CONTAINER TERMINAL OPERATIONS
THE TOOLS OF THE TRADE AND AN OUTLOOK FOR THE SECTOR'S FUTURE

PANAGIOTIS KARAKOSTAS

GREECE

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ABSTRACT

It is widely accepted that shipping is a capital-intensive industry, which requires large amounts of funds to function. Whatever aspect of shipping we examine whether it being actual shipping, the ports industry or logistics providers, the tools of the trade are expensive, heavy and dangerous equipment.

In this paper, we will focus more on the hardware and infrastructure of the container shipping industry. This sector of the maritime industry is a crucial part of multimodal transportation systems and belongs to liner shipping. We will start with a brief historical review of the shipping container and the ports designed to service this type of unitized cargo. Shipping cannot exist without ships so the provision of information about container vessels and their specialized construction is a definite requirement. Also, it is important to inform the reader about all the different types of containers that exist and their purpose.

All this without getting too technical about the specifications or general day-to-day operation since the main purpose of the paper will be to provide an insight to how technological and managerial developments will create value for the industry by facilitating more efficient, greener and quite importantly safer operations in the years to come. As mentioned before, the shipping industry is capital intensive and at the moment is facing something that some professionals might call a paradigm shift whose basis is the environment and all the subsequent regulatory reforms that will require the industry to decrease its environmental footprint.

To conclude the abstract, the paper will provide general information about the equipment and infrastructure of container shipping and in continuation it will show what the future of container shipping holds and what role the shipping agent will have to play during an era of change.

HISTORICAL OVERVIEW

Ancient Greek amphora.

Before the adoption of the shipping container, finished goods were transported in breakbulk form for thousands of years. There were forms of unitization before the ISO standard containers like ancient Greek amphorae, which were clay pots filled with various commodities like wine and oats. The norm of breakbulk cargo, which was the standard way shipping operated for millennia started to change in the middle of the 1950s.

On 26th April 1956 a crane loaded the world's first container ship with its cargo of ISO containers in under eight hours. One container was loaded every seven minutes.

Then came Malcolm McLean, a truck business owner from North Carolina with the idea of unitizing cargo throughout the transportation chain. In 1956, McLean purchased the Pan Atlantic Tanker Company and renamed it to Sea-Land Shipping. Now the proud owner of two WWII oil tankers, McLean, started converting them into the world's first container ships. The first was the SS Ideal X. On her maiden voyage as a container ship in April 1956, she carried 58 containers from New Jersey to Texas. This system dramatically reduced the cost of loading and unloading a ship. In 1956, manually loading a ship cost $5,86 per ton; the standardized container cut that cost to just 16 cents a ton. Containers also made it much easier to protect cargo from the elements or thieves, since they are made of durable steel and remain locked during transport. In the past, freighters spent up to 2/3 of their time in ports, loading and unloading. Port turnaround times, which were as high as 3 weeks, dropped to 24 hours. While still a problem, the rates of merchandise theft dropped dramatically once the goods were sealed away out of sight, untouched by human hands from origin to destination.

Since then, container shipping has become the major method of transporting finished goods in high volumes all over the world. As of 2025, the value of container shipping is estimated to be around 119,65 billion USD. It is a highly specialized market and belongs to liner shipping. Liner shipping usually transports high-value cargo or passengers and calls pre-specified ports on a fixed schedule. The need to keep the vessels' space occupied, to keep the level of service at high levels and to manage each individual container properly from the consignor to the consignee create the urgency to establish a specialized workforce. Sales, customer service, operations, are all tailored to meet the high expectations of this segment of maritime transportation.

THE SHIPPING CONTAINER AND ITS FORMS

The steel used to manufacture shipping containers is called CORTEN (Corrosion Resistance, Tensile strength). Originally used in building bridges and skyscrapers, its high durability and low relative cost made it a good candidate for this purpose since containers have to protect the goods stored inside them from the elements through the various stages of multimodal transportation.

The most common type of shipping container is the Dry Van. Manufactured in lengths of 20 or 40 feet, it is a solid method of cargo unitization and multimodal transportation. Also, 45-foot units are in circulation and are distinguished by the two protrusions on each side lengthwise. These containers provide good protection from the elements, pilfering and at the same time they are cheap to mend in case they get damaged.

Refer containers are used to unitize and transport perishable goods or goods that require a certain environmental temperature. They are manufactured in 20 and 40 foot sizes. The most common ones can reach internal temperatures of -35 to -40 degrees Centigrade but the so called “Ultra Reefers” can go as low as -70 degrees. Temperatures are controlled by a refrigeration unit which is usually mounted externally and plugged in an electric power outlet while on the vessel and at the container yard. If a power source is not available, then a GENSET is used to supply power to the reefer unit.

Flat rack containers are usually utilized for the transportation of heavy equipment and general cargo which cannot be loaded in a standard dry van unit. Same as with the dry vans, flat rack lengths are 20 and 40 feet. The cargoes, also referred to as Out of Gauge (OOG), can protrude from all sides. When the shipments are way over height, special extensions can be used along with Stretchable Racks (specialized flat racks with enhancements to handle high loads) so the gantry crane’s spreader can load and unload them. Furthermore, flat racks are foldable, which allows them to be stacked 3 over 1 when transported empty.

