing pressure to remove dams and return rivers to their natural hydrograph. And extreme weather stressors (symptoms of climate change perhaps) are moving from episodic to chronic.

Dr. Philip explored the question of whether the system is resilient by looking at how it has responded to another type of stressor – the explosive growth in the volume of crude oil being produced in the U.S. Transport of this crude oil glut used both the rail and inland/coastal waterways to overcome limitations in the pipeline system. U.S. domestic crude oil transport by rail grew from 20 million barrels in 2010 to 360 million barrels in 2014. Unfortunately, this was accompanied by an equally large increase in severe accidents, derailments, fires, etc., many of which occurred in population centers.

Largely unnoticed was the maritime role in the movement of this oil. In fact, the growth in waterborne barrels of oil over the period from 2010 to 2014 was even larger than the increase in rail barrels – an increase of 380 million barrels. And domestic maritime transport actually handled more total barrels than rail as well in 2014, 480 million barrels by water as compared to 360 million barrels by rail. And, “Crude- by-Barge” did so safely, with only 1 significant incident as compared with 16 in rail.

Dr. Philip's thesis is that this experience reveals the Institutional/Social "Resilience" of the U.S. maritime sector, and is a demonstration of "Antifragility". Antifragile systems are those that benefit from stressors by becoming stronger.

2. How is this trend impacting waterborne transport?

Resilient stakeholders and institutions can increase the effectiveness of fragile physical infrastructure. This resilient response culture reflects the alignment and cooperation of key major stakeholders:

Adaptive Infrastructure Owner – USACE, embraced operating flexibility, especially at local level

Progressive Regulator – US Coast Guard, empowered by OPA 90 (the Oil Pollution Act of 1990), but also embraced 'prevention through people'

Responsive Towing Industry – which adopted a Responsible Carrier Program and ultimately embraced full regulation

3. What are the short- or long-term implications of this trend?

U.S. Railroads – Sustainable – Not Operationally Resilient

U.S. Maritime – Not Sustainable – Operationally Resilient

U.S. Maritime Institutional/Social System - Antifragile

4. How can/should the waterborne transport industry respond to this trend?

A resilient governance framework has been adopted and implemented in the U.S. through the development of Waterways Action Plans. These have network wide application, stakeholder driven guidance, well-defined trigger points and responses, are activated multiple times annually, and are continually evolving – becoming "Antifragile". The following concepts of resilience and antifragility are reflected in today's Safety Culture in the U.S. maritime sector. These strategies will help the maritime sector to cope with the external forces, trends, and fundamental game changers.

- Adaptive Learning Process is the Key to Antifragility
- Allow for adaptation to positive stimuli and quick response to failures
- System that rewards change and doesn't punish failure
- Example: Hot-Wash assessment undertaken after events
- Quick Recovery and Redundancies
- Avoiding big risks with relatively low upside; fail not-so-badly
- Have alternative plans and options
- Example: multiple experts, parallel processes and procedures embedded in culture
- Group vs. Individual Mindset
- Experiences, successes, and failures of one can improve the overall group
- Example: Waterway Action Plans gain from prior experiences and responses, both good and bad
- Sense of Ownership
- A sense of ownership, or something to lose, means all participants are incentivized to succeed
- Example: the non-regulated emergence of Waterway Action Plans

5. References: Provide source(s) for this case study.

Philip, C. (2017, June). *Sustainable? Resilient? Anti-Fragile? - How Key Influencers Can Have a Big Impact*. Presented at PIANC AGA, Cairns, Australia.

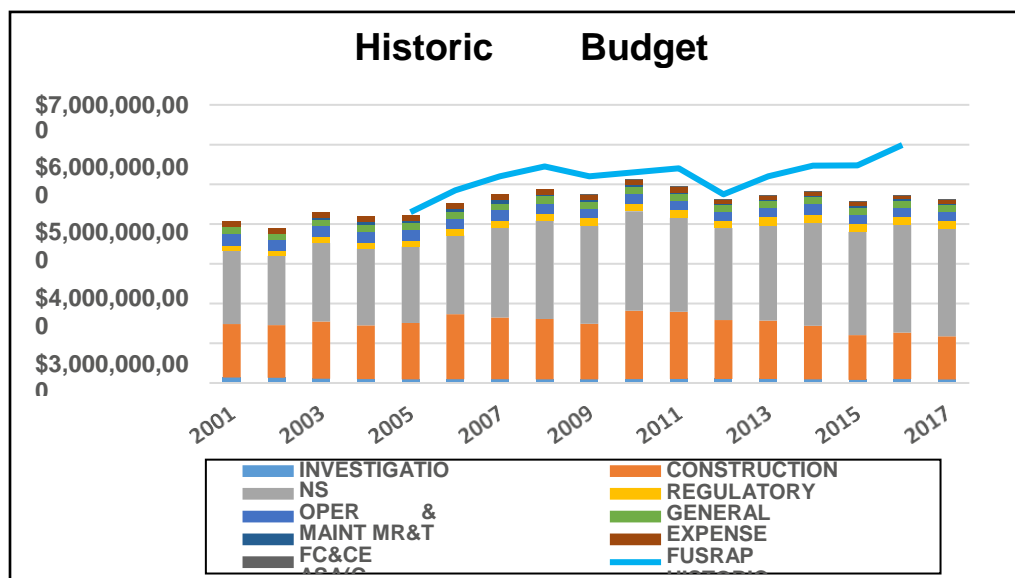
APPENDIX J CASE STUDIES – PROJECT FINANCE & DELIVERY

TG 181 PROJECT DELIVERY CASE STUDY

March 2018

PIANC Task Group 181 on “The State and Perspectives of Waterborne Transport Infrastructure” presents the following case study for guidance on best practices for better design, financing, and construction of sustainable infrastructure.

CASE STUDY NAME/LOCATION: 7.1 P3 Pilot Project, USA
PROJECT DELIVERY CATEGORY: Inland
PREPARED BY: Anne Cann, USACE



Source: Jackson, 2017

1. Project Description

The US has historically (at least for the past several decades) under-invested in its infrastructure. For example, in 2012, US investment in infrastructure was only 13% of its GDP, whereas most countries, regardless of GDP, are in the 18 to 22 % range (Jackson Presentation, 2017; Slide 5). This is reflected in the World Economic Forum’s 2017-2018 rankings of the relative quality of infrastructure, where the US is ranked 9th out of 138 countries overall, and 10th when it comes to roads and ports respectively (WEF, 2017).

2. How was the project configured, financed, and delivered?

The Corps Civil Works program has a rather sizable math problem, servicing a \$268B portfolio w/ \$4.6B/year budget, similar to spending \$70/year on O&M for a \$30,000 car (Jackson Presentation, 2017; Slide 8). It is clear that public funding of port and waterway infrastructure is inadequate to meet the needs. At the same time, many investment funds (e.g., pension funds) are looking for quality investment opportunities

in the infrastructure sector, which they view as low risk with steady returns. But this money is not coming into the waterborne transport system.

USACE is looking to P3/P4 as a viable alternative to the “business as usual” case. Key principles are:

- Life Cycle Perspective - private partner provides full up front financing/optimal funding stream with “bundled” project delivery across phases (design, construction, operations, maintenance, and/or rehab) potentially resulting in substantial time & cost savings;
- P3/P4 Background and Operating Context
 - P3/P4 not as mature in US: municipal bond market, unique us risk profile
 - P3/P4 is essentially another acquisition tool, though complex & longer term
 - P3/P4 cost of money and investor ROI, and primacy of Federal/taxpayer equities
 - P3/P4 application in water resources context presents challenges
- P3/P4 Can Help the Corps & Sponsors Address Two Critical National Civil Works Infrastructure Challenges
 - Existing Infrastructure: Sustain Performance, Extend Service Life, and/or Buy Down Risk for the Nation
 - New Infrastructure: Accelerate Delivery, Reduce Life Cycle Costs and Achieve Earlier Accrual of Project Benefits to the Nation
- Three Primary P3 Revenue Generation Mechanisms
 - User Payments;
 - Availability Payments (Federal Budget), and
 - Commercial/Ancillary Revenues

3. What challenges were encountered in financing and delivering the project?

A task committee of the ASCE COPRI Waterways partnered with the USACE to investigate this problem, and reported their findings in March 2017 (ASCE, 2017). In summary:

- USACE is not set up to easily accept private finance
- Private investors require a guaranteed revenue stream, but inland waterway projects traditionally have not been revenue-generating (e.g., locks do not charge tolls)

Public private partnerships are constrained by limits on how the Federal government can participate – revenue generation and retention; longer-term contracting authority; budget scoring and ranking policies; and the complexities of Federal vs. local ownership

4. What lessons learned from this project can be applied to improve project finance and delivery?

- Addressing the US infrastructure investment gap is a shared Federal, state and local responsibility and Navigation investment is essential for the US global trade and international competitiveness
- The Corps doesn't deliver anything by itself...critical to maintain focus on partners and commitments
- Economically justified P3/P4 investments can reduce risks to economic activity, lives, livelihoods and quality of life (Slide 12)

The US Administration's Infrastructure Initiative was announced in February 2018. The principles that will guide legislative enactment of the initiative are:

- Water Resources - Remove barriers and create innovative delivery models
- Inland Waterways - Promote opportunities for non-federal investments
- Incentives - Incentivize non-federal investments through grants
- Water Infrastructure Finance and Innovation Act (WIFIA) - Incentivize non-federal investments through low-cost federal loans
- Permitting - Streamline permitting processes

5. References: Provide source(s) for this case study.

ASCE. (2017). Alternative Financing and Delivery of Waterways Infrastructure. Retrieved from https://www.asce.org/uploadedFiles/News_Articles/alt_finance_report_final.pdf

Jackson, E. (2017, June). *US Army Corps of Engineers Civil Works Infrastructure Overview*. Presented at Cairns AGA Panel.

World Economic Forum (WEF). (2017). The Global Competitiveness Report 2017–2018. Retrieved from <http://www3.weforum.org/docs/GCR2017-2018/05FullReport/TheGlobalCompetitivenessReport2017%E2%80%932018.pdf>

TG 181 PROJECT DELIVERY CASE STUDY

March 2018

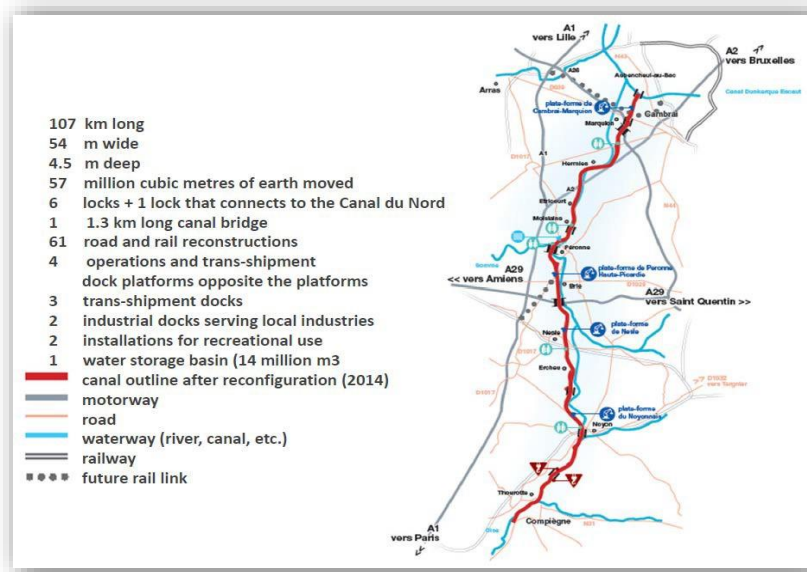
PIANC Task Group 181 on “The State and Perspectives of Waterborne Transport Infrastructure” presents the following case study for guidance on best practices for better design, financing, and construction of sustainable infrastructure.

CASE STUDY NAME/LOCATION: 7.2 Canal Seine-Nord Europe, France

PROJECT DELIVERY CATEGORY: Inland

PREPARED BY: Remy Croix, Egis

Project Layout & Features:



Source: Société du Canal Seine-Nord Europe, 2017

1. Project Description

The Canal Seine-Nord Europe (CSNE) is a proposed 107-km long canal connecting the greater Paris region with ports in northern Europe and the inland waterways of Belgium. It has a planned capital expenditure of € 4.5 billion including surveys, taxes, etc., with the construction works totaling € 3.3 billion. The Canal comprises four sectors:

- S1 - Enlarging River Oise (19 km);
- S2 - New canal, constructing 3 new high-lift locks, 1 canal bridge crossing the Somme River (1.2 km), 1 dam for water supply (14 Mm³) (53 km);
- S3 - Enlarge existing Canal du Nord via deep excavations, with no locks (27 km); and
- S4 - Connection to existing Canal de la Sensée, with 2 high-lift locks (9 km).

Since water supply for the Canal must be pumped, there are high performance requirements for water tightness of about 80 km of Canal. There is a total of about 60 bridges (road or railway) crossing the Canal.

2. How was the project configured, financed, and delivered?

The financing strategy has evolved over time. In 2008, the CSNE was announced as a public works project, with the first call for tenders in 2009 under a public-private partnership arrangement. Preliminary designs and estimated construction costs were prepared by two private consortia. In 2012, due in part to the high costs estimated by the private consortia, a decision was made to stop the public private partnership and to deliver the CSNE with public finance.

A dedicated project company combining a state-owned public establishment, VNF and the regional authorities was established, along with re-engineering and optimization of the project to reduce its costs. In 2017, the Seine Nord Europe Canal company was established, and has recently evolved into a regionally-owned public establishment.

The 2017 cost estimate of €4.5 billion is anticipated to be financed as follows:

- European Union = €1.8 billion
- Local Collectivities = €1.0 billion
- French State = €1.0 billion
- Loan = €700 million

3. What challenges were encountered in financing and delivering the project?

The total capital expenditure is quite high, and the French government has been looking for cost savings since 2007. The CSNE project is still awaiting formal approval to proceed, since it is not a classical kind of transport infrastructure, such as a toll road, with a dedicated funding stream.

The CSNE project also faces technical challenges, including high-lift locks and requirements for innovative approaches to manage and assure the water tightness of the canal.

Detailed design of the locks is still to be done in 2018, and economical solutions for canal water tightness and disposal of excess excavated material in a farm-intensive region are yet to be developed.

4. What lessons learned from this project can be applied to improve project finance and delivery?

It is premature to draw any conclusions or lessons learned from this project. In the coming year (2018), the project is expected to be approved for implementation by the French Ministry of Transport. It is anticipated that the local Region - Haut de France – will take a more prominent role in delivering the project.

