

The Future of Shipping

THE POSITIVE IMPACT OF JUST-IN-TIME
PORT ARRIVALS



WHITE PAPER

Contents

- 1 Introduction
- 2 Potential impact of a JIT arrival solution
- 3 Key drivers for JIT adoption
- 4 Current related activities by industry bodies
- 5 Challenges for widespread JIT adoption
- 6 Requirements for JIT adoption
- 7 The Wärtsilä solution
- 8 Pilot projects for the Wärtsilä solution
- 9 Conclusion

Introduction

The marine industry is changing. The competitive environment within the industry and regulatory requirements are creating the need to address the industry's established ways of working with a new set of criteria. These criteria are largely concentrated on operational optimisation to gain either monetary or environmental benefits. Simply continuing current operations as they are won't be enough to meet the targets set by the IMO, or to remain competitive within the industry. In addition to harvesting the benefits of new technologies, the industry should also look very closely at eliminating existing inefficiencies.

One of the main sources of inefficiencies, or waste, in maritime transportation is the unnecessarily excessive speeds at which ships sail to arrive at port only to have to wait for a berthing slot. According to multiple studies, container ships spend, for example, on average 6% of their time at anchor waiting for berthing, which results in extra fuel consumption, higher emissions, and congested ports. Wärtsilä has a strong position in offering solutions whereby a continuous dialogue between the port and the ship can eliminate the waiting time, and secure a Just-in-Time (JIT) arrival to the port. These solutions eliminate unnecessary fuel consumption and emissions, both during the voyage and at anchor. In addition to the obvious cost and efficiency gains, JIT arrival is a key component, through the utilisation of improved connectivity enabled by more affordable and reliable satellite communication, in achieving a greener maritime logistics system.



Potential impact of a JIT arrival solution

The benefits from enabling ships to arrive in port at the optimal time, without having to queue, are manifold and they apply both to the vessel owner/operator and to the port community, including terminal operator, port authorities and other stakeholders involved in the vessel approach to the berth. They can be summarised as follows:

FOR THE VESSEL OWNER/ OPERATOR, JIT ARRIVALS

- Reduce significantly both fuel consumption and emissions during the voyage by optimising the vessel's speed to meet the expected arrival time
- Eliminate the time waiting at anchor for port access, thereby eliminating wasted fuel consumption and associated emissions while maintaining the basic power needs of the vessel
- Increase navigational safety
- Improve rest hour planning for the ship's crew and nautical services

Slow-steaming for just-in-time arrivals has been simulated based on real operating profiles using Automatic Identification System (AIS) data. By reacting promptly to the time of arrival recommendations with a notification period of 24 hours before the actual arrival at berth, average fuel savings of up to 10% were achieved. However, since variations are big, the potential for individual voyage savings can be as much as 50%.

FOR PORTS AND TERMINALS, JIT ARRIVALS

- Reduce congestion around the port area
- Increase safety because of fewer vessels around the port area
- Reduce local area emissions due to decreased anchorage time
- Create better visibility for upcoming operations via digitally shared estimated arrival times (ETAs) for incoming vessels, and the possibility to communicate changed recommended arrival times (RTAs) digitally. This enables better and more efficient planning of operations within the port community.

Wärtsilä has analysed the impacts of JIT operations for the Port of Singapore, the world's busiest container transshipment hub. By 2040, when the final construction phase of the Tuas next generation mega port is due to be completed, Singapore's port capacity and traffic are expected to be double that of today. This increase in traffic creates an extra need for traffic flow optimisation.

In the analysis for the Port of Singapore's container operations, the ETA optimisation algorithms showed potential combined fuel cost savings of €160M for the vessels' fuel consumption in a year of JIT arrivals. In terms of CO₂ emissions avoided, this equates to some 1,6M tonnes annually, roughly equal to the emissions of 340,000 cars. In heavy traffic areas, such as the Malacca and Singapore Straits, the reduced congestion and the related decrease in collision risk are further important benefits deriving from JIT arrivals. This result was achieved by simulating having the final 72 hours of voyage time for 50% of the container vessels optimised for arrivals at Singapore.



Key drivers for JIT adoption

Winds of change

Shipping is a very traditional industry with a history dating back thousands of years. The way the market is set up, companies have tended to be rather slow to adapt to changes taking place in the world, partly because of the long legacy of doing things in a certain and well proven way. However, times are changing and so is industry thinking. There are considerable opportunities for using modern technology to improve existing operations, and this is being increasingly realised by the sector as a whole.



