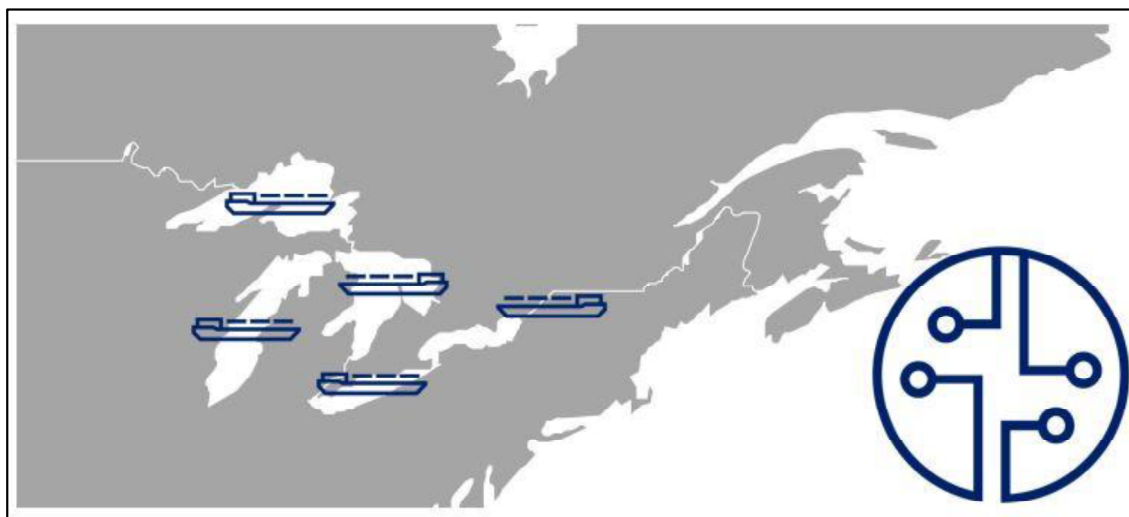


SMART SHIPPING – CHALLENGES & OPPORTUNITIES FOR THE GREAT LAKES ST. LAWRENCE REGION

Executive Report



SMART SHIPPING – CHALLENGES & OPPORTUNITIES FOR THE GREAT LAKES ST. LAWRENCE REGION

Executive Report

HPC Hamburg Port Consulting GmbH

Container Terminal Altenwerder
Am Ballinkai 1
21129 Hamburg
Germany

Phone: +49-40-74008-228

Fax: +49-40-74008-115

E-Mail: j.sommer@hpc-hamburg.de

Internet: <http://www.hpc-hamburg.de>

TABLE OF CONTENTS

| | Page |
|--|-------------|
| 1. INTRODUCTION | 1 |
| 1.1 Motivation | 1 |
| 1.2 Objectives | 1 |
| 2. SMART SHIPPING | 3 |
| 2.1 Vision of the Digital Future | 3 |
| 2.2 Smart Shipping Values | 3 |
| 3. TAKEAWAYS FROM THE INDUSTRY | 6 |
| 3.1 Just In Time Arrival | 6 |
| 3.2 Vessel Call Optimization | 7 |
| 3.3 Slot Management | 9 |
| 3.4 Data Sharing Platforms | 10 |
| 4. RECOMMENDATIONS FOR THE GLSL MARITIME SYSTEM | 12 |
| 4.1 Common Pain Points in the GLSL Region | 12 |
| 4.2 High Level Recommendations | 13 |
| 4.3 Potential Quick Wins | 13 |
| 4.4 Recommended Next Steps | 15 |

ANNEX

Annex 1: Sources

1. INTRODUCTION

1.1 Motivation

The Great Lakes St. Lawrence Governors & Premiers (GSGP), working with key regional partners, established the goals of improving the efficiency and competitiveness of the regional maritime transportation system to double maritime trade while shrinking the environmental footprint of transportation. The use of smart technologies and systems in the maritime sector is rapidly growing worldwide. Leading ports, carriers and others are leveraging smart shipping to increase efficiency, improve environmental performance and grow cargo trade. Smart shipping is in its infancy in the Great Lakes St. Lawrence (GLSL) region yet holds great promise if it builds on current initiatives, recognizes challenges, and is approached strategically.

