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Strategic Approaches are Necessary to Shipping and Port industry to become a Maritime Power

Lee Sung-woo

Supply Chain Management (SCM) is a process of connecting cargo from shippers to customers, in other words, a process in which companies produce and sell products. In recent days, SCM is going through a significant change; whereas shippers, who are the manufacturer of products, used to be the center of the chain in the past, customers, the purchaser of products, are now playing a central role. This changing trend is attributed to technological innovation, such as smart phones. Such a small device allows customers to make a decision on the whole process by simultaneously carrying out shopping, taking orders and purchase at one place. Therefore, shippers, logistics and distribution companies are all starting to pay attention to the trends of customers. As a result, the center of logistics value is shifting from shippers, such as shipping and ports industry etc. towards logistics and distribution companies which are located closer to customers.

Amid these changes, shipping companies and terminal operators are facing a serious competition for survival as they undertake projects based on large logistics infrastructures. With customers emerging as a new center of SCM, shipping and port companies, who used to be the center in the past, are now competing through the economies of scale and economies of scope. This is why top ranking global shipping companies continue to carry out M&A, while mid-sized shipping companies are undergoing consolidation.

South Korea's new administration has unveiled a plan to establish (tentatively named) the Korea Ocean Business Corporation. The plan aims to help shipping and port companies overcome the crisis, serving as a source for national wealth keeping up with the changes of global logistics environment. This is a much anticipated policy, which should be materialized at once. In order to make this organization to fulfill its own functions, it is important to understand and analyze the changing logistics market. After that, roles and functions of the organization should be designated. Keeping the demand cycle of the shipping industry in mind, the government should appropriately reflect its financial characteristics by selling vessels around the time

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of boom period and purchasing them around the time of slump. Furthermore, roles and functions of the organization should be assigned after understanding its relative relationship with the shipping and port industry as well as changing broad trends of the logistics industry. Rather than a simple combination between finance and shipping, it is necessary to establish a direction for the organization by understanding broad changes of logistics and considering relevant industries.

Meanwhile, the Korean government plans to implement (tentatively named) K-GTO policy, aiming to enhance the competitiveness of Korean terminal operators and establish global network. In doing so, the government intends to promote mutual growth of the shipping and port industry. This policy also requires clear designation of roles and functions. Basically, global network should be established by combining shipping and port networks and further to inland logistics networks. Only then, the benefits of the network would go to all national companies, along with Korean logistics companies. This policy is timely in the right direction. However, there are certain limitations for Korean companies to explore and develop foreign ports, as they have almost no relevant experience.

Looking into cases of expanding global port networks, Singapore has been able to achieve today's success by allocating appropriate roles between a holding company 'Temasek' and its domestic port operator, PSA. Equipped with finance and information functions, Temasek has taken a leading role in expanding global networks by working as brain, while allocating the role of hands and feet to PSA based on hands-on experience and networks. Having fully recognized the limitations of its capital and experience in foreign businesses, the Port of Rotterdam Authority of the Netherlands, which is a latecomer, is implementing a phased strategy to expand global networks over 10 years. The strategy follows the order of consulting, education, equity investment of ports and logistics centers, joint investment in ports and port operation. Both cases have successfully made inroads into foreign markets through strategic approaches such as selection and concentration and a phased strategy. Keeping this in mind, it is time to think about our strategy.

The newly established Korea Ocean Business Corporation should have a financial design considering the special characteristics of the shipping industry, while serving to recover the struggling shipping industry. Meanwhile, the purpose of K-GTO is to allow Korean port operators to establish a global port network, maximizing the profits of Korean companies that entered foreign markets. However, securing foreign port bases is not easy without adequate experience in foreign markets and understanding of port logistics markets. This is the very reason the Port of Rotterdam Authority have invested nearly 10 years, implementing a phased-strategy.

The establishment of Korea Ocean Business Corporation and the implementation of K-GTO should be carried out as soon as possible to make South Korea a global maritime power, as the government announced. However, it is of importance to clearly define its purpose, principal agents, and functions. The purpose is to establish

a system for creating a virtuous cycle of securing vessels and expanding a global logistics network. In doing so, the shipping and port industry will be able to leap forward through mutual growth. Connected with finance and SCM, public agents who fully understand the changes of shipping and port logistics industry should play a central role in this effort. Therefore, public financial institutions should play a central role in the shipping industry while port-related public institutions should be the main agent for the port industry. And now is the time to take a giant step forward to become a global maritime power.

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Utilization of Low-Value Fish: A Case from Yawatahama, Japan

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ABSTRACT

In Japan, wounded, small-sized, or low-profile fish are commonly discarded during distribution. However, this practice is blamed for indiscriminate overfishing of resources, environmental pollution, and adverse effects on ecosystems. Hence, to utilize these fish, these are labeled as low-value fish and processed on a commercial basis for the development of regional specialties that contribute to the local economy.

The study site, Yawatahama city in Ehime prefecture, is a center that specializes in low-value fish. The Yawatahama Chamber of Commerce and Industry plays a key role in promoting low-value fish. Local governments can increase awareness of low-value fish by developing recipes in conjunction with local restaurants, actively promote them, and issue certificates to restaurants handling low-value fish.

Keywords: Low-value fish, fishing industry in Japan, local economy

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1. Introduction

The supply and demand environment surrounding the fishery industry in Japan has been changing drastically in recent years.

First, in terms of supply, fish catches are decreasing because of stringent environmental regulations on fisheries and increasing imports of marine products. In particular, the production of aquatic products is declining because of indiscriminate overfishing and declining fishery resources due to changes in the marine environment. Meanwhile, distribution systems are changing due to the emergence of large supermarkets and development of the food service industry (Abe, Sato, and Shoki 2007). To provide reliable products to their customers, large supermarkets and restaurants require that producers and wholesalers satisfy four special conditions for the supply of products—maintain the *same amount, same time, same quality and size, and same price*. Due to environmental changes, fishes that are not uniform in size, enjoy low awareness, and have been damaged are losing sales points. Further, fishes that do not meet the above four conditions are called low-value fish. According to a FAO, the term 'Low-value fish' is difficult to define as the use of these fish different in many areas in Asia-Pacific. However, in Japan, low-value fish is perceived as low economic value in the market. It is not classified according to its size. Therefore, Low-value fish can be treated as non-edible at the distribution stage or traded at very low prices, but most of them are generally discarded on board or during distribution (Salia 1983). Ultimately, low-value fish are criticized as a waste of fishery resources and increase the burden on fishers (Dayton et al. 1995). Therefore, the impact of low-value fish on marine ecosystems has received considerable research interest, and a variety of ways have been investigated to reduce its severity (Kirby and Ward 2014).

Since the 2000s, fish consumption per person has decreased all over Japan (Hayashi 2011). Consumption per person recorded a maximum, at 40.2 kg, in 2001, but decreased to 25.8 kg in 2015 (WPJF 2016). In addition, fish is difficult to cook, generates a lot of garbage, and smells bad. However, health-conscious Japanese want to increase consumption of fish. Therefore, they purchase seafood that is easy to eat, such as processed fishery products (Ariji 2013).

Meanwhile, the fishes consumed in Japan are limited to some species. It is known that about 3,800 fish species are caught in the offshore area, but only about 300 kinds of fishes are distributed. About 100 popular fish varieties are distributed in large supermarkets and retail stores. In other words, fish consumption in Japan is largely accounted for by popular fish such as red sea bream, mackerel, and pollack, as well as high-quality fish such as whale, bluefin tuna, and eel (WPJF 2016). This rising demand fuels overfishing of fishery resources. Therefore, the International Union for Conservation of Nature (IUCN) has designated bluefin tuna and eel as endangered species, leading to diversification of seafood consumption. In particular, Ehime prefecture, which is one of the largest producers of aquatic products, intends to protect its offshore fishery resources by promoting the consumption of low-value fish as a substitute for the endangered species. Therefore, policymakers should formulate a strategy to expand the supply of low-value fish and develop a local specialty product based on it.

