D1.2 Analysis of Legal and Contractual Frameworks in the JIT/Port Call

MISSION

Funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor CINEA can be held responsible for them.

Deliverable information sheet

Version 1.0

Grant Agreement Number: 101138583

Project Acronym: MISSION

Project Title: Maritime Just-In-Time Optimisation Interoperable Port Call And Voyage Optimisation Tool

Project Call: HORIZON-CL5-2023-D5-01

Project Duration: 42 months

Deliverable Number: D1.2

Deliverable title: Analysis of legal and contractual frameworks in the JIT/port call

Deliverable Type: Report

Deliverable Dissemination Level: Public

Work Package: WP1

Lead Partner: Blue Visby Ltd

Authors: Blue Visby Ltd (Peter Rygaard Andersen, Mike Powell, Christian Wounlund, Benjamin Huw Thomas)

Contributing Partners: NTUA (Paniagiotis Sotiralis, Manolis Annetis, Faouzi Ntachan), TIC4.0 (Gonzalo Sandiás, Jorge Melero, José Andrés Giménez), FinTraffic (Olli Soininen, Maiju Kaski), FVP (Jorge Lara, Gabriel Ferrús)

Reviewers: VTT (Ville Hinkka), NAPA (Roberto Vettor), SDU (Julia Pahl, Helle Lyngborg)

Official Due Date: 30 September 2024

Delivery Date: 30 November 2024

List of acronyms

BIMCO	Baltic and International Maritime Council
C&F	Cost and Freight
C&FFO	Cost, Freight, and Freight on Board
CIF	Cost, Insurance, and Freight
CIFFO	Cost, Insurance, Freight, and Freight on Board
CII	Carbon Intensity Indicator
CLC	Civil Liability Convention
CO2	Carbon Dioxide
CSR	Corporate Social Responsibility
DCSA	Digital Container Shipping Association
EMSA	European Maritime Safety Agency
ESA	European Space Agency
ETA	Estimated Time of Arrival
ETC	Estimated Time of Completion
ETD	Estimated Time of Departure
ETS	Emission Trading System
ETS	Estimated Time of Starting
FAL	Facilitation of International Maritime Traffic
FOB	Free On Board
FOSFA	The Federation of Oils, Seeds and Fats Associations
GDPR	General Data Protection Regulation
GHG	Greenhouse Gas

GI	Global Industry Alliance
I.O.P.P	International Oil Pollution Prevention
I.S.S.C	International Ship Security Certificate
IAPH	International Association of Ports and Harbors
ICC	International Chamber of Commerce
IMB	International Maritime Bureau
IMO	International Maritime Organization
ISPS	International Ship and Port Facility Security Code
ITPCO	International Trade and Port Community Organization
JIT	Just-In-Time
JSON	JavaScript Object Notation
LNG	Liquefied Natural Gas
MARPOL	International Convention for the Prevention of Pollution from Ships
MEPC	Marine Environment Protection Committee
MLC	Maritime Labour Convention
MSC	Maritime Safety Committee
NOR	Notice of Readiness
P&I Clubs	Protection and Indemnity Clubs
PBP	Pilot Boarding Place
PCS	Port Community System
PESTEL	Political, Economic, Social, Technological, Environmental, and Legal
PSC	Port State Control
PTA	Planned Time of Arrival
PTC	Planned Time of Completion

PTD	Planned Time of Departure
PTS	Planned Time of Starting
RTA	Requested Time of Arrival
RTC	Requested Time of Completion
RTD	Requested Time of Departure
RTS	Requested Time of Starting
SEEMP	Ship Energy Efficiency Management Plan
SFTW	Sail Fast Then Wait
SOLAS	International Convention for the Safety of Life at Sea
TIC4.0	Terminal Industry Committee
TCO	Total Cost of Ownership
VTS	Vessel Traffic Services
WCO	World Customs Organization

List of tables

List of figures

Keywords list

- Port Call Process
- Just-In-Time (JIT) Optimization
- Legal Framework
- Contractual Framework
- Stakeholder Analysis
- Commodity Sales Contract
- Charter Party
- Contractual Process
- Port Call Optimisation
- Shipping
- Maritime
- Ports
- Vessel

Disclaimer

Table of contents

Executive summary

Commodity sales and purchase contracts often include demurrage provisions, which impose penalties on sellers for late shipment or on buyers for delays in receiving cargo. These clauses can create split incentives within the supply chain, as each party prioritise minimising their own penalties rather than collaborating to streamline operations. This misalignment can add significant complexity and costs, as stakeholders may focus on protecting their individual interests rather than optimizing the overall efficiency of the supply chain.

Banks may add to the complexity by introducing Letter of Credit stipulations that disincentivise the stakeholders from facilitating just-in-time (JIT) ocean transportation.

The above are just a few examples of the potential impediments to a JIT voyage operation emanating from split incentives. The examples, and many more cases, all have their basis in misaligned commercial documentation, whether commodity sales contracts, purchasing agreements, charter parties, Bills of Lading, Letters of Credit or otherwise.

The misalignment is caused by the inclusion of antiquated protective clauses that seek to protect the interests of one of the parties, penalise a counterparty for even small deviations from contract terms, and is usually a product of “business as usual” practices, an example of this would be the use of Sail Fast Then Wait (SFTW) in which vessels sail at a high speed to port in order to tender the Notice of Readiness (NOR), and potentially trigger the start of demurrage claims.

If JIT shipping operations are to become the norm rather than the exception, then an effective change management process is required. This process needs to start with an alignment of the commercial contracts between the individual stakeholders in the supply chain, a process that must be in place for the political, regulatory, operational and other process changes to become effective.

Different commodity segments have different commercial practices and different commercial contracts. For example, standard contracts from Gafta[1], and standard charter parties from the Baltic and International Maritime Council (BIMCO), are developed with balance and fairness in mind. However, a Gafta Contract for Grain in Bulk, or a BIMCO Graincon voyage charter party are rarely, if ever, negotiated without extensive deletion of lines or entire clauses, and the addition of multiple rider clauses, which are supplementary terms added to a standard charterparty which are not included in the standard forms. It is not unusual that the number of rider clauses to a charter party far exceeds the number of standard clauses that were part of the original document.

The international shipping association BIMCO is the recognised body for the development of standard documentation and document clauses for maritime transportation. In addition to developing documents under the BIMCO brand, BIMCO’s Documentary Committee also review and issue as approved documents, charter parties and other maritime contract forms published by other trade bodies or companies, provided they meet BIMCO’s standard for balance and fairness.

[1] Gafta "is an international trade association that protects the members’ interest by providing support through contracts and arbitration” (Gafta, 2024)

For an aligned contractual architecture for all the moving commercial parts of the supply chain to become a reality, it is important to understand the strategic drivers of the different contractual participants. A flowchart documenting the process flow from the initiation of the supply chain contract, commencing with a commodity sales contract and/or purchasing agreement in the bulk trades, or with a container booking in the liner trades, through to the completion of the port call process at the destination port adds a depth of understanding of the strategic drivers.

With a clear understanding of the strategic drivers of the stakeholders and the end-to-end process flow, it is important to document the external factors that may impact the transactional flow, and the risks that need to be observed and mitigated. A comprehensive PESTEL model helps create visibility of external risk factors, whether political, economic, social, technological, environmental or legal in nature.

The PESTEL output is an important contributory input to the identification of barriers to an optimised JIT transaction process, through which we identify the paths of least resistance to acceptance.

With a deeper understanding of the various collaborative and contractual factors that impedes the implementation of a systemic JIT voyage process from port of origin to destination port, and with clarity of the paths of least resistance to acceptance of the optimised supply chain, we evaluate potential incentives that could be introduced to engage stakeholders.

Incentives can take many different forms. The blindingly obvious incentive is the value of reducing waste in the process: working capital bound in stocks of raw materials and finished goods, ships waiting for berths for extended periods, idle cranes and other equipment and so forth.

Operationally, a systemically organised supply chain results in improved fuel consumption for the ships, optimised equipment utilisation on the landside, reduced working capital commitments to raw material and finished stock, just to mention a few examples.

Environmentally, the improved fuel consumption of participating ships results in reduced emissions of CO_2 and other greenhouse gasses, which supports the cargo interests' Scope-3 management in the raw materials as well as the finished goods segments – a factor that is increasingly prominent in many countries.

While none of the documents reviewed contains terms that specifically impede JIT arrival, it is still recommended that parties to a sales contract include protective wording in the document of carriage, such as the BIMCO JIT Arrival Clause for Voyage Charters 2021.

With a clear mapping of the incentives as they apply to each of the stakeholders, the result is a robust value proposition to each participant in the supply chain.

1. Introduction

The vertical fragmentation in the supply chain, with multiple interests in each voyage: ship owners, charterers, cargo seller and receivers, banks and others, often in chains of contracts, creates the problem of “split incentives”, which occur when the costs and benefits of an action within the charterparty are distributed in a way that advantages one party at the expense of the other.

The cargo seller may be interested in shipping their goods as late as possible in the shipping window negotiated in the commodity sales contract for production and related supply chain issues. The ship owner, on the other hand, may be focused on potential demurrage revenue as set out in the voyage charter party (depending on market conditions), hence sailing fast to the load port to tender Notice of Readiness as early as the laycan permits. The nominated ship sailing at service speed or faster therefore burns proportionally more fuel during the voyage than it would have if the arrival had been calibrated to the availability of cargo and continues to emit GHG emissions while awaiting berthing and commencement of cargo operations.

1.1. Problem statement

The age-old practice of “sail fast then wait” is a major contributor to global GHG emissions, both during transit and while waiting for berth at the arrival port. In addition to emitting proportionally high levels of CO_2 while sailing at design or service speed towards destination port, speed also contributes significantly to underwater noise pollution and increases the risk of whale strikes. Air pollution from ships waiting outside port areas contributes to or compound respiratory deceases resulting in premature deaths. According to analysis conducted by the Hong Kong University of Science and Technology, 418 premature deaths could be avoided for every 1% of anchorage emissions' reduction globally[2].

The business case for reducing speed to achieve JIT arrival at port entry is clear: reducing speed by 1 knot could reduce fuel consumption by 9% and CO_2 emissions by a similar factor[3] At an average VLSFO fuel price of $650 per ton sizeable savings are possible for most shipping segments.

Many attempts have been made to optimize the arrival of ships, and most have failed due to the fragmented nature of the supply chain actors and the misaligned terms of the contracts that govern the transactions between stakeholders.

The main stakeholders discussed throughout this document are fully defined in the sections below, most notably section 6.1 and 6.6.

The actors

[2] “The shipping practice of “Sail Fast Then Wait” and the Blue Visby Solution: Analysis of the health impact of emissions’ reduction”, Hong Kong University of Science and Technology, June 2024
[3] The impact of 1 knot on emissions”, https://www.sea.live/blog/the-impact-of-1-knot-on-emissions/, July 2023 (Sea.Live, 2023)

In this project we have used the stakeholder definitions of International Maritime Organization's FAL.5/circ.42[4]. In addition to the stakeholders identified in the circular, the following central actors in the supply chain are included as well, as to complement the terminology with actors that are seen from a contractual framework's point of view:

- Cargo seller, who will be responsible for chartering a ship under a contract on C&F/CIF terms[5]
- Cargo buyer, who will be responsible for chartering a ship under a contract on FOB terms[4]. May also be referred to as "Consignee".

The ship, as the owner's asset with specific requirements for arrival, departure, and passage, can be also assumed to be an actor, whose responsibilities breakdown into the responsibilities of individual actors identified by the IMO circular (i.e., ship owner, ship manager, ship operator, ship agent). These include generation of plans, reports and declarations and receiving instructions during the voyage, many of which are the ship's master (classified under ship manager and operator) responsibility, as the owner's representative.

The FAL Convention, established by the International Maritime Organization (IMO) in 1967, has been instrumental in enhancing information flow and simplifying procedures within the maritime industry. It functions as a regulatory and guidance framework aimed at reducing administrative burdens by standardising formalities, information requirements, and processes for vessels arriving and departing from ports.

The IMO's Facilitation (FAL) Committee meets annually to review and implement new regulations and recommendations, which are subsequently incorporated into updated FAL documentation (known as FAL forms) for use by port authorities and government bodies. These updates support global consistency and compliance in shipping processes, making vessel operations more efficient and reducing delays at ports.

Recently the FAL Committee adopted FAL.5-Circ.42, a circular that provides detailed guidelines for the implementation of the Maritime Single Window (MSW). The MSW aims to centralise and streamline the collection and exchange of information between vessels and ports, optimising the handling of ship arrival and departure data. By enabling a unified platform for reporting, the MSW improves efficiency, minimises redundancies, and supports real-time decision-making, aligning with the IMO's broader goals of digitalisation and enhanced facilitation in the maritime sector.

The contracts

[4] International Maritime Organization (IMO) Guidelines related to the harmonized communication and electronic exchange of operational data for port calls", International Maritime Organisation, March 2023

[5] INCOTERMS 2020

Commodity transactions are executed using a framework of contracts and other documents, of which we have focused on the following in this project:

- The **commodity sales contract**, setting out the terms agreed between seller and buyer, including the following:
    - Commodity, quality, quantity and price.
    - Delivery terms (INCOTERMS), delivery time/timeframe, or period of shipment.
    - Penalties for non-conformance, e. g., demurrage, which is penalty for delay in delivery of goods.
- The **voyage charter party**, which is the contract for the charter of a ship to deliver a cargo from one or more load ports to one or more discharge ports, as may be agreed. The voyage charter party is entered into by the cargo seller (in Cost insurance and freight (CIF) commodity sales contracts) or the cargo buyer (in Free On Board (FOB) contracts), and the disponent owner of the ship. Key terms include:
    - Instructions to proceed to the next port (load or discharge) at “due”, “convenient”, or “reasonable dispatch”.
    - Laycan, i.e. the first and the last day that the ship will be accepted as having arrived at load port ready to commence loading operations. Arriving before the first day in the laycan period can be acceptable to the charterer of the ship, while arrival after the last day (the “cancelling date”) gives the charterer the option to cancel the charter party.
    - Demurrage, a penalty payable by the charterer for exceeding the time allowed for cargo operations.
    - Despatch, a premium to the charterer for having completed the cargo operations faster than allowed, thereby releasing the ship to the owner earlier than planned.
- The **time charter party**, a contract between a ship owner or operator and a third-party (the charterer) for the hire of a ship for a period. During the duration of a time charter contract the charterer pays the daily hire and is responsible for fuel costs and costs relating to the cargo operations of the ship. Time charter parties have no bearing on the JIT process and have therefore not been considered in the project.
- The **bare-boat charter party**, which is contract between the financial owner of a ship and a third-party, usually for periods extending over several years, or indeed the lifetime of the ship. Under a bare-boat charter party the charterer is responsible for all costs pertaining the operation of the ship, with only the financing cost and amortization being covered by the financial owner.
- The **Bill of Lading**, which is a document of title, evidencing contract of carriage of the goods shipped.
- The **Sea Waybill** is used when the shipper decides to release ownership of the cargo immediately, but is not a document of title, and is therefore mostly used between trusting parties.

A fundamental obstacle for implementing JIT port arrival is the lack of alignment among the actors in the supply chain, and the conflicting, and often antiquated terms that are being used in the contracts governing the sales and shipping transactions.

1.3. Objective

The MISSION project aims to develop innovative digital solutions to optimise maritime voyages and port calls, strengthening their role as critical links in supply chains. These solutions will enable the sharing of relevant information and the synchronisation of ship arrival and departures, improve the planning and execution of operations (such as loading/unloading activities), and minimise fuel consumption and therefore GHG emissions during ships' approach, stay, and departure from ports.

Within this context, the objective of D1.2 is to analyse the current legal and contractual frameworks, identify the challenges and frictions that hinder the implementation of a more efficient procedure within the industry, as well as the challenges with the implementation of Just-In-Time (JIT) operations, and recommend the necessary changes to make JIT a practical and achievable reality.

In analysing the legal and contractual frameworks, D1.2 will identify the key actors responsible for various aspects of the vessel voyage, including the vessel owner, the vessel operators, and the charterers. It will explore how the existing requirements and structures contribute to non-collaborative working practices among these stakeholders.

D1.2 will examine the current contractual landscape in the shipping industry, focusing on challenges within charterparties and sale contracts that create split incentives, leading to a lack of cooperation among stakeholders. It will also propose new changes aimed at fostering collaboration and creating a more streamlined and efficient industry.

2. Collaborative work processes

To foster collaboration among the direct stakeholders in the port call process it is necessary to understand the drivers, strategic and value drivers, for each of the direct (main) stakeholders, based on their appropriate definition and mapping of the process flow from initiation to completion, and finally, through a comprehensive PESTEL analysis, to review the risks and opportunities that may derive from the process.

2.1 Map strategic drivers of direct stakeholders

In this section, the strategic and value drivers of direct stakeholders – when considering the port call process and the implementation of JIT port call optimisation – are identified and analysed respectively, to set up the context, together with the following sections, for the analysis of legal and contractual frameworks. Strategic drivers are considered the key priorities and initiatives for a business, organisation or project which contribute to achieving their goals[6],[7]. Strategic drivers are the critical scope of focus that determine the success of a project's, company's or organisation's strategy, and they should be aligned with its value drivers target and overall mission[8]. In the following paragraphs, strategic drivers are identified and described, followed by a correlation with the main direct stakeholder categories. A further analysis of the value drivers is conducted, in conjunction to the established strategic drivers. Value drivers are assumed as factors that increase the worth of a product, service or asset in a business environment[9].

Stakeholders are persons, groups or organisations with an interest in the activities and in the success of a business or project. The primary stakeholders usually include investors, employees or partners, customers or potential users. With the increasing attention on corporate social responsibility, the concept has been extended to include communities, governments, and trade associations. Stakeholders can be internal (direct) or external (indirect) to an organization or project; internal are those whose interest comes through a direct relationship, while external do not directly work for or with a company but are affected by (or affect) the actions and outcomes of the business.

For purposes of the MISSION project, the stakeholder categories have been identified within D1.1; the following analysis focuses more on the direct stakeholders, to later correlate them with the various strategic drivers that are identified. Based on the International Maritime Organization (IMO) Guidelines related to the harmonized communication and electronic exchange of operational data for port calls (FAL.5/Circ.52)[10], the main direct stakeholders are identified. Table 1 presents them in detail, with a short description as well as the subcategories[11] that are identified under each main direct stakeholder category; the latter is included as there can be multiple stakeholders that can play the role defined by the main stakeholder category, depending on various factors. The main stakeholder categories can be seen also as subcategories, serving the correlation between two different main stakeholder categories.

Table 1. Main stakeholders and subcategories

[6] (ASP, 2023)
[7] (Shweta Jhajharia, 2024)
[8] (UK Hydrographic office, 2022)
[9] (L.E.K. Consulting , 2017)
[10] (IMO, 2023)
[11] (IMO, 2020)

Main Direct Stakeholder Categories	Description	Stakeholder Subcategories
Berth Planner	A berth (terminal) planner is the party responsible for the berth calls. Main responsibilities include the proper management and scheduling of the berths at a port or terminal (arrival, dock, departure etc.) based on the governance port model, aiming to optimize the port efficiency and minimize the waiting times.	Terminal operator, berth operator, port authority, vessel traffic service
Cargo buyer	The party that receives the cargo at the end of the process, based on the contract. Cargo buyer may be the shipper – to transport purchased goods – and therefore the cargo owner during voyage. However, in most occasions the cargo seller is the shipper.	Shipper, cargo owner, ship charterer, ship owner
Cargo seller	The party that originally owns the cargo, either goods or products, before it enters into the contractual phase, and shipping activity is commenced. The cargo seller, besides using third parties, may be the shipper and freight forwarder, as well as the ship owner or charterer.	Shipper, freight forwarder, cargo owner, ship charterer, ship owner
Nautical service providers	Nautical services providers are parties that ensure the safe passage and berthing of vessels. This role provides nautical services to the ship (e.g., pilots, towage). The mooring service can be distinguished into onshore or offshore mooring. This service can also be needed in bunkering operations. The Vessel Traffic Services (VTS) refer to services corresponding to the safety in navigation. VTS is strongly linked with the harbour master.	Pilots, tugs, mooring services, linesmen, boatmen, vessel traffic service, operations control centre
Port authorities	Port authorities are the party that oversees the operations related to the port call and provides information about the vessel's arrival and departure. Port authorities is related to the procedures of clearance for the ship's arrival and departure.	Harbor master, customs and immigration services, port health services, vessel traffic service, coast guard, port police
Port Planner	A port planner is the party responsible for planning the port calls. Main responsibilities include the proper management and scheduling of all the activities within the port area such as vessel's cargo handling and ships' movements, aiming to optimize the use of port facilities and minimize the risks into the port area. The exact responsibilities are determined in relation to other roles in the port and the relevant stakeholders.	Port authority, harbour master, terminal operator, vessel traffic service, pilots, coast guard, operations control centre

Main Direct Stakeholder Categories	Description	Stakeholder Subcategories
Ship Agent	The ship agent is the party that represents the ship owner and/or the charterer. The primary role is to cover all logistical, administrative and regulatory issues arising during the port call and to ensure that the interests of the shipowner or charterer are protected. Ship agent is responsible for all relevant port and husbandry services, tending to the requirements of the master and crew, clearing the ship with the port and other authorities, including preparation and submission of appropriate documentation. Ship agent sometimes manages the vessel or cargo service providers as well as the process of clearance.	Ship agent
Ship Charterer	A ship charterer can be an individual or a company who hires a ship from a shipowner for an agreed period or for a specific voyage. The ship charterer can be a member of a shipping company or the intermediary of ship operator. The three major categories of ship chartering are time chartering (renting the vessel for a specific period of time), voyage chartering (hiring the vessel for a particular voyage) and bareboat chartering (where every responsibility on the vessel lies on the charterer).	Ship charterer
Ship Manager	A ship manager is a professional or a company that is responsible for the day-to-day management of the ship, on behalf of its owner. Main responsibilities include the smooth daily operation of the ship, maintenance aspects, safety and regulations issues etc. As a ship manager, could be considered the shore-side ship manager or the port captain or the captain of the vessel or any other entity in charge of the management of the ship.	Shore-side ship manager, port captain, vessel captain
Ship Operator	The ship operator is the party that determines how the ship is employed and where a vessel is to call. The role may be represented by the charterer, the shipowner, the cargo owner or cargo trader, the ship manager, the carrier, or parties representing/acting on behalf of before mentioned parties. The ship operator usually represents the shipping company.	Ship charterer, ship owner, cargo owner, ship manager, freight forwarder
Vessel or Cargo Service Providers	Vessels and cargo service providers are the parties that provide vessel services or cargo services to the ship and support the ship operations and the cargo handling. This	Bunkering services, lube oil suppliers, potable water bunkering, provisions and

Main Direct Stakeholder Categories	Description	Stakeholder Subcategories
	role may reflect to bunker or lube oil providers or repairs and surveys services related to cargo handling and lashing.	stores, waste collection per IMO/MARPOL class, repair service, cargo handling and lashing services, freight forwarders, terminal operator.

2.1.1 Overview of direct stakeholders

Following the definition of the main direct stakeholder categories, as well as the various subcategories that may be considered for the role of each direct stakeholder, the following table 2 provides an overview of the correlation among the direct main stakeholder and their respective subcategories in terms of their role description.

Table 2. Correlation between main stakeholders and stakeholder subcategories

	Main Direct Stakeholder Categories										
Stakeholder subcategories	**Ship operator**	**Cargo buyer**	**Cargo seller**	**Ship charterer**	**Berth planner**	**Port planner**	**Ship manager**	**Nautical service providers**	**Vessel or cargo service provider**	**Port authorities**	**Ship agent**
Berth operator					x						
Boatmen								x			
Cargo owner	x	x	x								
Cargo service providers									x		
Coast guard						x				x	
Customs service										x	
Freight forwarder	x		x						x		
Harbor master					x					x	
Immigration service										x	
Linesmen								x			

	Main Direct Stakeholder Categories										
Stakeholder subcategories	**Ship operator**	**Cargo buyer**	**Cargo seller**	**Ship charterer**	**Berth planner**	**Port planner**	**Ship manager**	**Nautical service providers**	**Vessel or cargo service provider**	**Port authorities**	**Ship agent**
Mooring services								x			
Operations control centre						x		x			
Pilots						x		x		x	
Port authority					x	x				x	
Port captain						x				x	
Port health services										x	
Port police								x		x	
Ship agent											x
Ship charterer	x	x	x	x							
Ship manager	x										
Ship owner	x	x	x								
Shipper		x	x								
Shore-side ship manager							x				
Terminal operator	x				x	x			x		
Tugs								x			
Vessel captain							x				
Vessel service providers									x		
Vessel traffic service					x	x		x		x	

2.1.2 Overview of strategic value drivers

Furthermore, as mentioned, for the purpose of mapping the strategic drivers of direct stakeholders, the strategic drivers which are related to the port call process and JIT port call optimisation are identified and analysed, based on

available literature[12] and domain expert contribution. More specifically, the following strategic drivers have been recognised.

