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Arctic Northern Sea Route prospects, obstacles & Chinese stance

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ARCTIC NORTHERN SEA ROUTE
PROSPECTS, OBSTACLES & CHINESE STANCE

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DECLARATION

I certify that all the material in this research paper that is not my own work has been identified and that no material is included for which a degree has previously been conferred on me.

The contents of this research paper reflect my own personal views and are not necessarily endorsed by the University.

(Signature):  .....

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ABSTRACT

Title of Research Paper:	**Arctic Northern Sea Route – Prospects, obstacles & Chinese stance**
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Since the Arctic region is turning bluer, as a consequences of climate change, a long awaited dream to use Arctic waters for commercial maritime transportation and establishing it as one of the primary maritime routes are taking shape.

The entire region can be trifurcated into three maritime zones or routes namely Northern Sea Route or Northeast passage-NSR/NEP, North West passage-NWP and Trans Polar or Trans Arctic. Looking at the existing and projected ice conditions prevailing in the area, NSR/NEP is extremely attractive to the maritime industry, when it comes to the available navigable waters and seasonal time to do so around the year. Moreover, availability of immense natural resources can generate ship's employment opportunities and can meet with the world future needs. Furthermore, its inherent advantage of being the shortest route connecting East Asia with Europe/N. America is looked as an alternative to the Suez Canal/Panama canal and has created a lot of buzz in the maritime fraternity.

Therefore, NSR potentials cannot be ignored or denied; yet many believe that they are exaggerated. There are several parameters, criteria's, issues and considerations, which need to be, identified, examined, evaluated and verified to judge the attractiveness and reliability of the Northern Sea Route. Notably emerging China is a key player in this gamble, leading the game. She needs to be studied to ascertain NSR future commercial viability.

Key Words: Arctic, Climate change, NSR/NEP, NWP, Trans Polar/Trans Arctic, China, Commercial viability

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List of Abbreviations

AMSA	**:**	Arctic Shipping Marine Assessment
ARCOP	**:**	Arctic Operational Platform
ASEAN	**:**	Association of Southeast Asian Nations
BRICS	**:**	Brazil, Russia, India, China and South Africa
EEZ	**:**	Exclusive Economic Zone
EIA	**:**	US Energy Information Administration
IAME	**:**	International Association Of Maritime Economists
INSROP	**:**	International Northern Sea Route Program
IMF	**:**	International Monetary Fund
IMO	**:**	International Maritime Organization
ISM	**:**	International Safety Management Code
IPCC	**:**	Intergovernmental Panel on Climate Change
JANSROP	**:**	Japan Committee For The Northern Sea Route Project
MARPOL	**:**	The International Convention for the Prevention of Pollution from Ships
MEPC	**:**	Marine Environment Protection Committee
MSC	**:**	Maritime Safety Committee
LNG/LPG	**:**	Liquefied Natural Gas / Liquefied Petroleum Gas
NASA	**:**	National Aeronautics and Space Administration
NOAA	**:**	National Oceanic and Atmospheric Administration
NSR	**:**	Northern Sea Route
NWP	**:**	Northwest Passage
OPEC	**:**	Organization of The Petroleum Exporting Countries
SOLAS	**:**	The International Convention for the Safety of Life at Sea
SONAR	**:**	Sound Navigation And Ranging
TEU	**:**	Twenty-foot equivalent unit
TPP	**:**	Trans Polar Passage
UN	**:**	United Nations
UNCLOS	**:**	United Nation Conention on the Law of the Seas
USD	**:**	United States Dollers
USGS	**:**	United States Geological Survey

1. Introduction

1.1. Background of Dissertation

Today one of the major threat human kinds is encountering is the problem of global warming. Global warming and climate change both refer to the observed century-scale rise in the average temperature of the Earth's climate system and its related effects (Global warming, n.d.). The gravity of the issue can be very well judged by the fact that the year 2014 ranks as Earth's warmest since 1880, according to two separate analyses by NASA and NOAA scientists (NASA, 2015). In view of this UN climate change conference was held in Lima, Peru from December 1 to 12; 2014, where world leaders and diplomats negotiated to cut off the greenhouse gas emission, the primary source of global warming. If not controlled now, it may have catastrophic results in future. Many of them can be observed these days. Reduction of Arctic ice cap is one of them, which continues to warm at twice global rate as suggested by some scientists and studies.

However, this reduction in ice cover over the Arctic region, is also seen as an opportunity for the shipping industry to explore the Arctic shipping routes, one of them is the Northern Sea Route, sometimes also identified as Northeast Passage. Which otherwise was inaccessible because of the heavy ice conditions almost throughout the year, making navigation conditions near to impossible.

The Northern Sea Route is in focus because of its inherent advantage of being the shortest to connect the land of some of the world largest trading Nations i.e. East Asia with Europe/North America. Thus, it is looked upon as an alternative to the Suez Canal, Panama Canal and Cape of Good Hope transits. Moreover, commercialization of this area will also boost up the exploitation of immense oil, gas and other mineral resource reserves in view of the ever increase demands and shrinking natural resource deposits. Outside OPEC countries, Arctic region is the biggest source of energy reserves in the world. This is one of the prime factors that so many nations and international agencies are running their program like Japan Committee for the Northern Sea Route Project (JANSROP), Arctic operational platform (ARCOP), Arctic shipping marine assessment

(AMSA) and International Northern Sea Route Program (INSROP) in search of future prospects. These nations include both Arctic as well as the Non-Arctic States like China, Japan, South Korea and India.

In view of globalization, it is expected that such efforts will move ahead much faster than before. Feasibility of such likelihood is still doubtful and under evaluation as economically there are several factors that need to be considered before judging the attractiveness. Being the shortest route can never be the standalone criteria. Above that the entire Arctic area is environmentally sensitive and unique in itself, any interference with the ecological or environmental system due to commercialization may exaggerate the problem of diminishing ice cover over the Arctic area. This will also add up additional dangers like oil spill danger, dangers from ships ballast waters, impact on and rights of indigenous people.

Besides aforementioned threats, we are still far beyond to effectively address some of the challenges the shipping industry would very likely to face during NSR transit. The availability of infrastructure, navigational aids, search and rescue, communications, trained manpower, emergency response program are some of the examples, but the list is not exhaustive.

China being one of the fastest growing economies in the world is expected to lead. The ever-growing Chinese interest particularly in last five years, in NSR is motivated by its immense hunger for hydrocarbons, countries food security issues, as agriculture products output are influenced from varying Arctic environment and its quest to find economic ways to transport its industrial products as well raw materials. Furthermore, this will also help China to establish its power and supremacy in the region and subsequently in the world forum.

NSR can be established as a backbone of international shipping between Asia and Europe/North America. Looking at its significance an intensive analysis of the entire prospects is required before proceeding furthermore in order to be assured about the

desired benefits shipping industry is looking forward from it. Commercial viability or use of NSR cannot be realized without the contributions from an economy like China.

1.2. Dissertation Topic Area

Business is all about grabbing the profit and transforming difficulties into opportunities. The saying fits perfectly to NSR and maritime industry. Due to this it is in the limelight today. The expected blue Arctic waters is the prime reason which is pushing the idea of using Arctic region as a bridge between two oceans i.e. Pacific Ocean and the Atlantic Ocean or we can say between East Asia and Europe/North America markets. Nevertheless, how strongly it can serve its intended purpose is a debatable question even today.

Theoretically the picture looks very glossy, as an example in a trip from Rotterdam; Netherlands to Shanghai; China the distance travelled can be reduced significantly up to 24 percent, which is almost a quarter less than sailing through the Suez Canal. This distance is equivalent of 15 valuable sailing days. However on the contrary the practical scenario and truth is far matte.

Everyone is running and trying to acquire the first position in the queue. Even Non-Arctic states like India, Japan, China, Singapore and South Korea are keen to investigate and grab the opportunity at its first attempt. Recently the news of China attaining the rank of observers in the Arctic Council has made the headlines in the maritime field also. China as a main contender, its stance on NSR is of utmost importance.

Although this topic is not new in the shipping fraternity but it is always subjected to further discussion and evaluation. Everyday with new findings, predictions, and changing world scenario it is likely to remain burning issue and a favorite topic for a considerable time from now.

1.3. Dissertation Purpose

The principal purpose of this dissertation is to evaluate the attractiveness of the Arctic Northern Sea Route, which is highly awaited and anticipated by the shipping industry. A major portion of the dissertation is focused on two broad aspects viz. environmental and economic, which will go side by side. These two key central area will cover other subject matters concerning NSR like the cargo flow, legal, technological, human resource, infrastructural, facilities, risk management, operational costs and others. As these are some of the key variables making a maritime route lucrative for profit generation. This will also help the reader to understand the enormous potential of the Arctic shipping and its impacts. Since this opportunity is derived out of the environmental concern of global warming, it is critically important to estimates Arctic shipping impression over the environment additionally the consequential commercial paybacks, which will lead to increase marine traffic in the region through economic analysis.

After evaluating the entire scenario, a brief analysis of Chinese stance will be carried out. This is imperative to the subject matter considering China's growing power, strategic location and influence in the region and global matters. China intentions regarding NSR and Arctic region is also quite discussed and debated ever since NSR commercial use is anticipated.

1.4. Dissertation Significance

From many years, NSR is seen as a bridge bringing major trading nations closer and a driver to speed up the transit time thus saving millions of dollars on every trip. However, it is until the 21st century, which gave us a chance to exploit this opportunity commercially for the first time. Thus, its significance cannot be neglected or underestimated.

Since 2008, when the global crisis hits shipping industry, it has not been fully recovered yet. It is the longest ever downturn in the maritime sector observed till date. It is now established that shipping cycles are no longer relied upon. Earnings are still to go a long

way before they can reach its historic peak. Shipping companies are not only struggling to save every penny possible, but they are required to follow new regulatory requirements. Ever-escalating bunker fuel prices, which contributes a major portion of the entire operating costs and piracy concerns in Indian Ocean / Malacca Strait region particularly has generated immense commercial interests over NSR thus has increased the significance of the Northern Sea Route. On top of this the fragile political situation in Egypt, which have authoritative control over the Suez Canal is also bothering the shipping fraternity. The area is also seen as world future energy reservoir, which augments its significance furthermore.

Human interference in the Arctic region, with shipping activities will unquestionably have an impact on the environment. Carbon footprints in the region are likely to increase along with others threats arising directly or indirectly. Pollutions from ships in any form either through operational or accidental need to be addressed effectively. An ozone hole in the Arctic is expected to grow larger over the coming decades as a result of man-made greenhouse gas emissions, which may cause climate change, before recovering after 2020 ("The ozone hole", n.d.). The region is also home for some of the world most fragile and unique flora and fauna species, thus ecologically sensitive. Any sort of outside invasion (dangers from ship's ballast water) or destruction of their habitat in any form is a serious matter of concern. Air pollution generated from ships may further help the Arctic ice to thaw at a faster rate, exaggerating the existing global warming issue. So, it has got environmental significance also. The commercial benefit we are looking from the NSR is at a certain expense and environment has to suffer the most. We have to thus decide what we can lose and to what extent we can go to get those benefits, which we are awaiting.

Chinese diplomacy and intentions over Arctic region is a bit difficult to understand. From hard to soft stands China always tried to show its existence and rights over the area even though she is not an Arctic State. To develop an effective framework of future

development and commercialization of this area and to maintain peace in the world, China's concerns, interests and intentions is significant undoubtedly.

1.5. Dissertation *Restrictions*

This research paper is an attempt to have a brief impression of the entire topic area giving readers a handy approach on the subject, as the evaluation of attractiveness of the Arctic Northern Sea Route is a very complex and requires data or further research which is out of bounds of writers available resources, facilities, time in hand and scope of this research paper. Looking into this, very selective and important parameters are taken into considerations to come up with the most viable and practical conclusions.

Even the most significant contemporary research program on NSR i.e. the International Sea Route Program (INSROP), who's massiveness stems from the facts that it last for almost six years with participation of about 390 leading researcher from 14 different countries around the globe resulted in 167 reports on the natural, social, economic, legal and environment aspects of the NSR concluded that additional research is desirable in some of its reports.

Additionally, it is hard to collect sensitive financial data, which is up-to-date, according to the market conditions. Companies / individuals are not interested/allowed to reveal such information to open sources. Very limited data can be found through popular sources like Internet or companies websites.

1.6 Literature Review

Researchers and scholars have carried out extensive work to explore, exploit and/or to evaluate potentials and impacts of commercial shipping along the Northern Sea Route, to highlight its attractiveness. Notably most of these studies are either comparative in nature with respect to the distance advantage or overall cost saving taking into accounts various parameters of the NSR against the traditional maritime route via Suez Canal/Panama Canal or focused on addressing specific critical issues like environmental, legal framework, navigational/climatic challenges etc. regarding NSR.

Some of these studies are extensively vast like the INSROP, AMSA even lasting for several years with efforts and inputs from highly established and recognized scholars around the globe and backed by several national / international private and/or public sector organizations. This literature review is an attempt to demonstrate the same. In order to have an organized and more logical presentation, it has been sub-divided into the different area of principal focus.

Economic Perspective

Halvor Schøyen and Svein Bråthen (2011) have carried out a comparative study of the Northern Sea Route with the Suez Canal, which was focused on bulk shipping prospects. It was found out that the shortest distance of NSR could significantly (more than double) increase the operational energy efficiency performance of the ship. However, the schedule reliability of the route is doubted and hence it was suggested that to be explored by tramp shipping and found not suitable for liner shipping operations. The minor bulk trade was found to be commercially profitable and worthy for supply chain with seasonality as the major limitation of the NSR.

Frédéric Lasserre (2014) attempted to evaluate the effort at modeling the profitability of Arctic shipping routes by different scholars from 1991 until 2013 with particular significance to the container trade. The majority of these models are very optimistic about the profitability assumption of the Arctic route and focused on cost analysis only. Notably the results differ according to the chosen parameter. However, the author included market considerations also in his studies along with partial conclusions from the past studies and has further gauged these findings.

Frédéric Lasserre and Sébastien Pelletier (2011) first time attempted to study the intentions of the ship owners one of most important stakeholders, who can contributes in the economic growth and development of the Arctic routes like NSR. The study was conducted with the help of the responses from 98 companies and was focused on finding ship owners interest areas in developing activities in the Arctic region. Besides examining the potential development of shipping in Arctic routes, this research must be

replaced in the context of intense competition between shippers, competition that makes both service reliability and costs of transport paramount and in this competition structure, the benefits of established routes between major hubs seems to prevail, so that new routes have difficulty being established.

The study concluded that ship-owners are desperately trying to cut fuel cost and increase their rotations in these hard economic conditions. Arctic routes being the shortest to connect Asia with Europe and present Arctic ice conditions particularly in the summer season there are very likely chances of an explosion in the transit traffic. However, the ship-owners intentions reflect the opposite picture. Most of the shipping traffic is not transit rather it is to serve the local Arctic establishment or related to natural resources exploitation. Moreover, container sector is not showing any enthusiasm and bulk sector remains caution about the Arctic commercial use. These findings found to be aligned with the AMSA 2009 report, which predicts the similar future for the route.

Frédéric Lasserre raised some of the critically significant questions at a roundtable discussion in Reykjavik one of which was “Are the Northern Sea Routes really the shortest? “ Svend Aage Christensen (2009) addressed his concerns through Danish Institute for international studies brief. After evaluation of different possible important trading routes, it was found that the results are quite mixed in nature and it is now too early for us to come to conclusions as some of the route may not be relevant for navigation and with changing patterns of trade it is difficult to evaluate the importance of individual routes. Moreover, we are also required to take care of the climate prognosis.

Another study, which is not aligned with the outlook of many that NSR, can serve as an alternative to Suez is by Albert B., et al. (2014) which argues the potentials of the NSR is questionable as we are required to tackle governance, technological, infrastructure, navigational and resources challenges first. They debated that above-mentioned issues offset any advantages of connecting Atlantic with Pacific via NSR. The prevailing ice

cover and market conditions or trends in international trade, however, will facilitate NSR to become a seasonal alternative only but not as the replacement for the Suez Canal.

Claes Lykke Ragner (2000) report attempted to gauge the NSR commercial potential and economic importance. It does so by first making a survey of past and present Northern Sea Route (NSR) cargo flows then the route's economic potential and importance, both as an international transit route and as a transport Corridor to and from the Russian Arctic regions, is discussed, before forwarding estimates of future cargo potential. The majority of data used in the report is extracted from the INSROP project. The report concluded that cargo flows of traditional items like timber, Coal will be expected to stay at the present level however in the hydrocarbon sectors it is likely to increase sharply. The use of NSR as a bridge between Asia and Europe is suspicious with present fees as operations in that region is not profitable. In coming year NSR will further lacks behinds due to immense shortage of icebreaking capacity, which is not going to get better considering the fact that the Russian government is not willing to invest several billion dollars into it.

Environmental Perspective

An analysis of the simulations of the Arctic sea ice characteristics affecting the navigation along the NSR and NWP performed by global climate models in comparison with observations, was done by Khon V. C. et al. (2010) The A1B scenario of the IPCC model anticipated that by the end of 21st century the navigable season (without icebreaker escort) will be stretched along NSR with a free passage from 3 to 6 months. Subsequently there will be 15% decrease in the year-round transit from Europe to East Asia when compared with the Suez transit. This will result in the increase marine traffic along the route and consequently greenhouse gasses emission, which will have a substantial environmental impact.

In another similar research efforts to project 21st century access to the Arctic marine environment for a spectrum of ship classes and climate change scenarios was conducted

by Scott R. S. et al. (2013), In all climate scenarios, marine access to Arctic region is projected to increase thus in view of the predicted future increase in the navigable season along the Arctic area, different ships classes (Polar & open water) were examined for accessibility and feasibility prospects. It was found that polar classed ships would remain more important than open water ships for operation in Arctic regions.

Looking into NSR importance it is critically required to monitor the sea ice conditions on a daily basis. This will not only facilitate navigation but also can be used and applied in/to several numerous services like search & rescue or exploration. The only way to do that is by, remote sensing a highly modern, advanced and sophisticated method of monitoring with the help of satellites. All the info and data related to this is compiled in a book named Remote Sensing of Sea Ice in the Northern Sea Route Studies and Applications by Ola, M. J., et al. (2007). This book covers a range of topics related to the monitoring of sea ice conditions in support of navigation in the Northern Sea Route.

Legal Perspective

Arctic regime geopolitical and legal issues are one of the focused areas, which are of specific importance looking into immense economic, social, environmental impact and potential of the Arctic region. IMO is the most active and authentic international organization working in developing and implementing an accepted legal framework in the Arctic region. IMO Guidelines for Ships Operating in Arctic Ice-covered waters is one of such attempt made by the IMO. Besides that, conventions and codes like UNCLOS, SOLAS, MARPOL, ISM and many more have its own implications over the maritime industry. Several attempts are made to address Arctic region legal, geopolitical issues and conflicts to have a peaceful establishment over the Arctic. Scholars and researchers have also carried out their own analysis and suggestions on it usually backed by national and international agencies working on this area.