Increasing focus on sustainability



Much of the pressure to change that we see today in the marine industry results from public attention to the climate crisis, something that affects all sectors of human life. Within the marine industry this is perhaps best demonstrated by the IMO's greenhouse gas (GHG) strategy. This aims to reduce the level of CO₂ emissions per transport work by at least 40 % by 2030, and by 70 % by 2050; and to reduce the total annual GHG emissions from international shipping by at least 50 % by 2050 (all compared to the baseline year 2008). To reach these IMO goals, change must come on all fronts: technological improvements, alternative energy sources, and operational improvements. Wärtsilä sees digitalisation and connected ecosystems as being key examples of the opportunities for creating the operational improvements needed. This is where the JIT arrivals initiative stands within the context of GHG emission reductions.

Improving collaboration towards a connected ecosystem

One feasible way to speed up adoption of the Just-In-Time concept would be for regulatory bodies, such as the EU, to push further implementation and set requirements that standards, like the standards developed in Sea Traffic Management (STM) validation program, should be followed. This would provide an outline format for communication, but still leave the implementation and innovation of solutions open for suppliers. The Wärtsilä concept, for example, enables the exchange of arrival time information digitally between ships and port, thus helping ships to operate in a Just-In-Time manner.



Ship and port digitalisation



The greatest incentive for adopting a JIT system would be if some of the world's major ports would start requiring ships to call the port to arrange just in time arrival times, and for the port to communicate the RTA to ships in a digital manner. Moving away from a first come first served basis and into a digitally-enabled dynamic slot planning system is a great means for gaining the momentum needed to overcome the existing waste.

Ship owners should also collaborate in enabling the creation of industry standards. There are already some positive developments in this area, such as the establishment of the Digital Shipping Container Association (DCSA) in the container vessel market. Many ship owners have also been active participants in the above-mentioned STM program, the IMO Global Industry Alliance (GIA), and the Port Call Optimization International Taskforce.

Current related activities by industry bodies

Sea Traffic Management

The recent Sea Traffic Management (STM) Validation project has piloted new protocols and a digital infrastructure for data sharing by some 300 vessels, 10 ports, and 6 onshore centres. It is the world's largest E-Navigation project, and represents collaboration by more than 60 partners, including administrations, universities, manufacturers, shipping companies, and other industry stakeholders. The STM Validation phase has now been completed, and an STM Consortium has been formed to maintain and further develop the infrastructure.

www.stmvalidation.eu



The IMO-GIA JIT Roundtable

The Global Industry Alliance (GIA) is a partnership initiative of the IMO under the framework of the GEF-UNDP-IMO GloMEEP Project that aims to bring together maritime industry leaders to support an energy efficient and low carbon maritime transport system.

glomeep.imo.org/news/imo-holds-roundtable-on-just-in-time-operation-of-ships



International Taskforce Port Call Optimization

Port Call Optimization taskforce looks at ship-to-shore data exchange from the port's perspective. Participants of the taskforce include not only ports but also shipping partners, standards bodies, and other industry stakeholders/endorsers. According to their website: "Port Call Optimization is about optimizing speed, draught and port stay, leading to lower costs, cleaner environment, more reliability and safety for Shipping, Terminals and Ports".

portcalloptimization.org



The EU Commission's Directorate-General for Mobility and Transport (DG MOVE)

The Commission's Directorate-General for Mobility and Transport ('DG MOVE') has set up a group of experts called the European Ports Forum (EPF) and a sub-group on sustainable ports, to share and promote initiatives that can enhance the sustainable development of ports, of port managing and operating bodies, and of the different actors active in the port area.



The BIMCO contractual clause on STM Virtual Arrivals

BIMCO has offered a virtual arrival clause, and more recently an STM clause for their voyage charter parties since 2013. On 13 November 2018, the Documentary Committee of BIMCO, the world's largest international shipping association, adopted a specific STM-clause developed to facilitate just-in-time port calls in commercial contracts. The Sea Traffic Management Clause for voyage charter parties enables a contractual arrangement on the implementation of JIT arrival, and helps charterers and ship-owners to agree on how to split the benefits arising from optimised voyage speeds when port calls are better synchronised. When these clauses are used, the ship operator commits to following JIT advice, and receives a pre determined percentage of the demurrage fee—plus the fuel savings—in exchange for adapting their operation when needed.



