



NIRAS



OPPORTUNITIES AND CHALLENGES FOR THE DANISH REALM'S MARITIME INDUSTRY IN THE ARCTIC

Danish Maritime Authority

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PREFACE

The Arctic is expected to be of increased importance for the maritime industry in the future. The Danish Realm¹ has a significant role in this development - both due to Denmark's position as a major maritime nation and due to the geographical location of Greenland in the Arctic and opportunities as mineral, oil and gas concerns.

In 2011, the Danish Realm published a common strategy for the Arctic, pointing to the future Arctic possibilities for Denmark, Greenland and the Faroe Islands. The strategy proposes how the Danish Realm in the future can exploit possibilities. As a consequence, the maritime activities in the Arctic are highlighted in the government's "Plan for Growth in the Blue Denmark" from 2012, as an area with growth opportunity.

However, competition in the Arctic is rough. Also other Arctic states have high ambitions and strong skills. In order to make the most out of it, the Danish Realm must prepare itself in order to focus and be at the forefront. This calls for attention from both the public and from the private sector.

To map this growth opportunity, NIRAS has for the Danish Maritime Authority and with financing from the Danish Maritime Foundation analyzed the commercial opportunities and challenges in the Arctic for the Danish Realm's maritime industries.

The analysis presents an overview of the Arctic opportunities within the Danish Realm and provides knowledge in order to pursue the Arctic business opportunities available for the maritime companies.

In the analysis, focus is set on the maritime activities in the Arctic related to mining operations, offshore oil and gas, cruise tourism and the opening of the Arctic passages and on how the public and private actors can provide the best conditions for the maritime sector to take part in the future growth of the Arctic.

NIRAS would like to thank the many experts, companies and stakeholders who, through interviews and workshops, have contributed to this report. It should be emphasized that only NIRAS is responsible for the content of the report and the conclusions.

¹ The Danish Commonwealth of Realm (which include Denmark proper and its two overseas constituent countries, the Faroe Islands and Greenland)

1 SUMMARY

The Arctic is expected to be of increased importance for maritime businesses in the future. This is caused by opportunities, which are gradually presenting themselves. Some of these have arisen due to increasing prices on mineral resources and increased availability in the Arctic due to global warming. In particular, the opportunities are associated with the development of mining, offshore drilling for oil and gas, cruise tourism and opening of the Arctic passages.

The Danish Realm's² maritime industry's clear strength is that several companies already operate in Greenland and have unique know-how in relation to the specific Arctic maritime conditions. That, combined with the fact that the Danish merchant fleet has a leading global market position, provides the Danish Realm's maritime companies well for future competition.

The opportunities

In **mining**, destinational bulk freight is the greatest opportunity for the Realm's maritime industry. Several companies are already active in Arctic, and have gained first-mover advantage over competitors. In addition to the direct opportunity associated with bulk freight, opportunities, particularly in the initial stage of future mining projects, will open for freight of equipment and materials for the mines. Also, a secondary opportunity may open for designing and supplying equipment related to the increase service transportation between the ports and the mines.

One of the greatest opportunities for the Realm's maritime industry in **offshore drilling** is the interlinked maritime support industry in the Arctic. In the near future, opportunities may first open in Norway, Russia and Canada. Such include ice management, monitoring drifting ice and towing of icebergs. There is also more opportunities in shipping oil and gas from the extraction fields - particularly because of the complex technical tasks related to installing pipelines to drilling rigs in the Arctic. Additionally, needs for emergency management for the rig staff may arise. Here, the Realm's maritime industry could provide "stand-by" vessels, which also are equipped for emergency response for minor oil spills.

Opportunities may also open for supplying equipment to both support and service vessels and possibly tankers that are necessary to operate the rig, and

² The Danish Commonwealth of Realm (which include Denmark proper and its two overseas constituent countries, the Faroe Islands and Greenland)

equipment for use in oil spills. Furthermore, there will be a need for related services such as feasibility and environmental studies.

The analyses show that the Realm's maritime sector role in **international cruise tourism** is limited in the Arctic. The sector does not have an established cruise industry, and hence does not have any competitive advantages to nations, that already have established such an industry. However, there may be an opportunity for the Realm's maritime industry in terms of supply of equipment and service deliveries to cruise ships. In particular, the cruise industry could be an interesting market for suppliers of rescue equipment, because of the large number of passengers. Opportunities may also arise in developing a maritime service and event industry to the many cruise ship tourists in Greenland.

In relation to sea carriage in the Arctic passages, the opportunities are greatest in the northeast passages and specifically in the short and medium term, transit and destination freight of bulk, oil and gas. The opportunity remains, however, limited in comparison to other conventional routes. Furthermore, we will probably observe increased project-freight shipping for the provision of equipment and materials to construction sites in the high north. Here, as a business model, the maritime industry stresses that we are likely to see increased use of multi-purpose vessels for various kinds of freight at once – a development which may open an opportunity for designing such vessels.

The challenges

The companies, which have been interviewed, stress a number of weaknesses and challenges for the Realm's maritime industry. These can be summarized in five main points:

Lack of Arctic competent employment in the maritime trades

The Realm, as an Arctic state, has accumulated experience in maritime navigation in the Arctic. This experience is however not sufficient to meet the future demand in human resources. In order to realize the commercial opportunities more Arctic skills on the ships, the shipping companies' offices and equipment manufacturers must become available. The skills sought for will range from navigating in Arctic waters, knowledge on special rules and safety, as well as on the materials and equipment that can tolerate the Arctic environment.

New Market Entries

The processes of entering new markets in other countries is another challenge - particularly in the mining and offshore industry - because of national laws on i.e. local production, employment, and other technical national requirements and industry standards. These laws act as technical barriers to trade. Especially for smaller companies barriers from doing business in other countries may appear to be substantial.

Market visibility of mining, oil and gas companies

Several companies have indicated that substantial challenges exist related to be enlisted on the supplier lists used by foreign companies, especially in mining. The problem is, inter alia, the time and cost consuming capacity needed to build up such relationships – a need which maintains a competitive disadvantage for the small and medium sized firms to enter the market.

High entry cost for new market players in the Arctic

It is generally expensive to establish oneself as a new, maritime, player in the Arctic. First, investment costs in the Arctic are larger due to the special ship design needed in order to sail through the Arctic waters, increased fuel consumption for navigation in ice, etc. Secondly, there are costs associated with acquiring the knowledge needed to succeed in the very special Arctic conditions. The knowledge about opportunities and challenges in the Arctic are still limited. If a maritime business wishes to enter the Arctic market, it is a challenge to know what to be aware of and where to look for relevant information.

Severe costs in Arctic communication and emergency management

A major maritime challenge in the Arctic is to ensure communication and manage emergency. The current communication possibilities between ships and with satellite are expensive and it is difficult to prepare for emergency response in these geographically vast and sparsely populated areas with harsh weather conditions. The response to accidents or problems may therefore not correspond to the response seen elsewhere in the world. This creates a challenge, especially, for cruise tourism in terms of security in the area.

The actions

To address the challenges, there are identified four areas that can build the capacity needed to meet the Arctic challenges and harvest the opportunities in the market for the Realm's maritime industry.

Firstly, a framework for **fostering collaboration** between companies and public institutions could be created. Particularly in the forthcoming years when opportunities in the Arctic are still in their infancy, a formal collaboration with the purpose of exchanging experience and discussing new initiatives, could contribute to new developments. Specifically, an Arctic maritime forum could be created for regular communication and meetings between industry and government agencies. If such collaboration proves to be successful, later an actual cluster organization could be constructed.

Activities within such collaboration could also include developing market entry guides on opportunities and challenges, as well as spreading knowledge on special Arctic issues. Alternatively, an Arctic center could be built, to serve as a first stop for companies interested in establishing themselves in the Arctic or want to seek opportunities in different markets.

Another action focus concerns the **targeting of Arctic training and educational efforts**. By virtue of the Arctic's growing importance, it would be a natural step to give the Arctic proficiencies greater attention in educational institutions.

An important step would be to integrate training in Arctic maritime conditions, including ice navigation, on the relevant maritime schools. Furthermore, the members of the maritime companies recommend that some maritime skills must be acquired through practical training and be targeted by in-service training. There may also be a need for enhancing the Arctic market awareness on the business schools and technical universities. More Arctic training empowers and positions the workforce to the companies that produce or operate in the Arctic. It also provides the maritime industry with a larger and more capable recruiting base to meet the future competition.

As a third area of action, it is necessary to **spread the maritime corporate marketing and presence** in the Arctic countries. According to several of the businesses, market visibility and presence are crucial for a company's market share - regardless of whether the share is obtained as part of an international consortiums or as a subcontractor. The cost of such market presence are substantial to small and medium-sized companies, but could be limited if the industry collaborates on sharing back-office facilities and representation for trade fairs and market conferences. Such sharing could build on the existing cooperation between industry and governmental export promotion agencies – including, but not limited to, the Trade Council of Foreign Affairs.

As a fourth suggestion one could examine the **framework conditions for use of special vessels in the Arctic**. In order to ensure competition for companies with

business models that involve specialized vessels for use in the Arctic, including icebreakers, consideration could be given to let the current laws on general maritime freight tax and fees apply to specialized vessels.