5. References: Provide source(s) for this case study.

Société du Canal Seine-Nord Europe. (2017). Canal Seine-Nord Europe. Retrieved from <https://www.canal-seine-nord-europe.fr/>

TG 181 PROJECT FINANCE CASE STUDY

March 2018

PIANC Task Group 181 on “The State and Perspectives of Waterborne Transport Infrastructure” presents the following case study for guidance on best practices for better design, financing, and construction of sustainable infrastructure.

CASE STUDY NAME/LOCATION: 7.3 America’s Central Port, USA

PROJECT DELIVERY CATEGORY: Inland

PREPARED BY: Bill Stahlman, Director of Engineering and Construction, America’s Central Port



Source: America’s Central Port, 2018

1. Project Description

America’s Central Port is located on the Mississippi River, three miles north of downtown St. Louis, Missouri in the center of the US transportation Network. The port’s location provides direct access to principal water, rail, and road networks. Seventy percent of the US population, and 62 percent of businesses can be reached in just a two-day drive from the Port. Economic impact of the Port is substantial

- \$282 million net economic impact annually, providing over 1450 local jobs, generating \$9.6 million in state and local tax revenue, and handling over \$1.1 billion in goods each year (America’s Central Port, 2013).

Beginning in 2009, the Port embarked on development of its \$50 million South Harbor project, a new off-channel harbor whose prime location just south of Lock #27 offers direct access to open, southerly barge navigation to the Gulf of Mexico. Project features include:

Rail access via newly constructed rail loops serving unit trains from six Class I railroads;

- High-capacity dry bulk terminal;
- Truck and rail scales;
- Storage expansion capability; and
- A general cargo dock designed to handle containerized shipping.

The harbor was operational and set to open in 2016 (World Trade Center St. Louis, 2015).

2. How was the project configured, financed, and delivered?

- Project delivery was in stages, under a conventional design-bid-build delivery model.
- The Port received \$14.5 million TIGER federal grant from the U.S. Department of Transportation. The Illinois Department of Commerce and Economic Commerce also approved a \$4 million grant. The remaining amount was paid with a loan from Regions Bank (BND, 2015).

3. What challenges were encountered in financing and delivering the project?

The Port does not receive any state, federal, or local subsidies, so it is fully dependent on own revenue to support itself. Even though they managed to receive \$18.5 million in grants, the Port will still be in long-term debt after financing the rest of the \$50 million by a loan (BND, 2015).

4. What lessons learned from this project can be applied to improve project finance and delivery?

Use of TIGER grant from USDOT facilitated project implementation

When the original bid came in below the Port's estimate, additional work was authorized to use the available funding to accomplish additional work

5. References: Provide source(s) for this case study.

America's Central Port. (2013). The Economic Impact of America's Central Port. Retrieved from: <http://www.americascentralport.com/wp-content/uploads/2013/06/Economic-Impact-Report-2013.pdf>

America's Central Port. (2017). News. Retrieved from <http://www.americascentralport.com/news/> Belleville News-Democrat (BND). (2015, October 9). America's Central Port to christen South Harbor soon. Retrieved from: <http://www.bnd.com/news/local/article38351142.html>

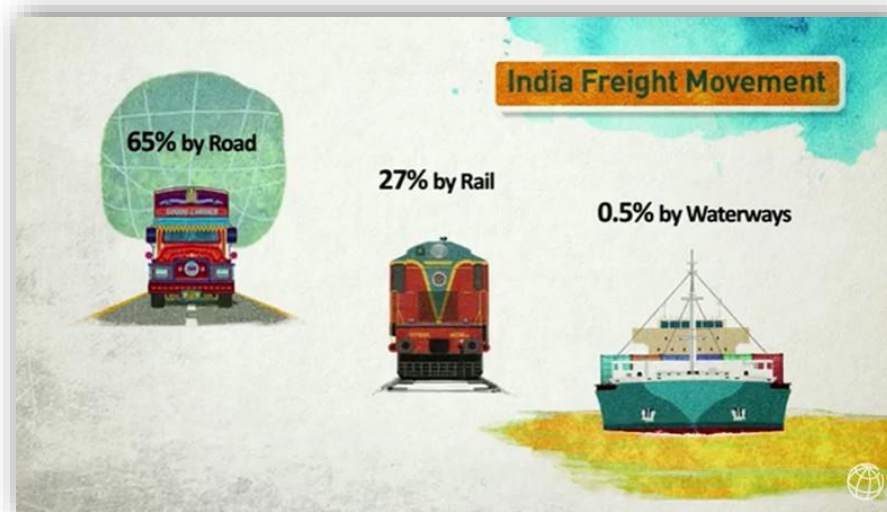
World Trade Center St. Louis. (2015, December 2). America's Central Port and St. Louis' Freight District: Economic Boons You Didn't Realize were There. Retrieved from: <http://worldtradecenter-stl.com/americas-central-port-and-st-louis-freight-district-economic-boons-you-didnt-realize-were-there/>

TG 181 PROJECT FINANCE CASE STUDY

March 2018

PIANC Task Group 181 on “The State and Perspectives of Waterborne Transport Infrastructure” presents the following case study for guidance on best practices for better design, financing, and construction of sustainable infrastructure.

CASE STUDY NAME/LOCATION: 7.4 Ganga Waterway, India
PROJECT DELIVERY CATEGORY: Inland
PREPARED BY: Anne Cann, USACE



Source: World Bank, 2017

1. Project Description

The Government of India is reviving the Ganga watercourse, known as National Waterway 1, or NW1, to move cargo from the eastern seaport of Haldia-Kolkata to Varanasi, some 1,360 km inland. Currently, cargo from the Gangetic states of Bihar and Uttar Pradesh takes circuitous land routes to reach the sea ports of Mumbai and Kandla, rather than going to the much-closer port at Kolkata. Since the Ganga is a seasonal river, year-round traffic is largely limited to the river's downstream stretch between Farakka and Haldia where the water is deep enough (2.5 to 3.0 meters) to allow passage throughout the year.

The project will enable commercial navigation of vessels with capacity of 1500 to 2000 tons. Improvements include the modernization of the aging Farakka lock, built 40 years ago. Currently there are long delays for vessels passing through this lock. The old lock will be upgraded, and a new lock will also be built, allowing simultaneous two-way traffic. The project will also set up a state-of-the-art River Information System (RIS). This modern communication will enable barge-operators and cargo-owners to track their vessels, locate berths in advance in terminals, and better plan their logistics. To make navigation safe both day and night, the project will help mark out the central channel for night navigation. Protocols are also being laid down for dealing with emergencies, including oil spillage from vessels.

2. How was the project configured, financed, and delivered?

The World Bank is financing the development of the Ganga waterway with a loan of \$375 million. Total cost of the Jal Marg Vikas project is estimated at \$650 million. The Capacity Augmentation of National Waterway 1 Project will help put in place the infrastructure and services needed to ensure that NW1 emerges as an efficient transport artery in this important economic region.

3. What challenges were encountered in financing and delivering the project?

The absence of essential infrastructure such as cargo terminals and jetties has been one of the reasons for the slow development of water transport in this region. To address this issue, the project will help establish six multi-modal freight terminals – at Varanasi, Ghazipur, Kalughat, Sahibgunj, Triveni, and Haldia. In addition, five new Roll On-Roll Off crossings at different locations will help trucks and other vehicles transfer from road to river and vice versa. The project will also help set up a vessel repair and maintenance facility at Doriganj.

Since the Ganga occupies a special place in the social, cultural, and environmental landscape of the country, the Inland Waterways Authority of India (IWAI) has sought to adopt the least intrusive methods of making the river navigable. It has therefore followed the principle of 'Working with Nature' while planning improvements to this waterway.

4. What lessons learned from this project can be applied to improve project finance and delivery?

Typically, making a river like the Ganga navigable year-round would call for large scale dredging to attain the depth needed. In this case special care has been taken to minimize the dredging needed. Not only does this reduce environmental impacts – it saves money both initially, and for maintenance. A 45 meter wide channel has been marked in the river's deepest part, and the Least Available Depths (LAD) needed for navigation have been determined, keeping in mind the need to minimize dredging. These measures will reduce the need for dredging to just 1.5 percent of the river's annual silt load of 10-11 million cubic meters. Even this limited dredging will only be done when absolutely necessary, and then using modern, less intrusive technologies. The intent is to keep sediment within the river's ecosystem. Where large shoals and islands exist, temporary structures made of natural materials such as bamboo will be erected to channelize the water flow.

Once operational, the waterway will form part of the larger multi-modal transport network being planned along the river. It will link up with the Eastern Dedicated Rail Freight Corridor, as well as with the area's existing network of highways.

5. References: Provide source(s) for this case study

World Bank. (2017, April 12). Developing India's First Modern Inland Waterway. Retrieved from: <http://www.worldbank.org/en/country/india/brief/developing-india-first-modern-inland-waterway>

TG 181 PROJECT DELIVERY CASE STUDY

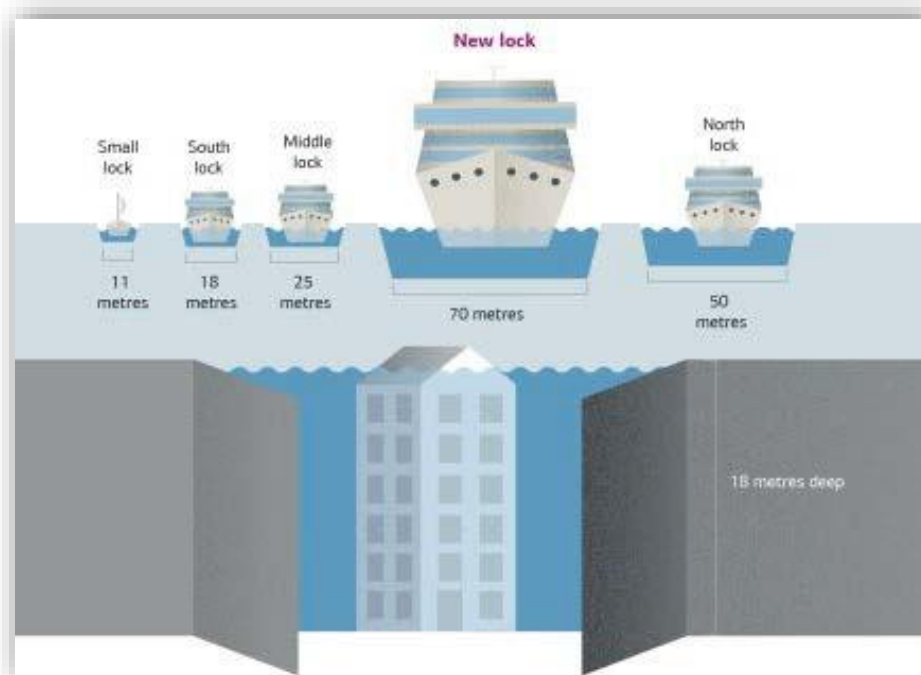
March 2018

PIANC Task Group 181 on “The State and Perspectives of Waterborne Transport Infrastructure” presents the following case study for guidance on best practices for better design, financing, and construction of sustainable infrastructure.

CASE STUDY NAME/LOCATION: 7.5 IJmuiden Lock Expansion, Netherlands

PROJECT DELIVERY CATEGORY: Inland

PREPARED BY: Bella Chinbat, Stantec



Source: KfW, 2017

1. Project Description

The Dutch Government is building the IJmuiden Sea Lock, the world's largest sea lock, at the mouth of the North Sea Channel. It will provide access to the Amsterdam port region and will be 500m long, 70m wide, and 18m deep. One of the main requirements is that it must be navigable even during low tides. Construction started in January 2016 and is expected to be operational at the end of 2019 (KfW, 2017).

2. How was the project configured, financed, and delivered?

The EUR 500 million, or approximately \$620 million USD, project was awarded to OpenIJ, a joint venture between two Dutch construction groups and financial investors. It is configured as a design, build, finance, and maintain (DBFM) delivery model. This mechanism has been used extensively in the road transport sector of the EU, but is relatively new to the waterborne sector.

Funding was provided by the Dutch government, Germany, private banks, European Investment Bank, and KfW IPEX-Bank. The EU's TEN-T programme is also financing some of the cost. Overall, the Ijmuiden project was configured and financed in a public-private partnership format (KfW, 2017).

3. What challenges were encountered in financing and delivering the project?

There were some financial setbacks reported by the two construction companies in the joint venture due to the stability of the caissons. There was significant cost overrun due to the special types of materials and equipment needed for the new design. Despite this project loss, the project continued to progress (Port of Amsterdam, 2017).

Construction of the new, larger lock within the confines of the existing lock complex presented constraints on the construction to be accomplished without significant adverse impacts on existing lock and vessel transit operations.

5. What lessons learned from this project can be applied to improve project finance and delivery?

Public-private partnerships help speed up delivery and enforce continuous project progress despite financial setbacks.

5. References: Provide source(s) for this case study.

KfW. (2017, February 17). Gateway to Amsterdam. Retrieved from <https://www.kfw.de/stories/economy/infrastructure/sluice-ijmuiden/>

Port of Amsterdam. (2017, December 13). Financial setbacks could throw completion of new sea lock into uncertainty. Retrieved from <https://www.portofamsterdam.com/en/news-item/financial-setbacks-could-throw-completion-new-sea-lock-uncertainty>

TG 181 PROJECT DELIVERY CASE STUDY

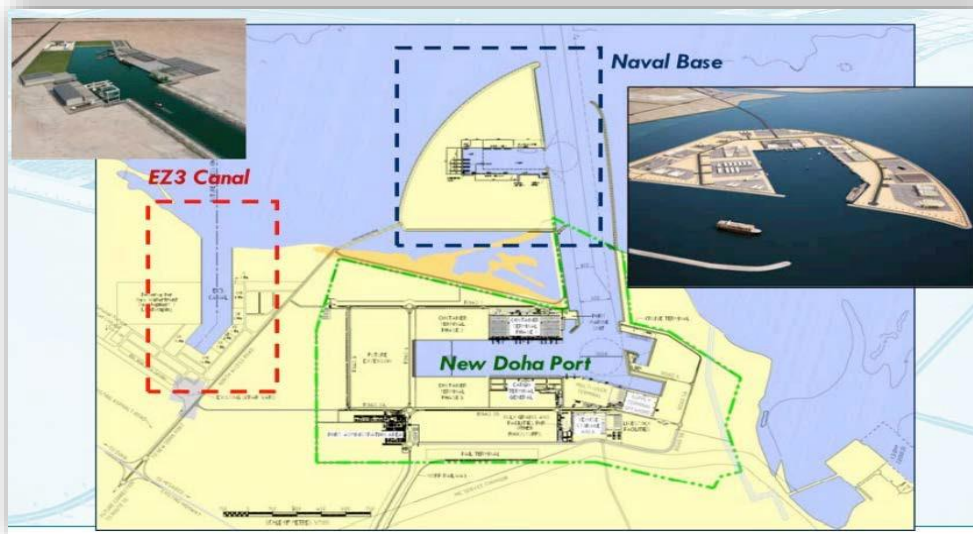
March 2018

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CASE STUDY NAME/LOCATION: 7.6 Port of Doha, Qatar

PROJECT DELIVERY CATEGORY: Maritime

PREPARED BY: Bella Chinbat, Stantec



Source: AECOM, 2016

1. Project Description

The \$7.4 billion New Port Project at Doha, Qatar is one of the world's largest greenfield port projects, and is adopting state-of-the-art technology that will enable it to accommodate growth to 2030 and beyond. It will be connected to an internal rail system and have the possibility to move 6 million TEU/year by 2030. The project is divided into 3 zones, the New Port, the Naval Base, and the Marine Canal.