2. Various cases of low-value-fish usage in Japan

Use of low-value fish has the advantage of reducing wastage of resources, but it has a disadvantage as well: it is difficult to find a market for low-value fish because of low awareness about it. However, considering that the Japanese archipelago stretches to the north and south, the fishes caught in each region are different, and the consumer culture is also different. Therefore, each region formulates a commercialization strategy for low-value fish based on their characteristics. In the following subsections, we present successful cases divided into regional and wide-area types. The regional type contributes to stimulating the local economy. For example, fish caught in the area are either developed as a local tourism resource or commercialized as a local specialty product. In the wide-area type, however, low-value fish is, for example, shipped all over Japan. On the other hand, the academic articles on the Japanese case are very small, so we referred to internet materials for the following cases.

2.1 Regional type

Onomichi city of Hiroshima prefecture presents an example of the regional type. Onomichi city has a well-developed tourism business and boasts a special product called Onomichi ramen. However, with no special products using regional aquatic products, its fisheries industry is declining. Since 2013, therefore, local governments have started to develop new ideas for the promotion of low-value fishes caught off the Onomichi city coast (Onomichi 2017). First, the Onomichi government issued certificates assuring that low-value fish would be provided throughout the year to restaurants offering these products. It was difficult to appeal to customers visiting restaurants since they were not familiar with low-value fish. However, with the issue of certificates, customers had sufficient information to recognize low-value fish and order appropriate products. With the cooperation of the neighboring fisheries cooperative, low-value fish are supplied smoothly at relatively low prices.

Another example of regional type is Itou city, Shizuoka prefecture. In this case, the Itou city Fisheries Cooperative actively planned the use of low-value fish (Ito 2017). The restaurant managed by Itou city Fisheries Cooperative was opened in September 2010. The fisheries cooperative sells items such as mackerel, squid, yellow tail, and horse mackerel, which are sold by auction and shipped to large cities, while low-value fish are delivered to restaurants directly. The fisheries cooperative developed various recipes and promoted the value of low-value fish through local broadcasting. Although customers came in large numbers, more than expected, right from the opening day, the deficit continued because the restaurant management lacked know-how. However, the restaurant brought in professional managers and developed a menu according to the needs of its customers, turning the deficit into a surplus.

2.2 Wide-area type

Pro Spa Co., Ltd., is an example of the wide-area type. Pro Spa, founded in 2002, is a fish-processing company located in Gamagori city, Aichi prefecture. Active

in the sale of low-value fish, the company has often been exposed to media attention. Pro Spa informs fishers in advance of the species they need and buy low-value fish at a price higher than the usual transaction price (PROSPAR 2017). Therefore, fishers feel motivated to work, paying attention to quality control, and supply fresh low-value fish. Pro Spa has also diversified the supply of low-value fish to ensure a stable supply throughout. They also deal with low-value fish in different areas, developing products suitable for each fish. Pro Spa handles remote items such as sailfin sandfish in Ishikawa prefecture and gray rockfish in Hokkaido and ships them to cities. In addition, HACCP certification is obtained and sanitary management is thoroughly monitored to produce low-value fish products. Lastly, Pro Spa shares its recipes with restaurants, and accept orders for less than a kilogram to promote low-value fish.

These cases can be divided into supply, demand, and administration. Low-value fish can be harvested from the area or obtained from other areas to assure regular supply. It is also necessary to develop products that can take advantage of local characteristics. Transactions with a large supermarket or restaurant in the region are important to establish a firm customer base. Finally, local governments can consider certification to develop tourism resources.

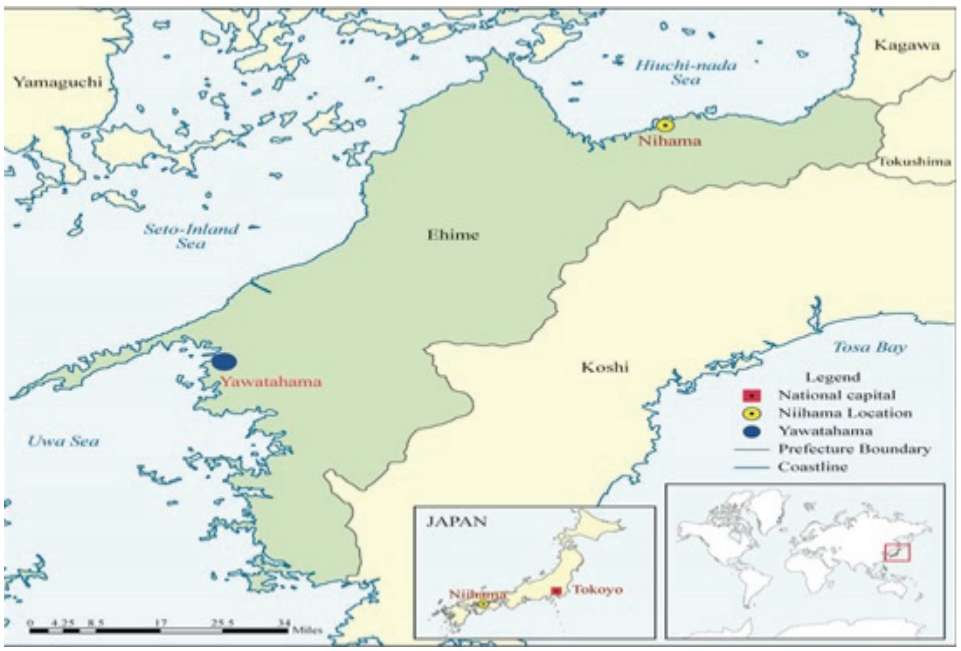
3. Research location and site selection

This research was conducted in Yawatahama city, Ehime prefecture. Ehime is located in the northwest of Shikoku, which is the smallest of the four main islands of Japan. Ehime boasts clean, uncontaminated resources. The western coastline of Ehime touches the Uwa Sea, while the northern part faces the Seto-Inland Sea. Various abundant aquatic products are harvested and cultivated here. Red sea bream, yellow tail, and pearl lacquer are cultivated in the Uwa Sea and boast the highest production and quality in Japan. The fisheries industry in the Seto-Inland Sea has more catch fisheries than aquaculture. However, the fisheries industry in Ehime faces a major crisis due to the decrease in the number of fishers and the aging workforce. The number of fishers decreased from 18,920 in 1985 to only 9,317 in 2010, of whom 59.2% were over 60 years and 41.7% over 65 years. This trend is especially remarkable in Yawatahama. The total population of the city is 35,643, with 16,666 males and 18,977 females. Of this total, 13,232 are aged 65 or older. The number of fishers has fallen from 450 in 2003 to 205 in 20155, of whom 51.2% are over 60 and 38.5% over 65 years. The elderly fishers are often called “pension fishers.” The pension fishers have almost zero income as fishery producers, so they do not have the tools, ice, icebox, or storage to maintain freshness (Mihara et al. 2004). The decline in the number and increase in the age of fishers influence brokers. Brokers are middlemen who sell fish that are auctioned off to retail stores or restaurants. Falling fishery catches have reduced the number of brokers, affecting the vitality of wholesale markets and auctions. Thus, pension fishers concentrate on popular fish and discarded low-value fish due to the difficulties of distribution. As a result, a large amount of low-value

fish were disposed of, which led to criticism about environmental deterioration.

To solve this problem, the Yawatahama Chamber of Commerce and Industry (YCCI) decided to commercialize low-value fish in 2014. The goal was to raise awareness of the low-value fish in the area and to develop special products and tourism resources based on low-value fish. It is a project to highlight the charm of the fish caught in the area but not consumed and to create added value. In November 2015, the project began with the tasting of dishes of low-value fish. The low-value fish were prepared in various ways—sushi, tempura, and boiled. The event was well received by the participants. YCCI plans to grow low-value fish into a brand representing the region. This initiative faces the problem of ensuring a smooth supply and building awareness of low-value fish. Therefore, YCCI needs to develop a strategy to solve this problem.

Figure 1. Map of the study area—Yawatahama city, Ehime prefecture



4. Discussion

4.1 Results of interviews with fishers and related persons

In order to establish a strategy for the utilization of low-value fish, interviews were conducted with various stakeholders from all sides, including supply, demand, and administration. The preliminary work involved understanding the stance of stakeholders in the low-value fish sector and laying the foundation for future development strategies. The following subsections summarize the interviews with several persons.

On June 20, 2016, depth interview was conducted in the YCCI on the project. Interview was implemented on the motivation, budget and direction of the project. Data were collected in middle 2016. Follow-up field work was conducted in late 2016 to clarify and supplement the data.

