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Transformations in organising maritime transport of perishable goods

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Abstract. Maritime transport of perishable goods, due to the nature of the cargo, requires very careful time planning and transport technology. Until recently, the main means for transporting refrigerated cargo were conventional reefer ships. However, the container revolution, which has been observed since the early 1990s, has a strong impact on the organization of the cold supply chains. The purpose of this article is to analyse the changes that have occurred in the technology of perishable cargo maritime transport, and evaluation of their impact on other links in the cold transport chain.

Introduction

Due to the perishable nature of transported cargo, cold chains require very precise planning in terms of transport time and technology. In the case of transcontinental supply chains, it is necessary to apply one of two links: maritime or air transport. So far, due to its duration, seaborne transport in many cases lost to air transport even though it was definitely cheaper. However, thanks to the changes in the way transport chains are organised, more and more cargoes that so far tended to be carried by air (e.g., flowers or pharmaceuticals) are now transported by sea. The market for refrigerated cargo transport is thought to be one of the most promising markets in the whole maritime industry.

For several years, there has been a stable increase in refrigerated cargo transport by sea. In 2013, it amounted to over 170 M tonnes, which represented 2.5% (DYNAMAR, 2014) of the global maritime transport of dry commodities (UNCTAD, 2014).

1. Traditional organisation of a land–sea transport chain for refrigerated cargoes

Traditionally, cargoes that require controlled atmosphere are carried by reefer ships. Reefer ships are small freighters equipped with tween decks. They may be adapted for transporting one type of cargo, e.g., frozen or chilled meat, (various) fruit or only bananas, or many other commodities (universal reefer ships). They may be adapted to maintain one set temperature in all the holds, or diversified temperatures depending on the particular cargoes being transported. Reefer ships may be additionally equipped with a ventilation system (required when carrying fruit and vegetables) and a humidity control system. Some reefer ships are adapted to carry containers on the deck.

However, a refrigerated cargo transport chain which includes carriage by a conventional reefer ship features a number of drawbacks that decrease its attractiveness. The transport chain itself comprises: carrying the cargo from the producer to the port, then transshipment into a refrigeration facility at the container terminal, storage, transshipment onto the ship, carriage by sea, transshipment, storage in a refrigeration facility, and carriage to the consignee. On its way from the consignor to consignee, the cargo undergoes at least four transshipment operations which not always take place in refrigerating conditions. Thus, the cargo is exposed to changes of temperature and humidity levels, which may result in losing its commercial grade. It is important that the cargo should reach the port and be loaded onto the ship in the shortest time possible (for example, bananas should be loaded onto the ship and placed in cold storage facilities within no more than 36 hours from picking).

2. Transformations taking place in the process of organising cold chains

In connection with the global economy development, which has resulted in, e.g., an increase in perishable goods trading (over 20 years, the maritime transport of cargo requiring controlled atmosphere has doubled – see Fig. 1) and the growth of containerization, changes have been gradually introduced with regard to cold chains organisation. Containers started to be used to transport perishable cargo.

Initially, maritime companies that specialised in refrigerated cargo handling started to replace conventional reefer ships with container ships adapted to carry porthole containers. These containers have insulated bodies, but they are not equipped with refrigeration units. Cold air is supplied from external refrigeration units provided by the ship. An advantage of this solution compared to the carriage by means of conventional reefer ships is the possibility to ensure controlled atmosphere over the whole transport chain, including transshipment nodes. However, a major drawback of this solution is the limited possibility of storing such containers at port terminals. Such container terminals would

need to be equipped with independent refrigeration units to be mounted on the containers (the so-called clip-on units) or use the terminal-based refrigeration systems (Fig. 2). Due to that, the use of porthole containers was gradually abandoned. The last container ship designed for transporting porthole containers was launched in 1995. Single maritime transport orders involving such containers were still handled in the first decade of the 21st century (GDV, 2016).