In order to accomplish regional goals, it is essential to identify systemically important platforms and technologies that can be built upon at a regional scale. For example, the US and Canadian Seaway agencies are working in partnership with the US Department of Transportation Volpe Center to develop a traffic flow management system with the aim to provide travel-time estimates between current locations of vessels transiting the St. Lawrence Seaway and key waypoints along their transit routes, applying to the entirety of the St. Lawrence Seaway, from Montréal, Québec, to Lake Erie. The arrival time estimates are intended to initially support the efforts of the Seaway traffic control center personnel and operators of key infrastructure along the Seaway (locks and moveable bridges), and also to assist vessel operators, captains, and pilots as well as intersecting rail and road users who rely on the moveable bridges that cross the Seaway. It is expected to produce notable safety, environmental, and business benefits to Seaway customers and stakeholders, helping to keep the Seaway competitive from a cost, safety, and efficiency standpoint. Ultimately, the implementation of an advanced traffic flow management system is expected to promote traffic management procedures and navigational tools to enable coordination of GLSL region-wide vessel movements.

1.2 Objectives

HPC Hamburg Port Consulting GmbH was engaged by GSGP to provide high level recommendations for Smart Shipping in the Great Lakes St. Lawrence region considering current best practice solutions and experience from peer projects. The focus of this report is on near-term opportunities, recognizing work that is already

underway such as the St. Lawrence Seaway vessel traffic management system or other initiatives that could be implemented soon. Many of the best near-term opportunities exist in portions of the GLSL system that currently experience congestion or where smart solutions could produce rapid, high-value outcomes. Quick wins that capitalize on these opportunities could be expanded and built on over time. Of course, many other opportunities exist throughout the GLSL system such as improving terminal operations and hinterland connectivity. Topics of this nature could be the subject of future analysis but fall outside the scope of this report.

2. SMART SHIPPING

Throughout the global maritime industry, a digital transformation is underway. Shipping still depends on many paper-based processes and despite major investments by many maritime organizations, the maritime industry in general is not as well prepared for digitalization as other industries, such as the airline industry. Hence, becoming *smart* can help to unlock the potential of maritime transportation.

2.1 Vision of the Digital Future

Digitalization is not an end in itself. In order to get the most out of the digital transformation, you need to first have a vision for your community. In the case of maritime transportation, the community includes carriers, ports, governmental agencies, cargo-owners et al. Ultimately, a strategy and a process to engage this community in strategic planning can help maximize the benefits of digitalization.

Aiming to be the winners of digitalization, imagine...

- There is **no congestion** on your waterways
- Relevant **information is available** whenever you need it
- Ships operate with **maximum safety**
- You meet **environmental goals**
- Customers can rely on the **punctual arrival** of their goods
- All resources are used **most effectively** for the **collective benefit of the supply chain**

Considering all these aspects of the vision, **Smart Shipping will help allow the GLSL region to unlock its full potential.**

2.2 Smart Shipping Values

There are six value pools where smart shipping can help in making maritime transportation more attractive:



Each of these value pools relieve pains and achieve gains for the maritime transportation community. The four most relevant values that could be created by Smart Shipping in the GLSL are given in more detail in the following.