An attempt to analyzes and discusses the issues raise by the IMO Guidelines for Ships Operating in Arctic Ice-covered Waters is made by Øystein J (2007). This report

explores whether there is a need for strengthened and binding shipping regulations for the safety of navigation and protection of the Arctic marine environment. Although IMO guidelines covers a wide range of issues from construction, equipment's, operations, navigation with regards to ice infected area of Arctic conditions only but there are certain issues of concerns, confusions which are unanswered and some important untouched area, which need to be addressed. Besides that's the guidelines are only recommendatory in nature therefore they are not legally binding on any party concerns.

Summary report of the study on Legal aspects of Arctic shipping conducted by the European Commission (2010) Directorate-General for Maritime Affairs and Fisheries is an important document of interest to understand the legal perspective of the Arctic. The study provides an overview of the international law of the sea, its main features, and maritime zones in the context of the Arctic marine area; discusses the international legal regime for the regulation of marine shipping; analyzes the national laws and regulations of the coastal Arctic States (Canada, Greenland, Denmark, Iceland, Norway, the Russian Federation and the United States of America); and draws conclusions and examines options for multilateral reform and consultation.

Comprehensive Perspective

The Arctic Council (2009) meeting at Reykjavik, Iceland in 2004 was held to address the critical changes and issues, associated with the Arctic. Some of these issues include climatic/Environmental matters, current and future commercial use of the area, natural resources exploitation, infrastructure and legal framework required. It was decided to carry out a comprehensive study program known as AMSA i.e. Arctic Marine Shipping Assessment. AMSA 2009 report is a result of that decision. The report got the approval at the council meeting held at Tromsø in the year 2009.

AMSA report was aimed to carry out a comprehensive study to cover a very broad perspective lying within the Arctic regions. It does not pay or ascertain attention on specific commercial routes or possible future route possibilities. However, AMSA

report covers unique information difficult to gather from any other sources, as the study is one of its own kinds, conducted for the first time in such a vast extent to study Arctic area.

The AMSA is designed to be circumpolar in breadth and also to consider regional and local perspectives. The assessment's central focus is on ships: their uses of the Arctic Ocean, their potential impacts on humans and the Arctic marine environment and their marine infrastructure requirements.

This study resulted in various recommendations and findings by the expert committee involved in gathering information, analyzing the facts and figures and drafting the report in order to save life and property and protect marine environment in Arctic waters. More specifically, all 17 recommendations fall under three broad interrelated themes: Enhancing Arctic marine Safety, Protecting Arctic People and the environment, and Building Arctic marine Infrastructure.

Arctic Council (2013) meeting held at Nuuk, witnesses the first official status report on the recommendations made in the 2009 AMSA report. The report not only highlighted the present situation but light was also drawn on some areas where further work is required to be carried out for a speedy implementing or where the scope of implementation is limited due to some underlying reasons.

Another comprehensive source of information is "Shipping in Arctic Waters" by Willy, Ø., et al. (2013), which is a result of efforts initiated by Ocean Futures in 2008. This is an authentic work of about seven scholars headed by Willy Ø, whose principle objective is to compare the three well-known Arctic routes by identifying influencing factors giving equal importance to onshore and offshore activities. The study highlights a wide range of conclusions based on the established facts, anticipations and comparison carried out by the authors.

The study, "Shipping in Arctic Waters" has a holistic/interdisciplinary approach and focuses on the Northeast Passage, Trans-Arctic Ocean shipping routes, and the

Northwest Passage. Similar efforts to study Arctic was initiated in 1993, with collaboration of three major institutes namely the Fridtjof Nansen Institute (FNI) in Norway, the Central Marine Research and Design Institute (CNIIMF) in Russia and the Ship & Ocean Foundation (SOF) in Japan. The collaboration resulted in one of the most extensive and recognized programs to carry out scientific study and research in the Arctic region and very well known as the International Northern Sea Route Program (INSROP). The massiveness of the entire program can be judged from the facts that it last for almost six years with participation of about 390 leading researcher from 14 different countries around the globe resulted in 167 reports on the natural, social, economic, legal and environment aspects of the NSR

In an attempt to collect these valuable resources of information compiled mainly from INSROP reports a book name “The Northern Sea Route-The shortest sea route linking East Asia and Europe” was published under the supervision of Hiromitsu Kitagawa. The work is the English translation of the original Japanese’s language report named "Hokkyokukai Koro". This book is a compilation of data focusing on the results of the International Northern Sea Route Program (INSROP) and on those of the collaborative domestic research project Japan Northern Sea Route-Geographic Information System (JANSROP-GIS) supported by the Nippon Foundation. It is an excellent piece of work aimed at shattering the myths associated with the Arctic. It’s finding clearly indicates that today technological feasibility is available to keep Northern Sea Route operational not only in summers but in winters also with the assistance of icebreakers facility. It also put some light on the expected work and issues required to accomplish or address before the dream to make NSR a competitive and attractive maritime route can be turned into a 21st century reality, a real boon to the shipping world.

China’s Stance

With China attaining the observer status in the Arctic Council recently, she becomes the most important Non-Arctic State, which need to be studied and analyzed. Moreover, its ever-growing economic power and dominance highlighted it further more. Chinese

scholars are also using terms like near-Arctic State instead of Non-Arctic State to reinforce this. A report prepared for the Ministry of Foreign Affairs of Denmark by Linda, J. & Seong-Hyon, L. (2013) highlighted China's policies, relationship with other States, her interests and concerned authorities, agencies pushing NSR activities. Chinese officials are making a concerted effort to focus on avoiding contentious issues, such as resource exploration and development and sovereignty claims. By advocating a focus on climate change, Chinese scholars strive to circumvent the sensitivity of Arctic resources and sovereignty issues and to calm concerns about China as a rising power.

Tang G. (2013) in her article named "Arctic issues and Chinese's stance" has very clearly identified and describes Chinese's stance with below mention four broad points.

1. China attaches importance to the changes in the natural environment of the Arctic, and actively cooperates with countries concerned to engage in Arctic scientific research.

2. China is concerned about the potential impact on global shipping and trade brought about by Arctic ice melting and hopes to engage in pragmatic and win-win cooperation with the Arctic countries.

3. China wishes to become an observer in the Arctic Council to have close cooperation with both Arctic and Non-Arctic States and make its contribution to the peace, stability, environmental protection and sustainable development in the Arctic.

4. China is willing to promote the establishment of a win-win relationship of cooperation between the Arctic and Non-arctic States.

1.7. **Dissertation** ***Methodology***

This paper will judge the attractiveness of Northern Sea Route with twofold broad perspectives viz. economic and the environment with a concise overview of Chinese stance on the NSR.

The paper wills use some of the exploratory research methods to determine the nature of the subject and helps us to have a better understanding of the research topic and of descriptive research method to present the more clear portrayal of the existing situation, which is a must to do before we can proceed further. In doing so, primarily qualitative tools will be utilized since it is difficult to quantify most of the attributes which make NSR attractive and feasible. However, where possible quantitative methods will also be incorporated.

The primary source of data will be from research analysis of scholars and information available via national and internationals stakeholders active for the issue investigated in this paper. One of such kind is the INSROP and AMSA report(s). Besides that references will also be quoted from the news and articles making a buzz in the shipping sector highlighting Northern Sea route. Reliability of online data is a big issue, therefore, to ensure that only reliable online sources are referred to.

The combination of these methods and technique will help us to judge the attractiveness in a better and more reliable way. A comprehensive conclusion will be drawn at the end, which will include some possible solutions of the existing and anticipated problems including pros and cons. Beside this, writers view focused on how this attractiveness can be perceived, as a threat or an opportunity, will also be added as concluding remarks. Overview of the Chinese stance on the topic area will also be presented at the end.

Special attention will be paid to quote the references where information is used or quoted directly expressing views and statements, which are not stated by the writers. Guidelines of ethical scientific research and APA (American Psychological association) style referencing will be adhered with at all times.

1.8. Dissertation *Outline*

Chapter-2 will provide the superior picture of the existing scenario with different options for shipping routes available in the Arctic region and NSR superiority over them. Present traffic flow and activities prevailing will be discussed in brief indicating the growth potential for the same in view of changing world economy and trading patterns. The present framework of the transportation system widely used as an alternative to the shipping route will also be highlighted.

Though as of now, use of NSR is subjected to seasonality. Only a few months in a year it can be accessible owing to severe ice conditions otherwise. **Chapter-3** will put some light on the future predictions on ice conditions and navigable months available to understand the feasibility or reliability of NSR in coming future.

Opportunities offered by NSR, which is the principle factor of it being come to limelight including some of the comparative analysis will be undertaken in **Chapter-4.** This will include brief distance comparisons between East Asian and European ports through the traditional route of Suez Canal and cost analysis of NSR in contrast with Suez focused on container transportation. The Potential of Arctic as future natural resource ground will also be discussed.

Chapter-5 will be focused on obstacles, need to be addressed beforehand so that NSR can stand in leading positions among other available existing maritime options.

Chapter-6 will concisely emphasize on China's role, interests, Policies, Contributions and stance on NSR.

Chapter-7 will draw the conclusions and writers remark based on the above-mentioned chapters evaluating the overall attractiveness of the NSR thus presenting the findings from the paper with final comments on overall Chinese perspective on the topic area.

CHAPTER 2: PRESENT SCENARIO

2.1 World Economic Background

The world economy has a deep impact on the shipping industry because shipping is a derived demand. World economy or trading pattern thus determines trade flows and in response to it, primary and secondary shipping routes. From centuries the center of gravity of world trade is North Atlantic region which include the US / Canada / and Western Europe however gradually it is shifting towards BRICS countries predominantly Asian economies like China thus moving outside the North Atlantic region for the first time. This fact can be established through world economic outlook projected by the IMF and as shown below in Table 2.1.

Table 2.1: - World Economic Outlook Projections

(Percent change unless noted otherwise)

	Year over Year						Q4 over Q4		
			Projections		Difference from October 2014 Projections		Estimates	Projections	
	2013	2014	2015	2016	2015	2016	2014	2015	2016
World Output 1/	**3.3**	**3.3**	**3.5**	**3.7**	**–0.3**	**–0.3**	**3.1**	**3.4**	**3.9**
Advanced Economies	**1.3**	**1.8**	**2.4**	**2.4**	**0.1**	**0.0**	**1.7**	**2.7**	**2.3**
United States	2.2	2.4	3.6	3.3	0.5	0.3	2.6	3.4	3.2
Euro Area	–0.5	0.8	1.2	1.4	–0.2	–0.3	0.7	1.4	1.4
Germany	0.2	1.5	1.3	1.5	–0.2	–0.3	1.0	1.7	1.3
France	0.3	0.4	0.9	1.3	–0.1	–0.2	0.3	1.2	1.3
Italy	–1.9	–0.4	0.4	0.8	–0.5	–0.5	–0.5	0.9	0.8
Spain	–1.2	1.4	2.0	1.8	0.3	0.0	1.9	1.8	1.7
Japan	1.6	0.1	0.6	0.8	–0.2	–0.1	–0.3	1.6	0.2
United Kingdom	1.7	2.6	2.7	2.4	0.0	–0.1	2.7	2.7	2.2
Canada	2.0	2.4	2.3	2.1	–0.1	–0.3	2.4	2.1	2.1
Other Advanced Economies 2/	2.2	2.8	3.0	3.2	–0.2	–0.1	2.3	. . .	. . .
Emerging Market and Developing Economies 3/	**4.7**	**4.4**	**4.3**	**4.7**	**–0.6**	**–0.5**	**4.5**	**4.1**	**5.4**
Commonwealth of Independent States	2.2	0.9	–1.4	0.8	–2.9	–1.7	–1.5	–3.5	1.8
Russia	1.3	0.6	–3.0	–1.0	–3.5	–2.5	0.0	–5.4	1.9
Excluding Russia	4.3	1.5	2.4	4.4	–1.6	–0.2	. . .	. . .	. . .
Emerging and Developing Asia	6.6	6.5	6.4	6.2	–0.2	–0.3	6.4	6.3	6.2
China	7.8	7.4	6.8	6.3	–0.3	–0.5	7.4	6.7	6.3
India 4/	5.0	5.8	6.3	6.5	–0.1	0.0	5.6	6.5	6.6
ASEAN-5 5/	5.2	4.5	5.2	5.3	–0.2	–0.1	4.6	5.1	5.5
Emerging and Developing Europe	2.8	2.7	2.9	3.1	0.1	–0.2	2.9	. . .	. . .
Latin America and the Caribbean	2.8	1.2	1.3	2.3	–0.9	–0.5	1.1	. . .	. . .
Brazil	2.5	0.1	0.3	1.5	–1.1	–0.7	–0.3	0.1	2.2
Mexico	1.4	2.1	3.2	3.5	–0.3	–0.3	2.6	3.4	3.5
Middle East, North Africa, Afghanistan, and Pakistan	2.2	2.8	3.3	3.9	–0.6	–0.5	. . .	. . .	. . .
Saudi Arabia 6/	2.7	3.6	2.8	2.7	–1.6	–1.7	. . .	. . .	. . .
Sub-Saharan Africa	5.2	4.8	4.9	5.2	–0.9	–0.8	. . .	. . .	. . .
Nigeria	5.4	6.1	4.8	5.2	–2.5	–2.0	. . .	. . .	. . .
South Africa	2.2	1.4	2.1	2.5	–0.2	–0.3	1.0	1.9	2.8
Memorandum									
Low-Income Developing Countries	6.1	5.9	5.9	6.1	–0.6	–0.5	. . .	. . .	. . .
World Growth Based on Market Exchange Rates	2.5	2.6	3.0	3.2	–0.2	–0.2	2.4	2.9	3.2
World Trade Volume (goods and services)	**3.4**	**3.1**	**3.8**	**5.3**	**–1.1**	**–0.2**	**. . .**	**. . .**	**. . .**
Imports									
Advanced Economies	2.0	3.0	3.7	4.8	–0.6	–0.2	. . .	. . .	. . .
Emerging Market and Developing Economies	5.5	3.6	3.2	6.1	–2.9	–0.2	. . .	. . .	. . .

SOURCE: - WEO Update, January 2015 Retrieved on 05th Feb 2015 from the World Wide Web: http://www.imf.org/external/pubs/ft/weo/2015/update/01/pdf/0115.pdf

There is a strong trading relationship between EU and Russia/Asian economies, the majority of which is through maritime transportation. Table 2.2 below will provide us with an overview of the same. NSR as a link between them will further going to flourish

the trade relations besides saving time and money required for transportations. This new prospects will bring markets closer than before. China will be a clear winner with immense potentials in energy and manufacturing sectors. Russia as a guardian of this route as a large portion of it lies within the Russian EEZ, will be playing a decisive role. The Russian government has already revealed their intentions to establish NSR as a highway between Asia & Europe and planned to invest hefty amount of capital for the infrastructure and facilities required in a phased manner. To implement the same, in an attempt to revive its economic conditions, they are facing and likely to face as projected by IMF (see table 2.1 above).

Table 2.2: - Trade Between EU – Asia / Russia

Trade in goods 2011-2013, € billions								
Year	***EU imports***	***EU exports***		***EU imports***	***EU exports***		***EU imports***	***EU exports***
	RUSSIA			*JAPAN*			*INDIA*	
2011	*201.3*	*108.6*		*70.6*	*49.1*		*39.9*	*40.6*
2012	*215.1*	*123.4*		*64.8*	*55.7*		*37.4*	*38.5*
2013	*206.1*	*119.8*		*56.6*	*54.1*		*36.8*	*35.9*
	CHINA			*S. KOREA*			*ASEAN COUNTRIES*	
2011	*295.0*	*136.4*		*36.3*	*32.5*		*94.2*	*69.2*
2012	*292.0*	*144.2*		*38.0*	*37.8*		*99.1*	*81.6*
2013	*280.1*	*148.3*		*35.8*	*40.0*		*96.8*	*81.8*
ASEAN Countries Inc. Myanmar/Burma, Cambodia, Indonesia, Laos, Malaysia, Philippines, Singapore, Thailand, Vietnam and Brunei Darussalam								

Source: - European Commission Data Retrieved on 07th Feb 2015 from the World Wide Web: http://ec.europa.eu/trade/policy/countries-and-regions/index_en.htm

Expanding global markets are in search of resources, which can satisfactorily feed their hunger for power and raw materials. The potential of the Arctic region cannot be denied, which is still today deemed as undiscovered and mostly untouched by human activities. This can generate employment opportunity for shipping and to some extend also help in resolving cargo imbalances and energy crises.

Economic growth is directly proportional to the energy demands for any nation. The Arctic region is more lucrative in this background also. To satisfy this hunger for energy, there will be a need to transport energy products, which are the lifeline for emergent economic growth. NSR is in a prime position to support it outside OPEC region in coming future. The Arctic region is gaining interest and focus worldwide due to this reason. Table 2.3 below will give us an overview of the world proven reserve, production and consumptions of fossil fuels like Oil, Natural gas, and Coal. It can be clearly observed that demands for these products has increased over time and will going to move in the same direction considering the fact that energy is the crucial mover for any economy.

Table 2.3: - World Fossil Fuels Reserves, Production & Consumptions

	2007	**2013**
Proven Reserves		
Oil (thousand million of barrels)	1,399	1,688
Natural Gas (trillion of cubic meters)	161	186
Coal (millions of tons)	…	891,531
Production		
Oil (thousand million of barrels)	82,383	86,808
Natural Gas (trillion of cubic meters)	2,963	3,370
Coal (millions of tons)	6,593	7,896
Consumptions		
Oil (thousand million of barrels)	86,754	91,331
Natural Gas (trillion of cubic meters)	2,954	3,348
Coal (millions of tons)	3,204	3,827
From – British petroleum, statistical review of world energy 2014		

SOURCE: - IMF World Economic Outlook, (Oct, 2014), Pg. 27, Data Retrieved on 05th Feb 2015 from the World Wide Web: http://www.imf.org/external/pubs/ft/weo/2014/02/pdf/text.pdf

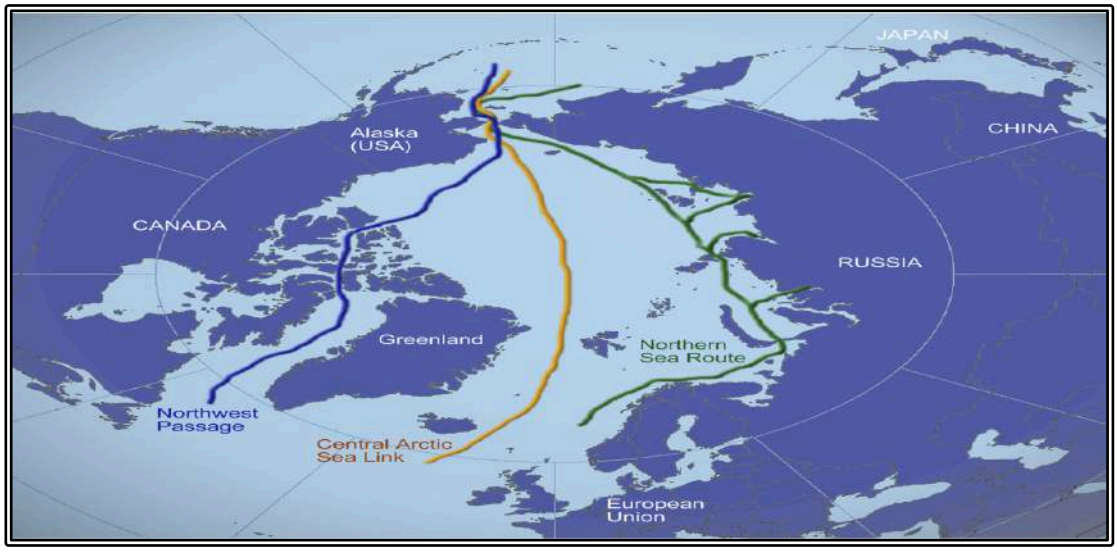
China is ranked as one of the largest energy consuming countries in the world along with United States and some others (BP, 2014). Chinese diplomacy and intentions are thus for safeguarding her energy interest in the Arctic region.