The New Port, also known as Hamad Port, will be a world-class deep-water port with a total area of 22 km² and an access channel 15m deep. The new Naval Base for the Qatar Emiri Naval Forces (QENF), located next to the New Port, will serve as their Special Forces headquarters. The QENF Training School will also be located there. The base will accommodate QENF vessels and visiting naval forces. The Canal of Qatar Economic Zone 3 will accommodate marine industries to support emerging marine business activities and host ecological recreational activities (AECOM, 2016).

The port will also enable Qatar to maintain its industry-leading position in LNG transport and distribution. Construction of the new port is expected to be completed in 2020 (Albawaba 2016).

2. How was the project configured, financed, and delivered?

The project is being delivered as a program of more than 30 work packages, such as civil works, infrastructure, buildings, and ports equipment. The first package of Port Basin and Inner Breakwater Excavation was awarded to China Harbour Engineering Company. The second package of Access Channel Dredging and Outer Breakwaters Construction was awarded to Middle East Dredging Company. A variety of procurement methods were used, including open tender, restricted tender, expression of interest, and prequalification are being used.

The procurement process is as follows:

- Process involves Client/Consultant Team, Technical and Tender Committees
- Tenders consist of separate Technical and Commercial Submissions
- Tenders reviewed against pre-approved evaluation procedures
- Evaluations undertaken by joint Client/Consultant Team under strict confidentiality
- Technical Evaluation Report is approved by Technical and Tender Committees
- Only technically compliant tenders progress to Commercial Evaluation
- Commercial Evaluation Report is approved by Tender Committee
- Recommendation to Award is approved by Tender Committee, Steering Committee, Prime Minister and Ministry of Finance

The project is being financed entirely by the Qatari government, as part of national project spending expected to top \$100 billion across infrastructure, real estate and other energy and non-energy sectors over the next decade (Albawaba, 2016)

Concessions for operation of the port and the adjacent duty-free trade zone will be solicited via competitive bidding.

3. What challenges were encountered in financing and delivering the project?

- While the Qatari economy is driven by its significant oil and gas resources, the government is committed to diversifying its economy in areas such as maritime transport and tourism;
- Although the new Doha port is being financed by the Qatari government, new regulations to promote private investment from external sources are underway;
- Various regional and global challenges have incentivized Qatar to diversify their sources of income and encourage private sector activity in sustainable development (The Peninsula, 2018).

4. What lessons learned from this project can be applied to improve project finance and delivery?

- A transparent, robust procurement process encourages participation from diverse suppliers, creating a favorable bidding environment for the government;
- Investment in maritime transport infrastructure can be an important component of a country's overall strategy for economic growth.

5. References: Provide source(s) for this case study.

AECOM. (2010, November). AECOM announced today that it has been awarded additional work on its existing six-year, US\$149.3-million agreement to provide program management services to the New Doha Port project in Qatar. Retrieved from <http://www.aecom.com/co/press-releases/aecom-announced-today-that-it-has-been-awarded-additional-work-on-its-existing-six-year-us149-3-million-agreement-to-provide-program-management-services-to-the-new-doha-port-project-in-qatar/>

AECOM. (2016, February). *New Port Project Doha, Qatar*. Presented at RPIC Marine Infrastructure National Workshop, Quebec City, PQ, Canada. Retrieved from: http://www.rpic-ibic.ca/documents/2016_MI/presentations/AECOM_formatted_-_Doha_-_NEW_PORT_PROJECT_28-01-2016_final.pdf

Albawaba Business. (2016, April). *Doha's \$7.5B New Port project set for completion in 2020*. Retrieved from <https://www.albawaba.com/business/dohas-75b-new-port-project-set-completion-2020-826016>

The Peninsula. (2018, March 7). Qatar's economy overcomes regional and global challenges. Retrieved from: <https://thepeninsulaqatar.com/article/07/03/2018/%E2%80%98Qatar%E2%80%99s-economy-overcomes-regional-and-global-challenges%E2%80%99>

TG 181 PROJECT DELIVERY CASE STUDY

March 2018

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CASE STUDY NAME/LOCATION: 7.7 Port of Miami, USA
PROJECT DELIVERY CATEGORY: Maritime
PREPARED BY: Nick Pansic, Stantec



Source: PortMiami, 2017

1. Project Description

The Port of Miami (Florida, USA) moved aggressively to be ready to take advantage of the potential for larger vessels to transit the expanded Panama Canal, investing over \$1 billion in land, waterside, and inside-the-fence improvements to the Port, using a combination of financing and delivery strategies best suited to the project components. As a result, the Port is fully ready to take the new larger ships, and is seeing other efficiency and operational improvements (reduced congestion, zero impacts to Miami-Dade residents) as well. Intent of the improvements is to double the Port's cargo business by 2020 and triple it by 2035, creating 33,000 permanent jobs.

2. How was the project configured, financed, and delivered?

The \$205 million deepening project is cost-shared between the Port and the US Army Corps of Engineers using monies allotted from the Harbor Maintenance Trust Fund (HMTF), which is funded by a tax levied on the value of imported goods.

The \$50 million rail project is funded through a four-way partnership: U.S. Department of Transportation \$22.8 million; Florida Department of Transportation \$10.9 million; Florida East Coast Railway \$10.9 million; and Port of Miami \$4.8 million.

The 4 new cranes at a cost of \$39 million was financed by the Port's balance sheet.

The tunnel is delivered as a design-build-finance-operate (DBFO), 35-year public-private partnership, with private investor providing initial capital, taking responsibility for design and construction, and recouping its investment via availability payments during the 30-year operation period.

Concessionaire financed the \$1 billion tunnel project using a combination of bank debt, its own equity, and a \$341 million loan from the US Dept. of Transportation's Transportation Infrastructure Finance and Innovation Act (TIFIA) program.

3. What challenges were encountered in financing and delivering the project?

According to the Port of Miami 2035 Master Plan, the port's major financial challenges are the following:

- Most revenue comes from self-funding enterprise from user fees
- Generally, grants and credit enhancements/loans are the main two financial support
- Tariffs are very competitive and a major issue with port tenants

As a result, the goal of the 2035 Master Plan is to diversify revenues and allow competitive fee structures to pay for the overall capital program.

4. What lessons learned from this project can be applied to improve project finance and delivery?

- Finance: Combination of fit-for-purpose public and public-private investment with DBFO concession for largest component (tunnel)
- Delivery: Mixture of design-bid-build (dredging), DBFO (tunnel), and capital purchase (cranes)
- Institutional: Federal, State, and Local cooperation to fast-track needed improvements to be ready for Panama Canal expansion.
- Benefits: Increased freight throughput with acceptably minimal social and environmental impacts to high-density population region and marine environment.

5. References: Provide source(s) for this case study.

Lander, J. (2014, November). Progress for PortMiami. *Civil Engineering Magazine*. Retrieved from <https://ascelibrary.org/doi/10.1061/ciegag.0000514>

PortMiami. (2017). Capital Improvements. Retrieved from <http://www.miamidade.gov/portmiami/capital-improvements.asp>

PortMiami. (2018). PortMiami 2035 Master Plan. Retrieved from <http://www.miamidade.gov/portmiami/master-plan.asp>

TG 181 PROJECT DELIVERY CASE STUDY

March 2018

PIANC Task Group 181 on “The State and Perspectives of Waterborne Transport Infrastructure” presents the following case study for guidance on best practices for better design, financing, and construction of sustainable infrastructure.

CASE STUDY NAME/LOCATION: 7.8 Suez Canal Expansion, Egypt
PROJECT DELIVERY CATEGORY: Maritime
PREPARED BY: Bella Chinbat, Stantec



Source: The Guardian, 2015

1. Project Description

In 2015, the Suez Canal in Egypt was expanded for \$8 billion USD. The expansion consisted of adding an additional lane to enable two-way traffic and reduce waiting times. The project was set to take 3 years to finish, but only took 1 year on the orders of the President. The existing channel was also further dredged to make the Canal accessible for larger ships. Canal travel time has decreased from 18 to 11 hours while revenues are expected to increase from \$5.3 billion to \$13.2 billion by 2023 (The Guardian, 2015).

2. How was the project configured, financed, and delivered?

The Egyptian Army supervised the construction. In order to complete the project within a year, 400 private companies and 25,000 workers were mobilized to dig new sections and dredge existing areas (Business Insider, 2015).

The Egyptian government raised funds by selling investment certificates. The shares for these certificates started from as little as 10 Egyptian pounds. With more than 80% of the total investment coming from Egypt's public, the bond issue secured the required funding within a short 10-day period (Business Insider, 2015).

3. What challenges were encountered in financing and delivering the project?

Some sources/experts say that there was little economic reason to expand the Suez Canal as there were no pressing needs for increased capacity. The number of ships passing through the Suez Canal in 2014 was still 20% below that of the pre-2008 recession level (Business Insider, 2015).

In addition, according to the Financial Times, the revenue growth to \$13 billion by 2023 was based on the assumption that there will be an unlikely sharp recovery in global trade growth and doubling of the number of the ships using the Canal to 97 per day. Global trade would have to increase by 10% per year to achieve the annual \$13 billion revenue by 2023 (Financial Times, 2015).

However, the expansion of the Panama Canal and potential for diversion of Suez Canal traffic to the new, more efficient, expanded Canal certainly played into the Government of Egypt's decision to invest in Suez Canal improvements.

4. What lessons learned from this project can be applied to improve project finance and delivery?

- The Egyptian government awarded multiple, parallel dredging contracts, enabling completion of the project on an accelerated schedule
- Selling investment bonds to individual investors proved to be an effective way to quickly raise money for the project

5. References: Provide source(s) for this case study.

Business Insider. (2015, August 6). "Build it and they will come" is not enough: Egypt's \$8 billion Suez Canal expansion sounds dubious. Retrieved from <http://www.businessinsider.com/egypts-authoritarian-president-is-celebrating-the-completion-of-an-8-billion-suez-canal-expansion-that-nobody-asked-for-2015-8>

Financial Times. (2015, December 22). Choppy waters for Egypt's Suez Canal expansion. Retrieved from <https://www.ft.com/content/ebccd98-8a31-11e5-90de-f44762bf9896>

The Guardian. (2015, August 2). Egypt to open Suez canal expansion two years early. Retrieved from <https://www.theguardian.com/world/2015/aug/02/egypt-to-open-suez-canal-expansion-finished-in-a-third-of-projected-time>

TG 181 PROJECT DELIVERY CASE STUDY

March 2018

PIANC Task Group 181 on “The State and Perspectives of Waterborne Transport Infrastructure” presents the following case study for an emerging trend or technology that is impacting waterborne transport and/or its infrastructure.

CASE STUDY NAME: 7.9 Stad Ship Tunnel, Norway

CASE STUDY CATEGORY: Maritime

PREPARED BY: Anne Cann, USACE and Fridtjof Wangsvik, NCA



Source: NCA, 2017

1. Project Description

The Stad Sea is the most exposed and most dangerous area along the coast of Norway. A ship tunnel will reduce the risk of incidents and accidents, making the voyage safer for both passengers and freight, as well as securing regularity. It will also strengthen industrial and commercial activities in the region.

The Stad ship tunnel will be the world's first full scale ship tunnel. There are no other tunnels made for ships, only for smaller boats – narrow boats and barges. These are in Great Britain and France. The length is 1700 m, and the volume of material extracted will be equivalent to 8 million tons of blasted rock. Total costs are estimated to be 2.7 billion NOK (350 million USD), and construction time is 3 – 4 years. Capacity will be 70 to 120 vessels per day, both passenger and cargo ships as well as recreational vessels.

2. How was the project configured, financed, and delivered?

The Norwegian Coastal Administration (NCA) website states that Stad Ship Tunnel is part of the Norwegian National Transport Plan (NTP) in the period of 2018 to 2029. This paves the way for the Norwegian Coastal Administration efforts to build the project. Funding would come from the government.

Use of the tunnel will be free of charge. However, compulsory pilotage, regulated by the Pilot Act, would be applicable for vessels over 70 meters in length using the tunnel. It is possible that compulsory pilotage may be replaced with a Pilot Exemption Certificate (PEC).

3. What challenges were encountered in financing and delivering the project?

NCA reports that, optimistically, the ship tunnel could open in early 2023. However, before the ship tunnel can be built, a number of prerequisites must be met. First, the project must undergo a process of quality assurance and cost estimates, a process called KS2. This is carried out by order of the Ministry of Transport and Communications. When this process is completed, the project is presented to the Parliament, who then decides on whether the project should be funded. If the Parliament approves the project, construction could start in 2019.

4. What lessons learned from this project can be applied to improve project finance and delivery?

- Navigation tunnels are unique and have limited global applications
- However, they can be an effective solution as demonstrated by Stad Ship Tunnel
- Navigation tunnels require the same safety and warning systems as road tunnels
- Vessels using the tunnel must be monitored to control access for high-risk cargo vessels

5. References: Provide source(s) for this case study.

Andreassen, T. (2017, June 13). *Stad Ship Tunnel—Security issues of a mega project*. Presented at PIANC Council Meeting, Pittsburgh, PA. Retrieved from http://www.ita-cosuf.org/images/PRESENTATIONS/2017_1/Andreassen.pdf

The Norwegian Coastal Administration (NCA). (2017). Stad Ship Tunnel. The Norwegian Coastal Administration. Retrieved from <http://www.kystverket.no/en/About-Kystverket/Stad-Ship-Tunnel-project/>

TG 181 PROJECT DELIVERY CASE STUDY

March 2018

PIANC Task Group 181 on “The State and Perspectives of Waterborne Transport Infrastructure” presents the following case study for guidance on best practices for better design, financing, and construction of sustainable infrastructure.