2 METHODOLOGY AND SCOPE

The analytical process is divided into three phases: research, interviews and analysis.

The research phase included a desk study and research interviews with key players, who have knowledge and insight on the existing size and opportunities of the maritime industry. In the research phase, the overall opportunities and drivers for the maritime industries in the Arctic were identified. These include general trends in the industry and how development can help to create growth for the Danish Realm's maritime industries.

At the end of the research phase, a hypothesis and development workshop was held which helped to identify the hypotheses regarding opportunities and challenges that were used as the basis for the interview phase.

The survey included interviews with 25 employees in maritime related enterprises. These interviews identified the Danish Realm's sector's existing strengths and weaknesses as well as their Arctic opportunities and challenges, according to the individual enterprises. The interviews also helped select and qualify those actions which are seen as most promising for the maritime industry Arctic growth.

As part of the analysis phase, the provisional results were presented at a maritime industrial policy seminar, held in Nuuk and organized by the Danish Maritime Authority in collaboration with the Department of Health and Infrastructure and the Ministry of Industry, Mineral Resources and Labour in Greenland. The seminar, which was attended by a wide range of relevant stakeholders contributed through presentations and plenary discussion to further qualification of the analysis.

The analytical process included 'snowball sampling' to identify new relevant areas and make recommendations for new interviews. It has secured a broad involvement of relevant stakeholders.

Several actors have highlighted the fishing sector as an interesting growth area in the Arctic - especially for Greenland. While it is recognized that the seafood industry in the Arctic would be an interesting driver of growth for some of the Danish Realm's maritime industries in the future, the fishing sector is not included as part of this analysis.

The analysis focuses on the Danish Realm's maritime industry, i.e. enterprises with maritime services or products or maritime skilled labour while ignoring

other interlinked businesses. An example of this delimitation can be found in the part of the cruise industry. Here, the analysis includes those opportunities of the maritime related businesses and interlinked maritime equipment industry services, but ignores the effect on non-maritime industries such as tourism services or the retail sector.

3 GENERAL TRENDS IN THE ARCTIC

In recent years, attention has increased on the Arctic region. Due to the global warming, the Arctic icecap is increasingly withdrawing and making the Arctic region more accessible. Furthermore, the increased world population, with a growing income and purchasing power, affects the demand for more energy and minerals globally. This - combined with the fact that a number of existing mines are gradually being exhausted - encourages the mining and oil companies to look for new regions to extract resources. This has led many to look towards the Arctic and the vast resources that are continuously becoming more accessible due to climate change and glacial retreat. Furthermore, the Arctic has, in recent years, experienced increasing attention as a future tourism destination, due to the world's growing population and a general trend towards experience-based tourism.

In the following, the overall trends affecting the Arctic maritime opportunities are presented. In chapter 4, the framework conditions for the Danish Realm's maritime industry are introduced. The findings on the specific maritime opportunities and challenges are presented in Chapter 5. The report concludes with a list of actions to unfold the opportunities.

3.1 Arctic mining

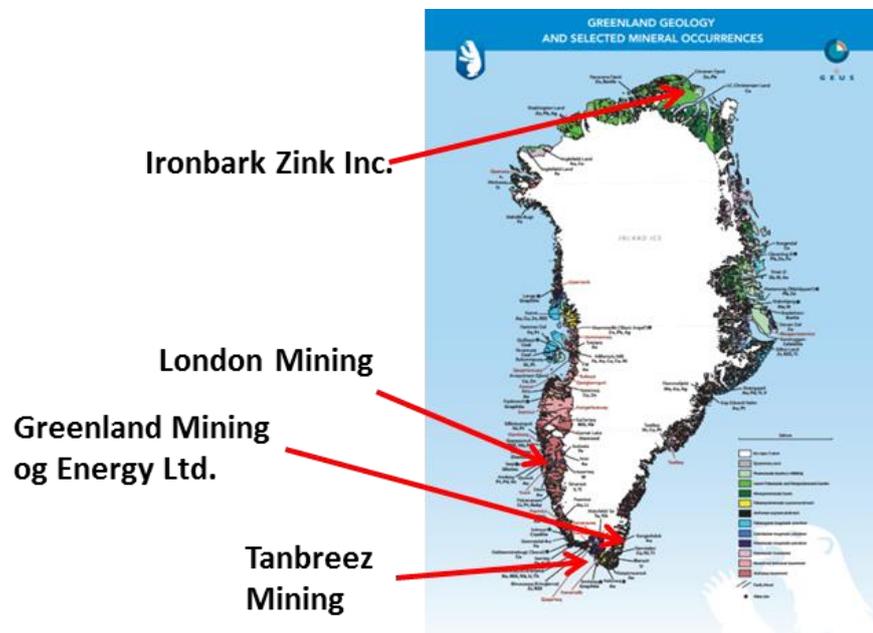
The increased demand for minerals is driven by three factors: 1) a growing world population, 2) steady improvements to global living standards and greater purchasing power, and 3) an increased share of consumer products containing minerals. The increased demand, combined with the mineral deposits becoming increasingly expensive to extract, has led to higher world market prices.

The increase in world market prices of resources has invoked increased attention to the Arctic's potential as a future destination for mineral extraction. This attention increases even despite the fact that the Arctic is a difficult and expensive area to operate mines due to the hard climate, limited infrastructure and difficulties in obtaining the energy used for extraction. The recent decline in the world market prices has also dampened the interest temporarily. However, it is expected that the attention will return in the long run, due to an expected increase in the future world prices.

The Realm's maritime industry focus on the Arctic includes, especially, focus on **Greenland**. Greenland contains large deposits of minerals. The Greenland Home Rule Government's (Naalakkersuisut) ambition is to continuously maintain 5-10 active mines, and in the period from 2014 to 2018, 3-5 more open mines are

foreseen. Focus is in particular on iron, copper, zinc, rare minerals, gold and gemstones, but other minerals may also appear. In the figure below, some of the more promising projects in Greenland are mapped.

The Tanbreez Mining project in the area of Killavaat Alunngat is expected to exploit approximately 3 billion metric tons of rare mineral ore. Once in operation, the mine is expected to produce an annual output of 500,000 to 1.5 million metric tons. Close to here (by Kvanefjeldet), Greenland Mining and Energy Ltd. are extracting rare minerals and uranium. By Isukasia, north of Nuuk, London Mining plans to establish an iron mine with an annual capacity to produce nearly 15 million metric tons of ore. Ironbark Zinc Inc. is establishing a Zinc Mine at the Citron fjord in northern Greenland, with a forecasted capacity on 250,000 tons of zinc concentrate and 30,000 metric tons of lead annually.



Figur 1. Examples of mining projects in Greenland

Other Arctic countries also expect to increase their mining activities in the Arctic and thereby enhance the increasing demand for maritime activities. This applies to Russia, Sweden, Finland and Norway as in Alaska and the northern provinces of Canada.

Estimates for **Canada** predict growth by 91 percent on the extraction of minerals in northern regions in the period from 2011 to 2020 with an annual increase of 7.5 percent. This applies, especially, for the extraction of metals, where growth of 138 percent is predicted over the period. In northern Canada, it is especially the territory of Nunavut that invests in mining exploration. Today mining involves gold in Meadowbank and Meliadine, and plans for extraction at

Mary River is ongoing. It is predicted that both Nunavut and the Northwest Territories offer a great opportunity for future mining.



Figur 2. Examples of mining projects in Canada

Alaska has historically had a growing mining industry. From 2000 to 2010, investments in mining exploration more than multiplied by seven, and there has been renewed interest for mining in this area. The largest part of the exploration continues, however, to take place in the southwest of Alaska (outside the Arctic), while only two percent (as of 2010) invested in exploration in northern Alaska. There is especially focus on gold in the northern regions, where also very large deposits of coal are forecasted.

Northern Scandinavia is believed to be one of the richest areas of minerals in the world. In **Norway**, the regions of Norrland, Finnmark and Svalbard (all Arctic) all rank among the five largest mining areas. Northern **Sweden** extracts relatively large amounts of iron ore (Norrbotten) and other metals such as gold (Västerbotten). The mining industry in **Finland** is also expanding in the Arctic regions. The country expects, in particular, to enhance its capacity of nickel, copper, aluminum and platinum.

Russia also possesses a vast mining capacity. The country has, however, had difficulties in identifying new mining reserves with sufficient profitability. Additionally, the industry suffers from a lack of investment funding, due to new legislation on mining. Despite these difficulties, mining exploration in Russia has intensified in recent years and the government has established a development program for the area, aiming at the extraction of chromium, zinc, titanium, aluminum, tin and uranium.

Based on the above, NIRAS assesses that the growth in Arctic mining exploitation within the next five to ten years may take off and create opportunities for the Realm's maritime industries. This is in line with the assessment of the maritime companies, which - according to the interviews - expect to increase their supply to the mining industry in the Arctic, in particularly Greenland, Canada and possibly Russia within a foreseeable future. Although parts of the production of the present and future mining industry will be further processed within the respective countries and transported via onshore infrastructure, the maritime industry assesses that the majority of the production will, due to the large distances in the Arctic rough terrain, be transported by sea. Particularly in Greenland there is currently no alternative to maritime freight.