A survey was conducted using semi-structured questionnaires. It was facilitated that gathering of supplementary information such as mentions from respondents. 81 respondents were implemented face to face on November 19, 2016.

The scale used in this study was reconstructed appropriately in the previous study. The items of each variable are as follows.

First, the low price assumes 100 yen per 100 grams. Is the price of the product cheap? Is it cheaper than other popular fish? What is the maximum amount you are willing to pay? As for the quality, is it delicious? Is the cooking method right? Does it match rice? The survey items of diversity are as follows. Do you feel seasonal? Do you feel the local characteristic? Can it be made into a variety of products? In this chapter, positioning of Low-value fish will be analyzed based on price and diversity.

4.1.1 Supply

Interviews were conducted with fishers and fisheries cooperatives in Yawatahama to find out how to recognize and distribute low-value fish. First, the fisheries cooperatives did not recognize the existence of low-value fish. Aquatic products that are not related to fisheries cooperatives, such as low-value fish, are not circulated. The scale and number of items handled in the fisheries cooperatives have fallen. Therefore, the cooperatives were reluctant to expand the distribution business. Low-value fish were considered as the problems of fishers and wholesalers. Most of the wholesalers are small-scale operators and participate in the auctions for only popular fishes. They were reluctant to deal with low-value fish, which they thought were not sold in the market or were sold at low prices. Ultimately, low-value fish had to be supplied through out-of-market distribution channels rather than the formal market.

4.1.2 Demand

The main demand for low-value fish is limited to restaurants, supermarkets, and general consumers in the city. Low-value fish were not distributed for a long time, so their cooking methods were unknown, and recipes using low-value fish were not developed. Therefore, few restaurants offered dishes of low-value-fish, and consumers had no opportunity to savor such dishes.

Consumers are still reluctant to buy low-value fish because of their low awareness level. They prefer popular fishes. Supermarket purchasing personnel also show this tendency. They think consumers will not buy low-value fish because consumers do not know how to cook or consume low-value fish. Meanwhile, the salesperson may not have enough knowledge to answer customer queries about how to cook the ordinary fish. In a retail store that only sells fish, however, the merchant would describe the characteristics of the fish and advise the customer how to cook it. However, due to changes in consumption patterns, such stores are not common. Moreover, consumers are less likely to cook fish because they buy fully cooked food in supermarkets.

Therefore, it is technically difficult to cook live fish. Supermarkets should sell cooked rather than live low-value fish.

4.1.3 Administration

Ehime prefecture mainly produces red sea breams, flatfish, and yellow tail, and their consumption is high. They are also seeking to brand them, for example, by improving the aquaculture environment and raising special feeds. To increase profitability, Ehime prefecture aims to increase its supply to the major cities, Tokyo and Osaka, through branding. Therefore branding of low-value fish is not in line with the current Ehime strategy. However, Yawatahama hopes to contribute to the local economy through low-value fish. In particular, the YCCI is actively involved in public relations activities in cooperation with public organizations, for example, by planning events using low-value fish.

4.2 Low-value fish utilization strategy of Yawatahama city

Yawatahama should set a correct strategy to promote low-value fish as a local specialty. The Japanese value fresh fish. Therefore, sales to local residents and local restaurants, rather than shipments to big cities, should be expanded. In addition, YCCI should strive to develop products for tourists visiting Yawatahama. In the following subsections, we explain the strategies for utilizing low-value fish.

4.2.1 Strengthen the food culture of low-value fish through food education

Japanese fish consumption continues to decline. In the past, the intake of fish was low when most Japanese were young, but fish intake increase with grow old. (Ishibashi 2000). In recent years, however, fish consumption in the elderly has decreased, and the industry is in a great crisis (WPJF 2016). In line with this tendency, the entire fisheries industry is declining. If the decline in the fishery industry continues, the Japanese food culture based on fish consumption will also decline. Therefore, students need to be educated, before their taste matures (i.e., until 7–10 years of age), to consume fish. Dietary education is intended to equip human beings with knowledge of "food" and the ability to make the right choice through various experiences and practices (Shimada et al. 2015). It is not mere cooking education, but comprehensive education about attitudes towards food, nutrition, and the traditional food culture. Yawatahama's schools should educate students about the benefits of resource conservation and nutrition associated with the consumption of low-value fish. School food service centers should undertake food-processing functions to provide a stable supply of low-value fish. In addition, recipes for low-value fish need to be developed.

4.2.2 Linkages with local restaurants and promotion by the local government

According to an interview, local restaurants are reluctant to buy low-value fish because they do not know how to care for and cook low-value fish. Since low-value fish have not been distributed so far, only a few fishers and the elderly know how to cook and care for them. Therefore, it is important that culinary techniques should

be disseminated among the chefs of the local restaurants that wish to handle low-value fish. At the same time, they should be apprised of the important role of low-value fish in protecting the environment and resources of the area and advised not to waste the fish. To this end, YCCI proposes to hold a recipe research meeting using low-value fish, where cooks and fishers can gather together to share ideas and develop new menus.

It is not known whether such research meetings will held periodically, but it is significant that the YCCI is intent on providing opportunities for producers and consumers to share their ideas.

4.2.3 Benchmaking the Japanese roadside station mall (Michi-no-Eki)

The Japanese roadside station mall, Michi-no-Eki, is the government-designated rest area found along roads and highways. Roadside station malls are set up by the local government in collaboration with the Ministry of Land, Infrastructure, Transport and Tourism in Japan. A parking facility, a break facility, and a local promotion facility are combined in a station mall. The local promotion facility has recently been spotlighted. A typical roadside station mall targets agricultural products. However, a roadside station mall sells produce harvested by surrounding farmers on consignment. Detailed information on who has grown the produce and where it was grown is provided. Since visitors trust producers and are willing to buy their produce, the number of malls is increasing (Yamamoto and Yuzawa 2012).

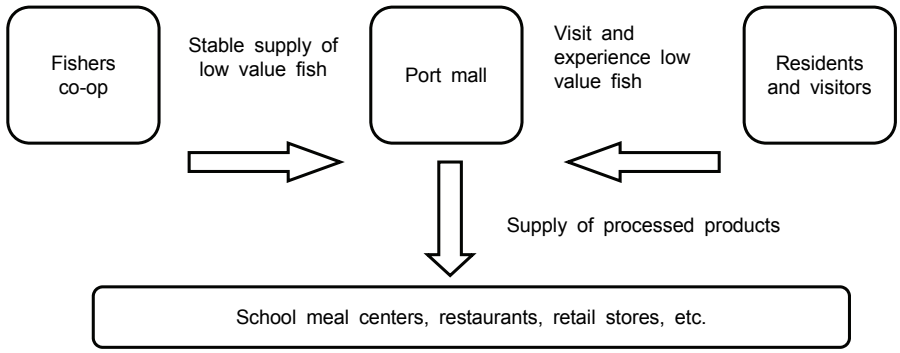
On the other hand, many tourists visit Yawatahama because the ferry connecting Shikoku and Oita of Kyushu runs daily. The local government operates a marine wholesale market in the port. However, there are no organizations and facilities such as a roadside station mall, but a few small retail stores exist. Therefore, one can consider the Japanese port mall (Michi-no-Minato) found along ports as a government-designated rest area.

The port mall focuses on aquatic products and sells low-value fishes. A mall consists of restaurants, shops, and food-processing centers. The restaurants promote awareness by deliciously cooking dishes of low-value fish for consumers. Customers are primarily local residents, local businesses, and tourists. The restaurant is responsible for the promotion of low-value fish. Customers can enjoy the fish dishes at the restaurant and then recommend its services to their families and acquaintances. The shop department sells low-value fish and provides information on cooking and storage methods. The sales sector sells fresh low-value fish and processed products such as bento and broadcasts information on low-value fish. The shop sector trains salespersons to provide correct information on low-value fish to customers and distributes low-value-fish recipes at the floor. The food-processing sector turns unused fish into easy-to-eat products. However, low-value fish have some problems as well: they are small in size and difficult to process, and their skin is difficult to peel. Therefore, it is difficult to cook low-value fish at home, restaurants, schools, etc. This problem should be solved through sale of primary and secondary processed products or final products rather than live fish. This is the role of food processing.

