Paper 2 - The State and Perspectives of Waterborne Transport Infrastructure Worldwide

PANSIC N.[1]; DE BOER T.[2]; and HEMPENIUS T.[3]
[1]MWH Global Inc., Chicago, Illinois USA, [2]Royal Haskoning DHV, Amersfoort, NETHERLANDS, [3]ARCADIS, Abu Dhabi, UAE

Email (1st author): nicholas.pansic@mwhglobal.com

ABSTRACT: At the 33rd PIANC World Congress in San Francisco, 31 May 2014, the Annual General Assembly formed a task force on the "State and Perspectives of Waterborne Transport Infrastructure Worldwide." PIANC Working Group 181 is charged with gathering relevant information on the current state of global waterborne transport infrastructure and assessing needs for new, expanded or rehabilitated facilities. WG 181 will investigate investment in new assets, expenditures on asset management (operation & maintenance costs), and emerging trends and technologies driving change in the system. The working group will then assimilate and interpret this information to provide expert guidance to industry stakeholders, policy- and decision-makers, and system end-users and beneficiaries, on the future state of the system.

1 INTRODUCTION

The World Association for Waterborne Transport Infrastructure (PIANC) has provided global guidance on waterborne transportation issues since its founding in 1885. PIANC's mission recognizes the importance of waterborne transport infrastructure to international trade and the global economy. Investments in environmentally-sound, sustainable inland and maritime facilities support stable and secure nations, stimulate economic development, and promote the well-being of communities worldwide.

Waterborne transport has never been more important than it is today. Major projects with worldwide impacts - such as the expansion of the Panama Canal – are expected to have notable impacts on global trade patterns. Emerging trends in global transport, including use of alternative fuels, institutional reforms, and new approaches 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 introduction of larger and more efficient vessels to the world fleet, increase the demand for port infrastructure modernization, expansion, resilience, and operational efficiencies. Yet waterborne transport infrastructure faces increasing challenges of world population growth, a changing climate, and limited funding.

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It is anticipated that the work of WG 181 will lead to an ongoing dialogue (via electronic media, workshops, conferences, etc) that will inform, educate, and facilitate meaningful adaptations of the system to address fundamental challenges and future uncertainties.

WG 181 kicked-off in February 2015, and will complete its work by August 2016. This paper provides a status report on the initial findings of the

group, with a particular focus on factors most affecting inland waterways

2 THE BIG PICTURE

The World Economic Forum (WEF) publishes a biennial report on the global competitiveness of over 100 countries, based on twelve "pillars" (WEF, 2014):

1. Institutions
2. Infrastructure
3. Macroeconomic environment
4. Health and primary education
5. Higher education and training
6. Goods market efficiency
7. Labor market efficiency
8. Financial market development
9. Technological readiness
10. Market size
11. Business sophistication
12. Innovation

It is noteworthy, but not surprising, that Infrastructure is one of the pillars that supports competitiveness. As part of their assessment, WEF establishes three categories of competitive drivers:

- ***Factor-driven*** countries compete based on their factor endowments - primarily unskilled labor and natural resources;
- ***Efficiency-driven*** countries begin to develop more efficient production processes and increase product quality because wages have risen and they cannot increase prices; and
- ***Innovation-driven*** countries must compete by producing new and different goods using the most sophisticated production processes and by innovating new ones.

Fourth and fifth categories, for countries in transition between the above three categories, are also identified. As an initial broad overview, it is instructive to map the PIANC member countries against this metric (Figure 1).

Note that the WEF terminology abandons the traditional categories of emerging, developing, or developed countries, in favor of what drives a country's economy and its competitive position in the global marketplace. PIANC can argue that

