Port Call Optimization
in three oil shipping markets

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Preface

This thesis is the result of a number of months of research into three oil shipping markets and the relevance of port calls to their business. This thesis is meant to obtain my MSc degree in International Economics at the Erasmus University Rotterdam.

The subject first of all had my personal interest. Working at a ports' harbour master division, I always wondered what it was that made shippers chose for a particular port, especially those shippers that are not bound by either a liner service or by industrial production needs, thus the more footloose commodity trades.

Working at the harbour masters' division of the Port of Rotterdam, my employer and indeed the port in question, I saw a change from being a pure authority, taking care of safety and the environment in the first place, to adding to that authority task the efficiency for the (sailing) port clients.

At the same time the -in itself- simple question 'what do we know about our clients needs', couldn't be answered by many people, nor did many of us really know 'who exactly are our clients'.

The questions became more pregnant after a number of initiatives were introduced that addressed the provision of all sorts of information from the harbour master to… Indeed, to who exactly. Not all of that information was new in itself. A lot of it was given orally by the port control center to those who needed it for formal permissions or for organizing their port processes. And in that sense the harbour masters' division was always concerned about an efficient port sailing process. The structured way of offering it, the (earlier) timing, the transparency and electronic means however certainly were new. Those changes made the earlier questions even more relevant and to them were added a couple of new ones; is it a matter of squeezing out the very last bits of inefficiencies in the shipping systems? Or does it really have an economical value of any importance?

A professional interest was also a driver for the subject of this thesis; working for the European and International Harbour Masters' Association, it appeared not to be easy to convince harbour masters of the relevance of early and accurate nautical information to port users. Perhaps they had the same questions and doubts that I had? And perhaps they needed prove before eating the pudding?

I hope this thesis offers some of this prove and I want to thank everyone who has contributed to it.

Content

Management summary

The role of the Port Authority has been changing over the years and is still a changing one in the present time. The performance of ports, a customer orientation and a supply chain focus are high on the agenda in these changes.
It seems only natural that herewith the harbour master, who traditionally cares about a high safety level in the port, adds to his focus a high performing port. In his case, such high performance will address the performance of the vessel in the port. And this is also where he can find his customer focus; in digging into the needs of the port clients as far as the port call concerns and contribute, for the clients, to a higher productivity of the vessel.

He can do so by taking an information position, notably an information position that focuses on the vessel and that takes the vessels' productivity as point of departure. The information in question has two dimensions; one, the exchange of planning information between all the port services around the vessel and two, by up-to-date, accurate and reliable nautical port information of all sections in the port. The harbour master who thus manages to optimize the calls that vessels pay at his port, contributes to the competitiveness of this port.

By looking at a structured way to the port customers' business, one can assess the relevance of nautical port information and the exchange of planning information. This is now done for three oil shipping markets, but could as well be done in such manner for the other wet bulk sectors, the dry bulk markets and the container sector.

One of the findings is that the need for ports to optimize the calls that vessels pay at their ports, has increased since the balance between production flows, being more captive to industry, and trade flows, being much more volatile, has changed towards increasing trade flows.

Another finding is that the need for optimization in port calls on the clients side lies with the industrial shippers and the traders, as well as it does with the shipowners, but for different reasons. The industrial shipper, having the market power, is a bigger driver though for optimization. And since large traders make a move towards more industrial shipping as well, the call for optimizing port calls only increases.

The processes that can be optimized by the harbour master appear not only to lie in the port leg, but also in the approach part of the sea leg and in the preparations for the port call; in deadweight utilization of the ship, when fixing vessels and estimating their freight rates. In the port leg it is the time ships spend in port that can be improved in two ways; in the organization of the services around the ship and in the execution of the port call, when there are no costly changes necessary in the initial plan of the visit.

And finally the study showed that the smaller the ship, the more added value of an optimized port call.

Chapter 1 INTRODUCTION

Port business and port management of course have been changing over the years. It seems however that notably the present-day knows some fascinating new developments in ports; there is an emphasis on value and supply chains and on customer orientation, on the performance of ports and therewith port competition and port choice, on changing market powers and vertical integration. The role that ports play or should now play is questioned and at the same time defended by seeking how to be truly part of the value chains and finding answers to the question what customer orientation exactly should mean.

In this changing business environment also the role of the port authority is changing from a more traditional facilitator to a true (co-)developer. The harbour master, whilst still assuring a safe port, being his role since centuries, is also not closing his eyes for the port customers businesses and their focus on port operations' efficiency and productivity. As the Intertanko[1] 'Knowledge Center' puts it; "Key to the success of a harbour master is being able to balance a ship's safe arrival and departure with the commercial pressures of not keeping a ship waiting longer than is absolutely necessary".

The harbour master may take this additional role notably by an information position via which he influences a number of processes around the ship whilst in port, approaching the port or even long before that.

Actively sharing information with numerous parties around and behind the ship, he can optimize the vessels' port call. An optimized port call in turn improves the productivity of the ship and makes for an efficient shipping industry and competitive port.

A high ship productivity is a priority for shipowners and shippers that increases as ships grow in size and therewith capital intensity. But it is a priority for ports as well now that ports face increasing competition for customers and sometimes reach the limits of their quay capacities and navigable waters.

So this is where harbour masters and port shipping industry can meet in this new area; in an improved port call performance through a pro-active information position from ports, notably the harbour master. This information position knows two aspects; first, the port information that port users require and second, the exchange of information between port users. Both aspects are key to support the shipping business processes and achieve a higher vessel productivity.

Which are these processes that are supposed to benefit of such harbour masters information position? And for who is this relevant and how relevant really is it? In order to find out, this thesis elaborates on port call optimization for seagoing vessels in three tanker markets; crude oil, oil products and chemicals and explores what an optimal port call exactly is for those shipping markets.

Seeking a customer orientation in these markets means digging into the oil trade and transport systems; the world seaborne oil transports, the present structure of the oil tanker markets, whether or not the shippers conduct industrial operations, the relationship between charterers and shipowners, the market powers they have, the contracts that bind them and whether the spot or rather the term markets are leading.

To get a comprehension of the magnitude of the oil shipping industry and hence of the value of port call optimization, oil shipping movements are considered, as well as voyage distances in relation to port stay time and the vessels serving the markets and inducing the port calls.

[1] Intertanko is the organization of independent tanker owners, representing 70% of the independent tanker fleet.

1.1 Research goal

The goal of this thesis is to investigate which are the elements of vessel productivity that can be improved by a harbour masters' information position such that the vessel can optimize its' port call.

Who is it that benefits from such port call optimization: which of the different actors in the oil shipping business are seeking for an optimized port call and who bears the costs for suboptimal port calls. In other words 'who would be the client of the port', if not the shipowner who is usually considered to be the client of the port. Does port call optimization contribute to supply chain optimization in the oil markets and is there a difference between segments?

What are the relative weights of an optimized port call for the three oil shipping markets.

1.1.2 Sub questions

ϴ Which are the economic decisions that affect a port call, which are the contractual obligations between charterers and owners, which are the processes behind a vessel calling at a port;

ϴ Who are decision makers when it comes to port call. Can an improved port call contribute to the choice for such a port? Is port time a decisive factor in port choice and for which sectors;

ϴ How has industrial shipping evolved, who has market power in the present day tanker market;

ϴ Owned ships, long term charters, ships employed in the spot market; is there a difference in operation and port call requirements?

1.1.3 Research method

The method of research is threefold;

Firstly by means of literature and desk study covering main scholar books in shipping economics, port economics and relevant shipping business law, as well as annual reports and companies' publications of the parties involved; shipowners, cargo owners, terminal operators, trading companies, port authorities.

Secondly by means of interviews and discussions with the above mentioned companies as well as with brokers, lawyers, industry associations, ship management companies, Port of Rotterdam.

And lastly by compiling or using supporting statistical data, both on an aggregated level from OECD, UNCTAD, Worldbank and on a more specific level from shipping institutions, brokers, Port of Rotterdam etc.

1.2 Scope

The scope of the thesis is first of all limited to the tanker market, and within this market notably the crude oil market, oil products market and chemicals market.

There are quite some differences between the crude oil, the oil products and chemical sectors and transport systems. These differences will appear to have their effect on the relative importance of the elements of port call optimization; the time spend in ports is different, the relevance of the port as compared to the sea leg is different, the relevance for loaded cargo volumes is different and also those who benefit from an optimal port call or loose from a sub-optimal one, are different. In brief, their trade and transport systems are different as explored in chapter three. The processes that are influenced by the harbour master information may have different impacts which is explored in chapter four. And the relevance of port call optimization knows differences, and this is explored in chapter five.

And a final remark on the scope of this thesis; the research does not focus on the Port of Rotterdam but does take this port now and then as an example to show concrete examples and magnitudes.

1.3 Thesis overview

The information in question that provides for an optimized port call is explained in the next chapter, as well as what needs to be understood by port call optimization; what is to be seen as a port call and how is the productivity of the ship to be viewed in relation to a port call. Chapter 2 also speaks about the changing role of the port authority and the role of the harbour master. In this respect, the present chapter started with the changing business environment in ports. The interested reader may find in Annex III the present-day setting in ports in a global summary of a number of researchers' observations.

Chapter 3 subsequently describes the present structure of the tanker markets; the supply side of transport -shipowners or operators and the oil majors owning and operating fleets- and the demand side, traders and -again- oil majors and other oil companies. Who is shipping the different oil cargoes and how. Who benefits and who loses out on a sub-optimal port call. How are the relations charterer – shipowner at present days and who has market power. What are the contractual obligations towards each other, affecting port calls.

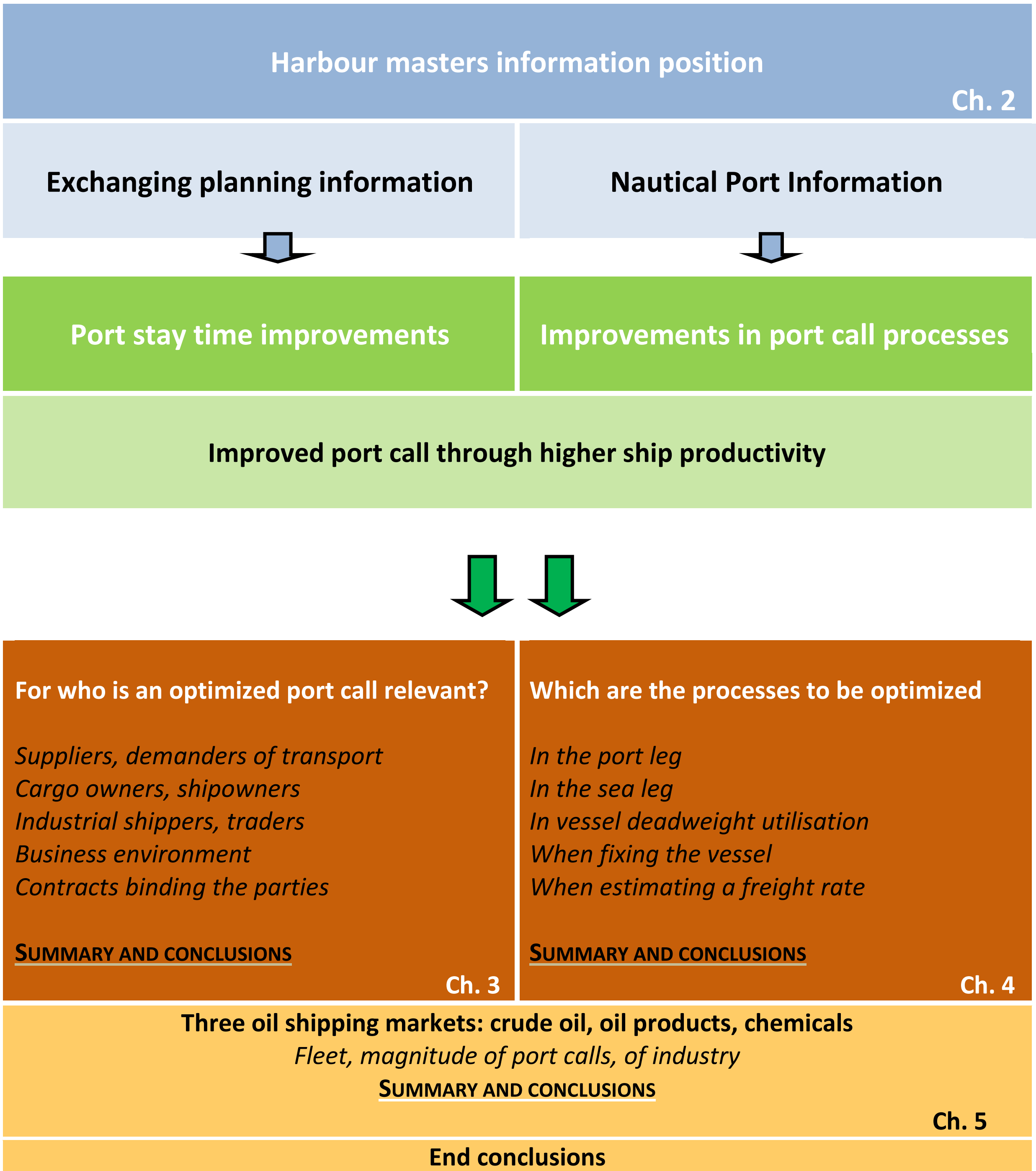
Chapter 4 elaborates on the processes to be influenced in order to achieve an optimized port call. Its' structure departs from an optimized port call being a call that (1) takes the least time for the ship to spend in port and/or (2) uses the least bunkers whilst approaching the port at optimal speed and/or (3) allows the ship to take the optimum volume of cargo to load or discharge at the port and (4) was well prepared when fixing the ship.

Chapter 5 gives a description of the tankers fleet size, tanker supplies and size of the markets. It describes the vessels employed for the different cargoes, their voyages -ship movements and distances- and the relative importance of their port calls.

Chapter 6 draws the conclusions.

The thesis ends with a glossary of terms and the literature overview.

1.4 Summary of the chosen approach



Chapter 2 THE HARBOUR MASTERS' INFORMATION POSITION

2.1 The changing role of the Port Authority

The ports business environment is constantly changing and in its slipstream so are ports and the port authorities managing them. Since maritime transport these days is no longer seen in separate silos; transport modes, ports, warehousing etc., a number of researchers have stressed the need for a changing role of ports as well as for the Port Authority. Competitive powers now lie in entire logistic chains. A port isn't a separate node, but is assessed in its contribution to the competitive power of a supply chain or value chain to which it belongs. The emphasis in present research lies in the logistics performance of the whole transport chain, of port competitiveness becoming increasingly dependent on the performance of the whole supply chain, and hence on port competition being carried between supply chains rather than between single ports ("chains compete, not individual ports") .
With supply chains becoming more and more efficient, ports are sometimes even considered weak links in the chain, "where activities are often carried out in a disorganized way, with high costs, inadequate customer services, lost opportunities and sub-optimisation of resources". The port industry must thus adopt a new attitude, moreover ports should go beyond their traditional role of simple transshipment point for freight and develop into 'fourth generation ports'. As an element in a value chain system, ports should deliver value to shippers and customer segmentation.

It is interesting in this respect to note that practically all research in this changing environment is addressing mainly the container business and is leaving the bulk sectors largely undiscussed.

This being said, with this changing role of ports in a new business environment of competing supply chains and a more market driven and customer focused approach, a number of researchers advice that also the role of the port authority should become a different one. A few of these researches are summarized in Annex IV.

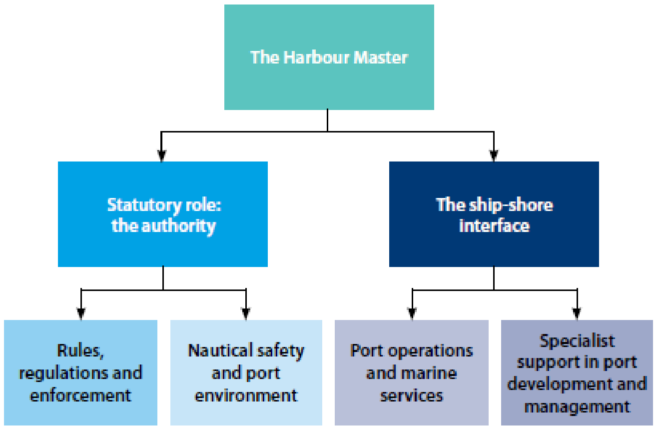
2.2 The role of the Harbour Master

Also the harbour master reviews his role in the changing business and port authorities environment and seeks for ways to chose a customer focus.

Who exactly is this harbour master and what does he do? Traditionally he is the person or the department that takes care of the controlling and co-ordinating of the arrival and departure of ships in the port and of the safe and efficient operation of the sea access to the port. His role includes the safety of the port and the ships within the port, the control of vessel movements, ensuring navigational safety on the water, diminishing the environmental impact of shipping traffic in the port and the emergency planning and response to incidents and accidents. He has jurisdiction over the water area of the port and part of the port approach, drafts the port byelaws and has the powers to enforce these and other legislation. So his duties encompass both a legal and operational responsibility for the movement of shipping.
His services are offered to all ships, irrespective of their trade and business model. This makes sense because the harbour master then acts at the (local) authority in the port, charged with a statutory role.

The authority role is not to be confused with the port authority; the organisation that governs the port. This governing body generally is responsible for the development of the port, the lease of land, port finances, spatial planning, intermodal networks, promotion activities and so on. Harbour masters may be charged with their statutory task as part of the port authority. They may also have their own, sometimes quite autonomous, responsibilities. However organised, performing a statutory task necessitates an authority in the port, and this will in many cases be the harbour master.

There is a second distinct instrument, next to his formal powers, that a harbour master may have at his disposal; operational assignment. It are these two aspects, the regulatory role and the exercise of jurisdiction on the one hand and the wider role as the ship-shore interface on the other hand, that cover the whole spectrum of mastering a port and the ships that call at this port.



The Work of the Harbour Master, Ch 1 Harbour Master–a profession defined, Nautical Institute, 2012

This second role, the ship-shore interface, as opposite to the regulatory position, makes sure that the marine operations in the port are not only safe and environmentally friendly, but run smooth and efficient as well. He may take a role in the planning of marine port operations. By now taking an information position, he can also contribute to the productivity of the ship and broaden his role as ship-shore interface.
In this role he can chose for another approach of port clients. He may take a look at the trade that the vessel serves and define what are the critical success factors to create value for the customer. Hence he may consider the needs of the port customers and perhaps even make a segmentation in services offered depending on the requirements of customers, hence chose for a true customer focus.

2.3 The harbour masters information position

The driver for this thesis are initiatives by the International Harbour Masters' Association and the Harbour Masters' division of the Port of Rotterdam that either address 1) the sharing of planning information and 2) nautical port information. Nautical port information contributes to the processes around fixing a vessel and subsequently organizing the port call and having an optimum deadweight utilization. Sharing planning information addresses the port stay and waiting time of a vessel. They both feed into the business processes of vessel operators contributing to;

- An improved turnaround time of the vessel, diminished port and waiting time
- Improved planning and reliability of sailing schedules and better organized services to the ships
- Improved port call preparations

2.3.1 Exchanging planning information

The harbour master division of the Port of Rotterdam is since recently engaged in a program to exchange planning information between all the services that are rendered to the ship in port and therewith seeks to contribute to a faster dispatch of sea-going vessels at arrival and departure of the ship. This in the believe that there are a number of delays around the services to the ship that can be reduced with better planning. Better planning means a co-ordinated planning by open exchange of individual services' planning information within the whole chain of events around the ship. Within the program it are notably the delays that arise around the departure of the vessel that are considered the biggest cause of deviations from the originally estimated and planned times of departure. This is turn is the cause of delay for the ship that is subsequently planned for the berth from which the first ship has left, with a delay. In the end it are a large number of small delays in a whole chain of events that add-up to an unnecessary delay to the vessel.

The project has defined a number of possible causes of delay;

Delays in nautical technical services to the ship	-pilotage, towing, mooring services
Delays in cargo services to the ship	-the cargo handling itself, ship to ship cargo transfers -surveys from inspectors to the cargo and draft surveys -document handling
Delays in services to the vessel	-bunkering, ship stores, sludge, slops, wastes, ballast water -technical breakdowns and repairs -ship vetting surveys -stowaway checks
Authorities' checks	-customs, flagstate, harbour master, immigration, seaport police
Vessel traffic planning	-locks, bridges -other vessels passing
Hydro-meteo situation	-weather conditions, fog, storm -tides

Source; Port of Rotterdam, Harbour Masters' Division, team 'Schip centraal', 2013

If the reliability of the services delivered to the ship -pilotage, tug operations, mooring operations, inspections, stores deliveries etc. etc.- can be increase by sharing planning information between all the services, delays for the ship can substantially be diminished. The program thus addresses the port stay time of the vessel.

2.3.2 Nautical port information

Avanti, Access to Validated Nautical Information, is an initiative from the International Harbour Master Association, IHMA, in which all information is provided by the individual harbour masters for their ports, in a standardized international format. It concerns all nautical information that is required for port entry and that is needed by the maritime industry, mariners, planners, ship managers, cargo bookers, ship operators, amongst others for an improved berth to berth passage planning, to comply with the IMO obligation for port passage plans etc.

The system provides in full transparency of information largely 'hidden' until now in internal port documents or notes that are made available upon request only. Or this information becomes available at a very late stage, for instance at pilot boarding, rather than being available beforehand for business processes use. Per section of the port Avanti gives pictures, charts, depth details and admission policies. An important part of Avanti are these different admission policies for different sections in the port. It are these admission policies that, if they are known beforehand, make earlier decisions possible regarding the planning for the vessels' reception in port and lower the risk of having to change berthing specifications at the last moment, something that frequently disrupts and delays a call. Exact depth information at each port quay finally make higher loaded volumes possible, something the industry is very keen to achieve.

The fact is that ships are loaded, discharged, sailed, operated and serviced by people who all use different sources of information about the same port. At present the marine industry and hydrographic offices struggle to collect this information via representatives who visit ports and terminals, or via captains reports after a port call. Despite these efforts information is never really up to date and available prior to entering port. There are indeed many different sources such as websites of ports and terminals, port and terminal information booklets or flyers, ship's agents and private databases, brokers information sources etc. These different, and mainly unauthorized, sources all provide other and often even incorrect or outdated information and there are many errors in the organization of a port call because of this fact. Errors that cost time and money to clients of the port.

The nautical port information in question is consulted for such things as speed restrictions and rendez-vous points for tugs, for port description and navigation, for available nautical services and communication, cargo loading and unloading requirements, tidal range data, ranges of water density, wind, visibility and speed restrictions, tug use and size restrictions, depth information and UKC restrictions, berthing details, passing and size restrictions, berth admission policies (Scherpenzeel van B., 2012).

2.4 The port call and vessel productivity

The port call can be viewed in three ways, it can be seen as;
- A single stretch in a voyage of a ship; as such it is the time that the vessel spends sailing from the pilot station to the berth at arrival and the other way round at departure. This is the time that is usually referred to as the port turnaround time.
- As the last part of the sea leg that the vessels sails from its' loading to its' unloading port.
- That part of the voyage that needs more preparation beforehand

Summary

Harbour masters Information position	Impact on the port call
Exchanging planning information	Impact on the port leg and last part of the sea leg
Nautical Port Information	Impact on the port leg and in the preparations of the port call

Optimizing port calls can be done in more than one way only. The perspective in this thesis is the productivity of the ship when calling at a port. The productivity of a ship, usually expressed in cargo ton miles per dwt, ultimately shows in its revenues. The revenues that a shipowner earns are (a) the freight rates that he can charge times (b) the total volumes carried, and he will seek to optimize both. The total volumes carried in turn depend on the total operating days and utilization; operating days are days the loaded days at sea, the days that the vessel carries cargoes[2], utilisation are the tons that are carried per day. The number of loaded days at sea is a commercial activity but is briefly touched because it clearly shows how port time as opposed to sailing time is perceived from an economic perspective.

So ship productivity in this respect has four dimensions; a time dimension (time is money), efficiency in operating the ship (such as speed and bunker use), deadweight utilization (the cargo loaded) and as little as costly surprises when calling and pricing (preparations and freight estimations). These dimensions are explored in chapter 4 “the processes to optimize ship productivity”.

2.5 Port call optimization in research

Many authors have studied the time factor role (Delfino, 2013) be it that this is studied from a perspective of benchmarking performance in ports, port competitiveness, from a point of view supply chain performance and logistics and the consequences for port authorities. In practically all cases and most notably in all supply chain literature, it is the container business that is addressed.

Delfino, Parola and Persico (2013) have demonstrated the relevance of the time factor in seaports as performance indicator by analyzing the operational performance of an Italian seaport (the Savona-Vado Ligure seaport in the Liguria Region, Northern Italy, Mediterranean Sea), defining the time factor as roadstead queuing time and seaport turn round time. The study does support the choice of the oil trades as subject for this thesis; their statistics showed that vessels specialized in dry and liquid bulk transport wait a lot of time for a berth available, respectively 18 and 12 hours on average, while container vessels average pre-berthing time is 5 hours.
39% Of the total time spent in this seaport by a liquid bulk vessel was waiting for a berth available, 19% for a dry bulk vessel, 16.5% for a container vessel and 16% for a general cargo vessel.

	Ship movements from 2002 to 2012 included	%	total turnround time hours, mean value	Pre berthing time, hours, mean value	Time at berth, hours, mean value
Container	2.594	13	30,36	5,00	25,36
Dry Bulk	2.806	14	94,25	18,49	75,76
General Cargo	4.959	25	28,32	4,62	23,70
Liquid Bulk	3.947	20	30,78	12,09	18,69
Passenger	5.621	28	8,72	0,92	7,80
Overall values	19.927	100	33,09	7,05	21,55

Source; elaboration Delfino, Parola, Persico, based on data provided by Savona Ship Informer

Also the probability that the waiting time before a new berth is cleared was less than a pre-set value was measured. With a pre-set value of 2 hours, the probability that a passenger vessel did have to wait for less than that was 99,9%, for general cargo it was almost 52%, for containers almost 40%, for liquid bulk almost 24% and for dry bulk 14%. With a pre-set value of 14 hours, it was almost 100% probably that passenger vessels, general cargo and container vessels had to wait less than that time, but for liquid bulk there was still a probability of 20% that that was not the case and even a little less than 40% for dry bulk.

[2] Ships only spend part of their time carrying cargoes. The average time use of VLCC’s is around 79% spent in trading and 21% in non-trading, being time spent for repairs, lay-up, waiting, short and long term storage and incidents. Of the 79% trading time, only 137 days -little more than ⅓[d] of its time- were spent carrying cargo. Ballast time accounted for 111 days and cargo handling, loading and discharging, for 40 days (Martin Stopford).

As a very global indication, these figures show that the choice for a number of liquid bulk trades is a relevant one when researching waiting times in port call optimization.

Unctad (2012) recently re-stated that the main objective of any port is to provide high quality services to all port users and ports therefore must always aim to higher efficiency to minimize time spent by vessels in ports and hence minimize costs.
Quality of port operations leads to improvements of ship operating efficiency and to reduction in shipping costs and therewith improvement in port efficiency. A ship's delay in port due to inefficient port operations is a major reason for increased operating costs. A ship's time in port is often defined as a key indicator to measure the efficiency and quality of port operations and therewith of a port in general. Ship's time in ports as a measure of port efficiency has been chosen more than once as factor to analyse the competitiveness of ports. Improvement in the efficiency of ship operational performance will increase the satisfaction of customers and it may affect customers in their port choice. The participants of an Unctad expert meeting in 2012, though a very limited audience, chose 'vessel time in port' -together with 'berth length' and 'total tones of cargoes handled'- as most desired indicators of port performance.

However, transport costs in oil markets are believed to be not very substantial. Stopford (1997) wrote that in the 1950s the cost of transporting a barrel of oil from the Middle East to Europe represented 49 per cent of the CIF cost. But by the 1990s, as the price of oil had increased, the cost of transport had fallen to just 2.5 per cent of the CIF price, and so transport cost became less important to the shippers of it. It is the question if this is still the case.

Furthermore it is generally believed that port costs are relatively low as compared to total transport costs and that time and reliability of service plays a less prominent role in bulk trades. For bulk cargoes in general, the value of cargoes is low which would mean that the time factor in transport is not very important from the point of view stocks. Also this can be questioned in present days.

Tongzon already showed in 1995 that, rather than with port charges, port users are more concerned with indirect costs associated with delays, loss of markets/market share, loss of customer confidence and opportunities foregone due to inefficient service.

Pettersen Strandenes and Marlow (2000) finally go as far as to suggest port pricing strategies that change from traditional differentiation to a price differentiation based on the quality of port service. Quality factors would be 'time in port' (the duration of the port stay) and 'punctuality of handling the vessel'. Shippers and shipowners in their view should be able to choose between different qualities and hence prices charged, in addition to the regular port dues. The value of speed and punctuality would then reflect the opportunity cost to shipowners of fewer fixtures per period. Such pricing scheme would also incorporate incentives to increase quality and efficiency in ports.

Annex III summarizes a number of other studies on relevant topics such as the value of port's time efficiency, port efficiency performance measures and present port choice decision problems.

Chapter 3 WHO IS SHIPPING OIL AND HOW

This chapter analyses the present structure of the tanker markets; the supply side and demand side of transport, shipowners, oil majors owning and operating fleets, oil companies and traders. Who is shipping the oil cargoes, how and why to particular ports, how are the relations charterer – shipowner at present days and who has market power. This will answer the question who benefits and who loses out on a sub-optimal port call and how certain contractual obligations towards each other, can affect port calls.

3.1 Modes of sea transport operation

Industrial and tramp shipping are two of the three modes of operation that can be distinct within sea transportation, the third one being liner shipping.
Industrial shipping is practiced by large oil extracting and manufacturing companies such as the oil majors. They usually own the cargoes shipped and control the vessels used to ship them either by owning or by chartering them. The own fleet and long-term charter fleet may have insufficient capacity to serve all cargoes and spot charters will then be added for single voyages. In all cases it is the industrial operator who controls the cargo and the fleet of ships. Ships schedules are integrated with the industrial processes and/or storage capacity at the destination port. Industrial shippers basically believe that it is cheaper, less risky, better serving their production needs or easier to coordinate their activities when ships are owned or operated internally.

In **tramp shipping**, ships are owned and exploited by shipowners who are usually specialised in specific cargo markets and -trades. Tramp shipping consists of carrying single cargoes in large volumes upon demand from individual shippers. Hence the routes are non-scheduled and tramp ships go from place to place depending upon where they can find cargoes; a ship that is engaged in the tramp trade follows the cargo it carries and has no published ports of call. Cargoes are carried at freight rates that are negotiated on a case-by-case basis whereby these freight rates are influenced highly by supply and demand.

Liner ships are operated on fixed and published schedules as well as on published tariffs. Their cargoes generally only constitute each a small part of the ship capacity, that is that a liner ship transports goods of many different cargo owners. In liner operations it is the cargo that follows the ship.
Liner shipping is not a relevant transportation mode in most of the commodity transport markets, nor is it in the oil sector. Industrial and tramp shipping are the modes of operation with the only exception being chemicals that for a significant part are transported via a sort of liner schedule.
Over the years tramp trade has decreased in relative terms due to the explosion of liner services and to containerization in general. Nowadays even chemicals for a part are transported by containers, be it not the well-known 20 and 40 TEU boxes, but specialized ones. Nevertheless also today a very large proportion of the world’s trade is carried in tramp vessels.

Both the industrial shippers, owning a part of their fleet used, and the oil traders turn to the tramp market. And some big oil traders have developed into industrial shippers. How has this market changed over the years and what is the present situation?

3.2 Types of transactions

A tramp ship generates business by charter parties, ocean shipping contracts to lease the vessel to a charterer. There is the period market and the freight or spot market and in both cases the cargo owner or shipper will enter into a contract with a shipowner for the hire or use of his ship. Usually, when crude oil or oil products are shipped, it is the case that the contract is for a full ship-load but this is not necessarily the case for the transport of chemicals.

The contract that is used decides who is in charge for the operation of the vessel. They are therefore very important since they divide exactly the interests between charterer and shipowner and are decisive in who bares the costs for a sub-optimal port call.

There are basically two types of charter parties; demise and non-demise. A demise or bareboat charter is the most far fetching period charter where the charterer has full responsibility for the operation of the vessel. Demise chartering is not uncommon for tankers and it comes very close to actual ownership of a vessel.

A non-demise charter arises when the shipowner provides the vessel plus its crew, whilst the charterer just supplies the cargo. The shipowner manages his vessel under the charterers instructions but there are several degrees in so doing:

- In the **period or term market** the shipowner lets the ship for a specific period to the charterer, earning a hire money.
- In the **freight or spot market** he provides a transport service to the shipper of the cargo, for which he receives a freight.

A non-demise charter may be a time charter for a stated and fixed period. Or alternatively it may be a voyage charter for a particular voyage, in which the shipowner agrees to carry cargo between specified ports for a prearranged freight or it may cover a number of consecutive voyages.

These different contracts basically put the shipping market risk and operational risk relating to running a vessel, in the hands of different people, either in the hands of the shipowner as the suppliers of transport, or in the hands of cargo owners and traders as the demanders of transport. It is this distinction that is relevant from a port call perspective.

3.2.1 Shipping market risks and operational risks in shipping

For a shipowner, his capacities of earning revenues by exploiting his ships depend amongst others on this distribution of risks. Shipping market risks arise from all the commercial activities; the soliciting for cargo, having a ship available at the time and a place where there is a cargo to transport, anticipating when to select next cargoes, deciding whether to risk a ballast voyage when opting for a better loading point and the freight rates that have to be negotiated.