3.2 Extraction of offshore oil and gas

A growing interest for oil and gas in the Arctic has evolved during the last decade. The US Geological Survey has estimated that 13 percent of the world's undiscovered oil reserves and up to 30 percent of the world's undiscovered gas reserves are situated in the Arctic. Out of the total oil and gas resources in the Arctic, over half of it is located in Russia, a fifth in the US and the rest in Norway, Greenland and Canada. Furthermore, more than four fifths of the oil and gas reserves are to be found offshore.

The increasing demand of oil and gas, combined with the fact that a number of the established oil and gas fields are running low, have led to higher world prices. This has attracted an increasing interest in exploiting the Arctic oil and gas fields.

Due to the economic crisis, and the increasing exploitation of shale gas and oil, the recent years has shown an increasing stagnation of the oil and gas prices. This is probably the reason why the progression of the Arctic offshore industry has slowed down. For example, Gazprom, Total and Statoil in 2010 all abandoned the extraction of gas at Shtokman gas field in the Barents Sea due to increased costs and an unfavorable market. The growing international political agenda to reduce the use of fossil fuels are also likely to influence offshore activities in the Arctic.

Because of the above, the outlook on the Arctic offshore exploration and extraction, in the past few years, has been more modest - especially the short term forecasts and, in particular, with regard to Greenland. This is confirmed by the maritime industry, who - according to the interviews - does not expect a larger extraction of oil and gas in Greenland within the next 20 years. This conclusion is also reflected in the literature, including the report "To the Benefit of Green-

land" which concludes that the production and export of oil in Greenland at its earliest can take off in the long run - after 20 or even 50 years. The report "The Oil and Mineral Strategy of Greenland for 2014-2018" sets no specific targets on the expected volume of oil and gas extracted in the near future. Instead, it sets up a strategy to maintain interest from investors and the continuation of publishing exploration permits.

Despite a more modest expectation for the development of the oil and gas industry, particularly in Greenland, there is still an opportunity for the maritime industry to provide services to the oil and gas industry in the more immediate future. The opportunity for the maritime industry is greatest when it comes to the actual extraction, but also for prospecting and exploration, the maritime industries provide services - on a smaller scale. Cairns exploration drilling in Greenland has shown that there are substantial maritime activities linked to the exploration phase. Therefore, as such exploration is expected to continue in the coming years, the maritime industry, linked to offshore activities, also face an opportunity in the short run in Greenland.

The extraction of offshore oil and gas also develops in other Arctic regions. This particularly applies to Norway, Russia and Canada. **Norway** has experienced much interest in extraction of oil and gas in the Barents Sea north of Norway. Statoil Petroleum A / S and Eni Norge A / S are expected to start production at the Goliat field in late 2014 and the Johan Cast Berg oilfield is expected to initiate exploitation from 2018. In **Russia**, there are large deposits of oil and gas, especially along the Siberian coast. The state-owned company, Rosneft, has partnered with Exxon Mobil to develop oil exploration in the Arctic, and Vankor oil field is the largest Arctic oil discovery in the last three decades. Also in the Russian part of the Barents Sea, large (primarily gas) offshore reserves are forecasted. The Kirinskoye gas field and Prirazlomnoye oil field are currently operating. Towards 2020, more offshore exploration activities are expected here, as in the Kara Sea and Pechora Sea.

Also, along the **Canadian** and **Alaskan** coasts, extensive exploration for offshore oil and gas are currently under way. By the end of 2012, 152 licenses for exploration molding or extraction in the area around the Mackenzie River and Beaufort Strait were given. ConocoPhillips is currently drilling offshore in the Northwest Territories and Statoil and Husky Energy have found oil in the Flemish Pass Basin off Newfoundland and Labrador.

The overall assessment from NIRAS is that there already exists an opportunity for the maritime industries to deliver to the Arctic oil and gas offshore industry.

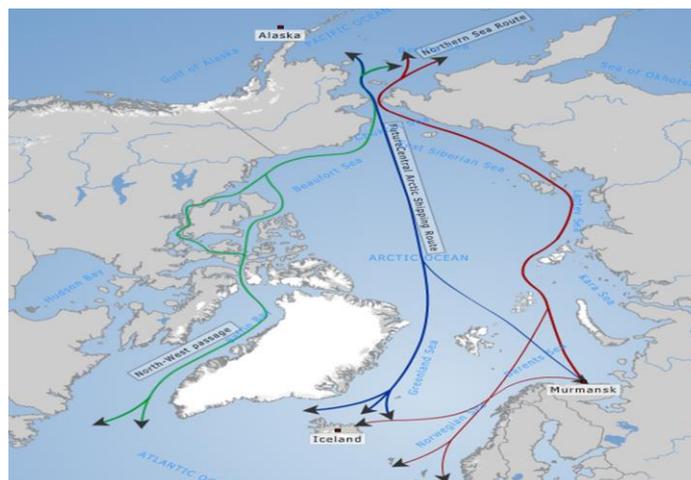
The industry's opportunity is linked primarily to northern Norway, Russia and North America, but opportunities also exist for providing services for the earlier phases of offshore exploration in Greenland.

3.3 Gradual opening of the Arctic passages

Despite significant fluctuations over time, the trend is that the Arctic icecap is melting and withdrawing, resulting in an expanding operating season each year. While there are diverging views on the rate of glacial retreat in the future, there is general agreement that the ice will continue to retreat. This means that while ice-free summers may increasingly appear in the coming years, considerable amounts of ice will continue to limit access to the Arctic passages during the winter months, also in the long run.

Following the continuing withdrawal of the Arctic ice, the Arctic freight routes will increasingly become attractive markets for the maritime industry. These routes involve: 1) The Northeast Passage, 2) The Northwest Passage and 3) The Central Arctic Route.

Northeast Passage is the name of a number of sea routes from the Kara Strait in the west to the Chukchi Sea and the Bering Strait in the Northeastern part of Russia. **The Northwest Passage** is the name of various shipping routes, which run north of Canada and Alaska from the Beaufort Sea in the west to the Baffin Bay in the east. **The Central Arctic Route** runs across the North Pole from the Greenland Sea to Bering Strait.



Figur 3. The three Arctic transport corridors

Today, the Northeast Passage is (highlighted in red in the figure above) the most accessible of the three routes and is only operating route today. The passage is, however, only operational in a very limited period of time every year.

The passage is navigable for about four months a year in the period from July to November and in 2013 71 ships were transported through the Northeast Passage. The Northeast Passage is administered by Russia via NSRA (The Northern Sea Route Administration), which also provides information and acts as maritime contact center for the passage.

The Northeast Passage is interesting for the maritime industry for several reasons. Firstly, it can significantly reduce the sea freight distance from Northern Europe to Asia compared to the traditional shipping routes through the Suez Canal. Second, it can secure access to Arctic mineral resources - not least in Russia. This - combined with an increase in world trade and the problems of piracy in the Indian Ocean – form a base for increased transport by the Northeast Passage in the future.

The sea freight distance from Asia to Europe by sailing through the Northeast Passage can be reduced by up to 40 percent on some routes. The saving is, however, reduced when the destination and shipping port is located more southern. When sailing from Rotterdam in the Netherlands and Shanghai in China (China's largest port) the distance will be almost 30 percent shorter through the Northeast Passage. However, when navigating between Rotterdam and Shenzhen in southern China, the savings are reduced to only 15 percent.

While the advantages of shorter travel time and fuel savings are obvious, there are also cost factors which point in the opposite direction for the maritime industry.

Firstly, ships sailing through the Northeast Passage must be equipped for the difficult conditions, which will enhance the shipping costs by 10-15 percent. There are also additional operating and maintenance costs involved by choosing the Northeast Passage, as well as higher insurance premiums. The maritime industry also point out that there may be significant administrative difficulties in building a partnership with the Russian authorities for navigation of the passage, but that these problems decrease significantly once cooperation is established.

The depth of the sea passages along the Northeast Passage is also a challenge - on some routes the passage is as shallow as 10 meters. The narrow passages, with low depths, put a limit on the size of the ships that can operate the route. This means that the industry's usual profits by economies of scale are lost as compared to the traditional, southern sea routes.

These disadvantages of the Arctic passages are also reflected in the current strategies for the larger shipping Nations. For example, China has, in recent years, invested heavily in the development of their southern freight routes and only shown limited interest in the Arctic passages.

Given the increased cost by using the Northeast Passage and the limited distance savings when the unloading and receiving port is located more southern, NIRAS assesses that the Northeast Passage primarily will be relevant for freight between northern Europe and northern Asia. The potentials for the container shipping industry to use the Northeast passages are also limited given the economy of scale by operating larger ships at the southern sea routes, and the higher operating costs. The view is, according to the interviews, also reflected by the majority of the managers within the maritime industry, who only see container freight by the Northeast Passage as a niche.

However, it is estimated that increased transit and destination transport of raw materials through the Northeast Passage may grow in the future, as the extraction of oil, gas and minerals in the Arctic develops.

An increase in project freight along the passages, with the goal to provide equipment and materials for construction projects in northern regions, is expected.

The maritime industry expresses expectations of an increased use of multi-purpose vessels for destination freight as a new business model. This may, for example, include a combination of equipment freight with the transportation of ore or - to a lesser extent - containers.