By organically linking these three sectors, port malls encourage consumers to feel a close affinity for low-value fish, leading to a buying momentum. Utilization

of low-value fish requires a place where consumers have easy access to low-value fish. Consumers can eat, appreciate, and increase the social awareness of low-value fish.

Figure 2. Relationship diagram of a port mall



4.2.4 Challenge to B-grade gourmet

B-grade gourmet is a cheap and common but delicious and reputable dish. The term or the concept behind it has been used from around 1985. Since 2005, the term B-grade gourmet has been used as an attempt to promote the local economy by promoting local food. Okonomiyaki of Hiroshima and Monjyaki of Tokyo are examples of B-grade gourmet dishes. In particular, tourists search for the area they intend to visit and the B-grade gourmet restaurant in the area. In other words, B-grade gourmet has turned into a food for tourists rather than local residents.

On the other hand, the Yawatahama city government actively promotes Yawatahama jjamppong (Chinese-style noodles with vegetables and seafood) using shrimp and squid caught off the nearby coast. The homepage of the city records the history and characteristics of Yawatahama jjamppong in detail, and everyone can also identify the location of the restaurant that serves jjamppong. Eventually, it has become famous, at least in the Kansai region, as the B-grade gourmet restaurant of this region. Based on this experience, local governments can identify B-grade gourmets to promote the use of low-value fish. The B-grade Gourmet Grand Prix is an event held every year to explore B-grade gourmets in Japan and introduce their characteristics. Developing food products based on low-value fish to participate in the competition is a useful endeavor.

5. Conclusion

This paper examined the status of fisheries in Japan, the changes in distribution systems, and the status of fisheries in Ehime prefecture and Yawatahama city. Methods to improve the utilization of low-value fish in Yawatahama city were then explored

after analyses of various case studies. In recent years, the problems of fishers and fisheries cooperatives have become difficult to resolve. With the uncertain management outlook, the exploitation of low-value fish presents a new challenge in a not so bright future. However, without major changes, the low-value-fish business is difficult to break up. Therefore, the creation of added value through low-value fish has a great significance for fishers in a declining fisheries industry. Fishers have a great motivation to expand the low-value-fish sector, develop local specialties from low-value fish, and thereby contribute to the local economy.

The agriculture and fisheries industry in Japan has witnessed a rising trend over the years. Local production and consumption in the 1980s (Ikegami 2003), production of high-quality branded products in the 1990s (Niiyama 2000), and becoming the sixth-largest industry in the 2000s (Ohashi 2015) are typical examples. Circulation of the economy and regional revitalization through recycling of regional resources have been gathering attention recently. Creation of added value for unutilized fish is a topic relevant to the latest circulating-economy and regional revitalization trends. Therefore, if the stakeholders of the low-value-fish sector cooperate with each other, the outcome can be considered a successful business model for Ehime prefecture and Japan.

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The Assessment of the Piraeus Container Terminal Privatization Initiative

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ABSTRACT

The geographical advantage of the Piraeus container terminal allows it to enjoy its unique position in containerized trade and global trade. Nonetheless, recently, the administration of the Piraeus port by a Chinese corporation named The China Ocean Shipping Company (COSCO) Pacific has captured the interest of the public and the attention of the media. Via this privatization, drastic changes are anticipated to occur in terms of infrastructure development, employment and logistics. Therefore, these will induce the creation of new trade routes between Greece and Europe, thus, offering a springboard of advantages to the surrounding regions. This paper examines major components that would be affected by above concession. The results suggest that the privatization of the port may lead to the new technology infrastructure improvements, as well as more efficient container capacity within the Piraeus Container Terminal.

Keywords: Piraeus, Seaport, Terminal Privatization, COSCO, Greece

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1. Introduction

Recently, the administration of the Piraeus port by a Chinese corporation named COSCO Pacific has captured the interest of the public and the attention of the media, since this is one of the initial major direct investments within the European Union made by a Chinese company. COSCO offered 280.5 million Euros to acquire 51% stake of the Piraeus port authority in the first stage of the transaction, whereas in the second stage an additional 88 million Euros was deposited to obtain the additional 16% stake in the port (Institution of Economic and Industrial Research, 2016). Under the circumstance of unemployment and economic stagnation, the tools which are available for new economic policies set by the Greek government are limited. Therefore, for the country's economy to reach significant levels of growth, fundamental reforms and other measures such as the utilization of public property play a critical role in the attraction of foreign direct investment (Institution of Economic and Industrial Research, 2016). In particular, the improvement of infrastructure within the port is expected to generate additional economic activities and benefits for surrounding regions. The changes mentioned above and alternations in the budgetary conditions of the nation, investments and economic activity of the Piraeus port will influence and shape the Greek economy as a whole.

The amount of literature which covers the situation of the Piraeus port before the privatization is rich, comprising of studies such as the one of Pagoulatos (2005), analysing the situation of the port based on a political approach. Further, Pallis (2011) explored the privatization of Greek ports in general. The most recent paper which assesses the privatization of the Piraeus container terminal is the one of Putten (2014) despite that, he discovered the effects of the privatization in Chinese-EU relationships and the Dutch economy. Hence, a gap in aforementioned research identified the need for a study which focuses both in the pre-privatized model of Piraeus as well as in its future effects.

This paper aims to highlight, analyze, and assess the trend of concession and the privatization of the Piraeus port and its competitiveness in the years to come. Accordingly, a critical analysis is conducted regarding its past and present via the rigorous interviews. Furthermore, an outlook of the Piraeus port will be investigated where it is believed that privatizations and concessions may be going to be a common phenomenon in the future.

2. Literature review

2.1 The impacts of privatization in seaports

There are various views on privatization, and there are many port assets that have the potential to be privatized. A large number of studies provided results suggesting that privatization may result in improved performance over public-sector operations (Berg and Shirely, 1989). More specifically, a report published in 1992 and prepared

by the World Bank examined 12 divestitures of state-owned enterprises within four different nations, and offered proof of privatization's benefits. Consequently, taking into consideration that privatization strengthens the operational performance of a port, the World Bank has started conditioning the loans. It makes available through its Public Enterprise Loans program on a developing country, and divests to the public sector of its ports. A recent example is the loans for Venezuela and Colombia which presently contain such a condition (Berg and Shirley, 1989). Further, privatizing ports has been motivated primarily by the expected economic benefit to be derived from the improved performance and efficiency and to reduce the government's long term financial and administrative responsibility for what is considered as a capital intensive business to support. Main motives for port privitization comprise of the promotion of popular capitalism through a wider share of ownership, the reduction of the power of public sector unions, the short-term rise of revenue and ultimately, to resolve difficulties in the relationship which exist between nationalized industries and the government (Cullinane and Song, 2002; Brittan, 1986).

In conclusion, port privatization may have a positive impact on port efficiency by the type of operation. Concerning effectiveness, while not definitive, Pagano et al. (2013) noted a tendency for privatized ports to be more effective than publicly run operations. Similarly, Pallis and Vaggelas (2017) found the evolution of the container ports market in Greece, recording the increased market concentration that followed the concession of the Piraeus port. Furthermore, the different trends (as regards throughput, investments, and commercial relations) were observed in the case of the privately operated container port. In addition, port privatization has positive effects on governments' balance sheets in the short term (Chen et al., 2017).

2.2 Characteristics of seaport privatization

There are a number of questions about why a public port should be privatized, what the key issues to consider in developing a "transaction model" are and what the post-transaction issues and risks are.

James (2014) suggested useful insight on why a port should be privatized. Consequently, he highlighted that advantage of private ownership over the public ownership may reply on the types of governments and ports. Similarly, Panayides (2015) argued that the privatization of the port of Cyprus could generate multiple and multidimensional benefits for the country. Also, he noted that the privatization would overcome challenges, while it would exploit opportunities which may be presented in the future.

There are numerous recorded efforts in reducing the public character of ports in a theoretical and practical level, aiming at covering political, economical and social needs. These goals may not seem reachable as long as port operations remain in the control of the government. Commonly, the efforts of privatization aim to improve the terminal operation. Secondly, they attempt to reduce the economic burden by utilizing funds from private companies. Last, but not least, another aim is that they make efforts in enhancing service quality which are provided to port users and simultaneously lowering price (Beech, 2004).