Fuel cost savings & lower emissions/compliance with regulations: Reducing fuel consumption of ships is a major driver to both ship owners and ship operators as the former party is now required to declare, annually, their ships CO2 emissions which results in either a fine to be paid for a surplus in their CO2 emissions or the ability to trade CO2 emissions on a 'cap and trade' system to reduce emissions via the respective carbon market (i.e., EU Emission Trading System). As a result, fuel savings is a driver to the ship operator at a voyage level (running cost) and therefore a driver to the ship owner in terms of CO2 emissions and its implicated costs. Such a driver supports JIT port call optimisation implementation as an enabler, since it allows ships to spend less time in ports by allowing a predetermining amount of time to reach the port and therefore burn less fuel, which reduces GHG emissions, and reduces implicated costs. This driver is also linked with regulatory compliance, which is also mentioned as a standalone strategic driver, since fuel savings may affect significantly the carbon intensity, and thus the Carbon Intensity Indicator (CII), as well as the Energy Efficiency Existing Ship Index (EEXI). These, in turn, facilitate the compliance with MARPOL Annex VI and its requirements.

Operational efficiency: Operational efficiency allows for better utilisation of assets and port and terminal infrastructure. This driver may support JIT port call optimisation implementation by improving the scheduling of ship arrivals, ensuring the availability of resources such as berths, cranes, and labour when needed. Furthermore, it supports the JIT implementation by reducing waiting times of ships waiting to dock, loading and unloading.

Port and terminal efficiency: Akin to operational efficiency, reliable and real-time information on the arrival of vessels assists terminals in optimising their berth planning. Work conducted efficiently results in higher customer satisfaction for the terminal. Furthermore, increasing port efficiency and reducing delays has a direct impact on the efficiency of ships and thus the Carbon Intensity Indicator (CII).

Navigational safety: According to EMSA's (European Maritime Safety Agency) "Annual overview of marine casualties and incidents" report[13], most accidents occur during or just before a port call. Therefore, it is very important to almost all stakeholders to ensure that ships can arrive, manoeuvre, and depart from ports without delays or incidents. JIT allows for a reduced number of ships near ports which increases navigational safety in port approaches as well as in anchorages.

Reduced operational risk, increase in safety: Reducing operational risk involves minimising the potential for incidents, inefficiencies and disruptions to the operation during the various timestamps of a port call process. It is of utmost importance as it covers safety, efficiency and regulatory compliance. This supports JIT arrival by allowing for proper communication between port authorities and ships. Furthermore, it allows for minimising operational efficiency risks by streamlining operations amongst the stakeholders, as well as minimising financial risks which would otherwise be incurred due to accidents or legal liability.

Digitalization: In the context of the port call optimisation, digitalisation refers to the utilisation of digital technologies to automate and streamline the process of the port call. This improves the efficiency of operations and data sharing, as well as the safety and security of the ports. This supports JIT arrival by allowing reliable common information to be utilised to track events in and around ships at ports including being informed of any major events of issues. Furthermore, it will allow ports to be more flexible in terms of planning, scheduling and turnaround times. Moreover,

[12] (Tsvetkova, A., Hellström, M., Schwartz, H., Rabetino, R., & Syed, H., 2024)
[13] (EMSA, 2023)

real-time data on the ship's arrival can assist terminals in their berth planning. Finally, considering the human factor, errors are prone to be made, therefore, digitalization can assist agents as well as operations in keeping a high state of control and mitigate possible errors.

Customer satisfaction: Customer satisfaction, in the context of the port call optimisation, applies to the expectation of the customers of the port. This can range from shipping companies to cargo owners. Customer satisfaction is important mainly important to the port as it dictates the port's reputation and competitiveness. This supports the JIT arrival, particularly the port, by reducing congestion problems, resulting in more efficient cargo flow. Similarly, the cargo owner's satisfaction is raised due to reduced risk in delays and disruptions which result in lower shipping costs.

Quality and reputation: The reputation of a port refers to its performance, efficiency, and overall standard of service as viewed by stakeholders such as shipping companies, cargo owners, and regulatory bodies. Having a low reputation can result in avoiding certain ports as a result of poor port efficiency, high port congestion, long turnaround times which leads to discharging at other ports that offer higher efficiency and lower waiting time. JIT contributes in solving issues that affect reputation is a combination of ways described in the collective application of the mentioned strategic drivers, such as digitalization, port and terminal efficiency and operational efficiency to name a few.

Contracts and adherence to contractual terms: Contracts refer to binding agreements either between stakeholders in the port call process or beyond as part of the maritime operations. The contracts highlight obligations of signing parties. Such contracts ensure a streamlined and systematic operation. This supports the JIT arrival by ensuring that contracts include clauses that allow the implementation of JIT from an operational and legal point of view. This can be the inclusion of an arrival clause into the voyage charter party to allow the ships' Master to adjust the speed of the ship without violating the contract. Another example is the inclusion of clauses that allow cargo to be traded seamlessly during a voyage, therefore the charter party contract can be passed through the sales chain like any other clause.

Communication methods - data sharing: In order to facilitate JIT arrival and port call optimization as a whole, data sharing is vital. It allows all stakeholders to be collaborative as well as be well-informed. This results in reduced idle times, costs, and vessel delays. This supports JIT arrival by using a data exchange platform. The platform will allow the exchange of information ranging from water depths and levels to Requested Time of Arrival (RTA). Furthermore, the platform should be able to allow ship operations centres to share timestamp data with ports. This will increase situational awareness by creating an interface where all actors are to share and view the data. This can also be used to connect outside actors such as shipping companies and/or other ports. The optimal data sharing platform and communication method should allow for standardized message exchanges, secure data exchange, multiple data inputs should be accepted, scalable, and adheres to international standards.

Standards and protocols: Standards and protocols are established methods and guidelines that ensure a safe and efficient port call process and port operations. JIT arrival is supported by having major stakeholders including regulatory bodies, assess incorporating JIT into existing regulations. As such, the IMO is considering the inclusion of JIT arrival into the Ship Energy Efficiency Management Plan (SEEMP). This will allow the choice of the speed to be based on actual information (MEPC 69/INF.11). Furthermore, the IMO GIA, is looking into requirement to have a global platform for the exchange of port planning information, including supporting the container cargo sector to use a common set of data strands (DCSA).

Berth availability: The berth availability is fundamental to the success of the port call process and therefore to the operational efficiency of the port, including its reputation. It plays a significant role in the turnaround time and operational costs of a ship. JIT arrival supports this by maintaining an optimal speed in order to arrive at the Pilot Boarding Place subject to the availability of each of the berth, fairway and nautical services. More precisely, this is

accomplished by communicating the RTA PBP to the ship regularly, which enables the master to determine the optimal speed of the ship. It is worth mentioning, however, that container liner services tend to run fixed schedules. In other words, these services run on a weekly basis on a fixed day. This means container liner services will arrive at a port within a fixed window each time. In a way this is a form of optimisation, however this is not applicable to all cargo types and more importantly, it is not an automated process.

Regulatory Compliance: The importance of standards and protocols and their role in directing a safe and efficient port operation also applies to regulatory compliance. Similarly, this supports JIT arrival by providing incentives based on a ship's Carbon Intensity Indicator (CII), from a port and terminal standpoint. The CII is a calculation that shows how efficient a ship is in transporting goods or passengers per year. This is expressed in grams of CO2 per design tonnage and annual distance sailed. As of now, the CII and therefore the fuel consumption does not distinguish between different stages of a voyage, including anchoring. As such, fuel consumption during anchoring influences the CII of the ship, since corresponds to a fuel consumption without a distance travelled. Therefore, extended waiting times to enter the port including long port stays, directly affect the CII. Therefore, ships could avoid ports with a low efficiency, high port congestion and long waiting times. These supports implementing JIT as it solves this issue from a regulatory compliance perspective.

As the main stakeholders and the strategic drivers are determined, the next step is to clarify the correlation of each strategic driver with the identified main direct stakeholders. Therefore, the following Table 3 summarises which of them are positively impacted based on the selected strategic drivers which have been defined.

Table 3. Correlation between main direct stakeholder categories and strategic drivers

	Main Direct Stakeholder Categories										
Stakeholder Subcategories	**Ship Operator**	**Cargo Buyer**	**Cargo Seller**	**Ship Charterer**	**Berth Planner**	**Port Planner**	**Ship Manager**	**Nautical Service Providers**	**Vessel or Cargo Service Provider**	**Port Authorities**	**Ship Agent**
Fuel cost savings & lower emissions / Compliance with regulations	x			x			x			x	
Operational efficiency	x			x	x	x	x	x	x	x	x
Port and terminal efficiency	x			x	x	x	x	x	x	x	x
Navigational safety	x			x	x	x	x	x	x	x	x
Reduced operational risk, increase in safety	x			x	x	x	x	x	x	x	x
Digitalization	x			x	x	x	x	x	x	x	x
Customer satisfaction	x	x	x							x	x

	Main Direct Stakeholder Categories										
Stakeholder Subcategories	**Ship Operator**	**Cargo Buyer**	**Cargo Seller**	**Ship Charterer**	**Berth Planner**	**Port Planner**	**Ship Manager**	**Nautical Service Providers**	**Vessel or Cargo Service Provider**	**Port Authorities**	**Ship Agent**
Quality and reputation	x	x	x		x	x	x	x	x	x	x
Contracts and adherence to contractual terms	x	x	x	x							
Communication methods - data sharing	x				x	x	x	x			x
Standards and protocols	x										
Berth availability					x	x					
Regulatory Compliance	x			x	x	x	x	x	x	x	x

As the main stakeholders and the strategic drivers are determined, the next step is to clarify the correlation of each strategic driver with the identified main direct stakeholders. Therefore, the table summarises which of them are mainly positively impacted – but also negatively – based on the selected strategic drivers which have been defined.

2.1.3 Define Value Drivers for Direct Stakeholders

Once the different strategic drivers outlined in the previous section have been established, the value drivers – the factors that increase the worth of a product, service or asset in a business environment as previously stated – and their impact will be explored on each of the direct stakeholders. In the context of JIT port call optimization, it is essential to understand the value factors that motivate the directly involved stakeholders. These stakeholders include ship operators, port authorities, berth planners along with vessel cargo service providers, and other nautical service providers, along with the cargo seller and cargo buyer. The identification and analysis of these value drivers not only facilitate the successful implementation of JIT processes but also ensure that all parties derive tangible benefits from the system.

2.1.3.0 Value Drivers for Ship Operators, Ship Manager, Ship Agent, and Ship Charterer

Since key actors such as ship operators, managers, agents, and charterers pursue similar objectives, often focused on operational efficiency, regulatory compliance, environmental sustainability, and cost reduction, it has been decided that they will be analysed together. By proceeding in this way, a more comprehensive view can be obtained, making it easier to compare the impacts of each value driver on the analysed different stakeholders.

Despite each actor's unique priorities, certain value drivers are shared across the stakeholder network. For instance, ship operators, charterers, and agents all benefit from reduced waiting times and demurrage costs enabled by JIT

arrivals, which translates into more predictable schedules and lower operating costs. Additionally, enhanced data sharing and digitalization boost operational transparency and coordination for managers, agents, and charterers alike, as real-time communication allows them to accurately predict ETAs, manage fuel usage, and anticipate port conditions. Finally, by achieving regulatory compliance and sustainability targets, each stakeholder contributes to a lower CII, a shared value that aligns with the industry's collective commitment to reduce environmental impact and adhere to stringent emissions standards. In this way, these aligned value drivers create a more efficient, cost-effective, and responsible maritime sector that meets modern market and regulatory demands.

Ship Operators

JIT arrivals offer ship operators significant benefits, including fuel savings, emissions reduction, and improved operational efficiency. By aligning voyage speeds with optimized schedules, JIT practices reduce fuel consumption and GHG emissions, helping operators comply with stringent environmental standards and improve their CII rating. This approach lowers operational costs while supporting sustainability goals.

Real-time access to port conditions and congestion data enhances decision-making, allowing operators to adjust speeds and optimize routes. This minimizes delays and fuel consumption, benefiting both operators and ship charterers by enabling more precise scheduling and better resource planning.

JIT practices also improve asset utilization by reducing idle time at ports and speeding up turnarounds, allowing operators to complete more voyages without expanding their fleet. This leads to higher revenue and operational gains, while better vessel management reduces environmental impact through more efficient fuel use and improved emission control.

Regulatory compliance is streamlined as JIT practices help operators meet evolving emissions standards, reducing exposure to fines and improving market reputation. Compliance also supports sustainability efforts and enhances financial stability by avoiding penalties and maintaining regulatory adherence.

Reduced waiting times also lower demurrage charges, directly benefiting operators. Accurate scheduling and minimized port delays improve scheduling predictability and reduce costs, which also helps ship charterers manage their logistics more efficiently.

Better coordination during port calls further boosts operational efficiency. JIT practices ensure smoother logistics by aligning vessel arrivals with available port resources, reducing bottlenecks and delays. This adherence to contractual timelines and the specified delivery location reduces the risk of contract cancellation by the charterer and strengthens the operator's reputation as a reliable partner. This coordination facilitates reliable delivery schedules and optimized logistics, benefiting both operators and their downstream customers.

Lastly, JIT practices enhance competitiveness by ensuring reliable delivery schedules and reduced costs, which attract repeat business and long-term contracts. With lower operating expenses, operators can offer more competitive pricing, strengthening their market position while reducing freight costs for cargo owners.

In conclusion, JIT arrival practices provide ship operators with numerous advantages, including cost savings, regulatory compliance, operational efficiency, and enhanced market competitiveness. These value drivers help operators improve both their economic and environmental performance, aligning with broader sustainability goals and contributing to a more efficient maritime supply chain.

Ship Managers

One of the primary benefits for ship managers is data-driven compliance. Through the adoption of digital platforms, managers can streamline regulatory compliance processes, ensuring that all requirements are met efficiently and with minimal redundancy. By reducing the need for repeated inspections—thanks to shared data on compliance status—ship managers save valuable time and resources. This proactive approach to compliance not only simplifies oversight but also improves the overall safety and reliability of the fleet, fostering confidence among ship owners and aligning with regulatory expectations.

Effective fuel and cost management is another critical advantage. With JIT and digital monitoring capabilities, ship managers can optimize fuel usage, which is a major operational cost. By reducing unnecessary fuel consumption, managers can more accurately project operational expenses and adhere to budget forecasts. This cost control is invaluable in managing tight budgets and aligning expenditures with strategic financial goals, allowing for a predictable and transparent budgeting process that supports long-term financial stability.

Enhanced situational awareness is also a significant value driver for ship managers, who rely on continuous data exchange to monitor fleet operations in real-time. Access to up-to-date information on port conditions, cargo status, and environmental factors allows managers to manage risks more effectively and coordinate port activities with greater precision. This comprehensive situational awareness ensures that potential issues can be mitigated proactively, enhancing the quality of service offered to clients and ultimately boosting customer satisfaction through reliable and efficient fleet operations.

Moreover, JIT practices enable fleet optimization, allowing managers to reduce idle time and improve scheduling across their operations. With better control over vessel arrival and departure timings, managers can allocate resources more efficiently and ensure that ships spend minimal time waiting for port services. This optimization leads to a more agile and responsive fleet, enabling managers to adapt swiftly to changes in demand or logistics, increasing the fleet's overall productivity and readiness.

Ship Agents

Efficient communication and coordination are essential to ship agents' operations. With access to real-time data on ETAs, port conditions, and vessel statuses, agents can provide seamless coordination with terminal and berth operators. By keeping all stakeholders updated, this real-time information minimizes port congestion and ensures a smoother, more predictable flow of operations. This streamlined communication allows ship agents to prevent potential delays, meet scheduling demands, and contribute to a well-organized port environment.

Streamlined administrative processes are another significant benefit for ship agents, who traditionally handle high volumes of paperwork and regulatory compliance tasks. Through automation and digitalization, agents can now reduce their administrative burdens significantly. Tasks such as document management, scheduling, and compliance checks are expedited, enabling agents to manage operations more efficiently and improve overall service reliability. These streamlined processes allow agents to focus more on customer service and coordination, rather than on manual documentation.

The improvement in operational efficiency and transparency also bolsters agents' reputations through quality service. By facilitating on-time cargo deliveries and minimizing unforeseen delays, ship agents enhance their reputations with clients. Timely and reliable service builds trust, which supports strong client relationships and fosters commercial development opportunities. Clients who consistently experience efficient, hassle-free service are more likely to develop lasting partnerships with these agents, which is particularly valuable in a competitive industry.

Regulatory compliance is another key area where ship agents realize value. Digital platforms support agents and other stakeholders in meeting regulatory standards, which reduces the risk of delays, fines, and penalties. Compliance with regulations helps agents avoid unnecessary costs and supports a safer, more reliable operational environment. By maintaining adherence to regulations, ship agents contribute to an enhanced reputation not only for themselves but also for the port as a whole, highlighting their commitment to safety and legal standards.

Ship Charterers

One of the primary benefits for ship charterers is demurrage cost savings. Reduced waiting times at ports directly lead to lower demurrage expenses, which are often incurred when vessels experience delays in loading or unloading. By minimizing waiting times, charterers not only reduce financial risks but also gain more predictable scheduling. This predictability aligns well with contractual terms, mitigating the likelihood of disputes and enhancing operational efficiency.

Fuel and charter rate efficiency are also critical for charterers, who benefit financially from optimized fuel consumption. Lower fuel use translates to reduced voyage costs, which can then lower the overall charter rate. This cost-effectiveness is further supported by improvements in the CII, reflecting the environmental sustainability of the voyage and aligning with market demands for eco-friendly operations.

Access to reliable ETA data and port conditions via data-sharing platforms enhances charterers' ability to manage cargo delivery schedules with precision. This real-time access to ETAs enables more efficient berth planning and cargo handling, leading to smoother port operations. By anticipating arrivals and departures more accurately, charterers can coordinate resources effectively, reducing idle times and optimizing service flow.

Finally, charterers gain a competitive advantage through reliability, as predictable and timely delivery schedules enhance their reputation and market position. Operating in ports that adopt JIT, the ability to have certainty about arrival and departure times at ports can increase compliance with clear and structured contractual terms regarding the Notice of Readiness (NOR) and laytime. This reduces the risks of costly disputes and improves the reliability of delivery commitments, further strengthening charterers' relationships with clients and promoting long-term contractual stability.

2.1.3.1 Value Drivers for Port Authorities and Port Planners

Port authorities play a key role in facilitating efficient maritime operations. Within this stakeholder group, sub-categories such as Customs and the Coast Guard have been identified, which will be analysed in this section. Since the Port Authority generally assumes the role of Port Planner, this will be examined as one of its own responsibilities. Their value drivers are essential for optimizing port functionality and competitiveness:

Port Authority:

JIT port calls allow port authorities to allocate resources such as berths, tugs, pilots, coast guards, customs, and VTS providers more effectively. Improved scheduling and communication optimize resource use, minimizing idle times and bottlenecks, leading to smoother operations and reduced congestion, thus lowering costs.

In turn, JIT calls reduce turnaround times and optimize vessel movements, increasing cargo throughput. This is vital for boosting port capacity and revenue. When ships spend less time waiting for berths, ports can handle more vessels and cargo, improving capacity utilization and making the ports more attractive to shipping lines.

Facilitating JIT arrivals helps reduce local pollution and GHG emissions. Ships adjust their speeds to arrive on time, consuming less fuel and emitting fewer pollutants. This aligns with environmental goals and regulatory pressures to improve air quality. Furthermore, as described before, efficient operations increase stakeholder satisfaction, including shipping lines, terminal operators, and local communities. Greater reliability and reduced congestion are key factors for this. More specifically, shipping lines benefit from more predictable services, terminal operators from better facility use, and communities from a lower environmental impact and economic growth. JIT calls foster stronger collaboration. Both these factor's together lead to an improved port reputation and give the port a competitive advantage by offering reliable, efficient services. This advantage is crucial in an industry where ports fiercely compete for business: ports committed to efficiency, sustainability, and stakeholder satisfaction are more likely to secure long-term contracts and investments, as highlighted by the IMO's JIT Arrival Guide.

When viewed from its role as a Port Planner, resource optimisation and congestion reduction improve safety. More reliable planning enables better coordination among the parties involved in a port call. Streamlined operations reduce the likelihood of accidents and disruptions. Lastly, the use of JIT arrivals reduces the time spent in congested waters, lowering collision risks and environmental hazards like oil spills. All of these benefits are further supported due to the real-time data exchange and coordination JIT calls support, further contributing to improvements in decision-making on routing, traffic avoidance, and congestion prediction. The combination of enhanced operational planning, reduced congestion and cost reduction further contribute to the aforementioned competitive edge and improved stakeholder satisfaction ports nowadays strive to achieve.

As a conclusion, it can be said that the adoption of JIT offers value drivers such as optimized resources, higher cargo volume, emission reductions, stakeholder satisfaction, competitive advantage, and safety improvements. These drivers help port authorities improve operational performance, contributing to sustainability and efficiency. Lastly, JIT practices help ports meet regulatory demands and capitalize on the economic and environmental benefits of streamlined supply chains.

Customs and Coast Guards:

Maritime authorities, such as coast guards and customs, regulate maritime activities to ensure safety, security, and environmental protection. In JIT optimization, these authorities benefit from certain key drivers, which foster collaboration for successful implementation.

Customs operating at ports with JIT arrival schemes benefit from the predictability of arrivals, allowing them to adapt and streamline bureaucratic processes for higher efficiency. This facilitates faster unloading of goods and reduces vessel turnaround times by enabling quicker cargo clearance. It benefits terminals by optimizing yard utilization and buyers by reducing delays in receiving goods. Moreover, this improves coordination between ports and their hinterlands, allowing better synchronization with land transport companies to ensure smoother connections.

As mentioned in the section "Port Planners and Port Authorities", well-coordinated JIT port calls enhance safety by reducing congestion and ensuring vessels follow scheduled times. This minimizes accidents, benefiting harbour masters and coast guards. Effective scheduling and communication are essential for maintaining high safety standards. In turn, JIT systems also improve security. By providing controlled and predictable vessel flows, these calls help authorities monitor maritime security threats. Scheduling and data sharing allow proactive risk assessments, reducing illicit activities. Likewise, data exchange in JIT systems supports the exchange of Port State

Control (PSC) inspection status, avoiding unnecessary inspections and saving time and money for shipowners, managers, and charterers and optimises infrastructure management and utilisation.

Understanding the value drivers within the JIT framework is key to success. Aligning objectives and benefits boosts efficiency, cost savings, and sustainability, enhancing competitiveness. JIT practices meet regulatory demands and position maritime authorities to capitalize on the economic and environmental benefits of streamlined supply chains.

2.1.3.2 Value Drivers for Berth Planner & Vessel or Cargo Service Provider

Given that the functions of both Berth Planner and Cargo or Vessel Service Providers are increasingly carried out by Terminal Operators, the analysis of the different value drivers at this point will consider these two roles as part of the Terminal Operator's responsibilities. Therefore, whenever either of these roles (Berth Planner or Service Provider) is mentioned, it will be understood as being part of the Terminal Operator's functions.

Terminal operators are directly impacted by the efficiency of port call processes. Their value drivers are critical for enhancing operational performance, reducing costs, and improving service quality. JIT port calls enable better planning and utilization of terminal facilities, including the optimal use of cranes, storage areas, and workforce. This leads to increased operational efficiency, reduced operational costs, and higher output for cargo loading and unloading. Additionally, by improving the allocation of resources like equipment and labor, terminal operators can increase equipment utilization (reducing downtime) and, as already mentioned in the sections above, reduce congestion at port locations, which boosts terminal throughput and revenue. By itself, the minimization idle time for vessels and terminal equipment is a significant value driver. JIT port calls reduce the waiting times for ships and terminal equipment, ensuring more efficient use of both. This allows for quicker turnaround times and more cargo processed within the same time frame, leading to better revenue and profitability.

From the point of view of the shipping lines, timely and predictable port calls enhance service levels and cargo owners. Shipping lines benefit from reduced delays and more efficient cargo operations, improving their satisfaction with terminal services. In turn, terminal operators can strengthen business relationships, attract more customers, and gain a competitive edge. Additionally, improved cargo handling and faster turnaround times contribute to greater customer confidence and loyalty, further enhancing the terminal’s reputation and, as mentioned before, contributing to the port’s overall reputation.