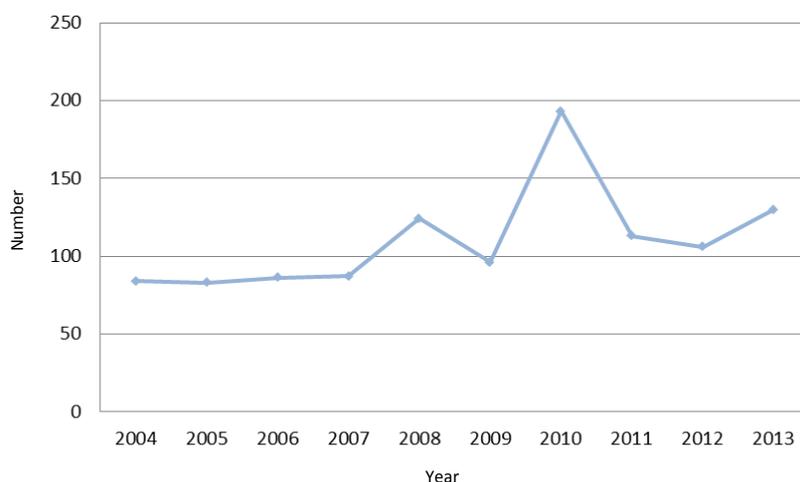
The advantage of the Northwest Passage is that the sea-depth is greater and, therefore, larger ships will be able to sail through the passage. The Northwest Passage also provides access to raw material resources in, particularly, Canada. Destination bulk freight from the mining industry is expected to grow within a few years, although the Northwest Passage has yet to fully open, due to the geography and large amounts of ice. Given the large amounts of ice, freight along the Central Arctic route still lies in the more distant future.

3.4 More global and Arctic tourism

International tourism is growing rapidly. The United Nations World Tourism (UNWTO) estimates the total number of international tourists will increase by an average of 3.3 percent per year in the period from 2010 to 2030. Particularly experience-based tourism will develop rapidly over the coming years. Because

of the remote situated geography and unique nature, the Arctic states may very well gain substantially from the continued growth of tourism.

Part of the future tourism in the Arctic will expectedly take place as cruise tourism. As the Arctic waters become available for a longer period of time each year, the basis for cruise tourism in the Arctic will expand.



Figur 4. Numbers of cruise tourism entries in Greenland waters during 2004-2013 (Source: Arctic Command)

Greenland has experienced inter alia an increase in the number of cruise sails over the last decade by approximately 11 percent, from 84 cruises in 2004 to 130 in 2013 (see Figure 4 above).

The trend, however, is characterized by large fluctuations, and the development has been disappointing compared to the original forecast of the number of cruises in the Arctic as a whole.

Nevertheless, current forecasts still see opportunities for cruise tourism growth in the Arctic in the future. The maritime industry does not express large expectations to the next decade's growth within cruise tourism, but predicts a gradual development that may eventually become commercially interesting. Here, small and medium-sized cruise ships, which are able to access smaller fjords and get closer to the Arctic nature scenery, are more economically promising.

3.5 Conditions for navigation in the Arctic

Large parts of the Arctic are characterized by an intermittent or permanent layer of ice, low temperatures, periodical darkness and rapidly changing weather conditions. These are all factors which influence navigation in the area. Sailing in international waters in the Arctic is, as other international shipping, regulated through UNCLOS and the conventions of the International Maritime Or-

ganization, IMO (such as SOLAS, STCW and MARPOL). At present there are no special designed international agreements for vessels operating in the Arctic, but the current ongoing negotiations on the Polar Code are expected to step into force in 2017.

The coastal states' territorial sea extends up to 12 nautical miles. The states may impose special rules on for example, requirements for safety at sea, protection of the marine environment and requirements for ship emissions. States may also impose special laws for ships entering national ports, and are entitled to physically inspect and enforce laws that apply both in national and international waters.

In addition, coastal states are entitled to enforce an additional twelve-mile contiguous buffer zone to the national waters. In this zone, the states exercise control over foreign ships to prevent infringement of national or regional custom regulations, financial regulations, illegal immigration and breaches of health regulations.

Coastal States are also entitled to establish a 200-mile exclusive economic zone from which they may impose sovereign rights to explore for, exploit, conserve and manage natural resources, including the conservation of the marine environment. These rights, to enforce rules on the environment and pollution, are, however, more limited than within the territorial waters. Coastal states that can prove that their continental shelf extends further than the, before mentioned, 200-miles zone, has a possibility to negotiate their exclusive economic zone beyond the 200-mile limit.

The IMO are currently working for the adoption of the so-called "Polar Code" in order to address the challenges associated with navigation in Arctic waters. The purpose of the code is to impose more strict requirements on ice classification and safety on board for sailing in Arctic waters. It will also impose operational requirements for the maritime education system and training of the crew, as well as navigation in ice-covered waters.

More strict regulation is also expected regarding environmental pollution from ships, especially in connection to the discharge at sea and reception on land of oil, chemicals, sewage and waste. However, regulations on ballast water and air emissions are not expected to be touched by the Polar Code.

The Polar Code is currently not adopted as negotiations on the environmental issues are still ongoing. Once adopted, the Polar Code is expected to come into force in 2017.

Monitoring, security and environmental emergencies

The increased activity in the Arctic calls for more focus on safety for ships, the crew and the environment. The Arctic states share the large challenges in monitoring and emergency response management of the Arctic.

The harsh climate and the fragile environment of the Arctic call, in particular, for the need of a rapid response mechanism in the event of an accident – something that is difficult due to the large geographical area. This applies as well for accidents involving vessels, the crew or the cargo, as for environmental accidents. Here, the serious consequences for cruise passengers involved in an Arctic accident draws particular attention, along with the consequences for the fragile Arctic marine environment affected by accidents related to oil exploration or extraction.

Furthermore, the fact that the traditional geostationary satellites, which are normally used for surveillance, do not operate in the northern Arctic imposes a challenge. The consequences are that the possibilities to monitor the vessels' nautical position in Arctic waters are limited. As part of a study on their Arctic activities, the Danish Navy has currently initiated a survey on various possibilities to improve the monitoring of the waters around Greenland.

Navigation and surveying

There are currently large areas of the Arctic which are insufficiently geographically charted. This results in ships taking longer detours away from their destination, or, if not possible, risking running aground in uncharted waters.

The Danish Geodata Agency and the Royal Danish Navy share the task of ensuring adequate charts for the Realm. The Navy is responsible for collecting the technical data, while the Geodata Agency processes and disseminates the data.

The number of charted waters around Greenland is gradually improving and the unmapped waters are not considered a large issue according to the maritime companies. The problem is limited, especially regarding mining and offshore projects since these projects usually include the development of charts. Instead, cruise tourism raises the largest concern in this context. This is because the risk of an accident is highest due to the incentives to sail close to the coast and icebergs, and also the consequences are most severe because of the large number of passengers.

4 THE MARITIME INDUSTRY OF THE DANISH REALM

According to the report "Employment and Production in the Blue Denmark" from 2014, approximately 63,000 people are directly and 44,000 indirectly employed in the "Blue Denmark". Thus, the maritime industry employs overall almost 110,000 people in Denmark, equivalent to approximately four percent of the total employment. Production in the maritime industry corresponds to nine per cent of the total Danish production. In Greenland and the Faroe Islands the maritime industry's share of employment and production is significantly higher making it an industry of great importance to the Danish Realm as a whole.

Currently, there are no figures on how many employees or how large a share of the maritime industry's revenue, that directly or indirectly are linked to Arctic activities. Of the companies that have contributed to this analysis, only a small proportion is engaged in Arctic or works exclusively with Arctic products and services. For most of the companies, the Arctic activities take up a relatively small proportion of their total production - typically less than ten percent. There are also plenty of the maritime companies that currently do not operate in the Arctic or manufacture equipment designed for Arctic activities. Thus, only a relatively small part of the Danish Realm's maritime employment and production is in fact attributable to Arctic activities.

For this analysis, NIRAS has identified five sectors in the maritime industry with growth potential from the Arctic development. These sectors are illustrated in figure 5 below.

The sector of **maritime design** includes the design and construction of ships (primarily specialized ships and support vessels), design and production of engine pumps and pipeline systems, as well as winterization of existing ships and equipment. The sector of **communication, monitoring and rescue equipment** includes production and maintenance of rescue equipment for Arctic conditions, development of navigation, communication and surveillance equipment to the Arctic and various database services. **Shipping** involves destination and transit cargo shipping with cargo, bulk and oil and gas (including equipment, waste and chemicals). It also involves cruise services, freight logistics and supply shipping. For the **emergency response, towage and salvage service** industries, tug assistance, environmental and emergency management to offshore projects, ice management, pilotage and icebreaking services (within the Danish territory) are of special relevance. Finally, the **maritime service** sector includes monitoring, maintenance services on local shipyards and the certification and classification of Arctic vessels, crew and equipment.



Figur 5. Categorization of the professions, by sector

The figure illustrates *examples* of companies active within the five categories that are expected to gain from the future Arctic maritime growth opportunities. Many of the companies listed in the chart are already involved in activities in the Arctic, especially in Greenland.

The following sections describe these five categories and players in more detail.

4.1 Shipping

The Danish Realm has a large, modern and competitive commercial fleet. Several shipping companies have ice classed ships and are already active in the Arctic seas.