Besides, the government's indirect goals pursue the redistribution of wealth towards societal groups which are less privileged compared to others, and making the port more efficient and attractive, which translates to an increase of vessels calling at the port. The initiative of the private sector may boost privately orientated initiatives of the nation's economy. Additionally, by introducing new technologies and modern management systems which will be incorporated within port operations would be necessary so as to improve the efficiency (Pardali and Michalopoulos, 2008).

3. Methodology

The most appropriate study that clarifies the understanding of this research problem might be an exploratory study which seeks new insights, asks questions, and assesses phenomena in a new light and perspective (Robson, 2002). Specifically, exploratory research is characterized by the search of literature and by conducting interviews with "experts" within the field of interest. In this case, these include stakeholders of the Piraeus port, political figures and other employees that hold management positions and are related to the port management and operation either directly or indirectly. Ultimately, the possibilities which may lead to the alteration of the direction of the questions due to the appearance of new data are relevantly high (Saunders et al, 2009, p. 139).

The primary data were obtained through twelve interviews. These interviews were drawn from individuals who have expertise in transport and maritime sector. The salient features which supported the reliability of the research findings, was the large sample of interviewees and the format of the interview questions. On the other hand, a weakest feature was the lack of secondary data relating to regional impacts of the Piraeus container terminal after the concession. Thus, the results of the study can be constructed as adequate regarding their quality.

The type of interviews were semi-structured interviews. The principal characteristics of the semi-structured interviews used are that the interviewer and respondents engage in a formal interview (RWJF, 2008). The reasons why semi-structured interviews were chosen is because semi-structured interviewing, according to RWJF (1988), is best used when there is only one chance to interview a participant, and when several interviews are sent into the field to collect data. In addition, semi-structured interviews are preceded by observation, unstructured and informal interviewing in order to develop keen understanding around the topic which is fundamental for developing meaningful and relevant semi-structured questions. Also, adding open-ended interview questions may stray from the interview guide. Nonetheless, it still offers the opportunity to identify alternative ways of viewing and comprehending the topic which is at hand (Cohen and Carbtree, 2006).

Specifically, this paper is based on a comparative design, which is concerned with the study of two or more cases. This specific design advocates that social phenomena are better understood when they are compared in two or more meaningful cases. Consequently, the individual characteristics of each case separately result in constructing a springboard for theoretical reflections about findings. Furthermore, the com-

parative design involves more than one case, which can be viewed as a multiple case study design, however, when following the comparative method, it mainly focuses on the specific context of each individual case and less with the ways in which the cases will be compared (Bell and Bryman, 2011).

This paper aims to determine the effects of the privatization of the Piraeus port, by assessing its effects on container throughput and underpinning its impacts on the surrounding regions. Therefore, the following data were drawn from containership companies, employees operating in the port, individuals involved in politics, import and export companies and drydocking yard managers situated in the Piraeus area. The following 12 participants have responded to face to face interviews which mainly consist of eight open ended questions.

Table 1. Participants' profile

Participants	Demographic characteristics
A	Drydocking yard manager in Piraeus
B	Drydocking yard manager in Piraeus
C	Containership owner
D	Piraeus port employee (initially against privatisation)
E	Import/export company in Piraeus
F	Shipowner
G	Containership owner
H	Containership company managing director
I	Containership company owner
J	Former Greek finance minister
K	Former minister of employment and social protection
L	Shipowner

4. Results and Findings

4.1 Impact of the public sector in the strategic model of the Piraeus port

Question No.1: *The Piraeus port despite its strategic location in the cross-roads of 3 continents was not able to take advantage in the past the increased container traffic compared to other ports in the Mediterranean Region. Do you believe that this was due to the strong involvement of the public sector in its strategic model? And if yes, why?*

Although question number 1 may seem vague and general in nature, it is intended to record how the involvement of the public sector affects the traffic of the port in the previous years. All participants argue about the flawed management of the public sector and its negative presence in the port. More specifically, this resulted

in the absence of infrastructure innovation within the port. Hence, clients (i. e. shipping lines) considered the port unattractive.

Further, one of participants highlights the low productivity of the government's management that lacked in terms of monitoring results and feedback. Therefore, incentives for better performance were not provided to employees. Additionally, another respondent argues about the scarcity of funds furnished by the Hellenic government which consequently resulted in the lack of infrastructure investments. Thus, the port could not be competitive. What is more, four out of twelve participants stress that the firm presence of labour unions was one major contributing factor to the inefficiency of the port. Specifically, regular strikes harmed the reputation of the port. Therefore, shipping lines avoided calling to the port with large vessels and utilized feeder vessels provided by third-party operators.

Overall, the main reasons which the port was not able to attract container traffic in the past are the lack of funds for infrastructure, and the regular strikes which occurred by the port syndicates. However, the predominant factor on which all participants agree on, is the strong involvement of the government which led to delayed decision making due to the extensive bureaucracy.

4.2 The influence of the private sector in the Piraeus port

Question No2: *Do you believe that the strong participation of the private sector (the involvement of COSCO) will help the generation of benefits such as increasing the efficiency of operations and quality of the port?*

In reply to question 2, three out of twelve participants, believe that COSCO will boost the efficiency of the port by conducting infrastructure developments. Hence, it is expected that infrastructure improvements will minimize the amount of time of loading and discharging operations. and, therefore, this will significantly augment the profitability equation of shipping companies.

Due to the expertise of COSCO in managing other subsidiaries, it will be able to improve operational deficiencies that currently suffer. In addition, participant C in order to highlight the importance of private sector investment makes a comparison between the privatized ports and ports that are still under public management and projects. He strongly argued that there will be no growth in the future, if it continues to remain under the control of the government. Furthermore, four out of twelve participants argued that COSCO would improve the efficiency of the port by providing funds from its worldwide reach. Additionally, one out of twelve participants argued that the more port infrastructure constructed the more tax revenues for the Greek government.

4.2.1 Achieving competitive advantage: A shortcut to the European markets

Question No3: *Will the Piraeus port gain a competitive advantage in the Mediterranean region due to its privatized-liberalized model?*

In reply to this question, three out of twelve participants stated that the Piraeus port is at a quite important location in the Mediterranean region. However, despite its salient location, other factors would determine its competitive advantage within the Mediterranean area. In particular, twelve out of twelve participants believed that the privatization would have a positive impact on three main components. Firstly, increased investments on port infrastructure would increase the port's operating efficiency. Secondly, there would be cost-effective incentives for shipowning companies that would get a benefit from the economies of scale of the port. Last but not least, the development of infrastructure is expected to create more labour positions.

Regarding its competitiveness, the port relies on its strategic location, which is situated very close to the Suez Canal and the Black sea than any other countries. However, two out of twelve participants argued that hinterland connections must be made to stable countries such as European ones and Russian. Further, its strategic location would enable the faster arrival of containers to the surrounding ports, achieving lower transportation costs. All in all, it is predicted that the management of the port would be more efficient, because there will be less political intervention and union influence.

4.2.2 Attraction of international logistics companies in the region

Question No 4: *In your opinion, will the privatization of the port provide access to new markets and products and attract more international firms in Greece?*

The respondents considered that the port would attract international firms for a variety of reasons. First, two out of twelve participants stated that the main reason for which multinational companies would be attracted to the Piraeus port is because it provides easier access to the European markets. Therefore, international companies would develop their logistics and distribution departments in the Greek region transforming Greece into the connecting point between Asia and the rest of Europe. Supply and demand imbalance, and cost cutting must be taken into consideration. Specifically, if the port increases its efficiency, then it will become more competitive, attracting more customers from around the world. To achieve it, eight out of twelve participants stated that railways must be upgraded to achieve the quick transportation of goods in Europe. One out of twelve participants highlighted that if adequate railway infrastructure is constructed, the transport duration from China to Europe will be shorten to approximately 10-12 days. Consequently, this is more attractive than utilizing containerships that transverse the Mediterranean Sea and then arrive at major ports such as Antwerp. Last but not least, the port efficiency is not the only factor that must be taken into consideration when discussing the attraction of international companies in the port region. Hence, bureaucracy must be minimized in order to make it easier for these companies to be established.