Open top units are roofless as their name suggests and sometimes do not have side doors. They are loaded from above via crane or forklifts. Cargoes vary from over height shipments or bulk cargo like grains, ores or construction materials. They are usually covered by a tarpaulin. Their special construction allows for bulk cargoes to be loaded from the top and unloaded by tipping them over.

Tank containers are used for the transportation of liquids, gases, powders, and foodstuffs among others. They are subject to the same ISO standards as the other types of containers and are handled in similar ways. They consist of a tank which is based on a frame. The frame’s corners have the same dimensions as a standard shipping container. Because of the volatile nature of the cargo transported in ISOTANKS, these units are subject to regular inspection by a competent authority like DNV in order for their integrity and transportational adequacy to be certified.

Open top container.

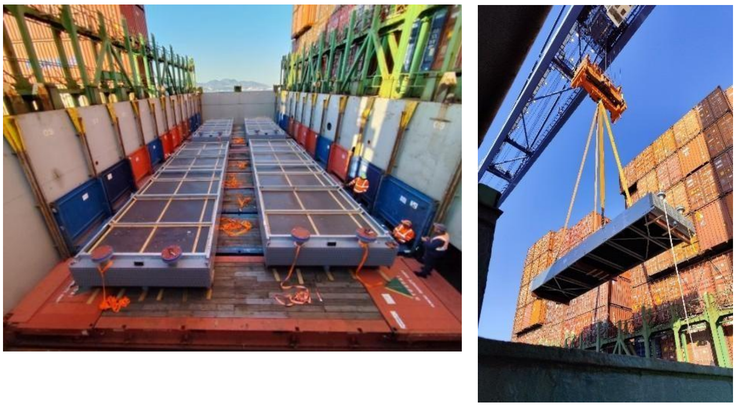
Tank container.

Reefer container genset.

Flat rack container.

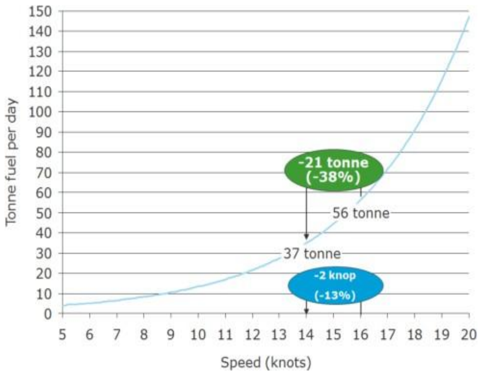
Dry van container.

Reefer container refrigeration unit.



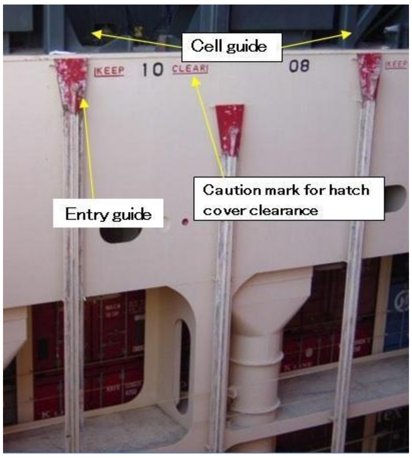
Breakbulk cargo transported by a container ship and discharged at Piraeus. This is a special category of cargo which can neither be loaded in a standard dry van nor a single flat rack. Usually, multiple flat racks are used to create a base upon which the cargo is loaded.

CONTAINER SHIPS



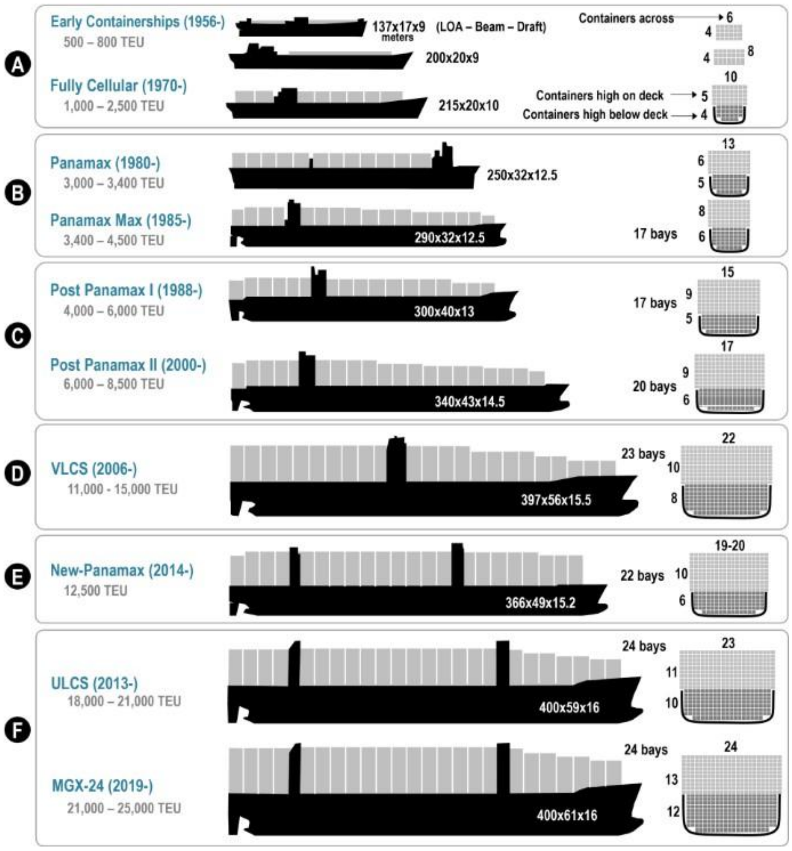
Vessel fuel consumption as a function of speed.