The opportunities for shipping in the Arctic are divided into two categories of maritime transport. The first category comprises shipping with oil tankers, gas and bulk carriers. The second category concerns supply shipping and logistics, including freight of equipment to construction sites and activities for offshore and mining projects, as well as regular container shipping.

The increase in mining and offshore activities and the opening of the Northeast Passage are the key drivers behind the shipping sectors potential in the Arctic today. DS Norden is currently shipping coal from the "Svea Nord" mine in Svalbard. Nordic Bulk Carriers has a large Arctic shipping operation, sailing bulk carri-

ers through the Northeast Passage during the summer - in the “open water period”. Other examples of Danish companies with Arctic growth opportunities are Blue Water Shipping, Maersk Broker, Maersk Tankers, Polaroil and Torm.

Examples of companies within shipping and logistics, that have operations and activities in Greenland, are Royal Arctic Line, Arctic Base Supply, Martek and Blue Water Shipping. Royal Arctic Line A / S has the exclusive right to ship goods to and from Greenland, ship internally between the towns in Greenland and ship from the cities to settlements. This exclusivity does not extend to freight between settlements and other possible destinations in Greenland.

4.2 Emergency response, towing and salvage service

Tugboat assistance, support vessels and ice management activities all have considerable Arctic growth potential. This is a result of increased mining, offshore extraction and increased maritime freight. In the Danish Realm, there are companies that offer services in all of the three areas. Companies that provide tugboat assistance are e.g. Svitzer and Viking Supply Ships, while Esvagt is an example of a company that provides support vessels and “stand-by ships” in relation to offshore activities in Norway and Greenland.

Ice-management is an umbrella term for various ice related activities e.g. monitoring the ice, towing icebergs, as well as regular ice breaking. Viking Supply Ships is a large player with operations in Russia, Canada and the Baltic Sea and Greenland Maritime Solutions is an example of a small Greenlandic company engaged in consulting services related to ice management.

Environmental emergency response is another growing business area for the Danish Realm’s maritime industry. The market has developed by the offshore drilling and mining companies, who needed solutions for operating in the fragile Arctic environment. Greenland Oil Spill Response is a company owned by the Greenland autonomous government. All oil prospecting companies within Greenland’s exclusive economic zone are obliged to contract them towards any oil related activity. Esvagt is another company that offers resources to combat oil spills.

4.3 Maritime service

The increase in maritime activity in the Arctic is likely to cause an increased demand for the Danish Realm’s businesses in the servicing, inspection and maintenance of ships and other related maritime vessels. Distance and the price are vital parameters for where the repair and maintenance of the ships are per-

formed. Nuuk Shipyard and MEST Shipyards are shipyards located in Greenland and the Faroe Island respectively. In Denmark, Karstensens Shipyard, Vestergaard Marine Service and Orskov Group are examples of shipyards with future opportunities in providing services for ships in the Arctic. Some players are currently exploring the possibilities to establish themselves in Greenland.

Maritime services also include certification, classification and approval of ships. In the past, the classification of ships for Arctic routes focused solemnly on the ice classification of the hull, but are today also including the classification of equipment, safety routines and crew. DNV GL is among the world's three largest companies that classify ships. The company has offices in both Denmark and Greenland and have a large market share of the classification of ships in Arctic waters.

4.4 Communication, monitoring and rescue equipment

For the industry of maritime safety and lifesaving equipment, there is a special need to develop and supply products that can withstand the harsh Arctic environment. Both Viking Life Saving Equipment and Harding are major companies that manufacture safety products for the maritime industry, and they both provide specially developed products for the Arctic conditions.

There are several companies that develop and produce navigation and communication equipment with regards to the Arctic challenges, two examples are Cobham Satcom and Lyngsø Marine.

4.5 Maritime Design

In parallel with the shift of standard shipbuilding from Denmark and Europe to mainly Asia, a niche market for building and designing smaller ships and special purpose vessels has developed in Denmark. Special purpose ships include for example stand-by vessels for the offshore industry, minor ice-strengthened dry cargo and container ships and ships for the Navy.

Karstensens Shipyard is an example of a shipyard that produces special vessels in Denmark. Upgrading existing ships (retrofit) and strengthening ships to withstand ice and winter conditions (winterization) are two areas with increasing demand where the companies of the Realm have strong competences. Winterization also includes modification of equipment and crew routines to operate in freezing temperatures, whether there is ice or not. This is done through examination and replacement of materials and equipment.

OSK-ShipTech and Odense Maritime Technology are two examples of companies that design specialized ice strengthened vessels. Their prints are sold on license and then constructed in other parts of the world.

There are many maritime equipment producers within the Danish Realm with strong market positions in design, development and production. An example from the equipment industry is DESMI, a large company producing systems for cooling water and pumps, as well as for oil spill response. Hempel manufactures paint and coating product series for the harsh Arctic conditions. Odense Maritime Technology has developed screws for ships sailing in the Arctic, so efficiency and strength is optimized for the conditions.

5 OPPORTUNITIES AND CHALLENGES FOR MARITIME INDUSTRIES IN THE ARCTIC

The overall Arctic opportunities for mining, offshore drilling, Arctic transit freight, as well as for the cruise tourism, will increase the demand of many maritime services, produced by the Danish maritime industry. This section introduces these services and where the Danish sector especially has a competitive advantage.

5.1 The maritime industries and mining

The maritime opportunities in mining are either directly or indirectly linked to the transportation, going to and from the mine. The demand for maritime freight services in mining is greatest during the operational phase, but also deployment and decommissioning involves freight, which only can take place at sea.

The Danish Realm's companies are already established as market players when it comes to Arctic bulk freight, thus the Realm has a first-mover advantage in terms of knowledge and equipment, including ice classed ships. This advantage may potentially trickle down to other companies and sectors through collaboration, knowledge networks and, not least, be assisted by the sector's existing high rate of labour exchange.

The Realm also possesses a strong market position in ice-management and Arctic ice towing and, thus, a good chance to get a significant share of the future market.

Several respondents within the maritime industries stress that their geographical presence in Greenland offers them a considerable competitive advantage. First, such local presence provides visibility and insight into the political processes related to mining, but it also develops networks, awareness and experience of local issues and challenges. The maritime experience from Greenland also provides good capabilities for navigation in ice filled waters.

Although the Danish Realm's maritime companies are well positioned to seize the future opportunities, there are also challenges. Even for the forecasted mining projects in Greenland, there are no guarantees that the bulk freight will be provided by a Danish company. Several of the companies interviewed for this study point out that they experience difficulties in entering their name on the supplier lists, regardless of it is as subcontractor for the international bidders or

for the mining companies. Being on such lists is critical in order to become a supplier to the future mining projects.

Opportunities

In mining, shipping operations of bulk is the greatest opportunity for the Realm's maritime industries. The extent of bulk freight depends on the mine type and extraction volume, where some mine types (e.g. gold mines) are characterized by relatively small transportation needs, while others (such as coal mines) are characterized by larger transportation needs. The Danish shipping companies already meet the international regulation standards of today, thus, chances are that the opportunity in Arctic bulk freight will be seized gradually, following the reinforcement of the international regulations (e.g. the Polar Code).

Destination bulk freight relate exclusively to the operational phase. However, a mine will also need freight of project materials and equipment during deployment and decommissioning. However, the total need for freight of equipment and materials is lower than that of bulk.

Besides materials and equipment, special freight of certain chemicals to the mines for the extraction processes are needed (depending on the mine type) along with freight of waste from the mine.

The remote position of mines in the Arctic prevents direct access to any goods or product. Any supplies must be transported to the site, usually by the sea. Such supply chain management is, therefore, a separate business opportunity for the Danish maritime sector.

In order to access the Arctic mines, the waters must be kept free of ice. Also, support vessels are needed to tow bulk carriers into the mining site. This calls for services such as ice management and towing vessels, as well as Danish pilotage service in the waters around Greenland.

There may also be a market to inspect service and repair the additional vessels needed for the future mining operations in Greenland. The increased transportation will also create opportunities for the industry of maritime equipment, to produce Arctic adapted equipment to the increased number of ships, due to heavier traffic. The production of the equipment will primarily take place in Asia, but the Danish Realm's sectors are competitive in design and the development phases.

Other prospects on a smaller scale may also develop. These include ice-management, monitoring of the freight routes, including ice thickness, and the design of Arctic adapted bulk carriers. The Polar Code will also open a market for the classification and certification of ships and staff.

Challenges

Some challenges exist however, which may dampen the maritime sector's chances of benefitting from the mining projects in Arctic. Protectionism, trade barriers and lack of collaboration are all issues specifically highlighted by the maritime industry as barriers. National regulation on local production or employment, and national technical requirements and industry standards may act as technical barriers for the companies. Such barriers are particularly large for small business entities (of which the Danish maritime sector is rich). Given that these challenges are particularly harsh on smaller entities, the maritime sector of the Danish Realm may face asymmetric competition, compared to other nations with a higher degree of large entities.