	Stage 1 – Factor Driven	Transition 1-2	Stage 2 – Efficiency Driven	Transition 2-3	Stage 3 – Innovation Driven
PIANC MEMBER COUNTRIES (National Sections)	India (60)	Iran (82), Saudi Arabia (20)	Colombia (69), Serbia (101), South Africa (53)	Argentina (104), Estonia (32), Poland (42),	Australia (21), Austria (16), Belgium (17), Denmark (15), Finland (3), France (23), Germany (4), Italy (49), Japan (9), Korea (25), Netherlands (8), Norway (11), Portugal (51), Spain (35), Sweden (6), Switzerland (1), UK (10), USA (5)
PIANC MEMBER COUNTRIES (Qualifying)		Morocco (69), Philippines (59)	China (29), Romania (87)	Brazil (56), Panama (40)	Canada (14), Czech Republic (55), Monaco
OTHER	Nicaragua (99)	Sri Lanka (65)	Egypt (118)	Russia (64), Turkey (44)	Hong Kong (7), Luxembourg (22), Malaysia (24), New Zealand (18), Qatar (13), Singapore (2), Taiwan (12), UAE (19)

Figure 1 - Global Competitive Profile of PIANC Countries

waterborne transport represents a key component of the Infrastructure pillar, at a minimum, and influences numerous other competitive pillars as well.

The majority of the PIANC member countries are categorized as "Innovation-Driven," which is to be expected given its long history and roots in the core European and North American geographies. It is also interesting to note the positions of non-PIANC member countries where maritime or inland transport infrastructure is significant, and has the potential to drive increased competitiveness of these countries.

3 WG 181 ROADMAP

WG 181's work plan includes four key tasks, with progress to date on each summarized below.

- **Task 1 – Data Collection**
  - A matrix of "geographies" has been developed to organize the regions, and countries for which waterborne transport infrastructure data will be solicited;
  - Both PIANC and non-PIANC countries have been identified;
  - Infrastructure is categorized as inland (shallow draft) or maritime (coastal and deep draft);
  - Cooperating agencies and data sources for non-PIANC countries have been identified.

- **Task 2 – Data Analysis to Inform Working Group Objectives**
  - A template for specific analyses that will be done to summarize, present, and interpret data collected in Task 1 has been developed;
  - Tasks 1 and 2 are proceeding interactively, considering how we will use data in order to collect it properly;
  - The WG will brainstorm key messages and deliverables that convey our analysis clearly and usefully.

- **Task 3 – Emerging Trends and Technologies**
  - The WG will brainstorm a list of trends and technologies that are driving investment, management, and change in waterborne transport;
  - Examples include: information technology, larger ports, vessel economies of scale, environmental issues (e.g. changing fueling of ships, etc.), logistic supply chain adaptations, restructuring of vessel routes, effects of larger vessels on landside infrastructure;
  - We will then rank and document the most impactful ones, based on our evidence;

- **Task 4 – Communicate Findings and Recommendations**
  - A draft outline of the way in which findings will be presented in writing has been completed.
  - A draft communications matrix has been developed, including internal and external stakeholders, to define their interactions;
  - In addition to, or instead of, a traditional WG report, we contemplate an ongoing dialogue – such as a website or technical conferences - as a key deliverable of the WG;

WG 181 holds monthly teleconferences to monitor progress against the work plan, with reports to PIANC leadership at key milestones until its expected completion date of August 2016.

4 DATA COLLECTION

The template for collecting basic data and perspectives on existing waterborne transport infrastructure has two parts:

- **Part I: Basic Data**
  - Transport Data: *Modal split of freight transport;*
  - Financial Data: *Budgeting for infrastructure works and financing of same;*
  - Infrastructure Data: *Identify infrastructural works for which your organization/institution is responsible;*
  - Historical Data & Future Trends: *Past phases in infrastructure development, current state, and future needs (25-year horizon).*

- **Part II: Perspectives**
  - Future Needs: New infrastructure required to respond to the evolution of trade and meet customer demands;
  - Emerging Issues: Trends and technologies affecting waterborne transport, opinions on how future transport will evolve;
  - Project Finance: Alternative approaches to structuring project finance attractively;
  - Project Delivery: Ways to improve project delivery, make construction faster and more cost-effective, or structure projects to be successful and prosperous;
  - Asset Management: How operation and maintenance can be done more efficiently;
  - Sustainability: Ways to make infrastructure more environmentally-friendly and sustainable, adopting "building with nature" concepts; and
  - Climate Change: Ways to manage the climate change challenge, making infrastructure more robust and resilient, expectations and response.