2.2 Arctic NSR Routes

In order to have a clear understanding of the subject matter, it is very important to understand the Arctic region shipping route and superiority of NSR among them. The

entire Arctic region is composed of three main maritime routes, which are under considerations these days namely Northern Sea Route (NSR) or Northeast Passage (NEP), Northwest Passage (NWP) and Trans Polar Passage (TPP)-Figure 2.1. Present existing navigable channel and sea ice conditions are favorable with NSR/NEP followed by NWP and TPP. However theoretically TPP provides the shortest distance to traverse the Arctic region among all, without any draft restrictions but can only be exploited if the region is ice-free. Several models indicate that the ice conditions will continue to be heavy during winter and spring seasons, even in 2050, and the route is not expected to be completely ice-free in summer Karl, M. E., (2010).

Figure 2.1: - The Arctic marine routes.



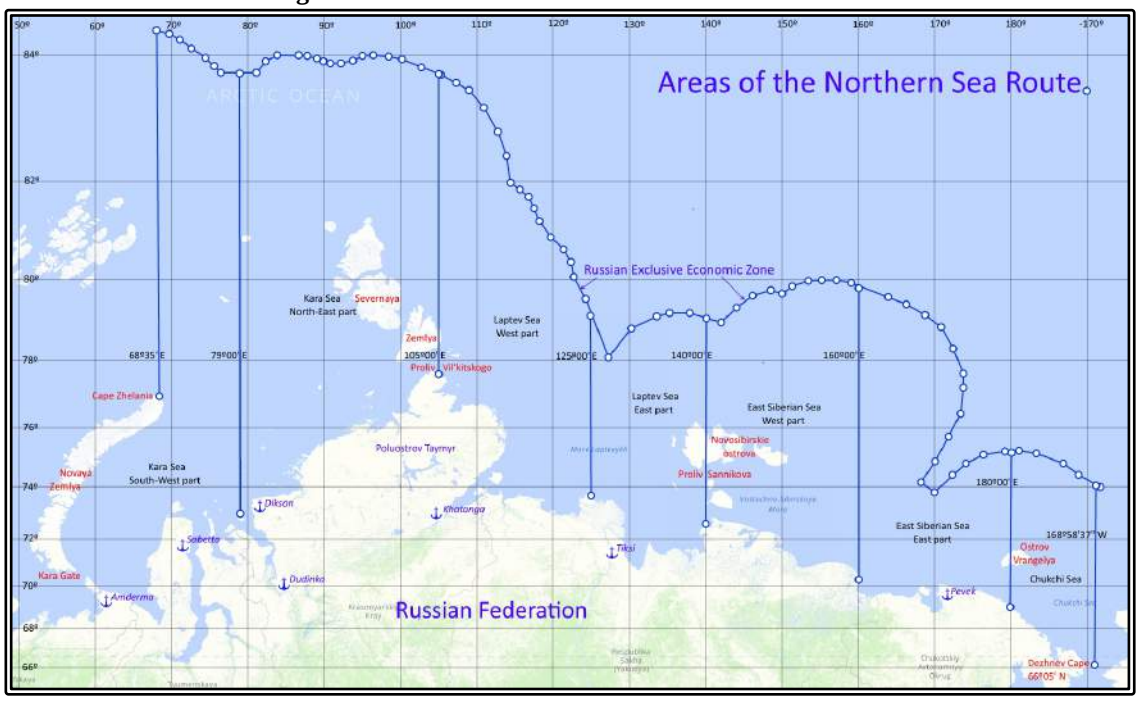
SOURCE: - Ronald E. Doel, Urban Wråkberg & Suzanne Zeller, (2014), Science, Environment, and the New Arctic, Journal of Historical Geography 44 (2014) 2-14

2.2.1 Northern Sea Route / Northeast Passage

The Northern Sea Route (NSR) runs mainly across the North coast of Russian Federation. The name NSR is politically motivated thus got official Russian definition. The federal law of shipping on the waters area of Northern Sea Route (2012), Article 5.1 defines it as "The area of the Northern Sea Route means a water area adjoining the northern coast of the Russian Federation, including internal sea waters, territorial sea, contiguous zone and exclusive economic zone of the Russian Federation, and limited in the East by the line delimiting the sea areas with the United States of America and by

the parallel of the Dezhnev Cape in the Bering Strait; in the West, by the meridian of the Cape Zhelanie to the Novaya Zemlya archipelago, by the East coastal line of the Novaya Zemlya archipelago and the western limits of the Matochkin Shar, Kara Gates, Yugorski Shar Straits" – Figure 2.2 below.

Figure 2.2: - The water area of the Northern Sea Route



SOURCE: - NSRA-The Northern Sea Route Administration, Retrieved on 09th Feb 2015 from the World Wide Web: http://www.arctic-lio.com/nsr_tariffsystem

Before the beginning of the 20th century, it is known as Northeast Passage (NEP). However even till date sometimes the name Northern Sea Route is used interchangeable with Northeast Passage, which runs across the North coast of Russian Federation and Norway. Thus, NSR is a part of Northeast Passage.

While the Northeast Passage includes all the East Arctic seas and connects the Atlantic and Pacific oceans, the Northern Sea Route does not include the Barents Sea, and it does not reach the Atlantic (Northern Sea Route, n.d.).

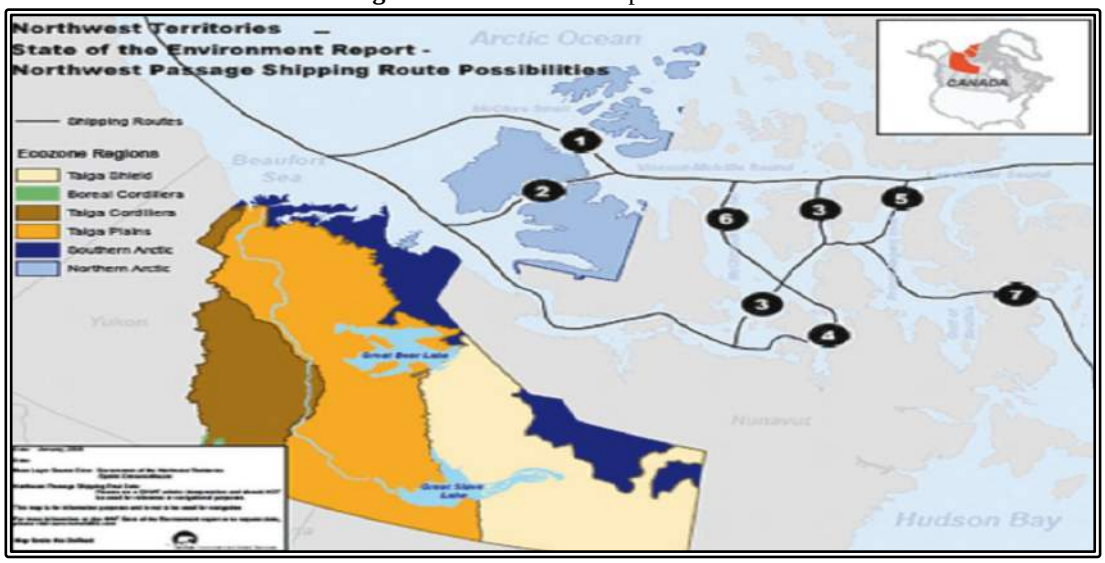
2.2.2 North West Passage

The Northwest Passage is the name given to a set of marine routes between the Atlantic Ocean and Pacific Ocean, spanning the straits and sounds of the Canadian Archipelago,

the Davis Strait and Baffin Bay in the East and the Beaufort Sea in the West (Willy, Ø., et al., 2013).

In contrast with the NSR navigation NWP routing is more complicated, challenging and unpredictable as the passage is primarily divided into seven secondary routes, which runs through Canadian archipelago (see Figure 2.3 below) connecting the Atlantic and the Pacific Ocean. The choice of the route is dependent on the prevailing sea ice condition at the point of transit. These straits are usually narrow and often infested with ice drifting from the central Arctic region during the navigable period. The potential benefits of this route are significant and are very similar to the NEP but it lacks certain desirable advantages like navigable channel, reliability etc. therefore provides an extra edge to the NEP when compared.

Figure 2.3: - NWP seven possible routes



SOURCE: - Willy, Ø., et al. (2013), Pg. 23, Shipping in Arctic waters-A Comparison of the Northeast, Northwest and Trans Polar Passages, ISBN 978-3-642-16789-8

2.2.3 Trans Polar Passage / Trans Arctic Passage

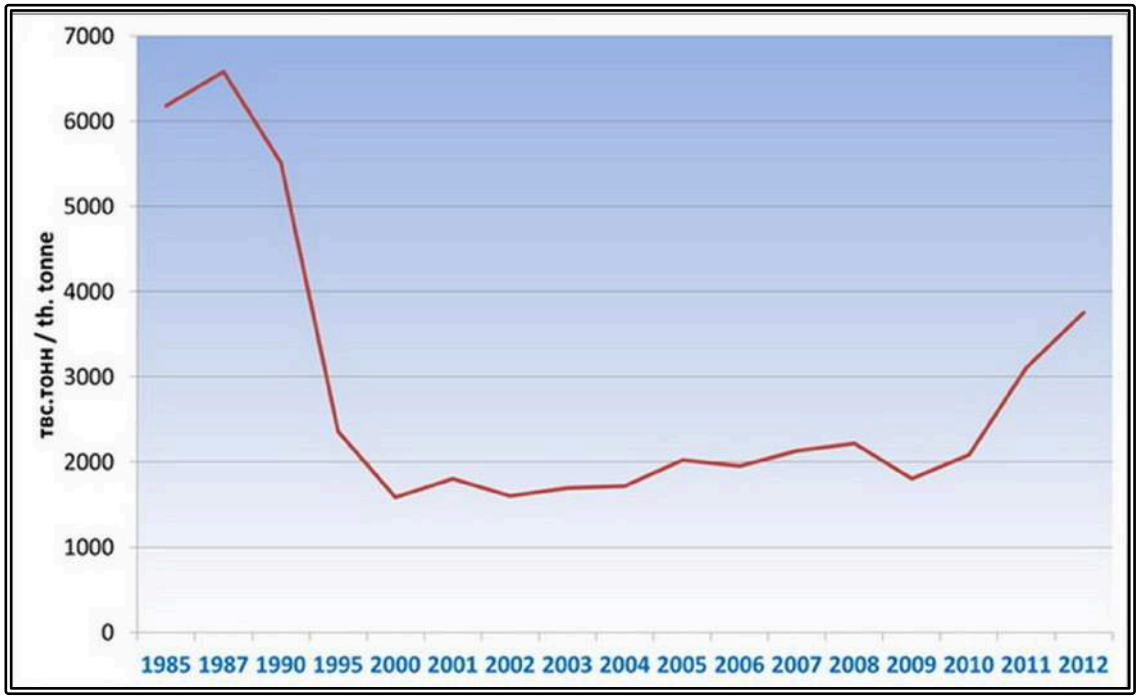
Another Arctic route, which connects the Atlantic and the Pacific Ocean, is the Trans Polar or the Trans Arctic Passage running through mid-off the Arctic area very close to the North Pole. The route lies in the International waters or the high sea as defined by the zonal approach of the UNCLOS. Thus no Arctic state has exclusive jurisdiction over the area, delivering the maritime traffic the freedom of high seas. Non-Arctic states are

more willing to utilize and explore this option as future trade route as other two routes have jurisdictions disputes and other concerns related to the rights of the sovereign States over the territorial Sea, Contiguous zone, and the EEZ. Besides that it is the shortest in distance of all. Similar to other options the route is not a fixed shipping lane, it comprises of many options as deemed safe and appropriate looking into sea ice conditions and available navigable channel. However, it is the one, which is most affected by thick ice cover around the year and at present can only be navigable with the help of heavy icebreaker assistance only, making it least feasible option. Some studies suggest that the extent and the rate at which Arctic region is thawing, Transpolar passage can be a feasible option by 2050. However on the opposite some of such studies contradict this claim making the picture more blurred to apprehend.

2.3 Arctic NSR Traffic Flows

Until July 1st 1991, when the NSR is formally opened and provided access to non-Russian ships as proposed by the Russian President Mikhail Gorbachev in 1987, access to NSR is restricted to Russian (or that time Soviet) ships only. This restriction was imposed in 1917 just after the Russian revolution. During this period traffic flows mainly comprised of research ships, military ships, yachts, Soviet ships engaged in transporting food, fuel and other daily necessities to the Arctic settlements and some other Cabotage activities between Russian Arctic ports. The historic peak, which the NSR has observed in traffic flows, was long back in 1987 reaching a striking figure of almost 7 million tons of cargoes. Unfortunately as a result of Soviet Union collapse the volume was decreased steadily till 1996 where it somewhat becomes relatively stable and maintained a level of 1.5-2.0 million tons per year (see Figure 2.4 below). Notably the graph represents the combined figures for domestic as well as transit cargo volumes. This excludes the considerable oil export from around the Barents Sea, an area outside the formal Russian definition of the NSR and consequently not included in its NSR statistics (Ragner, Claes Lykke, 2008).

Figure 2.4: - Cargo volume on the NSR over the last 25-year (Transit & Domestic)



Source: - Northern Sea Route Information Office Retrieved from http://www.arctic-lio.com/nsr_transits# 07th Feb 2015

The primary cause for this fall in traffic volume after 1987 is the inability of the Russian government to sustain the high subsidies provided to maintain the activities in the Arctic thus the traffic volumes ebbed.

In the traffic volumes figures transit volume is almost negligible. A very large number of transits are in ballast conditions only. INSROP results also do not portray an attractive depiction of NSR transits volumes in the short term. Transit volumes are expected to be zero or very close to this figure till 2015. Present NSR transit fee is the main obstacle to make transit profitable. A recommendation of approx. 26% reduction was made by some scholars and to some extend was also accepted by the Russian authorities. However even after this reduction transit operations are not seen as lucrative as already with current fees structure transit operations would be very unprofitable for the icebreaker operator unless very large convoys can be arranged. Therefore, it is expected the traffic volume will maintain its level of between 1.5-2.0 M tons annually for the next few years and there is no reason to expect a drastic increase in these figures.

Table 2.4: - NSR Transit Voyages

NSR TRANSIT VOYAGES				
Year	**2011**	**2012**	**2013**	**2014**
		For 20/11/2012	**As of Sep 30th**	
Total Transit	41	46	40	41
West-East	30	25	23	-
East-West	11	21	17	-

SOURCE: - NSR Information Office, Data Retrieved from http://www.arctic-lio.com/nsr_transits# on 12 Feb 2015

In order to increase traffic volumes by encouraging transit voyages, agencies like The Northern Sea Route information office is very active, which s owned and operated by Center for high North logistics (CHNL). Their objective is to provide businesses and international organizations with relevant and practical information in English for planning and arranging transit voyages on the Northern Sea Route (Northern Sea Route information office, n.d.).

2.4 Arctic NSR Activities

Since the 16th century, when Europe was the colonial power with a motive to expand their empires and to explore shorter trading routes to Asian colonies there was several expedition activities in the Russian Arctic region. A majority of them are sponsored by Great Britain and the Netherlands and was unsuccessful until 1879. That year is marked as a successful expedition over the Northeast Passage (the name which was given by Europeans and well-known during that time) by Finnish-Swedish explorer Adolf Erik Nordenskiöld on board the steamer named “Vega”. Although the expedition was a part of an attempt to find out new and alternative trade routes with Asia but Nordenskiöld himself was not so optimist about the same considering the fact that the conditions are far harsh to navigate in that area to make it viable for commercial activities.

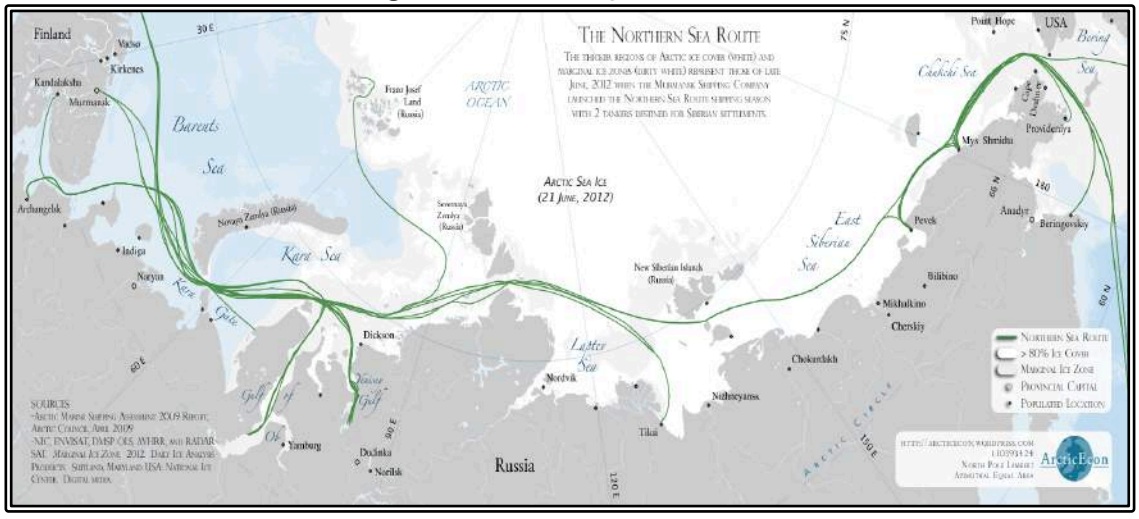
Arctic NSR activities are monitored and organized by The Northern Sea Route Administration (NSRA). It was established according to the order of the government of the Russian Federation No. 358-p (March 15, 2013), Federal law act No. 81 (April 30, 1999) p.3 art.5.1 “The merchant shipping code of the Russian Federation”, to organize

navigate in the water area of Northern Sea Route (NSRA, n.d.).