Generally, in order to fully seize the opportunities, the international competition for the sector must be fair, which is not always the case. An example is the "Jones Act" in the United States, which requires that all goods transported by water between U.S. ports be carried on U.S.-flag ships, constructed in the United States, owned by U.S. citizens, and crewed by U.S. citizens. The Jones Act makes it difficult for the Realm's fleet to operate in Alaska, or at least prevents it from reaping the full benefits. The equipment industry also faces challenges in Canada, as some equipment in Canada must be produced in Canada. Several companies also express concern with Russia's requirements to manage the freight to its mining projects themselves, much like their requirements regarding the oil and gas projects.

Several Danish companies also mentioned that they face challenges with the Greenland Mineral Resources Act, which requires that companies and labour involved in mining projects are from Greenland unless the Greenlandic companies are not technically or commercially competitive, or no skilled labour are available. However, chances are that Danish companies already registered in Greenland may benefit from this in comparison to their international competitors.

Finally, it is also seen as a challenge that the Danish sector's fleet today does not contain a sufficient number of ice-strengthened ships to meet the existing demand related to the freight of ore in the peak season.

5.2 The maritime industries and extraction of oil and gas

An oil and gas project is divided into a number of phases. The exploration phase involves a series of activities before starting to drill. This includes seismic studies, baseline studies, environmental studies and stakeholder consultations etc. These activities involve maritime operations. For example, some vessels are used for seismic data collection, others for environmental studies. The exploration phase also involves offshore drilling tests. Such tests are complex and involve the application of equipment and staff, as well as support vessels and vessels for emergency response.

The construction phase establishes the drilling rig and the deployment phase initiates the actual production. The latter, for example, involves for example freight of the oil and gas and supplies of materials and equipment. The decommissioning phase closes down the oil rig and involves shipping the dismantled parts away, as well as closing and sealing the well. In environmental fragile areas such as the Arctic, the decommissioning is usually finalized by a concluding environmental study.

The maritime companies of the Realm emphasized their comparative advantage in maintaining a fleet of oil and gas tankers, in order to reap future possibilities in the Arctic. They have also accumulated experience and knowledge of Arctic maritime operation and maritime support services through the sector's involvement in exploratory drilling in Greenland's waters, as well as in extraction drilling in particular Norway and Russia. This positions several of the Danish Realm's companies well to deliver support services (such as ice management, ice towing, emergency response management) as subcontractors to those oil and gas companies, involved in Arctic oil and gas drilling.

Several companies also believe, that the Realm's maritime sector will gain from being physically situated in Greenland, the day the Greenlandic oil and gas projects take off.

Some of the Realm's companies have built a close collaboration with Norwegian companies and are to be found on the supplier lists of the Norwegian offshore industry. Because of the increased Norwegian activity in particularly the Barents Sea, this is seen as a great advantage. The good collaboration between Norway and Denmark is generally seen as a great asset and competitive advantage, as Norway is expected to host a large share of the future Arctic offshore activities. Norway has an oil and gas industry operating in the Arctic, and the Danish companies maintain an extensive fleet of tankers and support vessels, prepared for Arctic conditions.

Opportunities

An increase in oil and gas exploitation in the Arctic will create a number of large opportunities for the maritime industries in the Arctic.

This includes, most importantly, Arctic destinational oil and gas shipping, except for those projects where the extracted oil and gas is transported through permanent pipelines. Whether such pipelines are constructed, depends on: 1) the length of the expected extraction time and 2) the technical complexity and cost of installing the pipelines. Long production lengths will make it more attractive to install pipelines, as it can reduce the costs of shipping. Pipelines are, however, costly, and shipping therefore more attractive on shorter projects.

Destinational shipping is, however, a considerable opportunity, as the majority of offshore drilling in the Arctic takes place in deep water, from where most extracted oil is transported by sea. Some gas is also shipped, although gas is more likely to be transported by pipeline due to the characteristics of gas. An example of gas being transported by ship is the Norwegian Snøhvit field in the Norwegian Sea. This is possible by converting the gas to liquid gas (LNG).

An increase in Arctic oil and gas projects will, besides destinational shipping, also - depending on local conditions - increase the need for maritime support functions. Such services include ice management, monitoring of drift ice and towing icebergs. The floating ice and icebergs can result in damaged rigs and equipment and, therefore, enhances the need to monitor and respond to any ice that moves towards the drilling rig. Not only must the waters around the rig, but the freight routes to and from be kept free of ice. There will, additionally, be a need for vessels, equipped to quickly respond to emergencies (so called "stand-by ships") and environmental damages, such as minor oil spills.

An increase in the number of rigs in the Arctic and interlinked maritime activity may also open up for a secondary service industry, for the ships sailing to the rigs. Shipyards in Denmark, which both designs and builds specialized vessels, may experience increased demand for producing and designing specialized vessels to support functions around the rigs. The equipment industry may deliver products adapted to the harsh Arctic conditions, similar to the need for mining projects. The risk of oil spills from ships and from the rigs may also develop a market for equipment to handle such emergencies, including booms, pumping systems, etc. Also, a more transportation connected to servicing the staff on the rigs is likely.

Lastly, the exploration phase will involve vessels for making geological tests, samples, as well as support vessels for emergency and ice management.

The exploitation phase will also open some smaller opportunities for design and winterization of tankers. Tankers are generally produced in Asia, but some Danish companies contribute to the design. The same applies to winterization. The offshore activity may also call for construction of flow ports, of which Danish companies may provide components. Offshore activities in Greenland will generate opportunities for additional pilotage and ice management services, as well as supervision by authorities and maritime services. Danish companies may also provide such services outside Danish waters, however, only to the extent that it involves on-site services. As for mining, ships sailing to the rigs, but also the rigs themselves, need Arctic adapted rescue equipment.

Challenges

The maritime industry sees a barrier to their activities in the Norwegian offshore market, as Norwegian companies like Statoil traditionally selects Norwegian subcontractors as partners. However, as the Realm's companies usually have a good standing among Norwegian oil and gas companies, they may have an advantage over other foreign companies.

As for the rest of the Arctic, some companies mention that the Realm's suppliers lack visibility vis-à-vis the oil and gas sector, in for example the U.S. and Russia. It is also a general opinion of the maritime sector that cooperation with the Russian oil and gas industry can be difficult and very bureaucratic.

5.3 The maritime industries and cruise tourism

International cruise tourism in the Arctic has expanded over the past decade, and the trend is expected to continue. This trend is, however, not expected to generate much growth in the Danish Realm's maritime industries by itself. The industry believes that growth opportunities exist, especially for small and medium-sized cruise ships that are built to access smaller fjords and get closer to the Arctic nature scenery. The Realm has no such fleet of cruise ships, and the development in Arctic cruises is primarily expected to benefit the already established cruise nations.

Opportunities

According to the industry, cruise tourism opportunities for the Realm's maritime industry are limited on the short or medium term. However, some medium and smaller opportunities exist which may benefit the Realm's maritime indus-

try. This applies especially to Arctic rescue equipment, because of the large number of passengers involved in the cruise industry.

Also, opportunities for the Greenlandic service and tourism industry, interlinked to the cruise tourism, exist, and can be further developed by an increased number of cruises and new routes. This includes smaller local cruise ships with local crew providing shuttle transportation to coastal destinations and day trips to local settlements. Other such opportunities include bringing the tourists closer to nature by, for example, whale watching, deep-sea fishing and boat trips to the ice sheet.

Although the cruise ships are likely to be constructed abroad, the design process of particularly the small and medium-sized Arctic cruise ships may create an opportunity for the Danish Realm's industries.

A number of smaller opportunities also exist for the maritime service businesses. For example, pilotage service and onboard guidance where navigators with local expertise are hired to guide cruise ships through the Arctic waters. In some cases tug assistance in relation to docking and navigating narrow passages, as well as the monitoring of ice movements, ice thickness and producing Greenlandic maritime weather reports, hold business opportunities.

Challenges

Cruise ship tourism is facing some challenges which hold back development in the Arctic and, especially, in Greenland. One of these challenges is the time and cost of launching new international cruise routes. Generally, it takes about three years to establish a new cruise itinerary. Shipping operators are therefore required to mobilize large investments with a high risk tolerance in order to develop such niche tourist destinations in the Arctic, where there is high uncertainty about the demand.

The infrastructure and port capacity also represents a barrier for cruise tourism in Greenland. Insufficient port capacity in the Arctic is generally a problem, and expanding and developing the port capacity is seen as critical to the future development. At the same time, the industry points out that the service industry in the Arctic does not today possess the capacity to meet the demands of a large cruise tourism industry. Furthermore, the tourism industry in Greenland is, today, less capable at attracting more tourism to the Arctic compared to other traditional cruise tourism destinations.

Several of the companies in the survey also highlighted the challenge of safety and emergency management regarding cruise tourism in the Arctic. Distances in the Arctic are so large that any assistance to ship emergencies are often several days away, as well as limited in capacity in order to meet the challenges related with larger cruise ships.

The combination of many challenges and the absence of competitive advantages diminish the chances for the sector's growth related to cruise tourism in the coming years. It should be stressed, however, that this conclusion is limited to the maritime sector, as market opportunities linked to the cruise tourism exists in other sectors.

5.4 The maritime industries and the Arctic passages

As the Arctic passages open, the Danish Realm's maritime industries could, increasingly, become key players for the future transit freight.