CASE STUDY NAME/LOCATION: 7.10 Panama Canal Expansion, Panama
PROJECT DELIVERY CATEGORY: Maritime
PREPARED BY: Bella Chinbat, Stantec



1,000th Neo-Panamax Ship Passing Through the Canal (Source: Panama Canal Authority, 2017)

1. Project Description

In 2016, the \$5.25 billion expansion of the Panama Canal, consisted of four components. The Third Set of Locks, Pacific Access Channel, navigation channel improvements, and improvements to the water supply. The Third Set of Locks Project, doubled the canal throughput from 300m tons to 600m tons of PCUMS, by building a new lane for “Neo-Panamax” ships. The Pacific Access Channel created a new access route north of the Third Set of Locks. The remaining improvements to channels and water supply consisted of dredging and raising the maximum operating level. As a result of the expansion, container ship capacities increased from 4,400 to 13,000 TEUs. As one of the world’s busiest canals, the expansion and increased capacity is already prompting port expansions around the world to keep pace.

2. How was the project configured, financed, and delivered?

The total project cost was \$5.25 billion, of which, \$2.3 billion was financed by contracts with bilateral and multilateral credit institutions. The following list depicts how much each lender financed:

- Japan Bank for International Cooperation (JBIC): \$800 million

- European Investment Bank (EIB): \$500 million
- Inter-American Development Bank (IDB): \$400 million
- International Finance Corporation (IFC): \$300 million
- Corporación Andina de Fomento (CAF): \$300 million

The rest was funded by the Panama Canal Authority (Panama Canal Authority, 2017).

3. What challenges were encountered in financing and delivering the project?

The expansion was initially expected to be completed in 2014, but was delayed due to unforeseen issues. As a result, financing also became an issue as costs increased. To continue the work without losing progress, the consortium and owner negotiated advanced funding to help manage the consortium's cash flow (NPR, 2014).

4. What lessons learned from this project can be applied to improve project finance and delivery?

According to the Panama Canal Authority, the following lessons were learned:

- Individually reach agreements with potential lenders
- Hire international financial and legal experts to establish long form term sheet according to ACP legal framework, Corporate Governance, Financial Strength
- Hire one law firm to represent lenders as legal counterpart
- Mirror common term agreement obligations/covenants to contractors:
 - Social and environmental clauses
 - Prohibited practices and ethics
- Use /adapt ACP existing reports to include lenders requirements
- Agree on one annual meeting to inform lenders
- Common legal, technical and financial due diligence meetings.
- Common SharePoint for due diligence sharing information
- Private meeting among credit rating agency and lenders
- Establish website for lenders to comply with CTA obligations

5. References: Provide source(s) for this case study.

Panama Canal Authority. (2017). Expanded Panama Canal Welcomes 1000th Neo-Panamax Vessel.

Retrieved from <http://micanaldepanama.com/expansion/2017/03/expanded-panama-canal-welcomes-1000th-neopanamax-vessel/>

Panama Canal Authority. (2017). The Expanded Panama Canal. Retrieved from <http://micanaldepanama.com/expansion/>

Panama Canal Authority. (2017). *Expansion Program Financing & Delivery Strategies*. Presented at PIANC AGA, Cairns, Australia.

NPR. (2014, January 8). As Costs Soar, Who Will Pay For The Panama Canal's Expansion. Retrieved from <https://www.npr.org/sections/parallels/2014/01/08/260793027/as-costs-soar-who-will-pay-for-the-panama-canals-expansion>



Appendix K

U.S. Waterway Infrastructure – Investments and Benefits

Jim McCarville, PIANC USA

PIANC Session 1.4.7

16 April 2015

Daegu, Republic of Korea

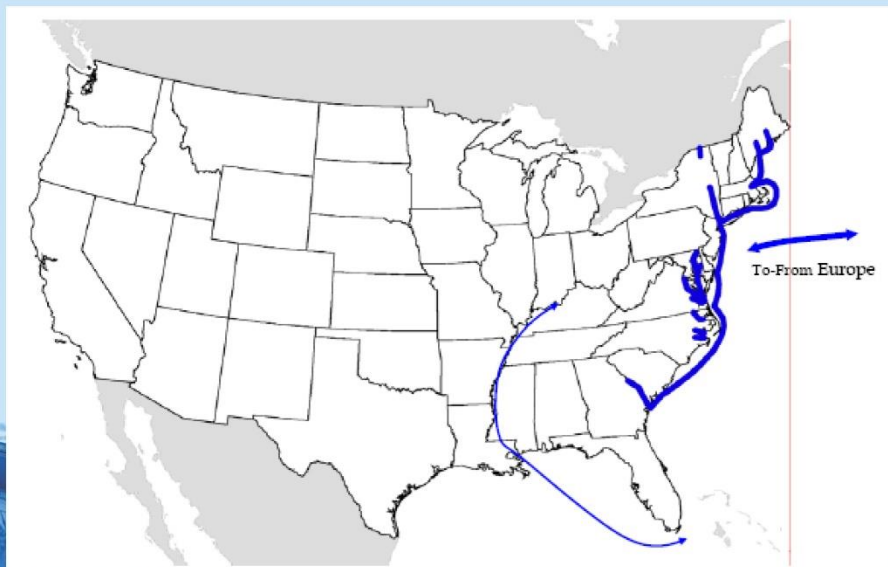
World Water Forum 7



www.pianc.us



Trade Patterns of the 18th Century



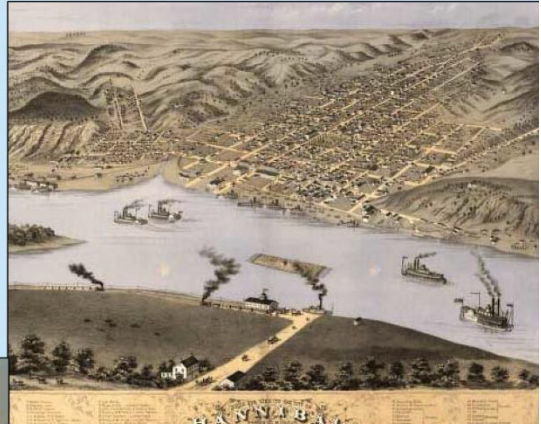
www.pianc.us



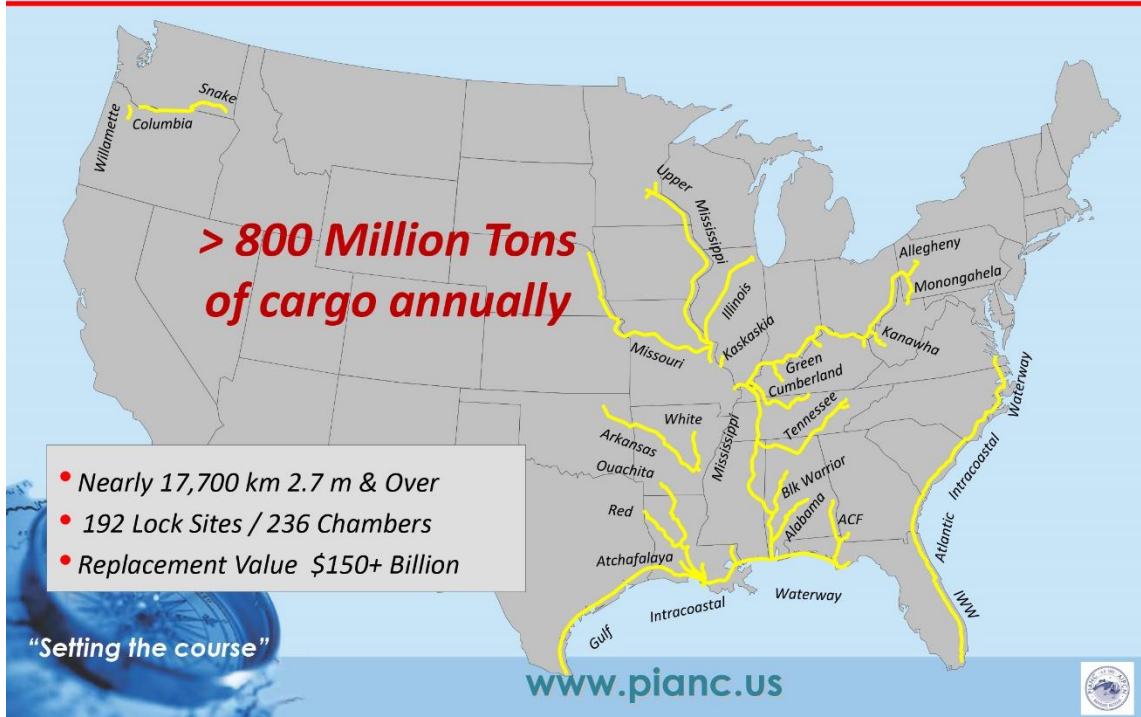
Evolution of U.S. Government Role in Inland Waterway Transport

- 1824 – authority to clear snags and make improvements
- Canal building era to mid-1800s (states)
- Post Civil War – suction dredging, jetties
- 1885: 1st of 46 locks and dams on Ohio

- 1930s: Present system of locks constructed on Upper Miss, Illinois, Tennessee and other waterways
- 1950s: Construction starts on present-day higher lift locks on Ohio
- 1960s-70s: Navigation improvements to Columbia-Snake system, Arkansas River
- 1985: Tenn-Tom Waterway completed
- 1995: Red River Waterway completed
- Present: Existing Infrastructure
 - Modernization, major rehab and expansion of (e.g. Upper Miss)
 - Operate and maintain



U.S. Inland Waterway System – Linking the Nation's Heartland to U.S. Gate Ports & the Global Economy



The Inland Waterway Connection: Linking the Heartland to the Coasts

A map of the United States illustrating the inland waterway network. The map shows major cities and waterways across the country. Key cities labeled include Kalama, Pasco, Vancouver, Portland, Umatilla, Lewiston, Clarkston, Sacramento, Oakland, St. Paul, La Crosse, Milwaukee, Chicago, Pittsburgh, Albany, New York / New Jersey, Dubuque, Quad Cities, Indiana Hbr, Cincinnati, Mt. Vernon, Louisville, Huntington, Norfolk, Kansas City, Omaha, St. Louis, Paducah, Nashville, Knoxville, Chattanooga, Birmingham, Decatur, Vicksburg, Little Rock, Memphis, Tulsa, Shreveport, Lake Charles, Houston, Texas City, Freeport, Matamoros, Corpus Christi, Port Arthur, Beaumont, New Orleans, Mobile, Gulfport, Plaquemines, Panama City, Jacksonville, Savannah, Charleston, and Port Everglades. The map also shows the Great Lakes and the Mississippi River system. A small inset map in the bottom left corner shows the Gulf of Mexico with the text "Setting the course". The website address www.pianc.us is displayed at the bottom center.

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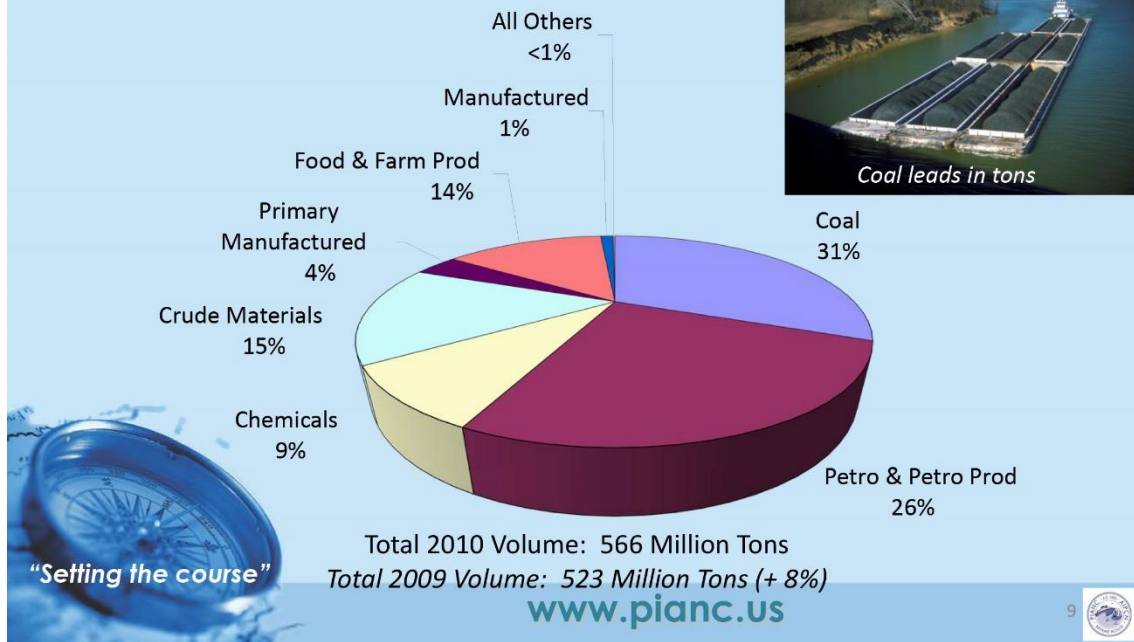
U.S. Freight Flows by Road, Rail, and Waterway. 2010