Smart Shipping increases safety

Typical safety issues in shipping are caused by

- Lack of transparency on planned routes
- Passage conflicts on narrow channels
- Dense traffic at bottleneck locations

Smart Shipping gives you **full situational awareness** and allows you to **predict and avoid potential danger** by

- Digital route exchange
- Identification of passage conflicts
- Planning for utilization of bottleneck infrastructure thereby reducing congestion



Smart Shipping increases efficiency

Smart Shipping reduces idle times and ineffective use of resources by

- Coordination at bottleneck infrastructure
- Predictability of arrival times
- Enabling optimized resource allocation

- Continuous improvement by business intelligence

Smart Shipping releases information

Common pains with regards to exchange of relevant information are

- Various sources and systems that are disconnected
- Paper-based information
- Repetitive information distribution
- No real time data

Smart Shipping gives all stakeholders **access to the right data** while giving the **data owner full control** by

- More standardized information
- More efficiency through paperless processes
- Secure exchange of data from one to many
- Real time data for everybody

Smart Shipping affects the environment

Smart Shipping allows you to improve your environmental performance by

- Reduced emissions by eliminating waiting time
- Reduced fuel use through eco-speed sailing
- Reduced marine threats to wildlife



3. TAKEAWAYS FROM THE INDUSTRY

In ports that have nautical restrictions or limited infrastructure like locks, bridges and channels, Smart Shipping has proven to allow higher throughput, making these ports more efficient and hence more attractive. Different information technology (IT) system solutions can be found which aim to fulfil the demand for smart ports and smart shipping. However, no standard product has prevailed in the market yet. The best practice solutions are presented in this chapter, indicating their gains for the respective communities.

3.1 Just In Time Arrival

In the beginning of 2020, the International Maritime Organization released the Just In Time (JIT) Arrival Guide. JIT Arrival is a concept in which a ship maintains the optimal operating speed to arrive at the Pilot Boarding Place (the place where the pilot needs to board the vessel in order to navigate it to the berth) when the availability of berth, fairway and nautical services is ensured. The JIT Arrival concept has been identified by the Global Industry Alliance (GIA) as a feasible opportunity to improve environmental performance and, specifically, reduce emissions. Simulations based on real operating profiles of vessels using automated identification systems (AIS) data indicates that with a notification period of 24 hours before the actual arrival at berth, average fuel savings of up to 10% were achieved. Due to variations in operations, the potential for individual voyage savings is suggested to be much higher.

*Up to 10%
fuel savings
in average
using JIT*

JIT Arrival is not only relevant for ports but also for river approach, lock or channel, or even an entire waterway. Here the vessel's arrival at critical points (e.g. at berth, pilot boarding station, lock, channel, river, etc.) during its route exactly when it can be processed is essential. Therefore, not only the ship operators need to reliably know the requested arrival time but also the community needs to know the planned arrival time of the ship.

Examples

The tool Navi-Port was developed by Wärtsilä with the sole purpose of enabling JIT Arrival. This IT solution enables the exchange of the requested time of arrival at a specific geographical location (e.g. berth or pilot boarding station) with a vessel and the planned and estimated time of arrival of the vessel at that location. Navi-Port was the result of a pilot conducted by Wärtsilä and the Hamburg Vessel Coordination Center (HVCC) together with the cruise ship operator Carnival Maritime. They have proven that a real-time exchange is possible and can be smoothly incorporated in the operational processes. The next step for the partners Wärtsilä and HVCC is to conduct pilots with bulk carriers and container carriers.



Source: Wärtsilä, <https://www.wartsila.com/marine/voyage/navi-port>, 2020

Values created by Just In Time Arrival

- ✓ Reliable arrival time
- ✓ Efficient, reducing waiting time
- ✓ Safer, improving congestion
- ✓ Environment friendly, reducing fuel use & emissions

3.2 Vessel Call Optimization

According to a study conducted by the Global Industry Alliance (GIA), based on the business intelligence of Marine Traffic, ships spend an average of 4% - 9% of voyage time waiting. Furthermore, about 15% of marine fuel consumption for the world fleet occurs under port stays, anchorage and when ships operate at very low speed (below 1 knot).

*Potential of
15% fuel
savings using
vessel call
optimization*

Vessel Call Optimization for the shipping cluster, likewise Port Call Optimization for the port cluster, are aiming to orchestrate all relevant services with the help of a

platform that enables information-sharing among partners in order to speed supply chain connections and minimize idle time.

Examples

The following examples of solutions for call optimization highlight two different approaches.