Due to increased costs associated with investing in Arctic adapted ships, a business model involving utilizing the ships throughout the year is needed. The, currently operating, business model by Nordic Bulk Carriers is based on summer transport along the Northeast Passage and winter freight in ice filled waters elsewhere. This model has proven both durable and competitive. The Royal Arctic Line is also working with transport to Antarctica during winter in the northern hemisphere, where part of their fleet is left idle due to ice. Such business models provide a good starting point for meeting the future competition.

The industry stresses that it is difficult and costly to establish cooperation with the relevant Russian authorities for freight in the Northeast Passage. However, these difficulties decrease significantly once cooperation is established. Thus, the first-mover advantage when operating on the Northeast Passage is particularly high for the Danish Realm's maritime companies (e.g. because of the trickle-down effect to other companies through the high rate of job shifts, typically for the Danish labour market). These high entry costs, however, are also the reason why other companies may totally refrain from entering the shipping market for the Northeast Passage.

Finally, it is a future challenge to maintain a high market share. As the market of the passages develops, the cost of upholding a high market share will increase and other players will enter the market. Here the challenge is to ensure that the market position of the Danish Realm's businesses is maintained, even when the first-mover advantages dissolve.

For the Northwest Passage, the national regulation on the involvement of local vessels is a challenge for the sectors' cooperation with North America and, especially, Canada.

Opportunities

The greatest opportunity, in the short term, exists in transit and destination freight of bulk, oil and gas. Also, more maritime project freight through the passages is expected, for the provision of equipment and materials to construct projects in the northern regions.

In the future, the importance of business models involving flexible multifunction vessels, designed to simultaneously transport different types of goods at once (for example, a vessel that transports both equipment and bulk), may increase. This is because such vessels are designed to continuously scale and adapt to the exchangeable need for transportation. This need may also generate a demand for designing such vessels. Besides, greater opportunity could arise in developing individual maritime product components adapted to Arctic waters.

Some minor opportunities may also arise, associated with an increased traffic on the Northeast Passage. These include the development and sale of Arctic rescue equipment, however, limited in volume because of the small crew needed on such transportation. Additionally, a demand for the design of new, ice classed ships, as well as for the winterization of existing ships (mainly design and planning).

Complementary to the business model with multifunction vessels, a niche market on special Arctic container freight may develop - even if mainstream container cargo itself, via the Northeast Passage, will not increase.

According to the interviews, demand for services on the Realm's shipyards will be limited. However, some opportunities for Greenlandic shipyards may arise if traffic will cross routes next to Greenland, especially, related to freight on the Northwest Passage or the Trans Arctic Route.

Challenges

The costs and time duration are the main barriers related to freight through the Northeast Passage. These are due to increased fuel costs associated with sailing in ice, as well as the extra time spent using the passage. The speed is generally lower and the limited development of the passage often results in queuing up for ice management services. Hence, such costs will continue to be a barrier

regarding the frequency of maritime transit freight through the passage in the future.

6 ACTIONS TO UNFOLD THE OPPORTUNITIES

It is generally believed that the Danish Realm's maritime industry is well positioned to seize the future Arctic opportunities, the day they start to unfold. Several companies are already active in the Arctic and they, generally, plan to increase their Arctic activities in the future.

Although the maritime sector is well-positioned, some improvements can be made. Therefore, the analysis has also been dedicated to identify ways to diminish some of the existing challenges and seize the opportunities in order for the Danish Realm's maritime sector to obtain the best possible conditions for the future Arctic markets.

By studying these challenges and opportunities, four ways of action have been identified which are likely to contribute to seize the future opportunity of the Danish Realm's maritime industries.

6.1 Increased cooperation

Fostering cooperation is a key success factor to get a share of the future, Arctic, opportunities. This fact recurs in almost all suggestions from both businesses and governmental entities. It is necessary to foster a general interdisciplinary cooperation between small and large sized enterprises that focuses on exchanging knowledge on the Arctic market development. In addition, structured, temporarily partnerships, designed to meet specific needs, may help improve market access.

Thus, one approach could be to establish a more formal collaboration between companies, research institutions and possibly public actors. This would in the forthcoming years ensure a forum for the exchange of experiences and create new initiatives to ensure continuous adaptation towards the future Arctic market.

Such cooperation should focus on tangible solutions on how to exploit opportunities or face the challenges. Solutions could focus on how to train staff and develop proficiencies, exchange knowledge about business models and customers, as well as establish partnerships to exchange staff skills or knowledge on foreign public administrative systems.

The knowledge sharing could involve the development of vocational guides to maritime business activities in the Arctic, in order to introduce new companies to the opportunities and the challenges of the Arctic in the future, as well as

introducing them to people with specific knowledge. The guide may also contain information about individual markets and major players in the markets.

An alternative approach could also be to establish an Arctic Centre, which collects and disseminates Arctic know-how and contacts to new companies, interested in the Arctic market.

6.2 Education and skills

Education, training and improvement of employees' proficiencies are a key focus area. This applies to both direct maritime skills and commercial and technical competencies. There are a number of these proficiency areas (e.g. local knowledge and maneuvering in ice covered waters) where the Danish Realm's navigators and other maritime graduates are in high demand, and their popularity may grow in the future. Of commercial proficiencies, a rising demand after knowledge on how to enter the Arctic market is expected. This includes such skills as knowledge on the Arctic opportunities, culture and business understanding. Of technical proficiencies, more know-how on new, competitive maritime technologies is likely to be in higher demand, including knowledge on how the harsh Arctic conditions interact with maritime technologies.

Increased training regarding Arctic conditions will enhance the employment chances for the graduates in companies operating in the Arctic, as well as enhancing the recruitment pool for the Danish Realm's maritime employers.

An initiative could be to focus on developing hands-on Arctic experience in education and in-service training. For example the maritime schools only offer theoretical training in ice navigation. Marstal Navigation School and SIMAC offers training via an ice simulator, but not as an integrated part of the graduation scheme. Here, ice navigation could be made an integrated part of the relevant courses, either as mandatory or voluntary subjects.

However, the industry stresses that some maritime proficiencies only can be acquired through hands-on experience and are focused on in-service training. For schools in Greenland, the hands-on experience is easily integrated into the training, while such experience for the students in Denmark and the Faroe Islands only can be gained through exchange programs with Greenland. Exchange programs may also be available with Sweden and Norway (or even with Russia or Canada), where such hands-on training is already offered. Some companies also mention that the Navy has experience and competencies when it comes to navigation in the Arctic.

6.3 Presence in the Arctic nations

According to the companies, market visibility and presence in countries like the USA, Canada and Russia are crucial for a company's market position.

The Realm's maritime sector could reduce their market entry costs if the industry collaborated on sharing back-office and marketing facilities. One way to do this could be to establish cooperation with the Trade Council of Foreign Affairs. Such representation could also be organized as a structured collaboration between the market leading Danish companies and SMEs.

The maritime sector stresses that visibility is key in order to become enlisted on the supplier lists of the mining or offshore industry. Once on the supplier lists, the chance of being selected to the projects increases substantially.

Both private and public actors could improve such visibility, by coordinating efforts and promoting the Danish Realm's maritime abilities collectively - or spreading the voice through their participation in trade fairs and market conferences.

Finally, information could be further pursued on whether SMEs would gain economically by contracting subcontractors rather than contracting the large multinationals directly.

6.4 The framework of specialized vessels for use in the Arctic

The interviewed companies emphasized several challenges, which touched the institutional framework conditions for using specialized vessels for use in the Arctic, including icebreakers.

Companies with a business model involving a fleet of specialized vessels or icebreakers, not currently covered by the special framework conditions for shipping, face a competitive disadvantage compared to the other major maritime nations. This creates an incentive to move the company abroad, whereby Denmark as a consequence may lose these business opportunities and interlinked skills. In order to retain these businesses and be instrumental for enhancing the sector's competitiveness, a closer look is recommended on how to apply the same framework conditions to specialized vessels, as to those for other types of vessels.