4.3 Piraeus port vs. Mediterranean ports - cargo volume competition

Question No 5: *Will the rising traffic of cargo volumes in the port boost the need*

for infrastructure developments in other ports within the Mediterranean region?

It is speculated that ports in the Mediterranean region would undergo infratructure developments for two reasons. Either because they wish to be more competitive compared to the Piraeus port, or because Piraeus would not be able to handle the excessive demand. Further, infrastructure developments would take place in Mediterranean ports in a game-theoretical context. Particularly, if the port manages to maintain high container loading/unloading rates, then other ports would undergo infrastructure developments to preserve their competitive position. This effect would take place to the ports closer to Piraeus primarily, and then spread to other ports farther from it. Moreover, taking into consideration competition peripheral roads must be made to avoid congestion.

4.4 Combination of Greek and Chinese management practices

Question No. 6: *In your opinion, will the cooperation between the Chinese government and the Greek government transfer positive management expertise in the operation procedures within the Piraeus port?*

Nine out of twelve participants believe that positive expertise will be transferred through this privatisation. Further, one must bear in mind the well structured and efficient management of COSCO which has specialized throughout the decades in evolving large infrastructure companies. However, there is a thin line between the management of COSCO and the operation of labour workers, and that must be taken into account in order to avoid future strikes. In addition, because of the higher volumes of TEUs handled by the port, the Piraeus port would be able to generate more income for the Greek government, which translates to additional job opportunities for citizens in the region. Overall, the combination of three out of twelve respondents believed that the combination of expertise between the Greeks and COSCO would ensure that operational procedures are run smoother, and port syndicates will not go on strikes as much as in the past.

Question No. 7: *'Do you believe that the management of the port will be improved and enhanced due to the sharing of managerial and operational knowledge between the Greek Government and the Chinese company COSCO?*

Eight of twelve participants believe that the combination of expertise will result to a good managerial model. Specifically, COSCO will aid the port by providing administrative expertise, while Greeks will offer their knowledge on the regional/local mentality. On the other hand, two out of twelve participants argue that COSCO will be doing things mostly on its own, and therefore there will be no combination/sharing of knowledge and management expertise.

4.5 Drydocking yards - potential for investments and larger ships

Question No 8: *To what extent will such an investment effect the already existing drydocking yards in the surrounding region and will it boost the need for the construction of new ones built by COSCO?*

COSCO's corporate investment plan combined with Greek ship repair and drydocking experience is expected to have positive effects. Specifically, COSCO operates numerous drydocking facilities in East Asia, and therefore it would benefit from having a reach on the West side of the globe. Also, due to the expansion of the container terminal and the upsize of container vessels, drydocking yard that are capable of accommodating larger vessels will be required. Having a larger container terminal will create incentives for larger vessels (e.g. Post-Panamax) to approach the port.

5. Discussion

5.1 The influence of the public sector on the Piraeus container terminal

The findings suggest that the public model of the Piraeus port in majority has had a negative impact on its operating efficiency and management. Specifically, the high involvement of the government in its pre-privatized model resulted to unnecessary bureaucracy, causing late decision making regarding infrastructure innovation and expansion. What is more, in combination with the scarcity of results monitoring, funds, and inconsistent policies the performance of the port was low. Hence, liner companies did not wish to call large vessels and chose to utilize smaller feeder vessels from third party operators. In the past, the Piraeus container terminal operated as a public service port. A port authority performed the whole range of the services related to the port and owned all the infrastructure. Yet, throughout the years, because of the inefficiencies they are related to, the presence of public ports has declined significantly (Rodrigue, 2016). In addition, despite the strategic geographical location of Piraeus in the crossroads of the Far East-West Europe and West-Europe-Black Sea routes, it did not manage to take advantage of the traffic increase in the Mediterranean. The principal reason behind this was that Greek ports operated strictly under the control of the public sector. Taking into account the fierce competition within the Mediterranean regions, other countries (e.g. Italy) moved on a more liberalized port model which included the development of specialized terminals (e.g. Voltri and Gioia Tauro Terminal).

Thus, the question which arose was whether Greece should proceed to a new reform in the port industry. Based on the preceding conclusions, the effects are anticipated to be rather positive. In the study of Pallis and Syriopoulos (2007), an evaluation was made on the Greek port reform, by analysing the financial condition of 12 ports which are limited companies. They noted that there was pressing need for port reforms. Likewise, Psaraftis (2007) pointed out that the benefits of port reforms in Greece would be significant. Pallis and Vaggelas (2005) found that the

vast majority of the port's CEOs were in favour of directive proposals, and they were seeking the involvement of private companies in the provision of port services. They argued that the participation of private companies would boost the service quality of the port, and simultaneously decrease tariffs.

5.2 Increased port efficiency through a privatized model

5.2.1 Port attractiveness

The attractiveness of a container terminal to shippers is of paramount importance to its success. Specifically, ports gain their economic relevance at both local and national levels, as they become logistical nodal points in a globalized market. So far, ports have induced the generation of employment with the attraction of industrial activities around them, hence boosting the regional economy. Further, the seaport can be regarded as a hub. It attracts firms that perform different but complementary activities, and consequently port clusters are created. In addition, the evolution of individual companies mainly depends on the evolution of the clusters from a micro-geographical perspective, so it is worthwhile considering the factors which affect the development of the cluster. What is more, there is a strong negative relationship between transport costs and trade volume, as well as between the cost level and the availability of port infrastructure. According to Sanchez et al. (2003), the lower the transport costs is, the higher become the foreign investment and service export levels and the chances for a country to have access to technology.

5.2.2 Transferring port operations to the private sector

The changes which take place within the port sector present numerous challenges to port administrators, terminal operators, and other service providers. On the other hand, these changes present opportunities fostering new ways of doing business and provide potential entrances with opportunities of entry throughout the range of port services and activities. Overall, 220 privatizations occurred from 1992 to 2004, and generated private investments which exceeded 21$ billion to upgrade terminals and to renew superstructure (The World Bank, 2016).

5.2.3 Outcomes from previous privatizations

To achieve an effective privatization, transparency and open competition through a structured international tendering process must be granted. The number of privatizations that have not been completed due to legal challenges is great. Therefore, in order to minimize legal challenges and conflicts, the role of the port administration after the privatization and any limits on the contractor's ability to operate should be stated within the bill package (The World Bank, 2016).

5.2.4 Potential outcomes from the privatization of Piraeus

To begin with, due to COSCO involvement, the container terminal of Piraeus is the fastest growing port. Specifically, COSCO aims to transform Piraeus into an important hub for transshipment containers in the Mediterranean and a major dis-

tribution center for East, Central and South-East Europe, including the region of the Black Sea. In respect of the distribution further than Greece, a significant factor is the ability of COSCO to attract multinational companies such as Samsung and ZTE. Ultimately, the implications for Piraeus's gateway function could be important; however, this process is still at early stages (Putten, 2014). Further, the Greek economy would be strengthened as well as the trade of goods between China and Greece, but also there is high potential for increasing the inflow of counterfeit or other undeclared goods. Additionally, COSCO pacific is a listed company in the Honk Kong stock exchange but is principally controlled by the Chinese Communist Party. Therefore, Greece may benefit from preferential financial and diplomatic support by the Chinese government. Hence, these features deem COSCO as an attractive partner for the Greek government and for the business partners of COSCO in Piraeus (Putten, 2014).

6. Conclusion

This paper aimed to identify the impacts of the privatization of the Piraeus container Terminal, as well as its effects on regions. Substantial changes are likely to occur within the Piraeus region after the privatization of the container terminal. The future effects of the concession agreement were investigated, taking into account its effects on the managerial model of Piraeus, and on the development of infrastructure. Specifically, this paper investigated the aspects of the pre-privatized model of the container terminal, as well as the development of the port after the privatisation. Also, it assessed the potential for the attraction of relevant logistics companies within the region of the port.

The research findings are of important gravitas, as they are able to state the potential impacts of the privatization of the Piraeus container terminal, as well as the core reasons which made it inefficient, and uncompetitive in the past. As it has been mentioned previously in the literature review, ports are able to benefit in multiple ways through privatization. This paper provided a different perspective focusing on the regional economic impacts of the container terminal and on whether the combination of Sino-Greek management expertise would be beneficial for both parties. At the moment, there is non-negotiable doubt by the Greek population surrounding the concession. Nonetheless, this research found that the port would upgrade its infrastructure and reform its management model, therefore fuelling the attractiveness of the port towards larger vessels. On the other hand, it is impossible to assess the precise regional impact of the port on employment because it depends on multiple variables.