Challenges for widespread JIT adoption

IN ORDER TO MAKE THE WIDESPREAD ADOPTION OF A JIT ARRIVAL SYSTEM FEASIBLE, CERTAIN CHALLENGES INHERENT TO CURRENT PRACTICES WILL NEED TO BE OVERCOME

Negative consequences of missing the port slot

Getting a preferred berthing slot at the port often requires speeding up in order to be in position in the vessel queue when slots are allocated on the typical first come first served basis. Missing this slot could mean delays in being able to take the next cargo onboard. If there are multiple vessels trying to get the same berthing slot in a first come first served slot allocation, there is systemic waste built in because only one of the vessels will get the preferred berthing slot. In a dynamic slot planning scenario, the slot could be allocated in advance, and even bidding mechanisms could be introduced to ensure optimally allocated berthing slots.

Operating economics and contractual agreements encourage early arrivals

Typical charter party agreements specify a set charter speed and a fixed arrival time. In the case of a delay on the port side, ship owners/operators are not able to react to a speed change, even if they wanted to. Current charges for delayed operations as specified in charter parties' compensation clauses, especially in voyage charters, can be seen as something of an obstacle to the wide scale adoption of a JIT arrival system. Agreements between charterers and ship owners create conflicting incentives compared to an optimal operation. Namely, demurrage fees are paid from the charterer to the ship owner for breaching the laytime. This is determined by the ship's original laytime, and adjusting the ship's schedule to achieve JIT arrival is not possible.

Exact arrival times are considered in some cases as business-critical information, or even a competitive advantage

In certain operations, the visibility of the port call timing is seen as sensitive, business-critical information. For example, movements of crude oil and oil products might influence market prices at their destinations locally. Publicly available AIS data is already able to show the estimated arrival times for vessels en-route. It is questionable whether these arrival times any longer provide a competitive advantage due to the open nature of this information today.

Vessels can be used as storage space to optimise revenues according to spot prices

JIT arrivals are not able to solve vessel traffic related inefficiencies in a scenario where price speculation, or the use of vessels for storage, prevents vessels from carrying out normal operational functions. The reasons for such practices are outside the scope of arrival time communication and optimisation. In such cases, the ship owner must be properly compensated for their asset usage.

Concerns over cyber security with JIT solutions

The marine industry has thus far shown itself to be quite conservative when it comes to adopting connected solutions for its operations. Being aware of the gravity and danger of risks connected with information systems, the maritime industry has drawn up certain documents addressing these matters, such as the IMO MSC-FAL. 1/Circ. 3 "Guidelines on Maritime Cyber Risk Management" issued in 2017, and BIMCO's "The Guidelines on Cyber Security Onboard Ships" version 2. Furthermore, Wärtsilä is not only guided by the existing standards and best practices, but itself takes an active part in the IEC Technical Commission 80 WG 6 workgroup engaged in the assessment of current threats and the development of new standards, such as IEC 63154. Wärtsilä Navi-Port has received Approval in Principal from Bureau Veritas (BV) for meeting BV's cyber security standards.

Lack of globally accepted standards for arrival time exchange

There are some standards developed by different consortia but not yet a globally accepted one, which the industry would have taken into use. Concerted industry effort towards common standards in ship-to-shore data exchange exists, and Wärtsilä is participating in various industry groups to secure that its products are always supporting latest benchmarks.

Requirements for JIT adoption

Collaboration

To achieve broader deployment of a JIT arrival system, there needs to be an open platform and standard for seamlessly connecting ports, for optimisation applications, and for Fleet Operation Solutions (FOS). The requirement here is to enable a continuous dialogue between ports, vessels, and voyage optimisation tools in relation to a JIT arrival.

The current mindset in the maritime and port sectors is very much focused on optimising operations in “silos”, separate from each other. There is a general lack of trust in sharing data openly amongst the different stakeholders. To overcome this silo thinking and secrecy there is a need to showcase the fact that sharing information that will enable vessels to arrive in port just-in-time has a positive impact on both vessel and port operations, financially as well as environmentally.

Removing contractual obstacles

In a voyage charter scenario, demurrage fees are paid to the ship owners for the period their vessels are still occupied after their originally agreed laytime. Demurrage is therefore paid when there is a delay in the vessel’s operating schedule. Without a virtual arrival clause enabling JIT arrivals, there are conflicting incentives for the ship owner: slow steaming for fuel savings means giving up on demurrage, and even breaking the contractual terms. Most common charter party agreements do not favour the JIT arrival concept, although in some charter party agreements there are virtual arrival clauses included. For example, the BIMCO charter party virtual arrival clause, introduced in 2013, sets rules for the charterer’s request for virtual arrivals, and the conditions under which fuel savings are shared and demurrage is paid.