As with other actors, environmental impact is another area where terminal operators could benefit. Terminal operators benefit from reduced emissions and improved environmental performance by optimizing operations. JIT port calls help lower GHG emissions and air pollutants by reducing idle times and optimizing ship speeds. This improved environmental performance not only improves regulatory compliance but also aligns with corporate social responsibility (CSR) initiatives, contributing to a cleaner and more sustainable port environment.

Terminal operators that implement JIT practices can gain a significant competitive advantage, since the availability of port equipment and berths is crucial for a successful JIT operation. By providing efficient, reliable, and environmentally friendly services, they can attract more business from shipping lines and cargo owners. This competitive edge is crucial in an industry where efficiency and sustainability are highly valued. Terminals that can demonstrate their commitment to these principles are more likely to secure long-term contracts and investments.

Efficient JIT operations also contribute to improved safety and risk management. By reducing congestion and ensuring that vessels and equipment are used optimally, terminals can lower the risk of accidents and operational disruptions both in waterside and landside operations. A well-coordinated JIT system reduces the likelihood of

bottlenecks and collisions, enhancing the overall safety of port operations. This risk mitigation is vital for maintaining smooth and uninterrupted terminal activities.

Since all of this contributes to an increased reputation of the port, as a result of accurate information regarding vessel location and arrival times, it offers a competitive advantage for all terminal operators that operate there. By enhancing the reliability of on-time deliveries, terminal operators can strengthen their market position and ensure more efficient cargo handling operations.

Finally, the ability to leverage digitalization for tracking cargo in real time, improving coordination with stakeholders, and optimizing scheduling further increases operational efficiency and safety. This technological advancement helps reduce delays, improve communication between the terminal and vessel service providers, and better align port operations with shipping needs, all of which contribute to superior service quality and stronger market competitiveness.

The value drivers for terminal operators in adopting JIT arrival strategies are multi-faceted, encompassing operational efficiency, reduced idle time, improved service levels, environmental compliance, enhanced competitive position, and improved safety. By aligning with these value drivers, terminal operators can achieve substantial improvements in their operational performance and environmental impact, contributing to the broader goals of sustainability and efficiency in the maritime industry. The integration of JIT arrival practices not only meets regulatory, and market demands but also positions terminals to capitalize on the economic and environmental benefits of a more streamlined and efficient maritime supply chain.

2.1.3.3 Value Drivers for Nautical Service Providers

Nautical service providers, including pilots, VTS providers, towage, and mooring services, derive significant value from JIT port calls. The efficient coordination of these services is vital for the smooth operation of ports and the broader maritime supply chain. Their value drivers include:

JIT scheduling allows nautical service providers to plan their operations more effectively, reducing wait times and improving service efficiency. When service providers have accurate and timely information about ship arrivals and departures, they can schedule their resources accordingly. This reduces the idle time of service providers and ensures that services such as piloting, towage, and mooring are provided exactly when needed. The JIT Arrival Guide highlights that efficient scheduling reduces operational delays and enhances the overall productivity of nautical service providers.

Better scheduling and reduced unpredictability mean that resources such as tugs and pilots can be utilized more effectively, reducing operational costs and enhancing service reliability. When service providers can predict demand accurately, they can allocate their resources in a way that minimizes waste and maximizes efficiency. This leads to cost savings for both the nautical service provider and its users and ensures that resources are available for other operations, thereby increasing the overall capacity and reliability of nautical services. The efficient use of resources is a key benefit highlighted in the JIT Arrival Guide, as it contributes to more sustainable and cost-effective operations.

When nautical services are scheduled and executed according to a JIT framework, there is less congestion and fewer operational uncertainties. This reduces the risk of collisions, groundings, and other accidents that can occur when multiple vessels and services are operating simultaneously without adequate coordination. Enhanced safety not only protects personnel and assets but also ensures compliance with safety regulations and standards. Overall, safety is increased, and operational disruptions are reduced as a consequence of the better execution of nautical services.

By reducing the variability in service demand, nautical service providers can achieve more stable revenue streams and better financial planning. Predictable demand allows service providers to plan their operations and finances more accurately, leading to more consistent and reliable income. This economic stability is crucial for long-term sustainability and growth, as it enables service providers to invest in infrastructure, technology, and personnel. The JIT Arrival Guide notes that stabilized demand helps service providers manage their resources more effectively and maintain a steady flow of operations.

JIT port calls foster better collaboration between nautical service providers and other stakeholders in the port ecosystem. Efficient communication and data sharing ensure that all parties are aligned and can work together seamlessly to achieve common goals. This collaboration enhances the overall efficiency of port operations and creates a more integrated and cooperative environment. The JIT Arrival Guide emphasizes the importance of stakeholder collaboration in achieving successful JIT implementation.

Optimized service provision and reduced waiting times contribute to lower emissions and a smaller environmental footprint for nautical service providers. When tugs, pilots, and other services are used more efficiently, fuel consumption is reduced, leading to lower GHG emissions and air pollutants. This aligns with the broader environmental goals of the maritime industry and regulatory requirements for emission reductions. The JIT Arrival Guide highlights the environmental benefits of optimized port operations, which are crucial for sustainable maritime practices.

Understanding the value drivers of nautical service providers in the JIT/Port Call framework is crucial for the successful implementation of these processes. By achieving the objectives and improving the benefits of all involved parties, the maritime industry can achieve greater efficiency, cost savings, and environmental sustainability. This, in turn, leads to enhanced competitiveness and resilience in the global shipping landscape. The integration of JIT practices not only meets regulatory, and market demands but also positions nautical service providers to capitalize on the economic and environmental benefits of a more streamlined and efficient maritime supply chain.

2.1.3.4 Value Drivers for Cargo Seller

Another fundamental stakeholder in port call operations is the cargo seller, for whom efficiency and timely delivery directly impact market performance and profitability. Through the adoption of JIT practices in port calls, cargo sellers gain value from key drivers that support both operational efficiency and financial outcomes. These elements are essential for enhancing collaboration among stakeholders and advancing the successful implementation of JIT practices.

One of the primary value drivers for cargo sellers is the predictability and reliability offered by JIT port calls. When ports operate within a JIT framework, sellers can anticipate shipment arrivals without excessive delays, thereby strengthening inventory management. Unlike conventional maritime transport, where unpredictable waiting times can necessitate additional inventory as a buffer, JIT allows sellers to operate with leaner stock levels, reducing storage costs and minimizing risks associated with price volatility and goods obsolescence. This flexibility is particularly advantageous in volatile markets, enabling sellers to respond swiftly to changes in demand and adjust pricing strategies, accordingly, improving both cash flow and profitability. Furthermore, it paves the way for the implementation of real-time cargo tracking systems, further enhancing customer satisfaction.

Cost efficiencies in JIT operations also result in fewer demurrage charges and delay penalties, thus reducing overall shipping costs. For cargo sellers, these savings not only represent direct financial benefits but also offer a competitive advantage by enabling them to deliver at more attractive prices. This cost reduction has a ripple effect: by avoiding prolonged port delays and additional charges, sellers can pass these savings on to customers, improving their market

position. Additionally, by establishing a reputation for reliable and economical delivery, cargo sellers can reinforce customer loyalty and attract new customers in a competitive environment. In addition, reliable scheduling can open the possibility for stock reductions: knowing the arrival and departure times of the cargo with reliability can improve stock planning.

Contractual benefits are another area where JIT practices provide significant value. In JIT-based port operations, real-time data exchange and improved scheduling facilitate transparent communication between cargo sellers and other stakeholders—port authorities, shipping lines, and terminal operators. This collaboration allows cargo sellers to negotiate contracts with greater confidence, backed by up-to-date information on shipping schedules and potential contingency measures for disruptions. This precision favours more effective contractual terms, helping sellers optimize both costs and service commitments in line with market conditions, while enhancing their capacity to navigate complex contractual relationships involving intermediaries, charterers, and vessel owners.

Compliance with environmental regulations is another key benefit for cargo sellers under JIT practices. Adherence to increasingly stringent environmental and safety standards is facilitated by optimizing vessel movements, reducing downtime and greenhouse gas emissions. As environmental regulations become increasingly central to corporate strategies, JIT port calls allow cargo sellers to comply seamlessly with these standards. This positions them favourably with stakeholders who prioritize sustainability, strengthens their public image, and provides protection against potential fines for non-compliance with environmental regulations.

For cargo sellers, improvements in customer relations are another positive outcome of JIT port calls. In a JIT environment, the reliability of scheduled delivery directly impacts customer satisfaction, as sellers can meet demand without delays. This responsiveness is increasingly valuable in an era where customer loyalty is influenced by speed and reliability. By aligning with JIT operations, cargo sellers ensure that customers receive products predictably, fostering long-term loyalty and increasing the likelihood of repeat business and referrals, thereby generating sustainable growth. Regarding cargo owners, in addition to the benefits shared with the cargo sellers, the higher operational efficiency translates into faster cargo deliveries and a streamlined supply chain. Thanks to this greater predictability in the logistics chain for sellers, allowing them to reduce disruptions.

In summary, while many value drivers—such as inventory management, cost reduction, and regulatory compliance—are shared among stakeholders, cargo sellers benefit uniquely from JIT through contractual advantages and the ability to flexibly respond to price and demand variability. By leveraging these unique advantages, cargo sellers are well-positioned to remain competitive in a dynamic, compliance-oriented market, demonstrating resilience and adaptability within the global maritime supply chain.

2.1.3.5 Value Drivers for Cargo Buyer

While many existing value drivers for cargo sellers also apply to cargo buyers, some are more significant for the latter. Like cargo sellers, cargo buyers benefit from increased delivery predictability through JIT operations. Both groups experience improved visibility on arrival schedules, reducing uncertainty and allowing for better alignment of purchasing and inventory management processes. This predictability reduces the need for excessive inventory, optimizes capital allocation, and lowers storage costs. However, unlike sellers, cargo buyers benefit more directly from maintaining reduced inventory levels, avoiding excess stock and freeing up capital for other strategic investments.

An important and unique advantage for cargo buyers is improved cash flow management. With JIT, goods arrive exactly when needed, allowing buyers to minimize the funds tied up in inventory and instead allocate capital to strategic initiatives, such as expanding product lines or enhancing customer experience. This approach aligns

inventory cycles with sales, making capital allocation more flexible and reducing risks associated with stock obsolescence or price fluctuations.

Another fundamental driver for cargo buyers is improved responsiveness to market fluctuations. JIT enables them to adjust orders based on real-time demand, reducing the burden of excess inventory and allowing a more agile response to shifts in consumer behavior or market dynamics. This flexibility is especially valuable in highly volatile sectors, where the ability to adjust supply according to changing demand is a critical competitive advantage. Buyers can capitalize on emerging opportunities without the constraints of surplus inventory, which could otherwise slow down strategic responses.

Furthermore, JIT enhances customer satisfaction by enabling cargo buyers to meet delivery expectations more reliably. With predictable and timely shipments, cargo buyers can ensure product availability for their customers, meeting or even exceeding service expectations. This reliability fosters customer loyalty and promotes repeat business, which is essential in a market where consumers demand fast and consistent service.

Improved supply chain coordination is another distinctive advantage for cargo buyers under a JIT framework. By reducing delivery times and enhancing synchronization with shipping lines, port authorities, and other logistics partners, cargo buyers can optimize their supply chains and mitigate potential disruptions. This coordinated approach minimizes delays, reduces administrative burden, and improves overall operational efficiency, providing buyers with a strategic edge for managing logistics and meeting demand on time.

Alignment with sustainability is an increasingly important value driver for cargo buyers, especially as consumers and investors prioritize eco-friendly practices. While sellers may focus on regulatory compliance, cargo buyers can leverage JIT as a way to minimize environmental impact across the supply chain. JIT reduces emissions associated with storage and decreases unnecessary handling, aligning buyers' operations with broader sustainability goals. By implementing JIT, cargo buyers can strengthen their brand reputation with environmentally-conscious consumers, increasing their appeal and differentiation in the market.

Finally, cargo buyers benefit from contractual simplification and potentially lower costs related to delays and storage. Under JIT, stakeholder coordination helps buyers avoid long waits at port and reduces penalties for delays. By incorporating JIT clauses or frameworks into their contracts, buyers can streamline terms and achieve smoother, less costly logistics operations, especially with the standardization of JIT clauses within charter agreements, as discussed in the JIT Arrival guide.

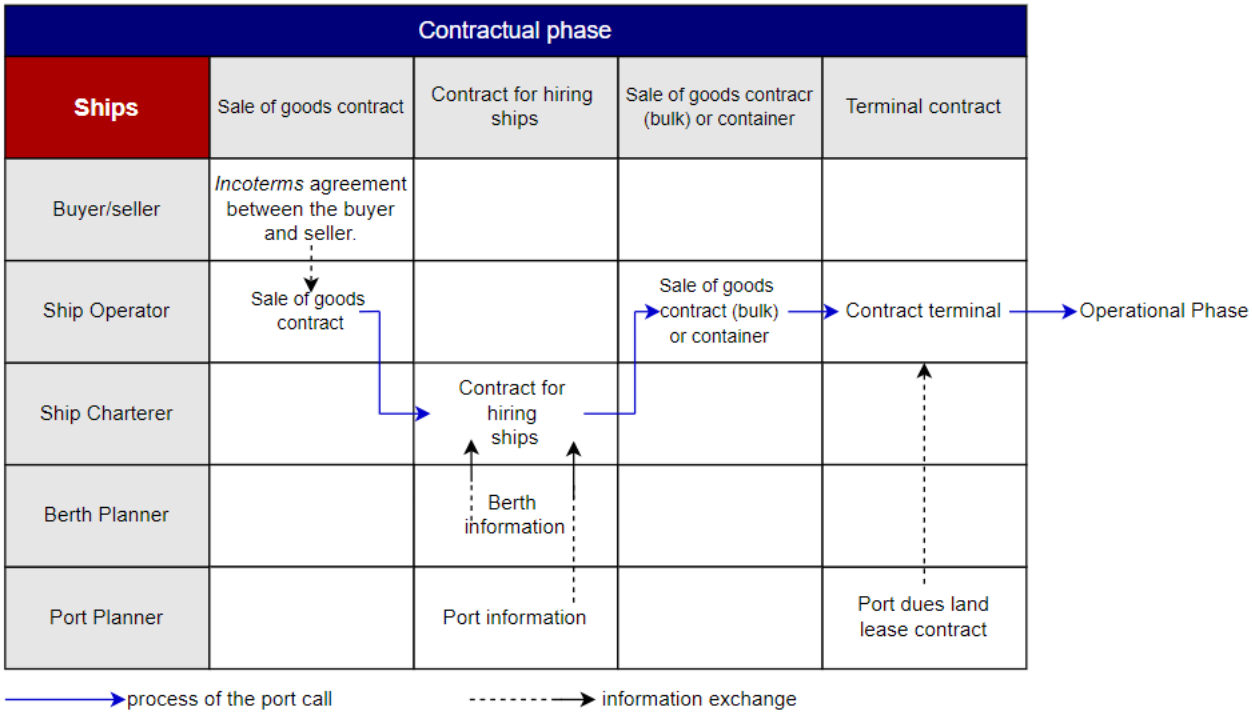
In conclusion, while both cargo buyers and sellers share certain JIT benefits—such as increased predictability and reduced inventory costs—the unique value drivers for cargo buyers include improved cash flow management, the ability to respond to market changes, greater customer satisfaction, optimized supply chain coordination, alignment with sustainability goals, and more favorable contractual terms. By effectively capitalizing on these distinctive advantages, cargo buyers can achieve greater resilience, flexibility, and competitive strength within the dynamic maritime environment.

2.2 Map process flow from initiation to completion

Based on the identification of direct stakeholders, this section is dedicated into describing the collaboration and interactions between them in the supply chain process, with respect to the port call. The port call business process introduced by IMO FAL.5/Circ.52 has been used as a basis, together with the analysis conducted in the IMO JIT guide (IMO, 2020). The containing swim lane diagram has been expanded to include additional elements in terms of

the supply chain process, including additional stakeholders/actors[14] as described in previous paragraphs, while also rearranging its structure – for the operational phase – to refer to the vessel arrival, the processes in port A (loading port), the vessel voyage, and the process in port B (unloading port). As in the FAL.5/Circ.52, the process includes both phases, the contractual phase and the operational phase, describing both the process flow and the necessary information exchange. In figure 1, the contractual phase overview is presented, while in Figure 2, the operational phase overview is presented. Due to the dense information of the operational phase, it has been broken down into more detailed parts of the process; thus Figure 2, figure 3 and figure 4 present in detail the operational phase, also including the appropriate abbreviations. The following paragraphs include an appropriate description of the process for both phases.

Figure 1. Process Flow - Contractual Phase overview. Source: Own work



As a reference for the contractual phase, it is noted that there are 4 main contract types that describe in overall the contractual phase of the process[15]. These are listed and described below:

1) *Contract of sale: absolute or conditional subject to agreement of the contracting parties. Absolute refers to the sale happening based on the agreement of the contract. Conditional refers to conditions which include chartering a ship for transportation. As part of the sales of goods contract, the buyer and seller agree on the*

[14] The identified stakeholders from IMO FAL.5/Circ.52 have been expanded to include cargo seller and cargo buyer. The swim lane diagrams presented below refer to all actors identified in the beginning of the section. Ship Manager represents also the Ship Operator. Secondary actors (stakeholder subcategories) have been excluded, as they would have resulted in information overload. The correlation can be done according to previous subsections.

[15] (IMO, 2020)

Incoterms[16] in order define the responsibilities with respect to the management of the shipment and aspects related to it such as insurance, documentation, customs clearance, etc.

2) *Contract for hiring ships: the charter (charter party) signs a contract with the ship owner. The chartered ship should fit at the load and unload port and berth. Therefore, updated port and berth information is required. Charter parities can have numerous different terms of clauses, however the most significant clauses applicable to JIT Arrival are:*
    i. *Delivery/redelivery of the ship: the agreement that covers the need of the ship to be delivered to the charterer by the owner, which is called laycan. Therefore, the ship is required to arrive at a predetermined and agreed location, which is included in the charter party, before the laycan ends and to tender a Notice of Readiness (NOR) to the charterer. In other words, the ship would be fully ready to load the cargo. If, however, the ship does not arrive within the pre-agreed period, the charterer is able to cancel the charter party in favour of another ship. The NOR location depends on the type of charter party: port charter party or berth charter party. In the former the NOR will be tendered upon the arrival of the ship in the port area whereas in the latter, the NOR will be tendered upon the arrival of the ship at the berth. Finally, at the end of the charter party contract, following the arrival at the discharge port, tendering of the NOR and discharging the final cargo, the ship shall be returned to the owner by the charterer, making it available to the next charterer in order for it to be delivered within the agreed laycan period.*
    ii. *Due dispatch: the master is obliged, upon the loading of the cargo, to start the voyage to the discharge port without delays (called due despatched) unless an exception clause exists. If the Master is advised that the berth is not available, the Master is still obliged to arrive without delays as per the contract agreement. Therefore, it is very important to clearly highlight this in the charter parties, the bill of lading as well as other contracts, in order to not ensure owners are covered in case accusations arise as a result of breach of the due despatch obligation.*
    iii. *Time allowed for loading/discharging: After tendering the NOR, the time allowance for loading/unloading of the cargo is stated and agreed in the charter party (also known as laytime/lay days).*
3) *Final contract of sale of goods: after signing the charter party the final contract of sale of the cargo can be signed.*
4) *Terminal contract: a contract to load, unload and store cargo. In the case that there does not exist a fixed contract with the unload terminal, a storage contract or a terminal service agreement is required to be signed between the customer (cargo buyer or seller) and the terminal.*

[16] (International Trade Administration, 2020)

Figure 2. Process Flow - Operational Phase overview (adapted from IMO FAL.5/Circ.42)

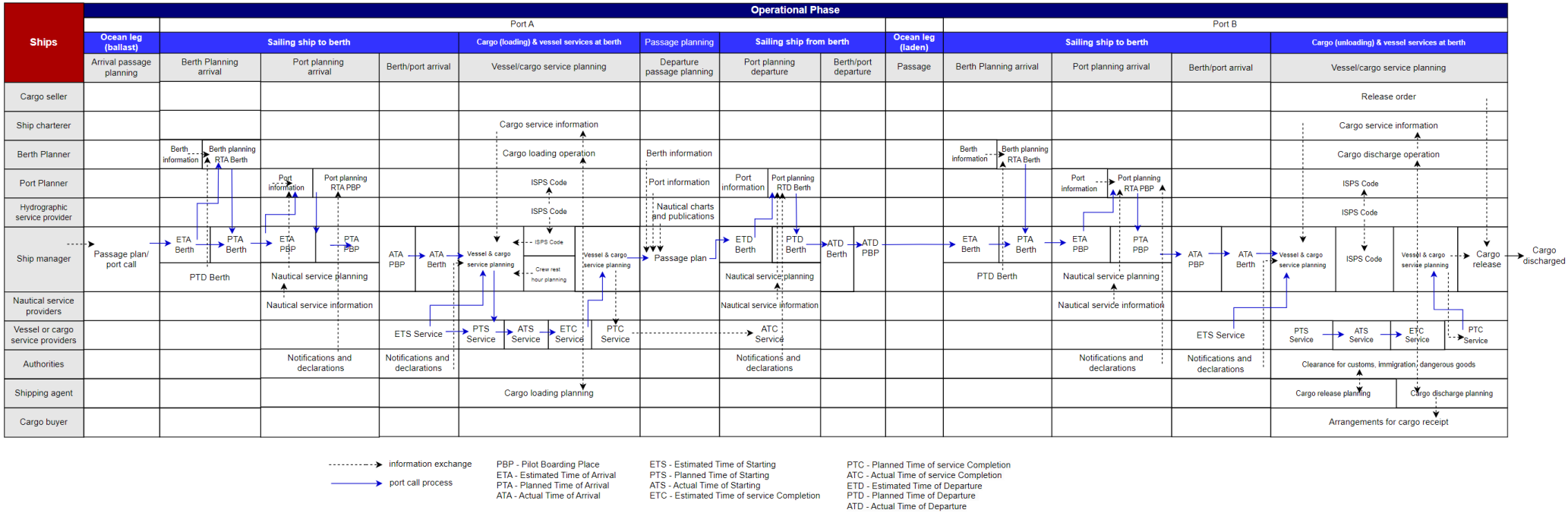


Figure 2. Process Flow – Operational Phase detailed view (a) (adapted from IMO FAL.5/Circ.42)

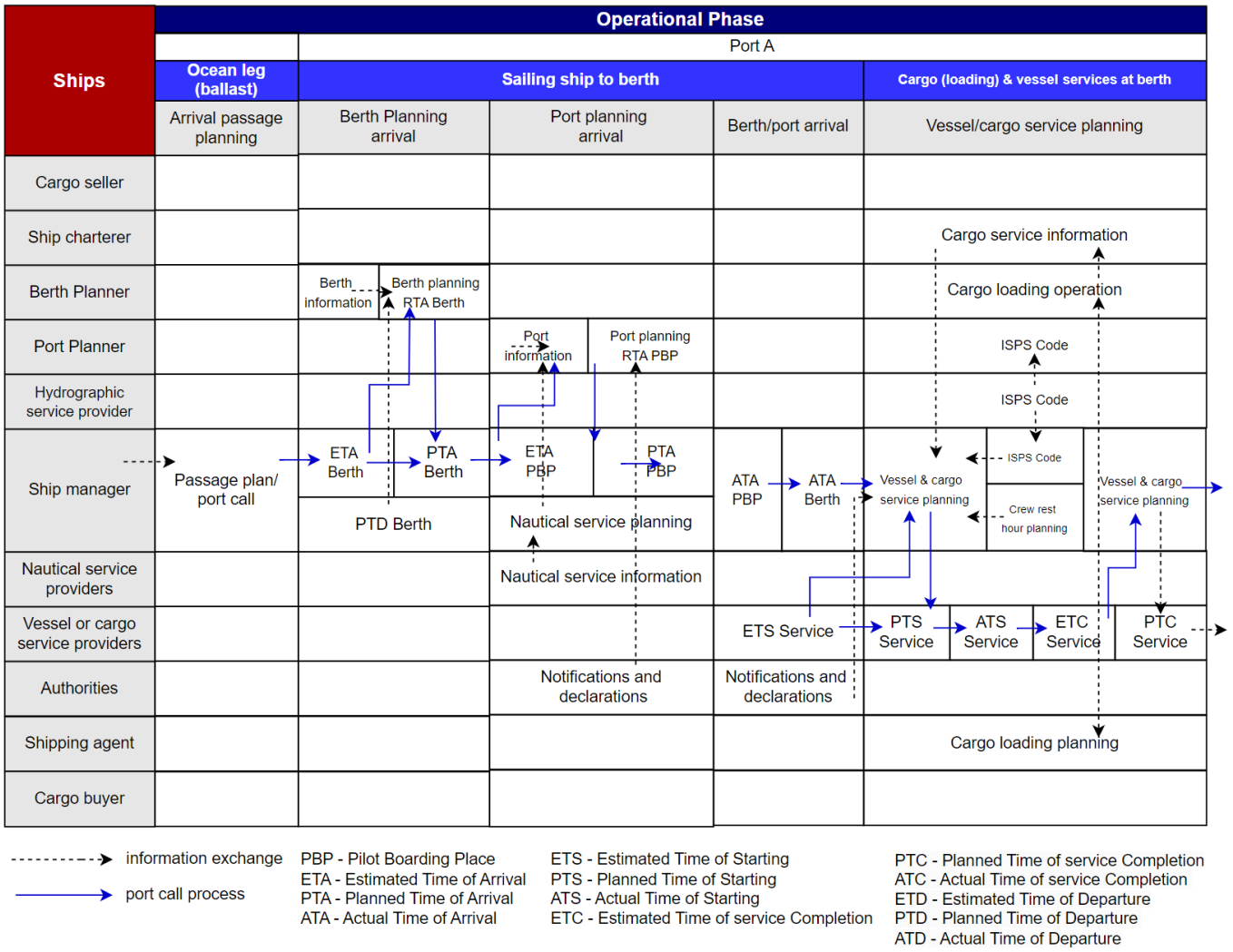


Figure 3. Process Flow – Operational Phase detailed view (b) (adapted from IMO FAL.5/Circ.42)