Operational risks arise from the ability of the ship to perform the transport. Controlling the ship and managing the vessel may in one situation be the responsibility of the shipowner and in another situation the responsibility of the cargo owner. The costs of running the ship determine to a large degree the performance of the transport and it is up to the one who is charged for these costs to benefit, or not, from the lowest possible levels of them.

In industrial shipping, where the ships are run by the industry such as the oil majors, the exploitation of the ships is in the hands of the industry itself. In the tramp market the management and control over the vessel and the distribution of the costs to run it may be in the hands of the shipowner or of the cargo owner, depending on their wishes and negotiations. Those finalize in the charter party that they decide to use, which may be either a standard one, or a more tailored made contract or combination of both. Many standardized contracts are issued by BIMCO, the Baltic and International Maritime Council, though everyone is free to use its own terms.

3.2.2 Charters and division of market and operational risks

Shipping market risks and operational risks are in general divided as follows between charterer and owner for the different charter parties, but may differ depending on what has been agreed upon in the shipping contract.

	Bareboat	Time charter	Voyage charter	COA
Revenue for the owner depends on	Duration and hire rate	Duration and hire rate	Quantity of cargo & freight rate	Cargo quant. & freight rate
Operational risk & responsibility	Charterer	Owner/charterer	Owner	Owner
Soliciting for cargo	Charterer	Charterer	Owner	Owner
Port choice by	Charterer	Charterer	Charterer	Owner
Responsible for port call efficiency	Charterer	Charterer	Owner	Owner
Time risk in port	Charterer	Charterer	Charterer/Owner	Owner
Time risk at sea	Charterer	Charterer	Owner	Owner
Operating costs	Charterer	Owner	Owner	Owner
Port charges	Charterer	Charterer	Owner	Owner
Bunkers	Charterer	Charterer	Owner	Owner
Loading/unloading	Charterer	Charterer	Charterer/Owner	Owner
Manning	Charterer	Owner	Owner	Owner
Master instructed by	Charterer	Owner for ship Charterer for cargo	Owner	Owner

Bareboat charter

A bareboat charter or demise charter is an arrangement for the hiring of a vessel whereby no administration or technical maintenance is included. The charterer obtains full control of the vessel along with the legal and financial responsibility for it. The charterer pays for all operating expenses, including fuel, crew, port expenses and P&I and hull insurance.

It is the charterer's responsibility to provide everything the ship will need. The shipowner, who may well be an investor or financer rather than a professional shipowner, only pays the capital costs for the vessel. The owner must provide a seaworthy vessel, but once the charterer accepts the vessel, the responsibility of seaworthiness is the charterer's. He thus takes over full responsibility for the operation of the vessel and appoints the crew, though in some situations it is the practice for the chief engineer to be the shipowners representative in order to provide the maintenance of the vessels machinery.

The charterer takes both the operational and shipping market risk. In this respect, managing an owned fleet and bareboat chartering (the hire period may well be twenty years) are practically identical. Since bareboat chartering involves the complete running of a ship, it can only be used by those companies having an organization in place to operate them, which is the case for the big oil majors and big oil companies.

Time charter
In a time charter the owner provides a vessel that is fully manned and equipped. The owner provides the crew, this crew however takes orders from the charterer. The owner is also responsible for insuring the vessel, repairs and engine parts. The charterer is responsible for everything else. A time charter diverts the costs of running a ship to the charterer.

A time charter contract gives the charterer the use of the vessel for a specific period, he hires the ship by the day, for a fee per day, month or year. The charterer has the operational control and directs the ship operations. The ownership and the day to day management is left in the hand of the owner.
The charterer instructs the master where to go and what cargo to load and discharge, and pays all voyage expenses and cargo-handling costs. In a standard time charter the charterer is free to employ the vessel within agreed trading areas. Within this area the charterer selects the ports and directs the vessel where to go.
The operational risks during a single voyage are for the charterer as he pays all the fuel, the port dues and all cargo-related costs. The market risk is completely for the charterer for the period of the hire; he pays this hire regardless of cargoes being available or not. The charterer also has the operational risk.

Also this form of chartering is reserved to those parties that have very regular shipments such as for production purposes or have regular cargo contracts to transport, and -again- have an organization in place to operate the ships.

Voyage charter
A voyage charter is the use of a vessel and crew for a voyage between a load port and a discharge port. The charterer pays the shipowner on a per-ton basis. The owner is obliged to provide a seaworthy ship, the charterer is obliged to provide the (full load of) cargo at a specified port and to accept it at the destination port. If all goes well, the specific ship that has been chartered arrives at the load port on the due date, loads the cargo, and transports it to the discharge port. Once the cargo is discharged here, the transaction is complete. The owner pays the port costs -except for the stevedoring costs-, canal costs, all fuel and crew costs. The payment for the use of the vessel is known as freight. So the shipper buys transport from the owner at a fixed price, freight, per unit of cargo and he only purchases the transport service when he needs it.

Both the operational and the shipping market risk are taken by the shipowner. The shipowner is responsible for managing the running of the ship and for the planning and execution of the voyage. If, over a certain period, he doesn't manage to obtain cargoes for transport, or if he has to wait for the cargo, it is the shipowner who loses out.

Contract of affreightment
A COA, Contract of affreightment, is a contract similar to a voyage charter, with the difference that the shipowner contracts to carry regular tonnages in specified quantities of cargo within a specific time frame for an agreed price per ton, also covering all the costs. He is obliged to provide the necessary cargo carrying capacity that serves the agreed cargo volumes and destinations. But the owner is able to plan, within an interval, to carry the shipments at his convenience, that is he chooses the vessels and the exact timing of cargo shipments, hence he is able to plan the use of his ships in the most efficient manner. As long-term contracts are involved, COA's usually involve a greater commitment from the owner to the shipper in providing a good service.

COA terms are much used by chemical parcel operators and it is in this case the shipowner who chooses the port and the order in which ports are visited. He either opts for a more-port discharge or a one-port call after which cargoes are further transported by barges. This choice depends amongst others on the services such as efficiency of port calls, delivered by the port.

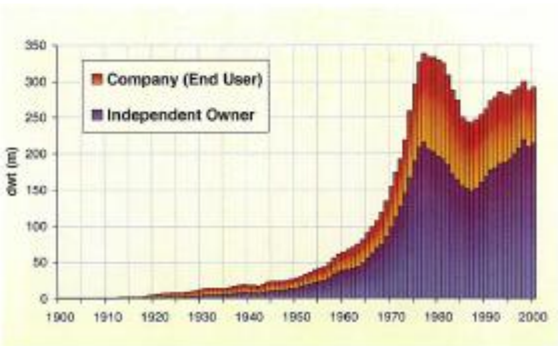
3.3 Tanker market developments

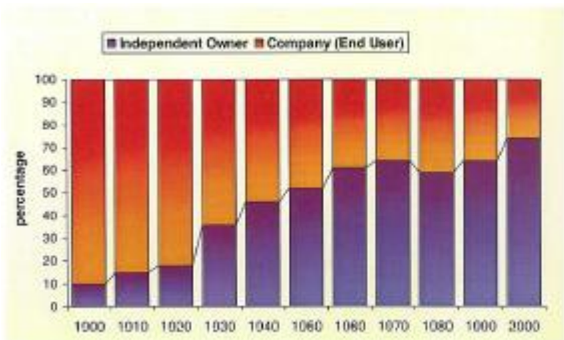
Industrial and tramp shipping business in the oil trades has undergone tremendous changes over the past decades. Changes not only in the sort of vessels employed (a constant increase in size and therewith scale economies), the hauls and trades (because of changes in production, refining and consumption areas) and costs and earnings (those are extremely volatile with as main underlying determinants production and refining capacities on one hand and fleet capacity on the other hand), but more importantly for this subject, changes in ownership structure, changes in turning to the spot or term market, and therewith taking the control of the vessel, and finally in the relation charterer-shipowner and the market power in this relation. This present situation determines who it exactly is that benefits most of an optimized port call.

The tanker market has long been characterized by a very small number of big chartering companies, notably the oil majors, that controlled to a large extent the tanker market. Until the 1970s the major oil companies, 7 at that time, processed about 80% of all oil in the world and they owned, operated or controlled most of the seaborne oil transport. The number of traders and state organizations engaged in the shipping of oil was much smaller at the time but increased considerably during the 1980s.

These days, the big (western) oil companies no longer own the tankers to the extent that they used to, but charter vessels from independent vessel owners for their transport operations. A significant proportion of the world tanker fleet nowadays is under charter to the oil companies, often on long-term charters. In 2003 the major oil companies collectively still owned approximately 7% of the world tanker fleet, and further had another 7% on the charter market, either on bareboat or on time charter (Clarkson, 2004). The oil producing countries on the other hand have tended in recent years towards both owning and operating their own tanker fleet. Tankers in this respect are crude and product tankers. Ownership of chemical tankers, being more specialised and capital intensive, is mainly in the hands of shipowners rather than in the hands of producers.

The following two graphs show these changes in tanker ownership in 1) dwt and 2) percentage. In red are the industrial shippers such as the oil majors, in blue the independent owners, offering tonnage on the tramp market.





SSY Consultancy and Research Ltd., A century of tankers, Intertanko, 2002

What changed from the seventies on was that most of the oil companies changed their focus to their core businesses of oil exploration, production and marketing and outsourced part of the transportation activities to independent shipping companies. Basically there were four causes for the big changes in ownership structure that the tanker market has undergone over the decades. First, the emergence of significant refinery overcapacity in Europe from the mid sixties. This created a spot market for oil and oil products. Secondly, the collapse in tanker demand in the seventies led many oil companies to changing their tanker strategy; a severe oversupply of tonnage, especially but not only in the VLCC segment, caused freight rates to drop to the extent that the tramp market became a more interesting option than operating vessels themselves. Thirdly the low returns on capital from shipowning, by the standards of international corporations, in combination with the higher flexibility that the independent owners developed, were important. The fourth element has been the shift in attitudes to environmental pollution. In 1989 the Exxon Valdez struck a submerged reef in Alaska, laden with crude oil, after which the 1990 US Oil Pollution Act led to many major oil corporations deliberately reducing their direct ownership of oil tonnage. This in an attempt to reduce their exposure to liability in the event of future incidents.

So the industry has seen a transformation from a highly controlled structure, with oil companies relying on spot market transactions for only 10% of their needs, to a situation where they take huge proportions of tanker capacity from the spot market. This graph shows clearly the developments in tank shipping ownership structure from 1950 to 2000 and the growth of the spot market.

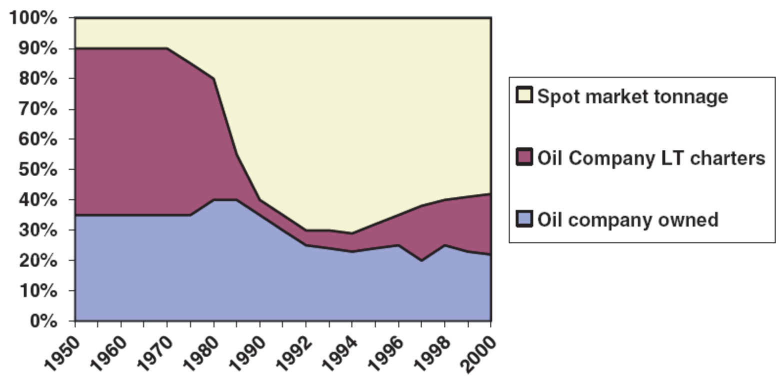
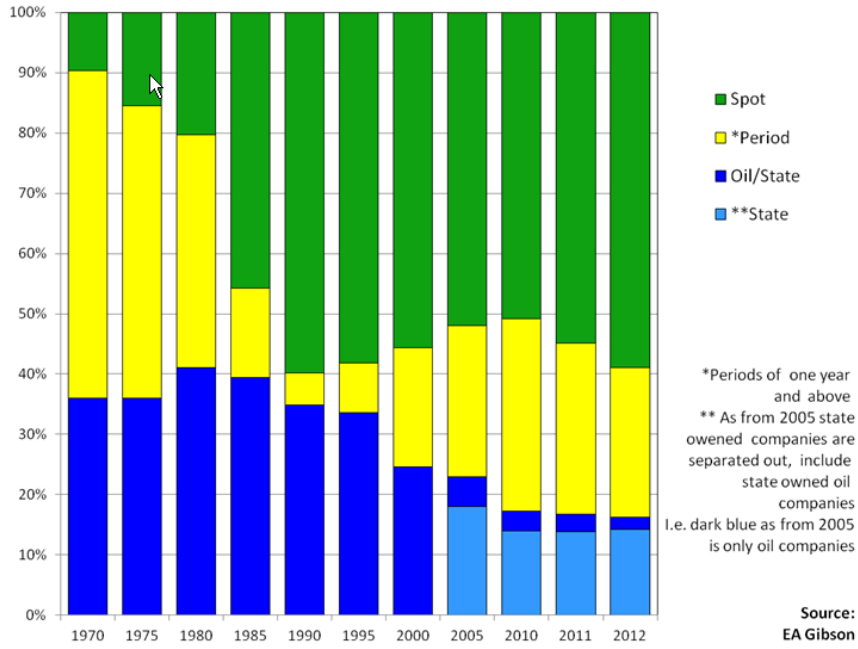


Figure 1. Ownership structure development in tank shipping.
Source: ISL Statistical Yearbook (several issues).

It is a matter of risk management and strategic policy that makes oil companies decide on the percentages of its oil shipments to be carried out in company-owned vessels, in long-term chartered vessels or outsourced to service providers in the spot market. How this effected the proportions of the tanker fleet employed by the oil companies in terms of owned vessels, the proportion hired on the period market and employed on a spot basis from 1970 till now is also shown by this graph;



The blue bars give the private oil company and state owned company tonnage. Until 2005 the blue is all 'non independent' tanker owners; oil majors, state owned tanker owners and state owned oil companies. Since 2005 the private oil company tonnage is singled out and indicated by dark blue. The rest is state owned tanker companies such as Sovcomflot and state owned oil companies such as Petrobas.

All this indicates the decrease of the oil companies owned fleet and the replacement by the period market (periods of over one year) and moreover the growth of the spot market. This growth of the spot market is due to the favorable freight rates on the one hand, but also to the fact that the spot market has managed to not only meet the extremely high safety standards that the oil companies require, but also to be organized much more efficiently and meet customer requirements other than their safety requirements.

That charterers and shipowners are less inclined to engaging in longer contracts -a sign that the market is low- also is shown by total period chartering activity. Since the volumes shipped in itself have not decreased, a decline of the period market must necessarily mean an increase of the spot market.

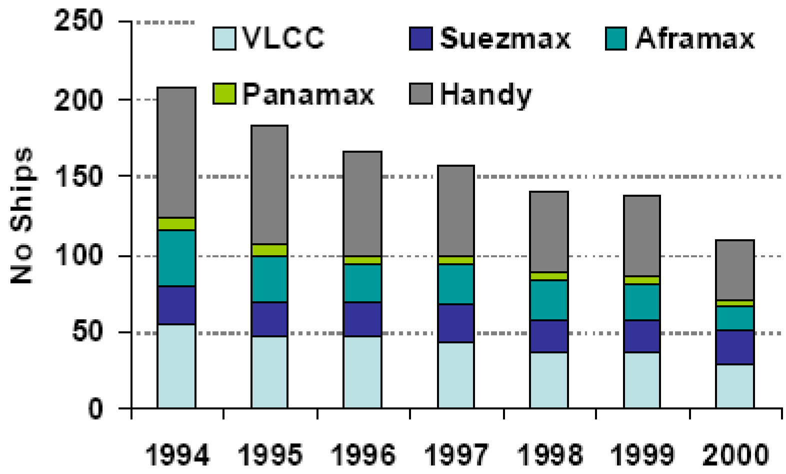
	2006	2009
Long term charters of 24 month or more	58%	34%
Long term charters between 1-2 years	25%	14%
Charter periods of less than 6 month	27%	24%

Unctad Review of Maritime Transport 2007 and 2010

Therewith the tanker market has become much more fragmented than it was in the past, with at present, because of the very low freight charges, a highest ever percentage of oil company needs being met from the spot market. Charterers even used as tactic to wait for the ideal moment to take advantage of shipowners being forced by their banks to find short term coverage. Whether this will remain the same for the next decade is difficult to surmise. There is a possibility that the oil companies will, as market conditions get tighter and prices of newbuildings have reached a low, review their long term strategy and raise again the share of tonnage they control on long term charter.

How the decline in ownership was distributed over different vessel categories, is shown by the next graph.

Oil majors owned fleets 1994-2000



Source; Clarkson Research Studies

If we take a closer look at recent developments in ownership of vessels by one of the oil majors, BP, we see figures change as follows; the BP Shipping fleet profile per 1-9-2005 was 20 crude carriers -with 5 to be delivered-, 21 product carriers -1 to be delivered-, 3 UK coasters and 9 East Med coasters. By the end of 2009 the BP Shipping fleet was 4 VLCCs and 37 medium sized crude and product carriers (BP Shipping Environmental Statement 2009 & BP Shipping Cleanseas 2005).

Pure ownership however is not the most relevant criterion and ownership is not reported consequently by the oil majors. Rather terms like 'fleet under management', 'bareboat chartered fleet', 'long-term leased fleet' or 'operated fleet' are used. This reflects the fact that for the operation and earnings -or losses for that matter- of the vessel, financial ownership is not determining but moreover disponent ownership is. A disponent owners definition is "deemed to be the owner but not actually the owner". In this respect disponent ownership is to be considered more or less equal to the chartered 'fleet under management' and is therefore often reported together.

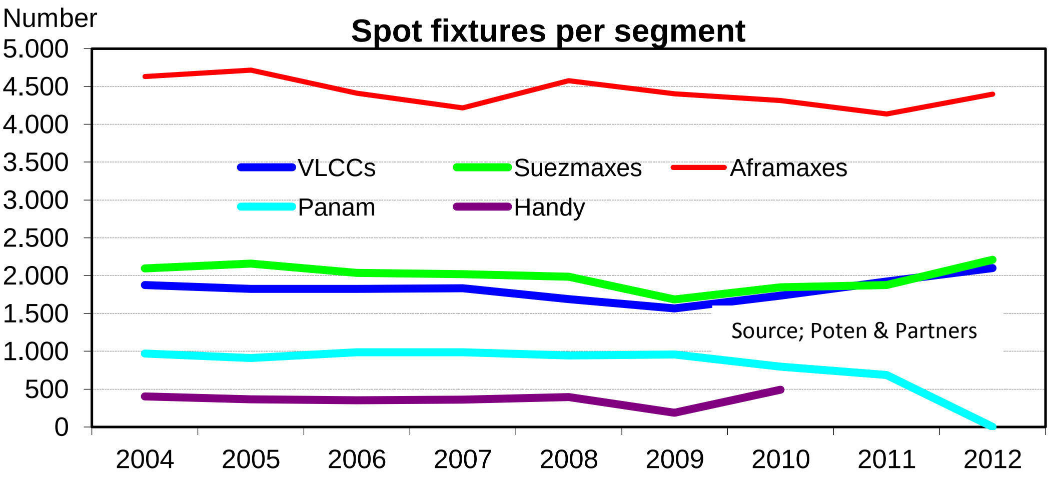
One specific reason for ownership of vessels by the oil majors has been left unmentioned; the shipping fleet of over 50 ocean-going vessels that Shell manages, has also as strategic purpose those of training reasons and therewith safeguarding sufficient sea-going experienced personal for the future.

On the term or period market, the oil majors are the main purchasers. A brief look at what some of the oil majors report in their annual reports concerning their time chartered fleet employment; in 2009 BP shipped half of its cargo (214 mln tons[3]) on BP-operated and time-chartered vessels; 5.228 voyages were undertaken on BP business, with 2.845 carried out using vessels operated by BP. On a daily basis, the average number of vessels over 6.000 dwt on their business (time and spot chartered) was 230 vessels.
TOTAL conducted its' shipping activity in 2012 by a fleet of 41 carriers, chartered under long-term or medium-term agreements. The company chartered almost 3.000 tankers on a voyage basis (to carry a total volume of 115 tons of crude oil and refined products), being 752 charter parties for crude oil

[3] Both tons and barrels are used as a measure for volumes of crude oil and oil products, usually in thousands of barrels and mlns of tons. To convert kb/d into mln tons; kb/d *365/1000/7.5

shipments and 2.100 for refined products (Totsa Key figures overview 2012). At any given time, TOTAL has 'more than one hundred vessels on charter', with sixty of them on time-charter.
The Chevron controlled fleet by the end of 2015 was 1 owned tanker, 22 bareboat chartered tankers and 18 time-chartered tankers, the latter defined as chartered for more than one year. During 2012 Chevron managed approximately 2.100 deep-sea tanker voyages, both on the spot and on the term and bareboat market.

These numbers show indeed that also the oil majors, who are the most likely purchasers on the term market, operate for a substantial part of their transportation needs also on the spot market. This graph shows the numbers of fixtures on the spot market in 2012; there were over 2.000 fixtures for VLCCs and Suezmaxes each and almost 4.400 fixtures for Aframaxes. It also shows that the short voyages, sailed by Panamaxes and product tankers and mainly transporting captive cargoes, are not serviced that much by the spot market, but rather by owned or long-term chartered tonnage.



Intertanko, 2013

The usually traditional industrial operator having become much more involved in the spot market, is one major change. Another one is that other types of industrial shippers have emerged; traders and terminals that eventually traded and stored that large volumes of cargoes that they started operating the ships themselves. The next chapter will research the relation between these different forms of transport and the requirements for an optimized port call.

As for the chemical industry, the shipping picture is different. The chemical industry, using highly specialized and capital intensive vessels, knows hardly any ownership of vessels by the producing industries, nor does it turn to the operation of vessels through the period market. Instead the chemical industry is inclined to opt for long term (notably COA) contracts with shipowners. There are a number of reasons for this;

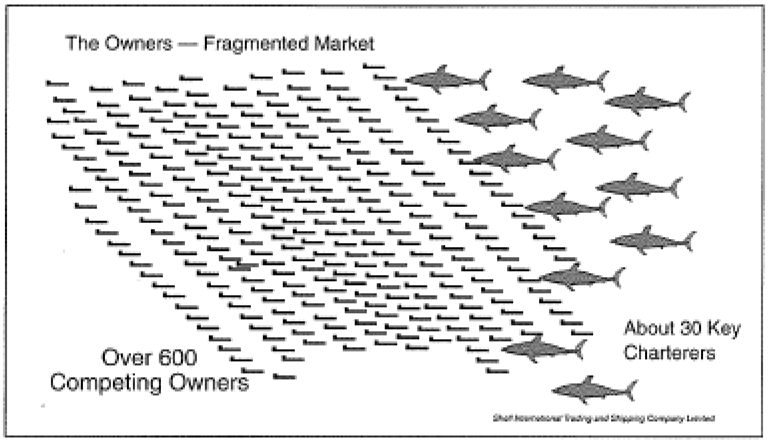
- Higher quality ships that are required for the higher quality cargoes; higher investments by shipowners are possible because of the long-term contracts with shippers
- Higher degrees of guarantees of availability of ships when needed
- A more timely delivery of vessels

3.4 Relationship charterers – shipowners

The two main actors are the buyers of transport -the charterers-, and the suppliers of transport -the shipowners-. The decline in the role of the major oil companies as shipowners, not as charterers, and the rise of the spot market and the independent tanker owners, as we have just seen, means that in economic terms the market has become much more competitive than it was. How is the market nowadays in terms of competition and market power?

According to Clarkson Research Studies (2004), the shares of ownership of the fleets by oil majors and other oil companies (including those that are state owned) are 19% for crude oil tonnage, 27% for oil products tonnage and 6% for chemical tankers. So that leaves the biggest shares of tonnage in all three markets with the independent owners (in which the independent public owners take a not insignificant part). This high market share does in this case however not translate in market power. The market power is in the hands of the charterers.

This image from the Institute of Chartered Shipbrokers (Wood, 2000) shows it all; the fragmented market of the many owners (the 10 largest independent tanker companies only hold 13,6% of the whole independent fleet) and the limited number of big charterers.



What adds to this is the fact that the oil majors more and more operate like shipowners, using each others fleet, which was certainly not the case in the past, and even trading their vessels on the spot market.

The marriage between charterers and shipowners is not an easy one and not always a merry one. Lloyds' List writes in the article 'Charter firms shun Liberty Congress' of 24 June 2013 that the Liberty Congress, bringing together all the major global shipowning bodies, failed to attract one single charterer, despite having invited large users and despite the fact that relations between the two sides were very prominent on the agenda. The chairman of the International Chamber of Shipping said that there were issues that needed addressing, including the too many industry disputes and claims, an increasing culture of late payments and a drift away from the industry's traditional code of ethics which he said had been 'almost ripped to shreds'.
A participant to the congress said 'the charterers idea of sharing responsibility in a charter party is; you pay for it, I have the benefit. We (shipowners) are required to do a million things. They (charterers) are just required to pay freight on time and not everyone does.' The article also said –and this shows in a way their lack of power but certainly also their weak economic position- that Intertanko, the independent tanker owners' association, is drafting a proposed code of conduct, to be sent to oil

companies and other charterers, urging charterers amongst others to pay freight more promptly and to speed up financial settlements for delays in ports. So far the marriage between charterers and shipowners…..

The interesting thing is that most people almost automatically consider the shipowners as the major clients of a port. However, seen the power that charterers have vis a vis the shipowners, it remains to be seen if this is indeed the case. In any case it are the charterers, in most cases at least, who are decisive in the choice of port to load and unload and therewith may appreciate most an optimal port call.

3.5 Who are the shipowners

3.5.1 Controlled fleet of major shipping nations

First of all, there is a small number of countries that take the biggest share of control of the world tanker fleet (this is regardless of where they flag their ships). The top 5 countries in control are Greece, with 1.355 vessels (over 1.000 gt and including liquid gas tankers), Japan (1.087 vessels), China (716), Singapore (632), Norway (604), having 41% of the total world fleet -in numbers of vessels- under their control. When ranking in dwt, the ordering is different, the top 5 now being Greece (the Greek tanker market comprises of not less than 135 tanker companies), Japan, Norway, China and the US, controlling 48% of dwt. But despite the top 5 control, 86% of the world tanker fleet in numbers of vessels is controlled by 30 different countries (ISL merchant fleet data bases, Clarkson Research Service Ltd., 2013), giving a first indication of the enormous worldwide competition in tanker shipping.

Within the different categories of tankers, there are considerable differences though in countries of domicile. Where Greece, Japan, China, Germany and Singapore are leading in crude and product tankers, Italy and Norway are important shipping nations for oil/chemical tankers. For the pure chemical tankers Japan and Norway are in the lead (ISL Shipping Statistics and Market Review, 2010).
So although a small number of countries control the biggest share of the fleet, tanker owners can be found in many countries and as said before, supplying oil transport takes place in a highly competitive market.

3.5.2 Independent shipowners

Tanker shipowners supply the vessels on the tramp market where they trade them on a spot or voyage basis. And they supply vessels on the term market mostly for industrial shipping purposes. Now that the big oil companies, as we saw, cease vessel operations as owners of their tanker fleets, owners build vessels to charterers' specifications when placed on long-term charter with them. And where the shipowners market naturally has changed over the years because of the changes in chartering policies of their main clients, they also changed their strategic risk and profit policies.
Shipowners started pursuing rather short term commitments that in general know higher risks and less predictability but that have the potential of higher profits. These replaced the long-term time commitments, characterized by lower risks but also lower profits.

The worldwide tanker fleet is build up by an independent tanker fleet, operated by independent tanker owners, and by a state-controlled fleet.

10 Largest independent tanker companies			10 Largest oil co./state tanker companies		
Tanker Company	**No tankers**	**M dwt**	**Tanker company**	**No tankers**	**M dwt**
Mitsui OSK Lines	108	14.1	Saudi Aramco	28	7.4
Frontline	59	11.4	China Shipping Group	78	4.9
Teekay	99	11.1	National Shipping Saudi Arabia	29	4.6
NITC	43	9.6	Sovcomflot	48	4.3
Overseas Shipholding Group	90	8.3	Cosco	33	4.2
NYK Line	28	8.2	Indian Govt	44	4.1
Tanker Pacific Management	56	7.0	Novoship	50	4.0
AET	57	6.9	BP	35	3.9
Euronav	28	6.6	Kuwait Petroleum Corp	20	3.2
DS Schiffart	30	5.8	China Changjiang Nat. Shpg	27	2.3
Totals	598	89.0	**Totals**	392	42.9
Independent fleet	4.391	352.2	**Total Oil/State fleet**	796	72.8

Intertanko Shipping Facts, 2009

Shipping companies know extreme fluctuations in their operating revenues as well as expenses, resulting in equally extreme income or income losses as shown by way of example by the following results for Frontline and Teekay, two of the major tanker shipping companies.

	Frontline Ltd.		Teekay Tankers Ltd.	
	2008	**2012**	**2008**	**2012**
Total operating revenues x 1000 US$	2.104.018	668.107	369.959	197.429
Total operating expenses x 1000 US$	1.395,831	677.683	170.964	537.624
Income (loss) from operations x 1000 US$	+ 850.480	-/- 7.237	+ 198.995	-/- 340.195

This overview shows for some other oil shipping companies the huge fluctuations in net profits, in mln US$.

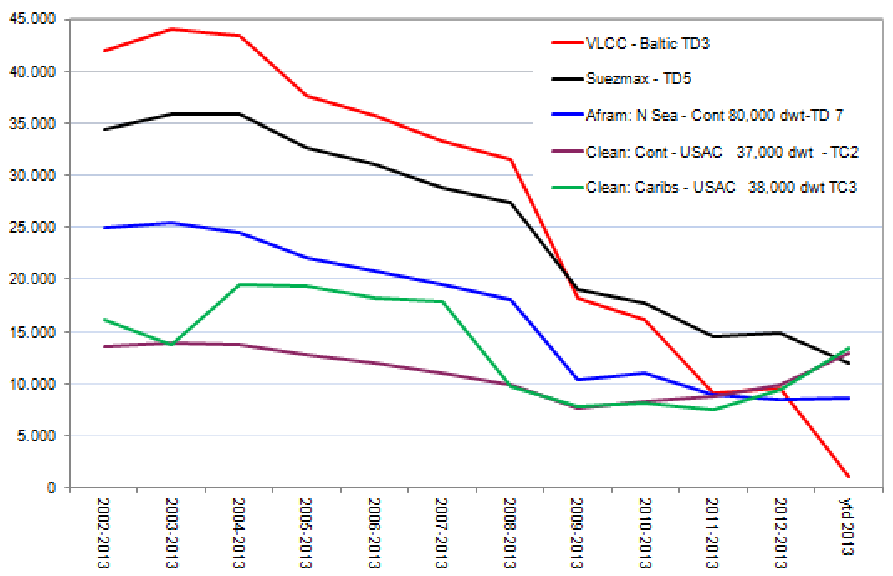
	2007	2008	2009	2010	2011
General Maritime	45	30	-12	-217	-153
Maersk	3271	3329	-1311	4705	2836
Torm	792	361	-17	-135	-453

Platts, Source; company statements

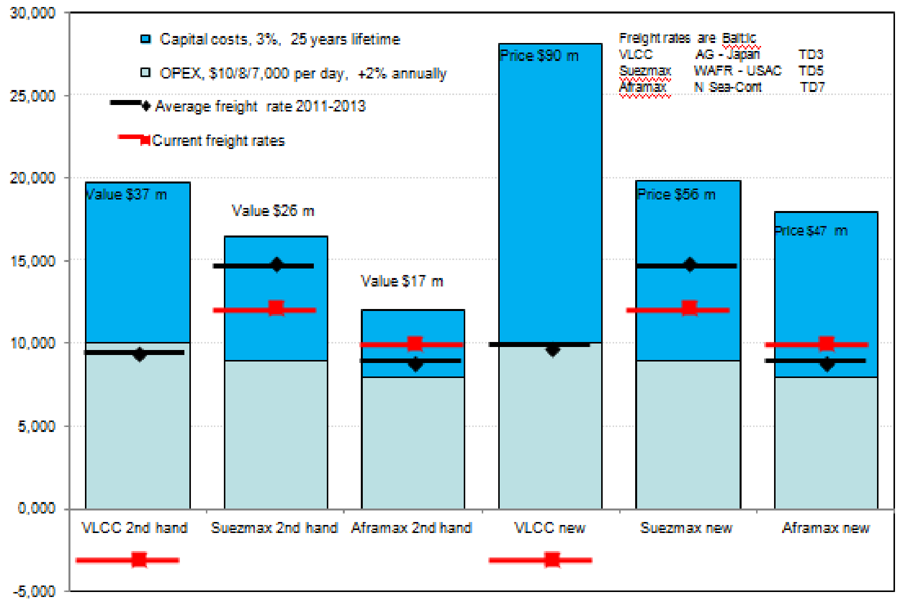
The focus on the high risk spot market, in combination with highly volatile, but on the average steadily decreasing freight rates, causes the recent losses in vessel operations for shipowners. The decrease in freight rates is shown by the next graph.