For time charters, where the charterer also pays for fuel, the charterer can more freely influence the arrival times, and JIT arrivals are easier to execute thanks to aligned incentives for the operation. Demurrage does not play a role in the time charterer scenario, as the vessel remains in the charterer’s use after the current voyage is completed.

Setting the standards

Considerable work has already been done in the area of setting standards for port call messaging. The EU funded STM Validation project, and its predecessors Mona Lisa and Mona Lisa 2.0, have developed the PortCDM (Port Collaborative Decision Making) approach, including the voyage exchange format (RTZ). Wärtsilä has been an active participant in the STM Validation project, and in the creation of the RTZ format, and the company’s solutions support these standards. BIMCO has also introduced an STM-clause to help the application of JIT arrivals in charter party agreements.

Dynamic slot planning

For JIT arrivals to work, ports need to move from a first-come-first-served basis to an orchestrated system where berth slots are allotted based on operations, availability, or even based on dynamic pricing. First-come-first-served based scheduling means that the vessel tenders a notice of readiness and receives the next slot in the queue. By default, this means that there is a built-in queuing system. When the port allocates slots in advance, and communicates the upcoming slots to vessels, this built-in requirement to queue for a slot is eliminated, and vessels can start executing just-in-time arrivals. Once the scheduling system allows scheduling to happen in advance, the systemic benefits of speed adjustments rather than built-in waiting times are unlocked, as target times are known sufficiently ahead of the actual port call.

Getting connected

Technologically, the need is to move to a collaborative environment wherein Port Management Information Systems (PMIS) and/or Terminal Operating Systems (TOS) based on operations in the terminal, can communicate regarding available berth slots digitally, utilising open standards such as the STM standards, to an open platform to which vessels or fleet operation centers can also connect. They should also communicate outwards to provide information on RTA’s for the slots, and here the same systems need to be capable of receiving the ETA information back from the vessel. The connections to such an open platform can either be built-in directly to the PMIS or TOS systems, or additional middleware components can be deployed to handle the conversion from legacy systems to the open platform format. Wärtsilä has also created a lightweight web interface for ports’ arrival time data exchange when PMIS/TOS integration is not an option.

Vessels need to be equipped with solutions allowing them to digitally receive the RTA, and to send the ETA information back to the open platform. Ideally, the RTA information would be used also for voyage optimisation, taking into consideration all aspects, such as weather, route, speed, trim etc. Vessels would need to be connected to the internet to be able to send and receive arrival time messages. Bandwidth-wise, arrival time exchange messaging requires a bandwidth of more than 32 kbit/sec, with a maximum latency of 2,000 ms. The amount of data transferred in the Wärtsilä solution is also quite limited, with data packages of 1–4 KB being sent every 5 minutes for ETA updates, and whenever there is a change in the RTA or PTA.

The Wärtsilä solution: Wärtsilä Navi-Port

The exchange of digital information and port side slot planning are crucial to achieving the benefits of JIT arrivals. The port is responsible for giving and maintaining Recommended Times of Arrival (RTAs) for vessels to arrive at the allotted time for their upcoming berthing slots. The RTA information is sent to the vessel, which then approves the RTA as its Planned Time of Arrival (PTA). Should the PTA be updated, the changed information is transmitted to the port. The vessel's speed performance changes its Estimated Time of Arrival (ETA), and a regularly updated ETA is given to the port via digital exchange for increased visibility. Wärtsilä has developed a solution, the Wärtsilä Navi-Port, to facilitate the arrival time exchange protocol.

In Wärtsilä Navi-Port, this works as follows:

1. RTA is given/updated by the port
2. RTA message is received by the Wärtsilä Fleet Operation Solutions (FOS) system, which then calculates a new optimal route for the vessel, and the processed data is sent to the Fleet Operation Centre (FOC) for approval (if no FOC exists, the message goes directly to the vessel)
3. RTA and route messages are sent to the vessel's navigation system, where the ship's navigating officer can accept them, and commit to a new PTA. On approval by the officer, the ship's speed is automatically adjusted to respond to the new arrival time
4. A change in PTA is shared with the port, and updated ETA information is regularly shared with the port as well
5. All is set for a JIT arrival

How the Wärtsilä Navi-Port works



The Wärtsilä Navi-Port is a part of Wärtsilä's smart voyage optimisation portfolio. These smart voyage optimisation solutions are created to make vessel operations more efficient, safe and ecological. The solutions are offered to assist voyage planning, voyage execution, port arrivals, and to improve the efficiency of the next voyage based on the post-voyage analysis of the collected data. In the development of the Wärtsilä Navi-Port, the company continues to work with pilot customers to build an arrival time exchange solution for both the port and the vessel so as to coordinate port arrivals.