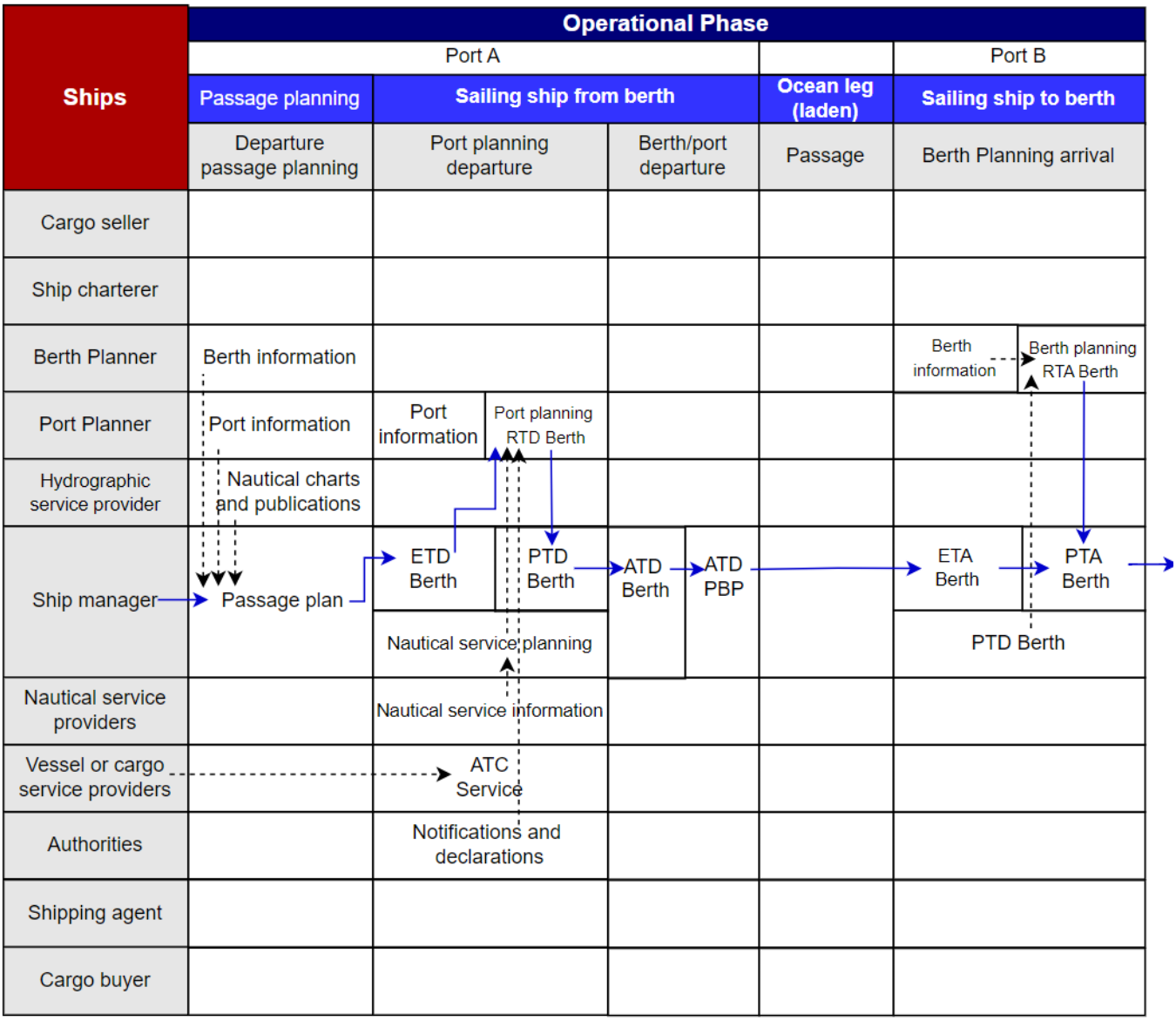
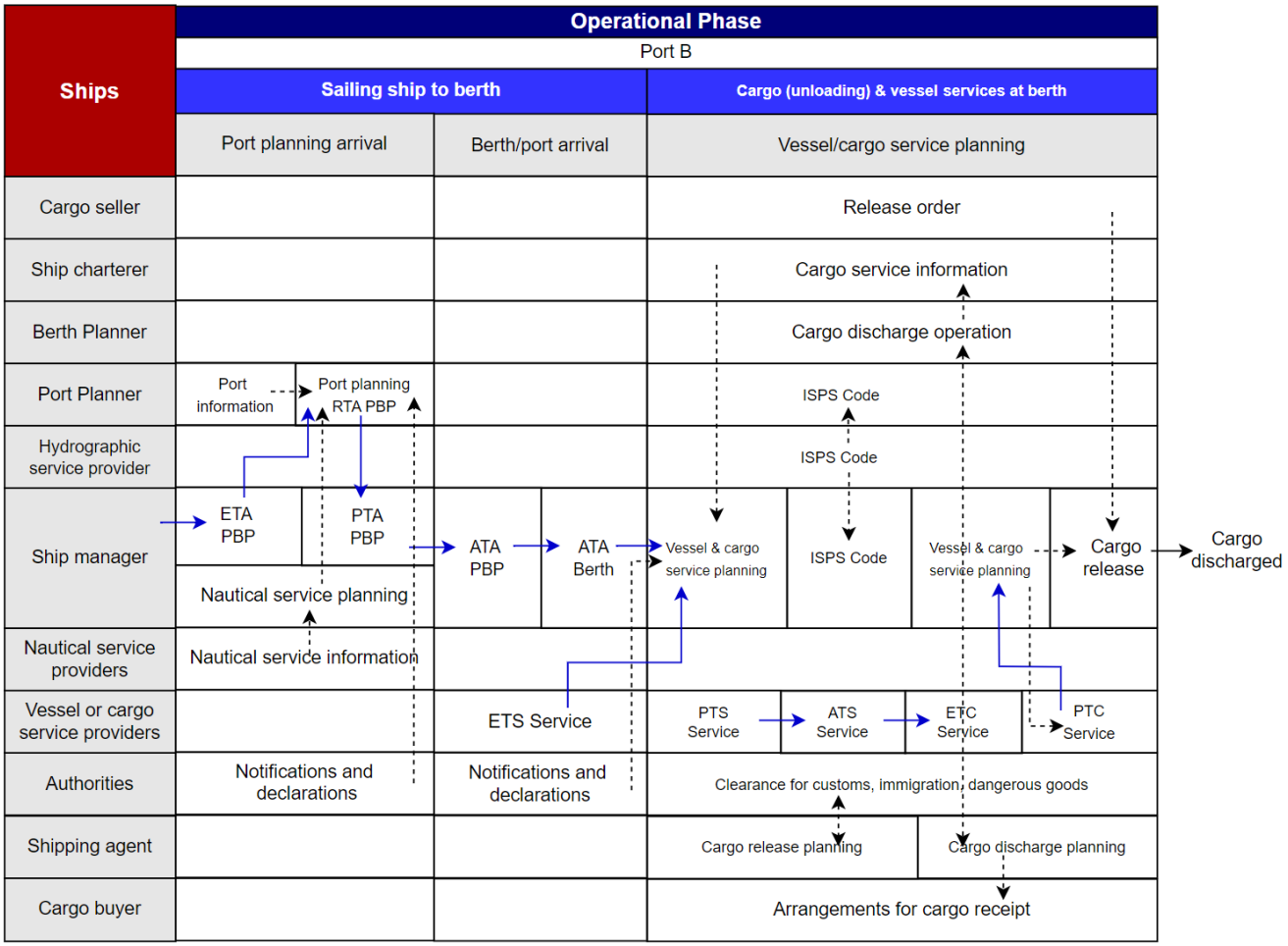


Figure 4. Process Flow – Operational Phase detailed view (c) (adapted from IMO FAL.5/Circ.42)



Following the visualisation of the process through the swimlane diagram of the above figures, the following paragraphs describe the operational phase segments, in order to enhance understanding of the process and the collaborations and interactions between the direct stakeholders.

- ***Ocean leg (ballast) to port A:*** *Based on a new or existing passage plan, the most favourable route is – or was (from previous berth) – developed based on identified hazards and best sailing practices to ensure a safe voyage. Based on SOLAS Chapter 5, this ensures sufficient sea room for the safe passage of the ship throughout the voyage as well as anticipating adverse weather conditions and implementing marine environmental protection. Of course, previous commercial planning (other cargo commitments), or service needs (refuelling, provisions, crew change, etc.) have been considered.*
- ***Port A – Sailing ship to be berth:*** *The planned speed between berths is set out in the charter party (previous voyage and cargo) as well as any restrictions that may apply in the port transit which can dictate that the speed is adjusted. The plan set for the speed of a ship differs for bulkers and tankers under voyage charter compared to container ships under time charter. The port planning is arranged by the port authority and can be delegated to pilots and tugs or the VTS and depends on the berth planning of the terminals in the port. As specified in the contractual phase and therefore in the terms of contract, the ship is ensured that it will fit at the berth, specified under the Safe Port clause in the charter party (probably for both previous cargo and*

cargo under consideration). At this stage, this covers the process for when the berth is available as well as when the ship can enter the port in order to safely reach the berth location, taking into account the planning and availability of the nautical services, fair way and weather conditions. The berth planning is arranged by the terminal. In the planning of the berth and port, the ETA information is provided by the ship manager, the requested-time-of-arrival (RTA) is provided by the berth and port planners. The planned-time-of-arrival (PTA) confirmation is provided by the ship manager to the berth and port planners. Over and above the agreements between operational stakeholders, an on-time clearance of the ship is required before the berth by the authorities which includes customs, immigration, health and port authorities.

- ***Cargo (loading) & vessel services at berth:*** *Cargo services are the purpose of the berthing of the ship as such the optimisation of the berth is dependent on the seamless operation of the loading and unloading. Furthermore, the coordination of the vessel services including bunker providers, waste disposal, crew changes, maintenance and repairs, water and provisions supply and provision suppliers, is very important in order not to affect the cargo handling services as well as ensuring that these processes are completed prior to cargo services are done. Therefore, once these critical processes are completed, the estimated time of departure (ETD) from the berth can be determined. The planning of the cargo and the vessel services is based on the estimated-time-of-starting (ETS) and completion service (ETC) which is provided by the service provider. The requested-time-of-starting (RTS) and the requested time of completion (RTC) are provided by the ship manager. The planned time of starting (PTS) and the planned time of completion (PTC) information is provided to the ship manager by the service provider. A crucial service for bulk trade is cargo surveying for quantity and quality which is required after the loading and unloading of bulk commodity goods. This identifies the quantity and quality of the cargo in order to comply with the goods contract. As for cargo transported in the container sector, a crucial service is the lashing services which is the process securing cargo to avoid unwanted movement before unloading and after loading containers on container ships. Over and above the agreements between operational stakeholders, the on-time clearance of the terminal security is of utmost importance to the services providers. The rest hour planning of crews should be taken into consideration particularly in the ports where numerous services are provided within a limited amount of time.*
- ***Port A – Passage planning:*** *Before sailing the ship from the berth, in order to leave the port, a similar process occurs in identifying a passage plan from port A to port B, with reference to the cargo under consideration. Again, passage planning ensures sufficient sea room for the safe passage of the ship throughout the voyage as well as anticipating adverse weather conditions and implementing marine environmental protection*
- ***Port A – Sailing ship from berth:*** *This stage is related to when the ship can leave the berth and the port. Similar to sailing to the berth, this depends on the availability of nautical services he fairway and the weather conditions. The planning of the ships departure from the port depends on the estimated time of departure (ETD) provided by the ship manager, requested time of departure (RTD) provided by the port planner, planned time of departure (PTD) confirmation from the ship manager to the port planner. Furthermore, the agent is required to arrange the nautical services such as pilots, tugboats etc. Over and above the agreements between operational stakeholders, an on-time clearance of the ship is required before the departure, by the authorities which includes customs, health, immigration and port authorities.*
- ***Port B (all segments):*** *The process described above is repeated at the port of discharge, that is port B. However, In terms of cargo service planning and unloading at the port discharge, the shipping agent provides the port customs, all the necessary documents for the clearance of the cargo. This often include the commercial invoice, packing list, export/import customs declaration and bill of lading & sea waybill[17]. The customs provide the clearance subject to inspections (if required) and communicates with the shipping agent.*

[17] (Alvares, 2019)

In order to arrange for the release of the cargo, a release order is issued by the buyer to the seller through the freight forwarder in order to facilitate the release and delivery of the cargo[18]. Once the release order is facilitated, arrangements are made for the collection and receipt of the cargo. Furthermore, the shipping agent provides the terminal operator with the cargo discharge plan[19]. The discharge plan shows the distribution of the cargo within the ship. Some of the main aspects considered in the preparation of the discharge plan include the preservation of cargo quality, minimum discharge time, safety of crew, and the structural performance of the ship. The terminal operator coordinates with stevedores (labour responsible for the load/unloading of cargo onboard the ship) in order to ensure the discharge operation occurs as per the discharge plan. Once the cargo is discharged, the shipping agent informs the consignee that the cargo is ready for collection.

2.3 PESTEL analysis

This section of the deliverable will focus on comprehending the context in which projects related to the implementation of JIT processes and Port Call Optimization are framed. By conducting this type of analysis, we aim to gain a clearer understanding of the forces exerting pressure on these initiatives, their nature, and the ways they will impact the success of these projects. Whenever significant changes are proposed within structures that have remained unchanged for many years, various points of resistance inevitably arise. These resistances necessitate the adaptation and reconfiguration of the solution to minimize barriers as much as possible.

To achieve this objective, we have chosen the PESTEL analysis methodology. This comprehensive tool allows for a detailed examination of the various variables that can affect potential new projects. By systematically describing the Political, Economic, Social, Technological, Environmental, and Legal factors, we will be able to create a detailed snapshot that provides the necessary insights to assess the feasibility of these initiatives.

Before diving into the detailed analysis of each factor, we will first review and classify the stakeholders, highlighting the level of impact each factor has on them. This preliminary step will enable us to streamline the detailed analysis, ensuring that we focus specifically on the stakeholders who are most likely to be affected by the context of each factor. By doing so, we can target our efforts more effectively and provide more relevant insights for those directly influenced by the identified variables.

The following is an explanation of the criteria used in the table:

- *"Low" impacts (green colour) denote that an adoption of the JIT port call system would have a negligible to low impact overall in the relevant category when viewed from the stakeholder's point of view. Little to no changes are required to adapt to the new situation.*
- *"Medium" impacts (yellow) mean that the uptake of JIT systems would have moderate impacts on the relevant category that might require from slight adaptation driven either from inside or outside of the organisation*
- *"High" impacts (red) denote that the stakeholder will be significantly impacted in multiple areas and issues, often resulting in significant changes and reactions from either inside or outside of its structure or organisation.*

[18] (Mihmidati, 2024)
[19] (TLC Logistics Chartering , 2023)

Table 4. Impact of different areas in each stakeholder. Source: Own work

Stakeholder	Political	Economic	Social	Technological	Environmental	Legal
Ship operator	Low	High	Low	High	High	High
Ship charterer	Low	Medium	Low	Low	Low	High
Berth planner	Low	High	Low	High	Medium	Low
Port planner	Low	Medium	Low	High	Medium	Low
Ship manager	Low	Low	Low	Low	Low	Low
Vessel or cargo service providers	Low	Medium	Low	Medium	High	Medium
Nautical services providers	Low	Medium	Low	High	High	Medium
Port authorities	Medium	High	Medium	High	Medium	Medium
Ship agent	Low	Low	Low	Low	Low	High
Cargo seller	Low	High	Low	Medium	Medium	Medium
Cargo buyer	Medium	High	High	Low	Medium	Low

Once stakeholders have been identified and the impact of each variable on their activities has been defined, the following sections will address in detail how these effects manifest, their specific characteristics, and whether there are any interrelationships between the parties. The analysis will focus solely on those stakeholders who have had at least a moderate or high impact, as indicated in the table presented earlier. All impacts were analysed using the author's expertise and judgement in these fields.

Political:

The political aspect of the PESTEL analysis will explore how government policies, regulations, and stability affect the implementation of JIT processes and Port Call Optimization. Understanding the political and contractual landscape will help identify any regulatory hurdles or supportive measures that could influence the success of these projects. Regarding political factors that may act as barriers or drivers, we clearly identify stakeholders whose roles involve regulation, oversight, and/or authorities with sovereignty over activities in port environments. Specifically for this project, the parties considered most involved include port authorities, customs, European regulators, local authorities, international organisations, and ministries. The complex contractual agreements between these parties and port operators can significantly impact the viability and speed of JIT implementation.

One of the main types of policies that can impact the feasibility of implementing and deploying a JIT process in ports is any policy aimed at combating climate change by reducing greenhouse gas emissions. In this regard, figures such as European regulators, local authorities, and government ministries tend to legislate based on these objectives.

Moreover, contractual obligations related to emission reduction goals can affect how stakeholders commit to these policies. In the specific case of MISSION, policies promoting emission reductions support such initiatives due to the incentives for parties to optimize their operations, either to achieve benefits or avoid penalties for non-compliance. These contracts often include clauses related to performance, sustainability, and emissions compliance, directly affecting operational decision-making.

A very illustrative example of this situation is the ETS, through which the cost of emissions is increased. Parties involved in this process thus have sufficient incentives to reduce emissions to meet their allocated quotas. The contractual frameworks associated with emission trading systems can further motivate compliance, as non-compliance may lead to severe financial penalties or contract violations. Conversely, without such policies, the incentives for achieving optimal processes would be lower because the costs of inefficiencies would not be high enough.

From the customs perspective, the efficiency of administrative processes related to goods declarations is crucial for streamlining operations. Ensuring that procedures are conducted swiftly, enabling smooth information exchange, and maintaining reasonable execution times are essential for achieving precise synchronisation of activities and processes. The implementation of Single Windows, supported by governmental and supranational bodies, aims to establish frameworks that facilitate these goals. Contractual obligations between port operators and customs authorities also play a role in ensuring compliance with newly implemented technologies. By centralising and harmonising data submission and processing, Single Windows reduce bureaucratic redundancies and enhance the overall efficiency of trade facilitation efforts.

Regarding international organisations, these entities wield substantial influence due to their capacity to exert pressure on regulatory bodies. Organisations such as BIMCO, International Association of Ports and Harbors (IAPH), International Trade and Port Community Organization (ITPCO), DCSA, and Terminal Industry Committee (TIC4.0) play crucial roles in optimising port operations. Their involvement extends beyond operational efficiency to advocating for policies that foster a conducive legislative and contractual environment for advancing JIT solutions. By leveraging their expertise and collective voice, these organizations can advocate for regional policies that incentivise the adoption of JIT practices, thereby promoting sustainable and efficient logistics operations across international ports.

An additional dimension could be the type of governance in ports and how it can influence the success of JIT processes and Port Call Optimization. Ports can be managed through public, private, or hybrid models, each with different implications for operational flexibility, decision-making, and the capacity to implement new technologies such as JIT. These governance models often involve complex contracts between the public and private sectors, affecting the speed at which changes can be implemented. In ports where public authorities have greater control, decision-making can be slower due to bureaucratic processes and the need for political consensus, which could delay the adoption of innovations. Conversely, private or hybrid management models may be more agile in implementing changes but could face challenges in aligning with public policy objectives, such as environmental regulations. The flexibility and terms of contracts in these governance models can directly impact JIT implementation.

Finally, political decisions related to various infrastructure investment policies can affect the resources needed to operate under a JIT regime in a port. For example, policies that delay or reduce investment in critical port infrastructure, as seen in cases like the North Terminal project in the port of Valencia[20], can severely limit the capacity to support JIT operations. Insufficient infrastructure, inadequate maintenance, or outdated facilities can hinder the smooth synchronisation of logistics operations, reducing the effectiveness of JIT processes and causing bottlenecks.

[20] The port expansion plan has been under discussion for at least 15 years, delaying the construction of a new terminal that would have doubled the operational capacity for container handling (Valenciaport, 2024).

Additionally, international conflicts can disrupt global supply chains and create political instability, affecting trade routes, port accessibility, and international cooperation on JIT initiatives. This highlights the importance of a stable political and contractual environment for the successful implementation of JIT in port operations.

In summary, the political and contractual framework surrounding these initiatives currently faces significant challenges, primarily due to emissions regulations. However, other factors, such as labour impacts and potential pressures from dockworker groups who may perceive JIT implementation as detrimental to their labour and economic prospects, also come into play. The future outlook will depend on how political institutions evolve and how contractual obligations between stakeholders are structured. If societal perceptions persist that environmental policies could hinder economic development by reducing competitiveness against countries and regions with less stringent regulations, the imperative to implement such innovations may diminish in broader political discourse.

Economic:

The Economic analysis will focus on the broader economic environment, including factors such as market trends, economic growth, inflation rates, and funding availability. This will help determine the economic viability and potential return on investment for these initiatives. Unlike what has been observed in political factors, concerning economic aspects, the stakeholders most affected by these types of projects are those directly involved in operations. Therefore, efficiency gains will have an impact on cost savings, resource optimization, improved activity planning, and the emergence of new business opportunities. Specifically, entities such as terminal operators, shipping lines, ship owners, and maritime services like pilotage, towage, and mooring can enhance their operational efficiency through aligned processes, effective communication among stakeholders, and interoperability.

Among the primary beneficiaries of improved port turnaround times are ship operators, ship managers and ship charters. Regardless of vessel type and service (tramp or liner), receiving precise and reliable information regarding the date and time when a vessel will receive agreed-upon services upon arrival at a designated point, and when it will have berth availability, allows operators to adjust sailing speeds between ports for optimal fuel consumption. This adjustment significantly reduces the primary cost factor in variable operating costs. Moreover, optimising vessel use as an asset can extend vessel lifespan, optimizing fleet renewal costs through improved floating operations.

Regarding nautical services, similar outcomes can be achieved. Having precise arrival information for a vessel at port allows for the creation of a visit sequence that provides the necessary data to plan with a high degree of accuracy how pilotage, towage, and mooring services can be provided. These services often need to react to unpredictable events, leading to inefficiencies when operations cannot be executed according to an optimal plan. By reducing these uncertainties, new levels of efficiency can be achieved, enabling a reduction in costs associated with the sector's current state of discoordination. Bottlenecks due to disruptions in logistics chains are becoming more frequent, adding new costs, and addressing these issues would be crucial.

All these analyses are framed within global trends where, for instance, there is a need to achieve optimal fuel consumption due to the significant impact of geopolitical tensions on fossil fuel prices. As it is known, fossil fuel prices are highly sensitive to geopolitical tensions, making efficient resource utilization essential to align costs with levels of activity and business.

Logistical costs have historically been a smaller component of final consumer goods costs. However, this reality may begin to change due to the economic challenges certain economies are facing. If this trend is not reversed, logistical costs could potentially exert greater influence on the prices of products traded internationally, leading to a reduction in international trade.

Another pertinent point is the reduction of vessel stay time in port. A significant portion of port call costs are related to port tariffs, often determined by the time a vessel spends moored at the berth. This time-based tariff structure underscores the need to optimize vessel stay times to ensure cost transfers are as efficient as possible.

