The Impact of a Warming Arctic on International Shipping

Transit Traffic along Arctic Routes – Developments, Opportunities and Imponderables

Oliver Thorsten Ried

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Abstract

This book aims to provide a picture of today's developments, opportunities and imponderables for Arctic transit shipping in both the Russian and Canadian Arctic with hands-on information for shipowners, environmentalists and representatives of international governmental bodies. The image of a potentially soon navigable Arctic Ocean has stirred worldwide public attention but was too often blurred by factually incorrect sensationalism and geopolitical sabre-rattling. This book offers a realistic overview of what we can expect from Arctic Shipping, how soon opportunities will develop and what difficulties remain to make the century-old dream of a shortcut from Europe to Asia reality.

First, the recent macro environment for shipping along Arctic routes is investigated. This includes an analysis of climate models, sea ice projections and local conditions from a seafarer's point of view. How long will the navigable season become in the future? How reliable are those predictions and does that mean that by the end of the century the Arctic Ocean will be a shipping lane like the Suez Canal today? Further, available infrastructure, legal controversies and environmental issues are presented.

Second, the suitability of potential new routes for commercial traffic is discussed. This comprises a review of present-day studies on profitability, identification of key performance factors and an evaluation of interviews conducted with leading industry representatives. The book answers the question whether the Arctic routes are at all compatible with modern liner shipping and for which shipping sectors it might be particularly interesting.

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List of Abbreviations

ACIA	Arctic Climate Impact Assessment
AMAP	Arctic Monitoring and Assessment Programme
ARCDEV	Arctic Demonstration and Exploratory Voyage
ARCON	Arctic Container
ARCTIS	Arctic Resources & Transportation Information System
Atmos. Environ.	Atmospheric Environment
AV	Akademiker Verlag
AWI	Alfred Wegner Institut
B Ins	Business Insurance
BB	Bond Buyer
C	Celsius
CAGR	Compound annual growth rate
CCG	Canadian Coast Guard
DGPS	Differential Global Positioning System
DNV	Det Norske Veritas
e.g.	example given
e.V.	eingetragener Verein
Ed.	editor
EEZ	Exclusive Economic Zone
ESA	European Space Agency
et al.	and others
FESCO	Far East Shipping Company
ft.	foot
Frhr.	Freiherr
Geophys. Res. Lett.	Geophysical Research Letters
GISS	Goddard Institute for Space Studies
GPS	Global Positioning System
HJIL	Heidelberg Journal of International Law
HSVA	Hamburgische Schiffsbau Versuchsanstalt
HWWI	Hamburgisches Welt Wirtschafts Institut
IAME	International Association of Maritime Economists
IGARSS	International Geoscience and Remote Sensing Society
IMO	International Maritime Organization
INSROP	The International Northern Sea Route Programme
Int J Prod Econ	International Journal of Production Economics

INTERTANKO	International Association of Independent Tanker Owners
IPCC	Intergovernmental Panel on Climate Change
J Transp Geogr	Journal of Transport Geography
J. Geophys. Res.	Journal of Geophysical Research
LIBOR	London Interbank Offered Rate
Mio.	Millions
NEP	North-East Passage
nm	Nautical mile
No.	Number
NOAA	National Oceanic and Atmospheric Administration
NSR	Northern Sea Route
NWP	North-West Passage
Ocean Coast. Manage.	Ocean and Coastal Management
p.a.	per annum
PAME	Protection of the Arctic Marine Environment
PNAS	Proceedings of the National Academy of Science
Pol Geo	Polar Geography
pp.	pages
RFR	Required Freight Rate
RUB	Russian Rouble
SAR	Search and Rescue
Sci G Sec	Journal of Science and Global Security
SIPRI	Stockholm International Peace Research Institute
SRES	Special Report on Emissions Scenarios
SWIPA	Snow, Water, Ice and Permafrost in the Arctic
t	tonnes
TEU	Twenty-foot equivalent unite
TRANSPORT RES A-POL	Transportation Research Part A: Policy and Practice
TRANSPORT RES C-EMER	Transportation Research Part C – Emerging Technologies
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
USD	US Dollar
VHB	Verband der Hochschullehrer für Betriebswirtschaft e.V. (German Academic Association for Business Research)
Vol.	Volume
WTO	World Trade Organization

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Paris, May 2014

To my grandfathers, who I never met but who passed on the explorer gene.