In parallel with outreach to PIANC country sections and cooperating agencies, such as IAPH and OECD, WG 181 is conducting a literature search for relevant information that need not be duplicated. For example, the European Union compiles statistics on freight transport for its 28 member countries, including modal split between road, rail and waterborne (Figure 2).

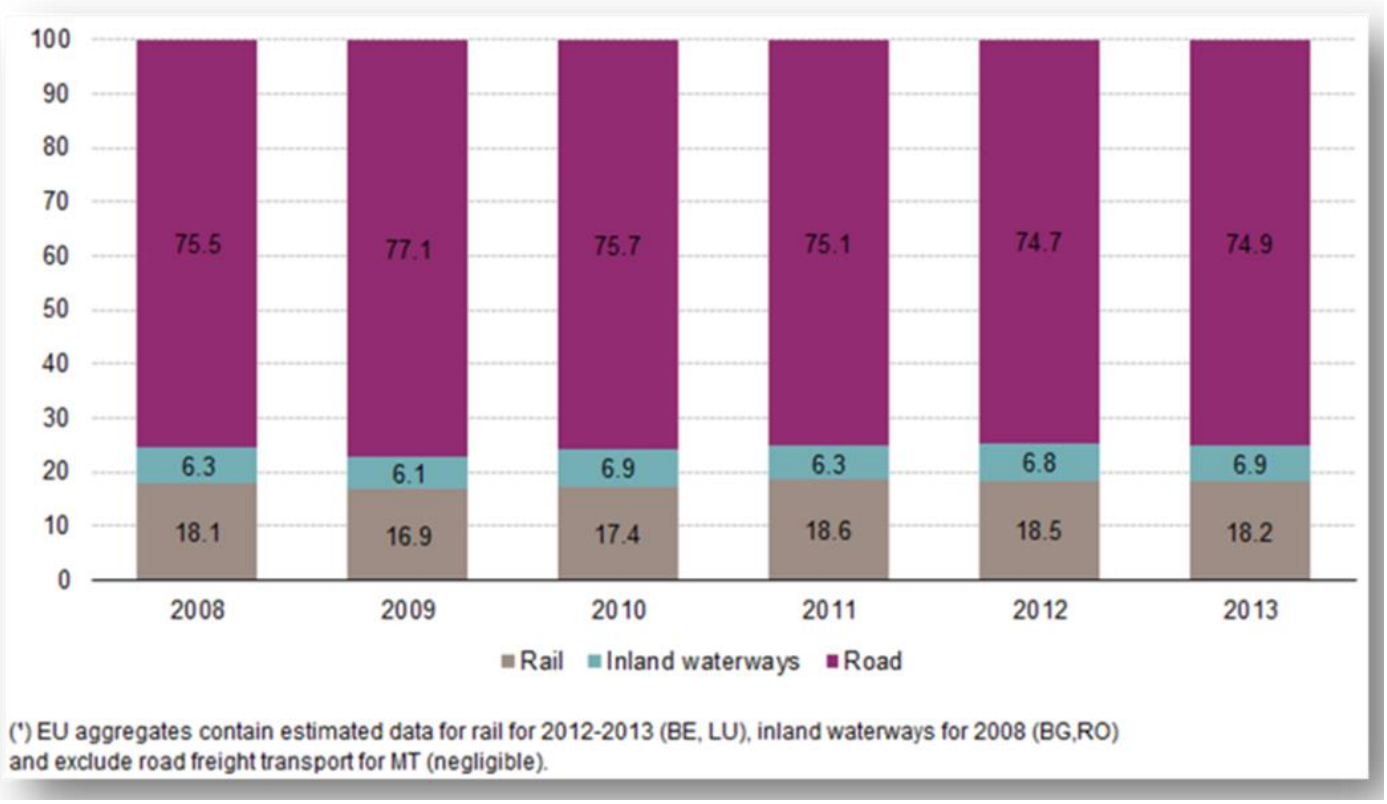

Figure 2 - Freight Transport in the EU-28 - Modal Split of Inland Transport Modes

Where possible, WG 181 will take advantage of this type of information to inform our work.

5 DATA ANALYSIS

5.1 Country & Regional Profiles

WG 181 will characterize the current state of waterborne transport infrastructure by developing regional profiles for the major origins and destinations of freight movements. Seven such regions have been identified:

- Africa and Middle East;
- Americas;
- Arctic;
- Asia-Pacific: Australia/New Zealand;
- Asia-Pacific: Remainder);
- Caribbean; and
- Europe.