Freight Flows by Highway, Railroad, and Waterway: 2010



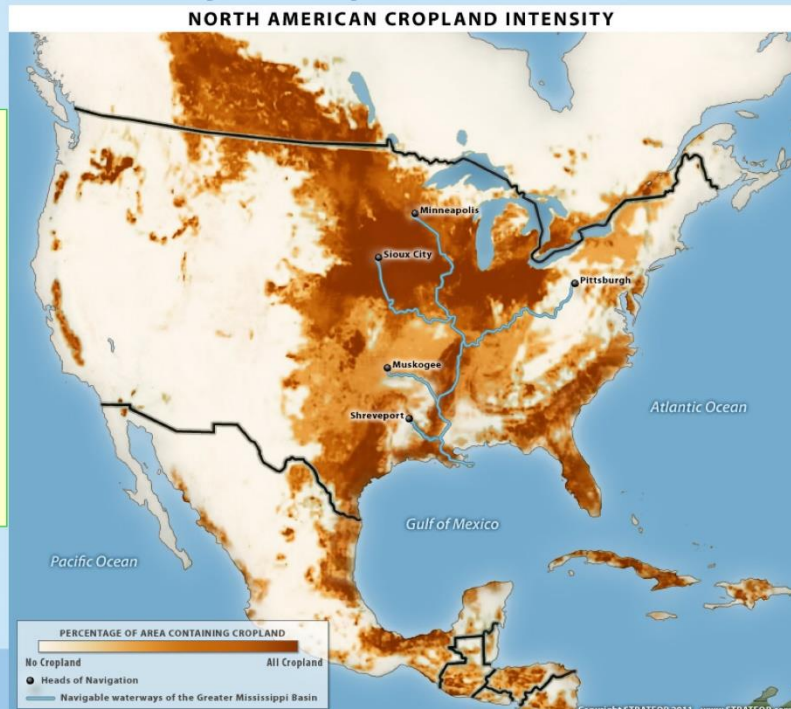
U.S. Inland Waterway Commodities

Share by Tons, 2010



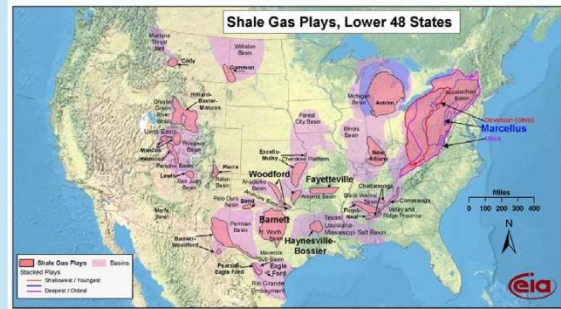
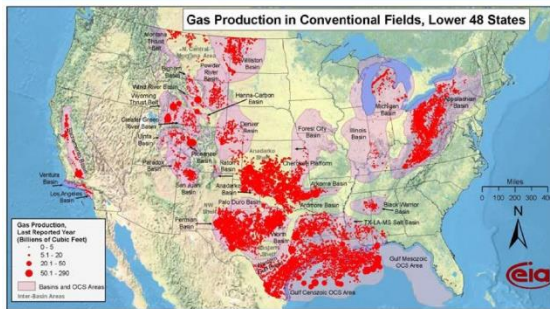
Agricultural Areas Proximity to Waterways - Exports

- Grain Exports
 - Over 70 million tons annually
 - 50% of grain, soybean and prepared feed exports move by barge



Energy Driver – Domestic Hydrocarbon Production

- **US Oil Production:**
 - Grew 18% in last year alone
 - US will be World #1 producer in 2015 **US is #1 Producer July 2014**
- **US Natural Gas Production:**
 - US is World #1 producer as of 2013 (more than Russia)
- **Cascading Effect on Other Industries --- Chemical, Plastics, all Manufacturing**



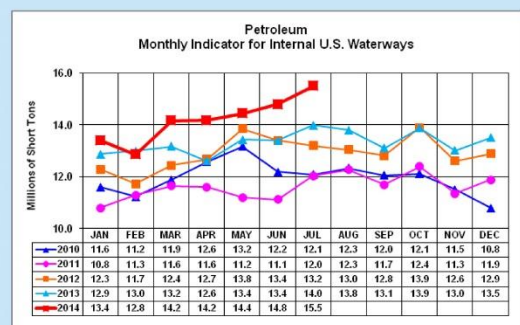
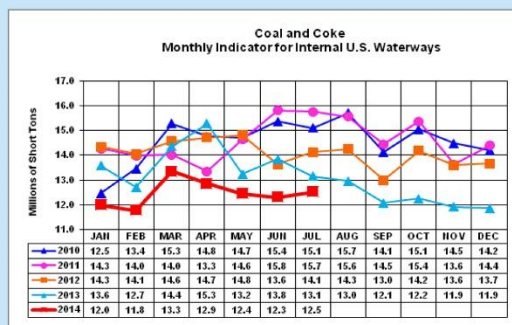
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Changes in Demand: Energy Transport on US Waterways Downturn in Coal, Uptick in Petroleum

Demand is not static and in some cases is overtaken by emerging or greater priorities.



IWW Coal transport
But...Demand for Coal Exports is
increasing

Petroleum transport increasing

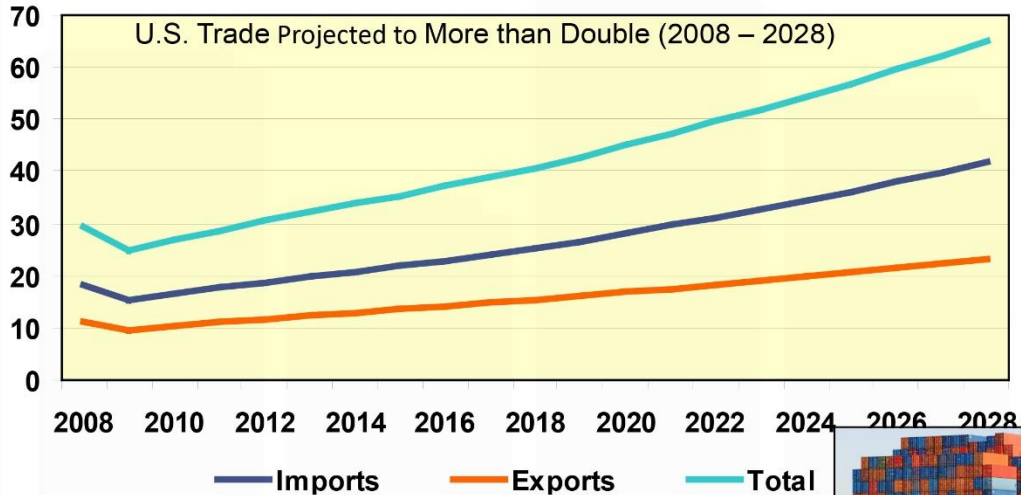
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Global Economy & Increased Importance of U.S. Maritime Transportation System

Millions of TEUs



Source: I H S G I World Trade Service

Port & Waterways Modernization Study, June 2012



Issue: Increasing Freight Transport Demand

- Freight traffic expected to increase by 61% (2010-40) from 17 billion to 27 billion tons
- Intermodal increases from 18 to 27% of freight by value
- How will this cargo be moved?
 - Roads: Little room left to expand, especially in urban areas
 - Rail: mileage has been decreasing; much former right-of-way has been developed
 - Rail capacity constraints in urban areas, tunnel clearances, single-track bridges



Peak-Period Congestion on High-Volume Truck Portions of the National Highway System: 2007



Peak-Period Congestion on High-Volume Truck Portions of the National Highway System: 2040





Role of Inland Waterways in U.S. Export Trade

- The Inland Waterways have a great impact on grains oilseeds and coal.
- Portland and the rail land bridge acts as a competitor to New Orleans
- Northeast Asia is the largest trading partner for exports from these ports
- Portland can accommodate all but the largest ocean going vessels and is the most direct route to northeast Asia
- New Orleans is the dominant port for the export of grains in the U.S.
- New Orleans has a significant trade in U.S. export coal, though Norfolk is the largest export port in trading metallurgical coal in particular

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Role of Inland Waterways in U.S. Export Trade

- New Orleans will be affected by expansion of the Panama Canal
 - With an expanded dimension Canal, Panamax vessels can be loaded to full capacity at New Orleans
 - Smaller Capesize vessels that can fit through the expanded Canal can be accommodated by drafts of Mississippi River ports
- Great Lakes markets are served by Seaway compatible vessels that can already transit the Canal
- Topping-off operations in the St. Lawrence River below Montreal or transloading into larger vessels are possible; however, current economics favor U.S. grain moving down the Mississippi River
- Most grain moving on the Great Lakes is Canadian origin wheat
- World demand for grain may cause grain traffic to increase on all routes, including the Columbia-Snake system

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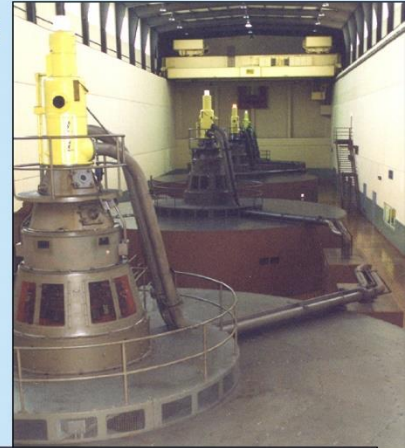
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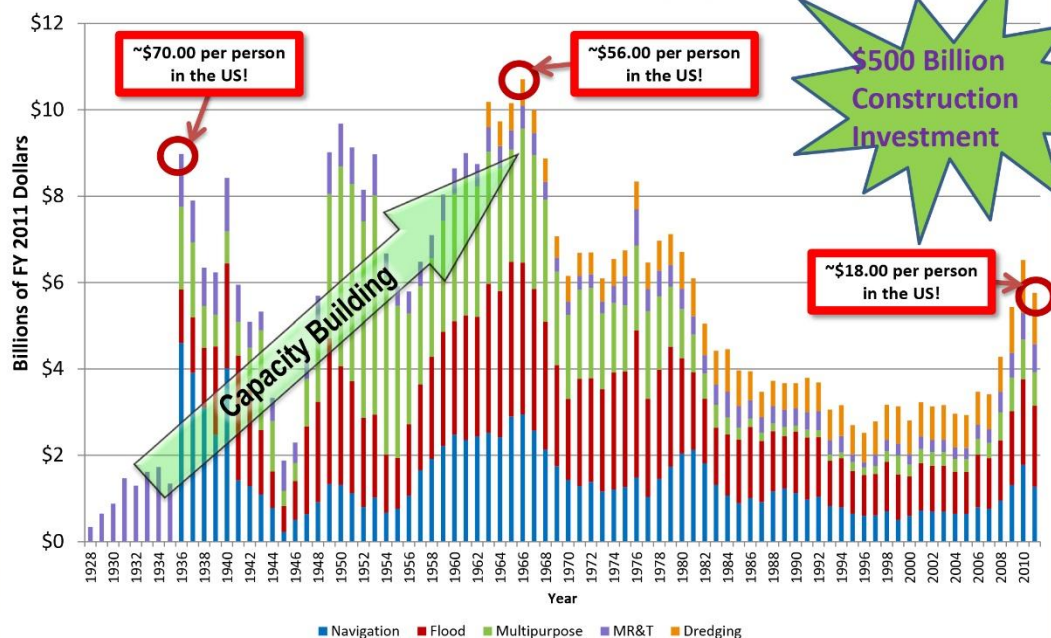
Integrated Water Resources Management

- Past development allows Inland Waterway projects to serve a variety of purposes
 - Hydropower
 - Flood Protection
 - Environmental Restoration
 - Water Supply
 - Recreation



Huge 20th Century Investment in U.S. Water Resources

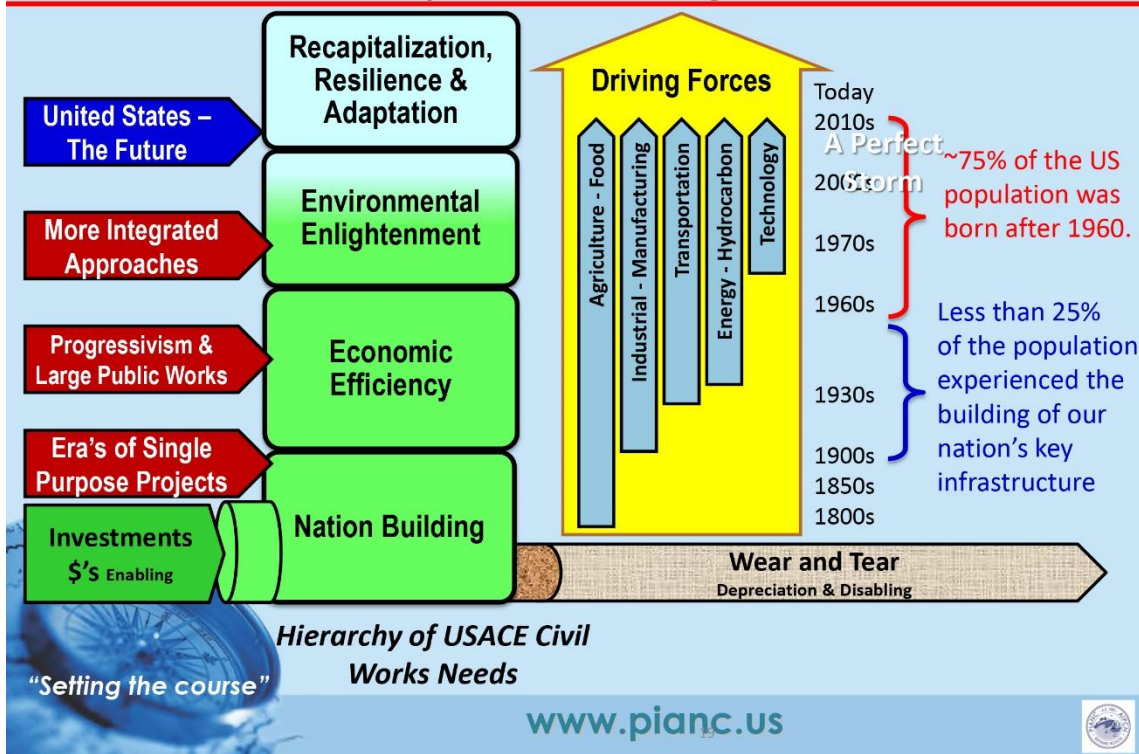
Historical Investments by USACE Functional Category



