CAPACITY AUGMENTATION AND STRUCTURAL EXPANSION OF EXISTING IW FACILITIES

PROPOSED TECHNICAL WORKING GROUP

TERMS OF REFERENCE

1. Background

As the global economy and international trade continue to expand, inland waterway transport (IWT), recognized for its efficiency, cost-effectiveness, and environmental sustainability, is becoming increasingly pivotal. However, numerous existing IW structures and facilities are no longer able to meet the rising demands of contemporary and future transport requirements, necessitating comprehensive expansion and capacity enhancement in some countries.

A critical challenge faced by global IW systems is the significant increase in cargo volumes coupled with the growing trend of vessel up-sizing. Furthermore, many traditional IW facilities, such as locks and ship lifts have a lack in, operational efficiency, hindering their ability to support modern logistical operations. The lock system on the Mississippi River as well as European Waterways built in the beginning of last century are exemplary cases of aging infrastructure. While technical upgrades have temporarily improved their throughput and operational efficiency, a more extensive and holistic infrastructural upgrade remains necessary.

The enhancement of capacity for IW structures should not rely solely on physical expansion; rather, the optimization of operational management and scheduling is equally critical. Intelligent scheduling systems and automated management technologies can substantially improve the efficiency of existing facilities. For instance, automated lock system on the Albert Canal integrates advanced sensor networks and automated control systems to facilitate unmanned operations, significantly reducing manual intervention while improving transit efficiency. Moreover, coordinated scheduling across multiple locks is vital for complex water systems with tiered lock structures. China's Three Gorges Project exemplifies this, with unified management and optimized scheduling systems facilitating seamless operations even under high traffic demands.

Additionally, the deployment of big data analytics and intelligent shipping platforms enables real-time monitoring, allowing for the dynamic optimization of vessel transit, thereby reducing congestion and bottlenecks. The application of emerging technologies plays a crucial role in enhancing the capacity of inland waterway facilities by employing real-time data monitoring, predictive analytics, and operational optimization to not only improve efficiency but also anticipate equipment failures, thereby minimizing downtime and maintenance costs.

In light of the growing environmental challenges posed by climate change, any efforts to upgrade and expand IW facilities must adhere to principles of sustainable development. Thoughtful planning and technological innovation should enable upgraded structures to operate with greater efficiency while minimizing their environmental footprint. Initiatives such

as Europe's "Green Corridor" and China's "Yangtze River Economic Belt Green Shipping Development Plan" aim to reduce carbon emissions and mitigate environmental damage, setting a precedent for eco-friendly inland waterway systems.

To effectively address these multifaceted challenges, the WG on Capacity Augmentation and Structural Expansion of Existing IW Facilities is both timely and essential. The WG would convene international technical experts, scholars, engineers, and policymakers to exchange best practices, collaboratively explore feasible strategies for enhancing the capacity of existing IW structures, and develop globally recognized technical standards and operational guidelines. By fostering international collaboration, the WG would serve as a catalyst for accelerating the modernization of IW systems, ensuring their sustainability and operational efficiency in the face of evolving global transport demands.

2. Objectives

The main goal of WG is to systematically compile and critically evaluate a diverse range of international case studies and technological advancements in navigation infrastructure enhancement, which may help to increase Capacity of Existing IW Facilities. This initiative seeks to:

- Establish a robust framework for assessing and enhancing the throughput capabilities of critical inland navigation hubs.
- Identify and integrate best practices and innovative technologies to elevate the operational efficiency and capacity of existing navigation structures.
- Develop comprehensive guidelines for the expansion and modernization of navigation facilities, underpinned by proven engineering solutions and adaptive project management strategies.

3. Earlier reports to be reviewed

- WG 207: Innovations in Shiplift Navigation Concepts
- WG 206: Locks
- WG 106: Innovations in Lock Design
- WG 155: Ship Behavior in Locks and Lock Approaches
- WG 25: Maintenance and Renovation of Navigation

4. Scope of Work

- **Evaluation of Navigation Facility Capacity**: Analyze key factors such as throughput limitations, traffic congestion, and infrastructure aging that affect facility performance. Review predictive models using real-time data and historical trends to optimize capacity planning. These models will help forecast future demands and identify areas for operational improvement.
- **Capability Enhancement of Existing Facilities**: Review advanced technologies like automation, digital twins, and real-time monitoring to improve facility efficiency. Focus on large vessel handling, predictive maintenance, and safety systems to reduce downtime and increase throughput. The goal is to enhance structural integrity and extend the operational life of existing facilities.
- **Expansion and Modernization Techniques:** Assess environmental, technological, and logistical factors critical for facility expansion and modernization. Prioritize sustainable

practices and integrate AI, big data, and automation for smarter infrastructure management. Case studies will provide insights into best practices and successful project implementation.