Today NSR is witnessing a wide range of activities, which mainly comprises of commercial cargo transportation, cruise, research, military, and fishing activities. Any ship intends to navigate in the NSR is required to adhere with Regulations for Navigation on the seaways of the NSR, 1990. It is regulated by the Russian legislation based on the principles of UNCLOS 1982 article 234 “Ice-covered areas”. UNCLOS Article 234 is primarily focused on safe navigation, prevention of environmental pollution and a non-discrimination approach for all States.

Arctic ports are the centers for commercial cargo transportations activities in the region. Major ports include Murmansk, Kandalaksha, Vitino, Onega, Arkhangelsk, Mezen, Naryan-Mar, Varandey, Amderma, Sabetta, Dikson, Dudinka, Igarka, Khatanga, Tiksi, Pevek, Provideniya. (Figure 2.5 below-names in the order from Left to Right). 2013 marked a banner year for interest on behalf of Asian shipping companies like China Shipping Company (COSCO) and Hyundai Glovis of South Korea as in August 2013, COSCO sent the first container ship through the NSR, the 19,000-ton Yong Sheng for its journey from Dalian to Rotterdam and in October 2013, Hyundai Glovis teamed up with Swedish company Stena Bulk to undertake its first pilot service of the NSR (“China’s Silk route”, 2015)

Figure 2.5: - Ports along the Arctic NSR



Source: - https://arcticecon.files.wordpress.com/2012/10/northern-sea-route-2012-russia.png

With its unique flora, fauna, and breathtaking beautiful landscapes, Arctic region is always being attractive for passenger shipping as a destination. One of the promising sectors of shipping is the Cruise or the Passenger shipping, which is known to be a profitable business even during the hard economic crisis. Quark Expedition is a US based leading company offering different cruise offers covering activities in the Arctic and Antarctic.

Research activities in the region are not new. Various projects of different organizations and States are underway in the Arctic covering a very broad area of subject matter aimed to pull the Arctic specific scientific knowledge and discoveries. In 2004, China has established her first Arctic station Yellow River station in Ny-Alesund, Norway under the supervision of Chinese Arctic and Antarctic Administration (CAA, n.d.).

It is the increasing importance of the Arctic and the NSR that has raised the military activities in the region. Today it's not only the eight Arctic powers — Canada, the US, Russia, Iceland, Denmark, Sweden, Norway and Finland which wants to deploy or show its military presence but other Non-Arctic States like China has diplomatically doing it and registered her strong objections on aggressive US and Russian military presence in the area in the international forum as she wants Arctic to be declared as an international zone. Area disputes among States are one of the Major reasons of increasing military presence. Such activities and conflicts are dangerous for the world peace.

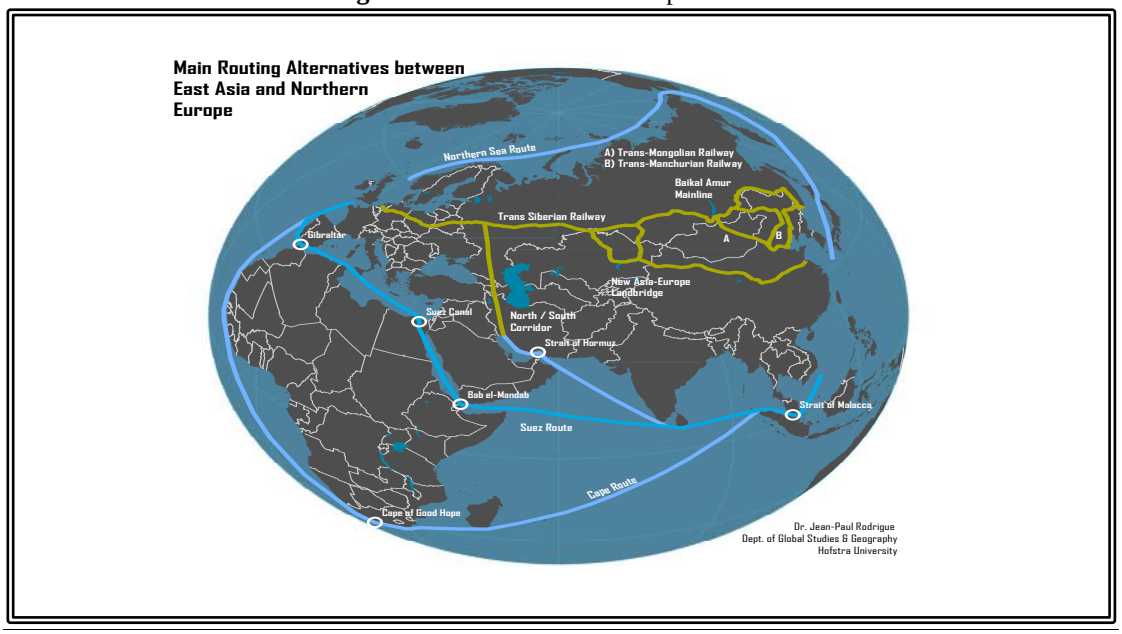
Other activities in the Arctic region include fisheries, forestry and minerals explorations. However, these activities are commercially limited owing to harsh climatic conditions and unavailability of facilities and infrastructure required.

2.5 Alternative Transport Corridors

Areas like Arctic region which is not very well connected by other maritime routes or lacks an established shipping routes are primarily served either by Railways, Land network or by pipelines in case of liquid cargoes. Time, Cost and reliability are the

decisive factors, which make any of these modes better than others.

Figure 2.6: - Alternative Transport Corridor



Source: - The Geography Of Transport Systems Retrieved from http://people.hofstra.edu/geotrans/eng/ch1en/appl1en/suez_alternatives.html 09th Mar 2015

Trans-Siberian Railways , which is extended to thousands of kilometers connecting vast expanse of Russia right from Moscow with the port of Vladivostok on the other side in the sea of Japan is the main line which can be considered as an alternative for the NSR. With a length of 9,289 km (5,772 mile), it is the longest railway line in the world consists of connecting branch lines into Mongolia, China and North Korea (Trans-Siberian Railways, n.d).

Besides Trans-Siberian Railways Trans-Manchurian Railway, the Trans-Mongolian Railway and the Baikal-Amur Mainline serves as other major Railways network used for transportation. These East- west rail corridors may be the main competitors of the NSR in future.

Furthermore, North-South land Corridor can be used as a connecting bridge between the Gulf and Russia making the entire network more accessible to other prime locations of interests for transportation. However, there is a need to further extend these

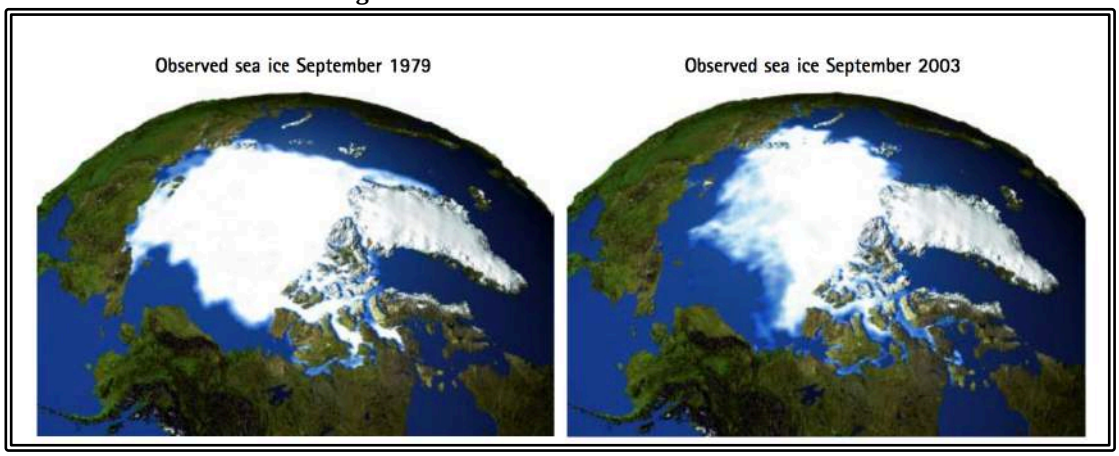
lines/corridors towards the Arctic ports to have an extensive network. The railway lines are facing the problem of different rail gauges between different connecting countries and other geopolitical issues. Moreover, such alternatives have serious financial and capacity issues to compete with Maritime transportation capacities.

CHAPTER 3: FEASIBILITY

3.1 Arctic Sea Ice Conditions

It is extremely important to understand the Arctic sea ice conditions. Economically it will have a direct impact on human activities like, shipbuilding activities, safer navigation or oil & gas exploration whereas environmentally it is co-related with the biological habitats of the Arctic species, global radiation budget [(a)], with ocean circulations (Polynya)[(b)] and with greenhouse gas emission from permafrost[(c)]. It has primarily two parameters the extent/area and the thickness of the ice. Importantly we need to understand that the word ice extent and ice area are not interchangeable, former is always a larger figure. Extent defines a region as "Ice-covered" or "not Ice-covered" on the other hand Area takes the percentages of sea ice within data cells and adds them up to report how much of the Arctic is covered by ice; area typically uses a threshold of 15% (FAQ on Arctic sea ice, n.d.).

Figure 3.1: - Historic Arctic Sea Ice Extend



SOURCE: Arctic Climate Impact Assessment-ACIA, Impacts of the warning Arctic, Pg.25, Retrieved From http://www.amap.no/documents/doc/impacts-of-a-warming-arctic-2004/786

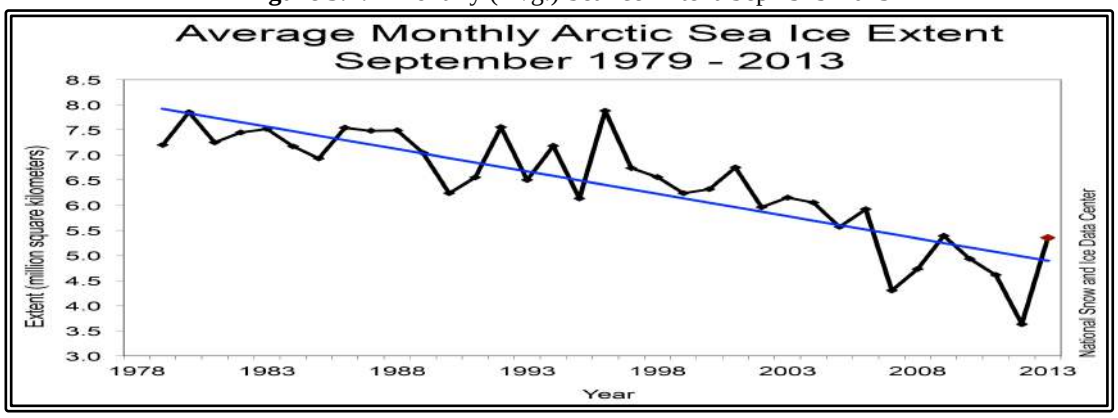
(a) The Earth's Radiation Budget is a concept used for understanding: How much energy the Earth gets from the Sun and How much energy the Earth-system radiates back to outer space as invisible light. From http://science-edu.larc.nasa.gov/EDDOCS/whatis.html

(b) A polynya is an area of open water surrounded by sea ice. It is now used as geographical term for an area of unfrozen sea within the ice pack. From http://en.wikipedia.org/wiki/Polynya

(c) In geology, permafrost or cryotic soil is soil at or below the freezing point of water 0 °C (32 °F) for two or more years. From http://en.wikipedia.org/wiki/Permafrost

The consistent decline in the Arctic sea-ice extent and thickness is observed over last few decades (see Figure 3.1 above). The Figure compares the observed sea ice extent in the month the September for two different years with the help of satellite images. The month of September is important as it marks the minimum yearly sea ice extent. It can be clearly seen that over a span of 24 years (1979-2003) considerable reduction in the ice cap had occurred.

Figure 3.2: - Monthly (Avg.) Sea Ice Extent-Sep 1979-2013



SOURCE: - Norwegian Polar institutes; http://www.npolar.no/en/themes/climate/indicators/sea-ice/

Looking at the trend as shown in the Figure 3.2 above, again for the month of September the sea ice extent indicates a decline of 13.7% per decade. Sea ice extend of about 8 Million Square kilometers has been reduced to about 5 Million Square kilometers from 1979 to 2013 in the month of September. Although these figures and facts are exciting news for the shipping and allied industries but scientifically it is a challenge that the human race is facing in the modern world today.

Arctic sea ice conditions (extent and thickness) are rapidly changing phenomena, therefore it is required to monitored continuously. Advanced scientific techniques like remote sensing, radar surveillance, SONAR, Electro-Magnetic devices and others techniques are used to carry out this task by the scientist to support their studies/research and provide reliable information/data required to be used by commercial activities like shipping and for information purposes. Different sea ice conditions may persist at any area and at any given time frame, to avoid ambiguity or confusion world meteorological organization has developed a globally accepted sea ice

nomenclature. This standard terminology is used while referring to Sea ice details.

Notably the term “SEA ICE” is deliberately used to differentiate it with some very commonly used terms like icebergs, Glaciers, or Lake ice. The most basic difference is that sea ice forms from salty ocean water, whereas icebergs, glaciers, and lake ice form from fresh water or snow. Sea ice grows, forms, and melts strictly in the ocean. Glaciers are considered land ice, and icebergs are chunks of ice that break off from glaciers and fall into the ocean. Lake ice is made from fresh water and freezes as a smooth layer, unlike sea ice, which develops into various forms and shapes because of the constant turbulence of ocean water (All about sea ice, n.d.).

Table 3.1: - Classification Societies Ice Class Equivalent

Classification Society	**Ice Class**				
Finnish-Swedish Ice Class Rule	IA Super	IA	IB	IC	Category II
Russian Maritime Register of Shipping - (Rule-2007)	Arc 5	Arc 4	Ice 3	Ice 2	Ice 1
Russian Maritime Register of Shipping - (Rule-1995)	UL	L1	L2	L3	L4
Russian Maritime Register of Shipping - (Rule-1999)	LU5	LU4	LU3	LU2	LU1
ABS	IAA A1	IA Ao	IB	IC	D0
Bureau Veritas	IA Super	IA	IB	IC	ID
CASPR,1972	A	B	C	D	E
China Classification Society	Ice Class BI*	Ice Class B1	Ice Class B2	Ice Class B3	Ice Class B
Det Norske Veritas	ICE-1A* ICE-10	ICE-1A ICE-05	ICE-1B	ICE-1C	ICE-C
Germanischer Lloyd	E4	E3	E2	E1	E
Korean Register of Shipping	ISS	IS1	IS2	IS3	IS4
Llyod Register of Shipping	1SS	IA	IB	IC	ID
Nippon Kaiji Kyokai	IA Super	IA	IB	IC	ID

SOURCE: - http://www.bsis-ice.de/material/table_iceclasses.pdf

Sea ice condition in the trading area defines the kind of ship required for navigating the area safely and as required by the international and local rules and regulations. They are known as ice class ships, as defined by the classification societies, which have further strengthened the hull, more scantlings and specialized equipment and arrangement to withstand adverse weather. The different class has different ice class notations meeting the guidelines provided by them and by the IMO. Table 3.1 above provides an approximate correspondence between them.

3.2 Arctic Ice Predictions

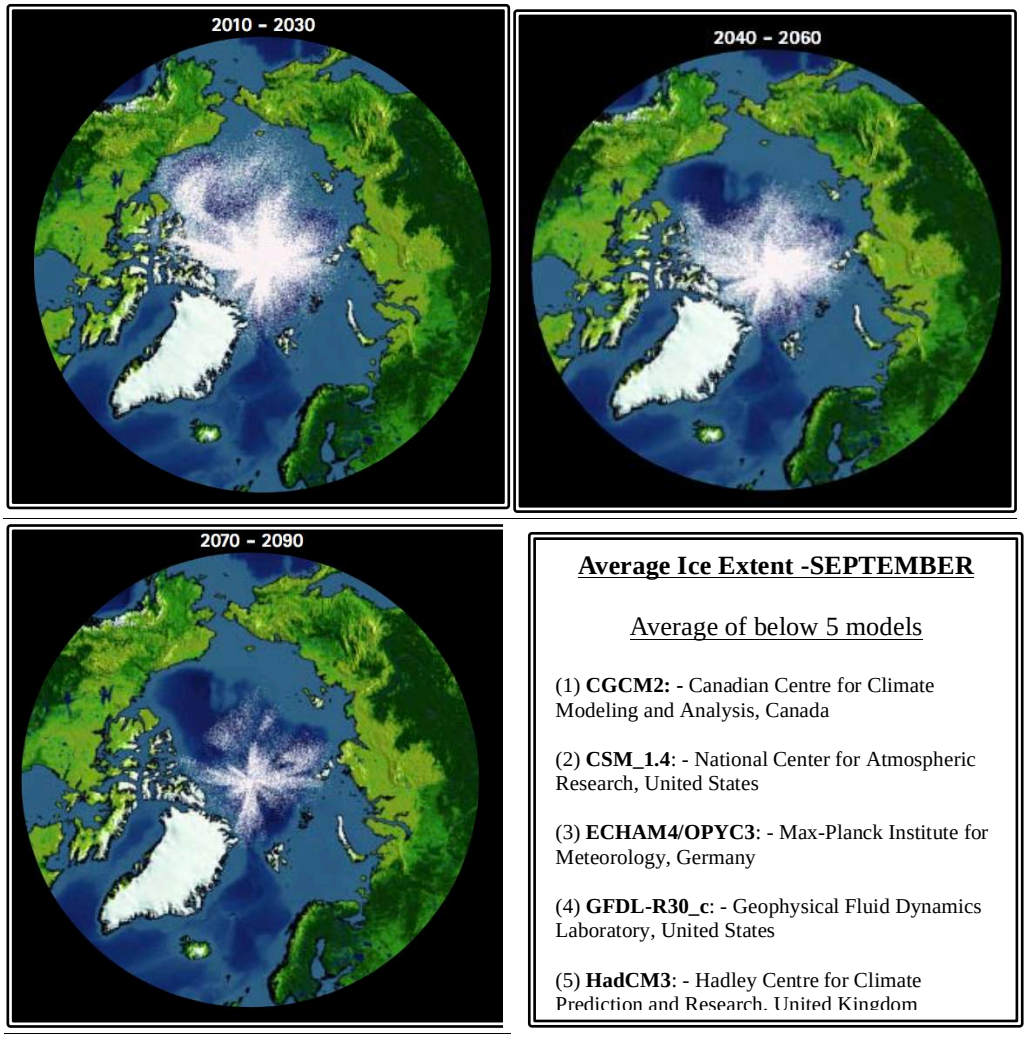
Scientists are using various climate models based on certain emission scenarios to predict the future ice extend. Almost all of them are predicting a significant and alarming decline in the Polar ice cap during the 21st century (see Figure 3.3 below). The greatest loss is expected to be in the fall (September-November). Approximately 90% of models predict the Arctic will be ice free by 2100, and many models predict this could occur as soon as 2050 IPCC-2013 (Future of Sea Ice, n.d.).