The Hamburg Vessel Coordination Center (HVCC) has developed a process and a



tool to optimize port calls in the port of Hamburg. Their approach is to have a central platform displaying the real time situation of all upcoming port calls and

having a team of operational experts working on a 24/7 basis to resolve conflicts in traffic. They account for terminal planning, vessel planning, service providers and the nautical restrictions on the river Elbe which vessels use to access the port.

Awake.ai is an IT ecosystem that uses visualization of planning and as-is data as well as machine learning and AI technology to optimize port calls. Predictions on delays in operations are derived and alerts flagged to all the parties. This system depends on the collaboration of the community to resolve these conflicts.

Values created by Vessel Call Optimization

- ✓ Reliable arrival time
- ✓ Efficient, reducing waiting time
- ✓ Safer, having less congestion
- ✓ Environment friendly, reducing fuel use & emissions
- ✓ More effective, optimizing resource allocation

3.3 Slot Management

With slot management solutions, time slots are booked and managed through a central platform for optimized use of limited capacities such as locks, restricted passages, service personnel and terminal berths. A slot management system centralizes the communication between the key stakeholders during a vessel voyage such as ports and terminals and the shipping lines, but also lock operators. The providers of berth capacities – typically the terminal operators – publish their availabilities and waterside volumes within given time slots (e.g. hours). Shipping lines can apply for a slot starting at a requested arrival time and giving the aimed movements on the vessel (e.g. a certain amount of container moves to be discharged and loaded for container vessels / barges). The length of the slot occupation will then be calculated based on the berth capacity and productivity, and the number of moves. Usually the reserved slots per port and terminal are visualized in a slot management solution so that every stakeholder has immediate and easy access to the current occupations at the berths and potential planning conflicts in order to optimize the routing for the vessels.

This solution can deliver significant savings of fuel and emissions as the port and terminal infrastructure is being used more efficiently and the shipping lines have reliable slots for their operations, thus they can adjust their routings. In summary, it reduces costly idle times at the terminals and for the shipping lines. Whenever locks are involved, the slot management solution should be extended to locks and lock operations as this usually is a bottleneck and unknown factor for route planning.

*Significant
cost-
efficiency
increase of
port
infrastructure*

Examples



One example, and a pioneer for slot management systems for barges in inland waterway transportation, is the RheinPorts Information System (RPIS) operated by RheinPorts – a joint venture of the Ports of Switzerland and the Ports de Mulhouse-Rhin in France along the Upper Rhine. In 2015, RPIS went live with a slot management system for the container terminals in the Upper Rhine region. RPIS is being extended step-by-step to other types of cargo – e.g. bulk and passenger traffic – as well as geographically extended to other port clusters along the river Rhine. One important success factor at RPIS is the integration into Customs systems as well as to lock operations systems in order to achieve further improvement potentials.

Values created by Slot Management

- ✓ Reliable arrival time
- ✓ Efficient, reducing waiting time
- ✓ Environment friendly, reducing fuel use & emissions
- ✓ More effective, optimizing resource allocation

3.4 Data Sharing Platforms

The concept is to have a platform, easy to access by stakeholders to share relevant information. Data sharing platforms enable the exchange of data from multiple sources for more collaborative and effective decision-making. Connecting many to all stakeholders across the supply chain through a digital platform is in line with the current trend in transport communities to “share in order to get”.

Examples

Best practice solutions in the industry include the following data sharing platforms: RPIS, NxtPort, awake.ai, Marine Fields PERSEUS, HVCC, PortXchange.

Values created by Data Sharing Platforms

- ✓ Transparent, sharing relevant & real time data with partners and, potentially, everybody
- ✓ More secure, standardized exchange of data with access control
- ✓ Efficient, enabling paperless processes & business intelligence
- ✓ More effective, reducing manual efforts

4. RECOMMENDATIONS FOR THE GLSL MARITIME SYSTEM

The GLSL maritime system is a vast and highly complex bi-national system that includes more than 100 ports and a large community of system users. Therefore, creating a smart shipping environment for the region can be very fruitful. It is recommended to take an iterative approach that integrates the stakeholders of the community.