The Wärtsilä Navi-Port can work as a stand-alone tool enabling arrival time exchange between ship and shore, but its benefits to the ship owner are best extracted when the arrival time exchange is used together with other voyage optimization tools from the Wärtsilä FOS system.

Wärtsilä has also participated in STM trials where the standard for a port call message format has been defined. More than 100 vessels have participated in the trials using Wärtsilä navigation systems.



Pilot projects for the Wärtsilä Navi-Port

Wärtsilä Navi-Port has been trialed together with Hamburg Vessel Coordination Center (HVCC), an entity coordinating the traffic entering the Port of Hamburg through the Elbe river, and Carnival Cruises, whose Aida vessels visit Hamburg during the summer cruise season. In these trials, the Wärtsilä Navi-Port provided the participating Aida vessels with their slot information (RTA) by sending it directly to their onboard Wärtsilä NACOS Platinum navigation system. Wärtsilä Navi-Port also provided HVCC with the up to date arrival data (ETA, PTA and ATA) directly from the navigation system. In this case, the vessel benefits from having the port call schedule information directly fed into its navigation system, and the shore-side vessel control centre benefits from the automated outbound communication, which reaches the vessel with less effort and greater accuracy. Wärtsilä Navi-Port has received the cyber Approval in Principle from Bureau Veritas, certifying that it meets their cybersecurity requirements.



Wärtsilä is also looking for further partners for the system's pilot testing, in particular for the testing of the arrival time exchange solution with new segments, new types of operation, and with new port interfaces. Piloting the solution with a broad variety of different sector operators, will allow the solution to be developed in such a way that it serves the needs of diverse types of customers in an optimal way.

Participants in the just-in-time arrival pilots benefit by either upgrading their Wärtsilä ECDIS subscription to unlock the Wärtsilä Navi-Port feature, or by installing the Wärtsilä Navi-Planner system on their participating vessels. Wärtsilä also ensures that the key ports/terminals visited by the customers' vessels are able to share the recommended arrival time information digitally.

Conclusion

The introduction of digitally based technologies is rapidly transforming the way in which the marine industry operates. Driven by the need to greatly enhance efficiencies in order to reduce operating costs, and by the requirement to comply with increasingly stringent environmental legislation, the industry appears ready to adopt new ideas and groundbreaking solutions in a way that was perhaps unheard of earlier.

In 2017, Wärtsilä announced its Smart Marine Ecosystem vision wherein the utilisation of digital technology, connectivity, and collaboration between industry players would create the greater levels of efficiency, safety, and environmental performance essential to eliminating industry waste. The Wärtsilä Navi-Port is an integral part of this initiative that takes a holistic look at ways of combating ingrained inefficiencies.

Technology enabling Just-In-Time arrivals presents an interesting opportunity to address some of the waste in the marine industry, as solving the problem mainly requires an improvement in the way berthing slots are allocated, and information of the slots communicated to the vessel. The level of capital expenditure is very low, and the potential benefits are big for operations where waiting times are experienced today.

The existing “first-come-first-served” port arrivals system is rapidly becoming unsustainable, both for cost and environmental reasons. The Wärtsilä Navi-Port represents a feasible and practical way to rectify the current situation. It offers obvious benefits to the port as well as to the vessel owner, and the ongoing pilot testing of the system in real life situations aims to confirm this fact.

JUST-IN-TIME SHIPPING WILL HELP BOTH VESSELS AND PORTS TO OPTIMISE THEIR OPERATIONS, WHILE RESULTING IN CLEAR AND MEASURABLE BENEFITS TO BOTH PARTIES. ALL WE NEED TO DO IS TO EMBRACE THE IDEA AND IMPLEMENT IT TOGETHER FOR A BETTER TOMORROW!

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Wärtsilä is a global leader in smart technologies and complete lifecycle solutions for the marine and energy markets. By emphasising sustainable innovation, total efficiency and data analytics, Wärtsilä maximises the environmental and economic performance of the vessels and power plants of its customers.