Average freight rates 2002-2013 in US$ per day

Source; Intertanko Council presentation, 2013



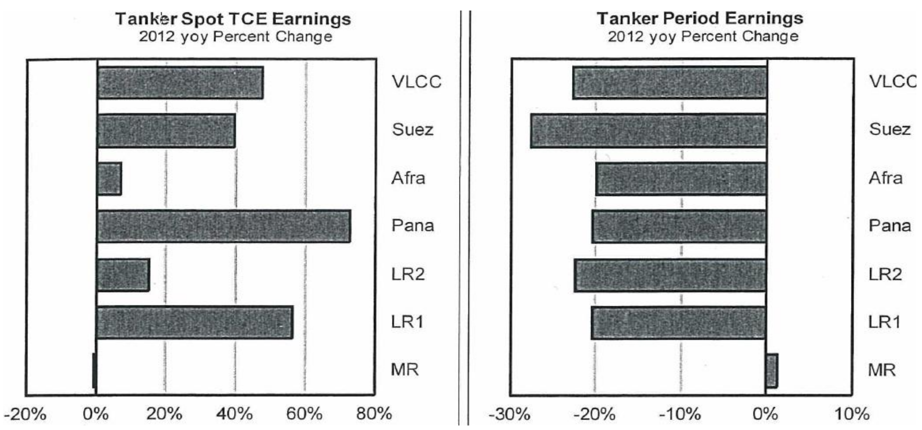
That the current tanker market rates even are consistently below operating costs, shows yet another graph that states the tanker break even and market rates (in .000$ a day). The overview was given in an Intertanko presentation that was well chosen titled as “surviving in a stressed market”. Intertanko indeed has a deep concern that the current tanker market rates are consistently below operating costs. The industry fears that this may threaten the sustainability, even the survivability, of the oil transportation industry. This situation, where tanker owners are not even covering their operating costs, cannot be sustained in the longer term according to the association of owners.



Intertanko Council presentation, 2013, source; DNB markets

The oil companies by the way are not, what would be ‘normal’ to expect, all that pleased with the low rates and profits. High quality vessels require maintenance investments and if those are compelled to stay behind, causing accidents or oil spills in turn, it are the oil companies reputations that suffer, not the shipowners reputations.

That earnings from the spot and period markets fluctuate totally differently show the following graphs. Where the spot markets are more risky as no long term contracts are at its’ basis, they presently have higher earning prospective than the period market.



SSY Consultancy and Research, World Oil Tanker Trends 2013, “Shipping Scorecard 2012”

So far the shipowners engaged in the crude and oil products shipping markets. Shipping of chemicals is conducted by other companies, notably by highly specialised companies. Chemical transport is provided by three groups of shipping companies;

-The parcel tanker pools that offer long haul liner services with larger ships, trading on long-term (COA) contracts
-The tramp operators, offering medium sized bulk chemical tankers of 10.000 – 20.000 dwt, trading spot, and grouping cargo together
- The independent owners of small tankers on the spot market, offering regional transport

The chemical tanker fleet is made up by (from the Odfjell Annual report 2012):

Odfjell	15,9 %	Tokyo Marine	6,5 %	Nordic Tankers	5,3 %
Stolt-Nielsen	13,1 %	Navig Chemicals	5,5 %	Other majors	17,4 %
Fairfield Line	7,9 %	MISC	5,4 %	Others	23,0 %

Owners of chemical tankers operate liner-type parcel services with a small number of major industrial charterers. The strong degree of control from the major cargo owners through long-term contracts has produced less volatility in earnings than in the other oil shipping markets. The chemical industry, more than does the oil industry and trade, builds on a long term relationship with the shipowners.
This shows in the percentages of long term contracts with charterers from the two biggest shipping companies; Odfjell reports a long term contract coverage for 2012 of on average around 50% of the total volume shipped by the company. Also Stolt-Nielsen, with also a focus on the parcel tanker trade, had a contract coverage of 74% of total volume shipped in 2012.
Stolt Tankers owned and/or operated 158 ships in 2012; 62 deep-sea parcel tankers and 96 coastal and inland tankers. 41 Of the deep-sea tankers were owned, 6 were time-chartered and 12 were joint service pooled vessels. The net-earnings by the way from the 41 owned vessels was 17,5% higher than for the vessels regionally exploited by daughter companies (Stolt-Nielsen Ltd Annual Report 2012).

3.6 Port choice

Who is it that decides on a port of choice and where are these decisions based on? Can an optimized port call in the oil shipping markets influence the choice for a port? To answer these questions we need to look at the oil production flows, the trade flows, the role that terminals play and in how far integration is an issue in the oil production and transport systems.

Crude oil flows are most captive to industry. Product flows are more volatile because of the fact that they are traded to a larger extent and there is more choice in terminals to ship the cargoes to. Chemical flows are even more volatile; though they are less traded, production facilities are much more scattered. Many plants are located in the hinterland which means that they can be delivered from more ports, as practically all ports have storage facilities for chemicals. This in term means that the need for ports to optimize port calls is most urgent in the chemical flows, with oil products in second position.

The oil flows captive to industry are for a large part in the hands of the oil producers. Those also engaged more and more in trading activities such that the volatile flows have grown. For the volatile flows, where the port choice is not beforehand that obvious between nearby ports, the harbour masters information position can contribute to the choice for a certain port. The captive oil flows notably benefit in optimizing their industrial operations in which shipping makes part. Port choice however is determined by production processes and refinery and terminal capacity and those refinery and terminal locations are only mobile over long periods of time. But when deciding on the area where to extent or close capacity, the oil majors will weigh in their decision process the costs of the whole production chain and will include call efficiency as one of the weighing factors in the investment decision.

3.6.1 The oil production flows

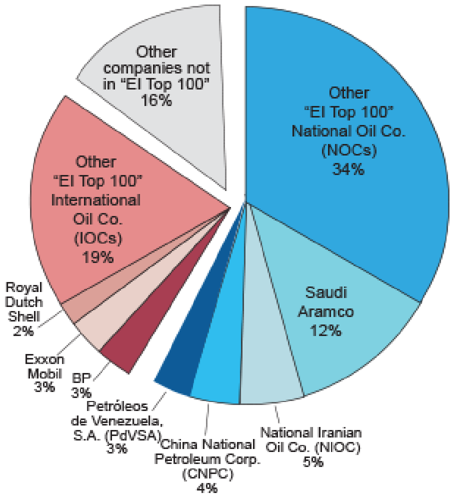
Where does the oil flow to and by who? One of the main reasons for the need to have oil transported is that exploration, refining and production take place in non-adjacent areas. The vast majority of crude oil shipping originates in the Middle East in the Persian Gulf and the Red Sea, the coast of Western Africa and South America. The exploration of oil resources around the world is the working area of just a very few independent international oil companies plus an equally limited number of state-owned (Kuwait, Saudi-Arabia) companies. Publicly traded international oil companies are commonly viewed as the dominant players but in fact state-owned national oil companies account for a much larger share of production.

The big oil majors may not be the primary explorers of oil, they are the main refiners and producers of oil and chemical products, and therewith they generate the main transport flows. Annex I shows how oil exploration, production and consumption take place in completely different areas of the world. It further shows that it are the refining capacities, divided differently over the continents, that ultimately determine where the oil is transported to. It also clearly shows that the export, and hence transport, of crude oil is originating in just a few areas, due to the exploration in those areas. Importing areas know a concentration as well, due to the refineries that the crude is traveling to by nature, but to a lesser degree.

There are three types of companies that supply crude oil to the world market; the international oil companies (IOCs) such as ExxonMobil, BP and Royal Dutch Shell. The national oil companies (NOCs) such as Saudi Aramco (Saudi Arabia), Pemex (Mexico) and PdVSA (Venezuela). They operate as an extension of the government and pursue not always market-oriented objectives, but rather governments' domestic or foreign policy objectives. All NOCs of the OPEC members fall into this category. Finally there are the 'autonomic' NOCs, government owned companies that however function as corporate entities and are primarily commercially driven. This category includes Petrobas (Brazil) and Statoil (Norway).

Share of world oil production by type of company

Source; EIA, US Energy Information Administration



In 2011, 100 companies produced 84% of the world's oil. National companies accounted for 58% of the world's production. Of total seaborne crude oil traded internationally in 2012, OPEC's oil exports represented about 60% of the total amount (EIA, based on LLI data).

Oil refineries must be ensured of an uninterrupted refining process. Apart from using the oil that is explored in their own internal upstream activities, the oil majors purchase their primary feedstock from other (competing) oil majors and from independent traders. Long term delivery contracts with internal and external suppliers must ensure a steady refining process. These trade flows are very captive to the refineries of the worlds' oil companies. This is also shown by the fact that around 90 % of physical crude oil is traded under medium- and long-term transport contracts (Reserve Bank of Australia, 2012).

Also the oil product flows –in smaller volumes than the base product crude oil- that the refineries and chemical plants need for their production processes, are highly captive. Global refining capacities though are changing over the years and they are no longer solely concentrated in the western world. As an example, the state-owned oil company Saudi Aramco recently build new refineries in Saudi Arabia, in partnership by the way with Total and Sinopec of China. The oil producing countries -notably Saudi Arabia and Kuwait- have been shipping increased volumes of refined oil rather than crude oil. But also India is becoming a competitor for the ageing western refineries. The result is increased tonne-mile demand for product carriers and increased numbers of port calls for refined products in the originally producing nations.

The export and import of oil products is much more scattered than is the case for crude oil. Oil products production is much more spread over different countries and distances between production and consumption are smaller. This is clearly shown in annex I by the shares that the different areas take in exporting and importing crude oil and products. These differences in world crude and product oil flows have huge implications for the distances of transport and therewith the relative importance of port calls.

In the chemical industry transport flows are for the biggest part induced by production needs. Not all feedstocks for the manufacturing of chemical products are supplied from the oil majors' own upstream refining operations, other market sources are used as well, such as competing oil companies. Whereas the product baskets of oil products differ between the oil majors from smaller ranges of products to much wider ones (depending on past investments in production lines), it happens to be the case that all oil majors produce chemical base products. Those are either used as feedstock for their own chemical plants on site, for chemical plants elsewhere or traded to third parties, in both latter cases requiring transport.

3.6.2 The oil trade flows

The oil producing companies all seek to sell their crude oil production for the highest negotiable price, whilst at the same time to their own refineries on the best financial terms. They also import and export products to align supply to local demand. For their trading successes, they not only rely on the oil that is refined within their own company, but also to an external network of other national and international oil companies, producers, refiners and traders. This being said, oil companies do have different strategies in this respect, and some companies policies may have as their main trading goal to optimize the feedstocks for their own manufacturing processes and to supply their retail marketing businesses. The sale or purchase of the excess or shortfall of oil products in that case is not impossible but done where necessary and less so as a profit goal of itself. Especially ExxonMobile focuses predominantly on the exploration, production and retail sales and the internal supplies that go together with these processes. Others, notably Shell, may have quite substantial trading activities with third parties.

Oil trading activities are the second reason, next to the flows that are generated by the production processes, for oil shipments around the world. There are a number of different reasons that cause (physical) oil to be traded, and hence transported and those reasons dictate to which ports the oil is going to.
First there is the imbalance between the production and refining capacities of the individual oil companies. Europe for instance knows structural overproduction of gasoline and structural underproduction, leading to shortages, of diesel and kerosene. This is amongst others due to developments in the consumers use of car fuels, changing on one hand from gasoline to diesel and on the other hand to more economical engines. This imbalance is expected not to change for quite a period and will therefore continue to have transport flows as a result. These transport flows are to a high degree captive in the sense that they are based on long term delivery contracts.

Yet another reason for the trade flows in oil and products are price differences caused in term by temporary shortages in production or end-user supply. Those flows are much more volatile. Price differences may arise when at a certain moment in time prices differ shortly between regions. This causes traders to buy and sell (and transport) between these regions and is called arbitration. Price differences may also be expected for future sales, causing traders to either stock and sell later (contango) or skip the storage stage and seek to sell immediately when prices are expected to decline (backwardation).
In these last flows, driven by trade options, and certainly in the product sectors, the independent traders are probably more active than the oil companies traders, though the international oil companies do not give a lot of information about the volumes that they trade on the market.

Trading crude oil for physical delivery in the spot market is less common than for oil products, simply owing to the logistics of transporting crude oil. A spot transaction in crude oil is a one-off deal for physical oil that is not covered by long-term contracts because the buyer has underestimated its requirements and the producer has surplus crude beyond what is committed to sell on a term basis. However called ‘spot’ deliveries, these deliveries, and this is different than in most other commodity trades, may take place more than 10 days after entering into the contract, with some deliveries contractually taking up to 60 days. However the time of organizing transport in these cases is not the bottleneck, organizing and financing a crude oil shipment is to such a degree extensive that only the oil majors and the very big traders can afford to enter in such venture. That is in fact in general the case for oil shipments; transport is so complicated and expensive that only the large and specialized traders and of course the oil companies, are able to engage in it.

Chemicals moreover are for the biggest part transported for production purposes. There is some share of trading activities in the chemical products, mainly for reasons of local shortages and surpluses, almost not for speculative reasons. Chemical manufacturers produce many different compounds and much of the seaborne chemicals trade is to supply temporary local shortages for a particular compound of feedstock. Chemical trades are therefore for a part very short term cyclical trades and the patterns of these trades may suddenly, and temporarily, change. A few commodities are traded on a more structural basis; those commodities notably that many producers have in their portfolio, that know very general product specifications and that are produced in relatively large volumes, for instance benzene.

3.6.2.1 Oil majors traders and independent traders

The oil majors all have a trading departments having as objectives to supply their refineries under optimal conditions and also to maximize the value of their production. Their activities in -physical- oil trade involve;

- the sales and marketing of the crude oil production explored by the own company
- providing a supply of crude oil for the own refineries
- importing and exporting oil products to fit the needs of production for the local markets

Traders of oil majors are most active in the trade flows that are directly related to the refining process, production flows and to long term production plans. But they also trade in the more structural shortages and surpluses of commodities. Where one international oil company may have the largest supply portfolios for crude oil, another one may be leading in oil products sales, depending on the strategic positioning of the groups' exploration and production focus. Traders of oil majors in present days do not operate otherwise than independent traders with a difference perhaps in being a bit more tight to company policies. These company policies and strategies make that not all oil companies do trade to the same extent. Shell for instance is a major trader, which also shows in the high numbers of Aframaxes that Shell charters, whereas the ExxonMobil strategy is much more focused on the industrial production process.

With the oil producers engaging in trading, trading volumes have increased tremendously over the decades, in crude oil but notably in the oil products sector. The oil majors estimate is that traded volumes in oil products these days are five times the volumes needed for their production purposes.

As an example of the magnitude of trading within the oil majors may serve that the TOTAL trading department employs a team of not less than 550 people. And as an example of volumes for production and for trading serve the next figures that TOTAL provides in their annual report 2012. TOTAL says to be one of the world's largest traders of crude oil and refined products, based on volumes, and is the only oil company being so specific on notably the traded volumes (volumes are in kb/d);

Group's worldwide crude oil production	1.220		
Purchased by Trading from exploration & production		976	
Purchased by Trading from external suppliers		1.904	
Total of Trading's supply in crude			**2.880**
Sales by Trading to Refining & Chemicals and Marketing & Services segments		1.569	
Sales by Trading to external customers		1.311	
Total of Trading's sales in crude			**2.880**
NB. Refined product sales (retail)		1.608	
NB. Volumes traded in derivatives (no transport requirements)		15.000	

TOTAL Registration Document 2012 and Totsa (TOTAL Shipping dept.) key figures overview 2012

Independent traders are also active in the trade flows that follow from structural production imbalances, however they are the most active in the trade flows that are caused by temporarily price differences and shortages. These trade flows are the most volatile and it is in these trades that -with the higher risks- the highest profits are possible.

Big independent trading houses are Cargill, Glencore, Vitol, Trafigura, Gunvor, Koch, Mercuria. All have different portfolio's and some of them may entirely focus on the different energy trades whilst others add some of the energy trades to their original portfolios of dry bulk cargoes.

Smaller shippers such as traders that have irregular requirements for ships contract freights on a cargo by cargo basis on the spot market.

3.6.3 Oil terminals

Oil tankers do not directly call at the refineries, but instead call at the jetties of the oil terminals, either owned by the oil majors or by independent companies. No oil will be delivered to a port where there is no terminal facility, either for production or for temporary storage. Tanker storage both serves as a buffer in order to help balancing the inflows and outflows of products needed in the production processes and as a depot for commodities awaiting price-increases before being sold. Some big traders own terminal capacity, most traders however store cargoes with independent terminals, either on short term or long term contracts. About 70% of all oil and chemical products in the port of Rotterdam is unloaded at independent terminals. Of the total storage capacity in Rotterdam (over 30 mln m^3) 45% is available for storing crude oil, another 45% for oil products storage and 10% for chemical products.

The land based terminals are extremely important in the oil transport chain and have a huge impact on ships' time in port for a number of reasons. First, though investments have been done by the industry and port authorities, the number of berths remains critical in the handling of the vessel in many ports, also in the Port of Rotterdam, resulting in waiting times for berths.
Especially in the chemicals business, investments in existing terminal loading and unloading facilities have been staying behind the developments in chemical tankers, a fleet being not older than five years in average, the jetties overpassing an age of 20 years in many cases. This is slowing down the speed of cargo transfers.

Second, the core business of terminals is storage. Also this fact is of influence on the investment policies of independent terminals that focus on storage capacity and maintenance policies. But terminals play an extremely important role in the berthing and handling of vessels, both of influence on the port stay time. However, whereas the charterer of a ship has a contract with a shipowner for the hire and terms of the ship, he also has a contract with the terminal for the storage of his goods. There is no contract however, nor is there any form of performance agreement, for a speedy service to the vessel with the terminal, other than the agreed loading and unloading capacities. Some see this as an important reason for delays for the vessel. The business model of a terminal is centered around storage, not on the vessel that brings in the storable cargo and it is not in the direct interest of the terminal operator how fast the ship is handled.

Terminals also play a role in the ship to ship transfers of liquid cargoes. This can be done either at a specific facility of the port, a buoy or a dolphin, or the transfer can be done at one of the quays of a terminal. Terminals in that case charge a fee for a ship to ship transfer but will only offer a spot when one is available. The transfer of contracted cargo with storage purpose again has priority.

In the chemical business, perhaps tank terminals play an even bigger role in the transport chain than in the oil products trade; organization wise and because of the smaller volumes it is almost impossible to match parcels for transshipment directly to another vessel or mode of transport, so practically all chemicals use a tank storage step as the link between sea and inland transport and before further distribution via barges, trucks and rail. In this respect it is interesting to note that the demand for containers as a mode of bulk-liquid transportation has increased over the past years and is believed to continue to increase. This is due to customers that tend to shift toward smaller lots in uncertain times. Tank containers also seem to have the reputation to move more reliably and on-time which makes this mode fitting better in just-in-time inventory management.

So oil shipments physically depend on terminal facilities that are available in ports (leaving aside the ship-to-ship transfers of oil cargoes). The terminals also determine, next to the production facilities in the port, in how far oil flows are captive to a port or are more volatile. This happens through the longer or shorter term storage contracts that cargo shippers have with terminals.

There are huge differences in this respect however between the crude oil, oil products and chemical transport flows. The fact is that the numbers of terminals and their dispersal over ports differ substantially. Where crude oil travels to 6 refinery terminals in the Port of Rotterdam, oil products have 12 tank terminals at their disposal and chemical products 15.

Port of Rotterdam	Number of terminals	Number of berths (seagoing vessels)
Crude oil	6	15
Oil products	12	32
Chemicals	15	37

From PoR Facts and figures Energy port and Petrochemical cluster, 2010

And where crude oil only travels to 5 of the 11 ports in the HLH range, all 11 of them have the facilities to receive mineral oil products.

There is another difference and that is that more crude oil terminals are owned by the oil producers, whereas the oil products are stored more in independent terminals. This means that also the oil producers are for products, as are the traders, more dependent on external storage and service, whilst crude oil storage and handling remains more within their own hands.

This is even more obvious for chemicals. Most chemicals are used for local production, and in the Port of Rotterdam there are not less than 47 sites for chemical manufacturing and products. Other chemicals are exported in response to local stock imbalances, or to areas where there is no local production of a particular chemical. Chemical plants are not necessarily located in the port area itself, but moreover in the hinterland. And there are indeed many production plants everywhere, though concentrated in certain regions, in the hinterland that can choose from a number of ports to assure their supply and distribution of (semi-)finished products. In fact all ports in the HLH range except for one, have tank terminals for chemicals. Those terminals require less investments as compared to the oil products terminals because of their smaller sizes. This all makes the flows of chemical cargoes to ports more volatile and a shipper will much more easily switch between shipping for instance via Antwerp or via Rotterdam, with Antwerp being bigger in chemicals than Rotterdam.

3.7 The charterers

The oil companies, being the primary producers, and the oil manufacturers (either state-owned or not), purchasing raw materials for production, are main demanders of tanker transport and therewith main charterers. The third group of charterers are the traders who purchase physical commodities with a view of reselling them. The oil traders that purchase and transport the trade flows, work either for the oil companies, or for manufacturers or for independent traders. They are constantly buying and selling oil cargoes, which by the way doesn't necessarily mean that they need transport for each transaction. And if a transaction indeed requires to be transported, the trader may or may not be in charge of the transport for the cargo parcels he purchased or sold, depending on if the buyer or the seller is in charge.

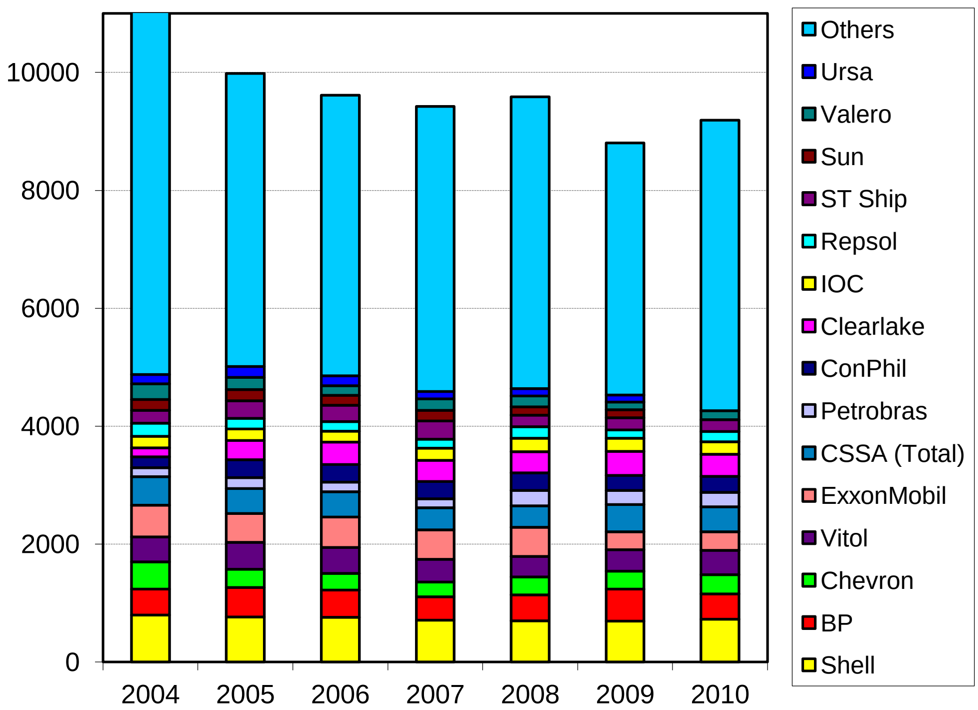
Some of these traders in charge of the transport, choose a short term business approach and purchase transport only when they need it, on the spot or voyage market. Others choose a long term perspective and become much more involved in the transport process, entering into period charters for their shipments.

Oil companies also maintain a certain approach to chartering based on long term, medium term and short term time-charters. Because of the long-term nature of crude oil transportation having to match the production schedules, a part of the transport is covered by the owned fleet, a certain amount of contracts are of a long-term time charter nature, with another portion of the contracts, for short-term needs, being voyage chartered on the spot market for single voyages.

According to Intertanko these are at present the largest charterers;
• The state owned oil companies Petrobras, IOC (India), Socar (Azerbeidzjan), Unipec and Petrochina (china), Reliance (India), Vela (shipping company of national oil company Saudi Aramco).
• The non-national oil companies BP, Shell, Chevron, ExxonMonil, Total, Conoco Phillips, Repsol, Sun (India), Litasco/Lukoil, S Oil and GS Caltex (South Korea).
• And the shipping departments of large traders Clearlake (shipping for Gunvor), ST Shipping (shipping for Glencore), Vitol, independent tankterminal operator Valero and private shipping company Ursa (Hong Kong).

The numbers of fixtures by all charterers worldwide were somewhere between 9.000 and over 10.000 on an annual basis;

Spot fixtures by largest charterers 2004-2010 (Intertanko, Poten & Partners)



2012 knew a number of fixtures of almost 9.200 of which a little less than 50% was taken by the 15 biggest charterers. The vessels that these biggest charterers use are given in Annex VI. What these figures show is that the larger the vessel category, the highest share of all fixtures is taken by the 10 biggest charterers (69% of VLCC charters is taken by the 10 biggest VLCC charterers whilst 48% of Aframax charters is taken by the 10 biggest charterers), indicating that the VLCC fleet is used predominantly serving production needs, by shippers engaged in a more industrial type of shipping (the VLCCs sailing over and forth to supply production processes of the raw material). The figures also show, by the huge amounts of the smaller Aframaxen that are chartered, how much some of the industrial shippers are engaged in trading.

Industrial charterers, those chartering for an industrial operation, usually strive to provide the required transportation for the organization's cargo request at minimum costs, hence the lowest unit cost levels per transported ton are of interest.
Shell, one of the biggest industrial shippers and charterers, has engaged in an extensive program to improve operations of its shipping activities and therewith maximise its fleet's efficiency. Within this program Shell is set to slash the number of shipping days it loses to inefficient operations. Notably port time is high on the agenda. Industrial shippers transport their crude oil usually on the more certain period market because delivery contracts for crude are made long in advance and need to assure an uninterrupted production process.

For the trade flows, it is quite usual for commodity cargoes to be loaded and subsequently marketed during transit. In some cases the unloading port is not known at the time of loading. Sometimes just a geographical region is given for unloading, and the particular unloading port is specified after the voyage has started. The charterers instruct the ship to proceed to a certain range of ports and determine the port of discharge while the ship is en route.

Who is it that decides on which port to call at? Ultimately the decision to route cargo through a port lies with the shippers, if he is not using a liner service. Who ships the goods then in turn depends on what buyer and seller have agreed on that point in their terms of sale; these terms of specify who is responsible for the transport stages and what port or ports will be used. The terms of contract may be either FOB (Port of Loading) or CIF (Port of Discharge).

The big oil companies deliver for 80% on CIF terms, whereby the costs, insurance and freight is to be taken by the seller. When sold on FOB terms (free on board), the seller loads the goods on board the vessel nominated by the buyer, after which the costs are passed to the buyer.

The reason for the big oil companies to deliver CIF is first of all the ships they have in ownership or long term charter and for which they seek employment. Second, since the oil industry with its universal market for homogenous and highly substitutable products is extremely competitive and for oil, only one single price -including transport costs- is expected, it pays to invest in a shipping system that adds as little costs as possible to the oil price. After all, the costs of transport ultimately are included in the oil price. Third, fluctuations in transportation costs are considered undesirable for the oil producers, therefore they wish control over transportation in order to exercise control over delivered prices.

The independent smaller traders however, having no transport system in place, are more reluctant to take the transport in hand. Those are all reasons why the oil majors and the biggest producers are in charge of a large percentage of transportation.
For the trade flows, a timely delivery of the cargo is important; the price that is agreed upon is a price at the agreed delivery time. If delivery is delayed the oil prices may have changed.

3.8 Integration

Whereas traditionally industrial shipping was only in the hands of the big oil majors, industrial shipping is now also an activity that is executed by oil manufacturing companies and traders.
Also in the oil logistics chains there are a number of forms of integration taking place with some big traders, next to the oil majors, taking ownership in terminals. As in industrial shipping, the operation of the vessel and the relationship with the terminal are in one and the same hand. It seems to be the case that these terminals perform much better in cargo throughput and loading/unloading productivity. The rumour goes, but could not be confirmed, that one of the integrated traders/terminals in Rotterdam has achieved to lower demurrage costs to shippers (see chapter 4) from 5$ per ton to 0,25$.

In the chemicals branch the integration of shipowners and terminals can be observed for a longer time already. The two main examples are Odfjell and Stolt Nielsen, combining the transportation and storage of chemicals, and in a lesser extent clean petroleum products, in one and the same company, hence providing for both transportation and storage services. Odfjell entered the chemical tanker trades in the mid fifties and the tank storage business in the late sixties. Their business strategy is not focused on either one of the two services but on a combination of the operation of the tanker fleet and tank terminals. The Odfjell chemical tanker business posted a gross revenue of 1.066 mln UD$ in 2012, whereas the terminal business generated a gross revenue of 145 mln US$. Revenue shares between tanker and terminal business within Stolt Nielsen, the second biggest chemical tanker owner, were quite equal (1.266 US$ operating revenue for their tankers and 190 US$ for their terminals).
Profits in both cases are however much higher for terminal activities than for shipping activities with Stolt Tankers' share of the groups operating profit (2012) being 13% (22 mln US$), and Stolt Terminals' share being 45% (76 US$). The larger profit shares for storage as opposed to shipping may indicate two things; first the reason why more importance is given to storage as opposed to shipping and second it may be a drive to raise operating profits for shipping through more efficient port calls.

The integration between shipping and storage brings another change with it in the chemical industry; whilst large number of chemicals shipping and storage companies used to operate mainly locally or within a certain region, the integrated companies may operate much more on a global scale, effecting ton-miles shipped, numbers of port calls and requirements for port calls.

Summary and conclusions Chapter 3

Information position	Impact on the port call	Impact for the port and port client
Exchanging planning information	Improves the port stay time	Charterer bears a cost since he needs to compensate shipowner if time in port exceeds the agreed limit. Shipowner looses voyages and earnings if ship is held up in port. Impact for the port; create capacity.
	Supports vessel speed decisions for the last part of the sea leg	For charterer if on time charter, for owner if on voyage charter. Owners increasingly negotiate to split costs, but have little market power. For owners; less risks of damage at anchorage. Impact for the port; reduction of emissions. Cooperation with terminals in berth assignment and notification is crucial.
Nautical Port Information	Improves the port stay time	In time delivery for trade flows is important point of view cargo price developments during voyage. In time delivery for productions flows important point of view production process continuation.
	Improves deadweight utilisation	Impact notably for the industrial shippers, shipping crude oil and heavy oil products between ports to meet their production schedules. For ports; increased cargo related port dues.
	Improves the organisation of the vessel call	Improved broker and operator services to both owner and charterer. Improved decision making by master of the vessel in behalf of owner or charterer.
	Improves freight rate estimation	For owners; accurate pricing gives less risk for competitive position and under-pricing of freight. For ports; efficiency of port calls is reflected in lower freight prices.

- A first distinction to be made is whether an oil flow is a production flow or a trade flows. A second distinction if shipping makes part of an industrial process or is purchased on the tramp market.

- This determines in how far and how an optimized port call contributes to port competeveness. Production flows are largely captive to industry in the port whilst trade flows are more volatile. For the captive flows, port call optimization adds to improving the production chains of the oil producing companies located in the port, mainly industrial shippers. An optimal port call point of view competitive position of the port is an issue in the long run, when producers decide on where to locate new investments. For the more volatile trade flows, port call optimization plays a bigger role in short term port competition.

- Crude oil and oil products both are trade as well as production flows with oil products being traded the most. Chemicals are predominantly a production flow. In crude oil and oil products transport it are the cargo owners that decide on the port of call. In chemical transport however, it are moreover the shipowners that have the biggest influence on port choice.

- Trade flows have increased over the years as compared to the production flows; oil majors increasingly started trading activities, trading became possible since transport costs lowered, production processes increasingly knew over-production and shortages that needed to be traded.

- The increase in trade flows evoked an emphasis on improved port calls for two reasons; oil being a homogeneous product traded at one single price at the market, is very sensitive to changes in transport costs, as these costs ultimately always are included in the oil price. Second, for the production flows, the production process in the end is always more important than the transport process.

- Nevertheless, for the industrial shippers an optimized port call is extremely relevant and has a lot of their attention nowadays, since oil transport costs are one of the factors for their competitiveness. Moreover it are only the big traders that can afford to take transport in their own hands, seen its complexity and price. Industrial shippers on the contrary, having a system in place, are well placed to provide the cheapest transport. So whilst trading is a huge activity and producers purchase their feedstocks increasingly from traders, the transport of the traded commodities is to a large degree done by the industrial shippers.

- Industrial shippers with large and long-term commitments for sea transport spread their risk by a portfolio approach in ownership of vessels, long-term chartering and spot chartering. This portfolio has changed dramatically over the years. Tanker ownership was at first dominated by the oil companies but later became mostly in the hands of independent owners. The major oil cargo shippers progressively reduced their owned fleets, preferring to rely on the tramp market for period chartered ships. Industrial shippers subsequently started to also use the spot market more and more. There are 3 reasons; the increased flexibility of the transport providers, the low freight rates and their increased activities in trading, as opposed to their traditional production activities. The tramp market of the independent owners always was and still is a highly competitive market. Characteristic in this market is the small number of big charterers that play the dominant role. These used to be the big oil companies but now also large traders increasingly choose a more long term perspective to shipping. Rather than purchasing transport only when they need it, they take more control of their shipments by entering into period charters.