For each region, a broad overview of the major maritime and/or inland transport infrastructure is given, supported by specific country examples where appropriate.

industry stakeholders, including the St. Lawrence Seaway Management Corporation, Saint Lawrence Seaway Development Corporation, Chamber of Marine Commerce, American Great Lakes Ports Association, Canadian Shipowners Association, Lake Carriers' Association, Port of Cleveland, Port of Windsor, and Fednav Limited.

The figures shown represent actual investment for the period 2009–2013, plus committed investment for the post-2013 period.

An example of country-level activity is Brazil, where the Federal government intends to enhance

Figure 3 - Great Lakes & St. Lawrence Seaway Port, Terminal and Waterway Infrastructure Investments

Figure 3 provides an example for the Americas region, showing waterborne infrastructure investment in the Great Lakes and St. Lawrence Seaway System (Martin Associates 2015). The study was conducted on behalf of a coalition of U.S. and Canadian Great Lakes-Seaway maritime

the inland waterborne transport (IWT) sector and consequently contribute to the sustainable development of the country's economy (ARCADIS, 2013).

To this end, the Ministry of Transport (MT) developed an "Inland Waterways Strategic Plan" that aims to increase the amount of cargo that is transported on the Brazilian waterways. The IWT plan is part of a broader strategy to increase the participation of the waterway in an integrated transport matrix by means of establishing guidelines for the development of the sector (Figure 4).

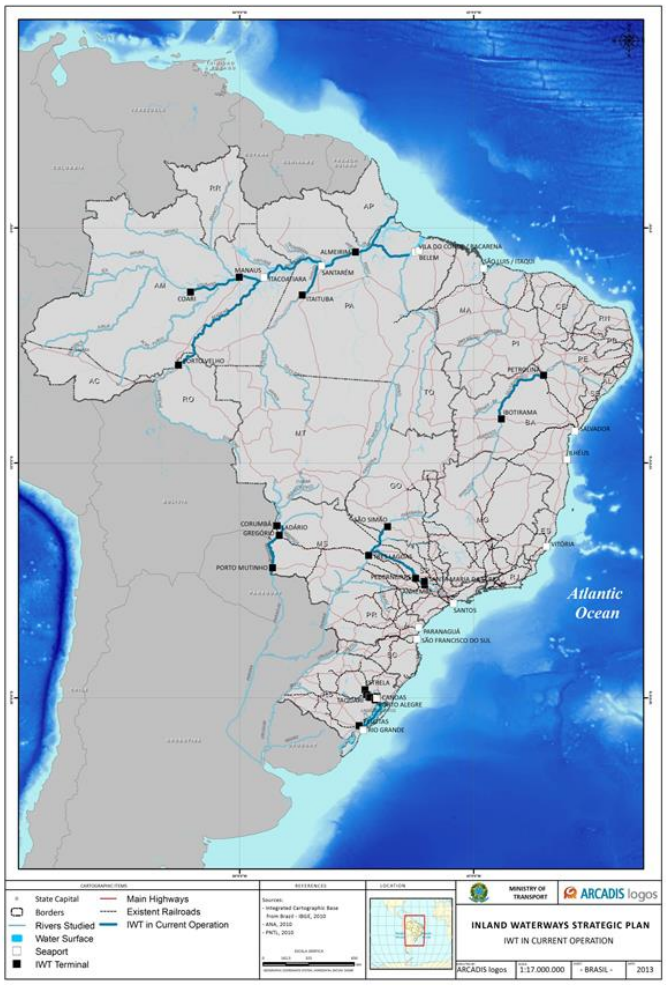

Figure 4 - Brazil Inland Waterways and Terminals

5.2 Project Delivery

Infrastructure projects are often met with financial and schedule challenges. A variety of alternative delivery and finance mechanisms are employed, depending on the specific project, to manage project risks and maximize the chances of a successful outcome. WG 181 will inform this topic by presenting case studies and their associated lessons learned.

Table 1 presents a summary of the alternative delivery methods adopted for the current expansion of the Panama Canal (ACP 2006).