4.1 Common Pain Points in the GLSL Region

The GLSL maritime system, specifically the St. Lawrence Seaway, can have dense traffic at its many locks, channels, and bridges. This causes unforeseen delays, inefficient use of resources and hinders ship operators to make efficient voyage planning.

Another issue is the weather conditions in the region, particularly in the winter, making ice breaking activities necessary. Real-time monitoring of these activities would lead to a better situational awareness.

A third issue expressed by stakeholders was safety threats due to potential wildlife collisions such as whales in the St. Lawrence. While digitalization and smart shipping will not change the activities of marine wildlife, it can help provide better information to pilots and crew to best plot their voyage to avoid collisions. Smart shipping can also create less dense traffic and therefore allow more flexible route planning and voyages.

The fourth issue mentioned particularly by ship operators and carriers is the inability to create the most fuel-efficient voyages due to the bottlenecks mentioned above and sometimes also missing information on the expected fuel consumption of the different possible routes.

These points indicate the difficulties facing stakeholders of the GLSL region to effectively measure the performance of the different sections and areas, and optimally traverse infrastructure such as locks and bridges.

In general, a prioritization of the pain points and gains through a smart solution which serves the whole community is a key success factor for the implementation of a digitalization strategy. Driving the change process to a more digitalized infrastructure within the whole community is highly important.

4.2 High Level Recommendations

Digitalization is rapidly evolving, and the capabilities of technology are expanding so quickly, that any plan for the next 5 or 10 years must adapt to changing conditions or it will run the risk of building upon obsolete standards.



To make smart shipping work for the GLSL, it should be an iterative process. Each iteration should produce new ready-to-use features and be rolled out to the community. This enables stakeholders to experience the change and assess its impact on their processes. This experience can be used as input for future decisions and should serve as a guide for adjusting the plan.

Another important aspect when creating a digital strategy towards smart shipping is the ongoing standardization initiatives of the industry. Many stakeholders have started to work on data and data exchange standards in recent years and have achieved useful and promising results. Being aware of their work and using their standards wherever appropriate will increase the sustainability of your system. It will make it robust for future developments and scalable to adapt to the growth of the GLSL community.

4.3 Potential Quick Wins

A high-value quick win identified is the implementation of JIT Arrival for the locks in the GLSL region. This project – ideally combined with the existing initiative in the Seaway - would not only be about digitalization but also about changing

communication and planning patterns as well as improving the processes in place. Extending the Seaway's initiative in order to have a consistent solution for the entire GLSL system would lower development and implementation costs, ease adoption and maximize benefits.

As the prediction of waiting times at the locks is quite complex, the introduction of a slot management system for locks should quickly lead to a more predictable and visible routing of the vessels.

Since route optimization was one of the pain points of the ship operators, this could also serve as a pilot project and quick win. Such a pilot project could implement a process and an application to support the voyage and route planning based on historic data and predictions such as weather. This could be done in a suitable testbed with a subset of the GLSL stakeholders to serve as a best practice for the implementation of smart route planning. Choosing the right routes will allow the ship operators to save fuel, operating hours and emissions.

For the GLSL maritime system, which already includes different IT systems, a longer term, aspirational goal would be to combine existing data sources (public and private) and refine them. The data can be used to visualize the bottlenecks and their current status and allow the stakeholders to incorporate the information in their planning.

Another long-term, aspirational goal is to enable data sharing through a platform to unlock the added value of business intelligence applications. By storing shared data for a period of time, it will be possible to measure efficiency and identify inefficiencies based on past events. This can be applied to locks, channels, terminals, ports and even the operations of nautical services such as pilotage, mooring, ice breaking and others. Having more consistent and comparable data, available through a data sharing platform is already providing significant benefits and a competitive advantage to other systems where they have been deployed. The Upper Rhine, for example, has accomplished this through the use of one central database. Less centralized data sharing platforms represent another approach that has been used successfully.