The purpose of this chapter is to provide general information about the vessels deployed by container shipping lines. Container ships are a type of vessel primarily built to transport containerized cargo. Container shipping as mentioned previously is part of liner shipping. It is an express service and requires higher speeds than other shipping segments. The reason is that the value of the transported goods is high, and their timely delivery is of great essence for everyone involved. While other types of cargo ships like tankers or bulk carriers are built with fuller forward and aft sections, container ships are more streamlined in order to achieve higher speeds. In addition to their streamlined design, containerships have more powerful engines when compared to other types of cargo carrying vessels, however, higher speeds mean even higher fuel consumption. As a rule of thumb, a 10% reduction of speed achieves almost 30% savings in fuel consumption. This means that a vessel’s fuel consumption varies exponentially for every additional knot gained or lost. Grasping the relationship between speed and fuel consumption is important for understanding the effects on voyage expenses and the environmental footprint of each asset.



Container ship cell guides.

Furthermore, container carriers have special stowage requirements. A lot of planning goes into each voyage in order to get optimal vessel stability and to ensure that the cargo is not spoiled during the voyage. Containers are usually loaded via Quayside Gantry Cranes. To assist in loading and unloading, cell guides are installed in fully cellular container vessels to help speed up cargo operations. Once a container is aligned with the cell guides the gantry crane operator can lower it quickly into position without having to make major adjustments. The unit is like being on train tracks and slides right down. Also, when it comes to their decks, they have lashing bridges. The purpose of lashing the containers that are stowed on deck is to prevent them from coming loose and falling overboard. Lashing is performed by using twist locks and lashing bars to strap down the containers on the vessel. The lashing bridge allows containers to be stowed higher when compared to older container ships. In other words, it acts like a chassis that holds the containers firmly in place. In the figure below, we can see the evolution of container ships by size and carrying capacity expressed in TEUs throughout the past 50 years.



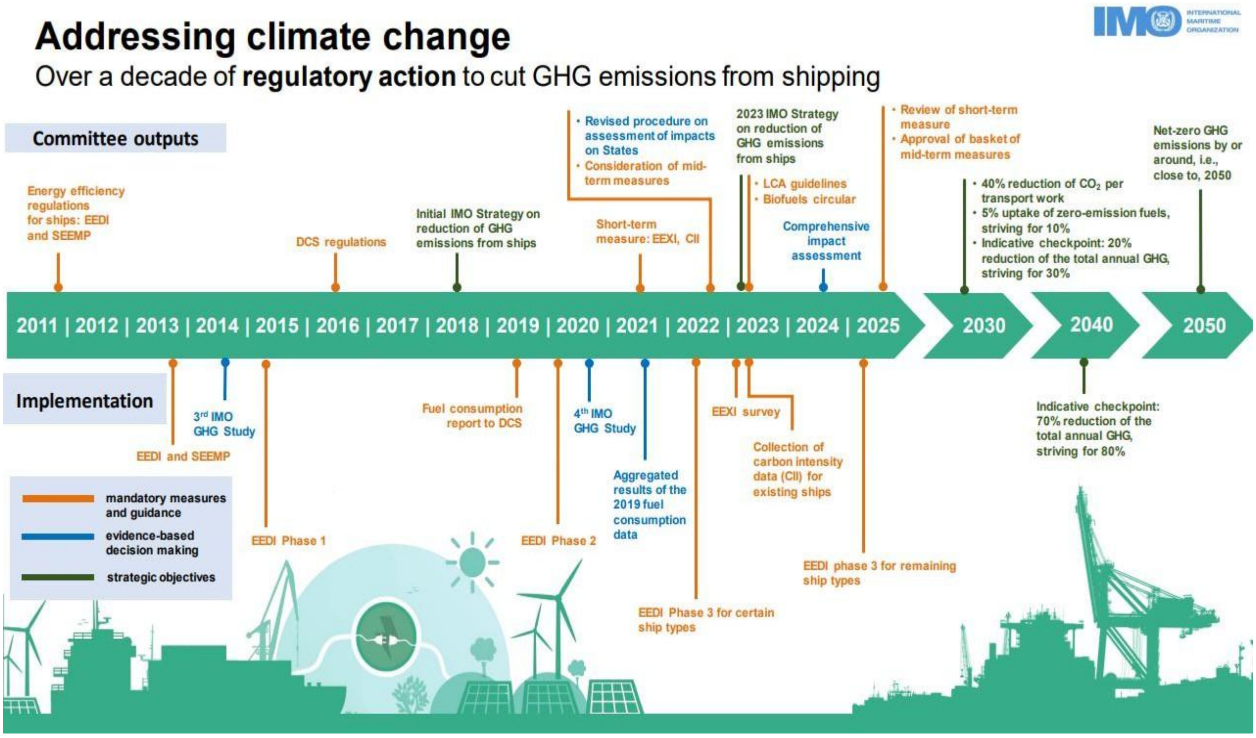
The evolution of container ships during the last 50 years.