- Also ports face a pressure to reduce port stay time since investments in throughput capacity stay behind developments in transport and shipping. A large portion of port stay time is consumed by vessel working time at the terminal. Investments are required to match the generally older terminals with the younger aged fleet. Terminals also have a decisive role in port stay time preceding the cargo handling process, notably in the manner and swiftness of assigning a berth. The business model of a terminal however is centered around storage, not on the vessel that brings in the storable cargo and it is not in the direct interest of the terminal operator how fast the ship is handled.

- The productivity of the ship in ports and during the port approach is an issue for improvement for industrial operators, more than it is for tramp shipping operators, and the pressure for change comes from the industrial operators.

- Finally, digging into the contracts that bind charterers, as demanders of transport, and owners, as suppliers of transport, there are a number of obligations that cannot be met without the proper information, however the industry has been accepting this situation. Shipowners and charterers engage since decades into those contracts that precisely stipulate the vessels obligations. The interface or link between these contractual obligations and the port or terminal however is very week.

Chapter 4 THE PROCESSES TO OPTIMIZE SHIP PRODUCTIVITY

This chapter analyses which are the processes that can be influenced by the harbour masters information position such that the port call may be optimized. It elaborates in 4.2 the port leg, where the time spend in port is an issue for the shipping and production industry. The last paragraphs deal with the processes in the sea leg and the preparation phase of the vessels voyage.

4.1 Loaded days at sea

Ships are productive and generate income at sea. In other words ships only earn money for their owners when carrying cargoes. Port time is a 'necessary evil' for loading and unloading cargo. The more port time, the less the ship is available for trading. Loaded days at sea are the productive days of a vessel as opposed to unproductive days that the ship spends. These unproductive days are not only spend in port, but also in ballast, a round voyage that has no backhaul cargo for its return trip. Obtaining backhaul cargoes has the greatest impact on the total number of loaded days at sea, but backhaul cargoes are not an option in all trades, whatever efforts the shipowner may make. In tramp business return cargoes may be a challenge; the port of destination may change during the trip and the new destination port may have fewer back-cargoes available. For tankers and other single cargo ships it is not unusual to spend half the ships' sea time in ballast. Combined carriers are more often able to pick up backhaul cargoes because they can carry a range of different cargo types. A rule of thumb is 'the bigger the ship, the more time in ballast'. The loaded days at sea as such cannot be influenced by the harbour master since they depend on the commercial efforts of the shipowner but they should be mentioned in relation to port stay time.

4.2 The port leg

The port leg, when the vessel stays in port, is considered as non-productive; the productivity of the ship is measured in ton-miles per dwt that it performs during the voyage. Port time ideally is the time needed to sail into the port and for loading and discharging cargoes which largely depends on the type of ship, its' efficiency and loading capacities and of the efficiency and capacities of terminal handling facilities.

Tankers do not necessarily need a lot of port time because basically they allow for fast handling speeds; the liquids they handle can be relatively easily pumped. New Worldscale Book[4] estimates relative short port times for tankers, namely an average of 72 hours that are needed as load and discharge time. This is not always realistic and there are many port calls where this time is exceeded.

Port congestion is one of the events that causes excess port time. However port congestion can be observed mostly in dry bulk export ports and in the wet bulk ports for instance when these face political turmoil, so in rather extreme conditions, practically all ports will know light congested situations. Hence a few words first on port congestion. Followed with a few words on terminal productivity, as this is a decisive factor for port time, however not under the control of the harbour master. After that we will continue with the port stay time that is indeed for a part under his control.

[4] Worldscale are the index points in which freight rates, in the case of oil tankers, are expressed. As basis for calculating these index spot rates, Worldscale uses a number of assumptions that are supposed to be realistic averages such as average service speed, bunker consumption, port time etc.

4.2.1 Port congestion

Port congestion is one of the most time consuming events for the ship and therewith influences the productivity of the ship in a very negative way. Port congestion arises when the port and terminal capacities are not sufficient to cope with the traffic arriving at the port causing waiting times. There are many factors that contribute to vessel build-ups at ports; bad weather, strikes, insufficient infra-structure, poor managements etc. Long queues at anchorage can also be a major safety and environ-mental issue for ports. PortStrategy (July/August 2011) stated that at various times over the last decade, as much as 8% of the world bulk carrier fleet has been stuck at anchorage.

The broker company McQuilling, reporting on port delays, considered the main causes worldwide (in 2009) to be things such as port workers protest actions, strikes, civil unrest, notably in West Africa, adverse weather conditions, notably hurricanes and visibility-impairing fog, sometimes necessitating port side shut-downs, port dredging, security boardings by coast guard officials (US). But the main cause of port congestion that McQuilling reports remains insufficient berthing or shoreside tankage availability upon vessels' arrivals, both in the US and in Europe, and bottlenecks caused by supply chain restraints at underdeveloped ports.

Serious congestion in ports is not something that can be solved by information sharing since it relates very much to infrastructural capacities and many times also simply to strikes. Congestion differs largely between importing and exporting ports, between regions and ports and fluctuates hugely over time depending on changes in economic activity to which port infrastructures have not had time to adapt. Port congestion has always been a concern and still is at present, but it was of particularly huge concern in the early 1970s and urged UNCTAD to study the causes. BIMCO, represented in the UNCTAD[5] working group, reported in 1976 a long list of major causes. Since a number of them are probably still valid today and relate to this thesis, they are briefly listed here;

- Inadequate consultation between the port authority and users of the port in respect of operations and development.
- Too many ships operating on certain routes and consequently calling for small tonnages and making inefficient use of berths.
- Ships spending longer than necessary at berth for reasons such as slack in their schedules
- Inappropriate policies which lead to transit facilities being used for long-term storage where space is inadequate, thus reducing berth throughput.
- Importers allowed to order shipments without sufficient funds to take delivery on arrival

Since port congestion has such a huge impact on the time that a ship spends in or near the port without being able to be productive, some more words on port congestion. W.K. Talley (Port Economics, 2009) expresses them as port queuing (or waiting time) costs; congestion costs that arise when the demand for port resources exceeds its supply. He distinguishes intentional and unintentional congestions. Intentional port congestion may be a result of preemptive priority, this is that priority is given to ships transporting a certain type of cargo over ships transporting another type of cargo.

Unintentional port congestion on the other hand may arise in the normal operation of a port. There is ship berth congestion that may arise when a ship has to wait for a berth that is currently occupied by

[5] UNCTAD, United Nations Conference of Trade and Development, has over the last decades published about maritime transport and ports as one of the key drivers of economic growth for developing countries. BIMCO is the Baltic and International Maritime Council, one of its' main activities is standardizing and improving charter party contracts.

another ship. There is ship work congestion that arises when a berthed ship has to wait to have its cargo loaded/unloaded until another ship has had its cargo loaded/unloaded. There may also be the incidence of vehicle gate congestion but that is mainly the case for container terminals.

Pettersen Strandenes (2000) says that the main part of the congestion costs is related to the opportunity cost of vessel time. This reflects both the alternative income that the vessel forgoes by postponing the next fixture and the capital costs of the cargo. The latter of course depends on whether selling the goods is postponed or whether port congestion merely implies that storage time on board the vessel replaces storage time on land.

On the terminal side, waiting times can be reduced by increasing the number of berths, by increasing working time at the berths and by increasing the terminal cargo-handling productivity. Increasing the number of berths though requires huge investments. With a too large occupancy ratio of berths, a port may face a serious possibility of congestion. If on the other hand the occupancy ratio is too small, it probably has undertaken huge over-investments.
A ‘waiting rate’, the ratio between the waiting time for berth and the time spent at berth, can be used as an indicator of possible congestion.

4.2.2 Terminal productivity

The berth time at the terminal, the ship working time, largely depends on the speed of cargo handling, the quantity of cargo a vessel has to load or discharge, the type and characteristics of the vessel, the type of equipment and other resources used at berth.
Most attempts to improve port productivity reduces the time the ship spends in port by improved cargo handling and terminal capacity. As such, port productivity is usually associated with terminal productivity. For liquid bulk handling, the performances of the terminals depend on the size of the ship, which provides pumps and energy. Loading and unloading time also depend on the cargoes, their viscosity, temperature etc. and on the safety regulations for hazardous products.

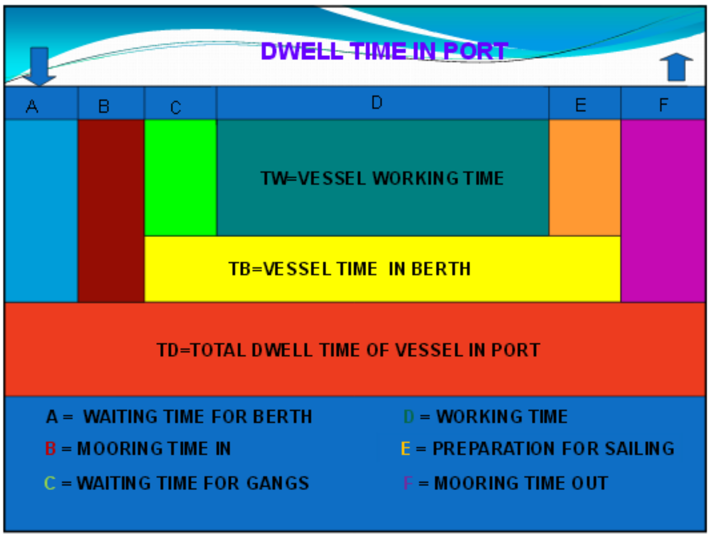
Terminal productivity is largely a matter for either the port management and terminals themselves, when investment decisions are to be made in either additional or more productive berths, in increasing cargo-handling productivity or in increasing working time.

Improving terminal productivity is further not taken into consideration in this study but ship and terminal productivity can of course not be seen in complete isolation of each other. An international survey in 1998 covering 1000 reports gathered from ships and 222 terminals in 46 countries (Alderton, 2008) showed that both ships and terminals experienced problems. Adverse comments were given over and forth on aspects of loading and discharging. Many terminals reported poor communications with the ship, lack of interest from the crew who were often asleep during the cargo work and ships not using cargo plans on which the terminal could anticipate.
Most of the reported problems related to the breakdown of communications and mutual understanding. Some 30% of ship reports considered the terminal interface unsatisfactory and said that frequently there was no terminal representative on site with authority to accept responsibility or take decisions. However a rather dated survey, many of the reported issues are still common practice in a lot of ports and some of them can be tackled by well organized information flows.

4.2.3 Port stay time

A ships port stay time can be defined as the time between the ship's arrival at a certain point, for instance the entrance buoy, and the ship's departure from the same buoy, though the buoys are a quite arbitrary choice. What is usually referred to as the ship turnaround time is the total time spent by a ship in port. Whichever way turnaround time is measured, an UNCTAD working group on port performance (2012) confirmed that from the customer point of view, the most relevant and important performance of a port is the amount of cargo that can be handled in the timeframe between arrival of the vessel and leaving the port.

A ship's time in port consists of ship working time and ship waiting time. Ship working time is the productive time at the terminal, also called berthing time or sometimes service time. Ship waiting time is the time spent waiting for a berth (berth waiting time) or waiting for services to the ship such as pilotage and towage services. Port stay time also includes manoeuvring time or sailing time, unberthing time, departing time and time for numerous port operations; delivering stores and inspections to the vessel and the cargo. UNCTAD visualizes the total port stay time as follows;



Unctad, 2012

When Lun (2010) discusses 'agile ports', a number of measures for evaluating such agile port are determined that take some of these time frames into account. Those being;

Work process	Performance indicator
Loading and discharging at quay	Ship's waiting time for it to be berthed
	Ship's waiting time for discharge and loading of cargoes to start
Ship operation	Ship's time spend in route deviations
	Total time delays

Chung (1993) said that one of the primary measures for ports to show operational performance is ship turnaround time. This usually being the duration of the vessel's stay in port and being calculated from the time of arrival to the time of departure, and expressed in either days or in hours. The average turnaround time would be determined by dividing total hours by total number of ships calling. Chung correctly states that in this basic form, ship turn-round time does not mean much, as the length of stay of a vessel is influenced by (a) the cargo volume, (b) the facilities made available and (c) the composition of the cargo itself. Thus it becomes necessary for the port to break the turnaround time down for tankers, bulk carriers, container vessels and general cargo vessels, and even to divide these

into domestic trade, regional trade and ocean going vessels.
In order to do so, a port would have to split total time in port into time at berth and time off the berth and within each, to record the amount and reasons for delay.

As for the oil trades, there are some specific circumstances that take time in port. The tanker market is extremely safety conscious and that brings with it a great amount of vessel vetting activities that mostly take place whilst in the port. But apart from vetting the ship, also the cargoes are inspected thoroughly; lab analysis are conducted to confirm that all cargo properties comply with the commercial specifications as agreed when closing the sale. Also the amount of cargo to be loaded on the tanker is inspected as well as inspectors who check that the tanks indeed are empty before loading, even a few centimeters left on the tanker bottom will be reported and subject to final account. After finishing the loading process, final samples are taken from all the tanks and analyses of the samples taken before and during loading are done by labs. Then all documents and reports will be prepared; bill of lading with loaded amounts and weights, certificates of quality and of quantity, receipts for samples, certificate of cleanliness before loading etc. The master signs for all the documents and the terminal gives the authorization to the vessel for departure from the terminal. The pilot, tug and unmooring services are ordered and the port authority is notified about the departure. The port authority, usually the harbour master, gives the final authorization to departure based on the traffic image at the departure time and compliance of the vessel to the port regulations. This whole process knows many instances that may cause disruptions and turn a fast turnaround time into a not so fast one.

Chemical tankers spend even more hectic times in ports; with their many tanks with up to 40-50 different products on board, planning of loading and unloading and all other port processes becomes much more complicated. The different cargoes may mean visits of different cargo surveyors and class, being events that, planned or unplanned, frequently disturbs all pre-planning made.

There may be many other causes, apart from the above ship operations related ones, for port delays. McQuilling reported in February 2009 that Aframaxes saw a significant increase in port delays in Europe and the Mediterranean, nearly doubling their stays year-on-year to an average of 4.9 days per calling. The main causes were strikes in a number of French ports and political unrest in Georgia and Gaza. There is no structural research to the causes for port delays and the causes that are raised by ‘educated guesses’ from the brokers range from terminal performance to weather conditions.

4.2.4 Port time and charter parties

As we saw, under a voyage charter, the risk of delay when the vessel is in port may more or less be shared between the owners and the charterers, the risk of delay during the sea voyage rests with the owners. It is this sharing of risks between charterers and owners that is relevant in knowing who is held responsible for port stay time and sea leg and who in the end pays for delays and fuel costs.

A voyage charter specifies a period, known as laytime, for unloading the cargo. The fundamental idea is that the charterers, without extra payment to the owners, have a certain ‘allowed time’ to spend on the loading and/or discharging of the vessel. If this laytime, the time in port, is longer than specified in the charter party and the voyage is therefore not completed within the contracted time, there will be a demurrage claim from the owner to the charterer. So the charterer has to compensate the owner if the time in port exceeds the agreed limit. The compensation, demurrage, is meant to reflect what the ship could be earning per day if not held up in port. If laytime on the other hand is saved, and time spend in port is shorter than anticipated, the charterer may require the shipowner to pay him a dispatch claim.

So it is important to know when the sea voyage is at an end and the ships' stay in port starts. This is when the vessel is said to be 'arrived'. Voyage charter contracts specify very precisely the time that is to be seen as laytime. The Voylayrules 1993[6] as well as Baltic Code 2003[7] definitions are;
'Laytime' shall mean the period of time agreed between the parties during which the owner will make and keep the vessel available for loading or discharging without payment additional to the freight. This means that when the vessel is on laytime, the owner doesn't charge a freight rate to the charterer[8].
'Demurrage' shall mean an agreed amount payable to the owner in respect of delay to the vessel beyond the laytime, for which the owner is not responsible. Demurrage shall not be subject to laytime exceptions.

The object of fixing these lay days and providing for demurrage and dispatch money is to penalize delays in loading and to reward promptitude. If not completed within the time contractually allowed, the shipowner is entitled to be compensated for the extra time taken and hence to be compensated for not trading the vessel. The demurrage rate is usually agreed beforehand and specified in the charter as a daily or hourly rate. The rate intents to cover the vessel's daily running costs. Dispatch, typically calculated at half demurrage rates, is rarely given in the oil and chemical industry, given the minimal lay-time allowances.

It is often said that shipowners have additional revenues from demurrage and that demurrage receipts help owners to prop up earnings when freight rates are low. And whilst it is true that annual demurrage costs for charterers are astronomical, from the owners viewpoint -pursuing profit- laytime is a loss of ship productivity and demurrage only covers for these costs. As the demurrage rate usually is half of the freight rate, costs for time lost in port are covered, but no profits are made. However there are situations known in which this doesn't hold, for instance (Oct. 2013) when a timecharter equivalent for an Aframax loading in the Baltic, discharging in Rotterdam was 17.500 USD/day whereas the demurrage rate was estimated to 24.500 USD/day.

So in tramp ship chartering it is the charterer who has to compensate the shipowner if the time in port exceeds the agreed laytime limit. The charter party will nearly always also contain clauses as to which delays or stoppages should be excluded or exempted when calculating how much laytime was used.

Post-fixture disputes are numerous between charterers and shipowners and a large part of them are due to a lack of clarity as to which party is liable for paying for waiting time in port. With these disputes comes a totally different point of port information being relevant to port call optimization. This is that when the legal terms and time definitions as used in the charter market, are also used in port information systems, this will be helpful in the numerous cases of disputes and jurisdiction when determining who to charge for what. This in turn will help to diminish costs and time of arbitrage.

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[6] Voyage Charterparty Laytime Interpretation Rules 1993, code name Voylayrules 1993, issued jointly by BIMCO, CMI, Chamber of Shipping, FONASBA and INTERCARGO
[7] Baltic Code 2003 Charterparty and Laytime Terminology and Abbreviations, Baltic Exchange, London
[8] The laytime allowed may be a single period covering both loading and discharging, or be separate for each period. In the latter case the transfer of unused laytime to the different periods may be agreed upon in the contract.

Both for the sea and for the port leg, the charterer requires the shipowner to execute the voyage without unjustifiable delays and deviations, however it is not always easy to determine which delay is justifiable and which is not. In general it is accepted that if he who has the voyage's control, usually the master of the vessel, and knows the prevailing conditions at trades and ports, judges that a delay is necessary for the safety of the ship, crew or cargoes, then the delay is considered justifiable. An example are occurring adverse weather conditions.
Over the decades the charter party contracts have either included or excluded all sorts of delays that have an effect on what is included in the laytime period in ports, for example;

Charter party clause	Effect on laytime	Effect on demurrage
Charter party says "72 hours weather permitting" with no mention of bad weather affecting demurrage	Delay due to bad weather will not count	Bad weather periods starting after laytime expired will count as demurrage
Time spent deballasting not to count as laytime "with no reference to deballasting and demurrage"	Deballasting time does not count as laytime	If vessel starts deballasting after laytime has expired deballasting time will count as demurrage
"Inward passage will not count as laytime nor, if the vessel is on demurrage, as demurrage"	Shifting into berth from anchorage does not count as laytime	Shifting into berth from anchorage does not count as demurrage

The Institute of Chartered Shipbrokers

Once the laytime starts it runs straight through until the cargo operations are completed or the time expires, whichever is the sooner, unless there is an express exception in the charter party. So the more is written in the contract with regards to laytime, the worse it is for the owners. Charter parties vary on these points but typical examples of excepted periods are; - The notice period, usually six hours at each port - Awaiting for tide/daylight - Shifting into first berth - Deballasting and discharging slops - Bad weather - Excess pumping at the discharge port(s) - Deduction if time ceases with documents on board - Strikes especially of shipowners servants or agents (The Institute of Chartered Shipbrokers).

A general rule is "once on demurrage always on demurrage". In other words, if the laytime is exhausted the vessel is on demurrage until all cargo operations are completed. This may have as consequence that time pressure is most felt for a departing ship since by then the allowed laytime is most likely consumed.

Annex V elaborates further on the specifics of laytime in voyage charters. What is important is that the time that is needed to wait for a berth, in case a berth is not immediately available, is counted as laytime. This means that laytime commences already when waiting. this in turn has as consequence that it is the charterer who is charged when the berth is not available. There is even a special clause, the 'ready berth clause' that says that laydays will begin to count as soon as the vessel has arrived at the port of loading or discharge "whether in berth or not". It protects the shipowner's interests even further against delays which arise from ships that have to wait for a berth.
But however it is thus the responsibility of the charterer to complete loading and discharging within the time allowed in the contract, he has very little means of influencing this process and usually has to await the terminals decision as when to start loading or unloading.

72 hours is the most common laytime period in the oil shipping contracts but a minority of the big charterers manage to insist on 96 hours. The rationale for 96 hours is that many demurrage claims are for periods of less than 24 hours and it is considered more cost effective to factor the additional 24 hours into the freight than employ people to check and invoice relatively small amounts of money.

Whatever time is set, the fact that all contracts specify very precisely what should or should not count as laytime, 'awaiting tugs or pilots', 'awaiting tide', awaiting daylight' etc. etc. indicate the importance that parties attach to every minute of the time spend in port.

4.2.5 The costs of delays

Demurrage would be a very good financial measure for port delays, if not the so called 'good demurrage' would exist and be included in total demurrage costs. Good demurrage arises when a charterer deliberately chooses to pay for the delay. This may be the case when a trader or producer expects a price-rise of his oil cargo, reason why he will opt to use the vessel for temporary storage, accept the demurrage claim and end up with a higher profit after the delayed cargo sales. For industrial shippers it is always the case that their industrial production is far more expensive than are freight costs. If cargoes need storage in vessels in order not to disrupt or interrupt production processes, demurrage is preferred above the latter costs.

In any case, demurrage claims in the industry are astronomical. There is an estimate from Shell that says that the company pays a yearly amount of demurrage claims of 100 mln €, including however the good demurrage. One could wonder why not change the contractually agreed allowed time in port if this time is so many times over passed. Two answers to this question are that by not extending the laytimes, owners keep the pressure on charterers to perform in time in port. A second answer is that when owners would extent laytimes, they would want to try to increase their freight rates at the same time so there will remain a cost anyhow.

In order to get a comprehension of the costs of delays per day, the time charter rates -though very volatile over the years- may serve; the average daily rates in US$ for time charters of different vessels and for different periods of time;

Average rates $/day

2009	12 mths	36mths	60mths
VLCC	$37 500	$38 500	$40 000
Suezmax	$29 000	$29 000	$30 000
Aframax	$21 000	$21 500	$24 000

Source; Barry Rogliano Salles Shipbrokers Annual Report 2010

Those were the rates for 2009. By 2011 the rates had dropped significantly, but they climbed again in 2012. In any case the objective remains the same and that is to give some indication of time costs in ports.

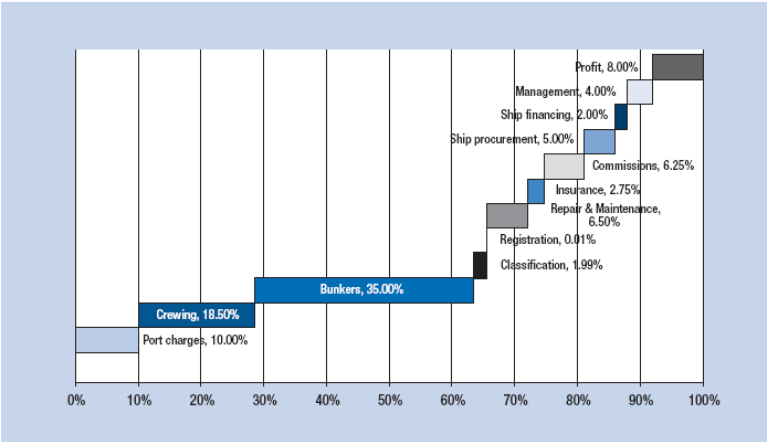
	Dirty Rates				Clean Rates		
	VLCC	Suezmax	Aframax	Panamax	LR2	LR1	MR
1q11	15,815	14,134	6,578	10,991	7,169	6,334	7,052
2q11	5,653	7,355	11,229	6,457	10,256	8,549	8,785
3q11	(1,152)	6,519	6,781	2,515	12,444	7,722	4,598
4q11	6,031	16,825	7,995	5,364	6,534	5,835	7,578
2011	**6,587**	**11,208**	**8,146**	**6,332**	**9,101**	**7,110**	**7,003**
1q12	15,421	22,096	7,144	11,045	2,758	4,247	7,822
2q12	19,273	18,028	7,748	14,957	7,801	10,206	6,509
3q12	(2,511)	10,089	11,233	7,338	12,069	12,589	3,621
4q12	6,740	12,288	12,518	10,414	19,217	17,392	9,938
2012	**9,731**	**15,625**	**9,661**	**10,938**	**10,461**	**11,109**	**6,973**
yoy pct chg	47.7%	39.4%	18.6%	72.8%	14.9%	56.2%	-0.4%

VLCC: 280k MEG-USG, 260k MEG-Japan, 260k WAFR-China; **Suezmax**: 130k WAFR-USAC; **Aframax**: 80k UKC-UKC, 70k Caribs-USG, 80k Indo-Japan, 80k UKC-USAC; **LR2**: 75k MEG-Japan; **Panamax**: 50k Caribs-USG; **LR1**: 55k MEG-Japan; and **MR**: 38k

SSY Consultancy and Research, World Oil Tanker Trends 2013, "Shipping Scorecard 2012"

When speaking about the composition of the costs that a shipowner has in operating his ships, port costs are mostly considered as being port charges. UNCTAD (2012) gives the following example of the cost components of a vessels' freight, showing that port charges make up of 10% of freight costs;

Figure 3.7. Freight rate cost components for a tanker of 10,000 dwt with 20 years of economical life



Source: Data received from a ship operator in February 2012.
Note: Figures refer to share of cost component as a percentage of total costs. Results are based on the assumption that the ship is staffed with a Turkish crew. Relative costs depend on many factors that may change over time.

UNCTAD Review of Maritime Transport 2012

Also when more in general the costs of transport are considered, it are always the port dues that are taken into account. The time in port and the loss of vessel productivity with high port stay times and waiting times is not taken into account. Reducing port dues though may have a much lower effect then reducing port time; port charges constitute about 10% of total freight rate. A reduction of port handling charges by 50 percent (port dues being halved!) would only lead to a total freight rate reduction of 5 percent[9].

4.2.6 Relevance of time to charterers and shipowners

Charterers and shipowners both benefit of an optimized port time but both in a different way. Charterers, having cost minimization of their transport as a goal, pay demurrage costs for delays and seek to minimize those. The owners, having profit maximization as a goal, may have the vessel execute a higher number of voyages when port stays are not delayed; a higher number of voyages adds to their yearly profits. Also an industrial shipper that operates time charters can have his vessels execute more voyages within their heir period. But then again, for charterers who operate on time charter basis, time is less critical when there is no successive cargo to be transported.

The broker company McQuilling Services uses models to calculate the effects that port delays have on the reduced availability of tonnage to answer global tanker demand. In 2008 port delays across the VLCC fleet were 1.7 days which effectively reduced supply by 17 VLCCs versus average stay times in 2007. For the other tanker markets the reduced tonnage as a result of port delays were;

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[9] An example of port dues (General terms and conditions for port dues for seagoing vessels, Port of Rotterdam); a tanker of 23.240 GT, not sailing in a scheduled service and transporting 4.000 tons of other liquid bulk plus 18.000 tons of crude oil, pays a vessel related due of € 6.786,- plus a cargo related part of € 14.759,-, totaling € 21.545,-. The dues are not related to the duration of the visit, provided that the use of the port for that visit was uninterrupted. Leaving the port to wait for a berth to become available or –in the case of oil tankers- for degassing or cleaning the ship is not seen as interruption of the visit when this happens within a timeframe of two or three times 24 hours.

Estimated tanker supply reduction with a port delay of 1 day

Tanker Sector	Port Delay (days)	Estimated Supply Reduction	Supply Reduction Given 2007-2008 Global Port Delays
VLCC	1	10	17
Suezmax	1	11	20
Aframax	1	23	2
Panamax	1	7	3

Mcquilling Services "Port delays soak up tanker supply", February 2009

By 2009 the orderbook for tankers was massive and the tonnage oversupply that resulted from that, was luckily somewhat mitigated by ships "just waiting around". This shows the relation between tanker oversupply and hence low freight rates and pressures that are felt in port turn round times. Depressed markets or an oversupply of tonnage are the main causes of low freight rates, and in such a situation the interests of shipowners and shippers may be opposite as for faster turnaround times as well as for slow steaming.

	Shipowner	Shipper/charterer
High freight rates	Operates more ships, port turn round time less important	Seeks to increases port turn round time
Low freight rates	Operates less ships and increases port turn round time	Less interest in increasing port turn round time

One must herewith bear in mind that there is in fact not one single freight market; vessel supplies or shortages and freight rate developments may be quite different on for instance the Mid-Far East Suezmax trade than on the Mid East-Singapore VLCC trade.

So a shipowner looses revenues when aggregated delays cause lesser voyages over a year. But he also faces another risk; a shipowner who has contracted cargoes to be transported, faces the risk of not being able to meet these obligations when voyages have to be cancelled because of delays.
For shipowners there are moreover a number of other reasons, other than time efficiency, that make that a reliable planning when in port is important, those being;

- A terminal that starts loading or unloading in say 4 hours rather than the planned 1 hour, will disrupt the crews' work- and rest time schedules and will necessitate a complex rescheduling
- Usually this will result in overtime payments
- Vessels usually use time in port for receiving new stores etc. and also this planning falls through

Both the Rotterdam and Amsterdam ports, in the eyes of an interviewed tanker owner, are slow ports where waiting times at the anchorage are more the rule than the exception, where no planning information becomes available to the vessel during this waiting time and where the above mentioned disruptions often happen.

Whilst the shortest port stay times are economically beneficial to owners and charterers, time efficiency in ports regrettably also has a number of downsides.

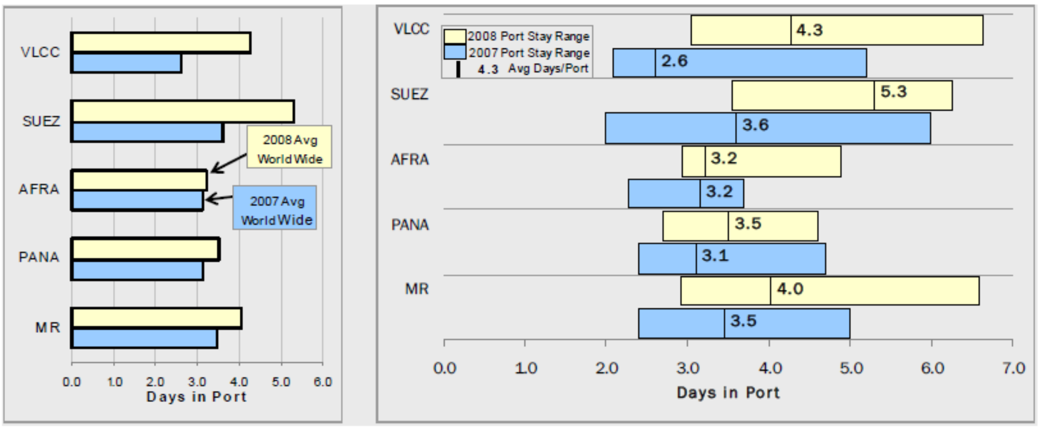
- Captains are often pressured by charterers to leave a port whilst staying alongside would be much safer seen the weather conditions. The charterer may though want the ship soonest in the next port for loading or unloading or is threatening that delays are very costly.

- Seafarers shore leaves minimize with short port times as well. Not only is this unattractive for the individual seafarer, it also makes that the profession of seafarer is becoming less attractive, ultimately leading to a loss of European seafarers. This in turn has as serious consequence that shore based positions in maritime professions are difficult to fill in.

4.2.7 Port delays by tanker sector

Is there evidence for serious port delays in the different tanker sectors?
The broker company McQuilling found, in a study of over 1.800 fixtures, that port delays have shown significant rise in 2008 when compared to 2007, particularly in the VLCC and Suezmax trades. The average time spent in port for a VLCC increased from 2.6 days to 4.3 days. Suezmax tankers' average port time increased from 3.6 days to 5.3 days in this same time.

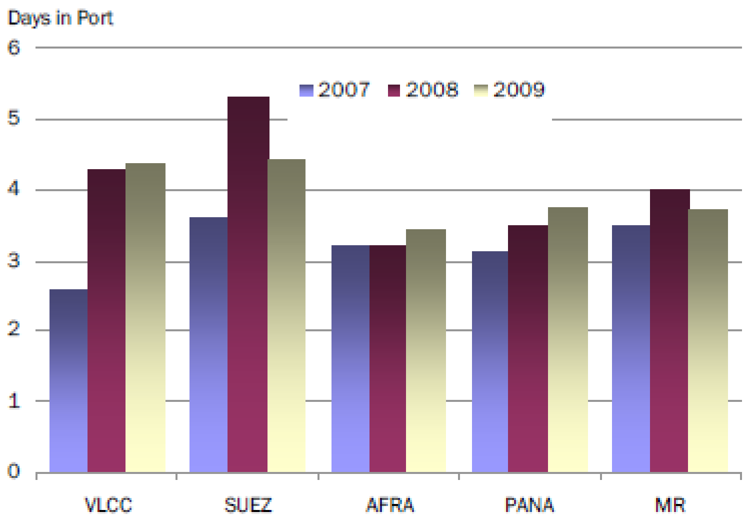
Days in port by tanker sector 2008 v. 2007



Mcquilling Services "Port delays soak up tanker supply", February 2009

The averages are particularly high because of a huge increase in port time for VLCC loadings in the Arabian Gulf and an even higher port time increase in the Far East. Both were caused by increased cargo operations, and hence had 'no available berthing' or 'awaiting shoreside readiness' as reasons for the majority of demurrage claims.
So whilst averages don't give a lot of information for individual ports, it does show that port time is seriously watched. The trends seen in 2008 continued further in 2009. Where in 2007 the tanker fleet spent an average 3.2 days in each port, this increased in 2008 to 3.8 days per calling, and then 4.0 days through 2009. Recall from the charter parties paragraph that the contractually allowed stay time is for the most of charterers typically 72 hours, so the averages exceed the allowed time year by year.