Additionally, considering entities such as port authorities, optimizing infrastructure like berths is crucial for extending the life span of facilities and avoiding higher maintenance costs and investments in infrastructure recovery. These types of expenses can be substantial, and not addressing them effectively could lead to economic losses and hinder operational capabilities.

Furthermore, speculation on commodity prices can directly impact the economic feasibility and operational planning of JIT processes in port operations. Fluctuations in the prices of goods, especially bulk commodities such as oil, grains, and metals, can lead shipping companies to revise their strategies, routes, and even the timing of their operations. For example, if there is a sudden spike in the price of oil, shipping companies may decide to slow down vessels to conserve fuel, disrupting JIT schedules and causing delays. Additionally, sudden changes in commodity markets may affect demand for certain services at the port, impacting the overall synchronization of operations and reducing the cost efficiency that JIT aims to provide. Additionally, depending on the charter party, whether it is a voyage or time charter party, sometimes cargo sellers and cargo buyers may benefit or be disadvantaged by being subject to a JIT arrival scheme. There are circumstances in which having a fixed delivery date requires regular updates to the ETA. In some cases, being committed to an ETA or PTA could negatively impact the price of the commodities being transported.

Another key economic factor is the size of the companies involved. Larger shipping lines and terminal operators may have greater flexibility and resources to invest in and adopt JIT processes, as they can better absorb the initial costs and risks associated with the transition. They may also benefit more from economies of scale, enhancing their overall profitability. Conversely, smaller companies may struggle to keep up with the investment required to implement these advanced processes and could be more vulnerable to market volatility or sudden changes in demand. Their interests may lie more in minimizing risk and operational costs rather than in pursuing the cutting-edge efficiency gains offered by JIT. This disparity in the interests and capabilities of different-sized companies could affect the overall success and adoption rate of JIT processes across the industry.

Social:

The Social component will examine societal attitudes, cultural trends, and demographic changes that might impact the acceptance and effectiveness of the proposed changes. This includes understanding stakeholder expectations and potential resistance from those who may be affected by the implementation. Social factors have been indirectly discussed when analysing political factors. However, to further detail these effects, it is important to consider the positions taken by civil society regarding issues such as emission reduction, carbon footprint reduction, and all measures aimed at minimising the environmental impact of productive activities. While the maritime port sector is relatively distant from the general population, it is widely recognized as one of the transportation sectors that generates the highest net emissions.

Considering this particularity, a society like Europe, which currently demands measures to reduce the environmental impact of maritime activities, will significantly influence the policies developed by legislative institutions. Another potential impact from civil society is the implications these initiatives may have on the labour market. Many of these projects propose solutions based on automating processes that currently rely on human intervention. Such changes often face significant resistance from groups directly affected by potential job losses. Given that groups associated with port activities are typically strong lobbying entities, it is crucial to consider this potential risk.

In the case of cargo buyers or cargo sellers, there are markets that socially demand that the products they consume meet high environmental standards. Being able to demonstrate that maritime and port logistics operations are carried out in a JIT arrival environment would not only make the products more competitive in terms of price but would also enhance the social reputation of both cargo buyers and cargo sellers.

Understanding and addressing these social dynamics will be essential for effectively implementing policies and initiatives aimed at reducing environmental impacts while navigating potential challenges in labour market adaptation within the maritime sector.

Technological:

Technological factors will be analysed to assess the current state of technology and innovation within the industry. This includes evaluating the availability of technological solutions, the pace of technological advancements, and the potential for integrating new technologies into existing systems. In the analysis of technological factors present in projects like MISSION, significant considerations were found. On one hand, the technological possibilities that can support such initiatives were assessed, particularly those without which the feasibility and success of JIT implementation would be unthinkable. On the other hand, we identify the gaps and challenges that currently exist in promoting the initiative. Both perspectives are important to analyse due to their key role in the potential application of scale optimisation in a synchronised operational environment to achieve timely arrivals.

Regarding existing technologies, there is currently a wide variety of systems developed exclusively for the maritime port industry, as well as others with general applications that can equally be deployed in this sector. Initially, there are no major challenges due to the existence of multiple types of technologies with diverse characteristics and functionalities. Particularly concerning information communication, there are precise communication devices capable of handling data related to documentation, blockchain technology, web services, and lightweight data formats such as JSON and XML. These technologies currently do not present significant cost barriers or technical obstacles.

However, there is a need to boost interoperability and communication between systems. Currently, many communications related to operations are not digital and automated but are conducted manually through VHF radios, emails, and phone calls. This manual approach often leads to errors and does not provide the high levels of reliability necessary for processes that depend on precise information. This is perhaps a major challenge as it would require many stakeholders involved in operations, many of whom have long-standing processes, to adapt their operations to include digital systems that perform part of the process actions. Nonetheless, as previously mentioned, access to technology that can enable JIT processes does not face significant barriers.

Regarding technologies aimed at harmonizing port traffic, such as remote traffic control centres and the adaptation of vessels for autonomous communication using Internet-of-Things technologies, these are of vital importance. While such technologies have been deployed in sectors like urban mobility, they remain experimental and have not yet reached sufficient maturity levels for widespread deployment in this sector.

Another major concern lies in cybersecurity. In a highly digitalised environment where sensitive information is constantly shared, it is crucial to have robust cybersecurity systems that instil confidence in all parties to integrate collaboratively into these processes.

Environmental

Environmental considerations will address the impact of these initiatives on the natural environment and how environmental regulations and sustainability goals might influence project implementation. This is particularly important in today's context where environmental concerns are increasingly paramount.

In the context of implementing a JIT Arrival project within port logistics, the environmental factor is crucial and involves a broad range of stakeholders. This is due to the significant operational impact that port logistics operations have on the environment, as well as the involvement of stakeholders in legislative and policy development processes. Over the past decade, legislation regarding emission reduction has accelerated rapidly, influencing and often conditioning the competitiveness of various sectors.

Currently, the push for environmental regulation has intensified, driven by the need to combat climate change and reduce air pollution. This regulatory landscape mandates that ports and shipping companies adopt cleaner fuels, enhance energy efficiency, and implement advanced emission control technologies. Such measures are essential for reducing greenhouse gas emissions and improving air quality, which in turn supports global environmental sustainability goals.

However, beyond regulatory compliance, there are specific environmental conditions that directly affect the feasibility and efficiency of JIT Arrival processes. One of the primary concerns is the increasing frequency of extreme weather events, such as storms (both in high-sea and the port's location) and floods. These events create significant unpredictability, complicating the precise scheduling and planning required for JIT operations. Future climate models predict a rise in the occurrence of such extreme weather, making it imperative for logistics planners to incorporate robust predictive tools.

Predictive tools and models that can forecast extreme weather events are vital for mitigating their impact. These tools should be integrated into the planning processes to allow for real-time adjustments and contingency planning. This integration ensures that port operations can maintain a high level of efficiency and reliability, even in the face of adverse weather conditions.

Furthermore, the implementation of environmental measures also involves a shift in the operational mindset. Stakeholders, including port authorities, shipping companies, and logistics providers, must collaborate to develop and adopt best practices that align with environmental regulations while optimising operational efficiency. This collaboration is critical to achieving a seamless transition to environmentally sustainable and economically viable JIT Arrival processes.

Legal:

Finally, the Legal aspect will focus on understanding the legal framework within which these projects will operate. This includes compliance with relevant laws and regulations, as well as identifying any legal risks that could pose challenges to the successful execution of the initiatives.

In the context of implementing a JIT arrival project within port logistics, the legal factor plays a pivotal role, impacting various aspects of the initiative from regulatory compliance to operational adjustments. This factor involves a complex interplay of international, national, and local laws and regulations that stakeholders must navigate to ensure the project's success.

Firstly, international maritime laws and conventions form the foundation of legal compliance for port operations. Instruments such as the IMO regulations, including the International Convention for the Prevention of Pollution from Ships (MARPOL) and the International Ship and Port Facility Security (ISPS) Code, set stringent standards for environmental protection, security, and operational safety. Compliance with these regulations is mandatory for ports and shipping companies operating internationally.

At the national level, each country imposes its own set of maritime laws and regulations that must be adhered to. These laws often encompass a wide range of areas, including customs procedures, environmental standards, and labour laws. For instance, national legislation may dictate specific requirements for the reduction of greenhouse gas emissions from ships, aligning with global efforts to combat climate change. Additionally, national security regulations might impose specific protocols for the handling of hazardous materials and the protection of critical infrastructure.

Local regulations add another layer of complexity, particularly in port operations. Local authorities may enforce unique environmental policies, port fees, and operational restrictions that vary from one port to another. These regulations can affect the scheduling, docking, and unloading processes, necessitating careful coordination and compliance to avoid legal penalties and ensure smooth operations.

A significant legal challenge in the implementation of JIT Arrival is the harmonization of regulatory standards across different jurisdictions. Given that international shipping routes often span multiple countries, inconsistencies in regulatory requirements can create operational inefficiencies and legal risks. Harmonisation efforts aim to standardize regulations, reducing complexity and facilitating smoother international trade.

Contractual obligations are also critical in the legal landscape of JIT Arrival projects. Agreements between shipping companies, port authorities, and logistics providers must clearly define responsibilities, liabilities, and compliance expectations. These contracts need to be meticulously drafted to cover all aspects of JIT operations, including penalties for delays, terms of service, and dispute resolution mechanisms. Chapter 8 of this document makes a deep dive on the contractual and legal parts of a JIT arrival.

Moreover, the legal framework must address the privacy and security of data. As JIT Arrival relies heavily on real-time data exchange and digital communication, regulations like the General Data Protection Regulation (GDPR) in Europe impose strict requirements on data handling and protection. Ensuring compliance with these data protection laws is essential to maintain stakeholder trust and avoid significant fines.

Additionally, the legality of data exchange is a crucial consideration in JIT Arrival projects. The transfer and sharing of data across different jurisdictions must comply with varying legal standards related to data privacy and protection. Ensuring that data exchange practices adhere to the legal requirements of each region involved is essential to avoid potential legal disputes and ensure the integrity of the JIT processes. This includes addressing issues related to cross-border data flow and ensuring that all parties involved in the data exchange are compliant with relevant data protection laws.

Lastly, the legal factor also involves labour laws and union regulations. Changes in operational processes due to JIT implementation can affect the workforce, potentially leading to labour disputes. It's crucial to engage with labour unions and comply with employment laws to manage the transition smoothly and ensure the support of the workforce.

3. Incentives

The implementation of the JIT system in maritime transportation promises to optimise logistical efficiency, reduce costs, and enhance the competitiveness of shipping companies. However, the adoption of this approach encounters several key incentives and faces a series of critical barriers. On one hand, potential benefits include minimising inventory levels, improving delivery synchronisation, and reducing vessel downtime. On the other hand, challenges range from the need for advanced technological infrastructure and the variability of weather conditions to the precise coordination required among multiple actors in the supply chain. This section explores these incentives and barriers in detail, providing a comprehensive analysis of the dynamics influencing the adoption of JIT in the maritime sector.

3.1 Identify barriers to acceptance

This section aims to identify the different barriers that hinder the acceptance of various stakeholders (identified in section 3.1) due to potential negative impacts on their activities. To structure and keep this section aligned with the rest of the document, it has been decided to base the analysis on the different factors that make up the PESTEL analysis, which has been discussed in general in section 6.

Political barriers

The adoption of JIT in maritime transportation, while promising significant operational efficiencies and cost reductions, is often hindered by various political barriers. These barriers can arise from regulatory frameworks, trade policies, and geopolitical tensions that complicate the seamless coordination required for JIT implementation. National regulations may impose restrictions on shipping practices, while international trade policies can introduce uncertainties and delays. Additionally, geopolitical issues such as territorial disputes and protectionist measures can disrupt shipping routes and schedules. This section delves into these political barriers, examining how they impede the effective adoption of JIT in the maritime industry and exploring potential strategies to navigate these challenges:

- P1 - Port governance model with strict regulations related to restrictions
- P2 - Inadequate physical infrastructure at ports to handle turnovers of goods
- P3 - Security restrictions at ports
- P4 - International conflicts impacting the JIT concept
- P5 - Trade agreements between countries and flow of goods
- P6 - Tariffs and taxes applied to imports and exports that could slow down processes
- P7 - Labour policies and laws that could workforce availability of JIT processes
- P8 - Cross-border regulations that could create bottlenecks and delays

Table 5. Barriers at political level and impact in the different stakeholders involved in JIT. Source: Own work

ID-No.	BARRIERS	PESTEL	Ship Operator	Ship Charterer	Berth Planner	Port Planner	Hydrographic service provider	Ship manager	Nautical service provider - Pilotage	Nautical service provider - Towage	Nautical service provider - Mooring	Nautical service provider - VTS	Vessel or cargo service providers	Authorities	Ship Agent
P1	Port Governance model with strict regulations related to restrictions	Political				X								X	
P2	Inadequate physical infrastructure at ports to handle turnovers of goods	Political	X		X	X								X	
P3	Security restrictions at ports	Political						X					X	X	
P4	International conflicts impacting the JIT concept	Political	X	X				X							X
P5	Trade agreements between countries and flow of goods	Political												X	X
P6	Tariffs and taxes applied to imports and exports that could slow down processes	Political											X	X	X
P7	Labour policies or laws that could workforce availability of JIT processes	Political	X					X	X	X	X	X	X	X	
P8	Cross-border regulations that could create bottlenecks and delays	Political												X	

The fact that different authorities are responsible for different parts of the JIT, the changes in political trends, less favourable to stimulating environmental improvements balanced with specific interests in JIT to avoid, for instance, the ships in anchorage areas close to port-city vicinity are also considered.

ECONOMIC BARRIERS

The implementation of JIT in maritime transportation, while offering potential benefits such as cost savings and enhanced efficiency, encounters significant economic barriers. High initial investment costs in advanced technology and infrastructure, such as real-time tracking systems and upgraded port facilities, pose a substantial challenge. Additionally, fluctuations in fuel prices and freight rates can create financial instability, making it difficult for companies to commit to the continuous, reliable service that JIT requires. The need for specialised training and workforce development further adds to the economic burden. This section explores these economic barriers in detail, analysing their impact on the adoption of JIT in the maritime sector and discussing possible solutions to overcome these financial hurdles.

- EC1 - Scenarios of winners and losers in terms of incomes
    - Calculation of share costs/revenues of JIT arrival
    - Disincentive related to demurrage rate
    - Stakeholders who do not get economic benefit do not want to participate in JIT
- EC2 - Uncertainty in the demand and level of prices
- EC3 - Size of the main customer and preferential treatment regarding the management of the cargo
- EC4 - Low efficient supply chains in terms of operation
- EC5 - Changes in transportation costs - Value of cargo versus cost of transportation
- EC6 - Complexity in the logistics coordination
- EC7 - Risks of supply chain disruptions
- EC8 - Fuel cost to adapt the port call to JIT scheme
- EC9 - Implementation of technology onboard translated into higher TCO - Implementation of ICT at ports and shipping companies and related costs of digitalization to improve planning and information sharing is an important factor to consider.
- EC10 - Idle time in the maritime business for specific cargoes
- EC11 - Competence issues - How port calls are managed economic criteria set

Table 6. Barriers at economic level and impact in the different stakeholders involved in JIT

ID No.	BARRIERS	PESTEL	Ship operator	Ship charterer	Berth planner	Port planner	Hydrographic service provider	Ship manager	Nautical service provider - pilotage	Nautical service provider - towage	Nautical service provider - mooring	Nautical service provider - vts	Vessel or cargo service providers	Authorities	Ship agent
EC1	Scenarios of winners and losers in terms of incomes	Economic	X	X	X	X	X	X	X	X	X	X	X	X	X
EC2	Uncertainty in the demand and level of prices	Economic	X										X		X
EC3	Size of the main customer and preferential treatment regarding the management of the cargo	Economic	X	X				X					X	X	X
EC4	Low efficient supply chains in terms of operation	Economic											X	X	
EC5	Changes in transportation costs	Economic	X	X				X					X		X
EC6	Complexity in the logistics coordination	Economic	X		X	X		X	X	X	X	X	X		
EC7	Risks of supply chain disruptions	Economic	X					X					X		X
EC8	Fuel cost to adapt the port call to JIT scheme	Economic	X	X				X	X	X	X				
EC9	Implementation of technology onboard translated into higher TCO	Economic	X	X				X	X	X	X	X			
EC10	Idle time in the maritime business for specific cargoes	Economic	X	X	X	X		X						X	X
EC11	Competence issues – How port calls are managed and economic criteria set	Economic			X	X								X	

Social barriers

The adoption of JIT in maritime transportation, despite its potential to enhance efficiency and reduce costs, is often impeded by various social barriers. These barriers stem from resistance to change within organisations, cultural differences among international stakeholders, and concerns over job security among workers. Employees may fear that the shift to JIT will lead to increased job demands and possible layoffs due to automation and efficiency improvements. Additionally, differing management practices and work ethics across cultures can complicate the seamless coordination required for JIT. This section examines these social barriers, discussing how they affect the adoption of JIT in the maritime industry and exploring strategies to address and mitigate these challenges.

- S1 - Change management
- S2 - Limited access or lack of new skills and training
- S3 - Personal incentives for the implementation of a new way of operating - putting the focus on the trust between stakeholders
- S4 - Unfavourable working conditions
- S5 - Limited access to professional development opportunities
- S6 - Stigma and Negative Perceptions - including discrepancy between working regulations at sea and at shore for personnel.

Table 7. Barriers at social level and impact in the different stakeholders involved in JIT. Source: Own work

ID-No.	BARRIERS	PESTEL	Ship operator	Ship charterer	Berth planner	Port planner	Hydrographic service provider	Ship manager	Nautical service provider - pilotage	Nautical service provider - towage	Nautical service provider - mooring	Nautical service provider - vts	Vessel or cargo service providers	Authorities	Ship agent
S1	Change management	Social	X	X	X	X		X	X	X	X	X	X	X	X
S2	Limited access or lack of new skills and training	Social	X	X	X	X	X	X	X	X	X	X	X	X	X
S3	Personal incentives for the implementation of a new way of operating	Social	X		X	X		X	X	X	X	X	X		
S4	Unfavorable Working Conditions	Social	X	X	X	X	X	X	X	X	X	X	X	X	X
S5	Limited Access to Professional Development Opportunities	Social	X		X	X	X	X	X	X	X	X	X		X
S6	Stigma and Negative Perceptions	Social	X					X	X	X	X	X	X		

Technological barriers

Implementing JIT in maritime transportation is often obstructed by various technological barriers. Key challenges include the necessity for cutting-edge digital infrastructure, such as real-time tracking systems, automated logistics platforms, and advanced communication networks. These technologies require significant investment and technical expertise, posing substantial hurdles for many shipping companies. Moreover, ensuring interoperability among diverse systems and establishing standardized technological protocols across international borders add further complexity. Additionally, cybersecurity threats and data privacy issues present significant risks to the smooth adoption of JIT. This section delves into these technological barriers, examining their effects on JIT implementation in the maritime industry and exploring potential strategies to address and mitigate these technological challenges. While high levels of congestion are sometimes incentives for the implementation of JIT, at the technological level, the most congested routes require the coordination of many different stakeholders. The wide variety of systems makes interoperability highly complex, and the incentives for parties to adapt their technologies to a JIT environment may be low unless a proper transition is managed.

- T1 - Lack of investments in technology – also linking the concept of lack of understanding of benefits from using ICT tools.

- T2 - Lack of connectivity at sea
- T3 - Cybersecurity of the data exchange
- T4 - Complexity in the technology onboard
- T5 - Complexity in the technology onshore
- T6 - Level of congestion in specific routes translated into delays and long-time staying
- T7 - Back-up security systems in case of failures

Table 8. Barriers at technological level and impact in the different stakeholders involved in JIT. Source: Own work

ID No.	Barriers	PESTEL	Ship operator	Ship charterer	Berth planner	Port planner	Hydrographic service provider	Ship manager	Nautical service provider - pilotage	Nautical service provider - towage	Nautical service provider - mooring	Nautical service provider - vts	Vessel or cargo service providers	Authorities	Ship agent
T1	Lack of investments in technology	Technological	X	X				X	X	X	X	X	X	X	
T2	Lack of connectivity at sea	Technological	X	X				X						X	X
T3	Cybersecurity of the data exchange	Technological	X	X	X	X	X	X	X	X	X	X	X	X	X
T4	Complexity in the technology onboard	Technological	X	X				X							X
T5	Complexity in the technology onshore	Technological			X	X			X	X	X	X	X	X	
T6	Level of congestion in specific routes translated into delays and long-time staying	Technological	X	X				X							X
T7	Back-up security systems in case of failures	Technological	X				X	X	X	X	X	X	X	X	

There are other possible technological barriers related to the inconsistency of timestamps and location definitions in port call processes, reliability and accuracy of data in port operations and the fact of management and adaptation to dynamic timestamp changes in port operations.

Environmental barriers

This concept faces significant environmental challenges. Key issues include the impact of strict environmental regulations, which can limit shipping operations and increase compliance costs. Additionally, the need to reduce

carbon emissions and minimise environmental footprints requires the adoption of cleaner, more sustainable technologies and practices, which can be costly and technologically demanding. Environmental conditions, such as extreme weather events and changing sea levels, also pose significant risks to the reliability and predictability essential for JIT operations. This section explores these environmental barriers, analysing their effects on the adoption of JIT in the maritime industry and discussing potential strategies to navigate and mitigate these environmental challenges.

- ENV1 - Increased port calls leading to higher emissions
- ENV2 - Port pollution
- ENV3 - Limitations or restrictions on vessels at berth

Table 9. Barriers at environmental level and impact in the different stakeholders involved in JIT. Source: Own work

ID No.	Barriers	PES-TEL	Ship operator	Ship charterer	Berth planner	Port planner	Hydrographic service provider	Ship manager	Nautical service provider - pilotage	Nautical service provider - towage	Nautical service provider - mooring	Nautical service provider - vts	Vessel or cargo service providers	Authorities	Ship agent
ENV 1	Increased port calls leading to higher emissions	Environmental												X	
ENV 2	Port pollution	Environmental		X	X								X	X	
ENV 3	Limitations or restrictions on vessels at berth	Environmental		X	X								X	X	

Legal barriers

Complex and diverse international maritime laws can create compliance challenges, complicating the seamless integration required for JIT. Contractual obligations between shippers, carriers, and other stakeholders often lack the flexibility needed to accommodate the dynamic and precise demands of JIT logistics. Additionally, liability issues and the enforcement of contract terms across different jurisdictions can lead to legal disputes and delays. This section examines these legal and contractual barriers, exploring their impact on the implementation of JIT in the maritime industry and discussing strategies to navigate and overcome these legal complexities.

- L1 - Data sharing among companies involved in JIT processes - commercial sensitivity of data critical for berthing ships, etc.
- L2 - Regulation on preference port calls of specific ships - sometimes port regulations do not meet the JIT needs.
- L3 - Contractual clauses - charter parties
    - Contractual barrier in voyage charters: The due dispatch clause
    - Ship carrying several different cargoes
    - Cargo traded during voyage
- L4 - Strict regulation on traffic management at ports
- L5 - Lack of regulation to implement JIT scheme

Table 10. Barriers at legal level and impact in the different stakeholders involved in JIT. Source: own work

ID No.	Barriers	PESTEL	Ship operator	Ship charterer	Berth planner	Port planner	Hydrographic service provider	Ship manager	Nautical service provider - pilotage	Nautical service provider - towage	Nautical service provider - mooring	Nautical service provider - vts	Vessel or cargo service providers	Authorities	Ship agent
L1	Data sharing among companies involved in JIT processes	Legal	X	X	X	X	X	X	X	X	X	X	X	X	X
L2	Regulation on preference port calls of specific ships	Legal			X	X							X		
L3	Contractual clauses - Charter Parties	Legal	X	X				X							
L4	Strict regulation on traffic management at ports	Legal				X						X		X	
L5	Lack of regulation to implement JIT scheme	Legal	X	X	X	X		X	X	X	X	X	X	X	X

In conclusion, we have outlined the key barriers to adopting JIT in maritime transportation, including economic, social, technological, environmental, and legal challenges. While these factors present significant obstacles, they are not exhaustive, and there is considerable potential for further exploration of additional barriers. Understanding and addressing these complexities is crucial for advancing JIT practices in the maritime industry, and ongoing research may reveal even more nuanced challenges and opportunities for improvement.

3.2 Identify paths of least resistance to acceptance

Having exposed the barriers at different levels to the adoption of the JIT solution in the maritime port sector, this section explores what could be the paths of least resistance to acceptance.