A major challenge ultra large vessel operators are presented with is the physical limitations of ports. Ultra large container vessels cannot call small ports due to limitations in draft clearance, quay length, gantry crane boom reach et cetera. This has led the container shipping industry to implement the hub-and-spoke model. Large vessels bring boxes in from different continents and smaller feeder vessels then distribute the cargo to smaller regional ports. Currently the largest container carriers have capacities of around 25.000 TEUs and lengths of 400 meters. It is uncertain if the trend of gigantisation will persist in the coming years. We know that tanker vessels like the Jahre Viking failed to fulfil their transportation role and were used instead as floating tanks. Containership builders should take this as an example and have to understand that further enlarging the vessels has to go hand in hand with the limitations of the facilities that service them.

CURRENT DEVELOPMENTS IN THE MARITIME INDUSTRY AND THE CONTAINER SHIPPING SECTOR

The shipping industry is currently facing various challenges when it comes to its environmental footprint and sustainability. Companies are becoming more committed to streamlining their impact on the environment. Also, the technological advancements of our time are increasing the competition within the industry and the need for integration. In this chapter, we will explore some of the pressing issues of the industry and the means that will be used in the coming years with the goal to rectify them.

SUSTAINABILITY AND DECARBONIZATION.



IMO2050 timeline.

IMO2050 timeline.

Currently, vessel operators are under pressure to reduce the environmental impact of their assets. The International Maritime Organization has set the goal to reach net zero Greenhouse Gas Emissions until 2050 (IMO2050 as the strategy is called). This strategy sets several milestones during the coming years so that shipping eventually ends up emitting zero Green House Gasses by 2050. Major milestones are the years 2030 and 2040 at which the IMO strives to reach net zero emissions by 30% and 80% respectively. Below we can see the entire timeline of the action taken by the IMO to address climate change.

ALTERNATIVE FUELS.

The use of alternative fuels is considered essential in IMO's strategy. The main types of alternative marine fuels are natural gases and biofuels along with their products. Fischer-Tropsch diesel and upgraded bio-oil via hydrothermal liquefaction can be entitled the 'most promising' alternative maritime fuels of the future, whereas HFO and LNG remain the 'most probable' to retain dominance without regulatory intervention. This suggests that for the maritime industry to transition towards sustainable alternative fuels, policymakers, governments, international organizations, and lenders must collectively align their policies to enable a more sustainable shipping industry. Not only by enforcing stricter regulations but also by providing the correct financial incentives.

LNG is a good solution, and this is also reflected by the fact that most new buildings are using dual fuel systems in order to incorporate the option of LNG. Some of the pros of LNG include cost efficiency over low sulphur marine fuels especially in regions where infrastructure is well developed and it is a fuel that has a high energy density therefore ships can travel longer distances without refuelling. On the other hand, it requires large investment for infrastructure development both on land for bunkering facilities and also on board each vessel. This is due to the fact that LNG is required to be stored in very low temperatures so as to remain liquid. Furthermore, in regions where infrastructure is underdeveloped, vessel operators will face logistical issues when it comes to supplying their vessels. Also, handling LNG requires strict safety protocols due to its flammable nature and special storage requirements. Zero carbon fuels like ammonia are also a great alternative to marine fuels but currently the technology for their commercial implementation lacks maturity. Some of their challenges for their broad implementation include the development of proper fuel storage facilities both aboard the vessels and ashore, the investment in bunkering facilities and general logistics regarding zero carbon fuels and the expansion of a reliable regulatory framework.

All in all, alternative fuels are a way of complying with IMO requirements and are a way to buy time until the development of the technology and infrastructure of zero carbon fuels is mature enough for commercial applications.

COLD IRONING.

The electrification of vessels via shore is not a new thing. Cold ironing as the practice is alternatively called has been applied on warships since the middle of the 20th century. For the time when large ships are docked at a pier, a high-voltage shore connection (HVSC) system is often used for eliminating emissions locally. This happens by limiting the use of diesel generators while at berth and by using in turn electricity produced by sources from ashore like conventional power plants and alternative sources like wind or solar energy.

Shore Side Electricity distribution station.

The pros of cold ironing are the reduction of air pollution, fuel savings, extended lifetime of a vessel's generators and the reduction of the environmental and social footprint of ports.