Average port calls, days in port by tanker sector 2007-2009



Mcquilling Services “Port delays continue to absorb tonnage”, February 2010

According to the McQuilling data, ports in the Mediterranean and throughout Europe continued to show an increase in port delays. VLCC averaged 5.2 days per calling and Long Range and Medium Range tankers 4.4 days, those European stay times being above the worldwide average. Only for the Suezmaxes, with an average 3.3 days per calling, European ports were faster than the worldwide average. McQuilling summarized by saying that improvements to port infrastructure appear at the moment the Achilles heel of market growth. Until accommodations for expanding trade are realized, port delays will continue to be the poisoned arrow in the heel of tanker turnaround time.

By 2012, after a period of serious recession in the shipping business, the average port days appeared not to be improved;

2012 port stay times per area and sector;

	VLCC	SUEZ	AFRA	PANA	MR2	MR1	Average
Global average	3.9	4.1	3.8	3.7	4.3	4.5	4.0
Middle East	2.4	2.1					2.4
Indian Sub Continent	2.3				4.8		2.8
East/South Africa	6.5	7.6					7.2
South East Asia	4.0	4.3	2.6	1.2	3.1		3.6
Australia/NZ			3.1		3.2		3.2
Far East	4.3	4.9	5.3	2.1	4.4		4.3
Northern Europe	2.7	3.6	3.1	2.7	4.0	2.5	3.5
Southern Europe/North Afr.	2.6	3.9	3.7	5.4	4.2	5.6	4.1
West Africa	4.5	3.1	2.2		6.2		4.2
North America EC	3.0	4.5	4.0	3.7	5.3	4.8	4.4
Carib/Mexico/Venezuela	5.4	4.2	3.5	3.5	3.1	4.1	3.9
South America EC		2.4	3.1	1.3	5.2		3.7
North America WC	7.0	4.4	4.1	4.0	4.0		4.2
Centr&South America WC	5.8	5.6	8.6	2.8	3.6	4.5	3.8

Source; McQuilling Services

What must be kept in mind is that, by lack of commonly used definitions of port time, not all waiting times are included in the reported times.

As for some causes, in the product trades, where trading volumes have increased enormously, it is notably the logistics that cannot cope with the increased volumes; especially in the vast petrol transports, barge logistics and the (un)availability of barges make that port times increase up to a degree that the system slowly gets stuck.

One of the few systematic studies on tanker delays in ports, a study to demurrage incurred on the 18 major routes as in chapter 5 (Mokia 2002), showed a good performance on the route North-Sea-North Europe as compared with the overall mean elsewhere. It showed on the other hand also that even on the route with the fourth lowest mean demurrage time, one-third of voyages incurred demurrage charges, rising to over 50% on the worst five routes. The authors concluded that the problem is extensive and that in extreme cases, lay-times extended to several weeks.

4.2.8 Relevance of time to industrial shippers

For industrial operators any interruption at the production plants due to undelivered or undeliverable feedstocks is much more costive than shipping operations are. In other words industrial operators must ship all their cargoes obtained from overproduction or necessary to keep the production process going no matter the costs. In this respect waiting times for ships or other transportation costs are of less importance than production continuation. On the other hand, in order to remain competitive, costs of transports and port call optimization are extremely important as we saw in chapter three.

Although the evidence doesn't show from the figures that were given in the previous paragraph for worldwide port times, big oil majors such as Shell spend many efforts to improve port turnaround time in analyzing thoroughly the chain of operational events per jetty, per ship, per cargo over the year and try to achieve tailor made improvements. The costs savings that can be achieved are considerable.

Industrial shippers appear to set specific KPIs to measure the productivity of the ship and one of those is port stay time. A target time is set per jetty, per type of ship and per product group and the target is set after precise analyses of port visits that are re-analysed each year. Each port, notably each jetty, is thus constantly scrutinized and analysed into the different stages of the visit in order to have a measure against which to compare performance. This shows the weight that the industrial shippers attach to port time. It also shows how closely ports and their performance are watched by the port clients. And it shows that improvements in port call efficiency are made on jetty level, not only on port level.
It also confirms that an average port turn round time is not of much value, and that such turn round time should be broken down to sectors and trades.

A rough indication from Shell about the division of demurrage claims over the different markets says that 20-30% of claims are incurred in the crude oil trades, whilst 60% is incurred in the product trades and 20% in chemicals.

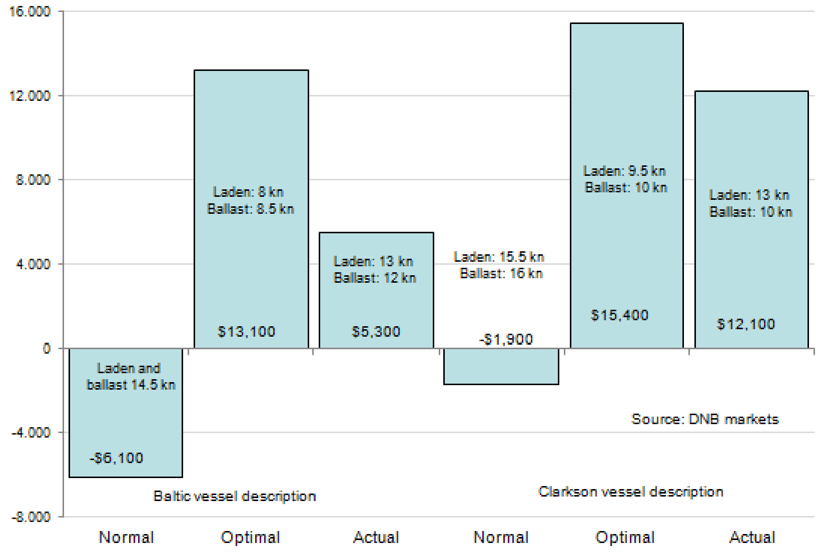
In the chemical tanker industry as a whole, port congestion and excessive waiting times are a true concern and both Odfjell and Stolt tankers, the two biggest owners in this sector, even state in their annual reports that port time takes up a disproportionate part of many voyages and that they strive to reduce port turnaround times. They even go as far as considering to reduce the number of ports to call at, in order to decrease risks of delay. The chemical is convinced that those ports that do not invest in infrastructure and port efficiency will simply not survive in the longer term.

Also big charterers in the chemical trades conduct on a regular basis Operational Reviews (OR) with the owners. In these reviews, being at the initiative of the charterer, voyages and ports are analysed thoroughly and KPI's such as port stay time are used to decide on performance. Parcel tankers appear to spend a huge proportion of their productive time in port; 40-50%, almost half of their time, whilst the other half is spend at sea sailing from one port to the other. Of the time spent in port, roughly half of it is spent 'for good reasons', being the transfer of the cargo. The other half is spent for other reasons, cleaning tanks for changing cargoes, conditioning of the tanks, shifting to other jetties, loading partial cargoes at different terminals etc. etc. There appear to be ports where 1/3d of port time is spent at loading/discharging whilst the other 2/3d is waiting time.

4.3 Vessel speed during the sea leg

So far the aspect of port stay time that was the subject of chapter 4.2. The next paragraphs will analyse the other processes via which the harbour masters information can optimize the port call.

For an optimum speed decision in the last part of the sea leg, information about the availability of the berth and tidal information is necessary.
The speed during voyage determines the time that a vessel takes on one voyage. A shipowner varies the speed of his vessels depending on the markets being high or low; by decreasing a vessels' speed the shipowner in fact takes capacity out of his fleet. This is why in depressed markets vessels tend to sail at lower speed, reducing supply that in turn hopefully increases freight charges. In a high freight rate market it pays to sail at full speed, therewith adding capacity and having additional earnings.
When fuel costs are high though, and this is especially nowadays the case, a reduced speed is more economical as the fuel costs saved may be greater than the loss of revenue. This graph gives the operations earnings when calculated at lower operational costs for three alternative speeds (in $ per day for a VLCC, for both a Baltic and Clarkson vessel description).



Intertanko Council presentation, 2013, source; DNB markets

For most cargo vessels the bunker fuel consumption per time unit is approximately proportional to the third power of the speed. Thus, reducing the speed by 20% reduces the fuel consumption per time unit

by about 50%. By slowing down for instance from 14 knots to 11 knots, the amount of fuel used in the voyage is more than halved.
So the optimum vessel speed depends on freight rates, fuel cost levels and more and more also on emission reduction. This optimum vessel speed has been the subject of many studies, now that slow steaming is more and more decisive if the vessel sails with a profit or not, bunkers being the highest cost component for tanker freight rates. The optimum vessel speed is an economic decision by the owner or by the charterer, depending on a spot or term contract. Owners pay for fuel costs under voyage charters, charterers do so under period charters.

Whoever makes the speed decisions for the whole of the sea leg, if information is provided about the availability of the berth and tidal information, he can decide to adjust the vessel speed in the last part of the sea leg and adjust it to arrive not earlier than at the time that a berth is available or to coincide with the tidal window. Again it is correct information that is needed to be able to plan this situation correctly.

The accurate tidal information is needed in order to calculate the optimum time of arrival at the pilot station or berth. Terminals may have tidal windows and if this is indeed the case it does make sense to arrive at a pilot station at a time that coincides with this window and adjust the speed whilst still at sea. This is notably the case for the large vessels carrying crude cargoes.

Berth availability is another type of information; delays in ports are mostly known about before the vessel leaves its previous port but nevertheless most vessels proceed to a congested port at close to full speed or if not typically congested, to a port where no berth appears to be available. On arrival, vessels then wait at the anchorage area (sometimes for days) before being assigned a berth. Apart the fuel that is unnecessarily consumed, with waiting at the anchorage come a number of risks, notably of grounding, collision and pollution.

The cause for this situation lies with the shipping contracts; many standard voyage charter parties require the vessel to proceed 'at utmost dispatch' to the destination port because ports generally queue vessels on a first-come, first-serve basis. Under these contractual arrangements, charterer and owner have disparate interests; the charterer has a high interest in the early arrival of the vessel because this determines how fast the vessel is served and lowers the risk to pay costs for delays. The shipowner on the other hand, paying for the fuel costs, has a high interest in reducing speed during the voyage and arriving just on time, an incentive that the charterer does not have.
Because of these contractual agreements that exist since long time, the shipowner has to negotiate with the charterer to perform the laden voyage at a reduced speed, taking slightly longer but resulting in a lower overall cost, because of the bunker savings achieved. This is if time to the charterer is of less importance and in-time arrival is less critical.

OCIMF, the Oil Companies International Marine Forum, and Intertanko, together with oil major BP, address these contractual agreements and advocate a virtual arrival system in place of a traditional first-come, first-serve berthing policy. Virtual arrival is a process that involves another contractual agreement, this time notably an agreement that gives the shipowner and the charterer the opportunity to adjust a vessel's speed. The commercial benefits will be shared between the shipowner and the charterer. So the virtual arrival process, if implemented by contractual agreement, can be of mutual benefit to owners and charterers. For ports there is the advantage of reduced hazards and emissions in their port approaches, when the vessel waiting times are minimized.

One of the pre-conditions though for virtual arrival indeed to materialize, apart from contractual terms, is to have the information about any delays at the discharge port. A harbour master will need to cooperate with the terminals to improve berth availability information.

That the savings are no pocket money shows the efforts requested from the owners and charterers once they agree to consider entering into a virtual arrival agreement for the voyage in view of a known delay; the shipowner provides ship performance information enabling an assessment of the voyage regarding the service speed of the vessel, charterer and owner agree on the methodology for calculating voyage data and the associated reporting requirements or agree on a Weather Analysis Service Provider for calculating voyage data and providing supporting reports. On completion of the voyage, a WASP or other entity that specializes in weather and vessel performance analysis, produces a final report providing post-voyage analysis and data to support confirmations of times and fuel calculations. All this to agree on who pays which part of the fuel bill!

Some of the other benefits finally that OCIMF and Intertanko stress are that the improved cooperation between owners and charterers will benefit the overall voyage planning. For example, parties can agree that some of the available time may be used for planned maintenance activities, statutory surveys, crew changes or vessel storing.
A second one is that the improved planning of in-port activities may also assist in reducing crew fatigue; operations can be planned well in advance and uncertainties associated with waiting times and periods at anchor are reduced.

4.4 Deadweight utilization

Information about constraints at the loading and discharging ports that can limit the cargo capacity for a ship, is necessary for an optimum deadweight utilization of the ship.
Deadweight utilization is the cargo capacity of the vessel[10]. It is a commercial decision whether the full deadweight cargo capacity of a vessel is utilized or if instead an owner accepts a part cargo. Especially many product tankers carry many part cargoes.
Decisive for the cargo volume to be loaded can be a precise order for production, or a cargo load offered for trading purposes. In these cases the vessel may not use its maximum deadweight capacity. But there are many other instances where the vessel takes the very maximum load that fits in the ship and for many vessel categories carrying crude oil and products, a maximum deadweight utilization, exactly within the limits of the port infrastructure, is of great importance. When no accurate or reliable depth information is available the charterer will apply safety margins when calculating the cargo load and these margins will, unnecessarily, diminish the cargo load and therewith increase the freight costs per ton. Shell, being one of the biggest industrial shippers, has identified as one of its' six key areas for improving shipping operations increasing the cargo-filling limits.

For a medium sized tanker such as an Aframax, a one centimeter difference in loaded draft may result in as much as a 90 ton margin. Unreliable charted depth and tidal information can result in an extra safety margin being applied to gain a required under keel clearance. This is a considerable reduction in cargo. The trend is for ships to increase in size, so ports have to strictly apply safety margins. Thus accurate

[10] Deadweight utilization is never at a full 100% due to bunkers, stores etc. that prevent a ship from carrying full loads. For tankers the rule-of-thump estimate is a maximum deadweight utilization of 96%.

depth information in approaches, fairways, buoyage, berthing and terminals is essential (Scherpenzeel van B., 2012).

Constraints at the loading and discharging ports though can limit the cargo capacity for a ship. The specific examples of port constraints in this case are maximum draft, maximum DTW and maximum displacement. Such constraints can exist with corresponding limits for both in-bound and out-bound ships. It is this precise information about the exact depth of the quayside before the terminal that is essential, both for the charterer and for the owner.
For the charterer, the freight costs per ton of cargo increases when not a full ship load can be sailed. The owners, when sailing a voyage charter, are paid freight for each ton of cargo carried. Especially in industrial shipping, where cargo loads can be fine tuned with production needs and storage terminals may absorb surpluses, sailing with the fullest possible loads decreases transport costs for the industry.

Quantity of cargo is also one of the contractual clauses in the charter parties. The voyage rates are valid either for a full ship load or a certain agreed upon cargo quantity known as the part-cargo minimum or PC tons. A 'full and complete cargo', knows a minimum and a maximum quantity. This means that the shipper guarantees to load at least the minimum and the ship may call for any quantity up to the maximum, which the charterer then must supply. The normal margin is 5 to 10% more or less than a stated quantity.
Normally the charterer enters the market place with an order of a certain quantity "10% more or less in owners option". In such case the owner can elect to carry anything between the stated quantity minus or plus the 10%.
The charterer always pays the PC tons even in the end he wasn't able to provide this amount of cargo. If however more than the part cargo minimum is onboard the ship, the additional amount, referred to as overage, is usually priced with a discounted rate for the entire voyage. From a shippers point of view overage is attractive since it typically means lower transportation costs per ton.
Also for the owner overage is attractive; as he was committed to carry a particular amount of cargo, he is now able to maximize profits from the optional cargo.
An industrial shipper will add another consideration to his decision about using overage, namely that of production and production needs; in cases of overproduction an additional amount will be delivered at cost price but without additional transport costs, whilst in cases of underproduction, the contractual right of delivering less cargo will be executed, therewith disturbing less the worldwide production chains.

A maximum deadweight utilization in the chemical trades is an issue from the point of view that chemical parcel tankers usually are only loaded for 60-65% of their capacity, due to the many part cargoes on board that all have their loading and unloading prescriptions. From the point of view draught of the vessel it is not an issue seen the small parcel sizes usually having low weights, though some chemicals may be heavier than some oil products.

There is another aspect that goes together with ships loaded to their load lines; that of safety.
The shipowner, protecting his interests, stipulates for a safe port when fixing the vessel. The charterer can then order the vessel only to a port which the owner and the master consider safe for the vessel. The classic definition of a 'safe port' given by Sellers L.J. in the case of The Eastern City (1958); "A port will not be safe unless, in the relevant period of time, the particular ship can reach it and return from it, in the absence of some abnormal occurrence, being exposed to danger which cannot be avoided by good navigation and seamanship." This means that a port or berth must be safe during the time the

particular ship will use it, and for thát particular ship; it does not matter if it is unsafe for other ship types and ships of other sizes. The vessel must be able to approach and leave safely. The port must not only be safe when the vessel is ordered to it, but also safe when the vessel arrives at the port. If in the meantime, the port has become unsafe the shipowner may refuse to send his ship there, and request the charterer to nominate another port.

The cargo being shipped between “safe ports and safe berths” as the contracts state, usually means that there should be a minimal risk for touching the bottom or that the vessel might be damaged whilst at berth. The guarantee is to be given by the charterers. It is, on the other hand, the responsibility of the master to load the vessel with respect to the safety of the vessel.

Again, the charterer has to take responsibility for something he cannot influence. When a vessel goes aground the shipowner may claim against the charterer for damage to the vessel by grounding and also for any general average expense and delay, providing that the charterer cannot prove negligence on the part of the master or pilot. Charter party disputes between shipowners and charterers regarding safe ports/berths are very common. The vast majority of these disputes concern physical damage to vessels and apart from the damage, the disputes themselves also incur time and costs.
Hence, charterers must determine that vessels, either in ballast or with a cargo load on board, can sail to the terminal and perform berthing and cargo operations safely and they need nautical port information to do so.
Whilst port managers and authorities are not involved directly in safe port/berth charterparty claims, they do become involved behind the scenes in many of the disputes between owners and charterers, for the obvious reason that the charterers of the vessel may have a claim against a port authority or berth owner.

Under a voyage charter the freight is charged per ton of cargo so it is in the interest of both the owner and the charterer to have the fullest cargo load, the owner point of view his earnings, the charterer point of view his costs.
A period charter is let for a certain period of time and the owner earns a hire fee regardless if and how much the ship will transport. So the cargo loads do not add to his earnings, the charterer on the period market though does have the cost savings as discussed before.

A maximum deadweight utilization is the most relevant for vessels carrying crude oil and dirty products. Clean products and chemicals tend to be lighter than those for dirty products and crude oil and full cargoes of those products normally do not attain their maximum deadweight draught. With a risk of over-generalizing, depth information is most crucial for industrial shippers who ship crude and dirty oils for their production process. For cargoes that are transported for trading purposes, it is the traded quantity that is decisive for the parcel size. With this parcel size as starting point, a vessel will be sought that matches best with the cargo.

4.5 Estimating freight rates, fixing of ships and port calls

Nautical port information as explained in 2.3.2 does improve the many decisions 'behind the scenes' that are to be made before the vessel starts its voyage.
Oil is for 99% traded in 'over-the-counter' (OTC) market. In these private markets trading is done directly between two parties, without any supervision of an exchange, an 'organised market'. This bilateral trade goes through the broker community, which has as consequence by the way that transaction details are not as observable as is the case in an exchange. Traded activities therewith remain for a part unknown and are for another part marketed at high prices.

Also the transport for the purchased cargoes is mostly organized with the intermediacy of brokers. There are two related functions that brokers notably execute for which they need nautical port information and the information in question will directly bear on an optimized port call. These are the functions of fixing and organizing the vessel call and matching cargoes and vessels on an operational level. And there is the function of estimating freight rates.

There are owners brokers, appointed by shipowners to secure vessel or cargo charters for their vessels, their main interest being to negotiate the best terms and revenues for the owners. And there are charterers brokers on the other hand that are expected to circulate and negotiate the charterers' order for tonnage and secure the most favorable fixture for the cargo interest. Charterers and shipowners constantly are engaged in complex contract negotiations in which their shipbrokers play a huge role.

Once the vessel is in port, and in order to prepare for berthing and cargo operations, the task of the master of the vessel, also then nautical information is required. For mooring, the master needs information such as positions and safe working loads of bollards or hooks. For oil cargo operations, he needs to know the diameter and position of the cargo manifold. A master who is able to prepare the vessel properly beforehand, by having access to the correct information, benefits not only of a safe, but also an efficient port call (Scherpenzeel van B., 2012).

4.5.1 Fixing of ships and organizing the vessel call

It is not compulsory to conduct transport negotiations through a shipbroker and many negotiations are conducted directly between charterer and shipowner. Most transactions though are done using a broking service, either via an independent one who provides his service to owners or charterers on a per cent fee of each concluded deal of say 1,5 %, or an in-house department. The numbers of fixtures by these brokers are huge; McQuilling reports a number of oil fixtures of 17.224 in 2012. With a claimed market share of 30% a world total would amount to over 57.000 fixtures a year.

Oil cargoes are fixed very quickly, typically a quote in the morning will be fixed by close of the business on the same day. This means that the fixing of a ship usually is done under huge time pressure. Oil companies and large traders will use a panel of brokers to which they offer their cargoes in order to find a vessel that matches the cargo characteristics, the cargo volume and that is at a position whereby the ballast leg and laycan[11] is as short as possible. For this last purpose brokers keep extensive position lists

[11] Laycan is often confused with laytime. The laydays refer to the time when a ship must present itself to the charterer. If the ship arrives before the laydays specified, the charterer does not have to start loading, if arriving after laydays, then the charterer can cancel the contract with the owner who delivered the ship too late in port. Hence the term laycan, shortened from 'laydays and cancelling'.

of where all their vessels are located at a certain moment in time, such that when the ship will be 'open', the broker can try to fix it for the most nearby cargo.
When seeking to match a cargo with a vessel, there are many factors to be taken into account that concern the port call. Are the load and discharge port known beforehand or will a range of ports be given? Will the vessel that is about to be offered indeed fit in the respective terminal or terminals? Are there wind, weather, or other restrictions for the berths in place that one should take into account? All these conditions need to be considered before doing an offer to the charterer, an offer that sometimes is open for as short as 10 minutes only; more brokers will compete in offering a vessel for one and the same cargo.

So whilst the puzzle to match an open vessel with a cargo and with port and terminal conditions needs to be sorted out in a very short time period, at the same time the decisions taken will greatly influence the port call later on; if based on the wrong or missing nautical port information, the operators who will eventually execute the voyage, will need to adjust the port call, and this will come with a loss of time and will bring unexpected costs with it.

For industrial shippers it is perhaps even more important to be able to organize port calls well; many industrial production flows are regular flows between particular ports. The ultimate goals of these flows are the prevention of interruption in production at plants due to lack of delivered raw materials, the lowest inventory holding costs and transportation at minimal freight. Since also the industrial shippers have engaged on the sport market for a large percentage of their transport needs, it has become a bigger challenge to organize these permanent flows in the required manner.

4.5.2 Freight rate estimation

A second issue is the freight rate that will be offered. Within broker companies there is a specific functionary called 'estimator' who is in charge of calculating the freight, about to be offered. The aim of such voyage estimate is providing the shipowner with an estimate of the probable financial return from a prospective voyage. The estimator will give several possible alternatives for a particular vessel, from which the owner will be able to choose.

Freight rates are extremely volatile. They depend for one part on the trading capacities and knowledge of the market of the shipowner or his representing broker and for the other, probably bigger, part to market conditions that are not under his control. The aspect that is explored here is the relation between a ports' reputation concerning vessel calls speed and organisation and the estimated freight rates.

In his estimation, the estimator takes account of a great number of variables such as the ship operating specifications, trading opportunities, various chartering methods and voyage returns possibilities. The port of call is also one of the variables; an inefficient port call will translate into a higher freight rate estimation.

Voyage tanker estimating is not an exact science and also this work is often carried out under high time pressure. Ideally time is required to investigate ports, possible delays in ports, port costs, bunker prices at various bunkering ports etc. etc. The estimator can take a pessimistic view of all these factors but then the business may look so bad that the owner is not willing to consider the voyage. Whereas had more accurate figures been used it could have been a suitable cargo to pursue (Wood, 2000). On the other hand if the estimator is too optimistic with respect to time and costs, the voyage may have some unpleasant surprises that make the whole enterprise uneconomical. So each voyage will be analyzed for cost effectiveness and profitable returns. Port time and reliable port information that guarantee the least of surprises once in port, are important elements in these analysis and will build up confidence in those ports. It is not unusual that two or three voyages are compared for a certain cargo and the issues important to an estimator, waiting time, cargo quantity etc. will certainly count greatly in deciding which voyage in the end will be executed.

An estimator who has confidence in a port being able to offer optimized port calls, will be able to estimate freight rates more accurately. The owner for which he has made his calculations will have less surprises later on about freights being too low and diminishing his earnings. Or being too high and bearing a risk for his competitive position.

Also in freight estimation draught restrictions in ports are very important to know precisely. If the cargo that is offered for the voyage is less than the full capacity of the vessel, detailed calculations will not be necessary. If on the other hand a full cargo load for a particular vessel type is offered, the estimator can increase the revenues of the voyage by loading the vessel up to its load line, but in that case he will have to find out if any of the ports or berths will have a draught restriction.

Summary and conclusions Chapter 4

The more the oil industry strives to improve the efficiency of their supply chains, the more emphasis they will put on the port call. There are a number of elements of a vessel call that bear on the productivity of the ship and hence on an optimized port call and that can be optimized by the harbour masters' information position, those are;

- The time spend in port
- Adjusting the vessel speed during the last part of the sea leg
- Increased deadweight utilization
- Organizing the vessel call
- The estimation of freight rates

Harbour masters' Information position	Impact on the port call	How
Exchanging planning information	Improves the port stay time	By better synchronizing the individual plannings of the services to the ship whilst in port, the total dwell time of vessel in port can be shortened.
	Supports vessel speed decisions for the last part of the sea leg	By providing information about berth availability during the voyage the waiting time for berth can be shortened & waiting time can be used for slow steaming. To achieve this the harbour master needs to reach out to the terminal operator.
Nautical Port Information	Improves the port stay time	By earlier and more accurate information fewer changes in the actual execution of the visit will be necessary.
	Improves deadweight utilisation	By more accurate depth information, carried cargo quantities can be increased because of safety margins that need less be applied.
	Improves the organisation of the vessel call	By having all necessary nautical port data available already during the preparations of the port call, the preparations will improve which in turn will improve the execution of the call.
	Improves freight rate estimation	By having all necessary nautical port data available during the extremely short time that is typically allowed for fixing a ship, estimating freight rates will be more accurate.

The time spent in port

- One of the main causes for a high port time appears to be jetty capacity in ports and this is the most critical in the chemicals sector. Chemical tankers are relatively young in contrast to the jetties they visit which makes discharging less efficient.

- Terminal handling is another bottleneck, and this goes for all of the three oil markets; depots invest in those facilities that are the most profitable and for a depot terminal this is storage, hence investments are directed to storage facilities, not to jetties, those are considered cost centers but for the ship they determine the time needed for loading and unloading. So the business model of a terminal is centered around storage, not on the vessel that brings in the storable cargo and it is not in the direct interest of the terminal operator on how fast or well planned the vessel is accepted at the terminal to start operations.

- For reasons of investments staying behind or port space restraints, port time improvements must be sought within the existing infrastructure. This is by optimizing business processes. And where the harbour master has little influence on infrastructure investments or terminal bottlenecks, he certainly is able to contribute to optimized business processes.

- So where the terminal is decisive for at least a part of the port stay time, terminal and vessel have no agreement about the service to the ship, other than cargo loading and unloading capacities, not about the speed of starting operations. The Harbour master may reach out to terminals in order to provide information about berth availability.

- For a shipowner there are losses of revenues when aggregated delays cause lesser voyages over a year and he faces the risk of not meeting obligations for transporting contracted cargoes. A shipowner has a number of other reasons -other than the shortest possible stay times- for a well planned stay, being in the fields of disruptions of crews' schedules, overtime payments and provisioning of the vessel and repairs.

- Port stay time is relevant for charterers and shipowners but for different reasons. The shipowners aim is that all stages should be completed as economically as possible. Laytime are costs for him and the laytime allowances are set as short as possible in the contracts. To the shipowner, time is money. The charterer wishes his cargo to be carried to its destination at the least possible cost per ton of cargo. Time may or may not be of importance to him but demurrage costs indeed are of importance to him.

- Time is a factor for charterers in the spot market, since they pay for delays in the port. With the increase of the spot market, the focus on time increases; delays are much more visible in demurrage claims. Time is a factor in the period market since less voyages can be made by the same vessel. This goes for owners as well as charterers.

- Whilst the shortest port stay times are economically beneficial to owners and charterers, time efficiency in ports may have a number of downsides and those are in the fields of safety being pressured and lack of maritime shore based personnel caused by the seafarers professions becoming less attractive.

- Causes of delays are not researched systematically by the industry. There are estimates by brokers that most delays are caused by terminals and by weather conditions. However brokers do keep track of slow ports and do take speed in consideration when planning a vessel call or estimating a freight rate.

- As for port time, there is no evidence in the oil shipping markets that shows that port times in oil markets are structurally exceeded. This may however be a matter of definitions; whether or not waiting times at anchorage are included in port times. Notwithstanding there is a focus on port stay time from the industrial operators and within the chemical transport markets. For the chemical shipping markets time in ports is a big issue, even to that extent that some owners consider withdrawing a number of ports from their calling schedules.

- Port stay time is the longest in the chemical transport. This is due to the many different packages, clients and berths that need to be delivered and visited. Chances of delaying port stay time are highest in chemical transport, because of all the factors that may delay the vessel at her visit.

Adjusting the vessel speed during the last part of the sea leg

- Fuel costs have an enormous impact on the operational earnings of a vessel. Shipping contracts in place and terminals using suboptimal or no queuing systems assigning berths, are the causes for ships sailing unnecessarily to ports at full speed. Once arrived at the anchorage area, they have to await sometimes for days, before being assigned a berth.

- The decisions to be made for the optimal speed during the last part of the sea leg can be supported by accurate tidal information and by information about the availability of berths.

- If it is the shipowner or the charterer that benefits from bunker savings at the last part of the sea leg depends on the contractual agreements between them; in the standard agreements the shipowner has the fuel costs in case of a voyage charter, a charterer in case of a period charter. More and more tailor made agreements for the division of bunker costs between shipowners and charterers in voyage charters are made. This requires negotiations between charterer and owner to perform the laden voyage, or part of this voyage, at a reduced speed, taking slightly longer but resulting in a lower overall cost. These negotiations may succeed if time to the charterer is of less importance. This in turn depends for industrial shippers upon their production processes being timely supplied with their feedstocks. For trade flows this depends on the contractual agreements between buyer and seller regarding delivery obligations and risks of price changes of the cargo during transport.

Increased deadweight utilization

- Decisive for the costs of transport of oil products are the costs incurred per ton of cargo and tankers do wish to sail for this reason with full cargoes and lowest costs per ton. Accurate and reliable depth information is required in order to load the ship to its full capacity and reduce the need of industry of applying a number of safety margins. Those safety margins are now still necessary because of lacking information but they seriously reduce the cargo load that can be transported. Depth information also supports the charterer and the master of the vessel in taking correct decisions about the safety of the berths, decisions that they are liable for.

- Under a voyage charter it is in the interest of both the owner and the charterer to have the fullest cargo load. On the period market is will be the charterer who will have the costs savings, whilst the amount of cargo will not be of interest to the owner.

- A maximum deadweight utilization is the most relevant for vessels carrying crude oil and dirty products. With a risk of over-generalizing, depth information is most crucial for industrial shippers who ship crude and dirty oils for their production process.

Organizing the vessel call

- By early information, this is long before arriving at the port, notably already when fixing the ship. It is now common practice that much information is available only at arrival at the port by oral transmission.

- When seeking to match a cargo with a vessel, there are factors to be taken into account that concern the port call and for which nautical port information is required. The information in question are prevailing restrictions as for the use of berths and of weather restrictions. It is the task of the brokers that work for either the cargo owner or the shipowners, to know and decide beforehand how to organize the port call, after which the operators, also from both sides, will execute the call.

- Whilst the broker company has no financial interest in a well organized port call, the shipowner and charterer do. And whilst the process of fixing a ship is usually done under high time pressure, the consequences of having to change a port call last moment, are costly and time consuming.