Political barriers play an indirect but important role in this adoption. The paths found to resolve this resistance are as follows:

- **P1 - Port governance model with strict regulations related to restrictions.** Developing flexibility in operations to quickly adapt to regulatory changes and restrictions (Flexible shifts and schedules, for example)
- **P2 - Inadequate physical infrastructure at ports to handle turnovers of goods.** Incentive and finance mechanisms to upgrade the infrastructure, mainly focus on the optimisation of the supply chain
- **P3 - Security restrictions at ports.** Real-Time Monitoring tools to be implemented to supervise the port activities and to analyse potential hazards. Risks management based on data.
- **P4 - International conflicts impacting the JIT concept.** Collaborative schemes between commercial agreements for win-win situations. Alert mechanisms to provide alternative routes to the ships navigating through dangerous areas
- **P5 - Trade agreements between countries and flow of goods.** Flexibility in the regulation and same rules for the different traffic of goods. Collaboration of shippers through trade associations, etc.
- **P6 - Tariffs and taxes applied to imports and exports that could slow down processes.** Implementation of Integrated administration management solutions to accelerate customs and other inspection formalities procedures
- **P7 - Labour policies and laws that could workforce availability of JIT processes.** Public-private collaboration to make more flexible the regulation with a scope based on throughput
- **P8 - Cross-border regulations that could create bottlenecks and delays.** Developing flexibility in operations to quickly adapt to regulatory changes and restrictions (flexible shifts and schedules, for example). Certification programmes to recognise same patterns and look for solutions in this matter.

The economic barriers also are direct and are related to different aspects such us technology, environmental and legal. Those possible paths of least resistance for those economic barriers are:

- **EC1 - Scenarios of winners and losers in terms of incomes.** Incentive mechanisms to encourage stakeholders to bet on the technology. Win-Win business models building processes to capitalize the main advantages of the JIT adoption.
    - **Calculation of share costs/revenues of JIT arrival.** For the calculation and distribution of the financial benefits of slowing down the ship, some charters suggest that the virtual arrival time calculation must be conducted by an independent third party agreed upon by both the ship owner and charter. It can be considered to share the fuel savings with the terminal, shipowner and charter in order to ensure all parties receive an equitable portion of the fuel savings thanks to JIT arrival. This, however, requires a check and adjustment of the entire contractual chain.
    - **Disincentive related to demurrage rate.** Include a JIT arrival clause in the charter party contract to ensure it can be seamlessly passed through the sales chain like any other clause. Standard clauses are usually undisputed by any party. This does not ensure a fair distribution of the costs/benefits; however, the distribution is agreed upon and time is not lost in renegotiation**.**
    - **Stakeholders who do not get economic benefit does not want to participate in JIT.**
- **EC2 - Uncertainty in the demand and level of prices.** Long-term contracts with clauses boosting JIT processes for all the scenarios.

- **EC3 - Size of the main customer and preferential treatment regarding the management of the cargo.** Establishing clear rules and procedures for every customer to provide the services. The governance model is an issue because the implementation of JIT in private ports or small ports where a customer could represent more than the 50% of the total business is difficult. Boost collaboration at port cluster level to get the approval of clear procedures.
- **EC4 - Low efficient supply chains in terms of operation.** Elaboration of a toolkit to implement JIT with special care about those developing ports in where the logistics are not mature enough, identifying the possible barriers and specificities to adjust and fine-tune the process
- **EC5 - Changes in transportation costs - value of cargo versus cost of transportation.** The speculative aspect of transport costs is a difficult barrier to resolve, especially for tramp shipping. Efficient management of port charges in anchorage areas could try to mitigate these situations. Additionally, sharing the Passage Plan and a reliable ETA well in advance would allow for anticipating events, improving coordination, reducing turnaround time, and thereby lowering the total port call costs.
- **EC6 - Complexity in the logistics coordination.** Provide robust, resilience and accurate IT systems that could facilitate the JIT operations in the port. The clarity in the standards for this kind of solutions is also key
- **EC7 - Risks of supply chain disruptions.** One of the main reasons to adopt JIT is to avoid this kind of situations. In that sense, a complete risk assessment of the JIT solution in the port could help to mitigate these possible risks
- **EC8 - Fuel cost to adapt the port call to JIT scheme.** External barrier that cannot be mitigated. If the port is bunkering hub, there can be some incentives for those entities asking for bunkering or supply if they approve to be part of the JIT scheme in the port
- **EC9 - Implementation of technology onboard translated into higher TCO.** Blend financial mechanisms from public authorities and possible rebates in the port dues and fees because the adoption of this technology.
- **EC10 - Idle time in the maritime business for specific cargoes.** Setting up an appointment service, both on the seaside and on the land side. A queue system in which those who commit to meeting their assigned slot are rewarded with economic benefits could help reduce unproductive time. It is important that this is applied on both sides of port logistics, for vessels as well as for trucks and trains.
- **EC11 - Competence issues - how port calls are managed and economic criteria set.** Establishing clear rules and procedures for every customer to provide the services. The Governance model is an issue because the implementation of JIT in private ports or small ports where a customer could represent more than the 50% of the total

The incentives for the social barriers are:

- **S1 - Change management.** Facilitate training and upgrading skills for free among the stakeholders involved
- **S2 - Limited access or lack of new skills and training.** Be more precise and simplify the front-end for all type of users
- **S3 - Personal incentives for the implementation of a new way of operating - putting the focus on the trust between stakeholders.** Establish an incentive mechanism that could favour wage improvements for the adoption of JIT schemes in the various jobs associated with the operation.
- **S4 - Unfavourable working conditions.** Establish an incentive mechanism that could favour wage improvements for the adoption of JIT schemes in the various jobs associated with the operation.
- **S5 - Limited access to professional development opportunities.** Facilitate training and upgrading skills for free among the stakeholders involved

- **S6 - Stigma and negative perceptions - including discrepancy between working regulations at sea and at shore for personnel.** Education and training information, recycling courses and follow-up by the process quality control department, etc.

From the point of view of technological barriers, the possible incentives to less resistance could be:

- **T1 - Lack of investments in technology.** Finance and grants opportunities to modernise the assets of the companies involved in JIT schemes.
- **T2 - Lack of connectivity at sea.** Development of collaborative R&D projects jointly with other sectors to resolve this problem. Adopt European Space Agency (ESA) standards and solutions to be developed in our sector.
- **T3 - Cybersecurity of the data exchange.** Implementation of integrated and seamless solutions to preserve this kind of problems in the systems like other cybersecurity actions in sectors like banking, etc.
- **T4 - Complexity in the technology onboard.** A combination of end user specificities analysis to facilitate the definition of the new job position responsibilities and duties, as well as training, etc.
- **T5 - Complexity in the technology onshore.** A combination of end user specificities analysis to facilitate the definition of the new job position responsibilities and duties as well as training, etc.
- **T6 - Level of congestion in specific routes translated into delays and long-time staying.** Specific coordination and mitigation measures considered when defining the JIT infrastructure adopted.
- **T7 - Back-up security systems in case of failures.** One of the main reasons to adopt JIT is to avoid this kind of situation. In that sense, a complete risk assessment of the JIT solution in the port could help to mitigate these possible risks.

The environmental barriers also are indirect. The possible paths of least resistance for those barriers are:

- **ENV1 - Increased port calls leading to higher emissions.** Establishing limits under regulation to enhance sustainable traffic growth. Avoid seasonality characteristic of the traffic where possible.
- **ENV2 - Port pollution.** Establishing limits under regulation to enhance sustainable traffic growth. Avoid seasonality characteristic of the traffic where possible.
- **ENV3 - Limitations or restrictions on vessels at berth.** Setting up an appointment service.

Finally, the legal barriers and the possible solutions:

- **L1 - Data sharing among companies involved in JIT processes - commercial sensitivity of data critical for berthing ships, etc.** Adopt transparency criteria, collaborative schemes without compromising the competence of each of the companies and agreeing on what information to share, in what quantity and establishing information sharing criteria like those used by public bodies (examples PCS, customs, etc.). Social/bilateral agreements can be established particularly in smaller port communities to agree on data sharing. Code of conduct: Agreements can be formalised without enforcement such that both parties can agree to share data. Contractual: Formalising agreements by application of private law with enforcement. This can be performed by amending existing contracts or by agreeing on new contracts. Port regulations: Agreements can be formalised through public law with enforcement. Port license to operate licenses can be provided with minimal conditions to service providers. Data owners can have the choice if the data is to be shared with other parties. Efficient planning of resources can enhance the exchange of information between stakeholders which can ensure mutual benefit.
- **L2 - Regulation on preference port calls of specific ships. Sometimes port regulations do not meet the JIT needs.** In particular, the formalities required in the EMSWe do not establish specific measures to

promote JIT in port calls. Including appointment services in PCS systems based on requirements aimed at meeting JIT in EMSWe could encourage parties to comply with this operational scheme.

- **L3 - Contractual clauses - charter parties**. Same rules for all kind of traffics at port level to avoid differences among customers.
    - **Contractual barrier in voyage charters: The due dispatch clause.** Implement a standard JIT arrival clause into the voyage charter party to allow the ships' Master to adjust the speed of the ship without violating the contract.
    - **Ship carrying several different cargoes.** Adapt the chart party to permit the ship to reach the Requested Time of Arrival at the Pilot Boarding Place (RTA PBP) while presenting the ship's Notice of Readiness (NOR) at the time it would have arrived if it had travelled at charter speed with due dispatch (virtual arrival) and physically arrived at the Pilot Boarding Place (PBP).
    - **Cargo traded during voyage.** Include a JIT arrival clause in the charter party contract to ensure it can be seamlessly passed through the sales chain like any other clause. Standard clauses are usually undisputed by any party. This does not ensure a fair distribution of the costs/benefits; however, the distribution is agreed upon and time is not lost in renegotiation.
- **L4 - Strict regulation on traffic management at ports.** Establishing limits under regulation to enhance a sustainable traffic growth. Avoid seasonality characteristic of the traffic where possible**.**
- **L5 - Lack of regulation to implement JIT scheme.** New regulations adopted in port clusters.

In short, all these barriers need to be addressed holistically by considering local communities, the regulation that impacts on them and seeking collaborative environments to make them happen. Those external aspects that are difficult to manage require close collaboration with public administrations and those that have to do with the stakeholders directly involved require a joint debate to adopt valid measures for the common good of those entities that implement JIT as a fundamental element of optimization of their operations.

3.3 Define incentive values

In the maritime sector, the adoption of JIT port call optimization offers a range of incentives shaped by PESTEL factors. These incentives are often closely linked to contractual agreements within the industry, influencing both the adoption and success of JIT methodologies. This expanded exploration examines how various incentives interplay with contracts and regulatory frameworks, including those provided by BIMCO and other key organisations.

Economic incentives

Cost reduction and revenue increase:

Fuel savings: One of the main economic incentives of JIT is the reduction of fuel consumption. By optimizing voyage speeds and minimizing idle times, maritime operators can significantly cut fuel costs. Contracts, such as BIMCO's "Standard Time Charter" agreements, often incentivize fuel efficiency through performance clauses that reward fuel-saving practices or penalize wasteful fuel use.

Higher revenue: Improved operational efficiency and reduced turnaround times lead to increased throughput, ultimately boosting revenue. For port operators and terminal managers, contracts often include performance bonuses tied to meeting efficiency targets. JIT methodologies enhance productivity, helping achieve these contractual goals.

Cost reduction: One of the significant benefits of JIT practices is reducing operational costs. By minimizing unnecessary delays and optimizing resources, maritime companies can achieve considerable cost reductions, which are often encouraged through contract terms rewarding cost-effective practices.

Contractual performance clauses:

Increased throughput and timeliness: Many maritime contracts, including those from BIMCO, feature performance-based clauses emphasizing timely operations. For instance, BIMCO agreements may include penalties for delays or rewards for on-time performance. JIT practices align well with these clauses, ensuring efficient port calls and helping stakeholders meet contractual deadlines, thus avoiding penalties.

Stable revenue streams: With more stable revenue streams facilitated by reduced delays and smoother operations, JIT helps ensure predictability in financial outcomes. Contracts that emphasize steady performance can benefit from JIT's ability to minimise operational disruptions and foster consistent revenue flows.

Social Incentives

Public and environmental relations:

Enhanced public relations: JIT optimisation benefits relations with local communities and stakeholders by minimising environmental impact and enhancing operational efficiency. Contracts may include clauses requiring environmental responsibility and community engagement. JIT supports these goals by improving sustainability efforts and fostering positive community relations.

Worker welfare:

Improved working conditions: Efficient operations, enabled by JIT, contribute to safer and more satisfying work environments. Contracts often include provisions focused on worker welfare and safety, aiming to improve working conditions. By optimising operations and reducing delays, JIT fosters a safer workplace, aligning with contractual commitments to improve employee well-being.

In summary, the incentives for adopting JIT port call optimisation are multifaceted, deeply intertwined with contractual frameworks across the maritime sector. Understanding these incentives - such as fuel savings, resource optimisation, increased throughput, environmental benefits, increased efficiency, higher revenue, environmental sustainability, operational efficiency, cost reduction, stable revenue streams, regulatory compliance, enhanced safety, public and environmental relations, efficient processing, and reduced costs - is essential for stakeholders. By aligning these incentives with contracts from organisations like BIMCO, maritime operators can successfully implement JIT methodologies, driving efficiency, sustainability, and compliance throughout the industry.

Technological incentives

Increased efficiency through technology:

Efficient processing: JIT heavily relies on advanced technologies like real-time tracking, automated scheduling, and data analytics. Contracts, such as those set by BIMCO, often promote the use of these technologies to improve performance. For example, BIMCO's "Standard Ship Management Agreement" encourages the use of tech to enhance operational efficiency. JIT leverages these advancements to achieve the desired increased efficiency outlined in contracts.

Resource optimisation:

Optimal resource utilisation: The efficient management of port resources like berths, tugs, and cranes is crucial for JIT optimisation. Contracts often feature provisions that emphasize effective resource utilization. Organisations such as the International Association of Ports and Harbors (IAPH) promote best practices incorporated into contracts. JIT practices help optimise resource scheduling and reduce bottlenecks, aligning with these contractual goals.

Environmental incentives

Environmental benefits: JIT practices help reduce emissions by cutting idle times and optimising voyage routes. This aligns with the growing number of environmental clauses in contracts, often stemming from regulations like the International Maritime Organization's MARPOL Annex VI, which mandates reductions in sulphur and nitrogen oxide emissions. Contracts requiring compliance with these standards benefit from JIT methodologies by lowering emissions and ensuring regulatory adherence.

Environmental sustainability: Contracts are increasingly incorporating sustainability clauses to align with global environmental objectives. These clauses often call for reducing carbon footprints or meeting specific environmental metrics. JIT practices support these contractual requirements by optimising operations to minimise environmental impacts and promote sustainability across the maritime industry.

Legal incentives

Regulatory compliance:

Compliance with laws and standards: JIT optimization assists maritime operators in meeting regulatory requirements through improved operational practices. Maritime contracts, governed by organizations like BIMCO and the International Maritime Bureau (IMB), include clauses mandating compliance with environmental and safety regulations. JIT methodologies improve compliance by ensuring efficient operations that align with legal standards.

Enhanced safety:

Safety and risk management: By reducing congestion and optimizing scheduling, JIT practices decrease the likelihood of accidents, thereby improving safety. Maritime contracts often include safety clauses that mandate adherence to safety standards. JIT practices reduce risks, ensuring compliance with these safety requirements and contractual obligations.

3.4 Map incentives to each direct stakeholder

Once the various incentives for implementing port call optimisation in a port have been identified, it is crucial to establish the relationships between these incentives and the key stakeholders involved (Chapter 6.1). Understanding these connections ensures that the optimization process aligns with the interests and responsibilities of each party. The following section presents a comprehensive map of the incentives within the port call process, highlighting which stakeholders are affected, how they are impacted, and the nature of their involvement. This analysis will provide deeper insight into the roles and expectations of each stakeholder, facilitating smoother collaboration and more effective implementation of port call optimization strategies.

Incentives are categorised as follows:

1. Clear guidelines and procedures for green operations: Standardised protocols for green operations (Legal, Environmental)

2. Cost reduction: Savings achieved through optimized operations and reduced delays (Economic)

3. Emission reduction: Lower emissions achieved via efficient scheduling or operations (Environmental, Economic)

4. Enhanced capacity utilisation and resource optimisation: Optimised use of resources and infrastructure (Economic, Technological)

5. Enhanced market position: Stronger reputation and competitiveness in the market (Social, Economic)

6. Enhanced safety and compliance: Ensuring compliance with safety and regulatory requirements (Social, Legal)

7. Environmental sustainability: Adopting practices that minimize ecological impact (Environmental)

8. Improved situational awareness: Access to real-time data and better decision-making (Technological)

9. Public and environmental recognition and relations: Positive recognition for sustainable and efficient practices (Social, Environmental, Political)

10. Reduced administrative burden: Simplified and streamlined operational processes (Economic, Technological)

11. Regulatory compliance: Adherence to international or local standards and regulations (Legal, Environmental)

To analyse the implementation of port call optimisation effectively, it is essential to examine the specific roles of stakeholders and their associated incentives. This mapping highlights the alignment between the incentives and the operational priorities of each stakeholder group. By clarifying the impacts and interdependencies, this framework provides a structured approach to understanding stakeholder expectations and responsibilities. The analysis establishes a foundation for streamlined collaboration, ensuring that port call optimisation strategies are both practical and aligned with the interests of all involved parties.

Table 11. Maritime stakeholders' roles in JIT port operations. Source: Own work

Incentives/ PESTEL factor	Berth planner	Cargo buyer Cargo seller	Nautical service providers	Port authorities	Port planner	Ship agent	Ship charterer	Ship manager	Vessel or cargo service providers

Clear guidelines and procedures for green operations *(Legal, Environmental)*	X	X		X	X				
Cost reduction *(Economic)*	X	X	X	X		X	X	x	x
Emission reduction *(Environmental, Economic)*	X	X	X	X	X		X	X	
Enhanced capacity utilisation and resource optimisation *(Economic, Technological)*	x		X	X	X	X		X	X
Enhanced market position *(Social, Economic)*	X	X			x		X	X	
Enhanced safety and compliance *(Social, Legal)*			X	X	X	X		X	X
Environmental sustainability *(Environmental)*	X	X	X	X	X		X	X	X
Improved situational awareness *(Technological)*	x		X	X	X	X		x	

Public and environmental recognition and relations *(Social, Environmental, Political)*	X	X		X			X		
Reduced administrative burden *(Economic, Technological)*		X				X		X	
Regulatory compliance *(Legal, Environmental)*	X		X	X	X		X	X	

The **Stakeholder-Incentive Matrix** presented here is designed to provide a clear and structured visualisation of the relationship between direct stakeholders in the JIT port call framework and their corresponding incentives. Each stakeholder plays a critical role in optimising maritime operations, and this matrix highlights the specific incentives that align with their objectives.

In this matrix:

- The **rows** represent key **incentives** derived from the PESTEL analysis (Political, Economic, Social, Technological, Environmental, and Legal factors), which drive stakeholder engagement and motivation.
- The **columns** represent the main **stakeholders** involved in JIT port call processes, including ship operators, port authorities, terminal operators, maritime service providers, maritime authorities, and customs and border authorities.

Each cell in the matrix is marked to indicate which stakeholder is incentivised by a particular factor. The objective is to map incentives to stakeholders to identify the driving forces that motivate each group to adopt and support JIT processes. This structured approach helps in visualising how different stakeholders benefit from JIT initiatives and aligns their incentives with broader industry goals.

Key highlights from the matrix include:

Berth planners *are incentivised by enhanced capacity utilisation, clear guidelines for green operations, and improved situational awareness, aligning with economic, environmental, and technological goals.*
Cargo buyers *prioritise emission reductions, cost savings, and better predictability in operations, aligning with economic and environmental objectives.*
Cargo sellers *are incentivised by enhanced market position, contractual simplifications, and sustainability efforts, which align with economic, social, and environmental priorities.*

Nautical service providers *benefit from cost reduction, enhanced safety, and improved situational awareness, addressing technological, economic, and legal incentives.*
Port authorities *gain from resource optimisation, regulatory compliance, and public and environmental recognition, aligning their efforts with economic, social, legal, and technological advancements.*
Port planners *are incentivised by enhanced capacity utilisation, streamlined green operations, and reduced congestion, supporting economic, environmental, and technological priorities.*
Ship agents *value cost reduction, improved situational awareness, and reduced administrative burdens, linking to operational efficiency, technological innovation, and economic sustainability.*
Ship charterers *are driven by cost reduction, enhanced market position, and regulatory compliance, aligning with economic, environmental, and legal expectations.*
Ship managers *benefit from efficient resource utilization, better operational safety, and improved decision-making through situational awareness, which align with technological, economic, and social goals.*
Vessel or cargo service providers *focus on enhanced safety, cost efficiency, and sustainability, supporting economic, technological, and environmental efficiency.*

4. Contractual architecture

For JIT arrival to work, i.e. optimising a vessel's voyage to arrive at a destination port entry when berth and/or cargo is available, the interests of the individual stakeholders in the supply chain need to be aligned. For this to the governing contracts must contain express (i.e., specific conditions agreed by all parties), mutually agreed clauses that permits the JIT process without penalties for late arrival of ship or late delivery of cargo due to adherence to JIT.

Bulk cargoes make up the largest part of commodities transported by sea. A plain vanilla bulk commodity transaction involves a cargo seller and a cargo buyer. The chain of contracts that may decide whether a JIT arrival process can be executed starts with a sales transaction with terms on point(s) of delivery, delivery or shipment date or date range, transfer of title and liability (as embedded in INCOTERMS 2010), potential penalties for non-conformance (e.g. demurrage) expressly covered in the sales contract.

The commercial transactions for commodities shipped in containers do not impact on the decisions whether to allow a JIT arrival process. Therefore, this sub-task does not include contractual considerations for containerised cargoes.

In this section, we will describe the flow of essential documents, and the notifications and messages triggered by the terms of the documents. We will then identify the gaps for JIT success in the existing documentary framework through an analysis of the key agreements supporting a bulk commodity transaction from agreement of a sales contract to final delivery of cargo. With clarify of the gaps in the contractual framework we will address key changes needed in the essential contracts to facilitate the JIT arrival process.

4.1 Identify End-to-End Document Flow in Plain Vanilla Transaction

The key documents in contractual process of a bulk commodity transaction includes the commodity sales contract and the charter party for fixing the vessel to transport the cargo from port of origin to port of destination, and the Bill(s) of Lading evidencing contract of carriage. Depending on the INCOTERMS governing the sales transaction, the seller or the buyer is responsible for chartering the ship, or space on a ship, to ship the cargo. The contractual stipulations embedded in the documents trigger several messages and notifications, which have been captured in the document flow. For the sake of completeness, JIT planning messages (Requested Time of Arrival; RTA) and IMO FAL declarations have also been included. Figure 6 is intended to show the complexities, stakeholder interaction and contractual requirements required to facilitate a JIT arrival.

Private agreements between a liner shipping company and its customers may include a commitment to meet scheduled arrival dates at destination ports within a liner shipping network, however, no such agreements have been identified in the public domain.

A review of liner shipping agreements that are available in the public domain has identified no contractual constraints for the implementation of a JIT port call process. In fact, a stipulation on the website of liner shipping company CMA CGM the following disclaimer is published:

"Schedules, ports of call and prices described [here above], are only for indicative and commercial purpose and cannot be considered as contractual commitment. As modifications and updates can be made at any time, you are invited to check them regularly or to contact our local agents"[21]:

The documents reviewed are described below.

Contract	Specimen	Conclusion
Slot Agreement	BIMCO SLOTHIRE	No constraints identified
Service Contract	BIMCO SERVICECON	No constraints identified
Charter Party Clause	BIMCO Containers Clause 2002	No constraints identified
Fixed Scheduling Commitment		This is essentially a JIT commitment, i.e. a way to ensure a consistent schedule, however it is driven hard by port operations and challenges to international routes: • Suez Canal • Port bottlenecks pushing schedules back (LA) • Fuel costs (when considering returning to the schedule)
Port Terminal Window		No Constraints Identified
Vessel Sharing Agreement	CMA CGM / MARFRET Vessel Sharing Agreement as filed with FMC	No constraints identified
Cooperation agreement	CMA CGM / COSCO Shipping / OOCL Cooperation Agreement as filed with FMC	No constraints identified
Bills of Lading	Bill of Lading CMA CGM Terms & Conditions	No constraints identified. Disclaimer of contractual commitment (see above)
Other	OECD Impact of alliances in container shipping	No constraints identified
Other	UNCTAD Liner Sipping: Is there a way for more competition	No constraints identified
Other	DTU: Liner shipping network design	No constraints identified

Each swimlane represents a stakeholder and an asterisk (*) indicates that a stakeholder is the initiator of a contract, or a notification or message triggered by a contract.

[21] (CMA CGM, n.d.)