For reference, a feeder container ship with a gross tonnage of 14.236 and approximately 900 TEU carrying capacity will be used. As reported in her Time Charterparty, the vessel in particular has an approximate consumption of 3,5 MT of LFO per day while at port. Based on data from Resolution MEPC.245(66), for every ton of LFO consumed a staggering 3,15 tons of CO_2 are produced and emitted into the atmosphere. The daily consumption of the vessel leaves us with approximately 11 tons of CO_2 in the atmosphere around the port. That is the equivalent of the CO_2 emitted by almost 600 sport hatchbacks per 100 kilometres. Cold ironing will allow the vessel to switch off its generators which will automatically minimize the fuel required to operate them and the subsequent emissions. Furthermore, generator maintenance is scheduled based on usage meaning the hours spent under operation. Less usage means less maintenance checks and services applied, which in turn means fewer spare parts and lubricants used as well as less manhours spent on them. In the Annex of the paper, we can see in a case study conducted by Sustainable Ships the time required for a Ro-Ro ship owner to reach the break-even point of investing in Shore Side Electricity (SSE) systems aboard the vessel. Based on that report a 4 to 5 year period is required in order to see the ROI. Considering that a newly built vessel has an operational lifespan of 25-30 years, then the 4-5 years required to see ROI on cold ironing facilities aboard a vessel seems to be a good condition to make the investment from the shipowner's side provided that the vessel will call ports that have in turn SSE outlets.

Challenges of the implementation of cold ironing include the creation of a substantial legal framework, the difficulty in unifying each region's electrical grid and its unique properties, the safety concerns as well as the capital-intensive nature of these undertakings. Regarding the legal framework, it is currently underdeveloped for the implementation on passenger and cargo ships, but efforts are being made by organizations like EALING, ISO and the IEC. EALING's goal is to create a common EU harmonized and interoperable framework – from a technical, legal and regulatory point of view. ISO and IEC have worked together in order to set the Standard 80005-1 for the general requirements of High Voltage Shore Connection (HVSC) systems. High voltage outlet systems already exist on land and the legal framework regarding safety is extensive. The same has to be developed for SSE systems in order to ensure the safety of both the shore operators and each vessel's crew that handle the relevant equipment. The European Maritime Safety Agency (EMSA) has provided guidance regarding the subject and with good focus on safety.

While alternative fuels are a good mid-term solution for minimizing emissions when underway, cold ironing is an excellent long-term solution when the vessels are at port. As demonstrated above, the benefits are evident provided that both shipowners and port facilities make the required investments for Shore Side Electricity inlets and outlets respectively.

CONTAINER TERMINAL AUTOMATION.

Automation involves three main dimensions: within the terminal (yard), its interface, and the foreland and hinterland. In a fully automated container terminal, both horizontal (quayside - yard) and vertical (stacking) operations are conducted by automated means. In semi-automated terminals, automation is applied only to the stacking yard.

Those in favour of terminal automation support that in automated terminals operations are conducted faster and safer, the environmental footprint of the facilities is reduced, and they create new job positions which are more specialized and therefore better paying. Those speaking against terminal automation support that the required investment is high and the maintenance costs that follow the implementation of automation are also elevated when compared to conventional terminals. Also, dockworker unions are a major barrier due to the subsequent loss of job positions that comes along with automation. Furthermore, there are concerns for cybersecurity. Container terminals that rely on automated vehicles, inventory management systems, and even gate operations are vulnerable to cyber threats that can disrupt terminal operations and logistics chains and thus delay the processes for several hours or even days in the worst case. An example is the ransomware attack on the Port of Rotterdam on the 30th of June 2017 when two terminals had to completely shut down operations until the issues were rectified. Nonetheless, successful automated ports show that careful planning and management can surmount these difficulties: operating expenses could fall by 25 to 55 per cent, and productivity could rise by 10 to 35 per cent, as indicated by a study from McKinsey.

A survey conducted by Knatz et al observed 62 automated terminals which are found in 23 countries, in all continents except Africa (and Antarctica). Most of the terminals are located in Pacific Asia and Europe. New automated terminal projects have been proposed for Busan in Korea, New Orleans and Long Beach in the US and Chile, while others are under development. Stevedoring companies operate 39 automated terminals, carriers operate 14 terminals, financial holding companies operate 6, and joint ventures or Consortia operate 4. From this it is evident that terminal automation is not subject to a certain geographic region. Also, investors come from various backgrounds but are usually related with the port industry. Equipment was obtained from various suppliers. Integration and a testing period followed. The integration of the new equipment with the Terminal Operating System (TOS) was facilitated by the terminals themselves at a rate of 75% (3/4 of all terminals observed by the survey). No correlation was found between the length of the testing period and the entity which undertook the installation of the equipment. The testing periods' length varied from 2 to 37 months.

It can be proposed that with the assistance of an agent acting as technical advisor this timeframe can be compressed. The agent can accumulate data from previous projects and share insights as to how the automation integration can be accelerated. This of course while taking into consideration each terminal's unique characteristics.