The estimation of freight rates

- Freight rate estimation determines if a vessel sails with a profit or not and as such is in the interest of the shipowner. Freight rate estimation is done by brokers who for these purposes keep track of the performances of ports such as port stay times; an inefficient port call will translate into a higher freight rate offered. This is disadvantageous for the shipper but also for the owner as it has a risk for his competitive position.

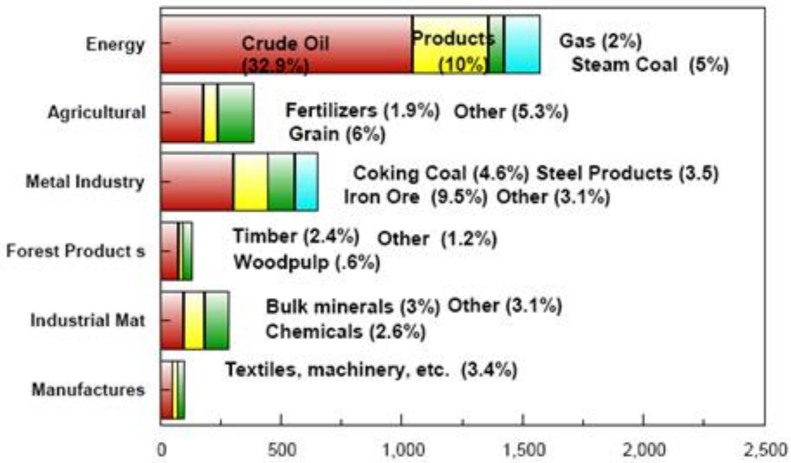
- Accurate pricing is in the interest of the owners shipping business. It is also in the interest of ports; from the alternative voyages for selection the port will be chosen that best contributes to the freight earnings and that has build up confidence in the calls, guaranteeing the least of surprises once in port. This is most relevant in those cargo flows that are more volatile, hence the trade flows.

Chapter 5 OIL SHIPPING SEGMENTS

Optimized vessel call is till now studied with the unit of research being the ship. If however in a sector the numbers of ships calling at ports are not that significant, this sector will not benefit much of improved port calls. Therefore the numbers of port visits give the magnitude that optimized port call may have for the shipping business as well as for the individual ports. Since worldwide port calls are unknown, as a way of looking is chosen for numbers of vessels trading. Hence this chapter researches the tanker fleets, tankers fleet sizes and the markets. It also studies the vessels employed for the different cargoes, their voyages -ship movements and distances- and the relative importance of the port calls in the different sectors.

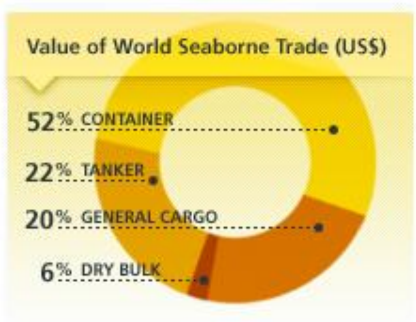
5.1 Relevance of oil trades worldwide

Comparing the wet bulk sector with the dry bulk and the container sector, one sees the magnitude of the sector. Dividing the world seaborne trade into main commodity groups of economic activity, this shows that energy dominates bulk shipping. The energy commodities (crude oil, oil products, liquefied gas and thermal coal) account for close to half of seaborne trade (in mln tons shipped per annum);



Clarkson Research Studies April 2004, "The tramp shipping market"

In 2011, according to the ISL world seaborne trade developments, crude oil and oil products represent-ted by far the largest commodity group in seaborne trade with approximately 2.8 billion tons handled. Measured in value of world seaborne trade, containers account for the biggest proportion of it (52%), whilst tankers account for 22% of the value.



Lloyd's List Maritime Intelligence Unit

By volume, the tanker sector represents around one third of international seaborne trade. The growth potential of this sector is enormous due to the increase in demand for carbon energy as a result of the growing middle classes in developing countries (Unctad 2012). The other two-thirds of world seaborne trade is for the dry cargo sector, including container shipping. This latter accounts for around 17 percent of world seaborne trade.

Measured in ton-miles, being the tonnage of the cargo shipped multiplied by the average distance over which it is transported, the share of oil in world seaborne trade has developed as follows;

Year	Oil	World total (billion ton-miles)	% Share
1970	6.487	10.654	61 %
1980	9.405	16.777	56 %
1990	7.821	17.121	46 %
2000	10.265	23.693	43 %
2005	11.749	29.598	40 %
2007	12.440	32.932	38 %

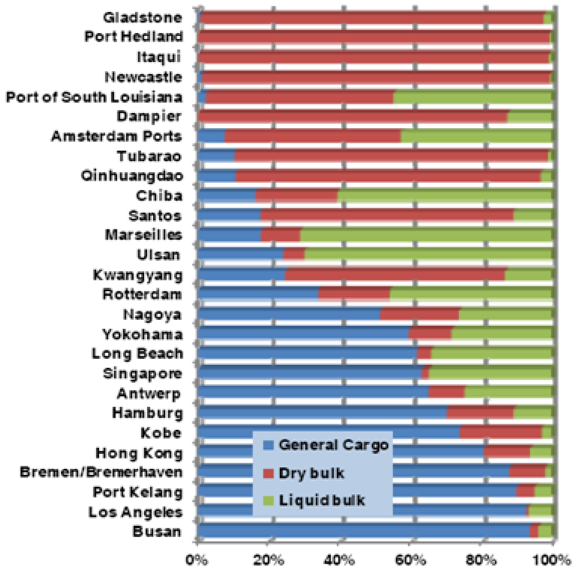
Lun, Y.H.V. Lai, K.-H., Cheng, T.C.E., Shipping and Logistics Management, 2010

So whilst the share has decreased rather dramatically, in absolute volumes the oil trade has doubled in the last 40 years. In numbers of vessels that sail the worlds' oceans, tankers account for 23,5 % of the total world fleet, whilst for almost 40% of dwt;

	Number	1000 dwt
VLCCs, product carriers, oil/chemical tankers	9.740	451.970
% share of world fleet	20,7 %	36,6 %
Pure chemical tankers	1.331	8.462
% share of world fleet	2,8 %	0,7 %

ISL, Shipping Statistics and Market Review, 2010

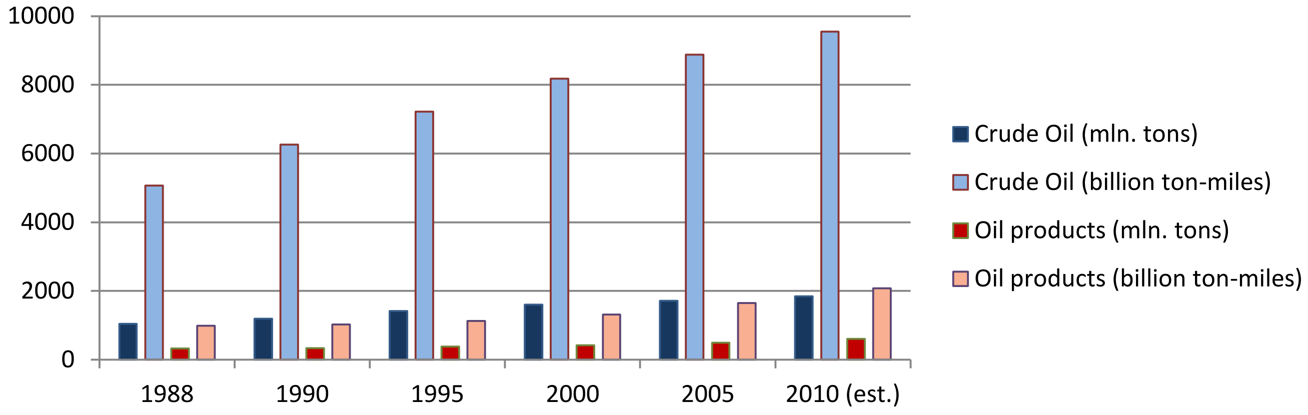
As for the distribution of general cargo, dry and wet bulk cargoes for a number of selected ports, the Institute of Shipping Economics and Logistics gives the following graph (per cent of total cargo traffic in 2011);



ISL SSMR 2012, World Seaborne Trade

Within the seaborne oil shipments, crude oil exceeds those of any other bulk material, with nearly 30 percent of total world seaborne shipments. Between 2008 and 2012, the seaborne trade volume of crude oil dropped on average by 1.1 % per year, but shipments of oil products gained around 2.6 % on average (ISL SSMR, 2013). Over a longer period, the changes in trade volumes and ton-miles are as follows.

world seaborne trade developments from 1988 to 2010 in tons and ton-miles



	Crude Oil (in mln tons)	Crude Oil (billion ton-miles)	Oil products* (in mln tons)	Oil products* (billion ton-miles)
1988	1042	5065	325	993
1990	1190	6261	336	1029
1995	1415	7224	381	1132
2000	1608	8180	419	1319
2005	1720	8875	495	1652
2010 est.	1850	9550	605	2082

Source; Fearnleys' Annual Review 2008
*Oil products includes clean and dirty products, excludes liquid gas

This shows that the transport growth of oil products from 1988 was a bit bigger (86%) than the growth for crude oil (78%). The growth of ton-miles though was much larger for oil products; 210% against 89% for crude. Ton-miles is usually the measure to determine tanker transport demand.

5.2 Oil transport systems

Crude oil tankers usually visit not more than one terminal per port call, whereas product tankers may call at four terminals and parcel tankers to as much as eight in the Port of Rotterdam. There are huge differences between the three trades in the numbers of berths that a vessels calls at within one single port visit. For a chemical parcel tanker it takes several berths per port visit to load or unload cargoes, sometimes up to eight per port visit. Naturally this requires a lot of planning, but also it bears with it an increased risk of disruptions and delays.

5.2.2 Crude oil transport

Crude oil transportation is the most straightforward of the three. Crude oil is transported from the oilfields of the oil exporting countries to refineries in the worlds' consuming areas. Basically the ships are loaded to their capacity in one or more loading ports and the crude oil is transported directly to its unloading port. From the receiving terminals the crude oil is transported via pipelines to the refineries, also to those refineries in the hinterland[12].

[12] About half of all crude oil amounts received at the Rotterdam terminals is used in the five refineries located at the port. The other half is transported, through pipelines, to the six refineries in the hinterland, in Antwerp, Germany and Flushing.

Transport of crude oil is therefore a straightforward matter of shipping and discharging at the terminals, not of any further transport by means of vessels. This makes that crude oil in Europe for 99% is an import product and as such many VLCCs basically have to return on ballast[13].

The crude oil that needs to be transported long distance, for instance from Russia to Singapore, travels mostly via a hub port such as Rotterdam. The shortest distance, in this example Russia-Rotterdam, is done by Aframax. The long haul from Rotterdam to Singapore subsequently by VLCC. Transshipment to the VLCC either takes place offshore or at a dolphin or buoy facility in the port that allows ship to ship transfer of liquid bulk cargoes.

Another reason for such ship-to-ship transfers is that not all ports have sufficient depth to receive VLCCs and therefore smaller tankers will do the last part of the trip in the port. These lightering operations are dominated by Aframax vessels. The process of lightering a VLCC, holding 2m barrels of crude oil, requires about four Aframaxes. The implication is that relative to numbers of VLCC voyages, only a portion of those voyage do actually end up in a port call.

5.2.3 Oil products transport

Transporting oil products is quite different from the transport of crude oils. Where crudes are transported from their exploration sites to a limited number of refineries, oil products travel from those refineries to a large number of plants for further production or consumption. Ports are therefore both loading and unloading ports and refined products use more modes of transport than vessel and pipe, notably barges for transport to the hinterland.

Oil products are transported via the storage terminals to production plants in the port or elsewhere. The most part of all oil products has as its' destination a terminal. Another part is transshipped by means of ship-to-ship transfer in order to travel further. Big oil tankers are loaded at the exporting port for transportation to importing ports but often the cargo will have to be discharged in more ports and to more clients. The cargo may then be transshipped to a number of smaller ships who deliver the goods to the purchasers. These ship-to-ship transactions often take place at sea, and not in a port, as this saves time and port dues.

Ships with oil cargoes not always have a fixed destination. Often the vessels start sailing from their loading ports whilst the trader hasn't yet sold the cargo. This happens in contango situations, when future oil prices are expected to be higher than present spot, short term, prices. Oil is bought relatively cheap at the spot market and sold at higher prices on the futures market. Discrepancies between spot and future markets make that destinations of cargoes may change frequently and last minute.

Another example is a trader who has bought a cargo of oil in the Middle East and expected at the moment of loading to sell it in the United States may well change his plans half way the shipment. For instance when he has the opportunity to buy and sell another cargo load in the US that is already in the vicinity of the buyer. As it is more efficient to sell a newly bought cargo to his client, there is no need to transport the original cargo to the US and this cargo will then travel last minute to another destination.

[13] In the Port of Rotterdam however, and only in recent years, crude vessels take fuel oil for shipment to Singapore and hence increasingly sail with return cargoes.

5.2.4 Chemical products transport

The chemical fleet is operated in much more complex and extensive trading patterns than is the case for oil products. Chemical tankers transport over 500 different products comprising over 4000 individual parcels. Unlike the vessels in the fuel oil example, chemical tankers have to call at a number of berths dictated by the customers, even within one and the same port. Calling these many berths is time-consuming, fuel-inefficient and costly. There is tank inerting involved plus extensive customers ships' inspection and internationally regulated vetting programs. Port congestion and excessive waiting time remain a concern for the chemical tanker industry, and especially in the chemical business port time many times takes up a disproportionate part of many voyages.

5.3 Throughput and port calls Port of Rotterdam

Oil throughput percentages may be significant in ports but may also see huge changes as show the figures for the Port of Rotterdam; crude oil accounted in 2012 for almost 24% of total throughput with a total volume of ±100 mln tons. Oil product volumes were ±80 mln tons and the other wet bulks ±35 mln tons.[14] The wet bulk section together was 49% of the total throughput. Wet bulk is a generally used category which is not always further specified. The wet bulk category includes chemicals but at the same time also products such as biofuels and edible oils. The best estimate from the Port of Rotterdam is that 2/3 of the wet bulk category in the Port of Rotterdam is taken by the chemical products.

Incoming and outgoing cargo flows are totally different for the three oil cargoes. Whereas crude oil is a practically 100% income flow, for oil products and chemicals incoming and outgoing flows are more balanced as this table shows (given in 1000 tons).

(1000 tons)	Incoming 2012	Outgoing 2012	Total 2012
Crude oil	98,2	0,1	98,3
Oil products	45,0	36,8	81,8
Chemicals*	13,7	8,6	22,0

*Assuming 2/3 of wet bulk is for chemicals

Port of Rotterdam Haven in cijfers 2010-2011-2012

The 80 mln tons of mineral oil products that are transshipped annually in the Port of Rotterdam, consist for a little more than 50% of imported products for which the port serves as an unloading port, and for an almost equal volume of exported products, the port thus being a loading port.

The same pattern shows over Europe, be it that exports of oil products in Rotterdam is more balanced with imports as compared to the Europe-wide average, resulting in product tankers being able to sail more with backhaul cargoes from Rotterdam.

2011	**Seaborne imports to Europe**	**Seaborne exports from Europe**
Crude oil	464,2	12,9
Oil products	132,2	86,4
Total	596,4	99,3

ISL Shipping Statistics and Market Review 2013 /BP Statistic Review of World Energy

[14] Several sources Port of Rotterdam

5.4 Structure of tanker markets

In order to know more about the tanker voyages and their port calls, we first examine the tanker fleet, the numbers of tankers that are trading worldwide and their employment, after which we go into their voyages and their port calls.

First we take a look at the different tankers, their use and the hauls that they are employed on. Oil tankers are often classified by their size as well as their occupation according to this so called market scale categories. According to UNCTAD (2008) oil tankers represented 36,5% of the world merchant fleet tonnage and roughly 50% of the total dry and liquid bulk ship tonnage. Tankers were responsible for about 38% of all ton-miles performed by cargo ships.

Name (market scale categories)	Vessel size in dwt[15]	Barrels of crude oil Average	Nrs. of vessels*	In m dwt	Use
VLCC	>200.000	2.000.000	614	188	Crude oil, Long haul Used amongst others in the Persian Gulf export trade Load areas; Arabian Gulf, West Africa, Red Sea, North Sea, Med. Demand for crude oil tankers is centred on the major oil companies.
Suezmax tanker	120.000 to 200.000	1.000.000	483	74,7	Crude oil, Medium haul Used amongst others for exports from West Africa and local distribution in the North Sea and Mediterranean trades Load areas; Med, West Africa, Black Sea, North Sea
Aframax tankers	80.000 to 120.000	700.000	913	97,7	Crude oil, Short haul, f.i. North Sea, Cross Mediterranean Increasingly capable of carrying clean products Load areas; North Sea, Med, Caribbean, Arabian Gulf, SE Asia, Black Sea, China
Panamax tankers	60.000 to 80.000	450.000	414	29,9	Crude oil, dirty products Very short haul
Product tankers@	10.000 – 60.000		3.367	106,7	Mainly refined (clean) oil products, some chemicals Demand for oil product tankers is typically short-haul, matching refinery production with intra-regional demand
Chemical tankers			1.144	6,3	chemical parcels Intra-regional short haul trades

@Also called handysize, general purpose (GP), Medium Range (MR), Large Range 1 (LR-1) tankers
*Nrs. of vessels trading in March 2013
Several sources; numbers of vessels trading and dwt; Clarkson Shipping Review & Outlook, Spring 2013
Chemical tankers; ISL Shipping Statistics Yearbook 2012

In the crude oil tankers there is the ULCC category, the Ultra Large Crude Carriers, ranging from 300.000 to 500.000 dwt, that is slowly being phased out as the commercial exploitation proved not to be successful. In 2011 the Port of Rotterdam had eight ULCC calls, in 2012 three.

As much as possible will the above categories be employed, with the VLCCs, Suezmax, Aframax and Panamax tankers mainly shipping crude oil. But also the classification crude oil tankers, product tankers, chemical/oil tankers and pure chemical tankers will be employed, depending on the available statistics.

[15] Next to dwt, deadweight tonnage, there is gross tonnage. These are totally different measures; gross tonnage applies to vessels, not to cargo, and is measured in cubic metres. Gross tonnage is used as a basis for dues in ports such as for pilotage and dry-dock services, for official statistical purposes and as a basis for Protection and Indemnity Club entries. Deadweight tonnage applies to the carrying capacity of the ship; the total weight of cargo, fuel, stores, fresh water, crew, that the vessel can transport. It is calculated as the difference between the tons of water the vessel displaces at its lightweight and the number it displaces when loaded down to its loadline. As a rule (M. Stopford, Maritime Economics), the non-cargo items account for about 5% of the total deadweight in medium sized ships, although the proportion is lower in large vessels.

Primary routes for VLCCs are long haul, mainly from the Middle-East, to Japan and the Far East and Europe. Suezmax tankers trade on more specific routes. The panamax sector is a rather small sector of the market, though expected to expand as crude oil exports from the west coast of South America increase and find their way to the US Gulf refineries.
All these tankers produce huge amounts of port calls worldwide, even if not all of them are employed. To give some sort of idea of numbers; a rough estimate from Shell is that this company has 200 calls a year at the Port of Rotterdam only, delivering crude oil. This includes 1 VLCC call per week. Shell oil products and chemicals generate yearly 600 calls each to Rotterdam.

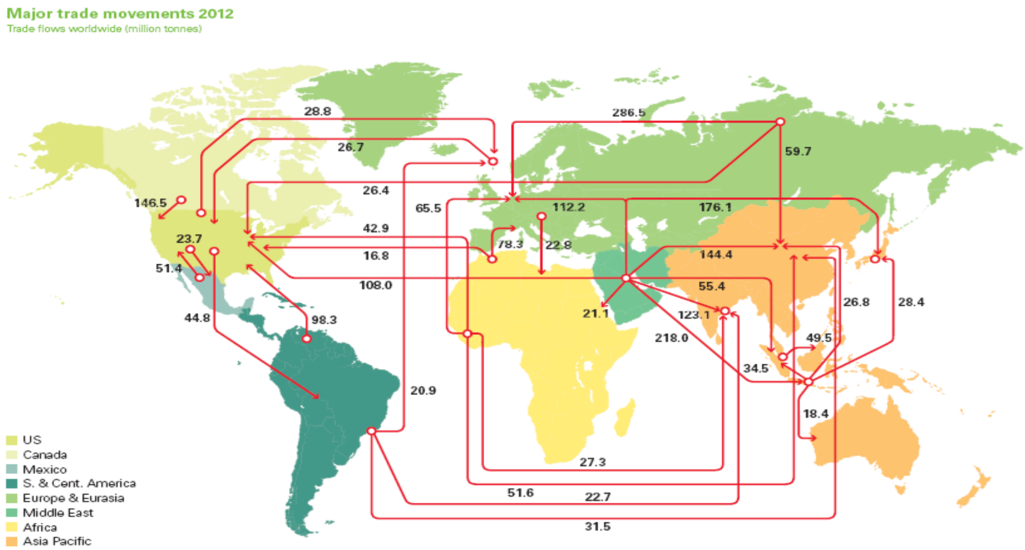
As for the number of voyages of all these tankers per year, this information is provided as follows by FearnResearch for 2012, with respect to laden voyages (FearnResearch does not track product tankers below 50.000 dwt). The number of vessel voyages over a year increase with decreasing ship size; an Aframax or product tanker trading short haul will do many more voyages, hence port calls, then a large crude oil tanker trading long haul.

Vessel category	Average number of voyages per year
200 kdwt+ (VLCC)	6.1 voyages
120-200 kdwt (Suezmax)	8.1 voyages
55-85 kdwt (Panamax)	8.0 voyages
85-120 kdwt (Aframax)	8.9 voyages
50-55 kdwt	11.7 voyages

5.5 Voyage distances

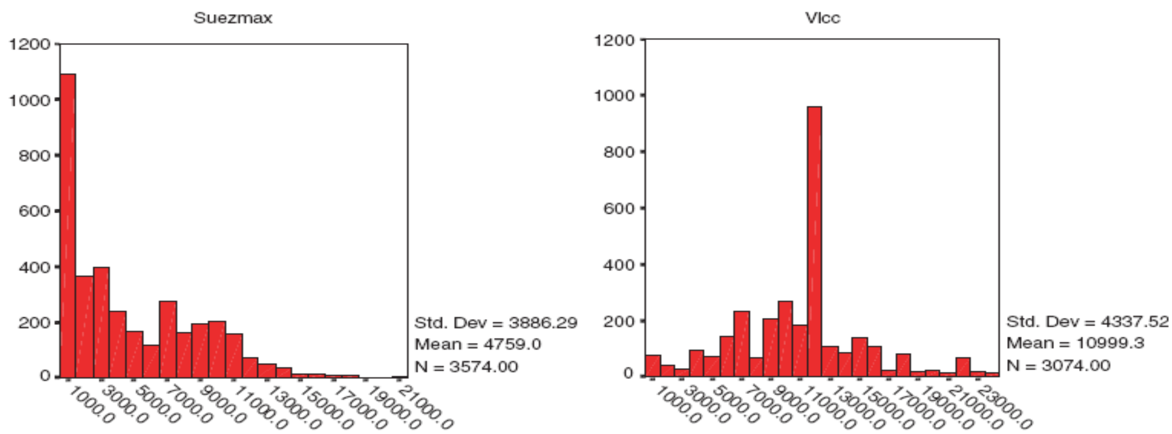
The transported volumes of crude and oil products as given in annex I for 2012 show the longer haul trade movements. These reported inter-area movements generate very substantial numbers of tanker voyages and port calls on a daily basis. But next to that, and those are not included in the figures, there are huge intra-area movements, for example those movements between European countries. Especially in the products and chemical products, the intra-area movements are very significant.

The relative size of the port leg as compared to the sea leg is important in order to know the relative importance of port stay times. This image shows the major trade movements. Inter-area movements in volumes are given in Annex I.



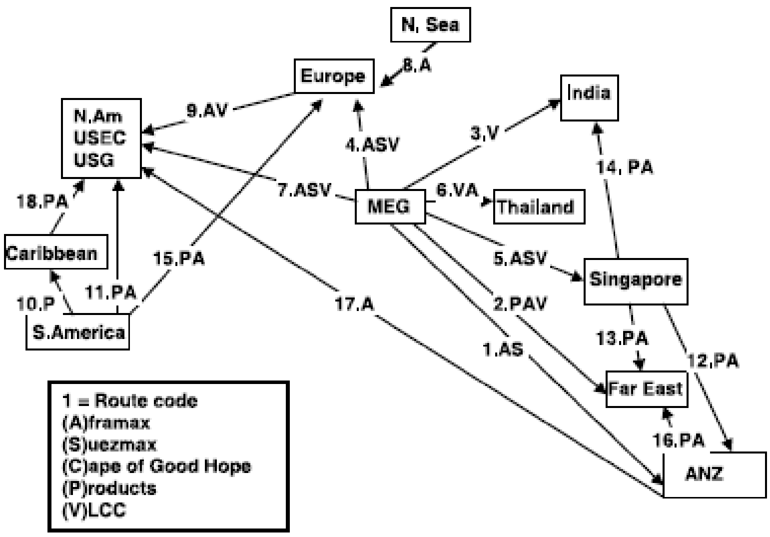
BP Statistical Review of World Energy June 2013

These trade movements and the employment of the different vessel categories on these trades dictate the voyage distances that vessel travel. The next data show round voyage (ballast leg plus cargo leg) distance distributions for VLCC and Suezmax vessels. The Suezmax segment can be considered as somehow representative also for Panamaxes and Aframaxes. The mean round voyage distance for these segments is about 4600 nm, which is 13,5 seadays at a spead of 14.5 knots (the standard average service speed of Worldscale). For the VLCC segment the mean is 11.000 nm, being 32 days.



LMIU (Lloyd's Marine Information Unit, London), Movement data 2004

The 32 days that a VLCC spends at sea on average, as compared to the average 13,5 seadays for Suez-, Afra- and Panamaxes shows that for a VLCC the time in port, which is not that different for the different vessels, is relatively less important than for the other categories. The major trading routes together with the vessels employed on these routes are given below, followed by their distances, from which subsequently are derived the average numbers of days at sea, their port times and the relative importance of the port leg as compared to sea time.



18 major trading routes and the vessels employed, Mokia (2002)

Distances in nautical miles, voyage times and the port leg sizes relative to the sea leg for the 18 major trading routes and the vessels employed;

Route	Vessel category	from	To	Distance, in NM	Voyage time, at 15 knots, days-hours	Port time in days	port leg relative to sea leg
1	S A	MEG	ANZ (Aus.NZ)	7.420	20 – 15	4,25	21 %
2	V A P	MEG	Far East	6.400	17 – 20	3,70	21 %
3	V	MEG	India	1.537	4 – 6	4,30	101 %
4	V S A	MEG	Europe	6.580	18 – 7	4,25	23 %
5	V S A	MEG	Singapore	3.845	10 – 16	4,25	40 %
6	V A	MEG	Thailand	3.960	11 – 5	3,75	33 %
7	V S A	MEG	N.Am., USEC, USG	9.789	27 – 5	4,25	16 %
8	A	North Sea	Europe	1.155	3 – 5	3,20	100 %
9	V A	Europe	N.Am., USEC, USG	4.854	13 – 12	3,75	28 %
10	P	SAmerica	Caribbean	5.198	14 – 11	4,00	28 %
11	A P	SAmerica	N.Am., USEC, USG	6.223	17 – 7	3,60	21 %
12	A P	Singapo.	ANZ	4.273	11 – 21	3,60	30 %
13	A P	Singapo.	Far East	2.570	7 – 3	3,60	51 %
14	A P	Singapo.	India	2.435	6 – 18	3,60	53 %
15	A	SAmerica	Europe	6.341	17 – 15	3,20	18%
16	A P	ANZ	Far East	4.487	12 – 11	3,60	29 %
17	A	ANZ	N.Am., USEC, USG	9.115	25 – 8	3,20	13 %
18	A P	Caribb.	N.Am., USEC, USG	1.155	3 – 5	3,60	112 %

Voyages via Kiel, Suez, Panama Canal[16]
For distances; MEG/Kuwait, Europa/Rotterdam, SA/Buenos Aires, ANZ/Sydney, Carribean/Kingston, NA/New Orleans, Far East/average Tokyo-Shanghai, India/Mumbai
Table by author, distances from BP Shipping Marine Distances Tables
Port time from standard charter parties (allowed laytime in voyage charters)

It goes without saying that a reduction of port time on a small voyage distance has the biggest relative effect. These effects are even bigger in the intra-regional trades; within Europe, the UK is both the largest origin country for oil products and destination (with France on a second place). As example serve the origin and destination of oil products' throughput in Rotterdam;

	Origin oil products to R'dam	Destination oil products from R'dam	Total*	Distance in NM	Voyage time days-hrs	Port time (hrs)	port leg relative to sea leg
Russia/Baltic	19,1	0,86	19,96	1.025	2 – 20	72 hrs	100 %
Middle East/Asia (Imp.;India, S. Korea, Qatar, Exp.; Singapore)	6,22	10,27	16,49	7.500	20 – 22	72 hrs	14 %
America's (USA, Brazil)	4,27	6,12	10,39	4.050	11 – 6	72 hrs	27 %
Africa (Canarias)	1	4,3	5,3	1.700	4 – 18	72 hrs	63 %
Rest of Europe	13,45	15,38	28,83	187	0 – 12	72 hrs	600 %

*2010, CBS, in mln tons, by lack of vessel call numbers, throughput tons are taken to compare volumes

[16] Ships carrying crude oil loaded in the Middle East and bound for discharge ports in North America or Northern Europe can be routed around the Cape of Good Hope or through the Suez Canal. The sailing time for a voyage around the Cape of Good Hope to Northern Europe is approximately two weeks longer (5 weeks rather than 3 weeks at 13 knots) than for the corresponding sailing time through the Suez Canal. For a voyage to the US Gulf Coast the additional sailing time around the Cape is approximately one week.

In fact a huge portion of the oil products transport to and from Rotterdam (not less than 40%!) is intraregional -between European countries- and it is exactly here that the port leg is the longest relative to the sea leg. And within Europe it are notably the two most nearby large countries that take the biggest share of this intraregional trade, stressing once again, in the case of Rotterdam, that the largest share of port calls have a port leg that is long in comparison with the sea leg.

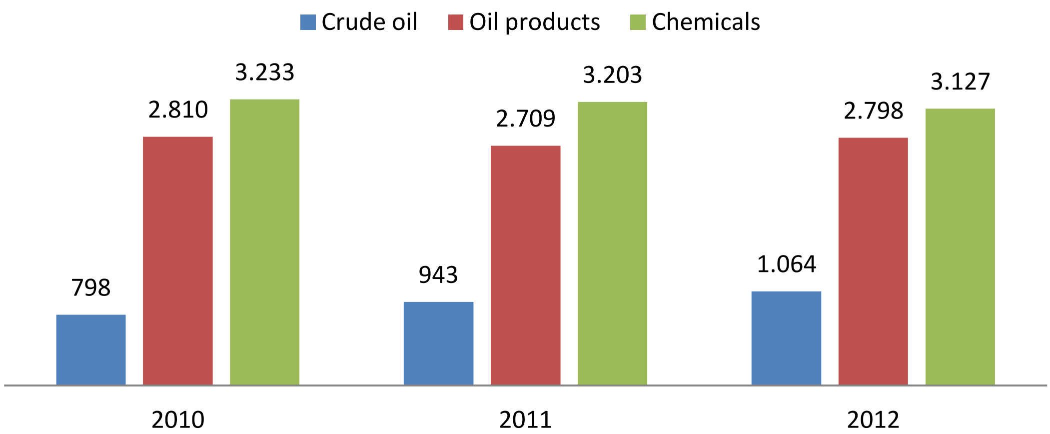
Oil products to Rotterdam from destination…

Oil products from Rotterdam with destination…

Source; Port of Rotterdam, CBS, in mln tons

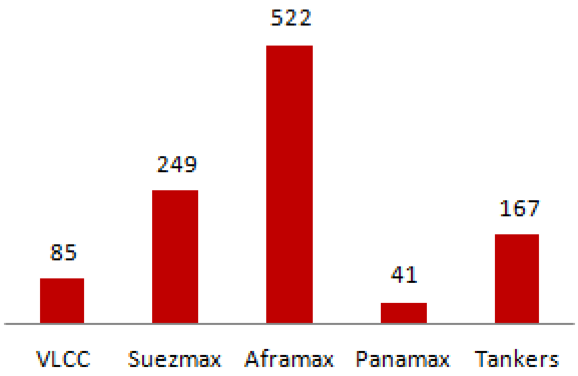
5.6 Numbers of ship calls

Apart from the voyage distances and relative port leg time, the numbers of port calls are of interest when considering port call optimization. In numbers of port calls for the Port of Rotterdam, both oil products and chemical trades were almost triple the number of those of crude oil calls, with chemical calls exceeding product calls. The numbers of calls for 2010-2012 were respectively;

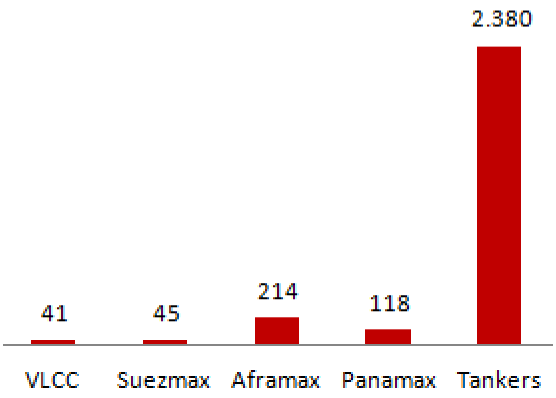


The vessels that transported these cargoes were predominantly Aframaxen and tankers, which is shown by the numbers of vessels calling the port of Rotterdam in 2012 for the different segments;

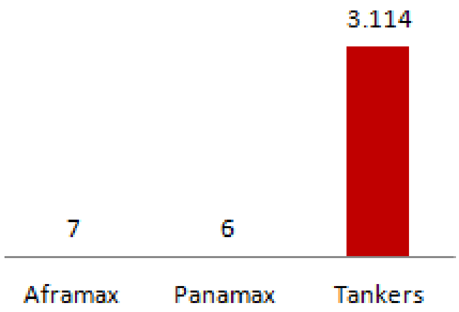
Crude oil port calls



Mineral oils port calls



Chemicals port calls



Summary and conclusions Chapter 5

Sector	Captiveness	Nrs. of vessels trading	Numbers of port calls	Relative time port-sea leg	Nrs. of terminals per call	Diste r-banc es
Crude oil	Highly captive to industry in port, production flows dominated by long-term contracts and oil producers	35% of total tanker fleet, 6-8 voyages a year	Port calls only to oil majors refineries. R'dam 2012; 1.064 calls, most Aframaxes	Many long haul voyages, port leg very short compared to sea leg	1 terminal per call	Few
Oil products	Less captive, industry divided over more ports, huge trade flows, independent traders in competition with oil majors traders	25-50% of total tanker fleet, up to 12 voyages a year	Large numbers of port calls to many terminals, also independent terminals. R'dam 2012; 2.800 calls	Many medium and short haul voyages in intra-regional trade, port leg compared to sea leg shorter	Up to 4 terminals per call	High numb ers
Chemicals	Predominantly production flows, no trade flows, industry scattered over ports and hinterland, volatile in port choice	Up to 40% of tanker fleet	Huge numbers of port calls to many ports. R'dam 2012; 3.130 calls	Predominantly intra-regional trade with very short haul voyages, port leg very long compared to sea leg	Up to 8 terminals per call	Extre mely high

- Crude oil transportation is the most straightforward of the three, being transported directly from the oil fields of the oil exporting countries to the, relatively limited, number of ports that have refineries using the crude as feedstock. Oil products on the other hand travel from those refineries to a much larger number of ports and plants for further production or for consumption. The destination of ships carrying oil cargoes is less fixed than for crude oil. Transporting chemicals knows even more extensive trading patterns than is the case for the oil products with even having to call at more berths within one and the same port.