Climate models are mathematical representations of the interactions between the atmosphere, oceans, land surface, ice and the sun (How reliable are climate models?, n,d,). They are quite reliable and thus can be trusted among, as they are hindercast simulated [(d)]. These models are very complex and there is no perfect model which can be used as a single reference model. Therefore different research institutes or organizations will have a unique name for its own model as the parameters or data used to create the model may vary significantly leading to entirely different scenario or/and results.

These models results and predictions are a clear indication that navigation is bit challenging in the winter months today however summers months will be extended providing longer time frame for the shipping industry to explore the NSR and the Arctic.

(d) Hindercasting is method of testing a mathematical model by using data from a past event From https://www.wordnik.com/words/hindcast

Figure 3.3: - Predicted Ice Extent (SEPTEMBER)



SOURCE: Arctic Climate Impact Assessment-ACIA, Impacts of the warning Arctic, Pg.30, Retrieved From http://www.amap.no/documents/doc/impacts-of-a-warming-arctic-2004/786

Gradually not the NSR, in fact, the entire Arctic region can be seen as ice free navigational area. Figure 3.3 clearly indicate that even 2010-2030 prediction shows NSR almost ice free for the month of September, highlighting its importance among the three anticipated Arctic routes. It is interesting to note that Arctic Sea ice is retreating much faster in the actual observed data when compared with the projected figures.

3.3 NSR Navigable Period

The navigation season is often defined as the number of days per year in which there are navigable conditions, generally meaning less than 50% sea ice concentration (Impacts

of a warming Arctic, 2004). NSR is becoming a first preference for many ship owners as the navigable period window is widening and it is evident from last year, when NSR administration received a record-breaking applications (exceeding about 600) seeking permission to transit.

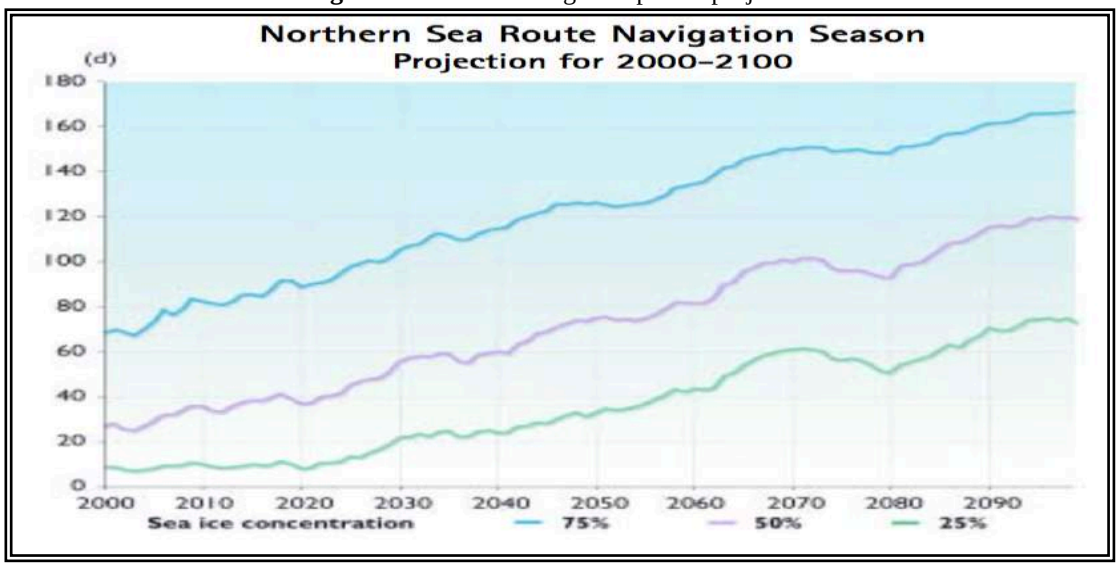
Figure 3.4: - Number of days the NSR has stayed fully open over the past five years

SOURCE: Green4sea, Retrieved From http://www.green4sea.com/ice-in-the-arctic-sea-continues-on-a-trend-of-recession/

Global ice center (GIC) expert on the Arctic affair Dr. Genki Sagawa, says that, "The number of days the NSR stays open can vary greatly from year to year, so the GIC has been keeping a close watch on Arctic ice trends. He added that even after the opening closes, it has still been possible in recent years to transit the route with icebreaker escorts until about November. Since a lot of ice starts to appear along the route about this time, finely detailed information concerning sea ice and weather conditions become critical in order to safely sail the NSR" (" Ice in the Arctic", 2014).

NSR future is also looked open with optimism, in view of Arctic Climate Impact assessment (ACIA) projection for the 21st century (see Figure 3.5 below). The projection is based on three case scenarios with 25%, 50%, and 75% sea ice concentration for the entire century, which clearly showing an upward trend in the number of NSR navigable days. The graph predicts that with a 75% sea ice concentration the navigation windows will last for approximately 170 days in a year and 120, 70 days respectively for 50% and 25% sea ice concentration scenarios by the end of 21st century.

Figure 3.5: - NSR Navigation period projections



SOURCE: Arctic Climate Impact Assessment-ACIA, Impacts of the warning Arctic Pg. 83, Retrieved From http://www.amap.no/documents/doc/impacts-of-a-warming-arctic-2004/786

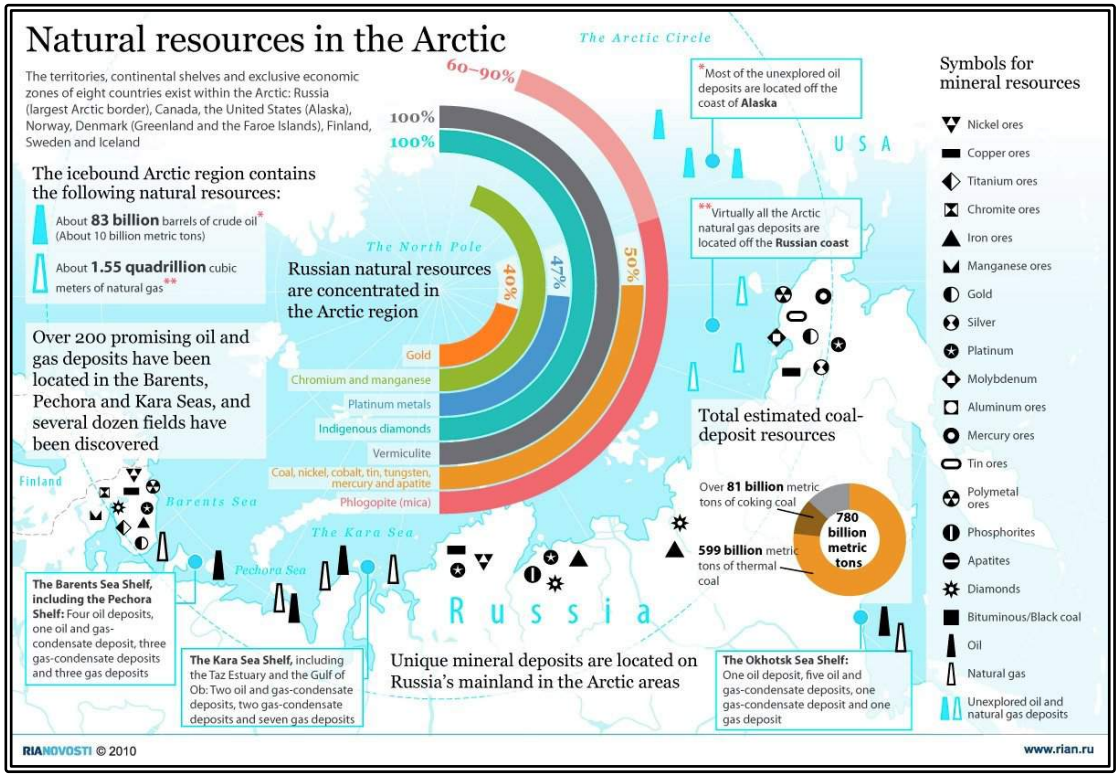
CHAPTER 4: NSR BENEFITS

4.1 NSR Region – Natural Resources Heaven

There is a huge disparity between the productions and consumption figures of natural resources by most of the countries today, forcing them to look around for new natural resource heavens, which can offer them assurance to fulfill their future appetite. NSR region is a ray of hope for them. The region above the Arctic Circle accounts for only about 6% of the Earth's surface area, but it could account for as much as 20% of the world's undiscovered but recoverable oil and natural gas resources (Arctic oil and gas, 2013). USGS had conducted an assessment for the undiscovered resources North of the Arctic Circle know as Circum-Arctic resource appraisal (CARA), which was released in May 2008. Using a geology based probabilistic methodology, the USGS estimated the occurrence of undiscovered oil and gas in 33 geologic provinces thought to be prospective for petroleum. The sum of the mean estimates for each province indicates that 90 billion barrels of oil, 1,669 trillion cubic feet of natural gas, and 44 billion barrels of natural gas liquids may remain to be found in the Arctic, of which approximately 84 percent is expected to occur in offshore areas ("Circum-Arctic resource", 2008).

Most of these resources lies within NSR limits and under Russian jurisdiction. Energy sector giants like Total, British Petroleum, Shell, Chevron and Exxon has already begun to invest heavily in Arctic region, particularly in the northern Russian territories, hugging the NSR. Large Arctic oil and natural gas discoveries began in Russia in 1962, with the discovery of the Tazovskoye field, Approximately 61 large oil and natural gas fields have been discovered so far within the Arctic Circle - 43 are in Russia alone (Arctic oil and gas, 2013). Notably these discoveries are made quite a long back but owing to extreme unfavorable conditions the productions costs are significantly high, therefore, these discovered field are mostly untouched until few year back when the region started to thaw at a rapid pace.

Figure 4.1: - Arctic natural resources



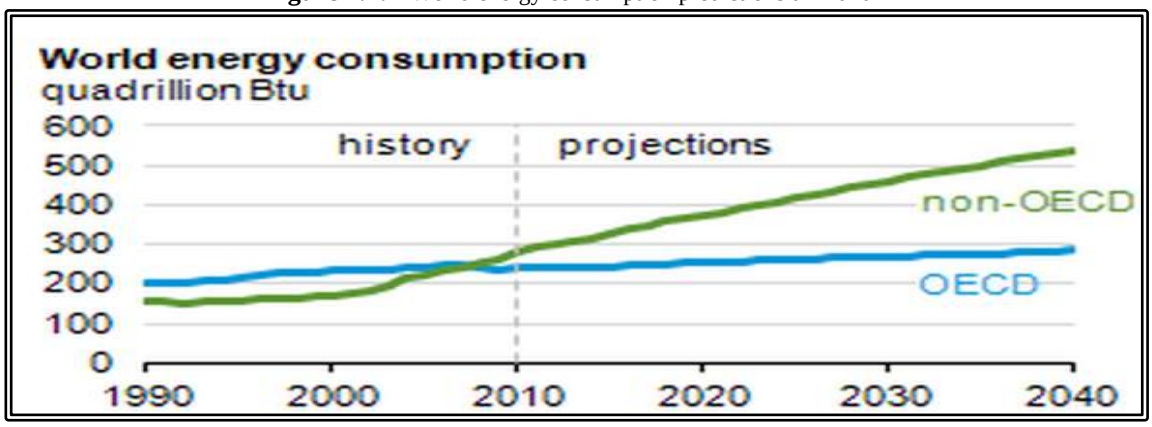
Source:- http://sputniknews.com/infographics/20100628/159604153.html

The region is not only rich in oil and gas but is also a home ground of various important natural resources like Platinum, Manganese, Iron ore, Copper, Coal, Nickel etc. (see Figure 4.1 above). Besides these resources the region is prosperous in fishery and forestry products -Russia, has a largest forest reserves in the world. Development of NSR and the region around it will push extraction of these natural resources, as such activities are restricted so far because of financial constraints and unavailability of facilities and infrastructure in the region owing to various economic, environmental and geopolitical factors. All these natural resources need to be transported, which means a likely increase in the shipping demand for all kinds of ships, which includes tankers, bulkers, LNG/LPG Carriers.

According to EIA's recently released International energy Outlook 2013 (IEO2013) projects that world energy consumption will grow by 56% between 2010 and 2040, from 524 quadrillion British thermal units to 820 quadrillion British thermal

units (see Figure 4.2 below) ("EIA Projects world", 2013). These predictions are based on extensive scientific theories and research involving advanced techniques and calculations made by established scholars thus can be relied upon. Looking into such perspective, our current energy deposits are not enough to cope up with these energy demands. In this scenario, the undiscovered oil and gas deposits in the NSR or in the Arctic region will be critical to fulfill these needs.

Figure 4.2: - World energy consumption predictions till 2040



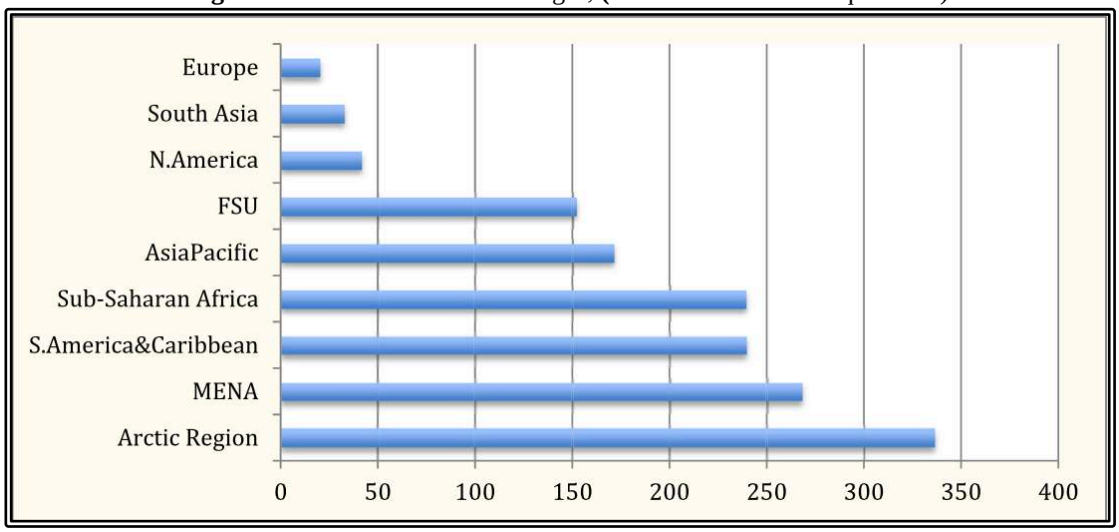
Source:- US Energy Information Administration, International Energy Outlook 2013.
http://www.eia.gov/todayinenergy/detail.cfm?id=12251

Comparing the predicted undiscovered oil & gas reserves of the world as revealed by a study of the USGS (see Figure 4.3 below), Arctic and NSR is a clear winner, as most of these Arctic reserves are located within the periphery of NSR only. Leading research institutes and oil majors are also engaged in uncovering a cost effective and more sustainable technique to discover, to drill and to extracts these resources with particular emphasis on the hostile conditions like Arctic. Besides this preparing contingency plans and environment sensitive policy is also critical and a challenging task because these attempts in the far North are also under continuous criticism of the environmentalist and Non-Government organizations (NGO's) like Greenpeace.

Although the world is trying to move towards safer and cleaner renewable sources of energy like Solar, Tidal, Wind or Geothermal, the dream is still far away to be turned into reality. Non-renewable energy sources like oil and gas will remain as primary energy means for few decades from now. Therefore, these reserves are extremely important and strategically significant for a country to keep her development moving in

a forward and positive direction.

Figure 4.3: - Undiscovered oil & gas, **(**billion barrels of oil equivalent)



NOTE:- (1) – Based on data by USGS, An estimated of Undiscovered Conventional Oil and Gas Resources of the World, Fact Sheet 2012-3028, March 2012.
(2)- The values used in the graph are the average of the three mean values, F95, F50, and F5. They represent a 95%, 50% and 5% chance of finding the amounts shown.

Source:- Graca Ermida (2014), Strategic decisions of international oil companies: Arctic versus other regions, Energy Strategy Reviews 2 (2014) 265-272

This is very clear that among all Arctic States, Russia owns a significant part of the entire reserves and jurisdiction over a major portion of NSR as per international laws. Russian policies and laws on natural resources extractions and NSR navigation will definitely going to direct the future of this area. In order to fulfill its energy deficit, Chinese policy makers are looking forward to extend the existing collaboration with her neighbor, in view of her escalating projected energy consumptions. Being close to each other and one of the biggest economies in the world both of them are looking for a win-win relationship.

4.2 Economic Analysis

The lure for this route is all because of the distance. The shorter the distance, more the saving is. This savings is twofold in nature one is the saving from the operations part mainly by burning fewer bunkers and other is saving by releasing fewer air pollutants like Sox and Nox from the ships, which would have caused if she has to cover bigger distances otherwise. NSR is always a frontrunner in this respect undoubtedly thus have got potentials to reshape the traditional shipping route between Asia and Europe. Following MARPOL Annex VI (Regulations for the prevention of Air Pollution from ships) enter into force on 19 May 2005 regulating emission of Sox, Nox, Volatile organic compound (VOC) and shipboard incineration from tankers, to adhere with its requirement ships are required to burn low-sulphur content fuel, which is more refined and naturally costlier also if compared with other grades of fuels. Ice infected water in the NSR may be considered as a threat to navigation, but slower steaming will also contribute to higher energy efficiency and greener shipping by reduced CO2 emission achieved by traversing at slow speeds.

In contrast with its rival southern route (via. Suez), NSR can be striking 37% shorter if for instance we consider a voyage From Yokohama; Japan to Rotterdam; Netherlands as

Table 4.1: - NSR vs. Traditional maritime routes

	To Rotterdam - (In nautical miles)		Difference between	
From	Cape of Good Hope	Suez Canal	NEP	NEP %
Yokohama	14,448	11,133	7010	37
Busan	14,048	10,744	7667	29
Shanghai	13,796	10,557	8046	24
Hong Kong	13,014	9701	8594	11
Ho Chi Minh City	12,258	8887	9428	-6
Note: Sailing distances between major East Asian ports and Rotterdam are calculated by taking the distance between Yokohama and Hamburg via the NEP and Suez Canal routes (as provided by Østreng et al 2013, p. 49) and approximating the additional distances originating before Yokohama and beyond Hamburg, using an online voyage calculator (http://sea- distances.com/). Distances assume no route diversions owing to ice conditions.				