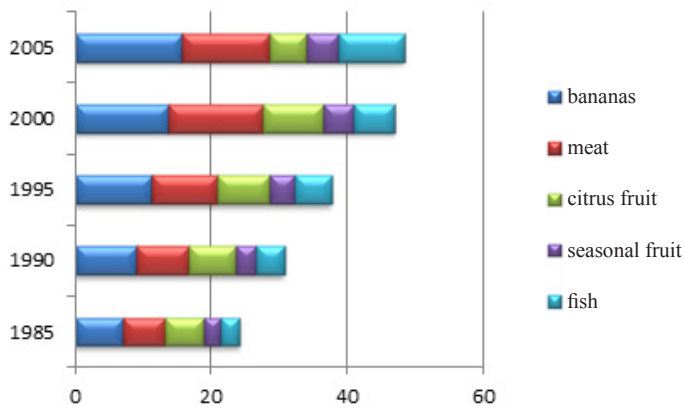


Figure 1. Growth of global transport of refrigerated cargoes in the years 1985–2005 (‘000 000 of tonnes)

Source: own elaboration based on GDV (2016).

Despite the inconveniences connected with the use of porthole containers, the changes initiated in supply chains organising could not be undone. As regards the transport of cargoes requiring controlled atmosphere, from the onset of the 1990s, conventional reefer ships have been gradually, but consistently, replaced by container vessels equipped with sockets for refrigerated containers. Reefer containers, as opposed to porthole containers, are equipped with refrigeration units that keep the controlled atmosphere inside the container. Thanks to the refrigeration unit, a container of this type is definitely more mobile compared to a porthole container. However, a reefer container also has its drawbacks. Its internal dimensions correspond to the ISO containers, and since it is equipped with a refrigeration unit, its cargo space is smaller than that of a porthole container. Air flow in refrigerated containers cannot be kept on the same level as in the case of conventional reefer ships. Moreover, they require a power supply source, on board and feeder transport vehicles as well as at a container terminal. This is one of the reasons why refrigerated containers are virtually not carried by rail (not enough rolling stock provided with a source of power).



Figure 2. The porthole container system: a) porthole container, b) clip-on unit, c) the hold of a container ship adapted to carry porthole containers, d) terminal-based refrigerating system

Source: TIS (2016).

Despite these disadvantages, the maritime transport industry has been gradually replacing the conventional reefer fleet with reefer container ships, as shown in Fig. 3.



conventional reefer ship



reefer container ship



container ships with reefer slots

Figure 3. Transformations taking place in the fleet used in refrigerated cargo transport

Source: own elaboration based on materials obtained from the companies: Green Carrier, Seatrade, and Maersk.

Consequently, the fleet of conventional reefer vessels is shrinking. Over 10 years (2001–2011), the number of those vessels decreased by 25%, and their total capacity – by 10% (Fig. 4).

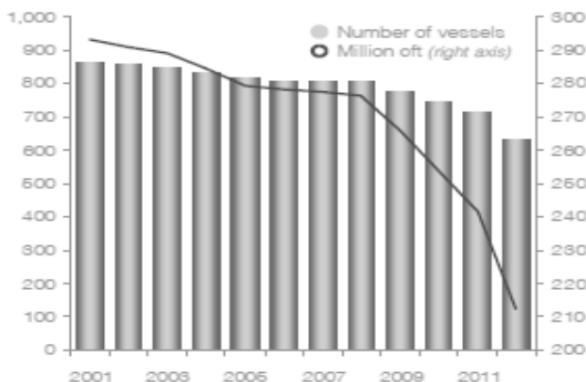


Figure 4. Changes in the global conventional reefer fleet in the years 2001–2011

Source: Damas (2013).

In 2011, the capacity of the global fleet of conventional reefer ships was estimated to be 260 K cu. ft., out of which ca. 80% was owned by 10 largest maritime transport operators (Table 1).

Table 1. Ten largest operators of conventional reefer fleet

Item	Operator	No. of vessels	Total capacity (cu.ft.)	Market share (%)
1	Seatrade	65	31,541,000	15.1
2	NYKCool	23	13,756,000	6.6
3	Baltic Reefers	22	11,874,000	5.7
4	Frigoship	39	11,733,000	5.6
5	GreenSea	41	11,286,000	5.4
6	Network Shipping	24	10,679,000	5.1
7	Star Reefers	17	9,114,000	4.4
8	Great White Fleet	10	5,906,000	2.8
9	Africa Express	8	4,679,000	2.2
10	Fyffes/Geest	8	4,563,000	2.2
Top 10		257	115,131,000	55.0
Others		382	93,559,000	45.0
Total		639	208,690,000	100.0

Source: DREWRY (2012).