CHAPTER I

Introduction and Preliminary Thoughts

1. Introduction

Global warming is a truly international challenge with wide ranging effects on people's lives all over the globe. It took governments years to acknowledge that climate change is actually happening and that it is not only going to affect natural ecosystems but it is also going to have far reaching consequences for our economy. Suddenly we find ourselves in the middle of this process that is changing the face of the world as we have known it for hundreds of years. Nowhere on earth are these changes as rapid and as severe as in the polar regions of our planet. Retreating sea ice has rekindled dreams of polar sea-ways to the riches of the Far East. It is the same fever that has pushed businessmen, explorers, military commanders and adventurers to seek the unknown passage through the impassable ice barriers of the high latitudes for centuries. What was tea, spices and gold in the old days is oil, iron ore and mass-manufactured T-shirts today. The motivation is the same: To find shorter, faster and cheaper routes for our trading fleets.

When the two non-Russian ships, the German heavyweight vessels 'Beluga Fraternity' and 'Beluga Foresight', completed their journey through the North-East Passage in 2008, the international press celebrated the beginning of a Golden Age of Arctic Shipping.[1] Six years later enthusiasm has subsided and made way for a somewhat more realistic view on the matter. Whether the new routes will play a significant role in the future is not only dependent on theoretical distances and climate but also on a variety of other factors.

This thesis will give a comprehensive overview of the current situation and realistic future developments. To the best of my knowledge no recent study exists that covers the state of research with a special attention on the economic implications for shipping companies and provides hands on information for practitioners. This work will attempt to close this gap. The focus of this study is on the suitability of the North-West and North-East Passages for transit traffic. The issue of commodity exploration is related but out of scope of this study und will therefore only be touched upon briefly.

[1] See EL-Sharif, Y., Der Spiegel, 2009.

1.1 Hypotheses and Research Question

This leads to the overall research question of this study: Will the melting of Arctic ices revolutionize international trade in the foreseeable future? In order to evaluate that I will examine the following hypotheses:

Hypothesis 1: Climate change will make it technically feasible to use the North-East and North-West Passage on a regular basis in order to shorten international shipping routes for trade vessels.

Hypothesis 2: The economic environment, regulatory framework and available infrastructure will make it commercially attractive for shipowners to use the new shipping routes.

1.2 Structure

The two hypotheses structure the thesis into two main parts, which are accompanied by an introductory section and a conclusion.

Chapter I, the introduction, contains some general preliminary remarks followed by a clarification of geographical connotations. The definition of the Arctic as such and the North-West/North-East Passage in particular will later be important especially when it comes to its legal status. Furthermore potential routes along the northern coast of Russia and through the Canadian Archipelago will be introduced. This is followed by a short overview of the historic development of commercial activity in the Arctic. A characterization of today's trade flows and shipping industry will conclude the introductory section. This last part will illustrate why transcontinental shipping is of vital importance for world economy and shortly outline major global trends in the shipping industry. Finally the alternative routes through the Suez and Panama Canal will be presented.

Chapter II broadly speaking contains the actual analysis. It is divided into the two main parts according to the two hypotheses introduced earlier. Part 1 starts out with a descriptive macro analysis of today's shipping conditions in the Arctic in terms of ice development and other general conditions that are decisive for potential regular shipping. It sets the stage for the micro perspective of the individual shipowner that is presented in Part 2. It begins with a retrospective analysis of sea ice developments in the Arctic and then depicts global continuing trends. Particularly relevant from the seafarer's point of view are Ice Thickness, Ice Extent and Ice Age that will be illustrated in detail in section 1.1.1.

This is followed by an outlook on future climate projections and general sea ice prognoses. Section 1.1.3 will then apply the overall trends as described above to the specific regional areas relevant for this study. This contains an examination of the regional and local ice conditions as well as specific routes in the Northern Sea Route, the North-West Passage and also on a still hypothetical Transpolar Seaway. Arctic shipping operations are a highly arduous endeavour and success is dependent on a lot more than just favourable ice conditions. Therefore section 1.2 will be dedicated to the additional challenges and imponderables associated with Arctic shipping that shipowners have to take into consideration. First of all, any form of operation is and will in the foreseeable future be subject to severe weather, extreme cold, darkness and quickly changing local ice conditions that remain extremely difficult to forecast. Secondly, Arctic shipping is to the present day limited by the absence of appropriate infrastructure. Infrastructure in this context means anything from suitable ports, search and rescue facilities, oil-spill response mechanisms, appropriate ships and icebreaker support to practical basics such as repair services and other maintenance functions. Thirdly, the Arctic has become a strongly disputed geographical area that is still reason for legal contradictions between the surrounding countries and other powers with strategic interests. Shipowners might be discouraged by the legal uncertainty that is still associated with the new routes. This section will be concluded by an elaboration on the bureaucratic procedures that have to be undergone to get passage approval from the authorities. Fourthly, an augmented usage of Arctic waters for commercial shipping brings about increased stress for the fragile environment in the area that until now constitutes one of the very last wild and undisturbed habitats on our planet.