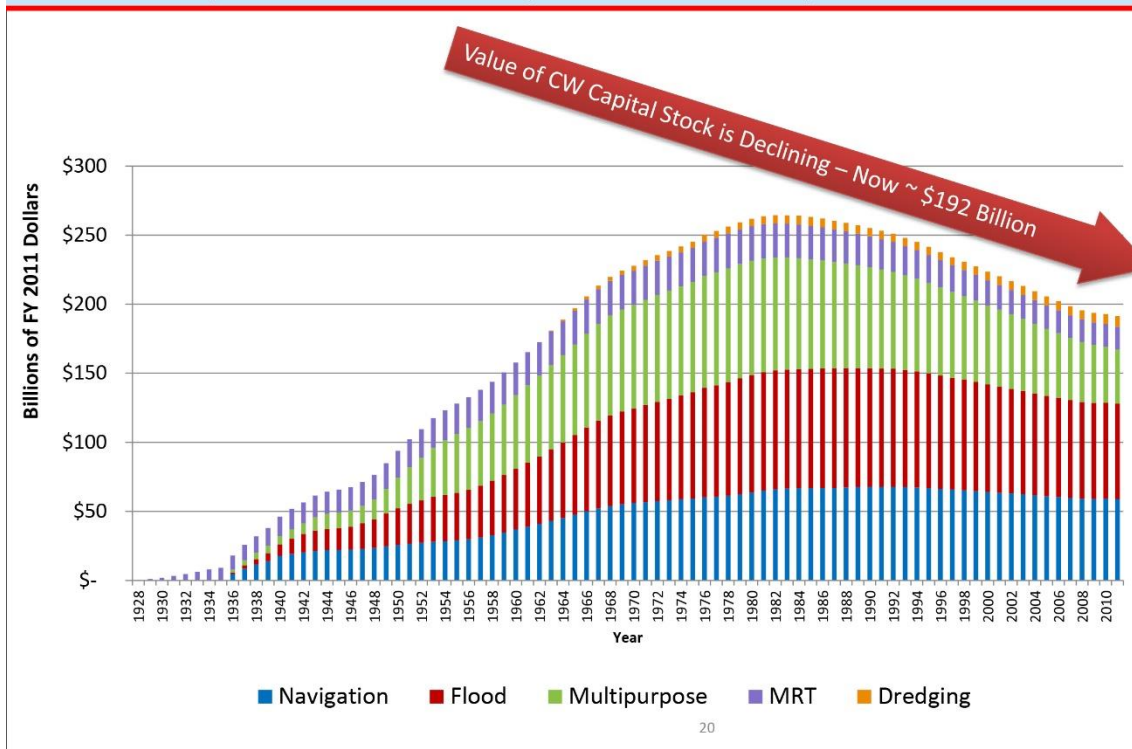
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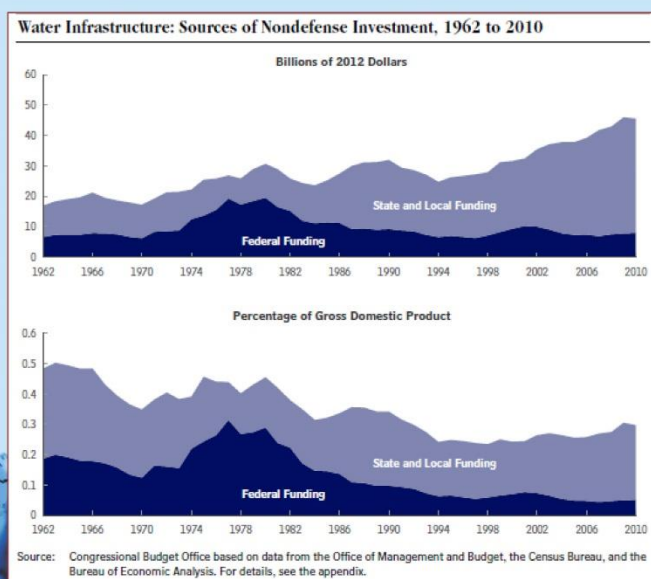
Two Centuries of Experience in U.S. Water Resources Development & Management



Persistence of Constrained Spending Driving Down Performance and Value of the Civil Works Capital Stock



U.S. Water Infrastructure Spending Trends



Between 1962 to 2010...

While total public funding
(in 2012 \$'s)
of water infrastructure has **increased**

As a % GDP, spending has
decreased

And Federal spending has **dropped**
dramatically as % GDP

Placing an **unsustainable burden** on
state & local funding sources as
infrastructure ages.

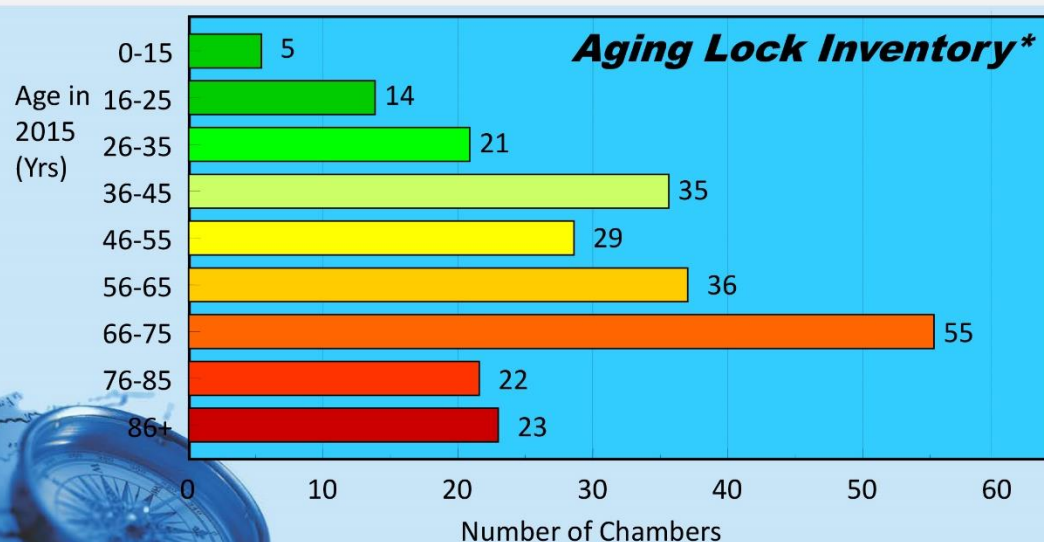
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Aging Civil Works Infrastructure

- Much of U.S. 20th Century infrastructure is approaching or exceeding original service lives – and thus at increased risk to populations, economy & environment



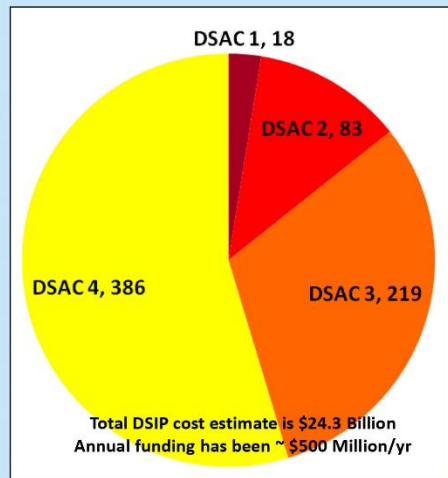
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*Includes all operational deep and shallow draft Corps and TVA navigation locks.

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USACE Dams are Also Aging and the Urgency of Dam Safety Actions is Increasing



USACE Dam Safety Action Classifications (DSAC's)

Dam Safety Action Class	Characteristics of this class
I URGENT AND COMPELLING (Unsafe)	CRITICALLY NEAR FAILURE Progression toward failure is confirmed to be taking place under normal operations. Almost certain to fail under normal operations from immediately to within a few years without intervention. OR EXTREMELY HIGH RISK Combination of life or economic consequences with probability of failure is extremely high.
II URGENT (Unsafe or Potentially Unsafe)	FAILURE INITIATION FORESEEN For confirmed (unsafe) and unconfirmed (potentially unsafe) dam safety issues, failure could begin during normal operations or be initiated as the consequence of an event. The likelihood of failure from one of these occurrences, prior to remediation, is too high to assure public safety. OR VERY HIGH RISK The combination of life or economic consequences with probability of failure is very high.
III HIGH PRIORITY (Conditionally Unsafe)	SIGNIFICANTLY INADEQUATE OR MODERATE TO HIGH RISK For confirmed and unconfirmed dam safety issues, the combination of life, economic, or environmental consequences with probability of failure is moderate to high.
IV PRIORITY (Marginally Safe)	INADEQUATE WITH LOW RISK For confirmed and unconfirmed dam safety issues, the combination of life, economic, or environmental consequences with probability of failure is low and may not meet all essential USACE guidelines.

- 707 dams at 557 projects
- DSAC chart includes all USACE dams except one newly constructed dam not yet been assigned a DSAC value*.
- Data source: DSPMT, 31 Oct 2014

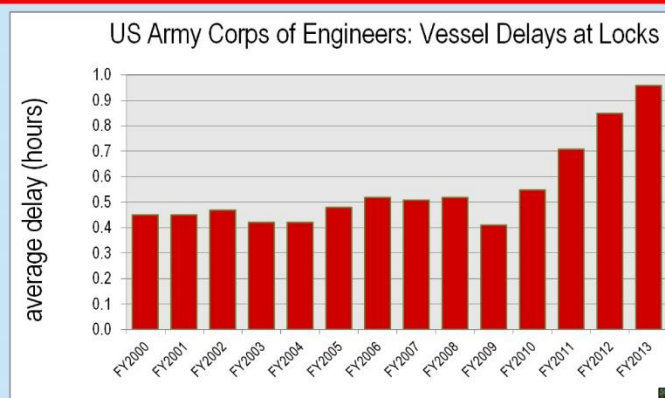
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*1 other dam not classified: Indiana Harbor Dam

23



Vessel Delays at Our Locks are Increasing



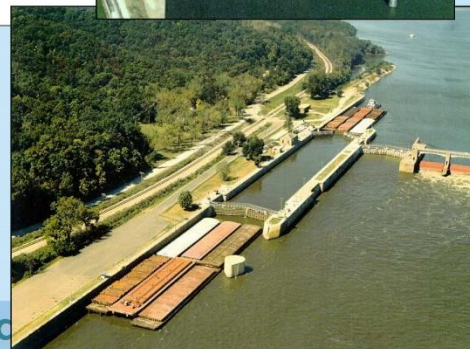
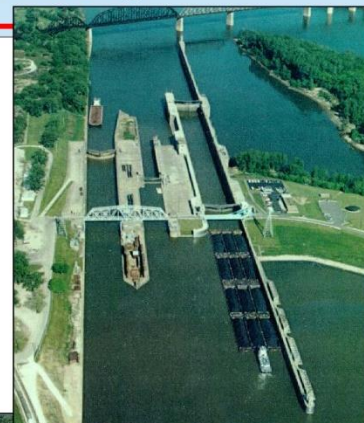
Since 2009:

- more than a doubling in delays!
- Roughly 770,000 hours of delays in 2013

These are actual delays experienced by vessels!

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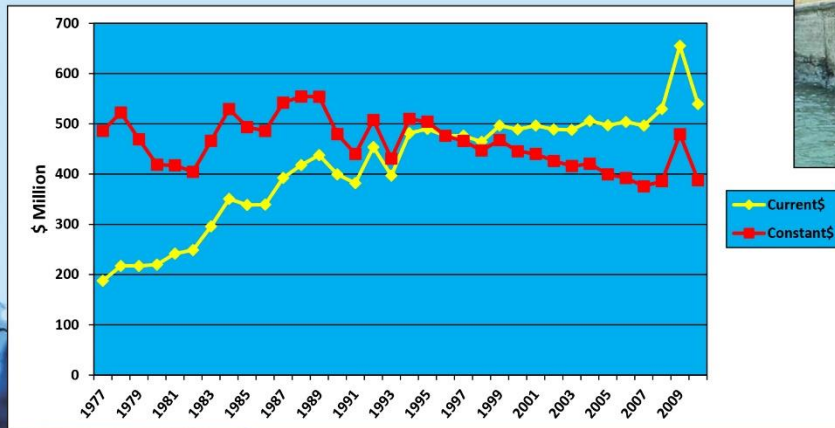


Challenge: Inland Waterway O&M Funding

1977-2010 Current \$ and 1996 Constant \$ *

Challenge: Flat O&M funding in constant dollars, even as project portfolio grows and ages...

Lock wall, Lower Mon 3



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* Fuel-Taxed Waterways Only

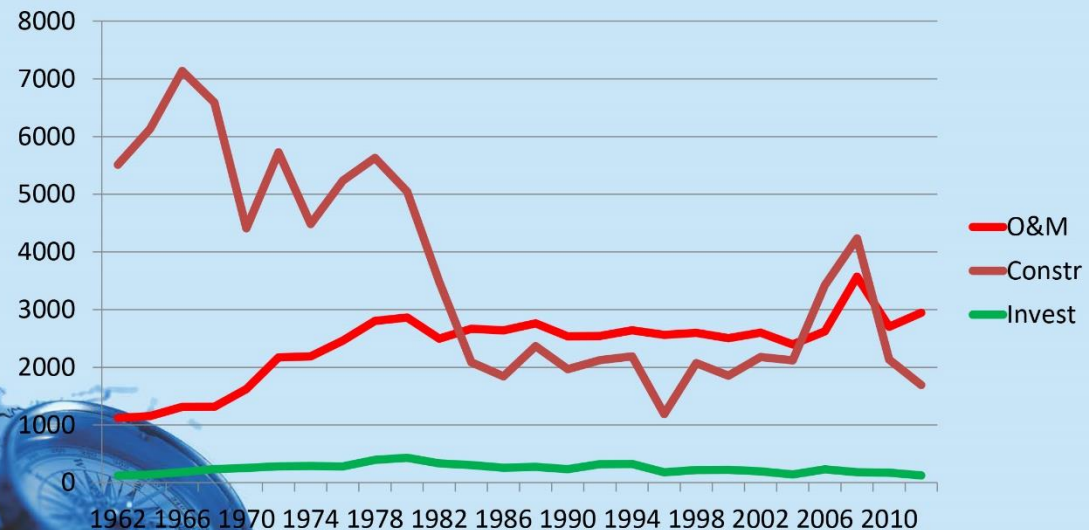
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Lock wall deterioration, Chickamauga



Long Term Constrained Civil Works Funding Trend

Appropriation (\$Million in 2012 \$)