SOURCE: - Albert, B., et al. (2014), Commercial Arctic shipping through the Northeast Passage: routes, resources, governance, technology, and infrastructure, Polar Geography, 2014 Vol. *37*, *No. 4*, 298–324,

shown in the table 4.1 above. A similar advantage can be observed for some other important maritime routes also. Distance advantage will not only cut the bunker cost required for a voyage, but it also indicates possibilities of more frequent trips between ports thus bringing more business for the companies and larger cargo turnover per year per ship. This will also ensure optimization of the manpower and resources for the ship owners/managers. In the long run availability of employment for the ship will intensify the rivalries of shipping companies and will result in the price war, eventually perhaps diminishing the profit margin dramatically.

Today shipping companies are investing huge capital on enforcing anti-piracy measures on board. Recommendations by the publication like Best Management practices (BMP) which is to assist ships Masters to avoid, deter or delay piracy attacks in the high-risk area are adhered with. Some of them are also hiring armed guards while the ship transits into piracy affected or high-risk areas. Ships are continuously monitored and assisted by naval forces in some areas, if needed. Even after such extensive measures reports of ships being hijacked for ransom are quite common. Owing to escalated risk in such areas, companies are required to pay high insurance premiums. The Arctic waters are free from the risk of piracy or maritime terrorism thus any such costs involved are near to nil.

Container business in NSR is more vulnerable than bulkers and tankers. Container shipping is based on liner service concept, which require a fixed number of ships to be involved to cover said number of port rotation on a timely basis. Considering the fact that owing to very harsh climatic and navigational conditions with limited support and assistance NSR navigation is less reliable, and more prone to delays and accidents/incidents. It is really difficult to maintain one of the extremely important key performance indicators (KPI) in the shipping market, which is punctuality. Moreover, to have an ice class fleet is a capital incentive and strategic decision. Similar reasoning can be applied to the transportation of perishable materials, using reefers where time constraint is the extremely critical element for the business line and consignees.

Modern concepts in the shipping industry like just in time, economies of scale and existence of transshipment hubs like Singapore, Shanghai or Rotterdam is hard to realize among the Arctic routes.

NSR trade is a niche market and investment appraisal through financial metrics or the cash flow metrics provides a platform to judge the investment profitability and risk factors involved. Compared to ordinary ships, the following items, among others, need to be considered for ice-classed ships: principal structure and strength, hull form, propulsion system etc. A 20% extra building cost is assumed for ice-classed ships. Based on various interviews and literature review, the building price of ice- classed ship is on average 20-30% higher than that of an ordinary ship with the same size. (Miaojia, L. and Jacob K., 2010). Capital cost fluctuates according to the building cost and thus volatile in nature therefore investment in ships particularly capital-intensive ships like the ice class, which are needed to operate in NSR, is a strategic decision and involved a deep analysis and understanding of present and future supply and demand curves. On top of the capital cost, in a typical market scenario a significant portion (usually 70%-80%) of it is to be repaid to the bank in account of loan undertaken. According to the project in consideration, there is also a depreciation cost involved. Depreciation cost usually depends on many factors; some of them are the age of the ship, maintenance standards by the company and others. Ships operating on NSR with harsh climatic conditions and inherent dangers, the ship as an asset depreciate at a faster rate.

In general second-hand prices and freight rates/earnings follows the same cycle. Both are highly linked. As per the studies conducted by Clarkson, one of the leading shipping consultant's in the world, an ordinary ship should lose 4 % of their value per year and for an ice class ship this depreciation can be higher owing to the harsh and unpredictable working environment. Noticeably, demand for extra tonnage by owners can make a second hand ship more valuable than the new building, which is sometimes observed in past and is a prominent practice in the market for a cost intensive ship like ice class e.g. 1995 built non ice class capesize worth $25m at the end of 2002 worth staggering $42m. Residual value depends upon number of factors and one of the

important elements is quality of maintenance. The resale price so estimated is based on the company record of high degree of maintenance standards and resale values of the past ship sold in the market.

There are various cost components involved to operate a ship in NSR. These may vary depending upon the stakeholder viewpoint and sometimes on management decision. For instance the decision of investing in a double acting ships (DAS; capable of running ahead in open waters and astern also using azipod propulsion system technology, when required like in ice infested waters) obviously, which is a costlier ship and can save icebreaker fees as the ship itself is designed and capable of operating without any

Table 4.2: - NSR Cost components (stakeholders viewpoint)

Operator's viewpoint	**Shipowner's viewpoint**	
Capital cost	Depreciation cost	---
NSR fee	NSR fee	---
Ice pilot fee	Ice pilot fee	---
Crew cost	Crew cost	Training, repatriation, Medicals, Insurance, social security
Maintenance cost	Maintenance cost	Article cost of ship, Lubricant cost, Dock cost, and Maintenance and spare part cost
Insurance cost	Insurance cost	H&M insurance and P&I insurance
Fuel cost	Fuel cost	---
Port dues	Port dues	---
---	Miscellaneous cost, Administration cost and Interest fee	

Source: - Cost Analysis of the Northern Sea Route (NSR) and the Conventional Route Shipping by Masahiko Furuichi and Natsuhiko Otsuka; Proceedings of the IAME 2013 Conference July 3-5 – Marseille, France

escort. Moreover, such ships are proved to be fuel and energy efficient in different experiments and studies conducted on them. Some cost relevant to a ship-owner may not be a matter of worry for a ship operator. Some of them are tabulated in table 4.2 above. Most of these costs are usually unavoidable for safe commercial operations like the port dues, NSR and pilotage fees etc. however, rest like the fuel and maintenance cost can be kept under control by efficient operations, administration and continuous evaluation by the owners/ managers.

Another important economic aspect to consider is the economies of scales, which is

exploited by the shipping companies to realize profits. Unfortunately owing to ship size restrictions (≈ 50,000 deadweight) this opportunity has to be missed by the companies. This restriction arises from the fact that ship cannot be wider than the icebreaker thus limits the beam size to a maximum of 30 meters and there are shallow straits in the NSR (New Siberian Island; Max Draught 12.5 meters), which cannot be avoided for transit.

Insurance is an integral part of shipping, offshore industry or in fact for any other sector because commercial activities cannot be carried out without any cover. Companies are required to undertake and share their responsibilities and liability in the event of any eventuality as per the domestic and international laws depending upon the area of operation of their business. During extensive research carried out in the INSROP project and by ARCOP, it was estimated and found that compared with the Suez route operations NSR insurance cost may rise almost up to twice.

As today shipping cycles or any other theoretical models are no more relied upon, long run earning can only be gauged by the demand-supply gap. Strong demand of commodities, which constitute a major portion of the NSR seaborne trade will be one of the key factors in maintaining a firm demand. New deliveries & demolitions are highly imbalanced, creating immense pressure on the existing fleet. Freight rates / earnings are diluting every year as a result of the economic downturn in the market. The supply will not decrease because the majority of the supply cost is fixed (capital / labour / insurance etc.) and it is from the very nature of the shipping industry (Variable cost constitute a small portion of the total costs). In the short run as long as the earnings are big enough to cover the variable cost the shipping companies will not withdraw its supply. Maritime supply is very price INELASTIC. In an industry with such a high degree of uncertainties, freight rates are the critical indicators of the long run performance. Moreover, freight rates are guided by supply and demand, which cannot be adjusted instantly

Notably some of the expenses like icebreaker facilities; administrative fees, Capital cost of ice class ships, and additional insurance premium required will offset these savings.

In case of damage or malfunctioning of critical instruments or machinery on board and structural breakdown, repairs cost can be considerably high because of unavailability of any nearby repair facilities and even to transport spare parts or technicians is also a cost incentive option. Some of the Scholars even argued that the distance advantage of the NSR is a myth and over hyped. As shown in the Table 4.3 below, which tabulate the distances calculated for some of the established maritime trade routes through different maritime channels. It was found that out of 14 such routes NSR/NEP was actually shorter in just four scenarios and sometimes just marginally shorter. Obviously NSR is also not in a place to offer large range of port calls during transits, however routes via Suez or Panama can offer a range of ports covering different markets, which is of paramount important for shipping companies especially in hard economic times like this as they are struggling to load their ships to the maximum possible capacities.

Table 4.3: - NSR Distance advantage comparison

	Panama	**NWP**	**NEP**	**Suez and Malacca**
London – Yokohama	23,300	**15,930**	13,841	21,200
Marseilles - Yokohama	24,030	16.720	**17,954**	17,800
Marseilles – Singapore	29,484	21,600	23,672	**12,420**
Marseilles – Shanghai	26,038	19,160	19,718	**16,460**
Rotterdam – Singapore	28,994	19,900	19,641	**15,750**
Rotterdam – Shanghai	25,588	15,570	**15,793**	19,550
Hamburg – Seattle	17,110	15,270	**13,459**	29,780
Rotterdam – Vancouver	16,350	14,330	**13,445**	28,400
Rotterdam – Los Angeles	**14,490**	17,790	15,252	29,750
Gioai Tauro (Italy) – Hong Kong	25,934	24,071	21,556	**14,093**
Barcelona – Hong Kong	25,044	23,179	20,686	**14,693**
New York – Shanghai	20,880	**17,030**	19,893	22,930
New York – Hong Kong	21,260	**18,140**	20,982	21,570
New York – Singapore	23,580	20,310	23,121	**18,770**
-All numbers calculated by Frédéric Lasserre in SIG Mapinfo, except the numbers for the Northeast Passage through the Kara Strait south of Novaya Zemlya, which have been calculated in Google Earth by Svend Aage Christensen. -Distance in km between harbors using various southern and northern routes				

SOURCE: - Svend, A. C. (March, 2009), Are the northern sea routes really the shortest, Danish Institute of International studies Brief

Talking of NSR economic compatibility and preeminence over other routes, it is very much desirable to compare the various costs involved for routes in considerations. Table

4.4 is such an attempt to have a clear view. Data presented in the table is adapted from the proceedings of the IAME 2013 conference held at Marseille, France on July 3-5 due to difficulty in gathering exact present costs involved from sources like internet or from email or interview responses from owners/managers. Some figures may vary slightly because of the fluctuations in the market conditions and thus prices however, it is very unlikely that the entire picture will diverge considerably.

Table 4.4: - NSR Vs. Suez Cost Comparison

Ship size/ NSR service-period SCR service-period	**4,000 TEU** **NSR**-105days **SCR**-260days	**4,000 TEU** **NSR**-0 day **SCR**-365days	**6,000 TEU** **NSR**-0 day **SCR**-365days	**8,000 TEU** **NSR**-0 day **SCR**-365days
Commercial costs				
Annual container throughput	36,400 (TEU/year)	33,600 (TEU/year)	50,400 (TEU/year)	67,200 (TEU/year)
Shipping unit cost per TEU	1,211 (USD/TEU)	1,355 (USD/TEU)	1,320 (USD/TEU)	1,211 (USD/TEU)
Annual voyages	NSR: 5 SCR: 8	SCR: 12	SCR: 12	SCR: 12
Depreciation cost	4,925 (11.2 %)	4,688 (10.3%)	6,728 (10.1%)	8,769 (10.8%)
NSR fee-5.0 (USD/GT), Ice pilot fee, NSR insurance premium	1,433 (3.3%)	0 (0%)	0 (0%)	0 (0%)
Suez Canal fee, Suez insurance premium, Aden emergency charge	3,115 (7.1%)	4,572 (10.0%)	7,099 (10.7%)	8,387 (10.3%)
Crew cost	954 (2.2%)	997 (2.2%)	997 (2.2%)	997 (2.2%)
Maintenance cost	491 (1.1%)	513 (1.1%)	736 (1.1%)	997 (1.2%)
Insurance cost	154 (0.3%)	161 (0.4%)	231 (0.3%)	301 (0.4%)
Fuel cost (650 USD/ton)	24,196 (54.9%)	25,815 (56.7%)	36,787 (55.3%)	43,787 (53.9%)
Port dues, container handling charge	8,822 (20.0%)	8,772 (19.3%)	13,932 (20.9%)	18,011 (22.1%)
Grand total	44,086 (100%)	45,522 (100%)	66,511 (100%)	81,011 (100%)
Environmental cost				
CO^2 ton/TEU	1.023	1.182	0.733	0.656
Unit (Upper: '000 USD/year, Lower: %)				
NSR: Northern Sea Route / SCR: Suez canal route				
Route: Yokohama (East Asia) and Hamburg (Northwest Europe)				

Source: - Cost Analysis of the Northern Sea Route (NSR) and the Conventional Route Shipping by Masahiko Furuichi and Natsuhiko Otsuka; Proceedings of the IAME 2013 Conference July 3-5 – Marseille, France

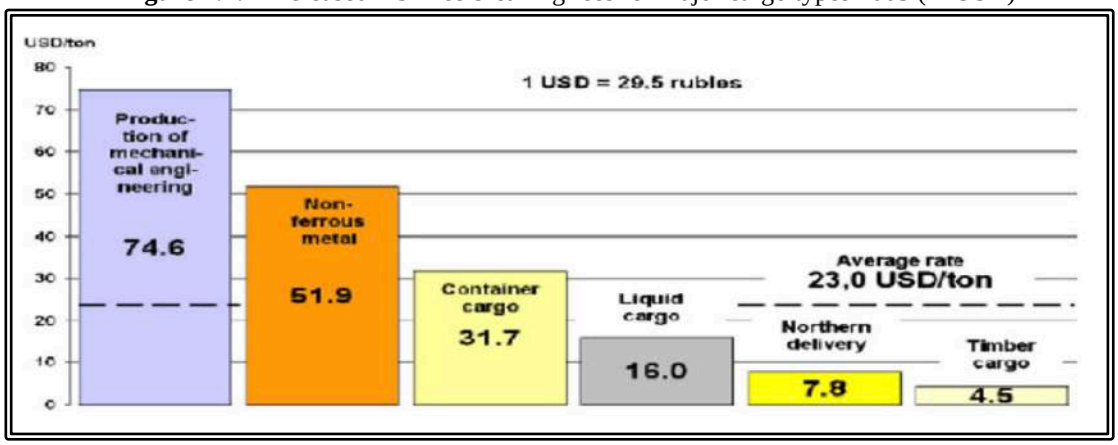
Cost for transporting per TEU, with different ship sizes and scenario with combined

NSR-SCR as well as individual shipping route is computed taking into account the NSR navigable period available. Ship considered for NSR navigation is 4,000 TEU ice class because of the draft restriction imposed by the NSR whereas; in cases of SCR ordinary ships are considered with a capacity of 4,000/6,000 and 8000 TEU respectively.

Clearly the striking cost component (more than half of the total cost involved) in the entire shipping operations is the fuel cost. Any decrease in the fuel cost can cut down the entire cost sharply. Looking at the shipping cost/TEU it can be inferred that NSR may be seen as vaguely competitive with SCR. For 4000 TEU ship using NSR cost/TEU is 11.89% lesser with 15.54% lesser emission compared to similar size ship used on SCR. However, NSR will definitely a costlier option if considered larger container ships (>8000 TEU) since NSR cannot offer economies of scale because of the choke points in the navigational channels. NSR is a clear looser in larger ships category even in smaller ships the savings are insignificant and cannot be realized looking at the potential hazards and insecurities involved.

Evidently a wise operator/manager/owner will only opt for NSR, if it can offer significant savings and lucidly it is failing to do so as anticipated or expected for a practical situation when smaller ships are used. One mean of doing that is to reduce the fees levied as icebreaking and NSR administration fees. They are extremely high and

Figure 4.4: - Increased NSR ice breaking fees for major cargo types 2003 (in USD)



Source: - Legal and administrative issues of arctic transportation, GROWTH project GRD2- 2000-30112 ‘‘ARCOP”, Finland. Adapted from Miaojia, L. and Jacob K.,(2010), The potential economic viability of using the Northern Sea Route (NSR) as an alternative route between Asia and Europe, Journal of Transport Geography 18 (2010) 434–444

resisted by some operator/manager/owner as reported in the news and scholarly articles. However, it appears highly unlikely from the past trend as shown in Figure 4.4 above indicating the rate icebreakers fee in USD for the year 2003, with an average of 23 USD/ton. This increase was resulted from the Russian government decision to terminate the subsidies offer to maintain the icebreaker fleet. Another possibility is the increase in the sailing period along the NSR, which is suggested by several climate models (see section 3.3). This will also help in boosting the annual container shipment capacity as a result of frequents trips. Obviously being shorter NSR leads in transit times and greenhouse gas emissions, which are faster and more environmental friendly in terms of emissions quantity.

CHAPTER 5: OBSTACLES

5.1 Environmental

Reliability, safety and security in the marine sector are always being subjected to the environmental condition encountered. NSR which is a part of harsh and somewhat unique in itself environmental conditions of the Arctic in terms of bathymetry, sub-zero temperature, winds, currents, remoteness and visibility (precipitation/fog/snowfall) is always a challenge for the shipping and other human activities.

Some area of NSR region is always being notorious for its sub-freezing temperatures almost round the year. The extent and thickness of sea ice are always subjected to the exposed temperature. Larger ice sea extent and ice thickness will impede the navigational speed. Prolonged exposure to low temperatures can lead to severe health hazards to life like frostbite, hypothermia or cold stress. A metal structure like ships, offshore installation, and equipment's are also affected and can be subjected to metal fatigue and failure. Specially designed equipment's, personal protective equipment's, technology, procedures and risk assessments are used and carried out for occupational safety and health related concerns.

In the Northern hemisphere winds blows mainly from the West because of the atmospheric circulation pattern of the region know as "Westerlies". The pressure difference in the area caused by topographic and/or temperature differences are the main cause for winds to blow. They can be identified by different nomenclature like anabatic (uphill) or katabatic (downhill) winds, blizzard or polar vortex etc. depending upon their formation pattern and nature. Cold wind primarily causes icing on structures and interferes with human and equipment performance. These winds are also responsible for the formation of the sea waves however; waves are also guided by other factors like presence of ice and water depths. Sea waves are responsible for ice moments. The most severe sea state is usually during the autumn time, which last from September to October, and during other time entire NSR region is usually ice-covered.

NSR area is also susceptible to foggy conditions, severely affecting visibility thus navigation and other human activities. Visibility is also affected by typical phenomenon observed in the NSR like blowing snows, ice glare, Northern lights (Aurora Borealis). Table 5.1 below will provide an overview of the environmental condition prevailing.