- Incoming and outgoing cargo flows are different for the three cargoes; in European ports crude oil is a practically 100% income flow, where for oil products and chemicals the incoming and outgoing flows may be more balanced, ports being for those flows both loading and discharging ports.

- In numbers of vessels trading, product tankers are the biggest category with the combined fleet of VLCC, Suezmax, Aframax and Panamax tankers for crude oil on second position. As the Aframax and Panamax fleet increasingly carry certain oil products as well, the fleet for products certainly is biggest. Using another classification that specifies not only the pure chemical tankers but also the combined chemical and oil tankers will put the tanker fleet carrying chemicals on second position. The growth of tanker transport demand over the period 1988-2010 was bigger for oil products than for crude oil.

• The different categories of vessels trade on different hauls, with the VLCC fleet trading the long hauls, and Suezmaxes, Aframaxes and Panamaxes trading medium to short hauls. Product and chemical tankers typically trade the shorter to very short hauls.

• Vessels for short haul routes are much more sensitive to port turn around times than vessels for the long hauls. The size of their port legs being much longer as compared to the sea leg. This brings with it that the relative importance of the port stay time is much bigger.
The largest crude oil carriers spend most days at sea with VLCC averaging 32 days at sea and Suezmaxes on average 13,5 days. Their port stay times are not that different though which means that the relative importance of port time is bigger for the smaller crude vessels. And it are these vessels that outnumber the large ones. For the oil products and chemical trades the effect is even bigger; these huge intra-regional transport flows know very short sailing times. In fact, for the Port of Rotterdam the biggest cargo flows in oil products are to and from the two most nearby countries.

• Crude oil is the most widely used source of fuel, supplying around one-third of the world's energy needs. In mln of tons shipped crude oil is the single largest commodity in world seaborne transport. This is perhaps why the focus is always so much on crude oil, and less so on oil products and chemicals. Crude oil tanker transportation appears to receive considerable attention, much more than the other tanker transportation markets, perhaps due to its' magnitude, its' influence on world economy and its extreme market volatility.

• From a point of view port call this emphasis on crude is less obvious though;
- The product tanker fleet and chemical fleet is larger than the crude fleet
- The largest crude vessels undertake on average 6.1 voyages per year, where the product tankers undertake 11.8 voyages
- Number of port calls in the product and chemical sectors outperform those in the crude sector
- The voyage distances are longest for the largest crude tankers whilst port stay time is not longer
- Global product tanker trade is heavily concentrated on local trades with 70% of the clean petroleum product trade concentrated on the short haul routes.
- Also chemical tankers serve the short haul trades where port stay times are relatively more important

So however there is an emphasis on crude oil point of view throughput volumes (crude oil constituting for 70% of total oil imports and exports, products for the remaining 30%), from the perspective of the port call, the transportation of oil products and of chemicals is more important.

END CONCLUSIONS

A harbour master who wishes to seek a customer orientation, can do so by choosing an active information position. Therewith he improves the productivity of the ship when calling at the port. This link between the productivity of the ship and optimized port call has not been made before from a port management perspective.

The productivity of a port is mostly considered as cargo throughput. The link between port productivity and vessel productivity is week, perhaps because shipping is a relatively unknown area for port managers. A link between shipping and port economics may provide though for an optimized port call. This strengthens the performance of the port and its competitive position. Strengthening a ports' competitive position is usually sought in strengthening supply chains, those in turn usually referring to container businesses. In the wet bulk business it are however production processes and trade flows that dictate improvements in the efficiency of the industries supply chains.

In order to know the relevance of an optimized port call in the oil shipping markets, one needs to study the actors involved and dig into the processes that can be influenced by the harbour masters' information position. The essence lies in thoroughly understanding and analyzing the customers businesses and processes. Also one needs to study the magnitudes of the port calls in the different shipping markets in order to know the relevance of port call improvements in the different sectors.

As for the actors to whom an optimized port call is relevant, it appears to be decisive to investigate;
• Whether the cargo flows are production or rather trade flows, in other words in how far they are captive to industry or more volatile. Trade flows have increased over the years as compared to production flows and this evoked an emphasis on improved port calls.
• If the shipping is done as an industrial operation or purchased on the tramp shipping market. Industrial shipping activities increase, both in the production and in the trade flows, and industrial shippers have huge market powers vice a vice the shipowners.

The need for optimization in port calls lies with the industrial shippers and the traders, as well as it does with the shipowners, but for different reasons. However, the need for improvements in the productivity of the ship in port is more felt by the industrial operators than it is by the tramp ship operators. It are notably the industrial operators where the pressure for change comes from, for two reasons being on the one hand the market power they possess in shipping and on the other hand the huge competitive pressures that characterize their production business of which shipping forms an integral part.

As for the processes that increase ship productivity with the proper information, those appear to lie:
• In the port leg; offering options to reduce port stay. Port stay time is relevant for charterers and for shipowners but for different reasons.
• In the sea leg; offering possibilities to optimize speed decisions approaching the port. Both shipowner and charterer may benefit depending on contractual agreements and market powers to change those.
• In deadweight utilization; increasing cargo volumes transported per vessel. Most relevant for industrial shippers shipping crude and dirty oils for their production processes.

• Preparing for the port call; bring about that the port call preparation and execution differ as less as possible and that the freight rate offered matches the actual costs. Most relevant for the trade flows, for both charterers and owners.

An optimal port call may thus be defined as 1) taking the least time for the ship to spend in port (the port leg), 2) using the least bunkers whilst approaching the port at optimal speed and (the sea leg to port approach), 3) the maximum volume of cargo loaded (deadweight utilization) and 4) being fixed at correct conditions and price (fixing ship and freight rate).

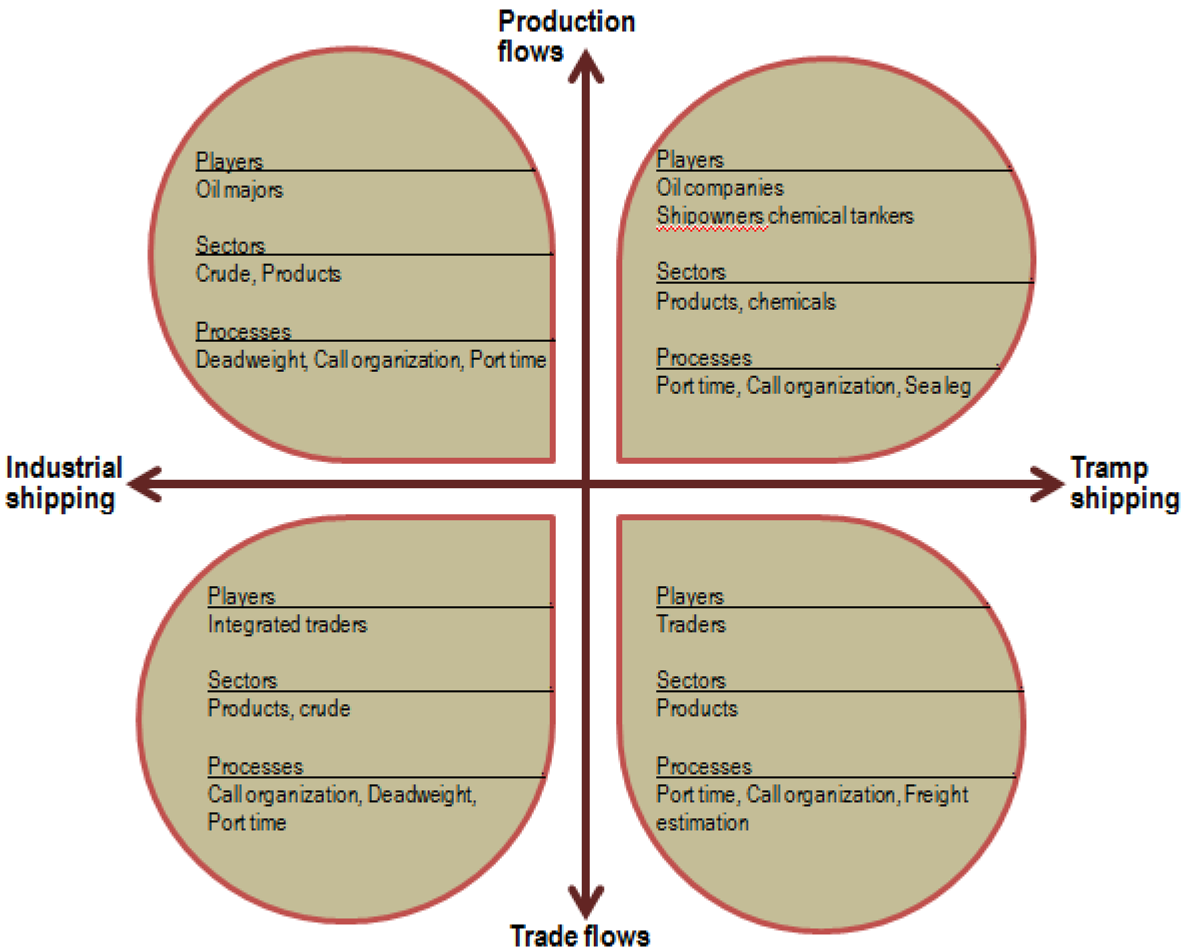
These are the elements and processes that can be influenced by information as provided by the harbour masters. Stay time in port can be optimized by exchanging planning information between all parties offering services to vessels whilst in port. The other elements can be optimized by nautical port information, information that is available in the industry but that is mostly incorrect or outdated because of the different, and mostly unauthorized, sources.

As for the port calls in the different shipping segments, shipping the three commodities crude oil, oil products and chemicals comes with different characteristics from the point of view port calls. Hence there are relative differences in importance of the port calls in the oil, the oil products and chemical markets.

Analysing all this reveals that optimizing port calls is much more relevant in the oil product and chemical trades than it is in the crude trades. The crude trades are more directed to the bigger ports only, so this has as consequence that port call optimization through the harbour masters' information position benefits not only the larger ports, but moreover also the smaller ones.

Actually, the smaller the ship, the more added value an optimized port call has, because;
- they call more frequently at ports
- they know more disturbances during the call
- they have shorter sea legs as compared to port legs
- there are more vessels trading
- that make more voyages per year
- and may visit more terminals in one port per call
- they are more engaged in trade flows where there is a larger port choice
- any improvements in transport costs per ton are relatively higher

It is evident that efforts that improve port calls, will be to the benefit of more players than just one, and will optimize not one particular process for each particular sector. Nevertheless, the players that relatively benefits most of an optimized port call, the sectors in which this happens most and the processes within these sectors can be summarized as follows;



Annex I Oil production and worldwide oil flows

Oil production

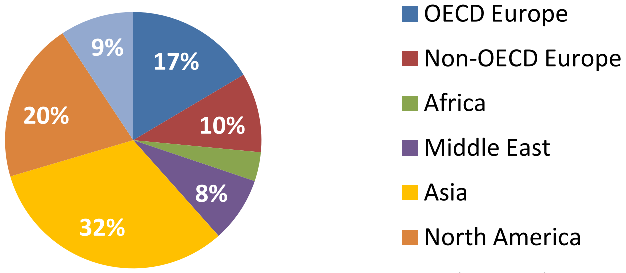
Crude oil is produced all over the world, however the vast majority of crude oil shipping originates in the Middle East in the Persian Gulf and the Red Sea, the coast of Western Africa and South America. The exploration of oil and gas resources around the world is the working area of just a very few independent international oil companies plus an equally limited number of state-owned (Kuwait, Saudi-Arabia) companies. Oil exploration, production and consumption take place in completely different areas of the world, as the next table shows. This is one of the reasons for the huge volumes of oil transportation and port calls.

Major oil producing countries 2011	Mill. tons	% share of total	Major oil consuming countries 2011	Mill. tons	% share of total
Saudi Arabia	526	20,6	US	834	35,6
Russian Federation	511	20,1	China	462	19,7
US	352	13,8	Japan	201	8,6
Iran	206	8,1	India	162	6,9
China	204	8,0	Russian Federation	136	5,8
Canada	173	6,8	Saudi Arabia	128	5,5
United Arab Emirates	150	5,9	Brazil	121	5,2
Mexico	145	5,7	Germany	112	4,8
Kuwait	140	5,5	South Korea	106	4,5
Venezuela	140	5,5	Canada	103	4,4
Total (majors)	2.547	63,7	Total (majors)	2.364	58,2
Others	1.449	36,3	Others	1.695	41,8
World total	3.996	100,0	World total	4.059	100,0
(OPEC share of world tot.)	1.696	42,4			

Source; ISL Shipping Statistics and Market Review, 2013

Publicly traded international oil companies are commonly viewed as the dominant players in the oil market. But state-owned national oil companies account for a much larger share of production. The two largest oil-producing companies in the world are Saudi Aramco, accounting for 12 per cent of global oil production (2011) and the National Iranian Oil Company, producing 5 per cent of global oil. In total, national oil companies control around 60% of oil production, and more than 80% of the world's proven oil reserves. The five largest publicly traded oil-producing companies (ExxonMobil, BP, Chevron, Royal Dutch Shell and Total[17]) each account for 'only' around 2 to 3% of global oil production, and collectively just 3% or reserves (Reserve Bank of Australia, 2012).

The estimated total refining capacity for 2013 is 95 million barrels per day, divided as follows over the continents. Refining capacities ultimately determine where the oil is transported to.



From; Oil & Gas Journal and BP Statistics, 2013

[17] The top-50 of the Fortune 500 of biggest companies worldwide, measured in turnover, the oil majors rank as follows (in billion US$). This ranking though is not necessarily equal to their shipping activities.

1. Shell (Europe);	481,7			
3. Exxon Mobil (USA);	449,9	10. Total (Europe);	234,3	
6. BP (Europe);	388,3	11. Chevron (USA);	233,9	(Fortune 500, CNN, 2013)

The big oil majors may not be the primary explorers of oil, they are the main refiners and producers of oil and chemical products, and they are main demanders for transport. Crude oil basically is delivered all over the world to any region in which there is a refinery with a sea-based port in which to berth large tanker ships. With 17.6 mb/d (mln barrels per day), equal to a market share of 19.2%, the US own the largest refining capacity, followed by China owning another 10.8 mb/d. These two countries achieve nearly one third of the global refinery capacities. The imbalance between the production and refining capacities of the individual oil companies is another reason for oil ship borne transports. Global refining capacities are changing over the years. As an example, In 2012, in Saudi Arabia, the state-owned oil company Saudi Aramco is building two 400.000 b/d refineries, in partnership with Total and Sinopec of China. This adds to the production capacity in the Middle East and will have an effect on transport flows. So over the years, the oil producing countries -notably Saudi Arabia and Kuwait- are shipping increased volumes of refined oil rather than crude oil, forcing the importing industrial nations to refine and re-export smaller volumes then they used to do.

The crude oil market is significantly larger than that for any other commodity. The value of crude oil production is more than twice that of coal and natural gas and 10 times that of iron ore. Crude oil is the most widely used source of fuel, supplying around one-third of the world's energy needs. This is perhaps why the focus is always so much on crude oil, and less so on oil products. Crude oil tanker transportation appears to receive considerable attention, much more than the other tanker transportation markets, perhaps due to its' magnitude, its' influence on world economy and its extreme market volatility. From a point of view port call this emphasis on crude is less obvious though.

Apart from supplying energy needs, crude oil is also used to produce a large variety of products including petroleum products, plastics, synthetic fibers and bitumen. Crude oil is an input to refined oil, the feedstock for the refining process.

When a barrel of crude oil is refined, around 40-50 per cent is used to produce petrol, whilst the remainder per cent produces products such a diesel, heating oils and kerosene (jet fuel), heavy bitumen and petrochemicals that are in turn used for the production of a large range of other products. The proportions depend on the quality of the particular crude oil, and the specifications of the refineries. In fact there exist more than 300 different types of crude oil, from the high-quality, nearly colourless ones characterized by a low density and a low sulphur content to the cheaper, heavier and higher sulphur containing, tar black variants. The light variants produce more higher-value products than the medium or heavy density crudes, hence their higher prices.

The output of the oil refineries are for more or less 85% fuels whilst the other 15% are feedstocks for the chemical industries (such as naphtha) and bitumen, used for production of asphalt. Crude oil that is refined in the refineries leaves the refineries as mineral oil products. Some of the refined products are meant for consumer use directly, as is the case for the automotive fuels gasoline and diesel and for marine and aviation fuels, others are further inputs to products of various industrial sectors.

The naphtha that the oil refineries produce from their crude oil inputs, is the main feedstock of the chemical industry, used as the basis for the composition of plastic products. Petrochemicals (organic chemicals) are the largest chemical segment, in terms of total volumes and product diversity. Chemical plants transform their feedstocks into base chemicals, those in turn are turned into synthetics such as rubbers etc. As for the base chemicals, or commodities, ethylene and propylene are the two main building blocks for the chemical industry. Next to these high-volume commodity chemicals there is a wide range of specialty products used in higher-value applications. Commodities and specialties trade are in the proportion of 3 to 1. Both know typical market cycles caused by supply and demand movements.

The end products of all these different base and specialty products are paint, plastics, rubbers, fibres etc. etc. Chemicals' comprise vast numbers of different and highly specialized and differentiated products. Odfjell for instance reports having shipped 498 different chemical products in 2012. In fact, the large numbers of diversified products have urged the industry recently to rethink product specialization in view of the transport difficulties that this brings with it.

Worldwide oil flows

The major destinations for crude oil shipments are the oil refineries of eastern Asia, western and Mediterranean Europe and eastern North America. The European Union, if considered a block, is the greatest crude oil importer. The Mid East is the primary source of supply for these crude oil shipments but the Caribbean (Venezuelan and Mexican sources especially) and west and north African supply sources are important as well. Both the US and Russia are important crude oil producers as well as consumers. In 2012, over 55 million barrels of oil were transported an a daily basis. The following overview shows main importing and exporting areas and growth from 1980 onwards.

Oil: Trade movements, in thousand barrels a day

Imports	1980	1990	2000	2010	2012	2012 share of total
US	6735	8026	11092	11689	**10587**	19,1%
Europe	12244	9801	11070	12094	**12488**	22,6%
Japan	4985	4802	5329	4567	**4743**	8,6%
Rest of World	8360	8812	15880	25160	**27496**	49,7%
Total World	**32324**	**31441**	**43371**	**53510**	**55314**	**100,0%**
Exports						
US	555	889	890	2154	**2680**	4,8%
Canada	445	955	1703	2599	**3056**	5,5%
Mexico	875	1387	1814	1539	**1366**	2,5%
South & Central America	3010	2367	3079	3568	**3834**	6,9%
Europe	n/a	n/a	1967	1888	**2174**	3,9%
Former Soviet Union	2040	2659	4273	8544	**8597**	15,5%
Middle East	17510	14212	18944	18883	**19699**	35,6%
North Africa	2820	2604	2732	2871	**2604**	4,7%
West Africa	2475	2248	3293	4601	**4564**	8,3%
Asia Pacific	2099	2182	3736	6226	**6419**	11,6%
Rest of World	495	1938	940	637	**322**	0,6%
Total World	**32324**	**31441**	**43371**	**53510**	**55314**	**100,0%**

Source; BP Statistical Review of World Energy, June 2013, n/a; not available

In mln of tons and divided into crude and products, transported volumes of oil in 2012 were as follows. These volumes only show the longer haul trades, as the intra-area movements -for example those movements between European countries- are not included in these figures. These reported inter-area movements of almost 2.000 mln tons of crude oil and 800 mln tons of oil products generate very substantial numbers of tanker voyages an port calls on a daily basis. What these figures also show is that crude oil constitutes for 70% of total oil imports and exports and products for the remaining 30%.

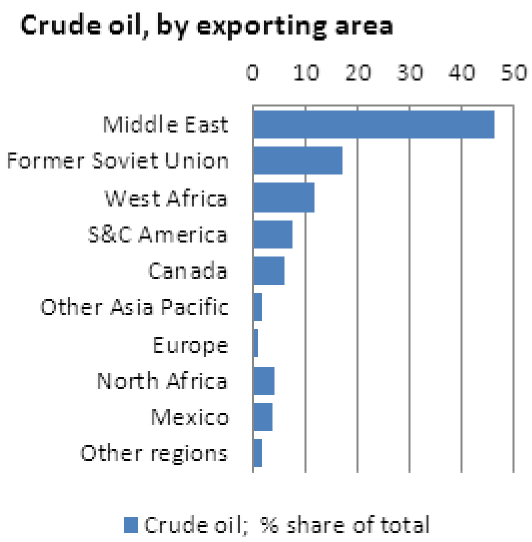
Oil: Imports and exports 2012

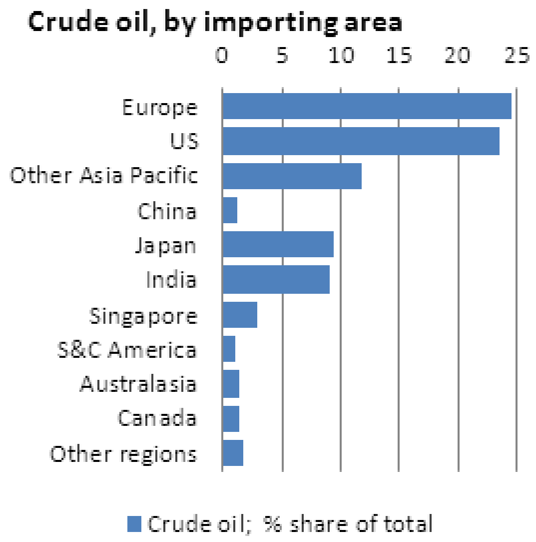
	Imports, in mln tons		Exports, in mln tons	
	Crude	Products	Crude	Products
US	424,0	100,5	1,1	127,5
Canada	25,7	10,1	121,7	29,7
Mexico	*	27,9	64,4	3,7
S. & Cent. America	19,6	67,7	156,9	33,1
Europe	474,9	142,8	19,1	85,9
Former Soviet Union	*	5,5	302,0	122,2
Middle East	11,1	26,8	881,1	98,5
North Africa	9,3	15,0	106,8	22,3
West Africa	*	11,4	216,1	11,3
East & Southern Africa	14,2	12,5	4,3	0,7
Australasia	28,7	18,2	13,6	7,9
China	271,3	83,0	1,3	25,8
India	177,1	15,5	*	64,7
Japan	186,7	48,2	*	10,6
Singapore	47,3	96,7	0,6	71,0
Other Asia Pacific	237,4	120,2	38,3	87,0
Total World	**1927,3**	**801,8**	**1927,3**	**801,8**

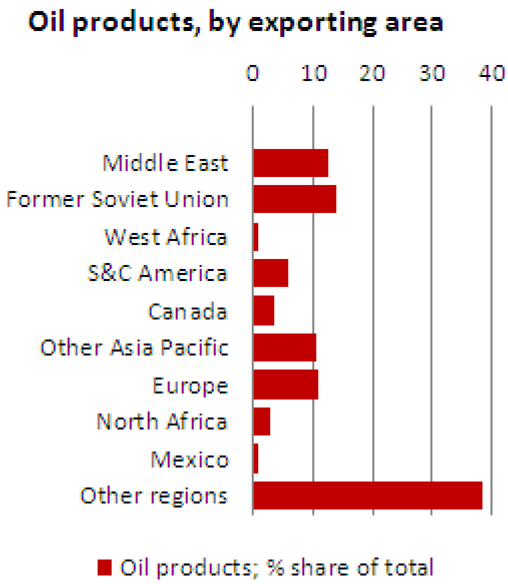
* Less than 0.5, Note: Bunkers are not included as exports
BP Statistical Review of World Energy, June 2013

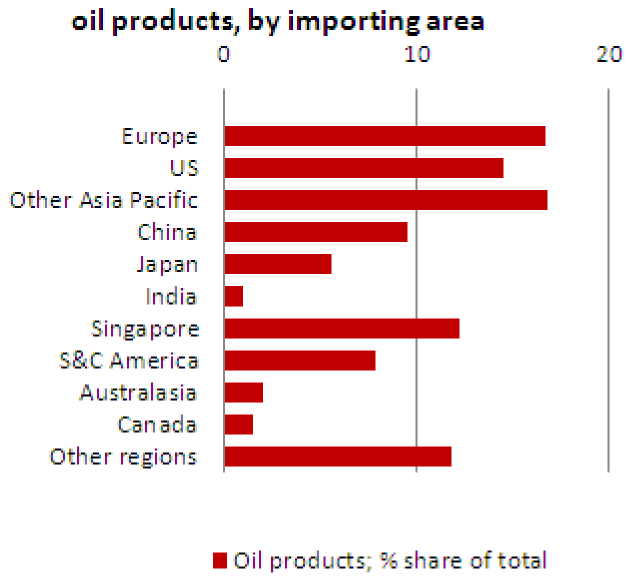
It also clearly shows that the export, and hence transport, of crude oil is originating in just a few areas, due to the exploration in those areas. Importing areas know such concentration as well, due to the refineries that the crude is traveling to by nature. Those refinery plants are only mobile over long periods of time.
The export and import of oil products on the other hand is much more scattered. Oil products production is much more spread over different countries and distances between production and consumption are smaller. This is

clearly shown by the shares that the different areas take in exporting and importing crude oil and products. These differences in world oil flows have huge implications for the distances of transport and therewith the relative importance of port calls.









Source; ISL Shipping Statistics and Market Review, 2013

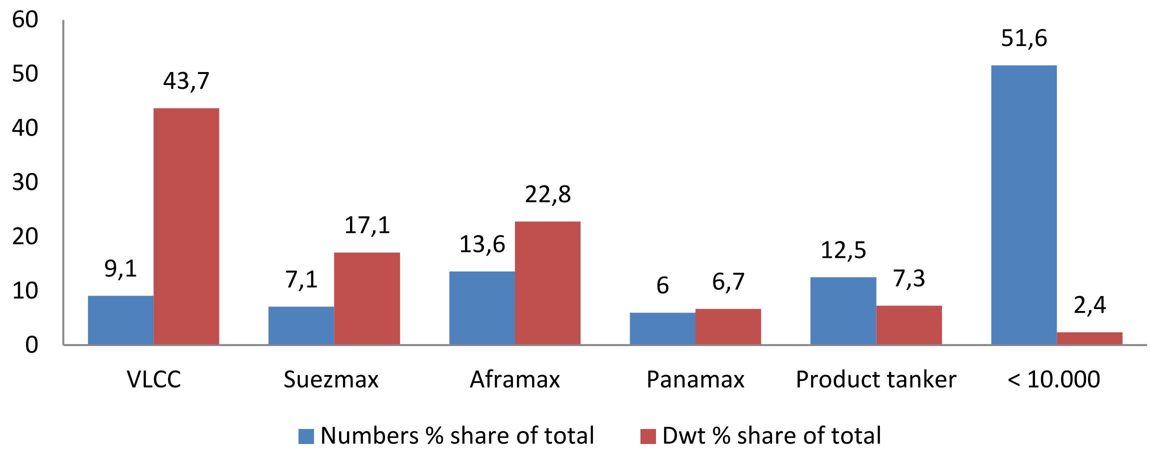
Oil import-export matrix 2012; inter-area movements (Source; BP Statistical Review of World Energy, June 2013)

To (Million tonnes)	US, Canada	S. & Cent. America, Mexico	Europe	Africa	South Asia (India)	Far East (China,Jap. Singap.)	Other Asia/Pacif/ Australasia	Rest of World	**Total**
From									
US, Canada	154,3	68,7	31,5	3,7	0,9	18,8	1,1	1,0	**280,0**
S. & Cent. America, Mexico	151,6	1,7	30,3	0,4	26,5	45,2	2,3	0,1	**258,0**
Europe	32,8	10,6	-	22,8	0,3	12,7	13,9	12,0	**105,1**
Former Soviet Union	26,6	1,3	286,5	3,1	2,5	75,8	18,3	10,2	**424,4**
Middle East	115,7	6,7	112,2	21,1	123,1	375,9	224,6	0,3	**979,6**
North Africa	24,3	4,3	78,3	-	4,5	12,3	4,7	0,8	**129,2**
Rest of Africa	47,2	10,0	65,5	-	27,5	60,8	21,5	-	**232,5**
Far East (China, Japan, Singa.)	0,6	5,8	1,8	1,6	2,1	11,9	80,4	1,6	**105,8**
India	2,0	4,3	8,1	8,5	-	13,5	12,1	16,3	**64,8**
Other Asia Pacific, Australasia	5,5	1,7	3,4	1,2	5,3	103,0	25,6	1,0	**146,7**
Total imports	**560,6**	**115,1**	**617,6**	**62,4**	**192,5**	**729,9**	**404,5**	**43,4**	**2.726,0**

Annex II Tanker fleet size

At the start of 2013, the crude and product tanker fleet comprised 6.619 tankers with 426 million dwt. This crude and product tanker fleet has seen a tremendous growth in the past years. About 40 % of the current tonnage in that segment came into service within the last 5 years. During the period 2009-2013 the average tonnage growth for this fleet segment was 4,4%.
The oil/chemical tanker fleet comprised of 4.798 ships with 85 million dwt. Within the past 5 years, the tonnage of the oil/chemical tanker fleet increased on average by 5.5 % yearly (ISL Shipping Statistics and Market Review 2013). This category includes a large number of small coasters.

World tanker fleet in % share, January 2013



ISL Shipping Statistics and Market Review 2013

The numbers of tankers that are employed in the different shipping markets differ quite substantially, with crude oil tankers taking 35% of the total tanker fleet, including the chemical tankers. This total fleet was 5560 tankers in 2013. With the present portfolio of tankers on order the number for 2017 will be around 6000 vessels (though this figure does not include the demolitions). The product tankers share in the total fleet is 24%, the chemical/oil tankers take 27% and the pure chemical tankers the remaining 13%. With the 2017 order portfolio the shares will not change substantially, be it that the product tankers share increases a bit at the expense of the chemical/oil tanker share.

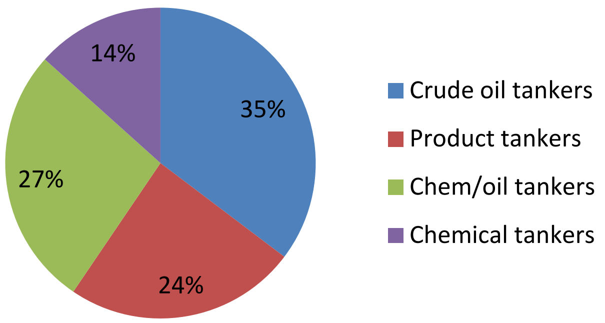
In dwt though crude accounts for 72% of total dwt, products for 14%, chemical/oil for 10% and chemicals for 3,5%. So even if it is safe to say, as many do, that for the world fleet of ocean-going tankers crude oil is the main cargo, in numbers of vessels this is less so.

The following numbers are the numbers of vessels trading in the Afrascale[18] category numbering. This scale is useful for knowing fleet sizes notably in the smaller tanker categories, until until 80.000 dwt, as Afrascale classifies in more segments than panama and product tankers only, which are used in the flexible market scale.