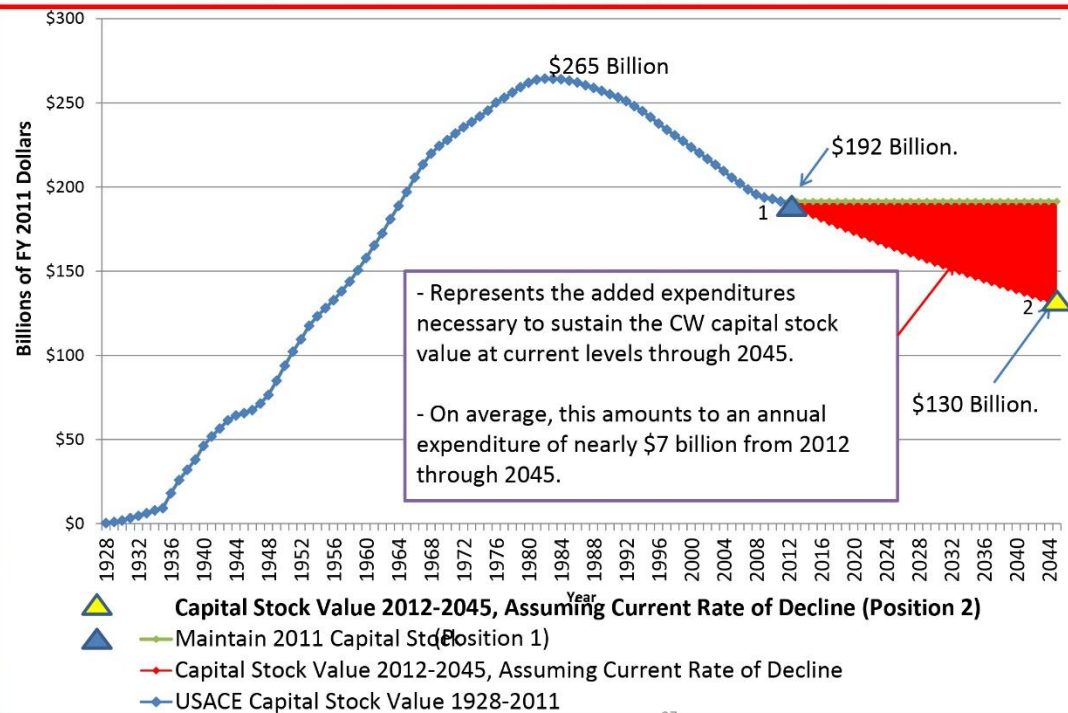


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USACE Capital Stock Value, 1928 to 2011 & Projected Decline s Highlights Annual Funding Gap of Up to \$7 Billion



Emerging Paradigm: Sustainable Infrastructure, Recapitalization, Adaptation & Resilience

White House Initiatives:

- “We Can’t Wait” Port Permitting
- Build America Investment
- Building a 21st Century Infrastructure



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Common Inland Waterway Transport Issues

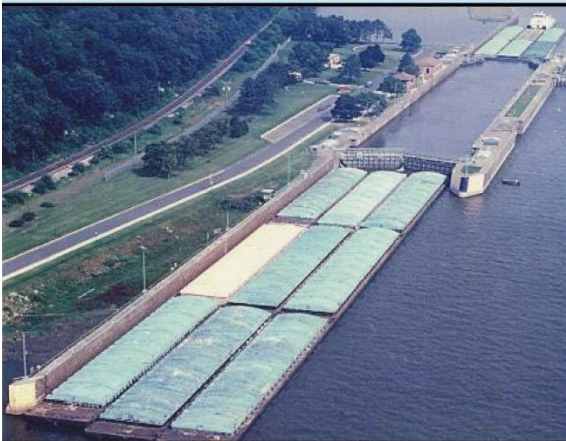
1. Increased focus on environmental sustainability
2. Leverage technology advancements
3. Need to re-capitalize aging Infrastructure
4. Need for seamless freight transport connections
 - between waterways & ports; and intermodal connections via rail, highway
5. Financing future needs with limited government budgets



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Common Issue 1 - Navigation & Ecosystem Sustainability



**Goal: Long-term sustainability of the
economic uses and ecological integrity of the
Upper Mississippi River System**

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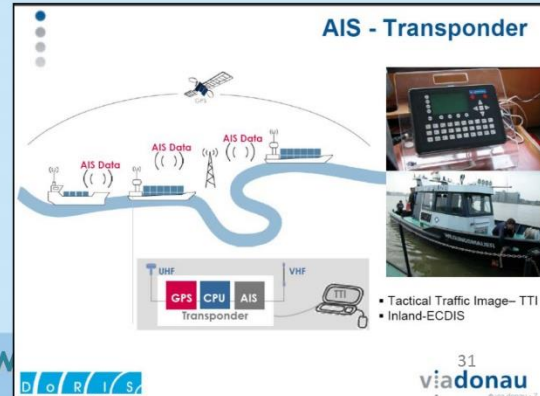
Common Issue 2 – Improving Technology:

In U.S. - Coasts & Rivers Information System (CRIS)

- Working with USCG and industry to implement new data exchange
- Real time river condition information for operators
- Automated data exchange for Corps and U.S. Coast Guard and vessel operators
- Similar to AIS system in use on Danube and expanding to Rhine

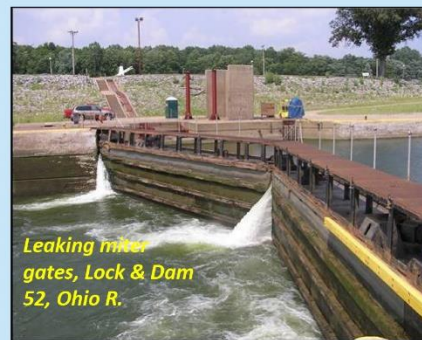


WWW



Common Issue 3 - Aging Water Resources Infrastructure

- >60% of locks more than 50 years old
- Investments in water resources infrastructure have declined in real terms
- Result: more frequent closures for repairs, decreased performance and costly delays



Crumbling lock wall, Lower Mon 3, opened in 1907

Concrete deterioration at Chickamauga could result in lock failure

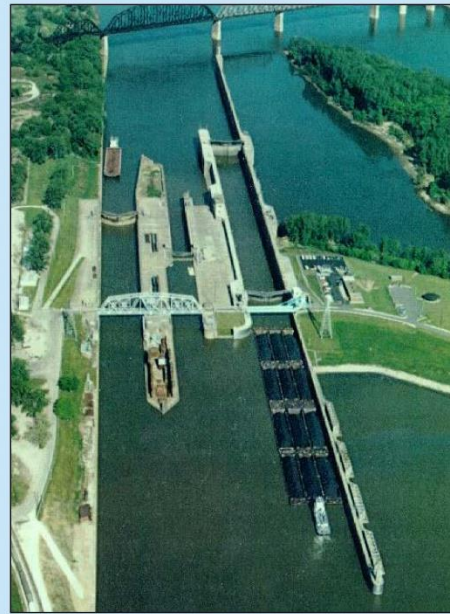
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Common Issue 4 – System Connectivity: Lock Sizes - Waterway Characteristics

Variations in capacity by
waterway...



Large mixed tows of over 30 barges are common on open water stretches of the Lower Mississippi River
"Setting the course"



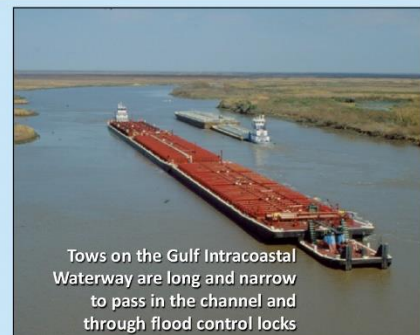
Common 15-barge coal tow at 1200' lock on Ohio River

www.pianc.us



Lock Sizes And Waterway Characteristics

Variations in capacity by
waterway...



Tows on the Gulf Intracoastal Waterway are long and narrow to pass in the channel and through flood control locks



Grain tow must be "cut" to pass Through 600-foot locks on Upper Mississippi and many other rivers
"Setting the course"



Tows on Columbia/Snake system in Pacific Northwest use unique locks with lifts over 100 feet.

Tows can draft 14 feet.

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Solutions: Inland Waterway Transport as THE Sustainable Alternative

- More freight could shift to barge, *if reliable*
- EU promotes waterways as environmentally-friendly alternative to highways and rail
- Container-on-barge highly developed in Europe
- Examples in US: Columbia-Snake; Gulf Coast service; Coastal movements along Atlantic
- Expect growth in container on barge traffic in U.S. perhaps accelerated by opening of expanded Panama Canal in 2016.



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Osprey Line 750 TEU
Tow on Mississippi River



What is at risk?



USACE Capital Stock presently yields
\$48.8 BILLION PER YEAR in realized NED
benefits!

"Setting the course"



2013 REPORT CARD FOR AMERICA'S INFRASTRUCTURE ASCE

Navigation Menu

AMERICA'S INFRASTRUCTURE G.P.A. D+

Each category was evaluated on the basis of capacity, condition, funding, future need, operation and maintenance, public safety and resilience. Methodology

Aviation	D	Ports	C
Bridges	C+	Public Parks and Recreation	C
Dams	D	Rail	C+
Drinking Water	D	Roads	D
Energy	D+	Schools	D
Hazardous Waste	D	Solid Waste	B-
Inland Waterways	D-	Transit	D
Levees	D-	Wastewater	D

ESTIMATED INVESTMENT NEEDED BY 2020: \$3.6 TRILLION

LEARN MORE

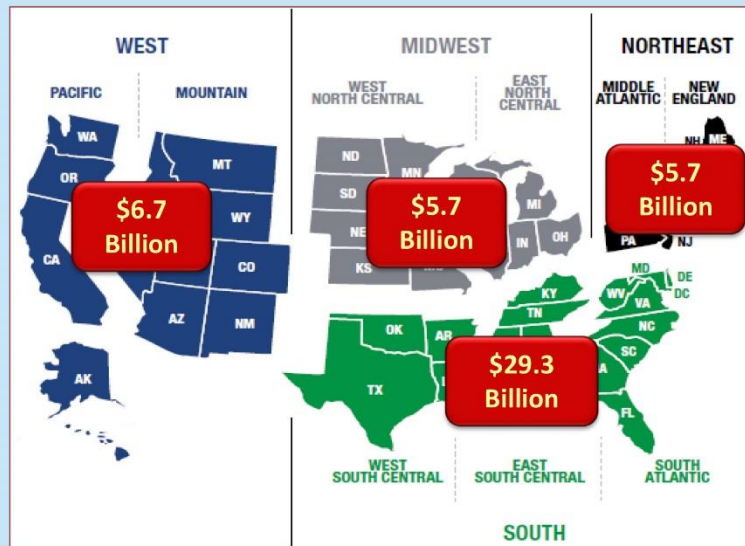
Potential Impact on "Public Benefits"

- Missed opportunities for:
 - Additional job creation
 - National and regional economic growth
 - Improved intermodal freight transportation logistics & reduced consumer prices
 - Increased exports and imports
 - Reduced flood vulnerability to life & property
 - Improved hydro-electric energy generation
 - Flexible provision of water supply
 - Enhanced fish and wildlife habitat & restored wetlands
 - Sustaining the availability of outdoor recreation
- Reduced contributions to legacy U.S.:
 - Standard of living
 - Economic prosperity
 - Quality of life
 - Environmental health
 - National security and defense

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What is needed?



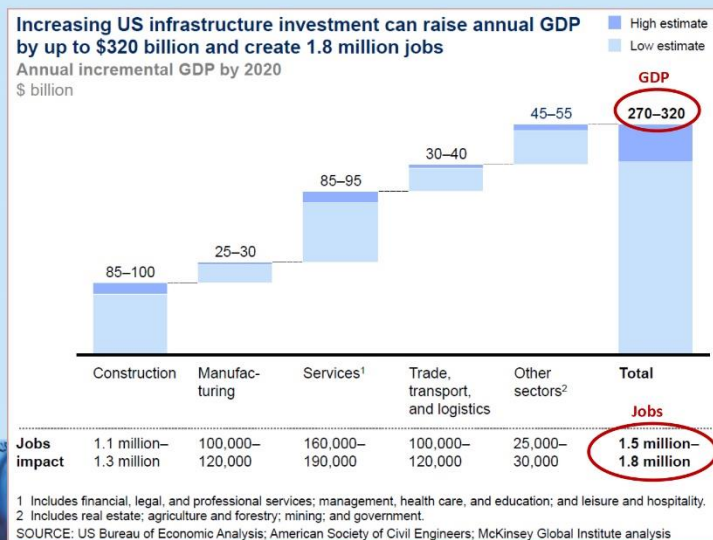
U.S. Chamber of Commerce
Estimates of Waterborne Transportation Needs
for 2013-2030

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Influence of Infrastructure Investment on GDP and Jobs



Added investment in infrastructure could yield, by 2020...

Addition of:
•up to 1.8 Million Jobs!
•up to \$320B to GDP

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USACE CW's Economic Benefits & Revenues to the Treasury 2010

Each dollar spent on the USACE Inland Navigation program generated
~ \$12.00 in economic benefits

Program	NED Benefits (Billions of Dollars)	Net NED Benefits (Billions of Dollars)
Flood Risk Management	\$23.1	\$22.5
Coastal Navigation	\$8.7	\$7.9
Inland Navigation	\$7.6	\$7.0
Water Supply	\$6.5	\$6.5
Hydropower	\$2.2	\$2.0
Recreation	\$3.3	\$3.0
Leases and Sales		
Total Annual NED	\$51.4	\$48.9

Notes:

(1) Net NED Benefits represent total NED benefits minus the costs of operations, maintenance, expenses, the USACE Regulatory program, FUSRAP, oversight by ASA(CW) and other USACE Civil Works programs.

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Thank you for your attention

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APPENDIX L

SUMMARY OF PANEL DISCUSSION

THE STATE AND PERSPECTIVES OF WATERBORNE TRANSPORT INFRASTRUCTURE WORLDWIDE

ANNUAL GENERAL ASSEMBLY, CAIRNS, AUSTRALIA JUNE 19, 2017

Background

The 2014 PIANC General Assembly in San Francisco, California resolved to form a task group on the State and Perspectives of Waterborne Transport Infrastructure Worldwide, with the goal of creating a worldwide inventory of the needs and delivery of waterborne transport infrastructure for future societal benefit and to investigate emerging trends and new technologies affecting the development of waterborne transport infrastructure

Task Group 181 has completed an initial investigation on this topic, has surveyed member countries, and now intends to form a permanent technical group to foster an ongoing dialogue on this important topic among PIANC members and other stakeholder groups.

Key findings of TG 181 are:

- Technical issues are becoming more cross-cutting – they don't fit neatly into a single Technical Commission
- Funding challenges for waterborne transport infrastructure abound, in all parts of the world
- Emerging trends and technology are affecting the waterborne transport sector now and this will increase in the future, with uncertain impacts
- These forces generate a need for broader, continuing, dialogue, both within PIANC and externally in order to maintain relevance.

This inaugural panel is intended to be the template for an ongoing dialogue at the AGA, which will bring a current, global perspective in accord with a regional focus.

Moderator – Ms. Anne Cann, Secretary, US Section PIANC and Vice-Chair, Task Group 181

Panelists & Topics:

Ms. Marika Calfas, CEO, New South Wales Ports:

The Intermodal Challenge – How to improve port connectivity with road and rail?