Table 5.1: - NSR Area environmental conditions overview

	Kara Sea	**Laptev Sea**	**E. Siberian Sea**
Winter Season	Oct-May	Oct-June	Oct-May/June
Temp. Typical	-26^{o} C	-30^{o} C	-21^{o} C
Temp Extreme	-48^{o} C	-50^{o} C	-48^{o} C
Ice Thickness	1.8-2.5m	1.6-2.5m	1.2-2m
Fog	100 Days	75 Days	80 Days
Summer Season	June-Sept	July-Sept	Mid June-Sept
Temp. Typical	07^{o} C	08^{o} C	15^{o} C
Temp Extreme	20^{o} C	26^{o} C	30^{o} C

SOURCE: - The rise of NSR, Skuld, Presentation by Capt. Binoy Dubey Dated 21 June 2012

NSR regions bathymetry is also unique. AMSA 2009 report says that Arctic is the smallest (14.056 million Km^2 covering 2.8% of total earth surface), shallowest (Average depth of 1,050 meters and deepest of 5,160 meters) and least sampled of the worlds

Table 5.2: - Water depths in the Straits of NSR

NSR Straits	**Depths**
Kara Strait (in the fairway part)	50 m
Matisena and Lenina	not less than 20 to 25 m
Vilkitskogo	50 to 250 m
Shokalskogo	200 to 250 m
Yugorskiy Shar	13 m
Sannikova	13 to 15 m
Dmitriya Lapteva	8 to 9 m
Bering	30 to 50 m
Note: - Open water depths for the NSR vary from between 20 to 200 m.	

SOURCE:- Navigating the Northern Sea Route- Status and Guidance, n.d., ABS Retrieved May 10, 2015 from http://ww2.eagle.org/content/ dam/eagle/publications/2014/NSR_Advisory.pdf

ocean. Some of them are extremely shallow and narrow thus limits the size of the ship that can pass over the region, thus economies of scale cannot be realized over the route. Table 5.2 above provides the available depths in certain straits in the NSR. Some of them are unavoidable for transit and proved to be the bottleneck or the choke points for navigation. The option of dredging is also not economically feasible due to the remoteness of the area and may cause inevitable damage to the fragile eco-system in the area, which is perhaps not possible to restore again.

5.1.1 Pollution

Undoubtedly pollution is the gravest challenge NSR and the entire Arctic is facing with the emerging scenario of commercialization of the area. Shipping and offshore (drilling) activities are two primary sources of pollutions. Ice-covered water has its own additional inherent risk in eventuality like oil spill owing to the fact that such area are habitat of some of the rarest species, sub-zero temperature decelerates the natural degradation process, oil may remain trapped under and in between the ice, difficulties in organizing a response plan as the facilities and resources required are not readily available because of the remoteness of the area, extremely high capital cost involved in the containment, recovery, and restoration process.

INSROP II.6.1 "Control of pollution from ships sailing by the NSR", provides a comprehensive overlook on this issue. It not only identifies the sources and causes of the pollutions but also provides guidelines for the control of pollution from ships sailing by the NSR under five different headings covering the overall prospectives.

Surprisingly, in MARPOL convention Arctic has not yet attained the status of the special area unlike Antarctica, which is a special area under MARPOL and is similar to Arctic in many aspects. However, MARPOL convention is the key IMO instrument regulating all aspect of pollution from the ships in the area via its six annexes. Notable an additional annex to MARPOL convention- Ballast Water management is proposed looking into threat ship ballast possess and is expected to come into force very soon. Beside MARPOL, coastal States has its own domestic regulations which can be

irrespective and more stringent to any international requirements. One of such kind is Russian act on environmental protection adopted in the year of 1992 to cover its maritime water covering NSR region. An overview of the discharge criteria is provided with the help of Table 5.3 below.

Table 5.3: - Control of discharge under MARPOL 73/78 & Russian Reg.

Pollutants	**MARPOL 73/78 (Within Special Area)**	**Russian Regulations**
Discharge of machinery space bilges	No Discharge Except: **1.** Bilge is not mixed with cargo pump room bilge or cargo residues. **2.** Ship is en-route **3.** Oil content of effluent ≤ 15 ppm **4.** Has oil alarm and auto stopping device	Discharge criteria are same as MARPOL 73/78 for the special area
Discharge of Sewage	No Discharge Except when: **1.** Sewage is communted and disinfected using system 3(1)(a) at a distance more than 4 n.m. from nearest land **2.** Sewage is not communted and disinfected at a distance more than 12 n.m. from nearest land **3.** Ship is en-route and proceeding at not less than 4 kts	No discharge except after treatment when coliform index does not exceed 1000 and ship is en-route and proceeding at no less than 4 knots
Discharge of garbage	No Discharge Except : Food waste at a distance of > 12 n.m. from the nearest land.	No Discharge: Garbage may be burned on board of ship
Note:- Applicable for Ships ≥ 400 GRT and Oil tankers		

SOURCE:- Adapted from INSROP II.6.1 "Control of pollution from ships sailing by the NSR"

Even after strict laws and enforcement, unethical, deliberate and illegal pollution incidents are still very common in the shipping Industry making it a challenging task. As an example in INSROP report II.6.1 states that “in 1992, 115 out of 184 ships navigating in the Arctic regions are inspected and 122 cases of contravention of the pollution regulations were identified by the authorities”.

Similar strict laws are applicable for offshore industry operating in and around the NSR region for pollution prevention as they possess a parallel threat to the environment.

5.1.2 Eco-System

The entire Arctic and thus NSR is the one of the most fragile and exceptional ecosystem existing. Invasion of the foreign species through shipping ballast and lethal effect on the existing eco-system by the mounting human activities and global warming may have catastrophic effects as suggested by the researchers in their numerous findings and studies.

The following large marine ecosystem (LMEs) are defined on the NEP: 1) the western part including the Barents Sea and the Kara Sea and 2) the marginal seas of eastern part of the NEP/NSR including - Laptev, East Siberian, and Chukchi seas. The number of known species decreases from the western part of the NEP/NSR to the eastern part of the NSR. This is partly a result of harsher environmental conditions eastward on the NSR, but also because the fauna of the eastern part are some of the least studied in the world (Karl, M. E., n.d.).

Migration of species is also common phenomenon observed. With commercial perspectives, fisheries are important and any such changes will affect the quantity and quality of the catch. Fisheries are the main source of food for the indigenous people thus important however Arctic fish catch doesn’t account a major part in the global figures.

A relatively newer concept of ecosystem-based management (EBM) to ensure sustainability is popular and recognized by the Arctic States as well as other Arctic stakeholders like the Arctic Council. In May 2011, Arctic Council Ministers called for the establishment of an expert group on Arctic (EBM in the Arctic, 2013). In the same conference, it was proposed to define EBM as

> “Ecosystem-based management is the comprehensive, integrated management of human activities based on best available scientific and

traditional knowledge about the ecosystem and its dynamics, in order to identify and take action on influences that are critical to the health of ecosystems, thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity" (ibid).

5.2 Legal Framework

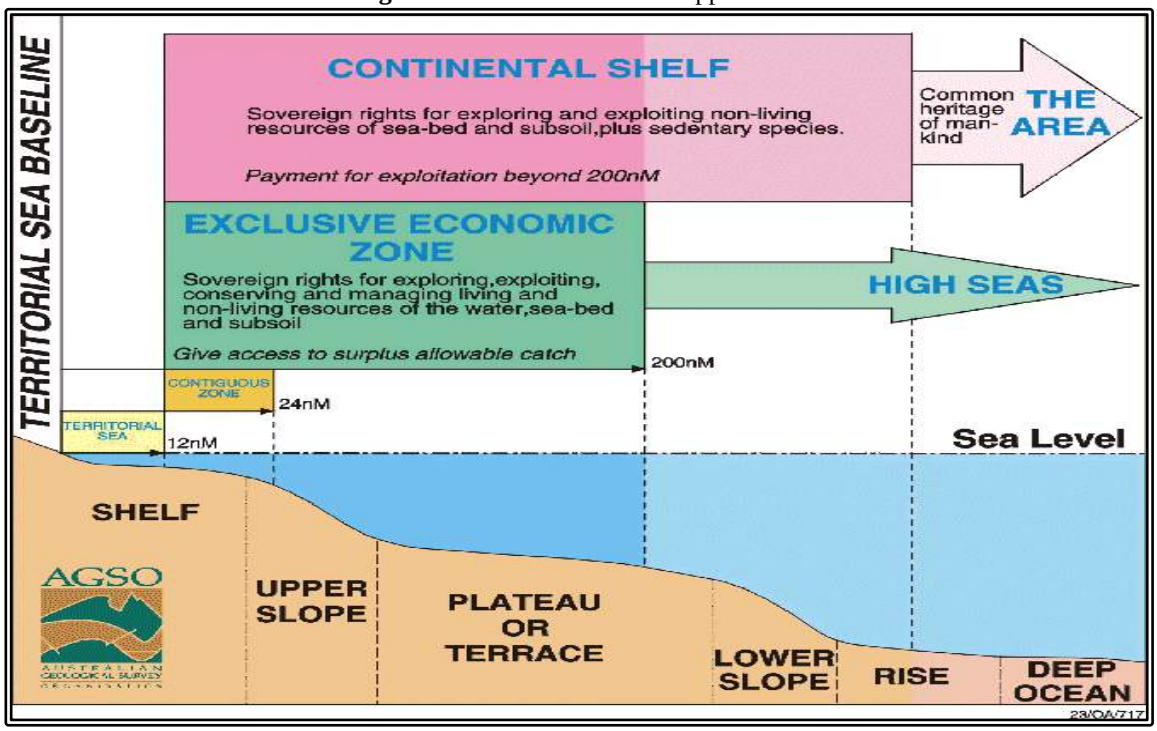
Notably there is no individual legal regime, which governs the entire Arctic region, contrary to its counterpart the Antarctic, which is governed by the Antarctic treaty system (ATS) even after it is the only inhabitant continent. The need for similar Arctic treaty was recognized by the European parliament in the year of 2008 when a resolution regarding the same was proposed. In the same year the five Arctic States in their Ilulissat Declaration consensually declare to extend their mutual cooperation for the Arctic region and believes that the existing law of the sea is an extensive legal framework and there is no need for formulating another such law, to regulates the Arctic and thus NSR region particularly. Undeniably the 1982 United Nation Convention on the Law of the sea (UNCLOS) is the backbone of the legal framework in the NSR and in entire Arctic boundaries. Interestingly even today except the United States of America all Arctic states are parties of the UNCLOS convention. NSR legal framework is not only complex, lacks transparency but also suffers from heavy bureaucratic procedures.

5.2.1 IMO

Russian federation claims jurisdiction and controls over a significant part of NSR, under UNCLOS zonal approach of the seas. As per the same the sovereign coastal States can exercise specific special rights and jurisdictions over different zones as defined and calculated by the laws established under UNCLOS- see Figure 5.1 below and through Article like 56 (Rights, jurisdiction and duties of the coastal State in the exclusive economic zone), 234 (Ice-covered areas) for regions like NSR. These zones include the internal waters, contiguous zone, territorial sea, exclusive economic zone and the continental shelf. Art. 234 stipulate that: "The Coastal States have the right to adopt and enforce non-discriminatory laws and regulations for the prevention, reduction and

control of marine pollution from ships in ice-covered areas within the limits of the exclusive economic zone". However the same UNCLOS also provides concept like freedoms of high seas, rights of innocent passage and many more to protect the rights of others States and to make a balance between different rights of the States, with a definitive aim to avoid conflicts or disputes among them.

Figure 5.1: - UNCLOS Zonal approach



SOURCE: - http://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/pubs/rp/rp9899/99RP06

Despite such inclusive efforts, claims over territories and conflicts are still persistent. Among them, US and Russia conflict is the most prevalent one. Russia claims its entire EEZ and possibly the high sea to be subjected to special coastal State rights for the ice-covered area. It further claims that ice-covered straits of the NSR are part of its internal waters, supporting this by several theories, including that of historic waters enclosed by straight baselines (Kolodkin, A and Volosov, M. 1990). However, US contradict Russian claims. Many such instances of struggle in between States can be quoted, as everyone is now aware of the strategic importance of the NSR and the entire Arctic area.

Mostly the root cause or/and reasoning behind such disputes and claims are the different

interpretation of the some Articles by different parties involved. The most classic example in the case of NSR is Article 234 only, which can be considered ambiguous thus left many questions unanswered like what degree of ice-covered is required, to which kind of ships this article applicable to, what is the scope of this Article etc. Such arguments are used in legal battles and arguments, which are always complex to judge and difficult to arrive at a unanimous decision acceptable to all parties involved. Another complicated issue is the claim over the same continental shelf by different states. The concerns arise as most of the offshore oil and gas deposits and activities are concentrated around continental shelf area, making it strategically important for all.

Unlike UNCLOS all other relevant Conventions of the IMO like the International Convention for the Safety of Life at Sea (SOLAS), International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL), Convention on the International Regulations for Preventing Collisions at Sea (COLREG), International Convention for Safe Containers (CSC), International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC), International Convention on the Control of Harmful Anti-fouling Systems on Ships (AFS), Convention on Facilitation of International Maritime Traffic (FAL), International Convention on Civil Liability for Oil Pollution Damage (CLS), Convention on Limitation of Liability for Maritime Claims (LLMC) etc. are also equally applicable in the NSR and in entire region as they are ratified and in force, as required number of maritime nations are parties to it.

5.2.2 Arctic Coastal States

There are five Arctic States or littoral states or Coastal States namely Canada, Denmark, Norway, Russia and the United States. Except the US, all other states have ratified the UNCLOS till date. Following the Ottawa declaration of 1996 Arctic Council is formed, one of the frontrunner intergovernmental forum which deal with the issue concerning Arctic affairs and promotes co-operation among all circumpolar State viz. Canada, Denmark, Finland, Iceland, Sweden, Norway, Russia and the United States. These

States enjoys the status of full members (8 in number) besides other Non-Arctic States with a status of permanent observers (12 in number including China) and ad hoc observer States.

Arctic States have full rights to make and enforce laws applicable to the foreign ships in the waters of their legal jurisdiction. Like the Russian federal law of shipping on the water area of the NSR, however, these requirements should be in accordance with the generally accepted international rules and regulations (GAIRAS), therefore, the Russian laws are in coherence with the UNCLOS requirements. These domestic rules are sometimes not transparent, difficult to comprehend and in line with international rules.

5.2.3 Non-Arctic States

Besides UNCLOS, one of the most important treaties for the Non-Arctic State is the Treaty concerning the Archipelago of Spitsbergen (Svalbard Treaty). The treaty establishes Norway's full sovereignty over the Svalbard archipelago but stipulates that it must remain demilitarized. Citizens from all states party enjoy the same right of access to and residence in Svalbard. Eleven institutions from 10 countries have established research stations at Ny-Ålesund, Svalbard, three of which are permanently manned (Linda J., 2010).

Willingness and commitment of Non-Arctic States like China, Japan, South Korea, India, Singapore to explore and make use of the NSR and the entire region to boost up and revive their economy from the downturn in the market is definitely going to agitate the political actions and legal activities specific to the NSR.

5.3 Arctic Infrastructure

Lack of infrastructure and facilities in the NSR and in the entire Arctic region is the main reason that makes shipping as transportation mode in the region still expensive however, it is one of the cheapest mode of transportation known and used by humankind elsewhere. It also puts the claim of the NSR being competitive with its rival Suez and Panama Canal routes on the back front. The situation is gradually expected to improve in view of the prospective commercial use and future predictions.

It is evident from the fact that today numerous shipping companies are operating in the NSR and in entire region and Arctic ports including along the NSR route are capable of handling larger ships and a variety of cargo types besides that there are numerous projects undertaken by various energy sector giants and others. All of these activities are only possible with a good infrastructure support. Parties using or intended to use NSR are aware of the fact that facilities and infrastructure are the backbone to highlight and make NSR attractive or commercially feasible. They are ready and eager to invest in order to gain from the benefits NSR is offering to them.

Some of the companies whose principle area of the business is the NSR region is The Murmansk Shipping Company (MSCO), which is the largest shipping company operating in the region. Others include The Far Eastern Shipping Company (FESCO), The Primorsk Shipping Company (PRISCO), The Tschudi, The Northern Shipping Company (NSC), The Arctic Shipping Company (ASC). Even traditional shipping companies operating on the traditional maritime routes are also tempted to use NSR. Examples to justify the fact is companies like COSCO. These companies are not only Russian or belong to Arctic States but belongs to other geographical areas also and they owned/managed/chartered a big ice class fleet in order to operate in the area. They are committed to further expand their fleet by adding additional ships.

Almost all of the icebreakers operating today in the NSR are Russian owned and some also use nuclear power. Due to more than 75% reduction of NSR cargo volumes since 1987, the existing icebreaker fleet is more than sufficient to accommodate all present NSR transport needs (Claes, L. R., 2000). However, since the fleet is considerably old and looking at the future scenario the icebreaker fleet is not sufficient to support the shipping operations.

There are several ports facilities in the region (see 2.3 Fig. above), some of them required modernization and further developnment. The International Maritime Satellite Organization (INMARSAT) system and the Russia’s Ocean system are used for satellite

communication in the NSR, but communication are expensive. Sufficient publications, charts, electronic navigation systems and aid to navigations are lacking today and they still don't cover the entire NSR area. Repair facilities are available at Dikson, Igarka,Tiksi etc, but they only offer minor repairs. Major repairs or dry dock facilities are desirable. Still additional work is to be carried out for more reliable ice information forecast and broadcasting. Existing icebreaker facilities are not sufficient and getting older. Search & Rescue operations are directed by the Marine Operations Headquarters (MOH), with dedicated salvage and repair teams stationed onboard ice class salvage tugs in Dikson and Pevek, as well as onboard the icebreakers. The NSR regions are covered by the Global Sea Salvage Distress System (GSSDS). According to a 1997 decision by the federal government, emergency radio stations keeping watch on distress and salvage frequencies will be established in the ports of Murmansk, Arkhangelsk, Tiksi, Pevek, Mys Shmidta and Provideniya (ibid). Fees for using Arctic facilities are extremely high and required to be set at a balanced way to keep NSR competitive with its rivals. Even today Arctic infrastructure lacks capital investments and have very long lead-time for projects due to remoteness.

To conclude for sure there is still a scope and need to upgrade the current state of infrastructure and the existing icebreaking fleet will definitely going to be a bottleneck, which need to address proactively as it can not be adjusted instantly and is very critical to support the cargo flows.

5.4 Technical Requirements

IMO and classification societies are two principal bodies, which deals with the standard settings (Regulatory, Operational, Technical). The minimum standards for the ships are established by IMO, which is an intergovernmental autonomous and specialized body of the United Nations. These standards are adopted by the IMO member States, which make them mandatory through countries legislative procedures. IMO member States are free to make these standards further stringent if deemed necessary by the law making body of the country. Sometimes they are the soft law or para-droit or non-treaty instruments, which are not enforceable by law and are used as a guidelines or

recommendations while formulating the requirements. This freedom, in fact, causes nonuniformity in the ice class rules of the Classification societies (see Table 3.1 above) as well as in domestic and international requirements.