7 INTERVIEW LIST

The following experts, companies and stakeholders have contributed through interviews and workshops to the data underlying the results in the analysis:

- **Jens Panum Have**, Director, Arctic Base Supply
- **Ole Bøgh Ulriksen**, Responsible for Greenland, Blue Water Shipping
- **Carsten Ørts Hansen**, Co-Director, CBS Maritime
- **Casper Jensen**, Vice President Maritime, Cohman Satcom
- **Jeppe Handwerk**, President & CEO, Copenhagen Group
- **Jenny Braat**, Managing Director, Danske Maritime
- **Michael Prehn**, COO, Danske Maritime
- **Jan Fritz Hansen**, Deputy Director, Danish Shipowners' Association
- **Morten Glamsø**, Chief Consultant, Danish Shipowners' Association
- **Niels Tanderup Kristensen**, Deputy Director, Danish Industry
- **Henrik Jensen**, Sales and Project Manager, DESMI
- **Henrik Bach**, Managing Director, DNV gl
- **Ulla E. Nielsen**, Director CSR, DS-Norden
- **Ole Ditlev Nielsen**, Chief Commercial & Safety Officer, Esvagt
- **Steen Sabinsky**, Director, Maritime Development Center of Europe
- **Nils Christian Wang**, Commander, Royal Danish Defense Academy
- **Lars Mohr Jensen**, Project and Development Director, Gatehouse
- **Rune Carbuhn Andersen**, Chief Consultant, Danish Geodata Agency
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- **Michael Aanmont**, Group Marine Product Manager, Hempel
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- **Torben Ørting Jørgensen**, General Manager, Maersk Broker

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- **Jens Jørgen Madsen**, Director Business Development, Maersk Drilling
 - **Lars Bo Jensen**, Senior Manager Business Development, MAN Diesel & Turbo
 - **Jeppe Carstensen**, Superintendent, Maritime Academy in Nuuk
 - **Jens Naldal**, Principal, Marstal Navigation School
 - **Christian Bonfils**, CEO & Partner, Nordic Bulk Carriers
 - **Kåre Groes Christiansen**, CEO, Odense Maritime Solution
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 - **Anders Ørgård Hansen**, CEO, OSK-ShipTech
 - **Niels Clemensen**, Executive vice president & CCO, Royal Arctic Lines
 - **Tina Jensen**, Head of Department, Dep. of Industry, Mineral Resources and Labour
 - **Carsten Nielsen**, Vice President, Semco Maritime
 - **Helle Lehmann**, Senior Vice President, Skuld
 - **Allan Warlev**, Commercial Manager Denmark, Svitzer
 - **Birgit Sølling Olsen**, Deputy Director, Danish Maritime Authority
 - **Francis Zachariae**, Deputy Director, Danish Maritime Authority
 - **Jens Vester Pedersen**, Captain/Supt., TORM
 - **Morten Vestergaard**, CEO, Vestergaard Marine Service
 - **Jan Steffensen**, COO, Viking Supply Ships
 - **Mads Daniel Skifte**, Senior Consultant, Visit Greenland

8 LITTERATURE

ABOUT ARCTIC GENERAL

- [1] Ministry of Foreign Affairs (2011): "The Kingdom of Denmark Strategy for the Arctic 2011-2020"
- [2] The Committee for Socio beneficial exploitation of Greenland's natural resources (2014): "For the Benefit of Greenland"
- [4] Prime Ministers Office (2013): "The Faroe Islands - A Nation in the Arctic"
- [5] Lloyd's (2013): "Arctic Opening: Opportunity and Risk in the High North"
- [6] The Norwegian Shipowners' Association: "Northern Area Strategy. Responsible actor active deltaker "
- [7] The Norwegian Foreign Ministry working group (2013): "økt skipsfart in the Arctic Ocean - with opportunities and challenges for Norway"
- [8] Interagency Working Group on Coordination of Domestic Energy Development and Permitting in Alaska (2013): "Managing for the Future in a Rapidly Changing Arctic".
- [9] Conley, Heather A., Terry Toland, Mihaela David & Natalya Jegorova (2013): "The New Foreign Policy Frontier - US Interests and Actors in the Arctic"
- [10] DNV GL (2014): "The Arctic - the next risk frontier "
- [11] United States Coast Guard (2013): "Arctic Strategy"
- [12] Arctic Council (2009): "Arctic Marine Shipping Assessment"
- [13] Codan Marine Service (2011): "Sailing in the Arctic"
- [14] The White House (2013): "National Strategy for the Arctic Region"

ON MINING

Transverse

- [15] Kesler, Stephen E. (2007): "Mineral Supply and Demand into the 21st Century "
- [16] Fraser Institute (2013): "Survey of Mining Companies 2012-2013"

[17] USGS (2008) "2008 Minerals Yearbook"

[18] EY (2013): "Arctic oil and gas"

[19] USGS (2008): "Circum-Arctic Resource Appraisal: Estimates of Undiscovered Oil and Gas North of the Arctic Circle"

[20] FNI & DNV (2012): "Arctic Resource Development - Risks and Responsible Management"

[21] IEA (2013), "Key World Energy Statistics"

[22] ECORYS (2012): "Mapping Resource Prices: The Past and the Future"

[23] The European Parliament (2010): "The Geopolitics of Arctic natural Resources"

Greenland

[24] Map of selected mineral deposits in Greenland: www.geus.dk

[25] The Government (2014): "Greenland's oil and mineral strategy 2014-2018"

[26] The Government (2013): "Mineral Resource statement in 2013"

[27] Government of Greenland - Mining Agency (2013): "Mineral exploration in 2013 in Greenland in 2013 - Reference from the activities"

[28] Offshore Center Denmark (2010): "Analysis and report on business conditions in Greenland"

Russia

[29] Ministry of Energy of the Russian Federation (2010): "Energy Strategy of Russia - For the Period up to 2030"

[30] Global Business Reports (2012): "Mining in Russia - Braving the Bear"

[31] Deloitte (2014): "2014 Russian Oil and Gas Outlook Survey - Russian Oil and Gas Sector Overview"

[32] EIA (2014) Country Report on Russia

Norway

[33] Norwegian Ministry of Trade and Industry (2013): "Strategy for the Mineral Industry"

[34] Norwegian Ministry of Foreign Affairs (2006): The Norwegian Government's High North Strategy "

[35] Oljedirektoratet (Norway) (2013): "Evaluation of Projects Implemented on the Norwegian Shelf"

[36] Ministry of Petroleum and Energy (Norway) (2014): "Facts 2014 - The Norwegian Petroleum Sector"

[37] The Norwegian Petroleum Directorate (2014): "Petroleum Resources on the Norwegian Continental Shelf in 2014 - Fields and Discoveries"

[38] The Norwegian Petroleum Directorate (2013): "Petroleum Resources on the Norwegian Continental Shelf - 2013 Exploration"

Sweden

[39] SveMin (2012): "A Vision of growth for the Swedish mining industry"

[40] VIA (2013): "Investment Opportunities in Mining North Sweden"

Finland

[41] Nurmi, P. (2013): "Finland's Mineral Strategy"

Canada

[42] The Conference Board of Canada (2013): "The Future of Mining in Canada's North"

[43] Ljunggren, D & Rocha, E (2011): "Arctic has great riches but Greater challenges"

[44] Nunavut (2012): "Mineral Exploration mining and geoscience - Overview 2012"

[45] Canada National Energy Board (2013): "Canada's Energy Future 2013 - Energy Supply and Demand Projections to 2035"

[46] National Energy Board (Canada) (2013): "Annual Report 2013"

United States (Alaska)

[47] ESI (2014): "Offshore Oil and Gas Governance in the Arctic, A Leadership Role for the US"

[48] Alaska Miners Association: "The Economic Impacts of Alaska's Mining Industry"

[49] Ebinger, Charles, John P. Banks & Alisa Schack Mann (2014): "Offshore Oil and Gas Governance in the Arctic - A Leadership Role for the US"

[50] US Department of the Interior and US Geological Survey (2014): "Mineral Commodity Summaries 2014"

ABOUT THE ARCTIC PASSAGES

[51] The Arctic Institute (2013): "The Future of Arctic Shipping: A New Silk Road to China?"

[52] Analysis & Strategy (2011): "Marine Traffic in the Arctic - A Report Commissioned by the Norwegian Mapping Authority"

[53] ABS: "Navigating the Northern Sea Route - Status and Guidance"

[54] Smith, Laurence C. & R. Scott Stephenson (2013): "New Trans-Arctic Shipping Routes navigable by Midcentury"

[55] Stephenson, Scott R., Laurence C. Smith, Lawson W. Brigham & John A. Agnew (2012): "Projected 21st -century changes to Arctic marine access "

ON CRUISE TOURISM

[56] Social Sciences and Humanities Research Council of Canada: "Cruise Tourism in Arctic Canada"

[57] Marquez, Janet, R., & Paul FJ Eagles (2007): "Working Towards Policy Creation of Cruise Ship Tourism in Parks and Protected Areas of Nunavut"

[58] Norwegian Ministry of Trade and Industry (2012): "Destination Norway - National Strategy for the Tourism Industry"

[59] Icelandic Tourism Board (2013): "Tourism in Iceland in figures"

[60] Adventure Travel Trade Association, The George Washington University & Vital Wave Consulting (2011): "Adventure Tourism Development Index - 2011 Report"

[61] The George Washington University School of Business, The Adventure Travel Trade Association and Xola Consulting (2010): "Adventure Tourism Market Report"

[62] The George Washington University & The Adventure Travel Trade Association (2013): "Adventure Tourism Market Study 2013"

[63] European Cruise Council (2013): "The Cruise Industry - Contribution of Cruise Tourism til Economies of Europe 2012 Edition"

[64] ITB Academy (2013): "ITB World Travel Trends Report 2013/2014"

[65] UNWTO (2014): "UNWTO Tourism Highlights - 2014 Edition"

[66] UNWTO (2014): "Tourism Towards 2030 - Global Overview"

[67] UNWTO (2014): "Annual Report 2013"

OTHER

[68] UNCTAD (2013): "Review of Maritime Transport 2013"

[69] Maritime Authority (2014): "Employment and production in the Blue Denmark"

[70] The Danish Government (2012): "Denmark in work – Plan for Growth in the Blue Denmark"

[71] NIRAS (2013): "The Blue Jutland"

[72] Danish Industry (2013): "benchmark"

[73] Working Group on accidents within the SAR area in Greenland (2007): "Report on accidents within the SAR area in Greenland"

[74] Man Diesel & Turbo: "Ice classed Ships - Main Engines"