The ACP 2006 master plan identified key program delivery risks, among other objectives, to inform decisions on how to best partition the overall expansion program into its component projects, and the preferred delivery method for each. A key driver for the dry excavation work was to provide opportunities for local earthwork contractors, while that of the third set of locks was transfer of schedule risk to the D/B entity.

5.3 Asset Management

Asset management can be defined as the optimal balance between performance, risks and costs over the entire asset lifecycle, aligned with the strategic goals of the organization.

A common theme of existing waterborne transport infrastructure is aging assets with a lack of investment for needed rehabilitation or upgrading to current design or reliability standards. As such, effective use of scarce resources and prioritization of investments are key asset management challenges.

There is often a fundamental difference in how maritime ports and inland waterways are managed. In the US, for example, the inland waterway system is operated and maintained by the Federal government, under the purview of the US Army Corps of Engineers. However, maritime ports are managed by state-chartered authorities who function as "landlords," with terminal operations and maintenance often provided by privately-contracted operators.

An interesting example of maritime port asset management is the Port of Rotterdam, which is the largest port in Europe (by tonnage), with an annual throughput of over 400 million tonnes of cargo, and in the Top 5 globally (Port of Rotterdam, 2013). Figure 5 shows their conceptual asset management model.

Figure 5 - Port of Rotterdam Asset Management Model

- Delivering a major capital project (Maasvlakte 2) on time;
- Making better use of existing space;
- Delivering return on investment;
- Driving knowledge and innovation;
- Providing multi-modal accessibility in a sustainable manner;
- Exhibiting corporate social responsibility; and
- Maintaining a high level of customer satisfaction.

Faced with added challenges of increased demand for transshipment, aging infrastructure, and increasing complexity of rules and regulations, the Port determined that a comprehensive, risk-informed asset management approach was the right solution. By adopting and implementing this approach, the Port was able to make a sound business case for life extension of its 65 kilometers of quay walls, and retrofitting – rather than outright replacement – of its patrol vessel fleet.

Table 1 - Panama Canal Expansion Program

Component	Capex	Delivery Method	Timeframe	Remarks
Channel and Entrance Dredging	$ 300 million	Design-Bid-Build	2007 – 2012	Competitive bid among international dredgers
Channel Dry Excavation	$ 800 million	Design-Bid-Build	2007 – 2011	Competitive bid among local earthwork contractors
Third Set of Locks	$ 3,400 million	Design-Build	2009 – 2016	Best-value procurement among international consortia
Raising Lake Gatun	$ 200 million	Design-Bid-Build	2010 – 2014	Competitive bid among local specialty contractors
Interest During Construction	$ 50 million	N/A	2007 – 2016	
Total	$5,250 million			

As a major node in the global logistics network, the Port faces numerous challenges to secure its future, including:

An interesting example of inland waterway asset management is the Hidrovia waterway in South America.

In 1995, the Argentine government let an 18-year concession agreement for dredging maintenance and signalization of an 800-km reach of the Rio de la Plata, from Santa Fe to the Atlantic Ocean. This reach is in the lower portion of a proposed 2700-km long improved navigable waterway that would extend up the Rio de la Plata, and the Paraguay and Parana Rivers through five countries (Argentina, Uruguay, Bolivia, Paraguay and Brazil), as shown in Figure 6 (World Bank, 2010).

Figure 6 - Hidrovia Waterway

Other examples of asset management strategies for inland waterways abound, including the St. Lawrence Seaway, the Rhine-Main-Danube in Europe, and the Nile Basin in Africa.

WG 181 intends to research and present a case study of asset management aspects of these types of waterways.