Part 2 moves away from the macro perspective of environmental changes that determine whether shipping is generally technically feasible towards more concrete considerations concerning profitability. The section will start out with the theoretical cost and time savings. It has to be determined whether the shorter routes in reality really lead to shorter traveling time and reduced fuel consumption. Various studies on profitability have already been conducted. In section 2.2.1 a selection of these studies will be reviewed and summarized. Often they concern different routes and are based on very different assumptions. That makes them hardly comparable. Nevertheless, they offer the opportunity to identify a range of key success factors that determine the profitability of the new shipping routes. These key factors as describe in section 2.2.2 are namely: Passage fees, bunker prices, investment costs and cost of capital, insurance premiums, and the existence of sufficient cargo flows. These academic conclusions will be followed by an overview of the shipowners' views of

the topic in section 2.3. This will help understand which of the success determinants are considered most relevant in practice. The section is extremely important as it gives a voice to the single stakeholder group who has a direct influence on the routing of their vessels. Politicians, researchers and customers may have a preference for one specific route or another, yet in the end it is the shipowners who decide which route to sail. This should be reason enough to give higher prominence to their intentions than previously witnessed in the public discussion of the topic.

Chapter III is the last chapter of this thesis and sums up the results. This chapter will answer the research question and review the hypotheses. Further it will differentiate between different shipping sectors and evaluate whether the Arctic routes are more suitable for some sectors than for others. Often new opportunities are initially taken by some pioneers in an industry who pave the way for the following crowd. Chapter III tries to identify who these pioneers might be in the case of Arctic shipping. Ultimately, an outlook on further research opportunities will be provided.

1.3 Research Approach – Methodology

This thesis is primarily based on a literature review. A secondary analysis of available academic literature and data was conducted. Since the increasing potential of Arctic shipping became publically aware in the 1990s countless studies and papers investigated the topic. This means that I had the chance to avail myself of a wide range of material. Nevertheless, as mentioned earlier it was impossible to find a recent study that provides hands on information for the industry in a regionally inclusive manner. A work that summarizes the enormous quantities of available data seemed to be missing. Therefore this thesis is based on the work of its predecessors and attempts to be as inclusive as possible instead of collecting own data that again would only be able to cover a very specific part of the issue due to practical limitations.

Especially in Chapter II this study is entirely dependent on external sources and their climate models. I do neither possess the means nor the knowledge to evaluate the accuracy of these observations and forecasts. But as this is not a climate science work this is also not the aspiration of this thesis. To nevertheless ensure a certain level of objectivity a number of different models from independent research institutions were used. In cases of significant discrepancies between models these different opinions are indicated and discussed. In cases of minor discrepancies sound averages will be used.

In order to test the first hypothesis this study reviews several climate models and past ice developments to derive predictions for future sea ice conditions. Whether it is technically feasible to use the Arctic Seaways is predominantly dependent on ice conditions. Several successful passages have demonstrated that it is generally possible but the question is if these passages will remain exceptions under unusually favourable conditions or if they are going to become the norm in the foreseeable future.

Regular passage traffic will ultimately be directly contingent on the length of the navigation season. Key questions to test the first hypothesis are therefore: How long is the navigation season today? How long will it probably be in 20, 50 or 100 years? How does climate change affect the key factors ice thickness, ice extent and ice age? Can shipowners rely on an entirely ice-free Arctic during the summer months in the future? What about the winter season? Which parts of the passages usually face the most severe ice conditions? And how will the changes affect these specific areas?