Ms. Calfas began with the observation that Australia is an island – everything moving in and out must go through ports and move by water. Australia has more than 70 ports which service the 5th largest shipping activity of any nation in the world.

These ports are connected by a long-haul rail network, but Australia is increasingly focused on short-haul rail for containers. Most of the containers contain goods destined for cities, and short-haul rail is being developed to ease road congestion.

Ms. Calfas discussed Australia and the Port of New South Wales' approach to landside congestion in their busy ports located in urbanized areas. They are building short range rail to take the containers/cargo out of the port and to distribution centers located on the outskirts of the metropolitan areas. This is an interesting strategy, since in most other PIANC countries it is felt that short haul rail is not economical.

Ms. Calfas discussed Port Botany (near Sydney) as an example. Port Botany is the largest container port in New South Wales, handling 2.3 million TEU per year. The majority of these containers, 80%, travel no further than 40 km from the port. On-terminal rail lines connect with inland Intermodal

Terminals, and 18% of the containers are moved out of the port via rail. The goal is to increase this share, and thereby reduce the number of trucks on the roads around Port Botany.

A second example is the Port of Fremantle in Western Australia. This port is connected by rail to the Kewdale/Forrestfield Hub, a distance of 28 km. The Kewdale/Forrestfield area is an important component of the freight network in Western Australia due to its accessibility by road and rail, and proximity to industrial areas. This is more than just a rail terminal – it is a logistics hub. In 2007 a long term lease agreement was entered into between the State Government and Asciano Services Pty Ltd to redevelop and manage the rail freight terminal, and it can now accommodate long term growth projections up to 1 million TEU per year.

The Port of Melbourne is working on a similar strategy to Sydney. The plan is based on the development of an efficient, dedicated rail terminal at the Port of Melbourne connected by rail to a system of suburban private intermodal terminals. This will provide an alternative to the current 100% road based container transfer system in Melbourne, and will relieve much road congestion.

Ms. Calvas' major conclusion is that port capacity is only as good as the landside connections.

Major General Donald E. Jackson, US Army Corps of Engineers:
The Delivery & Funding Challenge – Alternative Financing and Delivery of Waterway Infrastructure

MG Donald E. Jackson is Deputy Commanding General for Civil and Emergency Operations in the U.S. Army Corps of Engineers. In this position he leads all civil works missions in the Corps of Engineers. He is also Acting First Delegate for the U.S. Section of PIANC.

MG Jackson began with a map and description of the U.S. ports and inland waterway network and data to show how vital it is to the national economy. Then he presented a chart of how the World Economic Forum ranks the quality of U.S. infrastructure, showing that it is number 14, lower than most other developed nations.

The crux of the problem in the U.S. is that infrastructure requirements outpace the Federal resources available to deal with them. This was illustrated with a time-series chart of the growing need for capital investment in inland and coastal water resources infrastructure and the relatively static level of federal investments.

The Trump administration is mounting an Infrastructure Initiative, aimed at improving all U.S. infrastructure. President Trump has stressed the importance of safe, reliable, and modern infrastructure for both national security and economic growth. He identified our Inland Marine Transportation System (IMTS) as one of the four "R's" of this initiative: Rivers, Runways, Roads, and Rails. He noted the significance of the 12,000 miles of IMTS to American export and manufacturing industries, specifically agriculture, steel, and coal.

A basic principle of the initiative is federal partnering with private, state, and local entities to recapitalize infrastructure. The U.S. Army Corps of Engineers is trying to use Alternative Financing approaches to leverage the (insufficient) Federal dollars. However, there are several challenges which need to be overcome in order for this to happen. These are listed below:

- Revenue Generation and Retention: the ability to collect, retain, and reinvest fees/charges
- Longer Term Contracting Authority: enables longer term transactions (20-50 years)
- Federal Budget Scoring Policy: scores full federal project cost up front in the first year
- Federal Budget Ranking Policy: prioritization of projects based on one primary metric
- Complex Mosaic of Authorities and Local Responsibility/Funding: Federal owned/operated + local owned/operated + mix of both

MG Jackson's closing thoughts were that navigation investment is essential for U.S. global trade and international competitiveness, and this is true for all PIANC member nations. We must develop and prioritize a sustainable investment strategy to ensure safe and reliable water transport infrastructure. Because of the difficulties listed above, infrastructure investment will be a financial and cultural (generational) challenge for decades to come. MG Jackson also noted that the U.S. infrastructure

requirement is a shared responsibility among federal, state, local, and private sectors, and therefore partnerships are critical. The U.S. Army Corps of Engineers is part of a larger team; we depend on others in government, industry, etc. to frame requirements and recommend priorities.

Mr. Rogelio Gordon, Panama Canal Authority:
Panama Canal Expansion Program Financing and Delivery Strategies

Mr. Rogelio Gordon is Executive Manager of the Transit Resources Division at the Panama Canal Authority. He has been with the Panama Canal Authority since 1979, and has degrees in Engineering and an MBA.

In June of 2016, the Panama Canal Authority (ACP) completed a major expansion project which doubled the capacity of the canal by adding a new lane of traffic allowing for a larger number of ships, and increasing the width and depth of the lanes and locks allowing larger ships to pass. Mr. Gordon discussed how the Panama Canal Authority planned for, and financed this huge undertaking.

A critical step was to set Financial Objectives at the outset. These would guide the development of a financial plan, and were as follows:

- Geographical diversification
- Common Terms agreement and Individual Credit Facility Agreement
- Unlinked financing
- No guarantees from ACP nor government
- Disbursement flexibility
- Acceptance of ACP contracting regulations
- Full communication and coordination with lenders
- Competitive spreads as per ACP financial strengths

Two financial reporting obligations: Debt/EBITDA (The net debt to earnings before interest depreciation and amortization (EBITDA) ratio is a measurement of leverage, calculated as a company's interest-bearing liabilities minus cash or cash equivalents, divided by its EBITDA); and Debt service coverage.

Acceptance of ACP insurance coverage and owners' insurance coverage policy

No intervention within the operations of the canal.

The financing package was signed in December 2008, with five different lenders: Japan Bank for International Cooperation; the Inter-American Development Bank; International Finance Corporation; Banco de Desarrollo de America Latina; and European Investment Bank.

Mr. Gordon distilled the whole successful experience down to a list of 'lessons learned', which he shared with the AGA delegates. They are:

1. Individually reach agreements with potential lenders
2. Hire international financial and legal experts to establish long form term sheet according to the ACP legal framework, Corporate Governance, Financial Strength
3. Hire one law firm to represent lenders as a legal counterpart
4. Mirror common term agreement obligations/covenants to contractors:
 - a. Social and environmental clauses
 - b. Prohibited practices and ethics
5. Use/adapt ACP existing reports to include lenders requirements
6. Agree on one annual meeting to inform lenders
7. Common legal, technical, and financial due diligence meetings
8. Common SharePoint for due diligence sharing information private meeting among credit rating agency and lenders
9. Establish a website for lenders to comply with CTA obligations

Most of these lessons have broad applicability, and they can inform the plans and approaches of all PIANC member nations and organizations as they build, modernize, and expand their water transport infrastructure.

**Ms. Milou Wolters, Rijkswaterstaat:
Future Trends for Navigation**

Ms. Milou Wolters is Senior Advisor in the field of strategic asset management and network development for navigation and infrastructure at the Dutch Rijkswaterstaat. She is also a Vice President of PIANC and Acting First Delegate of the Dutch Section.

Ms. Wolters discussed some of the major factors and trends that are impacting the waterborne transport sector, and what PIANC can or should be doing to shape or cope with these. She cautioned at the outset, “Do not expect answers, just the opening of some windows”.

The water transport sector has many perspectives, including the infrastructure owners such as ports, locks and dam operators, the shippers and carriers who move goods on the waterways and oceans, consultants, researchers, contractors, etc. Ms. Wolters suggested that PIANC needs to broaden its perspective beyond pure technical matters in order to be more of a voice with decisionmakers who determine investment levels in waterborne transport infrastructure.

Her second major point was that the topic of TG 181 is so broad that it warrants more of a PTG (Permanent Task Group) treatment, whereby PIANC continuously investigates and promotes dialogue on the topic.

Some of the trends, disruptions, and unknowns which need to be considered are:

- New Technology – autonomous navigation, drones
- Continuing – increasing ship size, more demands for deeper and wider waterways, port channels, etc.
- Increasing world population and economy
- Information technology – digital world
- Aging infrastructure
- Climate change
- Uncertain budgets

Ms. Wolters discussed the multiple demands for waterfront locations which impact ports, which are nearly always located in urban areas. There are pressures for urban development as well as environmental protection.

There are increasing spatial claims on waterways and coastal areas, and these competing water users sometimes conflict. Waterways and nearshore areas are used by modern society for much more than water transport. They are prime housing locations, many forms of recreation (boating as well as fishing, water sports), sites for wind farms, fish farming. This dictates a need for balancing the multiple demands and stakeholders, for an integrated approach to managing our water resources.

Since these trends are global, there is an increased need for international cooperation and collaboration. PIANC has been a leader (since 1885) in fostering international collaboration on technical issues related to waterborne transport.

The focus of PIANC is already broadening, with establishment of the Permanent Task Group on Climate Change, many working groups addressing sustainability, and resilience, and, of course, Task Group 181 which is the stimulus of this panel discussion.

Ms. Wolters then introduced the idea of fundamental game changers which lead to transitions. She defined a transition as a process of fundamental and irreversible change in a society's culture, institutional structures and practices. It takes from 25 to 50 years for a transition to fully materialize. Transitions can be identified in societal systems like energy, transportation, water, agriculture, health care, etc. They are the result of a co-evolution of economic, cultural, technological, ecological, and institutional developments at different levels.

Transitions are characterized by the emergence of new structures, cultures, and practices. Other key characteristics are co-evolution, self-organization, and adaptation. Examples of possible transitions are: switch from coal to natural gas; movement from a linear to a circular economy; or a shift from bureaucratic health care to human-centered care.

What are the implications of all this for PIANC? Ms. Wolters suggested that PIANC should be ready to cope with multidisciplinary questions as opposed to narrow technical issues. PIANC should be ready to work on multidimensional problems/challenges, such as how to design or re-design a port that can handle the growing size of ships, is climate proof, and adaptive.

River transport must deal with water discharges and water quality issues and many competing users/stakeholders as well as navigation.

Dr. Craig Philip, Vanderbilt University:
Sustainable? Resilient? Anti-Fragile? - How Key Influencers Can Have a Big Impact.

Dr. Craig Philip is Research Professor of Civil and Environmental Engineering at Vanderbilt University and Director of the Vanderbilt Center for Transportation Research. Dr. Philip has spent 35 years in leadership positions in the transportation industry, including maritime, rail and intermodal. From 1993 to 2014 he served as President/CEO of Ingram Barge Company, as it grew to become the largest U.S. domestic marine transportation carrier.

Dr. Philip began with a description of the mature inland waterway system in the U.S. It was robust and world class when built by the U.S. Army Corps of Engineers in the first half of the 20th century. It is a multi-mission system, operated for navigation, flood risk reduction, hydropower, and serves other purposes as well.

Today, there are real concerns that the U.S. waterway system may no longer be sustainable (i.e. able to satisfy system demands over time and in the future). Its role in economic vitality and growth is underappreciated. There is increasing pressure to remove dams and return rivers to their natural hydrograph. And extreme weather stressors (symptoms of climate change perhaps) are moving from episodic to chronic.

Dr. Philip then explored the question of whether the system is resilient by looking at how it has responded to another type of stressor – the explosive growth in the volume of crude oil being produced in the U.S. Transport of this crude oil glut used both the rail and inland/coastal waterways to overcome limitations in the pipeline system. U.S. domestic crude oil transport by rail grew from 20 million barrels in 2010 to 360 million barrels in 2014. Unfortunately, this was accompanied by an equally large increase in severe accidents, derailments, fires, etc., many of which occurred in population centers.

Largely unnoticed was the maritime role in the movement of this oil. In fact, the growth in waterborne barrels of oil over the period from 2010 to 2014 was even larger than the increase in rail barrels – an increase of 380 million barrels. And domestic maritime transport actually handled more total barrels than rail as well in 2014, 480 million barrels by water as compared to 360 million barrels by rail. And, “Crude-by-Barge” did so safely, with only 1 significant incident as compared with 16 in rail.

Dr. Philip’s thesis is that this experience reveals the Institutional/Social “Resilience” of the U.S. maritime sector, and is a demonstration of “Antifragility”. Antifragile systems are those that benefit from stressors by becoming stronger.

This resilient response culture reflects the alignment and cooperation of key major stakeholders:

- Adaptive Infrastructure Owner – US Army Corps of Engineers, which embraced operating flexibility, especially at the local level
- Progressive Regulator – US Coast Guard, empowered by OPA 90 (the Oil Pollution Act of 1990), but also embraced ‘prevention through people’
- Responsive Towing Industry – which adopted a Responsible Carrier Program and ultimately embraced full regulation

A resilient governance framework has been adopted and implemented through the development of Waterways Action Plans. These have network wide application, stakeholder driven guidance, well-defined trigger points and responses, are activated multiple times annually, and are continually evolving – becoming “Antifragile”.

The following concepts of resilience and antifragility are reflected in today’s Safety Culture in the U.S. maritime sector:

- Adaptive Learning Process is the Key to Antifragility

- Allow for adaptation to positive stimuli and quick response to failures
- System that rewards change and doesn't punish failure
- Example: Hot-Wash assessment undertaken after events
- Quick Recovery and Redundancies
 - Avoiding big risks with relatively low upside; fail not-so-badly
 - Have alternative plans and options
 - Example: multiple experts, parallel processes and procedures embedded in culture
- Group vs. Individual Mindset
 - Experiences, successes, and failures of one can improve the overall group
 - Example: Waterway Action Plans gain from prior experiences and responses, both good and bad
- Sense of Ownership
 - A sense of ownership, or something to lose, means all participants are incentivized to succeed
 - Example: the non-regulated emergence of Waterway Action Plans

These strategies will help the maritime sector to cope with the external forces, trends, and fundamental game changers which Ms. Wolter discussed in the previous talk.

Key takeaways from Dr. Philip's presentation are:

- U.S. Railroads – Sustainable – Not Operationally Resilient
- U.S. Maritime – Not Sustainable – Operationally Resilient
- U.S. Maritime Institutional/Social System - Antifragile



(Photo Credit: N. Pansic, Stantec)

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