The following symbols have been used in the diagram and includes the commercial contract, notifications to for example the vessel or other stakeholders, JIT messages which optimise the voyage, and declarations:

Notes for the swim lane (indicated in the diagram)

1. *Transport requirements*, Load/discharge window**
2. *Voyage instructions*, Bunker stem*, Agent appointment**
3. *Packing List*, Bill of Lading*, Export Customs Declaration*, Certificate of Origin**
4. *Statement of Fact update*, Bill of Lading*, Export Customer Declaration*, Certificate of Origin**

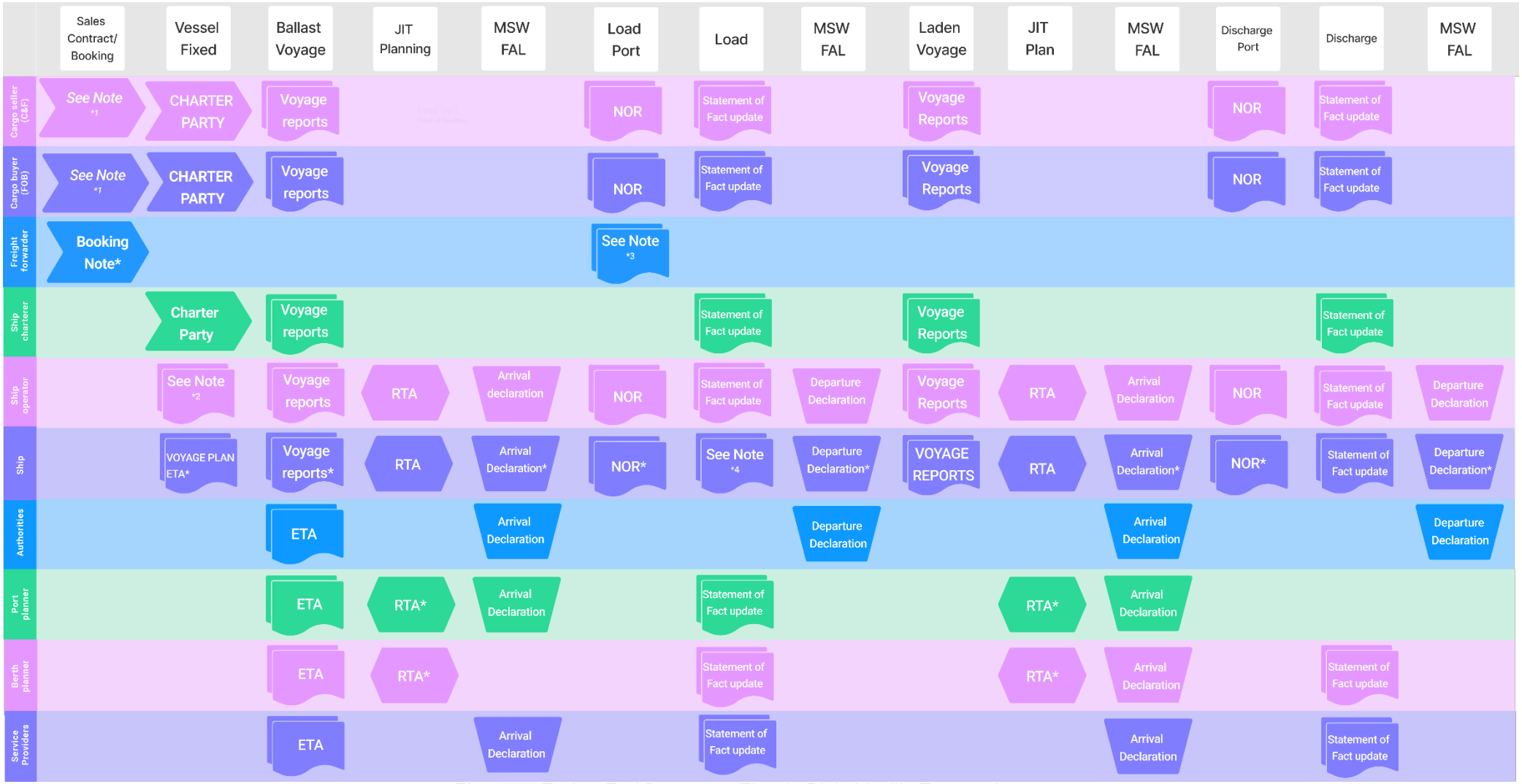


Figure 5. End-to-End Document Flow in Plain Vanilla Transaction.

4.2 Identify gaps for JIT success in existing contracts

Having identified the document flow in a plain vanilla commodity transaction we examine the key contracts that support the commodity transactions from agreement of a sale through the chartering of a vessel to delivery against a Bill of Lading or a Sea Waybill to identify obstacles to the execution of a JIT port call process.

To determine the contracts analysed in this document, it was important to recognise that most charter parties are based on standard forms, many of which are publicly accessible, such as those provided by BIMCO. These charter parties and bills of lading typically adhere to standardised templates, designed to streamline the process, with companies noting the contract to their specific requirements. It is not uncommon for a standard template to be used and heavily redacted and amended. When examining sales contracts specifically, it is worth noting that these are often tailored to individual companies and are generally not publicly available. Most standard forms are publicly accessible from the authoring organisations. However, when it comes to sales contracts, the nature of these documents means that certain details are sometimes less readily available.

In selecting documents for this analysis, we prioritised the most widely used standard forms to provide an industry overview which would offer an essential and comprehensive perspective on the process. A complete list of contracts used in this analysis is provided in the appendix. However, for reasons of commercial confidentiality, only documents residing in the public domain have been included.

The type and scope of commercial contracts analysed is described in the following table:

Type of contract	Number of forms analysed	Trade covered
Commodity sales contracts, including contracts for shipment of cargoes and legal reviews of specific contracts	24	Grains, coal, iron ore, feeding stuffs, crude oil,
Voyage charter parties	20	Coal, gas, grains, chemicals, vegetable/animal oils and fats, cement, ore, fertilisers, heavy lift cargoes, LNG, iron ore, relief cargoes, crude oil and oil products, general voyage charter party
Documents evidencing contracts of carriage (Bills of Lading, Sea Waybills)	16	Gas, grains, chemicals, cement, coal, ore, combined transport, general use Bill of Lading and Sea Waybill, liner Bill of Lading, fertilisers

4.2.1 Bulk commodity sales contracts

Commodity contracts play a pivotal role in the global trade and economy. These agreements facilitate the movement and exchange of essential goods such as oil, gas, metals, grains, and sugar. Commodity contracts are legally binding agreements between parties for the sale and purchase of commodities, and underpin global supply chains, ensuring the smooth flow of goods across borders.

Standard contracts issued by trade associations such as Gafta (The Grain And Feed Trade Association), FOSFA (The Federation of Oils, Seeds and Fats Associations), and indeed by many major energy, mineral and agricultural companies and traders, usually embrace INCOTERMS 2010, a set of definitions of international trade terms developed by the International Chamber of Commerce (ICC). It defines the trade contract responsibilities and liabilities between buyer and seller. The exporter and the importer need not undergo a lengthy negotiation about the conditions of each transaction. Once they have agreed on a commercial term like “free on board” (FOB), they can sell and buy at FOB without discussing who will be responsible for the freight, cargo insurance, and other costs and risks.

INCOTERMS were first published in 1936 - INCOTERMS 1936 - and are revised periodically to keep up with changes in the international trade needs. The complete definition of each term is available from the current publication - INCOTERMS 2010, although transactions are still executed based on previous editions (e.g. INCOTERMS 1980, INCOTERMS 1990 or INCOTERMS 2000).

The contract may be absolute, meaning that the sale occurs on agreement of the contract, or it may be conditional, i.e. dependent on certain conditions such as chartering a ship for transportation. The type of contract (absolute or conditional) will depend on the desire of the contracting parties.

Based on the INCOTERMS the party responsible for transport of the cargo (this could be either the buyer or the seller) needs to charter a ship or space on a ship, if a ship is needed. The search for available and suitable ships might be undertaken by a (chartering) broker.

4.2.1.1 Subsection conclusion

An overview of the analysed documents is given in the table below.

Table 12. Representative of documents analysed. Source: Own work

Contract/terms	Notification	Vessel nomination	Laycan	Shipment/ delivery period	Laytime/ lay days	Port nomination
Cargill Berth 20 Port Loading Protocols 2023-2024	+	+	+	+		
COREX Iron Ore Purchase and Sales Contract			+	+	+	+
GAFTA Contract for Grain in Bulk_1_2022		+		+	+	
STASCO GTC FOB	+	+	+		+	
Yancoal Proposed Coal Sales Agreement		+	+		+	

Many, but not all, of the sales contracts reviewed contains stipulations regarding notification, nomination and laycan timeframes.

Similarly, several of the contracts reviewed contains formats for Letters of Credit, stipulating the inclusion of the start and end dates of the loading period.

The review has not identified any contractual stipulations that explicitly hinder the Just-In-Time (JIT) port call process. However, the commercial decisions made by each actor, driven by their individual interests, remain a significant barrier to effective collaboration which is representative within table 12.

+ indicates that an impeding stipulation described in the heading is included in the contract/term analysed.

4.2.2 Voyage charter parties

In shipping, a voyage charter describes an agreement to hire a vessel for a specific voyage or round-trip between specified ports. The one-off nature of voyage charters means they are commonly used for one-time shipments and occasional shipping requirements. For example, an oil company taking advantage of an unexpected crash in oil prices may decide to buy more stock than usual and choose a one-off voyage charter for a deep-sea tanker to transport the crude oil from Ras Tanura port in Saudi Arabia to Corpus Christi port in Texas, United States.

A voyage charter is agreed between a shipowner (who provides the vessel) and a charterer (who pays to transport goods). The charterer pays either a lump-sum or quantity-based freight rate to transport the cargo for the specific voyage, as well as the cost of loading and unloading the goods.

Shipping associations including BIMCO, Intertanko, ASBA and others publish standard charter parties for use in the specific trades, usually developed in close co-operation with representative organisations from the trade involved, as well as representatives from Protection and Indemnity Associations (mutual liability insurance associations, usually referred to as P&I Clubs). The shipping associations collaborate on revisions and regularly provide a seal of approval for each other's documents. Charter parties developed by one or more charterers or commodity interests may also be approved by the shipping associations, usually following a negotiation process aimed at balance and fairness of terms. Due to the nature of the contractual terms, it prioritises best dispatch at all points to ensure the voyage is completed as quickly as possible.

In addition to the specific terms regarding loading, discharging, laycan, laytime, demurrage etc., the voyage charter parties developed by the shipping associations includes clauses regarding adherence to specific national laws, for instance, the US Oil Pollution Act 1990, as well as international conventions on liability and other aspects like "The Hague Rules", "the Hague-Visby Rules" or "the York-Antwerp Rules".

4.2.2.1 Subsection conclusion

Below in table 13 is an overview of the document that have been analysed in this section.

Table 13. Representative documents analysed.

Contract/terms	Despatch[22]	Charterer's cancelling option	Speed adjustment	Alignment of terms with B/L
CEMENTVOY	+	+	-	-
AMWELSH 93	+	+	-	-
COAL-OREVOY	+	+	-	-
INTERTANKVOY 87	+	+	+	-
SYNACOMEX 2023	(+)[23]	+	-	-

The primary obstacle to JIT is the obligation on shipowners to proceed with "due or utmost despatch" and "without deviation". This is a critical aspect of making JIT arrivals work as ships are otherwise unable to adjust their speed to arrive at a port at an optimal time to avoid delays without breaching their usual voyage charter obligations.

The cancelling provisions ("laycan") may also prevent a JIT process. Some voyage charter parties include a specific timeframe for charterers to accept extending the cancelling date provided the ship owner provides timely notification they anticipate a late arrival, but such terms will not, on their own, facilitate a JIT process.

If the charterer accepts extending the cancelling date, and such acceptance may impact on the timely, contractual delivery of the cargo the receiver, it is important that the ship owner is protected from any liability for the delay, such protection to be embedded in the charter party terms and referenced aligned with the terms of the Bill(s) of Lading for the cargo(es) under carriage.

[22] Respectively termed "due", "utmost", "reasonable", "convenient".
[23] SYNACOMEX' clause 2 stipulates "with all convenient speed" rather than despatch.

4.2.3 Time charter parties

A time charter is an agreement to hire a vessel and its crew for a specified period, usually a set number of months or years. During this period, the charterer has more control over the ship, including choosing its schedule, route and cargo handling procedures. These features make time charters most suitable for businesses which ship cargo on a consistent and regular basis. Under a time charter, the cost of using the vessel is either a fixed amount or a hire rate, which is typically calculated daily. For example, a gas company may use a time charter to hire an LNG carrier to regularly ship gas from Qatar to Japan.

Time Charter Parties have not been included in the review as they have no bearing on the JIT arrival processes under review.

4.2.4 Documents evidencing contracts of carriage

According to the United Nations Convention on the Carriage of Goods by Sea (in force: 1992-11-01): "Bill of lading" means a document which evidences a contract of carriage by sea and the taking over or loading of the goods by the carrier, and by which the carrier undertakes to deliver the goods against surrender of the document. A provision in the document that the goods are to be delivered to the order of a named person, or to order, or to bearer, constitutes such an undertaking.

Being a document of title, conferring title to the goods, the Bill of Lading is customarily referenced in the sales contract and the voyage charter party, hence any deviations from the terms of those documents could have a bearing on Bill of Lading holders' willingness to take delivery of the contracted commodity following a deviation from the shipment date to accommodate a JIT process.

Also known as "Express Release Bill of Lading" or "Straight Bill of Lading," a Sea Waybill is used when the shipper decides to release ownership of the cargo immediately. This means that the goods can be delivered to the person identified in the document, and they will simply have to verify their identity instead of presenting a document to claim the freight. A Sea Waybill only plays an evidential function and does not give title to the goods (non-negotiable).

When the shipment is loaded, the shipper receives a Sea Waybill simply as a reference, hence neither the shipper nor the importer is obligated to submit any additional documents to the carrier, and therefore the cargo is released as soon as it is available at the port. In the context of JIT arrival, the Sea Waybill is not relevant.

4.2.4.1 Subsection conclusion

The clauses contained in the Bills of Lading analysed are protective in nature, referencing a selection of internationally agreed conventions and other legal instruments, for instance:

- General Paramount clause, referring to "the Hague Rules" and its subsequent amendment, "the Hague-Visby Rules".
- General Average clause, stipulating that general average shall be adjusted, stated and settled according to York-Antwerp Rules 2016.
- New Jason Clause, committing the shippers, consignees or owners of the goods to contribute with the carrier in general average.
- Both-to-Blame Collision Clause.

None of the clauses listed have any bearing on the port call process, and the review has not identified any other contractual stipulations that would impede a JIT port call process.

The Sea Waybills for bulk commodities analysed ("Chemtankwaybill 85", "Genwaybill 2016", and "Yaraseawaybill") all contain the same clauses as contained in Bills of Lading (see above). These Sea Waybills have no bearing on the port call process and would not impede JIT arrival.

The combined transport sea waybill and the liner sea waybills ("Combiconwaybill 2016", and "Linewaybill 2016") reviewed both contains clauses regarding the methods and routes of transportation.

The Linewaybill 2016 clause 4 may in fact facilitate a JIT arrival process, stipulating:

"(a) As the Vessel is engaged in liner service the intended voyage shall not be limited to the direct route but shall be deemed to include any proceeding or returning to or stopping **or slowing down** at or off any ports or places for any reasonable purpose connected to the service including maintenance of the Vessel and crew, and the Vessell may still sail with or without pilots, undergo repairs, adjust equipment, drydock, be towed or tow vessels in all situations".

"(b) Whether expressly arranged beforehand or otherwise, the Carrier shall be at liberty to carry the goods to their port of destination by the said or other vessel or vessels either belonging to the Carrier or others, or by other means of transport, proceeding either directly or indirectly to such port and to carry the goods or part of them beyond their port of destination, and to tranship, land and store the goods either on shore or afloat and reships and forward the same at the Carrier's expense but at the Merchant's risk."

The Combiconwaybill 2016 clause 6 is less explicit, stipulating:

"(1) The Carrier is entitled to perform the transport, and all services related thereto in any reasonable manner and by any reasonable means, methods and routes."

"(2) In accordance herewith, for instance, in the event of carriage by sea, vessels may sail with or without pilots, undergo repairs, adjust equipment, drydock and tow vessels in all situations."

4.2.5 Section conclusion

None of the commodity sales contracts reviewed contain terms that would penalise one of the contractual parties if a JIT port call process was executed.

The voyage charter parties carrying the obligation on shipowners to proceed with "due or utmost or convenient or reasonable despatch" and "without deviation", confers an obligation on the ship owner or operator to instruct the ship to sail at the vessel's normal service speed towards the destination port, leaving the ship owner or operator exposed to losses if instructions were given to reduce speed in order to accommodate a JIT port call process.

In addition to the speed issues addressed above, the contract cancelling provisions ("laycan") could expose the ship owner or operator to losses if a JIT port call process resulted in the arrival of ship after the cancelling date.

Due to the nature of ocean transport, the transit time involved, and the international scope of the trade, payment for goods requires careful consideration. Most payments are made via a letter of credit (L/C), which is part of the contract of sale and arranged by the buyer. Upon receipt of the transport documentation, provided that the bill of lading (B/L) is clean without any additional comments and compliant, the bank releases funds to the seller according to the agreed

credit terms, such as "at sight" or deferred payment. The bank's primary obligation under an L/C is to release funds upon sight of compliant documents, with injunctions to halt payment being exceptionally rare.

The Bills of Lading and Sea Waybills reviewed, containing only protective clauses, do not in themselves prevent a vessel from aligning its arrival with a Just-in-Time (JIT) process. However, since a B/L is a document of title and is referenced in the L/C (often the preferred payment method), the L/C terms must be carefully observed to avoid penalties or cancellation. The interconnected nature of the L/C, B/L, and any JIT clauses in effect can lead to situations where a bank may consider the L/C requirements unmet - for instance, if transportation documents, including the B/L, are issued late. This situation could increase legal risks for the parties involved and potentially slow the adoption of JIT arrival practices.

4.3 Define contractual amendments required

For JIT arrivals to be facilitated, several changes and amendments would be required to be adopted across parties. Depending on the transaction, some of the terms of the sales contract may be reflected in the voyage charter party, for instance, a delivery date or date range may be expressed as the laycan at the load port, potential penalties for non-conformance may transition into the demurrage provisions, just to mention two examples.

To facilitate a JIT arrival process, it is therefore essential that the terms of the sales contract contain mutually agreed clauses that will permit the optimisation of the voyage speed of the ship to arrive at its port of destination at an agreed date and/or time. These terms, whether native or included as rider clauses into standard contract forms, shall flow into the voyage charter party and, where applicable, into any associated document evidencing contracts of carriage.

4.3.1 Bulk commodity sales contracts

The international shipping association BIMCO is the recognised body for the development of standard documentation and document clauses for maritime transportation. In addition to developing documents under the BIMCO brand, BIMCO's Documentary Committee also review and issue as approved documents, charter parties and other maritime contract forms published by other trade bodies or companies, provided they meet BIMCO's standard for balance and fairness.

The considerations offered below may serve as guidance but are not exhaustive.

- *For contracts on FOB terms:*
  - *The parties agree that the charter party for the vessel chartered by the buyer shall include the BIMCO Just-In-Time Arrival Clause for Voyage Charter Parties 2021 (or any subsequently amendment thereof), and that the buyer shall direct the owner of the chartered vessel to optimise the speed of the vessel to arrive at the delivery port(s) at the agreed time.*
  - *The buyer furthermore warrants to ensure that the terms of the bills of lading, waybills or other documents evidencing contracts of carriage issued by or on behalf of the Owners provide that compliance by Owners with this Clause does not constitute a breach of the contract of carriage, as set out in subclause (e).*
- *For contracts on CIF/CIFFO/C&F/C&FFO terms:*
  - *The parties agree that the charter party for the vessel chartered by the seller shall include the BIMCO Just-In-Time Arrival Clause for Voyage Charter Parties 2021 (or any subsequently amendment thereof), and that the seller shall direct the owner of the chartered vessel to optimise the speed of the vessel to arrive at the delivery port(s) at the agreed time.*

- *The seller furthermore warrants to ensure that the terms of the bills of lading, waybills or other documents evidencing contracts of carriage issued by or on behalf of the Owners provide that compliance by Owners with this Clause does not constitute a breach of the contract of carriage, as set out in subclause (e).*

4.3.2 Voyage charter parties

The international shipping association BIMCO is the recognised body for the development of standard documentation and document clauses for maritime transportation. In addition to developing documents under the BIMCO brand, BIMCO's Documentary Committee also review and issue as approved documents, charter parties and other maritime contract forms published by other trade bodies or companies, provided they meet BIMCO's standard for balance and fairness.

BIMCO's approved clause for Just-In-Time Arrival for insertion into Voyage Charter Parties is commonly accepted as the yardstick for contractual clausulation in shipping documents and has therefore been selected as the contractual amendment in voyage charter parties that is most likely to find general acceptance.

Overview of BIMCO's Just-In-Time Arrival Clause for Voyage Charter Parties:

"The Just-In-Time Arrival Clause 2021 is for use in voyage charter parties where owners and charterers have agreed to operate a just in time arrival scheme that permits charterers to ask owners to optimise the speed of the ship to arrive at a destination at an agreed time. The clause takes a generic approach so that it can also form part of different vessel and port management schemes around the world. It may also be used together with the BIMCO Port Call Data Exchange Clause 2021 which has been designed to encourage wider application and use of the IMO data model framework for the harmonised exchange of ship/port information."

4.3.2.1 Just in Time Arrival Clause for Voyage Charter Parties

BIMCO offer a Just in Time Arrival Clause for their Voyage contracts (BIMCO Just in Time Arrival Clause for Voyage Charter Parties 2021), this amendment is discussed below:

(a) The Owners and Charterers shall use their best endeavours to obtain and share information regarding the Vessel's arrival time, this shall include, but not be limited to, information from, or required by, any relevant third party. Any port specific requirements shall be met.

(b) Notwithstanding any other clause in this Charter Party, the Charterers shall be entitled to request the Owners in writing to adjust the Vessel's speed to meet a specified time of arrival, or closest thereto, at a particular destination. Such request shall always be subject to the Owners' consent which shall not be unreasonably withheld and, in the case of an approach voyage, also subject to agreeing an amended cancelling date. The Charterers shall not be entitled to request an adjustment of speed outside the normal safe operational limits of the Vessel.

(c) Extra time used on a sea voyage as a direct consequence of the Vessel adjusting speed pursuant to the Charterers' request shall be the difference between:

(i) the "estimated time of arrival" as provided by the Vessel prior to the Charterers' request to adjust the Vessel's speed to meet a specific time of arrival, or closest thereto, at a particular destination; and

(ii) the "actual time of arrival" at that destination, or closest thereto.

Such extra time shall be compensated by the Charterers to the Owners at USD __ per day pro rata or as otherwise agreed by the parties which shall consider the savings in fuel by the Owners and shall be payable by the Charterers to the Owners, prior to completion of final discharge.

(d) Where the Vessel proceeds at a speed adjusted in accordance with subclause (b), this shall constitute compliance with, and there shall be no breach of, any obligation as to despatch and shall not constitute a deviation.

(e) The Charterers shall ensure that the terms of the bills of lading, waybills or other documents evidencing contracts of carriage issued by or on behalf of the Owners provide that compliance by Owners with this Clause does not constitute a breach of the contract of carriage. The Charterers shall indemnify the Owners against all consequences and liabilities that may arise from bills of lading, waybills or other documents evidencing contracts of carriage being issued as presented to the extent that the terms of such bills of lading, waybills or other documents evidencing contracts of carriage impose or result in the imposition of more onerous liabilities upon the Owners than those assumed by the Owners under this Clause.

4.3.2.2 Explanatory Notes

BIMCO has published the below explanatory notes on the sub-clauses contained in the above clause:

"Subclause (a) requires the parties to share information with each other regarding the ship's arrival time. This includes information, such as arrival times, to and from any relevant third party such as an agent, port or terminal. The words "any port specific requirements shall be met" are intended to apply to circumstances where the port or terminal requires the use of a specific data exchange format, such as the IMO Data Model Framework.

Subclause (b) gives the charterers the option to ask the owners to adjust the ship's speed to meet a certain arrival time or "closest thereto" (as the requested time might not always be within the ship's capabilities), at a particular destination. If the charterers' request to adjust speed might result in the ship not arriving within the cancelling date, a new cancelling date must be agreed. Otherwise, the charterers could cancel the charter party if the ship arrives after the cancelling date, even if the late arrival was due to the charterers' request.