The WG will focus mainly on locks, shiplifts and weirs, even if the capacity of an entire waterways segment may be considered as ultimate target. The WG will not focus on RIS, IAS, IA, remote navigation, … technologies, but will raise their specific benefits by referring to existing PIANC WGs on issues such as RIS, Smart Shipping, Digital Twin, etc.

5. Matters to be investigated

Some of the issues to be investigated include:

- **Throughput Capacity Evaluation**:
    - Factors influencing the throughput capacity of existing navigation facilities.
    - Development of a robust evaluation system and predictive methodologies for capacity planning.
- **Enhancement of Existing Facilities' Capabilities:**
    - Integration of advanced technologies for optimizing the performance and structural integrity of existing navigation structures.
    - Adoption of technologies and methods to safely manage the transit of larger vessels.
    - Evaluation of safety protocols and maintenance strategies to ensure the longevity and efficiency of facilities.
- **Techniques for Facility Expansion and Modernization:**
    - Assessment of environmental, technological, and logistical factors that impact the modernization and expansion strategies of navigation facilities.
    - Requirements and prerequisites for successful expansion projects, including regulatory considerations and technological deployments.
    - Case studies that illustrate successful expansions and enhancements of navigation facilities, providing empirical evidence and insights into best practices and challenges.
- **Comparative Analysis of Global Practices:**
    - Compilation and analysis of international case studies to identify and benchmark global best practices in navigation facility expansion and enhancement.
    - Investigation into the adaptation of these practices in different geopolitical and economic contexts to understand their applicability and impact.

- **Development of Guidelines and Recommendations:**
    - Formulation of comprehensive guidelines for the expansion and modernization of IW facilities based on the findings from the investigative research.
    - Recommendations for policy adjustments and strategic initiatives to support the sustainable development of navigation infrastructure.

6. Intended product

The report is envisioned as a pivotal resource that will not only enhance the operational capabilities of existing IW facilities but also support the strategic planning and execution of future expansion projects, thereby contributing to the broader goals of economic development and environmental sustainability in the maritime sector.

7. Working Group membership

The working group will comprise a multidisciplinary team of experts, including facility managers, civil engineers, maritime consultants, transport economist and academic researchers, each bringing a wealth of experience and specialized knowledge to the report.

8. Target Audience

The findings of this report are intended to benefit a wide range of stakeholders, including global navigation facility owners, operators, and governmental bodies, providing them with actionable insights and strategic guidance for upgrading and modernizing their infrastructural assets.

9. Relevance

The Working Group Report is particularly significant for regions with limited financial resources. It aims to maximize the efficiency and safety of existing facilities while minimizing economic expenditures. The sustainability aspect will also consider the integration of environmental management practices, ensuring that enhancements are compatible with ecological preservation and climate resilience.

Relevance to Countries in Transition

For countries in transition, often grappling with economic constraints and infrastructure deficits, this report provides a crucial toolkit for leapfrogging to modern, efficient, and resilient IW infrastructure. It outlines cost-effective strategies for enhancing existing facilities, which is particularly critical where new constructions may be financially unfeasible. By applying the best practices and guidelines suggested in the report, these countries can improve their trade capabilities and economic integration, fostering regional development and economic diversification. Additionally, the policy recommendations aim to assist governments in attracting investments and aid from international entities by aligning their infrastructure projects with global standards and expectations.

Relevance to Climate Change

The report addresses climate change by promoting the implementation of green technologies and practices in the expansion and modernization of IW facilities. It advocates for energy-efficient operations and the integration of renewable energy sources in maritime infrastructure, contributing to the reduction of greenhouse gas emissions from the sector.

Furthermore, the report emphasizes the importance of designing resilient infrastructure capable of withstanding extreme weather events and rising sea levels, ensuring long-term sustainability and continuity of operations in the face of climatic uncertainties. These measures directly contribute to global efforts in mitigating climate change impacts and promoting environmental stewardship in maritime transport.

Relevance to Sustainable Development Goals (SDGs)

This report directly supports several Sustainable Development Goals:

- **SDG 9 (Industry, Innovation, and Infrastructure):** By fostering innovation and promoting resilient infrastructure, the report aids in building sustainable and scalable solutions in maritime transport.
- **SDG 11 (Sustainable Cities and Communities):** It contributes to sustainable urbanization through the enhancement of infrastructure that supports large-scale maritime activities, which are vital for the economic health of coastal cities.
- **SDG 13 (Climate Action):** The integration of climate-resilient measures and reduction of carbon footprints in IW facility operations aligns with global climate action targets.
- **SDG 14 (Life below Water):** The report promotes environmentally friendly practices that mitigate the impact of IW infrastructure on marine ecosystems, supporting the conservation and sustainable use of the oceans, seas, and marine resources.

Overall, the strategic enhancement of IW facilities as detailed in the report not only aids in immediate operational upgrades but also aligns with broader socio-economic and environmental goals, supporting sustainable development globally.