THE SHIPPING AGENT'S ROLE IN THE EVOLVING SHIPPING INDUSTRY

Agents are a major part of shipping and have various forms based on the relationship they have with their principal. A ship agent is the party that represents the ship's owner and/or charterer (the Principal) in port. If so instructed, the agent is responsible to the Principal for arranging, together with the port, a berth, all relevant port and husbandry services, tending to the requirements of the master and crew, clearing the ship with the port and other authorities (including preparation and submission of appropriate documentation) along with releasing or receiving cargo on behalf of the Principal.

As mentioned in IMO's FAL Convention, one of the responsibilities of the ship agent is to arrange a berth for the vessel. This is facilitated by various communications between the

Filters | 12 May 2025 → 26 Jun 2025 | GRPIR - Piraeus Container Terminal SA | Search vessel

Vessel	Last Update	Status	Terminal	Service	Voyage	Prev. Port ETD Berth	ETA Pilot	Berth Arrival ↑	Berth Departure	Actual Arrival	Actual Departure	Cargo Ops Start
[redacted]	Today at 06:06 (LT)	Departed	GRPIR-GRPCT	[redacted]	053	TRBOS 08 May 09:45	09 May 12:00	12 May 15:00	C 14 May 06:30 T 14 May 03:30	12 May 14:36	14 May 02:00	-
[redacted]	Today at 15:27 (LT)	Scheduled	GRPIR-GRPCT	[redacted]	006	ILASH 15 May 11:00	17 May 12:00	C 17 May 15:00 T 17 May 15:36	C 18 May 23:30 T 18 May 23:00	-	-	-
[redacted]	Today at 16:54 (LT)	Scheduled	GRPIR-GRPCT	[redacted]	016	TRMER 17 May 14:30	19 May 11:42	C 19 May 23:00 T 19 May 23:36	C 21 May 08:00 T 21 May 08:12	-	-	-
[redacted]	Today at 12:54 (LT)	Scheduled	GRPIR-GRPCT	[redacted]	054	TRMER 20 May 10:00	22 May 07:42	C 25 May 14:00 T -	C 26 May 22:00 T -	-	-	-
[redacted]	Today at 15:54 (LT)	Scheduled	GRPIR-GRPCT	[redacted]	007	CYLMS 26 May 09:12	28 May 02:07	C 28 May 03:07 T -	C 31 May 17:07 T -	-	-	-
[redacted]	Today at 15:42 (LT)	Scheduled	GRPIR-GRPCT	[redacted]	017	TRISK 28 May 14:00	-	C 30 May 17:42 T -	C 01 Jun 15:42 T -	-	-	-
[redacted]	Today at 14:12 (LT)	Scheduled	GRPIR-GRPCT	[redacted]	055	TRMER 02 Jun 09:45	-	C 04 Jun 02:29 T -	C 06 Jun 00:29 T -	-	-	-
[redacted]	Today at 15:27 (LT)	Scheduled	GRPIR-GRPCT	[redacted]	008	CYLMS 06 Jun 10:02	-	C 08 Jun 03:57 T -	C 10 Jun 17:57 T -	-	-	-
[redacted]	Today at 15:42 (LT)	Scheduled	GRPIR-GRPCT	[redacted]	018	TRMER 11 Jun 04:14	-	C 13 Jun 02:56 T -	C 15 Jun 00:56 T -	-	-	-

Example of the User Interface of a berth alignment platform.

agent, the terminal, the vessel's master and the vessel operator. It is evident that multiple parties are involved and without the agent acting as a hub of communications it would be difficult to arrange a berth properly. After April of 2024, the container terminal at Piraeus faced difficulties due to the rising berth waiting times instigated by the simultaneous arrivals of vessels. This lead to feeder as well as mainline containerships to be waiting days at a time until a position was available for them at the terminal's quays. Shipping is profitable when the vessels are travelling. For them to be waiting is detrimental both for the shipping company and their customers. When cargo is loaded on a vessel it has a purpose and must reach its destination on time. Consequently, a port must follow a just in time policy when it comes to berth planning. This can be facilitated if the port's agents cooperate and share information on a common platform. Below is an example of such an interface where information is shared regarding the berthing prospects at Piraeus Container Terminal of the vessels operated by a single carrier.

The agent provides the Estimated Time of Arrival (ETA) of each vessel, cargo information and the time she will be ready to start cargo operations. The terminal takes into account the information provided and gives the berthing prospects. The issue with the platform below is that the information displayed, as already mentioned, concerns the vessels of a single carrier that call Piraeus. If there was a platform where all the agents of the port could input the expected arrivals, then there would be grounds for the agencies to cooperate and synchronize the arrivals of the vessels. Waiting times would decrease and the terminal's productivity would increase. Also, because the port of Piraeus operates on a FIFO basis for feeder vessels, there would be more clarity and ease of tracking the arrivals. Operators would have better feedback regarding their competition and for making decisions regarding the speed and consequently the fuel consumption of each vessel. If a competitor is hours ahead then there is no point to speed up, waste fuel and ultimately berth later than the competition. This is just a small example of the unity that should characterize shipping agencies – working together in order to increase the value added by the provided services.