Subclause (c) - among the benefits of using just in time arrivals schemes are reductions in emissions, fuel consumption, and time on demurrage. The Clause contains a very simple compensation mechanism that avoids references to fuel consumption and fuel prices. The reason for this non-prescriptive approach is that to arrive at an accurate figure the parties would have to make a calculation based on the ship's fuel consumption and the relevant bunker prices in operation. This would in turn create discussions about fuel consumption and what price should apply (Platts, current market price or price actually paid, etc.). Consequently, it is not possible to create a generic bunker sharing mechanism in a standard clause that will work for all. Instead, this should be worked out between the parties on a case-by-case basis.

An example of how this has been done by two commercial parties operating in the LNG trade is as follows: The parties agreed to bands for the bunker price and demurrage - the higher the bunker price (which translates into larger savings for owners due to lower fuel consumption), the higher the reduction of the demurrage rate. The reduction of the demurrage rate applies to the time saved, i.e., if the charterers ask the ship to arrive 12 hours later than its original ETA, the reduced demurrage rate will apply for those 12 hours.
In practice this could work as follows:

Bunker Price per metric ton	Percentage reduction of demurrage rate
USD 300 – USD 600	20%
USD 600 – USD 700	40%

The actual bands and percentages of the demurrage rate will depend on the contractually agreed demurrage rate and the consumption curve of the vessel. Sample calculations can be used to establish bandings and percentages.

The parties should agree on a rate that reflects the bunker savings made by the owners. No default figure has been included because the amount should be negotiated between the parties. If the parties do not fill in an amount, then subclause (c) will not apply and there will be no compensation payable by charterers for the extra time used and the owners will keep any bunkers savings.

To calculate the amount of extra time used on the voyage the parties should subtract the “estimated time of arrival” (when the request to adjust speed is made) from the “actual time of arrival”. The estimated arrival time will be the time the ship would have arrived if it had proceeded without adjusting speed, subject to prevailing weather conditions.

Subclause (d) overcomes one of the primary obstacles to implementing a JIT scheme. Owners are obliged under charter parties to proceed with due or utmost despatch and without deviation. This subclause protects the owners from being in breach of these obligations when adjusting the ship’s speed in response to a request from charterers.

Subclause (e) protects the owners from claims from bill of lading holders or other third parties. The charterers are required to ensure that all third-party documentation complies with the clause and to indemnify owners against any liabilities beyond those set out in the clause.”

Referencing the document flow in Annex 1 with the declarations required in FAL.5/circ.41, it is relevant to include BIMCO’s Port Call Data Exchange Clause 2021, designed specifically for use with the IMO data model framework for ships that will call at ports where the scheme has been implemented and where the exchange of ship/port information requires the IMO data format.

4.3.2.3 BIMCO Port Call Data Exchange Clause 2021

"If the ports of call or any relevant third party require information regarding the arrival and departure of the Vessel to be provided using the IMO data model framework, the Owners and Charterers shall use their reasonable endeavours to do so".

"IMO data model framework" means the Data Set and Reference Data Model defined in the IMO Compendium on Facilitation and Electronic Business (FAL.5/Circ.41.), or as subsequently amended."

4.3.2.4 Explanatory Notes

BIMCO has published the below explanatory notes on the sub-clauses contained in the above clause:

"There are currently different systems in place globally for information sharing between ships and ports regarding ships' arrival and departure times. The IMO Data Model Framework aims to harmonise this information so that it can be sent in the same format in all ports and terminals around the world. For this purpose, the IMO Data Model Framework has introduced a number of "timestamps", for example, the "Requested Time of Arrival" (RTA). The timestamps will be used together with a position, such as, "the pilot boarding place" or "berth". The combination of the timestamps and positions is what will be used in the communication between ships and ports for planning arrivals and departures."

The Port Call Data Exchange Clause has been drafted to promote the use of the IMO Data Model Framework as a globally harmonised method of exchanging arrival information between ships and ports.

The clause requires the parties to use their reasonable endeavours to provide information regarding a vessel's arrival and departure using the IMO data model framework.

The clause is designed not only for parties operating just in time arrival schemes, but also for other conventional port calls where adherence to the IMO time stamp terminology is required. It can therefore be used independently from the BIMCO Just in Time Arrival Clause for Voyage Charter Parties 2021 because using the IMO data format may apply for normal ship arrivals where a "just in time" scheme is not used.

The words "or any relevant third party" are meant to cover other parties operating within a port that might not be covered by the port authorities' rules for sending information."

4.3.2.5 Documents evidencing contracts of carriage

Although none of the Bills of Lading and Waybills reviewed include terms that specifically impede JIT arrival, it is nevertheless recommended that the parties to a sales contract include protective wording in the document of carriage as recommended in subclause (e) of the BIMCO Just in Time Arrival Clause for Voyage Charters 2021 (or any subsequent amendment thereof).

It is imperative that the terms of a Letter of Credit issued to guarantee payment of a commodity sales transaction is aligned with the terms of the shipping document that will facilitate a JIT port arrival process

5. Conclusions

Having clarified the strategic drivers of the direct stakeholders in the supply chain, the process flow from initiation of the supply chain process to the arrival of ships at the destination port was analysed, mapping the collaboration and interactions between the stakeholders.

Through a comprehensive PESTEL analysis the paper provides insights into the forces that exert pressure on JIT processes and Port Call Optimisation, identifying how political, economic, social, technological, environmental and legal dimensions could impact the successful implementation of MISSION's objective to contribute to increasing the transparency of the operational processes associated with port calls, increasing situational awareness among the agents involved, thereby improving the management of arrivals and departures from ports, reducing avoidable anchorage times and increasing the level of service to ships.

A critical component for creating acceptance of JIT port call optimisation among stakeholders is to understand the value drivers that motivate them. We have identified these value drivers for each stakeholder and analysed how they will facilitate the realisation of JIT processes, contributing to a robust value proposition for all actors. In our analysis and discussions about the current system, we identified the issue of split incentives, where one party benefits at the expense of the other. This dynamic underpins the existing contractual framework and hinders the adoption of more environmentally sustainable practices.

Following the process established with the PESTEL analysis, we have identified the barriers to acceptance of the MISSION objections, including the following examples which could impede the introduction of JIT:

- Geopolitics and the potential introduction of (new) tariffs (Political).
- The need to sacrifice demurrage income, which is essentially a premium on an inefficiency, would require ship operators to accept a changed business model, where prolonged ocean passage delivers freight income that compensates for sacrificed demurrage revenue (Economical).
- The impact of automation of port operations on labour forces, as recently evidenced by union action in North America (Social).
- Restrictions at berth, e.g. enforcement of cold ironing policies at ports, i.e. requiring ships to connect to shore power during berth calls, to reduce emissions from the ship (Environmental).
- Restrictive terms and clauses in the commercial contracts and voyage charter parties hindering JIT implementation (Legal).

Based on the analysis of barriers to acceptance, we have explored what could be the paths of least resistance to acceptance from the perspective of the PESTEL framework.

At the outset the value of JIT processes to each stakeholder appears to be obvious: Reducing waste in the supply chain would benefit all. However, the complexity of the supply chain processes and the documentary architecture that governs its transactions could derail the successful implementation, if stakeholder interests are not aligned. We have therefore analysed which types of incentives will become available from port call optimisation. Having identified the incentives, we have established the relationships between each incentive and the key stakeholders involved. Understanding these connections seek to ensure that the optimisation process aligns with the interests and responsibilities of each party.

Finally, we have identified the end-to-end document flow a plain vanilla transaction to identify the key commercial contracts that may impact the JIT process. We have then reviewed standard contracts used for the sale and purchase of bulk commodities, the voyage charter parties used for the chartering of vessels to deliver the commodities, and the documents evidencing contract of carriage, i.e. Bills of Lading and Sea Waybills, to identify documentary stipulations that may impede the JIT process.

The review of the standard commercial contracts has enabled us to consider amendments required to allow and facilitate the JIT port call optimisation process, with specific emphasis on utilising established documentary clauses published by international industry bodies like BIMCO. Although the reviewed documents contain no explicit terms that obstruct Just-In-Time (JIT) arrival, the commercial decisions influenced by these contracts create friction. To further promote JIT adoption, this paper recommends incorporating protective language, such as that outlined in the BIMCO Just in Time Arrival Clause for Voyage Charters 2021. This inclusion would foster a more collaborative and commercially aligned approach, encouraging stakeholders to embrace JIT and work together effectively.

6. References

Alvares, J. S. (2019). *Analysis of the role of shipping agent in the logistics chain and operations of curde oil tankers during their port call to the oil terminal of Balao, Ecuador.* EP FLOPEC.

ASP. (2023). *Understanding Strategic Business Drivers,.* Retrieved from https://www.theaspteam.com/blog/understanding-strategic-business-drivers

BIMCO. (2021). *Just In Time Arrival Clause for Voyage Charter Parties.* Retrieved from https://www.bimco.org/contracts-and-clauses/bimco-clauses/current/just-in-time-arrival-clause-for-voyage-charter-parties-2021]

Blue Visby (Geng Li, Jiajing Chen, Wanying Chen, Alexis Lau, Christine Loh). (2024). *The shipping practice of "Sail Fast Then Wait" and the Blue Visby Solution: Analysis of the health impact of emissions' reduction.* Retrieved from The shipping practice of "Sail Fast Then Wait" and the Blue Visby Solution: Analysis of the health impact of emissions' reduction, ,

CMA CGM. (n.d.). *Port Schedules* . Retrieved from CMA CGM : https://www.cma-cgm.com/ebusiness/schedules/port/detail?PortScheduleViewModel.POLDescription=MATADI%20;%20CD%20;%20CDMAT&PortScheduleViewModel.ActualPOLDescription=MATADI%20;%20CD%20;%20CDMAT)

EMSA. (2023). *Annual Overview of Marine Casualties and Incidents 2023*. Retrieved from https://emsa.europa.eu/publications/item/5052-annual-overview-of-marine-casualties-and-incidents.html

Gafta. (2024). *Gafta*. Retrieved from https://www.gafta.com/

IMO. (2020). *Just In Time Arrival Guide.* Retrieved from https://greenvoyage2050.imo.org/wp-content/uploads/2021/01/GIA-just-in-time-hires.pdf

IMO. (2022). *FAL.2/Circ.133 :LIST OF CERTIFICATES AND DOCUMENTS REQUIRED TO BE CARRIED ON BOARD SHIPS.* Retrieved from https://wwwcdn.imo.org/localresources/en/OurWork/IIIS/Documents/FAL.2-Circ.133%20-%20List%20Of%20Certificates%20And%20Documents%20RequiredTo%20Be%20Carried%20On%20Board%20Ships,%202022%20(Secretariat).pdf

IMO. (2023). *FAL.5/Circ.52, I:\CIRC\, GUIDELINES FOR HARMONIZED COMMUNICATION AND ELECTRONIC EXCHANGE.* Retrieved from https://wwwcdn.imo.org/localresources/en/OurWork/Facilitation/FAL%20related%20nonmandatory%20documents/FAL.5-CIRC.52.pdf

International Chamber of Commerce. (2011). *ICC Guide to Incoterms 2010.* Retrieved from https://halleycables.com/img/cms/INCOTERMS%202010%20Guide.pdf

International Trade Administration. (2020). *An Overview of The Incoterms*. Retrieved from https://www.trade.gov/know-your-incoterms

L.E.K. Consulting . (2017). Identifying and Managing Key Value Drivers. *Executive Insights*.

Mihmidati, N. W. (2024). *Release Order: An Important Document in Container Shipping.*

Sea.Live. (2023, July). *The impact of 1 knot on emissions*. Retrieved from Sea.Live.

Shweta Jhajharia. (2024). *The Four Strategic Business Value Drivers All Leaders Should Know.* Retrieved from https://growthidea.co.uk/blog/the-four-strategic-business-value-drivers-all-leaders-should-know

TLC Logistics Chartering . (2023, October). *Why should our clients care what a ship agent is about?* Retrieved from TLC Logistics Chartering : https://www.tlclogistics.lt/en/why-should-our-clients-care-what-a-ship-agent-is-about/

Tsvetkova, A., Hellström, M., Schwartz, H., Rabetino, R., & Syed, H. (2024). *A transition towards clean propulsion in shipping: The role of PESTLE drivers and implications for policy. Marine Policy, 161, 106002.* Retrieved from https://doi.org/10.1016/J.MARPOL.2023.106002

UK Hydrographic office. (2022). *Understanding the drivers, solutions and enablers within the shipping industry.* Retrieved from https://www.gov.uk/government/news/understanding-the-drivers-solutions-and-enablers-within-the-shipping-industry

Valenciaport. (2024, September 27). *One more administrative step to make the North Terminal of the Port of Valencia a reality*. Retrieved from https://www.valenciaport.com/en/one-more-administrative-step-to-make-the-north-terminal-of-the-port-of-valencia-a-reality/

Annex 1 - Declarations

The FAL Convention has been in force since 1967 but is kept continually amended and updated by Governments at the FAL Committee of IMO – which usually meets once a year at IMO's London Headquarters.

The FAL Convention seeks to standardize the information required by Member States from ships when calling a port to facilitate international trade.

According to the FAL Convention, public authorities shall introduce arrangements to allow the submission of declarations in electronic format, according to the guidelines and the requirements provided in the IMO Compendium.

Declarations may be required in paper form (FAL Forms) by the public authorities in exceptional circumstances in accordance with Standard 2.11.

This is the list of declarations for ship arrival and departure:

1. General declaration (FAL 1)
2. Cargo declaration (FAL 2)
3. Ship's Stores Declaration (FAL 3)
4. Crew's Effects Declaration (FAL 4)
5. Crew list (FAL 5)
6. Passenger list (FAL 6)
7. Dangerous Goods Manifest (FAL 7)
8. Delivery bill for mail consignment as described in the Acts of the Universal Postal Union, the Universal Postal Convention and its Regulations currently in force
9. Maritime Declaration of Health (International Health Regulations
10. Ship Sanitation Control Exemption Certificate or Ship Sanitation Control Certificate or extension (International Health Regulations)
11. Security-related information as required under SOLAS regulation XI-2/9.2.2 (MSC.1/Circ.1305)
12. Advance electronic cargo information for customs risk assessment purposes as set out in the WCO Safe Framework of Standards
13. Advance Notification document for Waste Delivery to Port Reception Facilities (MEPC.1/Circ.834/Rev.1)

The maximum information of the declarations 1) to 7) referred above is shown in appendix 1 of the last amendments to the annex of the FAL Convention, which entered into force on 1 January 2024.

Annex 2 - Certificates and E-certificates

All ships are required to carry certificates that establish their seaworthiness, type of ship, competency of seafarers and so on. These certificates are provided by the flag State of the ship and may be inspected by port State control officers.

To facilitate the clearance and inspection period for ships in port and in accordance with the formalities required of ships on the arrival, stay and departure of ships, the FAL Committee together with other IMO bodies issued FAL.2/Circ.133 on *List of certificates and documents required to be carried on board ships*, 2022. (IMO, 2022).

The FAL Committee agreed in 2014 (FAL 39) that electronic certificates should be treated as equivalent to traditional paper certificates, provided that the certificates and the website used to access them conform to the guidelines approved by the Organization and that specific verification instructions are available on board the ship.

Table 14. List of certificates and documents required to be carried on board ships (IMO, 2022).

1. Crew list	14. Class certificate
2. Registry certificate	15. Customs declaration
3. I.S.S.C. certificate	16. Safety Construction Certificate
4. I.O.P.P certificate	17. Safety Equipment Certificate
5. Supplement to the I.O.P.P. certificate (Form B)	18. Safety Radio Certificate
6. International Tonnage certificate	19. General Declaration (FAL Form 1)
7. CLC for oil pollution damage	20. Cargo Declaration (FAL Form 2)
8. CLC for bunker oil pollution damage	21. Ship's Stores Declaration (FAL Form 3)
9. Maritime Declaration of Health	22. Crew's Effects Declaration (FAL Form 4)
10. AIS Attestation or AIS service report	23. Crew List (FAL Form 5)
11. International Load Line certificate	24. Passenger List (FAL Form 6)
12. P&I Club certificate of entry	25. Dangerous Goods Manifest (FAL Form 7)
13. Safety Management certificate	

Annex 3 - Arrival/Departure declaration and information requirements

Port and other relevant authorities will require the following data to be submitted before ship's arrival:

Table 15. Data required for port call

Data required for port call
1. IMO No.
2. Flag
3. Call sign / MMSI No.
4. GRT/NRT/DWT
5. LOA/breadth/draught
6. Quantity/quality of cargo
7. Last port of call
8. Next port of call
9. Registered owners

Table 16. Pre-arrival/pre-departure forms requirements

Pre-arrival/pre-departure forms requirements	Pre-ETA
Pre-arrival notification	72 hours
Pre-arrival notification	24 hours
ATA notification	
ATD notification	

ISPS forms	
Hazmat notification - pre-arrival	
Hazmat notification - pre-departure	

Annex 4 - Commercial documents and processes that may impact JIT arrival

The types of commercial documents and processes that may affect the timely arrival of a ship unless they are aligned for the purpose of optimising the supply chain includes the below documents. The sales contract between the seller and the buyer of the commodity contains contractual stipulations about delivery of the cargo, the delivery dates etc.. As a JIT port call process could result in the vessel delivering its cargo at a later date than the stipulated delivery date, the buyer might be entitled to demurrage or other damages, or indeed befree to terminate the contract, unless it contains express provisions that permits the delivery after the due delivery date without penalty. Such provisions need to flow into the governing charter party for the delivery voyage, in order to protect the ship and its owners from penalties for a delay.

Table 17. Commercial document

Commercial document
Commodity sales contract
Charter Party
Contract of Affreightment
Surveyor reports: • Hull/tank cleanliness • Quality • Quantity
Bill of Lading
Waybill

Annex 5 - Operational notifications, records and invoices

The **Notice of Readiness** is the key notification from the ship to the charterer/cargo shipper that the ships is ready to commence cargo operations and, subject to the stipulations of the Charter Party governing the voyage, triggers the commencement of laytime. In the dry bulk trades, it is customary for ships to sail at speed to the load port in order to tender Notice of Readiness as early as permitted, with a view to generate demurrage revenue to the ship owner/operator when laytime is exceeded.

During the port call the ship, the ship's agent, the charterer/cargo shipper or their agent, will maintain a detailed timesheet of all cargo loading or discharging events and any stops in the cargo process, from the End of Sea Passage and Notice of Readiness tendered until cargo operations have been completed, whether within or exceeding the laytime allowed under the Charter Party. The timesheet will be compiled into a **Statement of Facts**, which forms the basis for the **Laytime** computation. If the cargo operations have been completed within the time allowed the charterer/cargo shipper may be entitled to **Dispatch**, i.e. compensation for time not used. If, on the other hand, cargo operations exceeded the time allowed, the ship owner/operator will be entitled to **Demurrage**, as compensation.

For the sake of completeness, a list (not exhaustive) is included of the invoices that derives from the various nautical, commercial and port call processes:

- Weather routing services invoice
- Commodity sales invoice
- Freight invoice
- Demurrage invoice
- Dispatch invoice
- Commission invoices (address, brokerage)
- Disbursements Account, including agency fee, harbour dues, nautical services etc.
- Surveyors invoice

Annex 6 - Documents reviewed

Commodity sales contracts

- *AWB (Cargill Australia Limited) General Terms & Conditions*
- *Cargill Australia Mobile Shiploading – Berth 20 – Port Adelaide Inner Harbour Port Loading Protocols 2023/2024*
- *Cargill Australia – Export Grain Services Agreement 2023/2024*
- *Cargill General Sales Contract Terms and Conditions November 2016*
- *Commoditylaw: Review of the Shipping Conditions for Sales of Indonesian Coal Basis FOBT Kalimantan*
- *COREX Iron Ore Purchase and Sales Contract (Delivering Cargo) (V1.0)*
- *Gafta Contract No. 1 – General Contract for Shipment of Feedings Stuffs in Bags – Tale Quale – CIF/CIFFO/C&F/C&FFO Terms*
- *Gafta Contract No. 38 – Contract for Grain from Argentina in Bulk – FOB Terms*
- *Gafta Contract No. 41 – Contract for Grain in Bulk Parcels – RYE Terms – CIF/CIFFO/C&F/C&FFO Terms*
- *Gafta Contract No. 59 – Contract for South African Grain in Bulk – Cargoes – Tale Quale - CIF/CIFFO/C&F/C&FFO Terms*
- *Gafta Contract No. 64 – General Contract for grain in Bulk – FOB Terms*
- *Gafta Contract No. 79A – Contract for United Kingdom and Ireland Grain – FOB Terms*
- *Gafta Contract No. 94 – Contract for the Arrival of Grain in Bulk – RYE Terms*
- *Gafta Contract No. 101 – Contract for the Shipment of Feedingstuffs in Bulk - RYE Terms – CIF/CIFFO/C&F/C&FFO Terms*
- *Gafta Contract No. 114 – Contract for Fertiliser in Bulk or Bags – Parcels of Cargoes - Tale Quale - CIF/CIFFO/C&F/C&FFO Terms*
- *Gafta Port Terms No. 129 – Loading Terms for United Kingdom Ports*
- *Gafta Contract No. 200 – Supply Contract General Terms in Bulk or Bags*
- *Richards Bay Coal Terminal Proprietary Limited – Shipping Regulations*
- *Shell International Trading and Shipping Company Limited (STASCO) – General Terms & Conditions for Sales and Purchases of Crude Oil (2010)*
- *Shell International Trading and Shipping Company Limited (STASCO) – General Terms & Conditions for Sales and Purchases of Products (2010)*
- *Shell International Trading and Shipping Company Limited (STASCO) – General Terms & Conditions for Sales and Purchases of Crude Oil – FOB Deliveries (2023 edition)*
- *Shell International Trading and Shipping Company Limited (STASCO) – General Terms & Conditions for Sales and Purchases of Crude Oil – CIF and CFR Deliveries (2023 edition)*
- *Shell International Trading and Shipping Company Limited (STASCO) – General Terms & Conditions for Sales and Purchases of Crude Oil – DAP Deliveries by Vessel (2023 edition)*
- *Yancoal / Shandong Energy (Hainan) Intelligent International Technology Co., Ltd. – Export Coal Supply Contract (FOB) (September 2023)*

Voyage charter parties

- *Amwelsh 93 Americanized Welsh Coal Charter*
- *Asbagasvoy Gas Tanker Voyage Charter Party*
- *Austwheat 1990 Australian Wheat Charter*
- *Bimchemvoy 2008 Voyage Charter Party for the Transportation of Chemicals in Tank Vessels*
- *Biscoilvoy 1986 Standard Voyage Charter Party for Vegetable/Animal Oils and Fats*

- *Cementvoy 2006 Voyage Charter Party for the Transportation of Bulk Cement*
- *Coal-Orevoy Standard Coal and Ore Charter Party*
- *Ferticon 2007 Fertiliser Voyage Charter Party*
- *Gencon 76 Uniform General Charter*
- *Graincon Standard Grain Voyage Charter Party*
- *Heavycon Standard Heavy Lift Charter Party*
- *LNGvoy Liquefied Natural Gas Voyage Charter Party*
- *Nipponcoal Coal Charter Party*
- *Nipponore Iron Ore Charter Party*
- *Quafcocharter Qatar Fertiliser Company (SAQ) Fertiliser Voyage Charter Party*
- *Synacomex 2023 Continental Grain Charter Party*
- *Tankervoy 87 Tanker Voyage Charter Party*
- *Worldfood 2017 United Nations World Food Programme Voyage Charter Party*
- *Yaracharter Voyage Charter Party*

Documents evidencing contracts of carriage

- *Asbagasbill Bill of Lading to be used with Asbagasvoy*
- *Austwheat Bill*
- *Bimchemvoybill 2016 Bill of Lading to be used with Bimchemvoy 2008 Charter Party*
- *Cementvoybil 2016 Bill of Lading to be used with CEMENTVOY 2006 charter party*
- *Coal-Orevoybil to be used for shipments on the Coal-Orevoy charter*
- *Combiconbill 2016 Negotiable Combined Transport Bill of Lading*
- *Congenbill 2022 Bill of Lading to be used with charter parties*
- *Conlinebill Blank Back Form of Liner Bill of Lading 2016*
- *Ferticonbill Bill of Lading to be used with the Ferticon 2007 charter party*
- *Grainconbill 2016 Bill of Lading to be used for shipments under the Graincon charter party*
- *Intankbill 78*
- *Yarabill Bill of Lading to be used with Yaracharter*
- *Genwaybill 2016 Non-negotiable General Sea Waybill*
- *Chemtankwaybill 85*
- *Combiconwaybill 2016*
- *Linewaybill 2016*
- *Yara Seawaybill (2006)*