6 EMERGING TRENDS AND TECHNOLOGIES

WG 181 has identified a number of emerging trends and technological advances that are influencing the development and management of waterborne transport infrastructure. These include:

- Container Ship Size – economies of scale driving increases in vessel capacities up to 19,000 TEUs – where will it end?
- Slow-Steaming/LNG Fuel/ Clean Engines – originally a response to excess vessel capacity, carriers are seeing economic and environmental benefits to slow-steaming; this along with cleaner fuels and engines, will improve the sustainability of waterborne transport;
- Smart and Green Ports – making ports "smarter" and more environmentally-friendly brings economic benefits as well;
- Port Alliances – Major European ports, such as the Port of Rotterdam, are entering into strategic alliances with ports in the Middle East and South America that give them more influence on the logistics chain;
- Shipping Alliances – overcapacity of vessels is leading large carriers like Maersk to enter into alliance agreements that enable resource sharing and cost reduction;
- Maritime Silk Road – China is investing in port development along the Indian Ocean to better manage their supply and export chains;
- Arctic Navigation – increased activity in this region is driven largely by resource extraction objectives (oil and gas development), and to a lesser extent by the prospect of interoceanic transits facilitated by global warming;
- Information Technologies and "Big Data" – can be expected to have the same impact on waterborne transport infrastructure as has been evidenced in other sectors of the 21st century global economy; and
- Maritime Law & Policy – disputes and conflict resolution in the Asia-Pacific and Arctic regions are arising from a universal desire to gain a competitive advantage, highlighting the importance of governance.

A current response to several of the above trends is the significant investment and expansion of container port capacity in the Middle East. Larger vessels and slow steaming strategies require ports with deeper drafts, longer quays, bigger cranes, larger container yards and shorter stays for vessels.

According to a recent Journal of Commerce article (JOC 2015), countries in the Middle East are expanding capacity and investing billions of dollars in ports and terminals in order to accommodate expanding business in the Asia-Europe trade lane.

Projects are in planning and preparation across the region, with HPH recently announcing plans to quadruple the throughput of the Oman International Container Terminal to 6 million TEUs.

port" concept, offering traders mobile applications and round the clock electronic transaction facilities that provide real-time information through their smartphones and from any location (DP World 2013).

Due to climate change, the Arctic is warming faster than any other region on Earth. The international Arctic Council, comprising eight circumpolar states (Canada, Denmark, Finland, Iceland, Norway, Russia, Sweden, and the United States), has recognized the incontrovertible links among marine transportation, environmental protection, and sustainable Arctic development (http://www.arctic-council.org/index.php/en/). This emerging transportation and development opportunity poses infrastructure challenges but also