Another major activity of shipping agents is the provision of an interface between the vessel and the port's authorities. Without getting clearance from the coast guard, local customs office et cetera, berthing and the start of cargo operations cannot be facilitated. The ship agent must have good knowledge of how local authorities operate so as to provide all the necessary documents on time and also complete all the necessary procedures prior to a vessel's berth. Nowadays, clearance procedures can become simple via the implementation of IT solutions. One good example is the effort by EMSA to launch the so called Maritime Single Windows on a pan-European scale at first and then to other neighbouring nations. These single windows are platforms that provide a single interface for all procedures required by each nation's various local authorities. Documents like the crew lists which are required by immigration offices, bonded store lists which are required by customs and so on are uploaded by a specified individual who has the authority to represent the vessel on the maritime single window prior to her call to a country's port. Information about the vessel's arrival time, waste carried aboard, security level et cetera are uploaded on these platforms as well. The main aim of the EMSWe Regulation is to lay down harmonized rules for the provision of the information that is required for port calls in particular, by ensuring that the same data sets can be reported to each Maritime National Single Window in the same way. This Regulation also aims to facilitate the transmission of information between declarants, relevant authorities and the providers of port services in the port of call, and other Member States. Currently EMSA's timeframe for the total implementation of maritime single windows in the EU spans until 2027. Some might argue that such undertakings could minimize the role of the shipping agent and ultimately could lead to their extinction. However, this concern can be thwarted by two arguments. One is that the shipping agents do not only provide clearance services to their principals, but their role goes further than that. They are also the interface between the vessels' crew and a port's nearby town. Shipping agents provide services like crew changes, parcel customs clearance and delivery aboard, vessel and crew certificate renewals and quite importantly, medical assistance to the seafarers. These services are more critical and therefore enhance the agent's role to their principal. Consequently, the simplification of clearance procedures through digitalization will create room for the shipping agent to exploit other streams of income by providing services of higher value. The second is that the shipping agent usually acts as a failsafe or a mediator once things go wrong. Situations that require immediate and sometimes hands-on attention cannot be controlled from afar and without the deployment of "middlemen". For instance, if a vessel is malfunctioning while at port then the shipping agent has to coordinate quickly with the principal in order to fix any issues prior to her departure time. A ship will be off-hire if an event occurs which is specifically mentioned in the list of events in the off-hire clause. This means that the charterer will not pay freight until the vessel is ready to continue her voyage. In addition, ports are usually charging quay idle time after cargo operations are finished therefore the timely departure of a vessel is in everyone's best interest. Imagine if such malfunctions had to be dealt with by a Shipmanagement office located in Hamburg and the vessel being located in an African port without the deployment of an agent. What does the office know about the local authorities' procedures? Do they keep contact with the local workshops? Even if they do, which workshop will provide the most competitive offer? All these questions are easily answered by the shipping agents who are deeply rooted in the ports they serve.

Even though shipping is a capital intensive industry and the aforementioned technological advancements are important, the human factor has to be considered as well. Another issue where the shipping agent can have a pivotal role is the seafarers' welfare. Actions can be taken so as to raise awareness for the issues that seafarers face. Some of them are:

- Mental health issues
- Contractual and Legal Issues
- Lack of Shore Leave

Seafarers stay away from their homes and loved ones for prolonged periods of time. This along with the demanding and often hazardous nature of their work can strain their mental condition. Agents can help raise awareness and funds via various methods like conferences, open days et cetera to combat this issue. Also, they can provide psychological support to the seafarers via certified professionals and counselling to their families. Furthermore, agents can specialize in the legal aspects of the seafarers' work contracts and help maintain their integrity. Seafarer abandonment is a serious contractual issue. According to the ITF, a total of 312 vessels were abandoned in 2024, up from 132 vessels in 2023. The general secretary of the ITF, Mr Stephen Cotton, supports that: "…the solution lies in plain sight: better regulation, enforcement and accountability from governments". This is where the shipping agent can assist at a local and regional level by raising awareness of the policy makers regarding the problem of seafarer abandonment. Also, they can inquire about the issue with the seafarers and get better insight regarding it.

All in all, the agents have crucial roles to play in shipping. From the traditional obligation of vessel clearance and the facilitation communications to more special issues like seafarer welfare and the integration of technological solutions, they can provide a plethora of services, which add value to the supply chain and assist in its optimal operation. It is argued that new technologies will minimize their role but the above prove that their activities can be multifarious and very valuable to the industry. Consequently, it can be supported that if the agents can keep their traditional business model and at the same time look to expand their services then they should not have anything to fear for the future.