The conventional reefer fleet is ageing fast. 65% of the fleet is older than 20 years, the ages of another 20% range from 16 to 20 years. Over the past 5 years, 230 conventional reefer ships were scrapped. Only in 2011, 39 ships of this type ended up in a ship-breaking yard, while in 2012 – it was already 74. In the same period, not a single new conventional reefer ship was launched (Fig. 5).

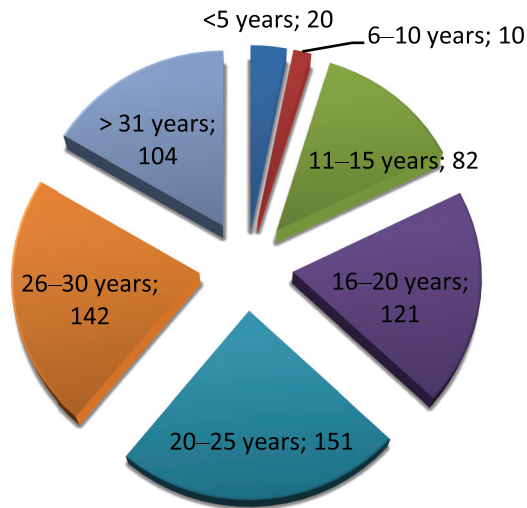


Figure 5. Age structure of conventional reefer fleet

Source: DREWRY (2012).

The changes observed with regard to the reefer container fleet follow two trends:

1. Operation of container ships that are fully adapted to transport refrigerated containers.
2. Operation of cellular container ships with some slots equipped with sockets to connect refrigerated containers.

Container ships that are fully adapted to transport refrigerated containers are purchased predominantly by large companies which need large-scale marine transport for their products. For example, the Great White Fleet operator being part of Chiquita Brands International, an American holding dealing with bananas production and distribution, in 2013 engaged reefer container ships to serve the shipping route Guayaquil – Port Hueneme (USA, West Coast). Similarly, the Dole Ocean Express Cargo operator being part of the Dole holding – a producer and distributor of fruit and vegetables – has ordered three full-reefer container ships of 1500 TEU capacity each. These vessels are scheduled to be launched in 2016.

However, this solution does not provide companies specialised in perishable goods trading with a full freedom to create supply chains. Recently, the second solution is found

to be applied more and more often. Companies no longer want to maintain their own shipping lines for the purposes of transporting refrigerated cargo, and turn to outsourcing the maritime transport services. This solution is selected by operators serving large companies which need large-scale marine transport for their products, as well as independent operators and logistics companies specialised in cold chains organising. For example, in 2013:

- the Great White Fleet operator suspended the shipping route Ecuador/Guatemala–Hueneme served by reefer container ships and chose to charter some slots on the CCNI/CSAV/Hamburg Süd route;
- Dole Ocean Express Cargo replaced 5 conventional reefer ships (serving the routes between Ecuador and the Mediterranean ports) with slots on MSC container ships;
- Geest (Fyffe) replaced the dedicated shipping route: Central America–Europe with slots on Maersk Line ships;
- Cosiarma (GF Group) suspended its Agrexco Mediterranean shipping line that operated two “hybrid” reefer ships (DYNAMAR, 2014).

As a result of the changes taking place in the way of transporting perishable goods, the capacity of the refrigerated container fleet is estimated to be 2.3 M TEU. Currently, the capacity of the global container fleet to handle refrigerated cargo reaches 900 M cu. ft. (DYNAMAR, 2014). In 2012, the container fleet covered 91% of the total capacity of the fleet used in transporting refrigerated cargoes (DREWRY, 2011).

The container fleet has taken over the major oceanic shipping routes. Currently, there are over 100 shipping lines that connect the southern hemisphere (Latin America, South Africa, and Australia/New Zealand) with the ports of the northern hemisphere (Far East, Northern America, and Europe). They operate nearly 800 vessels with the average capacity of 4.5 K TEU, each with ca. 550 sockets for refrigerated containers. They can transport over 61.5 K of such containers per week.