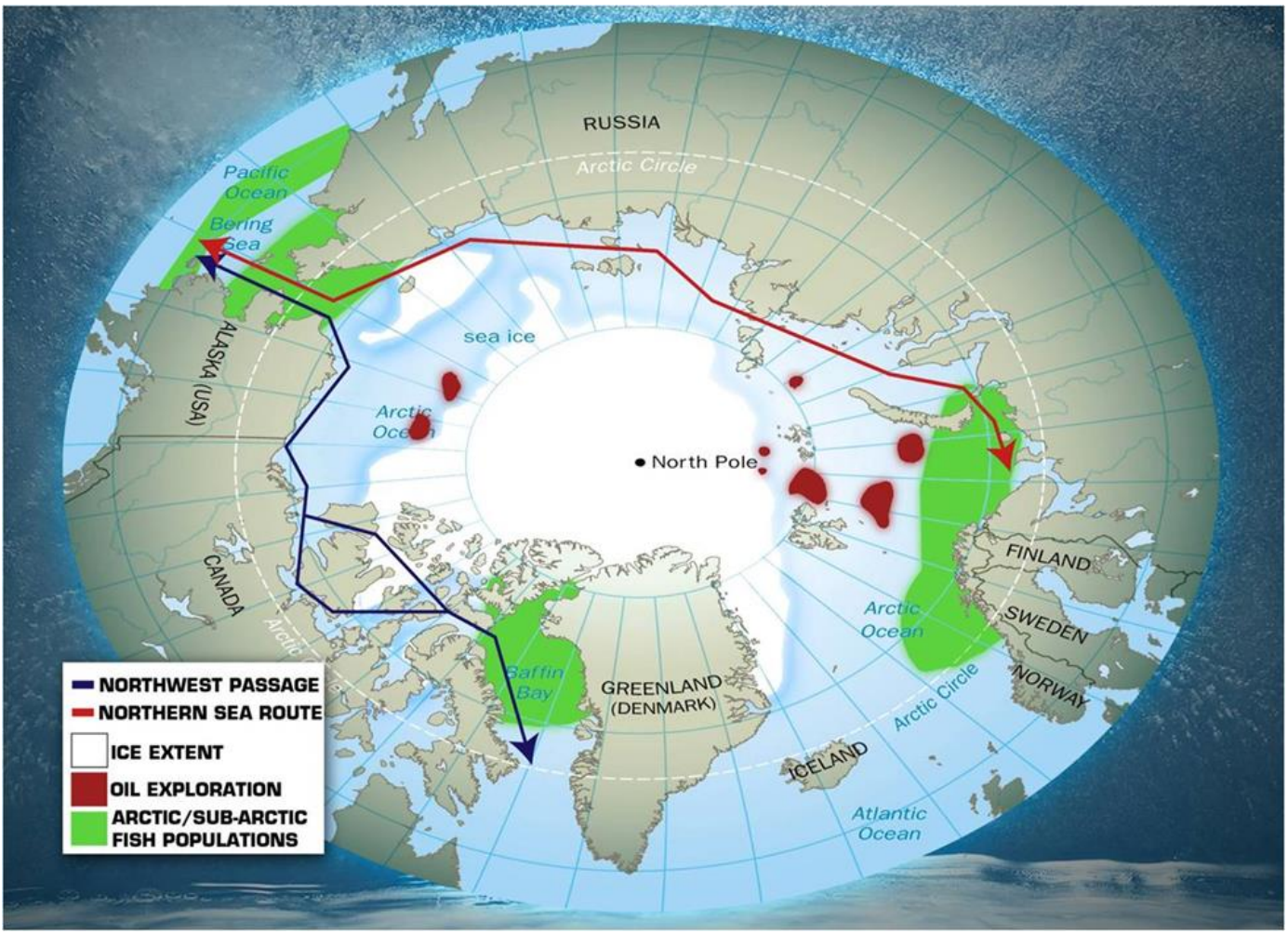

Figure 7 - Arctic Resources and Transit Routes (US Coast Guard, 2015

To retain its competitive position at Jebel Ali Port as a major gateway for the GCC, Middle East, India and Africa regions, DP World has created a "smart

opportunities to take advantage of advances in physical and informational technologies (Figure 7).

7 FINDINGS AND RECOMMENDATIONS

7.1 Advances in World Infrastructure Engineering

WG 181 intends to identify and present examples where advanced engineering is changing the waterborne infrastructure picture/future.

7.2 Perspectives on the State of World Transport Infrastructure

WG 181 intends to present its perspectives by identifying data gaps, disparities in levels and types of investment, and its overall recommendations.

7.3 Target Audience

Over its 130 year history, PIANC has earned a reputation for technical leadership in the design, delivery, and management of waterborne transport infrastructure. But our span of influence is quite limited, as we are relatively unknown beyond our membership, affiliated organizations, and other stakeholders with a vested interest in the waterborne transport sector.

The AGA 2014 resolution succinctly identified the challenges and opportunities facing the industry as we move into the 21st century. As such, they have empowered WG 181 with the task of establishing and communicating: the basis of the current global system; future needs for investment, development, or improved stewardship; an analysis of the gaps between need and reality, in a way that helps foment positive action to correct the situation.

To be successful in communicating the above, it is necessary to highlight our key messages and identify the target audience(s) so that those empowered to improve the systems are properly informed and have the ammunition they need.

Target audiences can include any of the following:

- Policy-Makers;
- Shippers & Carriers;
- Planners, Designers, Builders, Financiers, Regulators;
- Scientists, Researchers, Educators;
- Professional, Industry & Non-Profit Associations; and
- John Q Public.

WG 181 will measure its success, in part, by how effective PIANC becomes as the recognized voice of data, information, knowledge, and, yes, wisdom, in the waterborne transport infrastructure sector.

7.4 Conclusions

The work of WG 181 supports PIANC's mission to provide expert guidance and technical advice and keep the international waterborne transport community connected through its global work products.

It also helps achieve the PIANC vision as the leading international source of waterborne transport related knowledge in the 21st century.

Finally, it aligns with a key PIANC strategic initiative to promote the development and improvement of global waterborne transport infrastructure and enhancement of its economic, environmental and social benefits.

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