In general, we recommend an assessment of the tools already in the market. Existing tools hold the potential to solve most cost-effectively some of the identified pain points. Eliminating the time-consuming and costly need of software development reduces the time to action drastically and can create the right momentum of change for your community.

4.4 Recommended Next Steps

In summary, we recommend proceeding immediately with one or more pilot projects to achieve quick wins. As these pilot projects are implemented, relevant stakeholders should be convened to jointly prioritize longer-term measures to resolve the pain points mentioned in the previous sections. A deep-dive assessment of the market to identify suitable ready-to-use solutions will expedite this prioritization process. The result of these activities should be:

- Identification of the best opportunities and rapid implementation for quick wins
- Selecting of testbeds for additional pilot projects
- A plan for how quick wins can be systemically leveraged and built upon over time

Annex 1

SOURCES

Definitions

| | |
|------------|--|
| Smart Port | https://en.wikipedia.org/wiki/Smart_port https://www.porttechnology.org/news/what-is-a-smart-port/ https://www2.deloitte.com/content/dam/Deloitte/nl/Documents/energy-resources/deloitte-nl-er-port-services-smart-ports.pdf https://sustainableworldports.org/ |
|------------|--|

| | |
|----------------|---|
| Smart Shipping | https://www.porttechnology.org/technical-papers/smart-shipping-and-the-supply-chain-evolving-with-iot-connectivity/ |
|----------------|---|

Initiatives

| | |
|----------------------|---|
| Just In Time Arrival | https://sustainableworldports.org/wp-content/uploads/MEPC-75-INF.22-Just-In-Time-Arrival-Guide-Barriers-and-Solutions-Secretariat.pdf |
|----------------------|---|

| | |
|------------------------------------|---|
| Port Collaborative Decision Making | https://pdfs.semanticscholar.org/ce1b/4e555d67e957e407944c6fb7e69c6c4f5bb.pdf |
|------------------------------------|---|

| | |
|------------------------|---|
| Sea Traffic Management | https://www.seatrafficmanagement.info/ |
|------------------------|---|

Standardization

| | |
|------|--|
| DCSA | https://dcsa.org/ https://www.porttechnology.org/news/major-shipping-association-one-step-closer-to-global-standards/ |
|------|--|

| | |
|-----|---|
| GS1 | https://www.gs1.org/ |
|-----|---|

| | |
|---------|---|
| IMO-GIA | https://glomeep.imo.org/global-industry-alliance/global-industry-alliance-gia/ |
|---------|---|

| | |
|-------|---|
| IPCSA | https://ipcsa.international/ |
|-------|---|

| | |
|-------|---|
| ITPCO | https://portcalloptimization.org/ |
|-------|---|

| | |
|---------|---|
| TIC 4.0 | https://www.porttechnology.org/news/tic-4-0-to-drive-search-for-data-standards/ |
|---------|---|

IT Solutions

| | |
|---|---|
| Abraxa | https://abraxa.com/ |
| Awake AI | https://www.awake.ai/ |
| CBS & RIS | https://www.cyberlogitec.com/solutions/maritime/cara/ |
| HVCC | https://www.hvcc-hamburg.de/en/ |
| i4sea | https://www.i4sea.com/en/about-us/ |
| Inchcape Shipping Service – Smart Sight | https://www.iss-shipping.com/products-and-services#smart-sight |
| Navi Port | https://www.wartsila.com/marine/voyage/navi-port |
| NxtPort | https://www.nxtport.com/ |
| Perseus | https://www.marine-fields.com/product/ |
| Port Call | https://marine-digital.com/portcall |
| Port Vision | https://www.portvision.com/ |
| Portcast | https://portcast.io/ |
| Portchain | https://www.portchain.com/ |
| PortXChange | https://portxchange.portofrotterdam.com/ |
| RPIS | http://www.rheinports.net/en/home.html |
| Searoutes | https://www.searoutes.com/ |
| Sleipner | https://sleipner-maritime.com/ |
| Tegplay | https://tegplay.nl/ |
| XVela | https://www.xvela.com/ |