In the near future the research herein could be broadened by examining whether the Piraeus container terminal will compete with the port of Thessaloniki. However, for future research to be conducted, more data regarding the port's impacts on the regions must be acquired and more reports about the container throughout of the terminal must be released from companies. Further, more research could also focus on how the port will shift the Asia-Europe trade route by halving voyage time through the transshipment of goods from the Piraeus port.

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The Experimental and Numerical Study of the Appendage DRAG Influence on Resistance of Ship

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ABSTRACT

The Resistance and power prediction is based on the result of CFD tools and model experiments. Appendages resistance is significant for high speed vessel. This paper discusses the significant increment of appendages resistance of high speed vessel. The model was tested with appendages and without appendages in the Ship Model Towing Tank at Marine Hydrodynamics Centre, Myanmar Maritime University. CFD analysis is also carried out and the results are compared for ship with skeg. The comparison of results shows that the coefficient differences are less staggered at higher speeds.

Keywords: Ship model experiments, CFD, Towing Tank

NOMENCLATURE

LOA	Length overall (m)
B	Breadth Moulded (m)
D	Depth Moulded (m)
T	Draft (m)
LWL	Length waterline (m)
▽	Volume of displacement (m3)
S	Wetted surface area (m2)
Δ	Displacement (tons)
VS	Speed of ship (knot)
PE	Effective power (kW)
M	Notation for model testing
P	Notation for program
Rt	Total resistance (kN)
CT	Total resistance coefficient
CF	Frictional resistance coefficient
CR	Residual resistance coefficient
Fn	Froude's number

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1. Introduction

Resistance calculation and power prediction are important in designing high speed vessel. Traditionally model testing is used to predict the resistance and power of the new design vessel. The use of appendages will alter the total resistance of the vessel. Appendages resistance is important for prediction of the resistance of high speed vessel. The increment of appendages resistance for high speed vessel is studied and compared with the resistance of ship with skeg.

Now a day CFD tools are widely used for prediction of ship's resistance and power. However the flow around the ship's hull is complicated, so that model experiments are still the most reliable data source on ship resistance determination. The model experiments are carried out in the Ship Model Towing Tank at Marine Hydrodynamics Centre, Myanmar Maritime University. Towing tank size established 2011 made in UK (CUSSON Technology) is 60m in length, 4m in breadth and 4m in depth. Maximum carriage speed is 4 m/s. CFD codes are also used in design step, validation of the results is carried out by comparing the model test results.

2. OBJECTIVE

This paper focuses on comparing the total resistance of high speed ship with and without appendages and to make verification for model tests results of the ship with skeg and CFD.

3. STUDY AREA

The total resistance of the ship of 81.33m in length with skeg is calculated by using CFD tools and then required is power predicted. Model of 2.42 m in length is fabricated and tested in model basin at Myanmar Maritime University. Total resistance of the ship is calculated from the towing test results by using Froude's Law of Comparison. In order to calculate the ship resistance non-dimensional coefficients have been used:[1, 2]

$$CT = CF + CR$$

Friction component of resistance is calculated by using ITTC'57 correlation line.

4. METHODOLOGY OF STUDY

4.1 DETERMINING THE MAIN DIMENSIONS

Main hull forms is round bilge symmetric displacement type with transom stern. The vessel has a centreline skeg. The main characteristics of the ships are listed in Table 1 below-

Table 1. Characteristics of ship

Main Particulars	Full Scale	Units
LOA	81.33	m
B	11.39	m
D	7.50	m
T	3.34	m
▽	1317.07	m^3
Δ	1350	tons
S	911.91	m^2

4.2 MODEL MAKING

The scale of ship model is 33.6 and wooden model of 2.42 m in length with centreline skeg is fabricated by CNC. For the prediction of appendages resistance, shafts, struts, bilge keels and two rudders are attached to the model. Stabilizers are also attached to the both sides of the model. The main particulars of the model at design condition are described in Table 2.

Table 2. Main particulars of model at design condition

Main Particulars	Model Scale	Units
LOA	2.420	m
B	0.339	m
D	0.223	m
T	0.099	m
▽	0.035	m^3
Δ	0.0356	tons
S	0.808	m^2

Fabricated wooden model with appendages are shown in figures below. Figure 1 shows the model with centreline skeg and Figure 2 is the installation of stabilizer to the model.

Figure 1. Model with centreline skeg

Figure 2. Installation of stabilizer to the model

5. EXPERIMENTAL APPROACH

Two test case studies have been carried out for the speed range of 1.04 to 2.174 m/s (Ship speed of 12 to 25knots). The appendages attaches to the model are listed in Table 3 below for each case.

Table 3. Model test Conditions

Test No.		1	2
Appendages	Rudder	☑	
	Shafts	☑	
	Shafts Brackets	☑	
	Stabilizer Fins	☑	
	Bilge Keels	☑	
	Skeg	☑	☑
	Strut Bossings	☑	
	Hull Bossings	☑	

6. NUMERICAL APPROACH

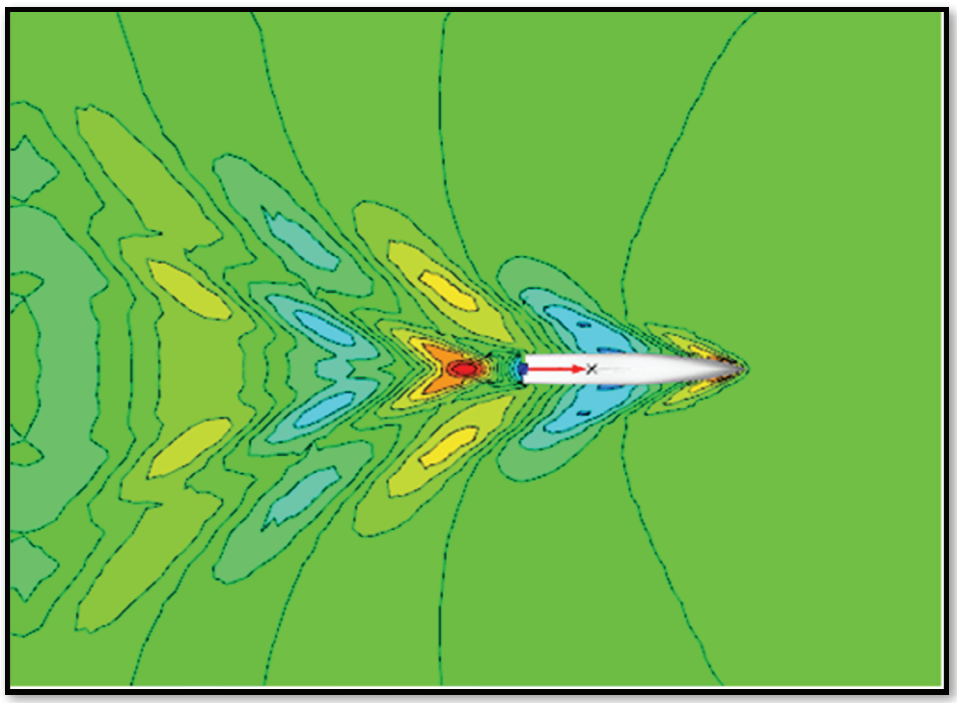
The complexity of the flow around ship's hull, model experiments are still the most reliable data source on ship resistance determination; nevertheless, numerical

methods have strongly advanced in this field, so that a combined use of both model tests and CFD codes can be very useful for ship design and for understanding the ship hydrodynamics [3].

Numerical computations are carried out around vessel using the code *SHIPFLOW*. The three software packages *XMESH, XPAN and XBOUND* are used for simulations. The main hull has 140 grid sections and 16 grid points. The free surface is panelled by 98 stations in longitudinal direction and 16 grid points.

CFD simulation is carried out for the ship hull with centreline skeg from the speed range of 12 knots to 25 knots. Figure 3 shows the CFD simulation of ship at a speed of 23 knots.