Just because changing environmental conditions might make it technically feasible to sail formerly ice-covered waters does not necessarily mean that it will also be economically attractive. Eventually the financial attractiveness will determine the number of commercial vessels in the Arctic though. To test the second hypothesis a number of recent studies on profitability will be reviewed and key success parameters identified that influence the cost-effectiveness of the new routes.

As mentioned earlier the shipowners play a crucial role in the evaluation of the second hypothesis. To get an impression of their attitude towards the new routes, which is naturally determined by economic considerations, this thesis reviews the 2011 study by Lasserre and Pelletier[2] and contributions of industry delegates to international conferences[3].

Further I sought direct contact with shipowner representatives whose input was gathered through unstructured interviews. The interviews with representatives of leading shipowner associations were conducted between February and April 2014. It is the aim of this thesis to be of practical value for the shipping industry and therefore needs to contain practitioners' opinions. Their input is highly valuable. The following institutions were contacted to ask for their contribution:

[2] See Lasserre, F./Pelletier, S., J Transp Geogr, 2011, pp.1465-1473.

[3] See for example: Soether, R., Northern Sea Route, 1999, pp.35-38.

- Armateurs de France (French Shipowners' Association)
- Verband Deutscher Reeder (German Shipowners' Association)
- UK Chamber of Shipping
- Norges Rederiforbund (Norwegian Shipowners' Association)
- Danmarks Rederiforening (Danish Shipowners' Association)
- China Shipowners' Association

These contacts were chosen because they represent a good selection of potential Non-Russian users of Arctic Sea routes but do in no way claim to be exhaustive.

The following people agreed to speak to me:

- Simon Christopher Bergulf (representing Danmarks Rederiforening)
- Charlotte Demeer Strøm (representing Norges Rederiforbund)
- Daniel Hosseus (representing Verband Deutscher Reeder)
- Patrick Rondeau (representing Armateurs de France)

A complete transcript of these interviews can be found in the appendix. This small sample did not allow for any statistical analysis. Therefore all quantitative tools were rejected in favour of a qualitative analysis, which appears to be the only meaningful approach.

Key questions to test the second hypothesis are: What are the main success factors that determine the profitability of the new routes apart from ice conditions? Under what circumstances will Arctic operations be profitable? Operations between which ports are actually in the catchment area of the North-West/North-East Passage? For which will the classical routes always be favourable? Are shipowners planning to start regular Arctic operations in the near future? If not, what do they consider to be main obstacles?

Important sources of information in general were libraries and online resources.

The following libraries were used:

- The Library of HEC Paris
- Deutsche Nationalbibliothek in Frankfurt and Leipzig (German National Library)
- Private Collection of Nautical Literature Fritz Ried

Important online collections that were used are:

- Business Source Complete, EBSCO Host
- LexisNexis
- ScienceDirect (Elsevier)
- Google Scholar

Significant databases for statistics and basic data that were used are:

- Alfred Wegener Institut – Helmholtz Zentrum für Polar- und Meeresforschung (AWI)
- National Snow and Ice Data Center at the University of Colorado (NSIDC)
- Arctic Monitoring and Assessment Programme (AMAP)
- The Northern Sea Route Information Office
- NASA Scientific Visualization Studio
- Arctic Council – Arctic Marine Shipping Assessment

To receive an accurate picture of the current situation only very recent studies will be considered. This seems appropriate because in the last 10 years ice conditions in the Arctic have changed to a degree that was unpredictable 20 years ago. Furthermore due to political changes especially in the Russian Arctic information from before 1990 are either not available or can only be used to a very limited degree. Naturally this constraint is only relevant for issues that are subject to these recent changes.

Additionally the trustworthiness of the sources used is considered. To assess trustworthiness this study relies on the peer review provided by VHB Jourqual[4]. In the majority of the cases a peer review is not available though. In these cases it will be evaluated whether the publication was made by a trustworthy source such as renowned universities or international organizations.