CONCLUSION

- Container shipping is a major sector of the shipping industry. It started in the mid-1950s and gained traction quickly due to the benefits it provided for the transportation of goods. It decreased shipping costs and turnaround times.
- Various types of containers and supplementary devices exist today and all of them are exploited in order to cover specific transportation needs.
- Container vessels differ from other types of merchant vessels due to the special nature of the industry. Their design is optimized with speed and maximum capacity in mind.
- Currently the shipping industry is under pressure to limit its environmental footprint. IMO2050 is the summarization of the effort by the International Maritime Organization to gradually decrease vessel emissions until net zero is reached via regulatory reform.
- Regulatory compliance is very important among vessel operators and the new regulations regarding the fuels have put strain on their OPEX and have created the need for alternative fuels. These will buy the industry time until zero carbon fuels and other energy sources are mature enough for commercial use.
- Cold ironing is a good solution for decreasing the environmental footprint of vessels while at berth. Technology is mature for commercial use, but the legal framework needs to be more advanced. Also, more steps have to be taken in order to fully standardize its technical aspects. Its implementation requires long term planning due to the various stakeholders involved and the large amount of investment required.
- Terminal automation is a dividing subject. Some support the idea of fully automated terminals while others are totally against it. The stakeholders need to measure whether the benefits, like operational efficiency, outweigh the disadvantages like the required investment and the backlash from the trade unions due to the lost jobs.
- The role of the shipping agent will most likely change in the coming years along with so many other aspects of shipping. It is of utmost importance for them to find ways to add value to the supply chain. Along with the usual obligation of getting clearance, it is important to develop other services as well.
- In addition to the technological factors out there, the shipping agents have to contribute also to the human factor in shipping. They are the people who come in contact with seafarers the most and must be by their side when it comes to the troubles they face, which stem from the hardships of their peculiar yet amazing profession.

ANNEX

COLD IRONING ECONOMIC FEASIBILITY STUDY BY SUSTAINABLE SHIPS

General		
Ship name	RoRo Lets Go	
Ship type	RoRo Cargo	
Ship main type	RORO SHIPS	
Year built	-	
Drive train	Direct Drive	
Cruising speed	18.0	[knts]
GT	50,443	
Deadweight	20,615	[mT]
Displacement	-	[mT]
Cargo capacity	0	[m^3]
Length	216	[m]
Beam	33	[m]

Aux engine		
Designation	Aux name	
Aux engine power	2,300	[kW]
Aux engine type	4-Stroke	
Aux engine speed	High	
Aux engine RPM	1,200	[RPM]
Aux fuel tank volume	-	[m^3]
Aux fuel type	MDO	

Equipment		
Main switchboard voltage	6,600	[V]
Frequency	60	[Hz]

		Conventional	Shore Power	
Max. power	[kW]	920	782	-15%
Average power	[kW]	920	782	-15%
Energy required	[kWh]	22,080	18,768	-15%
Engine hours	[hrs]	24	0	-100%
Average SFC	[g/kWh]	248	0	-100%
Fuel consumption	[kg]	5,480	0	-100%
Fuel consumption	[liters]	6,157	0	-100%
Fuel	[€]	€ 4,802	€ 4,703	-2%
Lease / rental	[€]	€ 0	€ 0	-
Maintenance	[€]	€ 480	€ 82	-83%
Spares / consumables	[€]	€ 48	€ 39	-20%
EU ETS	[€]	€ 1,142	€ 114	-90%
FuelEU	[€]	€ 1,104	€ 297	-73%
OPEX Total	**daily**	**€ 7,576**	**€ 5,234**	**-31%**

Generalized economic assesment		
CAPEX	€ 979,200	[€]
Dayrate	- € 2,342	[€/day]
Payback days	418	[days moored]
Shore power days	72	[per/year]
Inflation	3%	
Resulting payback years	4	[years]

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FIGURE SOURCES

Figure 01. Cover page.

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Figure 02 , Chapter 1. Ancient Greek amphora.

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Figure 03 , Chapter 1. On 26th April 1956 a crane loaded the world's first container ship with its cargo of ISO containers in under eight hours. One container was loaded every seven. https://inboxprojects.com/history-shipping-container/1472

Figure 04, Chapter 2. Dry van container.

Figure 05, Chapter 2. Reefer container refrigeration unit.

Figure 06, Chapter 2. Flat rack container.

Figure 07, Chapter 2. Open top container.

Figure 08, Chapter 2. Tank container.

Figure 09, Chapter 2. Reefer container GENSET.

Figures 04 to 09 were acquired from HMM's website:

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Figure 10A, Chapter 2. BBK Cargo.

Figure 10B, Chapter 2. BBK Cargo.

From the author's personal photo album.

Figure 11, Chapter 3. Vessel fuel consumption as a function of speed.

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Figure 1, Chapter 3. Container ship cell guides.

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Figure 14, Chapter 3. The evolution of containerships during the last 50 years.

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Figure 15, Chapter 4. IMO2050 Timeline.

https://wwwcdn.imo.org/localresources/en/MediaCentre/HotTopics/Documents/updated%20timeline%202023.pdf

Figure 16, Chapter 4. Shore Side Electricity distribution station.

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Figure 17, Chapter 5. Example of the UI of a berth alignment platform.

Portchain berth alignment platform.

From the author's personal photo album.