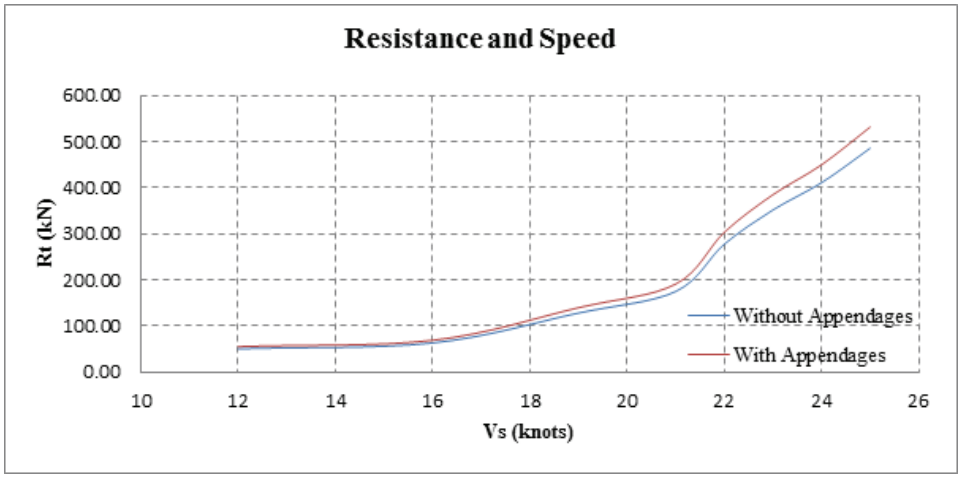
Figure 3. CFD simulation of ship at a speed of 23 knots



7. RESULT COMPARISON

The resistance comparison of the ship with appendages and ship with skeg is carried out for the speed of 12 to 25 knots. The comparison results show that when the speed of ship becomes higher, the total resistance of ship with appendages become higher than ship without appendages. Resistance difference is 8% at 12 knots and 9.5% at 25 knots. Figure 4 shows the resistance comparison of two tested conditions.

Figure 4. Resistance of ship with and without appendages



When No.2 model experiments data is selected to compare results as estimated by CFD, following results are found. For residual resistance coefficient, model towing test results are higher at most of the speeds. Differences are mostly from 1.5 to 6.5%. At the speed of 16 knots (Fn = 0.3) the residual resistance coefficient difference is about 15% (Fig. 5).

Figure 5. Residual resistance of CFD and towed model

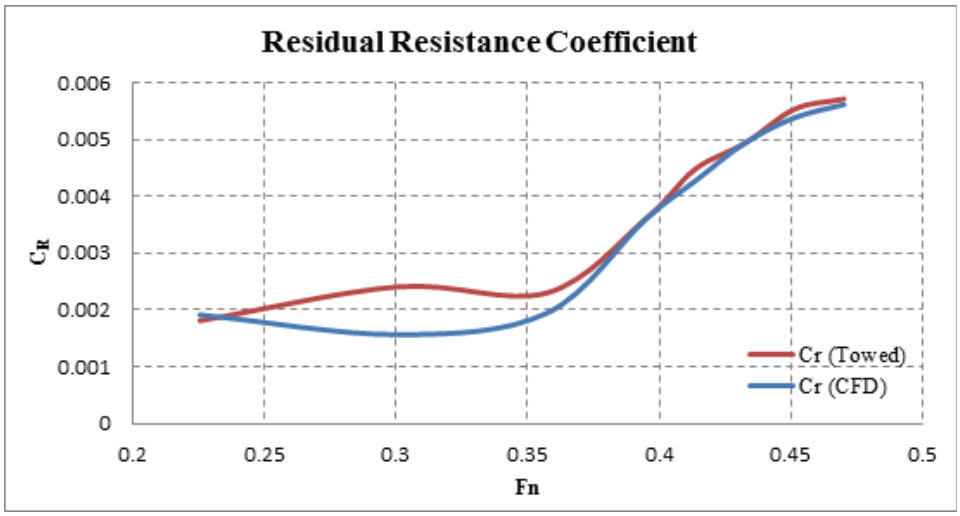


Figure 6. Resistance comparisons of CFD and towed model

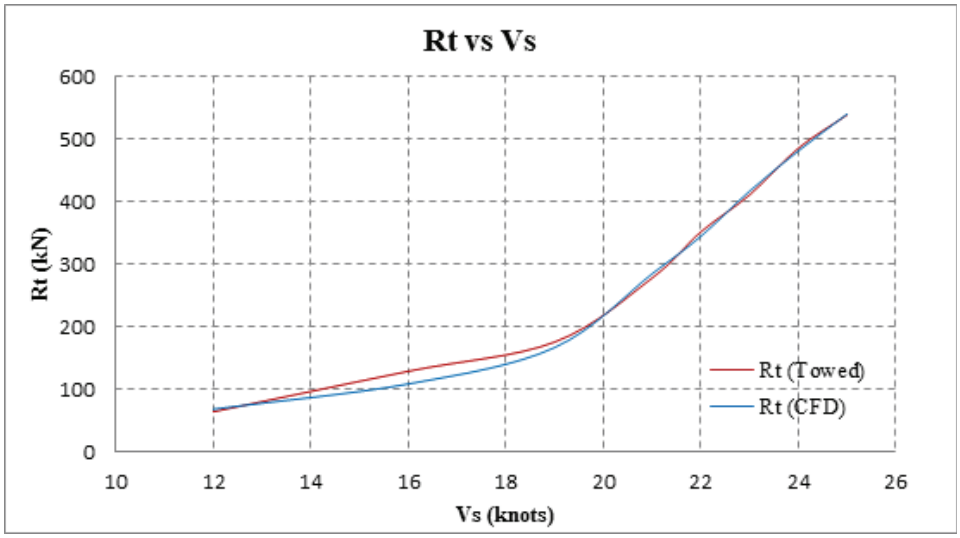
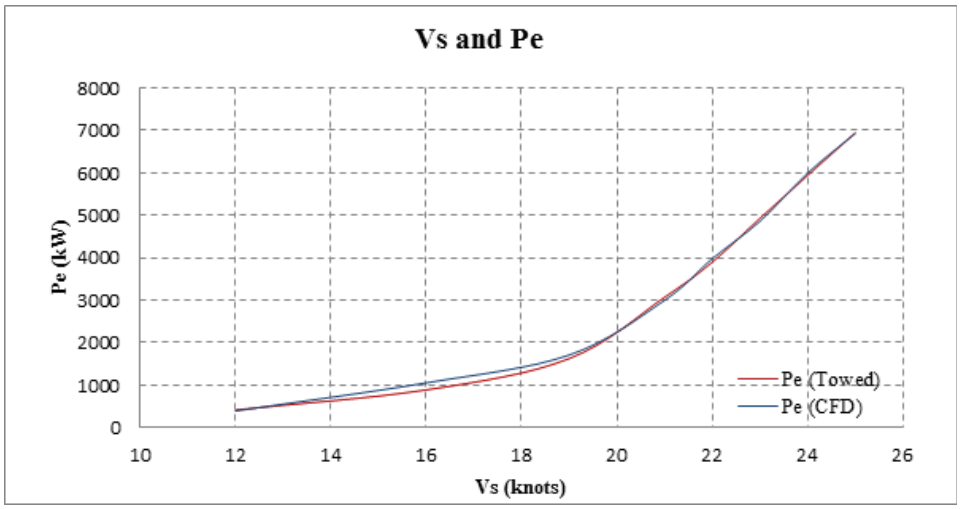


Figure 7. Effective powers of CFD model and towed model



8. CONCLUSION

Towing test analysis was carried out for the model with two conditions. Test no.1 is with all appendages without propeller and test no.2 is bare hull with centreline skeg. The higher the speed, the more the total resistance of the ship with appendages becomes. The results of test no.2 are compared with CFD results and the comparison shows that experimental results and CFD results have good agreement. At higher speeds, the coefficient differences show less staggered. But it is still need to carry out self-propelled test numerically and compared with the model test result.

9. ACKNOWLEDGEMENTS

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Data and Documentation. Data sources, models and estimation procedures are expected to be documented to permit replication by other researchers. Data used in the analyses should be made available to other researchers for replication purposes. Submission of appendices, model documentation and other supporting materials is encouraged to facilitate the review process.