The changes that have been taking place in the fleet are reflected in transshipments in seaports. In 2010, the Rotterdam port handled 2 M tonnes of perishable cargo, out of which 80% was containerized. The share of refrigerated containers is forecast to increase up to 90% in several years (Port of Rotterdam, 2014). Therefore, the Rotterdam port is planning a new investment project. The Rotterdam Cool Port will be intended only for refrigerated containers that require temporary storage and/or additional handling, delivered to the container terminals located in the Maasvlakte area. The terminal will be adapted to redistribution of the containers by means of all modes of transport: feeder ships, railway and road transport. Following the project completion in 2015, Rotterdam Cool Port will be providing 12 K sockets for reefer containers, thus becoming the largest port in Europe to handle this type of cargo.

Table 2. Shipping lines serving the north–south routes by means of container ships of the capacity exceeding 1,000 TEU, of which at least 20% may be taken by refrigerated containers

Shipping line	No. of shipping lines	No. of carriers	No. of vessels	Average capacity (TEU)	Average no. of sockets for refrigerated containers
Latin America	62	29	454	4,300	610
South Africa	20	17	186	4,800	590
Australasia	30	24	185	3,800	470
Total	108	38	778	4,100	550

Source: DREWRY (2012).

The changes that have been taking place with regard to organising perishable goods transport are also visible in Polish seaports. Only until recently was most of the bananas imported on reefer vessels coming directly from Central and South America, and handled at the Cargofruit terminal (WOC). In 2000, more than 130 K tonnes were transhipped there, while in 2011 it was only 21 K. Currently, definitely more cargo is transported in containers through the ports located in western Europe, i.e., Hamburg, Bremerhaven, Rotterdam, and Antwerp, the destination ports of transoceanic vessels coming directly from Central America. Then the containers are transported by road from the ports to banana ripening plants located in Poland.

Summary

Summing up the changes taking place with regard to organising supply chains for refrigerated cargoes, they lead to the total abandoning of conventional reefer ships and switching to transporting refrigerated containers on reefer container ships with slots equipped into sockets for refrigerated containers. This leads to irreversible changes for the companies specialised in perishable goods transport. The companies which so far had their fleets now cease to operate them and they become merely logistics operators without their own means of maritime transport. Similar changes are observed in seaports. To ensure operation continuity, the terminals that specialise in handling refrigerated cargo with short storage times (e.g., fruit and vegetables) have to switch to refrigerated container handling in lieu of storing goods in refrigerated warehouses. An exception are the refrigerated warehouses specialised in handling long term storage cargo, i.e., frozen fish or meat. High demurrage costs for refrigerated containers incline the decision-makers to store their cargoes in port cold storage facilities rather than in containers.

So far, refrigerated containers stand for a small part of cargoes handled in Polish seaports, which results from the way supply chains have been organised so far. Delivery time is also the main reason why containerized cargoes imported from outside Europe

are transhipped in western European ports onto trucks, and not feeder ships. Providing a larger number of direct transoceanic container ship connections to Polish seaports will contribute to an increase in handling this type of cargo.

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PRZEOBRAŻENIA W ORGANIZACJI TRANSPORTU MORSKIEGO ŁADUNKÓW ŁATWO PSUJĄCYCH

Słowa kluczowe: zimne łańcuchy dostaw, transport morski, transport kontenerowy

Streszczenie: Transport morski ładunków łatwo psujących, ze względu na właściwości ładunku, wymaga bardzo starannego planowania czasu i technologii przewozu. Do niedawna głównym środkiem do przewozu ładunków chłodzonych były chłodniowce konwencjonalne, jednakże rewolucja kontenerowa, jaką obserwuje się od początku lat 90. silnie wpłynęła na organizację zimnych łańcuchów dostaw. Celem artykułu jest analiza zmian, jakie zaszły w technologii przewozów ładunków wymagających kontrolowanej atmosfery w transporcie morskim oraz ocena ich oddziaływania na inne ogniwa łańcucha transportowego.

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