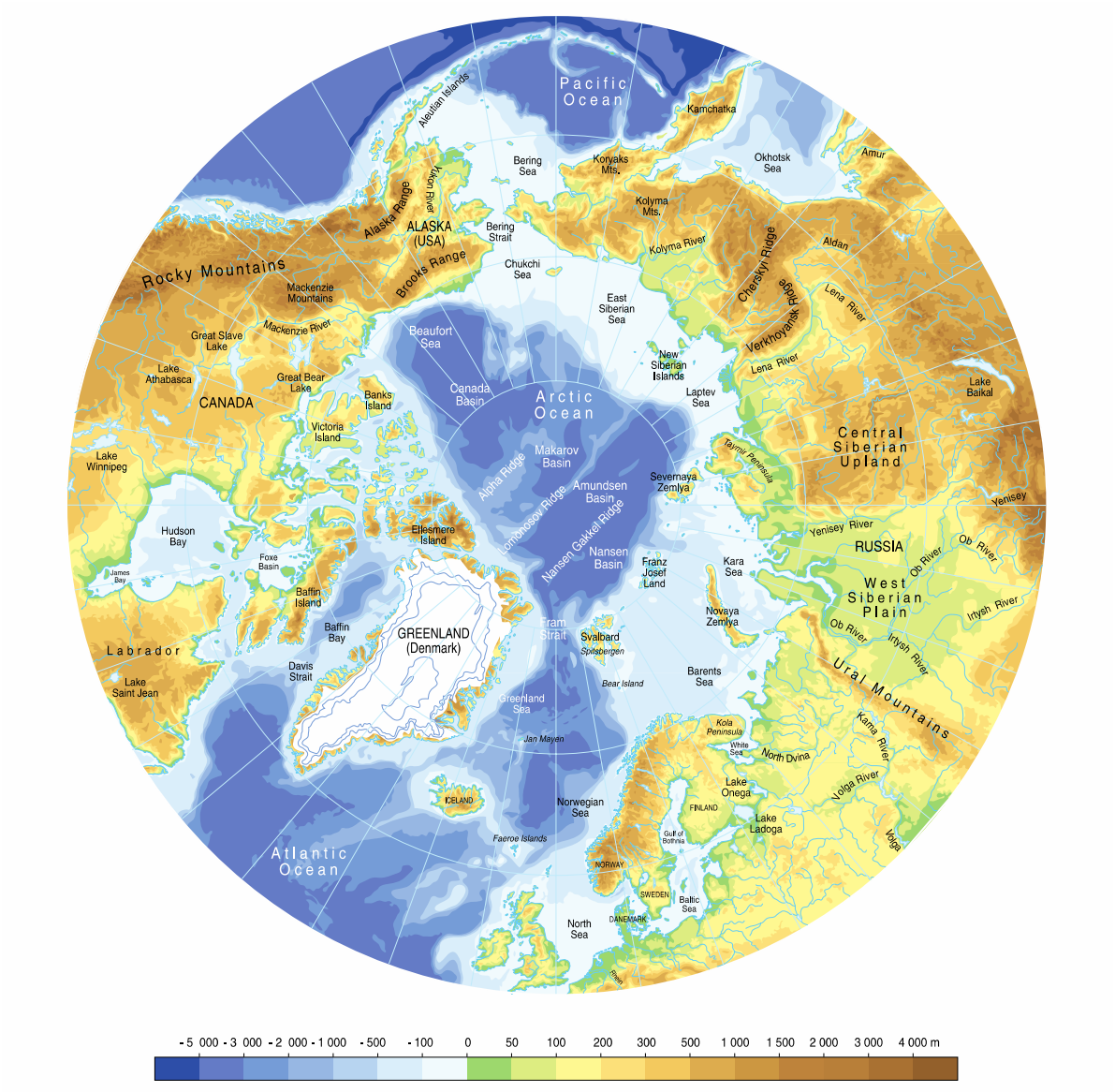
The bibliography follows the standards published by HEC library.[5] The footnotes contain journal articles in the format '*Author, Journal Name (abbreviation), Year, Page*', books in the format '*Author, Keyword, Year, Page*' and online resources in the format '*Author, Keyword, URL, Citation Date'.*

[4] Journal ranking by the German Academic Association for Business Research, available from: http://vhbonline.org/en/startpage/.

[5] Available from: http://www.hec.edu/Library/Information-tools/Research-guides.

2. Geographical Denotations and Range of this Study

Figure 1 Topographic view of the Northern Polar Region



Source: AMAP, Assessment Report, 1998.

This study analyses potential shipping routes through the Arctic Ocean with a focus on transit shipping. Thereby it considers all realistically imaginable routes that connect the Atlantic and Pacific Ocean through the seas in the north of the American and Eurasian continent. The two possibilities that immediately come to mind are the two legendary passages that lead along the northern coast of Russia and Norway, The North-East Passage and through the Canadian Archipelago and along the northern coast of Alaska, The North-