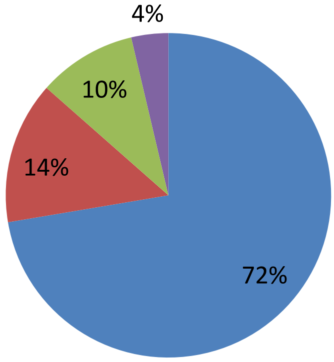
	Crude oil tankers		Product tankers		Chemic/oil tankers		Chemic. tankers		Total	
	No.*	m dwt	No.*	m dwt	No.*	m dwt	No.*	mdwt	No.*	m dwt
2010	1750	308,62	1254	61,02	1619	49,57	458	12,0	5081	431,21
2013	1963	356,14	1344	69,78	1510	48,27	743	18,1	5560	492,29
2017**	2116	387,53	1572	83,43	1542	49,24	773	19,0	6003	539,20

[18] In wet bulk there are two prominent sets of ship size nomenclature that partly overlap; the Afra scale, introduced by Shell Oil in 1954 in order to be able to average world freight rates for accounting purposes of oil shipments by the oil majors (at the time the main shippers of oil cargoes, having their own transportation means), and the newer market-oriented tanker scale, in brief 'Market scale'. Also Afra, as a tanker capacity range scale, is still in use nowadays.

World tanker fleet in numbers/shares, 2013



World tanker fleet in dwt/shares, 2013



*Idle fleet (laid up tonnage) not included
**Total May 2013 + ‘on order 2013-2017’

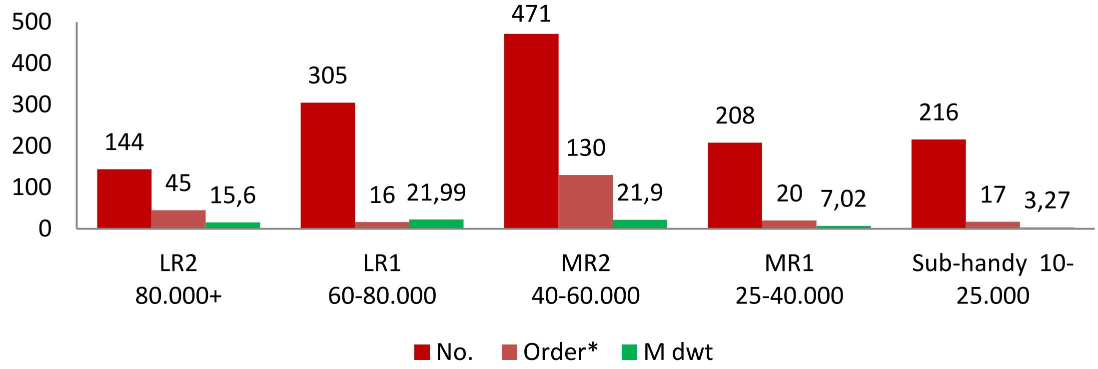
Source; Lloyds’ List, June 2013, data provided by Clarksons

These are the numbers of trading vessels, next to that there is the idle fleet part, or tonnage laid up. There are a number of reasons for tonnage to be laid up, one of them being that oil traders use vessels as temporary, floating, storage awaiting an upward movement in oil prices. As this idle fleet does not engage in transport, they are not considered in this overview as trading vessels. Over the years 2005-2011, the percentage of the laid up fleet compared to the total merchant fleet (not only tankers) has ranged from 0.9% to 2.2% (Clarkson register).
In tramp shipping however there may furthermore be a discrepancy between the terms ‘laid up’ and ‘idle’ as ships may be waiting for cargo, hence are resting and not transporting cargoes . Tanker capacities waiting to take cargo are highly volatile but may be quite substantial.

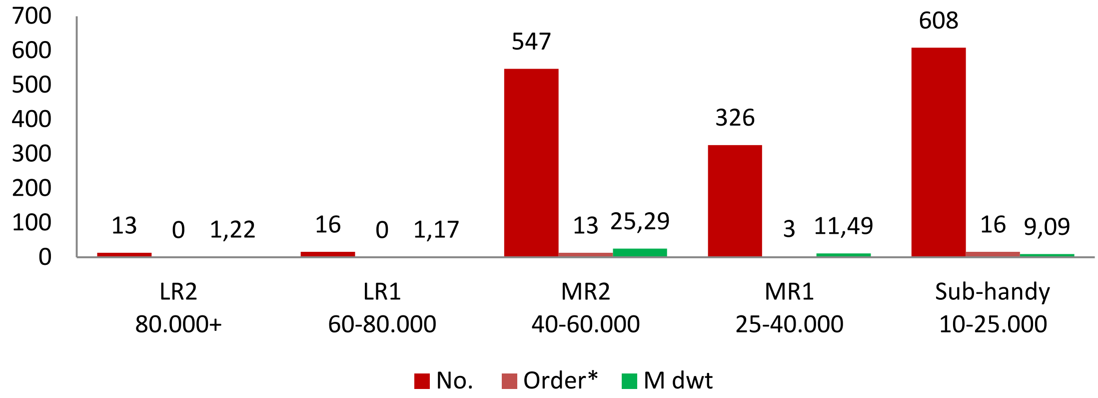
These data are for vessels of over 10.000 dwt. There is a considerable group of small tankers though, sized under 10.000 dwt. According to Clarkson Register this number was 4.629 in 2007. These small tankers mainly engage in short sea and inland transportation.

Whilst the crude oil tankers are generally divided in an identical way across industry, this is not the case for the products and chemical tankers. Also in statistical use products and small tankers categories are not clearly defined, reason why one finds different divisions and therewith different numbers. Parcel tankers may be used as a category, ranging from 30.000 to 80.000 dwt and able to carry petroleum products as well as chemicals. Product/chemical tankers are equipped to transport, in different tanks, combinations of oil and chemical cargoes. Pure chemical tankers are for the carriage of chemicals only. They represent a small percentage only. There is a considerable interplay between the different tanker segments; handysize and medium range tankers for clean petroleum products are employed for the transport of chemicals as well. The vessels that transport chemicals are small tankers under 10.000 dwt or large parcel tankers.

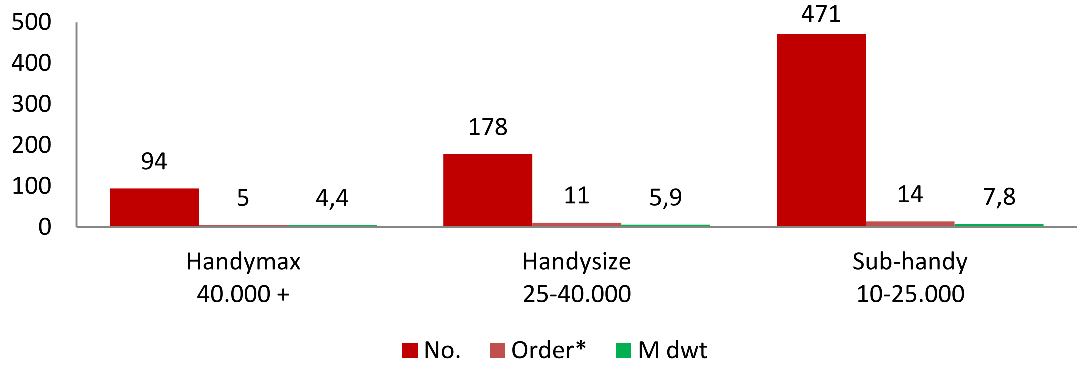
Product tanker supply



Chemical/oil tanker supply



Chemical tanker supply



Source; Lloyds' List, June 2013, data provided by Clarksons, data for May 2013
*On order for the period 2013-1017

Annex III Present day changes in ports' business environment from researchers observations

An optimal port call lowers transport costs. Transport costs in general play an important role in trade. The relation between time and trade has been widely studied and it was shown that time indeed is a trade cost and even to that extent that an increase in shipping time (delays) is an entry barrier (for manufactures entering a particular foreign market); an increase in shipping time of one day reduces the probability that a country will export manufacturers (to the USA) by 1.5% (Hummels, 2001). Econometric estimates suggest that the doubling of an individual country's transport costs leads to a drop in its trade of 80% or even more (Sánchez R.J. (2003), from Hummels, 2000; Limao and Venables, 2001). Radelet and Sachs (1998) estimate that a doubling of transport costs leads to a drop in the rate of economic growth of more than half a percentage point. Clark, Dollar and Micco (2004) showed that seaport efficiency is an important determinant of shipping costs. An improvement in port efficiency from 25th to 75th percentiles reduces shipping costs by more than 12%, or the equivalent of 5.000 miles in distance, the result being robust to different definition of port efficiency (Clark, 2004).

Again, this research was done by investigating a great number of liner companies. But the relation between seaport efficiency and maritime transport costs are obvious. Other studies to the relation between time and country trade competitiveness, done regularly by the Worldbank, show that a 10% increase in transport time reduces bilateral trade volumes by between 5 and 8%. These Worldbank estimates are low compared to estimates of the impact of transport costs on trade flows. The OECD (Nordas, 2006) found a reduction in trade value ranging between 5 and 25% for every 10% increase in time for exports, though the results depended strongly on sector and export destination.

Andersson et al (2009) say that the focus indeed is on minimizing costs, but that this is the case when different processes in a supply chain are planned individually. This focus however changes to profit maximization when several planning aspects in a supply chain are combined, since the overall goal of the total supply chain is profit maximization. Profit maximization includes more opportunities in a better utilization of the individual ship and therewith of a fleet.

However many research has been done to port efficiency and port performance, including in such research time efficiencies such as vessel turnaround times and terminal turnaround times as systematic performance indicators, the overwhelming part of this research takes container transport as subject. For instance RJ Sánchez et al. (2003) who measured three groups of port efficiency factors in 19 South American ports; time efficiency factors, (terminal) productivity factors and an 'average stay per vessel' variable. The first one, representing port's time efficiency, accounted for more than 40% of the total variance. It accounted for the bureaucratic turnaround of a container, the terminal turnaround for loading and unloading of a container, the average waiting time for ships during congestion time, the average waiting time for ships without congestion in the port, and the time of port congestion during the year. One of the conclusions was that especially for low-value export commodities, small changes in port costs and productivity may make the difference between being or not competitive in the global market.

All the attention for container transport improvements is perhaps not that surprising seen the overwhelming attention for logistics in relation to port performance. Logistics is all about door-to-door transport including all manufacturing industries that a product or –earlier- a base material finds in its way to its' end-user. Manufacturing companies need to manage their supply chains more efficiently and this has huge consequences for ports.
Woo, Pettit and Beresford (2011) state a great number of authors that compare performance and efficiency of container ports or identify indicators or methods appropriate for port performance evaluation. They also list the many studies that address the consequences for port authorities who have to cope with all new challenges in this field. Woo et al. say that the main challenge that ports face from the structural change in logistics chains is that their main customers, the shipping lines, are becoming more powerful with stronger bargaining power and competition between ports is getting more intense both at inter-port and intra-port levels. This may well be the case for container lines, where the bargaining power stems from the emergence of (smaller) numbers of bigger global mega carriers. For the oil markets on the other hand the situation for market powers may be quite different.

In relation to bargaining power, decisions on port choice are also researched mainly for container lines. Woo, Pettit, Beresford (2011) give a number of authors in this field, some of them indicating that shippers play the key role in determining port choice (Robinson, 2002; Tongzon, 2002). Others find that shipping lines are key players in determining port choice. Interestingly when ports are asked to evaluate the importance of clients, 'shipping company' was indicated as the most important client, 'forwarder' as the second most important and 'shipper' as the third most important.

The very strong accent on liner economics in maritime research these days also shows in the subject of horizontal integration -through mergers and alliances- and vertical integration -through for instance the operation of dedicated terminals-. Those are studied in relation with port performance, for instance by Notteboom (2004) and Slack et al. (2001) who said that the changes that shipping companies have made -rearranging their service networks with the aims of global coverage and diversification- affected every facet of the maritime industry, especially concerning port operations. Heaver et al (2000) studied the effects on ports of the closer integration that is developing in the maritime and port industries, amongst others the extent to which the relationship of liner (!) shipping companies and port authorities change. Again, this subject has been studied mainly for the container and liner markets.

It is clear that the complexity of supply chains continuously increases with the numerous vertical integrations that are the result of the rapidly globalizing economy and highly competitive environments; shipowners engaging in terminal business, traders developing own logistics services or even engaging in shipping business, carriers integrating freight forwarders etc.

The result is that it is no longer obvious who exactly the clients of the port are. Robinson (2002) questions control and power in the rapidly restructuring logistics and supply chains. He says that the questions 'which player will exert more control over the chain?', 'which player will dominate the chain?' are critical to the strategic goals of third party service providers –hence of ports. In the new paradigm, ports will segment their customers in terms of a value proposition.

Also Magala and Sammons (2008) state that "the question of who actually chooses a port is a legitimate one. Notwithstanding, a universal answer is yet to be provided, partly because the answer is complex and research has not paid sufficient attention to the issue."

Annex IV The changing role of ports and the port authority

This annex briefly considers a number of theories that suggest that the role of ports and port competition is changing in a new business environment of competing supply chains. With this changing role of ports, a number of researchers advice that also the role of the port authority should become a different one.

Supply chain management started in the eighties when production processes were re-evaluated in order to reduce costs in production chains. Globalization has further added to the growing importance of logistic supply chains. For both supply chain management as for logistics management, the focus first was on reducing costs; logistics is a sequence of events that are all carried out by separate firms with little integration of the separate logistics elements. Crucial is that each firm covers its costs plus margins, and that this cost-plus calculation takes place at each subsequent logistic step. The essence of value chains however is that it is an organized network of firms working together by sharing resources and rewards in the pursuit of targeted markets and customers (Poirier).

Song and Panayides (2008) say that port authorities have traditionally played the role of facilitator, focusing on the provision of superstructure and infrastructure for berthing and loading/unloading operations and as such research has focused on efficiency and performance within ports. Contemporary developments in maritime transport and logistics indicate that ports should play an important strategic role as a member of a supply chain.

Notteboom and Winkelmans (2001) have put forward that a successful port (authority), like a successful actor, must constantly be prepared to adopt new roles in order to cope with the changing market environment. They brought forward that in the post-Fordian market environment of global corporations, outsourcing, deregulation and technological innovation, shipping lines, forwarders, terminal and transport operators have responded by vertical and horizontal integration. The economies of scale approach followed by many seaports however does not provide all necessary tools to cope with this highly competitive market environment. The scale economies approach has to be complemented, if not partly replaced, by an economies of scope approach, based on greater flexibility and a focus on the logistics performance in the whole transport chain. Hence, the strategic scope of port authorities should go beyond that of a traditional facilitator.

Carbone and de Martino (2003) say that ports are (potential) members of different supply chains and that their contribution to the chain's requirements –and therefore their potential role in a certain supply chain– depends on the one hand on the availability of efficient infrastructures and inland connections as part of a global transport system. On the other hand on the ability of actors to contribute to the value creation in a transport system and accomplishing the qualitative attributes; guaranteeing reliability, continuous service, punctuality, frequency, a good productivity level, availability of information and security.

Magala and Sammons (2008) say that ports have always been part of the maritime transport chain but their full integration in supply chains is a recent phenomenon. Earlier chains were highly fragmented, uncoordinated and inefficient. Ports were important but weak links in the chain. Individual firms in the chain including ports were internally rather than market-driven; their focus was on maximizing their own profit by being managed as stand-alone entities. Shippers were more concerned with minimizing transport cost to remain competitive. Shippers nowadays see a port as just an element, albeit an important one, of the whole system.

A number of authors (Robinson, 2002, 2003, 2006, Magala 2008) say that in the highly competitive and rapidly globalising economy of today, the integration of supply chains is taking place and individual firms no longer compete as solely autonomous entities but rather as supply chains. Port competitiveness is becoming increasingly dependent on the performance of the whole supply chain and is no longer only determined by its physical strengths. Ports can no longer expect to attract cargo simply because they are natural gateways to rich hinterlands. As a result competition more and more takes place between supply chains, rather than between single ports. Chains compete, not individual ports.

As far as the choice of a port of call concerns, this choice depends more and more on the costs and performance of the total supply chain. Major port clients are now likely to choose ports not simply on their efficiency and location advantages but rather on the quality and reliability of the entire supply chain. Ports are chosen on the basis of faster, better and more cost-effective access to the markets in which shippers compete for profit. Shippers may no longer choose a port as such but rather a port-oriented supply chain in which the port is embedded as a critical element.

Robinson (2002) argues that ports must now be seen as elements in value-driven chain systems or in value chain constellations and that this has consequences for the way in which ports and port authorities position themselves in this new business environments. As an element in a chain system they deliver value to shippers and customer segmentation and targeting should be on the basis of a clearly specified value proposition. This is another paradigm then seeing ports as places with particular, if complex, functions.
Robinson questions what is the role of ports in this new, logistics-restructured environment. He finds a number of, in his eyes, unsatisfactory answers with a number of authors and summarizes those as '… we understand what the role of ports has been in the past, or under different circumstances, .., but we are now somewhat perplexed and puzzled by what role port authorities should play in this new, changing logistics environment'. Subsequently he seeks to define an adequate framework within which appropriate answers might be sought.

Also Paixao and Marlow (2003) reflect on the role of ports as an element in the whole logistics chain and reason that the third generation ports as defined by UNCTAD, should in fact now be followed up by a fourth generation ports. The UNCTAD third generation port is a port in which port authorities and operators establish a wide range of logistics and value added activities, developed in conjunction with industrial and commercial business. Due to present constant changes in the external environment, even third generation ports are no longer sufficiently equipped and organized to deal with the resulting high levels of market uncertainties. Paixao and Marlow say that "being currently surrounded by an environment characterized by a high degree of complexity, where activities are often carried out in a disorganised way, with high costs, inadequate customer services, lost opportunities and sub-optimisation of resources, the port industry must adopt a new attitude". If not, ports may be left behind whenever alternative transport systems can be designed.

Fourth generation ports, agile ports, would be better able to compete successfully with each other whilst at the same time becoming key logistic elements of the transport chains. Such a change will enable ports to meet the future trends of supply chains insofar as time-based strategies to reduce inventory costs along the logistics pipeline are concerned, and to decrease both transit time in ports and lead times, thereby creating a greater utility and variety of the services being delivered. By increasing productivity, fixed costs per unit handled decrease. The authors see a need for ports as logistics interfaces to improve productivity and prevent undue delays to occur.
To become an agile, fourth generation port, port operators are advised to use Business Process Redesign technique that can overcome bottlenecks by existing port layouts and eliminate ports' wastes, eliminable processes, resulting in cost reductions. Also the use of Just In Time techniques in a port environment is advised, meaning cargo arriving and departing exactly when it should with no tolerance for early or late arrivals or departures. One of the attributes with JIT is 'flow'. The other four being flexibility, short cycle times, short lead times and superior service performance. The authors say that the flow concept within a port environment allows operations to be carried out at a speed which will cause no sort of disruptions along the supply chains.

Also Mangan et al. (2008) shows that ports can play a variety of different roles within supply chains and that they are not restricted to their traditional role of simple transshipment point for freight. Finally, Marlow and Paixao-Casaca (2003) suggest that successful seaports are customer focused and continuously improve performance.

Annex V Laytime in voyage charters

This annex will elaborate on the specifics of laytime in voyage charters and seeks to define the consequences.

Since one of the many court cases around laytime disputes[19], a voyage charter is divided into four successive stages;
1. The loading or approach voyage; vessel voyage from the starting date of voyage charter to the place specified as place of loading
2. The loading operation; delivery of the cargo to the vessel at the place of loading
3. The carrying or loaded voyage; vessel voyage from place of loading to the place specified as place of delivery
4. The discharging operation; delivery of the cargo from the vessel at the place of delivery and its receipt there by the charter or other consignee

The two voyage stages (the stages 1 and 3) are in the hands of the shipowner, whilst loading and discharging are joint operations between the shipowner and the charterer.

Laytime commences at the vessels' arrival in port, notably to the place as specified in the contract, and usually when a valid notice of readiness (NOR) is given. This is a formal statement from the master or the ships' agent to the charterer that the vessel has arrived in the port and is 'in all respect' ready for loading or discharge. Usually the charterers are entitled to some hours of notice time (free time, grace time) before the laytime starts to run. The original intention of this notice time was that the charterer, after they had been made aware of the ship's arrival and readiness, should be allowed to a certain time to arrange loading or discharging. However there is no longer such practical reason for notice time, most voyage charter-party forms still entitle the charterer to notice time (Gorton, 2009).

The vessels' arrival is important as it is this moment that laytime commences, and hence it is the moment that the liability for delay changes from the shipowner to the charterer, at least under a voyage charter.

Laytime ends when the loading and discharging has been completed or when the time as specified in the contract expires if these operations are not finished within that specified time. 'Completion' in the tanker trade is usually defined in terms of disconnection of the hoses. In recent years however some shipowners suffered delays after hoses were disconnected, notably due to waiting for documents to be delivered, and they submitted claims. The result is that now some charter parties are amended in order to cover these eventualities and have a clause that says "time will count if the vessel is delayed for charterers purposes beyond a certain period after disconnection of hoses". This period is often 3 hours.

There are berth, dock and port charters, depending on how the destination for loading and unloading is specified. Berth and dock charters specify precisely the destination and it is therefore easy to say whether a vessel has reached its berth or dock. This is less so the case with port charters, where a ship may have arrived in a port but not necessarily at its terminal. From jurisdiction, notably 'the Reid test' (Johanna Oldendorff case, 1973), we learn that in a port charter, if a vessel is arrived at a port but cannot immediately proceed to a berth, the vessel is said to be 'arrived' if it has 'reached a position within the port where she is at the immediate and effective disposition of the charterer'. Such place is usually a place where waiting ships of that type usually lie within the port. A charter by the way may be a berth charter for loading and a port charter for discharging.

In respect to laytime there are two different voyage charters; those with customary laytime and those with fixed laytime. In customary laytime, the risk of delays lies with the shipowner. In customary laytime the period allowed for loading or unloading is allowed to depend on the circumstances at the particular port and may therefore very form ship to ship and from time to time. Thus the period allowed cannot be determined in advance, unlike in fixed laytime. Customary laytime appears to be slowly disappearing.

Demurrage finally may be contractually stated in dollars per day, in which case a full day's demurrage is payable, even if the delay is actually only part of a day or even say half an hour. Otherwise a pro rata rate is agreed and then only the real over-time used will be charged.

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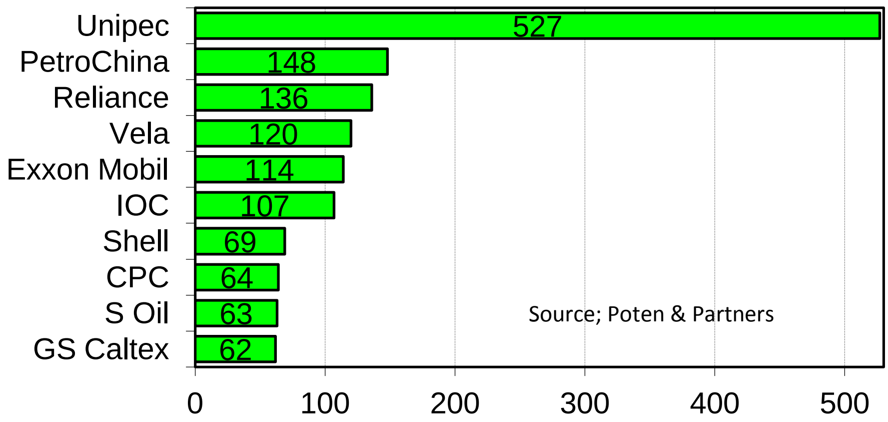
[19] The Johanna Oldendorff case, 1973, Laytime and demurrage, 5th edition, John Schofield, 2005

Annex VI

2012 knew a number of fixtures of almost 9.200 of which a little less than 50% was taken by the 15 biggest charterers. What were the vessels that these charterers used?

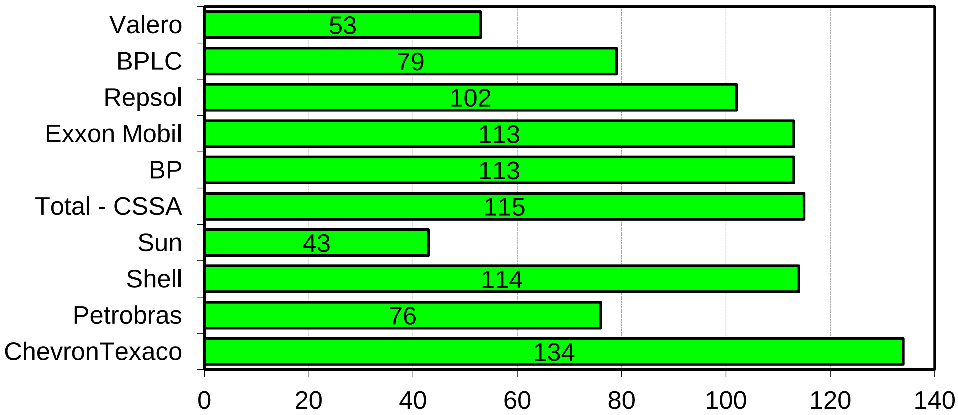


VLCC

Largest VLCC charterers 2012

Total reported fixtures; 2089

10 biggest: 69% of total

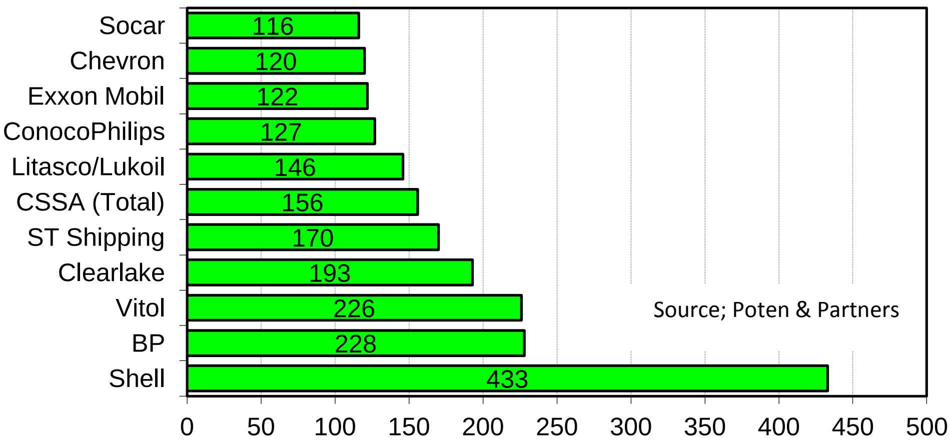


Suezmax

Largest Suezmax charterers 2011

Total reported fixtures; 1.876

10 biggest: 61% of total



Aframax

Largest Aframax charterers 2010

Total fixtures reported; 4.398

10 biggest: 48% of total

Intertanko, 2013

Glossary

BALAST LEG
A voyage with no cargo on board, to position a ship for the next load port or dry-docking

BARE BOAT CHARTER
the owner of the ship contracts a ship (for a fee, usually long-term) to another party for its operation. The ship is then operated by the second party as if he owned it

BARGING
Transfer of cargo to/from a ship from/to a barge

BROKER
An intermediary who negotiates freight contracts between owners and charterers as well as the sale and purchase of ships

CARGO
A set of goods shipped together from a single origin to a single destination, often referred to as an order. The terms shipment and cargo are used interchangeably

CHARTER PARTY (C/P)
Agreement between a shipowner and a charterer, outlining terms and conditions governing the transaction. The agreement may be for one or several voyages, or for a certain period of time

CHARTERER
The party hiring and paying for ships or ship space. This may be the cargo owner, an intermediary or the receiver of the cargo

CIF
the purchase price of the goods (by importer) includes payment of insurance and freight which is arranged by the exporter

COMMODITY
A set of goods that can be stowed together in the same compartment

CONSIGNEE
The person to whom the shipment is to be delivered

CONSIGNOR
The seller of the goods

CONTRACT OF AFFREIGHTMENT (COA)
An agreement between an owner and a charterer setting the terms for transportation of given quantities of cargo during a given period of time

DEADWEIGHT TONNE (DWT)
A measure of the weight-carrying capacity of the ship. The total DWT is the weight of the ship and the cargo the ship may carry over and above bunkers, fresh water, spare parts etc.

DEEP-SEA (GLOBAL) TRADE
Sea-borne trade that moves on intercontinental trade routes

DEMURAGE
Compensation paid by the charterer, supplier or receiver of the cargo for each day or pro rata for time spent in port during loading/discharging, in excess of the lay-time stipulated in the Charter Party

DISPATCH
The money which the owner agreed to repay if the ship is loaded or discharged in less than the laytime allowed in the charter-party

FOB GOODS
Purchased at cost and the importer makes his own arrangement for insurance and freight

FREIGHT RATE
Agreed price for transportation, stipulated either per metric tonne of cargo, cubic metre of cargo or as a lump sum for the total cargo

FULL SHIPLOAD
A load that consists of a single cargo that for practical and/or contractual reasons cannot be carried with other cargoes

IMO
International Maritime Organisation, the international UN advisory body on transport by sea

INCOTERMS RULES (International Commercial terms)
Series of pre-defined commercial terms published by the ICC, International Chamber of Commerce, that are the most commonly used terms in international trade. The rules intent primarily to clearly communicate the tasks, costs, and risks associated with the transportation and delivery of goods

KNOT
A measure of the speed of the ship. 1 knot = 1 nautical mile per hour, that ≈ 1.85 km/h

LAYCAN PERIOD
delivery time of chartered ships

LAYTIME
The period of time agreed in a voyage charter during which the ship may load or discharge the cargo

LOAD
The set of cargoes that is on the ship at any given point in time

LOADING PORT
Pickup location

OECD
Organisation for Economic Co-operation and Development, an information-gathering body. The members are industrialised countries in Western Europe, North America and the Asia/Pacific region

OFF-HIRE
The time a ship is prevented from being gainfully employed for its owner or charterer, e.g. time used for repairs

OPA 90
The US Oil Pollution Act of 1990. A US federal law that imposes strict requirements on shipping companies, ships and crews when trading in US waters

OPERATING EXPENSES
Expenses for crew as well as all other expenses directly connected with the running of the ship, including maintenance and insurance

OPERATOR
A person in a shipping company whose main duties include managing contact between the ship and the charterer, giving instructions to the ship and the port agents concerning stowage, loading and discharging of cargo, and arranging purchase of bunkers etc.

PARCEL TANKER
Tanker designed for the simultaneous transportation of several different segregated cargoes

PERIOD CHARTER
The vessel is hired for a specified period of time for payment of a daily, monthly or annual fee. There are three types; time charter, trip charter and consecutive voyage charter

POOL
A co-operation between owners who supply their ships for an operation where net revenues are pooled and divided according to a pre-determined distribution key

ROUTING
The assignment of a sequence of ports to a vessel

SEGREGATION
The division of a ship's cargo space into individual tanks

SHIP MANAGEMENT
The administration of a ship, including services such as technical operation, maintenance, crewing and insurance

SHIPOWNER
A party that owns ships and makes decisions on how to use them to provide shipping services, when and how to buy new ships and what ships to buy

SHIP AGENT
A company that represents the owner of a vessel and is engaged in the routine business related to vessel arrival, operation, and departure of ships

SHIPPER
The owner of the transported cargo or individual or company with cargo to transport

SHIPMENT
A specified amount of cargo that must be shipped together from a single origin to a single destination

SCHEDULING
Assigning times (or time windows) to the various events on a ship's route. Refers to the assignment of the vessels in the fleet to trade routes. It does not imply allocation of vessels to specific trade routes, but rather to specific shipments, and is associated with tramp and industrial operations. Due to higher uncertainty regarding future demand in these operations, their schedules usually have a shorter planning horizon

SHORT-SEA (REGIONAL) TRADE
Sea-borne trade that moves within regional trade routes (not intercontinental)

SPOT RATE
Freight rate for cargo parcel agreed based on the current market level

TIME CHARTER (T/C)
An arrangement for the hiring of a ship complete with crew against a fee, payable as a specific sum per time period. The party that hires the ship pays for bunkers, port and canal charges and any other voyage-related costs

TIME CHARTER EARNINGS
Gross freight revenues minus voyage costs divided by number of trading days, usually expressed in USD per day

TONNE
A gross registered tonne is a volume of 100 cubic feet (2.83 cubic metres). Gross registered tonnage is basically the volume of the ship's closed areas, excluding the bridge, the galley and a few other areas. Net registered tonnage is the gross tonnage less volumes needed for the operation of the ship (deck storage room, engine room etc.), i.e. the volume available for cargo

TONNE OR METRIC TONNE
1.000 kg

TRADE
The geographical area where a ship mainly trades

TRADING DAYS
The number of days a ship is not off-hire

TRANSHIPMENT
Transfer of cargo from one to another ship. For example, cargo from a ship within global trade to a ship within regional trade bound for final destination/harbour

UNLOADING PORT
Delivery location

VOYAGE
A sequence of port calls, starting with the port where the ship loads its first cargo and ending where the ship unloads its last cargo. A voyage may include multiple loading ports and multiple unloading ports

VOYAGE CHARTER
An agreement for the transportation of cargo from the port(s) of loading to the port(s) of unloading

VOYAGE EXPENSES
Expenses directly relating to the voyage, such as bunkers, port charges, canal dues

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