The objective of ship classification is to verify the structural strength and integrity of essential parts of the ship's hull and its appendages, and the reliability and function of the propulsion and steering systems, power generation and those other features and auxiliary systems which have been built into the ship in order to maintain essential services on board. Classification Societies aim to achieve this objective through the development and application of their own rules and by verifying compliance with international and/or national statutory regulations on behalf of flag administrations ("Classification Societies", n.d.).

Stringent technical requirement apparently raises new building and maintenance cost and requires qualified and experience personnel's to operate them. High-end technical equipment's are naturally costly and require a higher degree of maintenance standards. In case of malfunctioning or breakdown, repairs / replacements are costly affair.

5.5 Human Element

In any industry, the human element is the most critical aspect to be addressed irrespective of the level of automation or technologies driven equipment's are being used. Shipping/offshore sector is no exception to this. Human error is the most common factor involved in any incident or accident and this fact is now established by various studies and scientific findings. Besides extensive research and efforts from different agencies addressing this gap is the most difficult task as it is driven by an extremely diverse number of factors, and can also vary on a case-to-case basis.

International Convention on Standards of Training, Certification and Watchkeeping of Seafarers (STCW) is the bible to address the human resource issue. NSR is ice-infected area with inherent dangers and need, which required qualified and trained personnel's or navigators for smooth operations. The IMO's guidelines for Ships Operating in Arctic

Ice-covered Waters also provide criteria for similar purposes. It defines ice-navigator as "any individual who, in addition to being qualified under the STCW Convention, is especially trained and otherwise qualified to direct the movement of a ship in ice-covered waters." The need of standard procedures to be adopted, training and qualification required, manuals, forms and checklists, emergency preparedness, drills, record keeping, documentation, responsibilities, authorities, auditing and certifications covering both ships and shore-side are covered. International Safety Management (ISM) Code also highlights the need for similar actions however, it is more general in nature. Notable some parts of these instruments are only for guidelines purposes.

Even maritime administrations, Flag States, and the Coastal States are committed to regulate and govern standards for the officers, crew, companies, and training institutes, ensuring quality and enforcement of rules and regulations. We need to understand that a person can be trained to navigate in conditions like Arctic, but the experience is more important which can be gained with time only. There is a severe scarcity of training institutes, qualified faculty particularly in the developing nations, who can run such specialized courses. Moreover, quality assurance for such institutes is always doubtful and difficult to regulate. Today youth is not attracted toward seafaring profession and seafarers are attracted towards shore opportunities thus to prepare future working force is a thought-provoking task especially for an area like NSR which demand high standards. The working environment in such area is harsh thus can lead of fatigue, a typical cause behind most accidents.

5.6 Safety

IMO, the key institute working on the safety and security aspect of shipping has adopted the International Code for Ships Operating in Polar Waters or Polar Code, which is expected to be enter into force on 1st Jan 2017 and thus applicable to ships constructed after that date. It will be mandatory under SOLAS and MARPOL conventions. The 94th session of the MSC in November 2014 has adopted the Polar code and SOLAS amendments about the same while May 2015 marked the 68th session

of the MEPC committee and adoption to the MARPOL convention amendments.

The International code of safety for ships operating in polar waters (Polar Code) covers the full range of design, construction, equipment, operational, training, search and rescue and environmental protection matters relevant to ships operating in the inhospitable waters surrounding the two poles (Shipping in polar waters, n.d.). Another IMO instruments to cover safety and security aspect includes the ISM code and the ISPS code made mandatory under the SOLAS convention.

To further enhance the safety of the passenger ships working in NSR, IMO assembly has adopted the guidelines on voyage planning for passenger ships operating on remote areas like NSR and the Arctic via resolution A999(25). Similarly, MSC has adopted a ship reporting system in the Barrent Sea area, which will be mandatory in nature in its 91st session held in November 2012.

Aforesaid are some example of IMO attempt to enhance safety in the ice-covered areas like NSR however, we still have to go far ahead. Emergency preparedness and response with particular emphasis on medical response, recuse operations/facilities are still not fully organized and coordinated. Fire fighting appliances (FFA) and life saving appliance (LSA) and others critical safety equipment's are prone to damages due to sub-freezing temperature. Ship-icing, chocked sea chests, and frozen water ballast possesses stability issues hard to manage sometimes, if neglected. Other elements discussed under sub-sections like human environmental, human element, Arctic infrastructure and others all contributes to the safety aspect.

Both structural and engineering capabilities of the ship and the geophysical properties of the surrounding ice regime determine whether ships may traverse ice-covered waters safely or not (Scott, R. S., et al., 2013). The Arctic Ice Regime Shipping System (AIRSS) provides a framework for assessing whether a ship may navigate safely in ice-covered waters based on its design and the ice conditions present (Transport Canada

1998). The ability of a ship to enter a particular ice regime is given by the Ice Numeral:

$IN = (C_a * IM_a) + (C_b * IM_b) + \ldots\ldots + (C_n * IM_n)$

Where: IN is the Ice Numeral,

C_a/C_b is the sea ice concentration in tenths of ice type a/b

and IM_a/IM_b is the Ice Multiplier of ice type a/b.

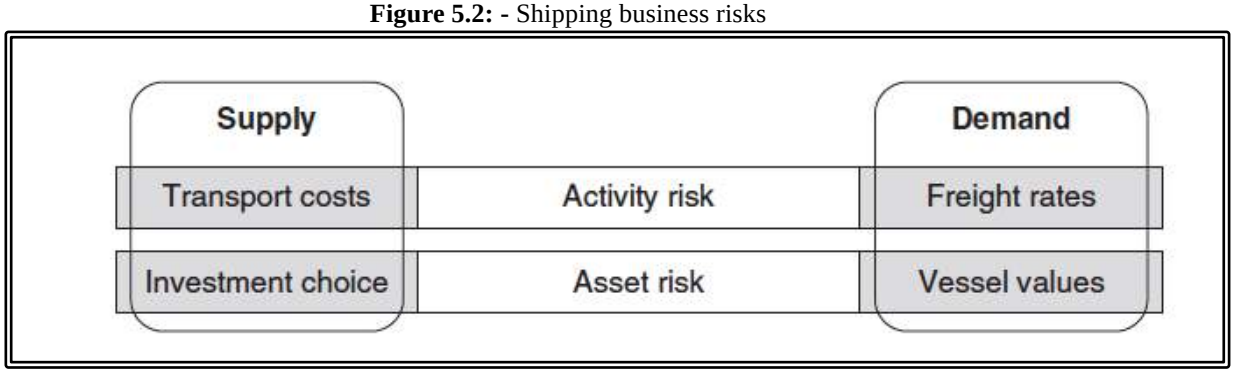
A negative Ice Numeral signifies that the ice regime presents a significant hazard to the given ship. Although passage may be possible in such conditions, the likelihood of accidents has been shown to be considerably higher where the Ice Numeral is negative (Timco et al. 2004).

5.6 Risk Management

Risks are diversified in nature and require logical and systematic approach while dealing with them. The risk in its generally accepted definition is defined as the product of the probability and consequences of the incident. In NSR, both are of extraordinary high. Risk management deal with four main elements namely: risk identification, risk evaluation, risk management, and risk monitoring. Shipping business risks are guided by the market fluctuations and by the fragile balance between the demand and supply side. Additionally the area of operation like the NSR, personnel's abilities, technical advancement, political regime and situation etc. are factors, which add up extra risk in the business. Some of the risks are external thus hard to judge and deal with e.g. political or credit risk. Risks can be broadly classified as activity and asset risk as shown below in Fig. 5.2. Today shipping companies are using several ways to mark/identify, manage and mitigate their business risks through derivatives, insurance, maintenance, auditing, inspections, training, certification, research & analysis and many more ways/instruments. This sub-section will primarily deal with the insurance part. Insurance is an integral part of any industrial sector to mitigate the risk involved, covers possible liabilities and for commercially carrying out business activities legally. Insurance will also help a shipping company to reduce its tax liabilities in some economies.

INSROP recognized that risks required coverage was: Hull & Machinery (H&M), cargo insurance, Protection & indemnity (P&I) and a number of miscellaneous risks. P&I insurance, including cargo insurance, depends on a ship size and a type of cargo, and H&M insurance compiles with the ship price, taking account for the estimated damage rate. Furthermore, those H&M policies do not cover navigation in ice-infested waters

Figure 5.2: - Shipping business risks



SOURCE: - Adapted from Harlaftis, Tenold & Valdaliso, 2012

and require special arrangements with the insurer. For instance, and although double hulled ships had been operating in Arctic waters for a long period, double hull may involve higher repair and maintenance costs and, thus, higher insurance premiums (Karl, M. E., 2010).

Underwriters are usually worried about the number of claims from NSR insurance covers, as the Ice-covered water of NSR possesses damage dangers significantly (see Table 5.4 below). This usually raises the insurance premium cost involved in NSR trade. Today Insurance market is quite broad and provides various insurance covers very specific to the need and desire of the companies. Even then, NSR insurance is

Table 5.4: - Ice damages in the NSR

Russian Arctic Seas	Average Intensity of Navigation	Percentage of Damages N=800
Kara Sea	Highest	40%
Laptev Sea	Unknown	20%
East Siberian Sea	Unknown	21%
Chukchi Sea	Lowest	14%
Year 1954-1990		

SOURCE: - Adapted from Østreng et. al. (1999a), pp.10-11

costlier compared to other covers and can go up to twice expensive when compared with another type of insurance covers available. Availability of numerous options sometimes may cause confusion and difficulties in decision-making.

CHAPTER 6: CHINESE NSR INTEREST AND STANCE

6.1 Chinese Interest

Being closer to the NSR region, short distance and cost saving in transportation additionally with climate change concerns and energy deposits in the area are the primary reason of Beijing's NSR interest. This will further flourish Chinese exports and imports trade volumes. Arctic passages are nearly 2,000–3,500 nautical miles shorter than the customary sea routes from Chinese coastal ports to the east coast of North America, and reduce the length of customary routes from ports north of Shanghai to the ports of western Europe, the North Sea and the Baltic Sea by 25 to 55 percent (Kai Sun, n.d.).

There is also a developing interest in Arctic fisheries in the 2.8 million square kilometers beyond the exclusive economic zones (EEZ) of the five adjacent states. While the fishery is not yet viable, the melting sea ice has encouraged the Arctic Five to consider fisheries management approaches, which will have to involve a wider group of states ("Interest & roles", 2011). China will likely to lead into this, being the world most populous nation China is facing another challenge of food security.

This increase in the trade volumes will definitely be a golden opportunity for the Chinese ports in higher latitudes and Chinese shipping companies. China will definitely like to be a leader among maritime nations by record port turnovers and strengthening her maritime fleet. In container sector, Shanghai is already a world leader in term of containers throughput per year leaving behind extremely competitive ports like Singapore and Busan; South Korea. Beijing will be delighted to extend this performance to another maritime sector like bulk, gas and tankers.

Expansion of commercial activities in the NSR will also bring energy-hungry China closer to immense resource ground of Arctic, safeguarding her future energy needs. China is looking forward to diversifying its energy investments and the region surrounding NSR is an ideal ground for it. This can be seen from the statement made by

the governor of the Yamalo-Nenets autonomous region in Russia - a coastal region which accounts for over 90 percent of Russian natural gas production at Shanghai Expo 2010. He said, “he was ready to offer partners in China a mutually advantageous and constructive cooperation in the regional natural resources sector. We are ready to act as intermediaries between an investor country and the oil and gas sector and create a good investment climate” (“Russia Invites”, 2010). Nevertheless, it is Chinese interest in the energy sector that made the Russian diplomat to express his willingness for such an attractive investor like China.

Infrastructure deficit NSR region will provide China-based enterprises a scope to manufacture machinery parts and other important components / items required to build the facilities in and around NSR region. With cheap labor and favorable government policies, China can stand far ahead in the competition with other competitors in the open market. This is extremely critical for Chinese economy in view of the recently launched “Made in India” campaign by the Indian prime minister Mr. Narender Modi. It will help the Chinese government to increase it valuable foreign exchange reserves. Moreover, it will help Beijing to further extend collaborations and diplomatic relations with one of her strategically important and powerful neighbor like Russia and other the Arctic States.

Like any other nation in the world, China is also suffering and worried about the dramatic consequence of climate changes and Arctic thawing. Chinese agricultural output is severely affected by it. As Chen Lianzeng, deputy head of China’s State Oceanic Administration has said, “As the largest developing country located in the Northern hemisphere, the climatic and environmental changes in the Arctic will have a profound effect on the climate and environment in China, and directly relate to Chinese industry, agriculture and people’s living. Therefore, the conduct of scientific research and expectation on the Arctic has significant meaning to China and its sustainable development” (Kai Sun, n.d.). Primarily because of this reason the Chinese government is spending billions of Chinese Yuan on Arctic research and exploration programs

annually.

Increasing military presence of the Arctic State in the region has forced the nearby Non-Arctic States like China to develop more comprehensive stand to cover their security concerns. Geopolitical tension in the region is likely to hike because of the increasing Arctic interest. In a rare open-source article about the Arctic by an officer of the People's Liberation Army, Senior Colonel Han Xudong warns that the possibility of use of force cannot be ruled out in the Arctic due to complex sovereignty disputes (Linda J., 2010).

6.2 Chinese's Stance & Policies

Attending an Arctic forum organized by the Norwegian government on Svalbard in June 2009, Hu Zhengyue, Chinese assistant minister of foreign affairs has said "China does not have an Arctic strategy", the country does appear to have a clear agenda regarding the Arctic (Linda J., 2010). Till date, no clear and dedicated policy towards NSR or Arctic is being officially announced. The Chinese government is very cautious and diplomatic in drafting and presenting the Chinese stance in the global platform. Since the Arctic routes, significance was highlighted China was very keen and participated in most of the activities related to Arctic exploration and research. Although China's role and influence in any decision-making forum were quite faint as it is not an Arctic State. In order to make sure that China should at least participate or witness in Arctic policy decision-making and discussions, she tried her best to attain some significant status in any such forum. She was succeeded in her attempts recently when she gains permanent observer status at the Arctic council. China is very optimistic that in near future the Non-Arctic States like her will play a more decisive role in such forums. A new term used by Chinese scholars to refer to China as a 'near-Arctic' state reinforces this presumption (Linda, J. & Seong-Hyon, L, 2013).

Instead of taking a hardline approach China has declared that she recognizes and respects any States sovereignty and abides by all International rules pertaining to it.

This applies to the Arctic region and to the Arctic States however interestingly sometimes she also claims Arctic region as “treasure to humankind” and rejected certain claims of the Arctic States. Rear Admiral Yin Zhuo has argued that the “Arctic belongs to all the people around the world, as no nation has sovereignty over it… China must play an indispensable role in Arctic exploration as we have one-fifth of the world’s population.” (“The Four Drivers”, 2014).

Chines policy makers unanimously thinks that Arctic issues or problems are global in nature rather regional as it will affect the globe thus no States can claim exclusive rights over such issues and the principle of sovereignty can be sideline because of this reason. Controversially, China is well alert that her territorial tensions with neighbors over the Yellow Sea may going to counteract her new notion of near-Arctic concept as other States may also use the same tool to protect their own vested interests and claims.

One of the ways by which China is continuously making her presence in the area is by participating in various research programs alone or in collaboration with the Arctic States and International organization active in the region. This will help to portray that her primary concern is to study and evaluate the climatic and environmental consequences of the global warming, however China’s anxiety regarding commercial political and military impact due to increasing possibility of Arctic or more specifically NSR use is difficult to hide.

China is a forefront runner in the Arctic research and expedition. Her policies are favorable for the same and she had made clear that it is important to do for the Chinese economy and people’s welfare. Currently, China has one icebreaker, the Xuelong (Snow Dragon), which was purchased from Ukraine in 1993. Under the new plan, this will be joined with a sister ship (Paul G., 2010). This is a clear indication of Chinese intention to go ahead with polar (includes both Arctic & Antarctic) research programs and to further extend it. Chinese Arctic and Antarctic Administration (CAA) working under the auspices of State Oceanic Administration (SOA), which reports to the Ministry of

Land and Resources (MLR) is a principle agency managing funds and projects undertaking in the polar region. There is a proper hierarchical system to undertake polar related matters. Institutions like Polar Research Institute of China, Shanghai Institute of International Studies, The China Institute for Marine Affairs, The Chinese Academy of Science and state-run Chinese universities Arctic projects are valuable source of information and guidance for the diplomats to formulate a better Arctic policies and stance on Arctic for China.

China's most recent 12th national economic and social development five-year plan from 2011 to 2015, Chapter 14, promote the development of marine economy clearly indicates her interest for NSR and the region. Looking at the latest development in the world affairs (Ukraine Controversy and subsequent sanctions on Russia), one can easily make out that Russia's relationship with the Western powers and especially the US is dragging away further more. Beijing definitely wants to take advantage of this and may seek significant benefits. One of the examples of this can be the incident of the Kara Sea, where US oil major Exxon jointly with Rosneft discovered massive hydrocarbon reserves. The project was on the verge of completion but due to tensions in the relations Exxon was forced to quit just before the extraction task. Russia is now looking for a reliable companion to build the long-term partnership and China is the obvious contender. Chinese policies and diplomacy will react to gain better bargains and more rewarding opportunities.

6.3 Relationship With States

Chinese coastline doesn't hug the Arctic periphery. The fact possess weight in regard with Chinese perspective, as a cordial relationship is desirable for China with the Arctic States like Russia and Norway, which have jurisdiction and sovereign rights in most part of the NSR. China is willing to work with the Arctic States on issues of common interest and mankind.

Russia is the most strategic Arctic partner for China. Both partners have common grounds and reasons to extend their help to each other in the dynamic economic and political world platform. China wants to rejuvenate her hopes to use NSR as a modern silk route. Chinese shipping and energy sector giants like COSCO and China oil are working hand to hand with Russian companies. Both sides are also trying to make their respective policies more favorable for each other. However, their relationships have seen several up and down also. The Law of the Sea Convention, which most of the Arctic falls under, "stipulates that the high seas and the resources in the seabed there are the common heritage of mankind." Paul Goble a longtime specialist both in the government and in the academy on Eurasia believe that this position "could bring China into conflict with Moscow's rather more expansive notion of the extent of the Russian seabed in the Arctic" (Paul G., 2010).

Despite the fact that China Arctic researchers base the Yellow station is on the Norway's Svalbard Island her relationship with Norway is not always warm enough. After Liu Xiaboo, a jailed Chinese scholar, and human right activist was awarded 2010 Noble peace price, China's relationship with Oslo was almost frozen. Chinese foreign policy gave more importance to indicate that she will follow a zero tolerance on any attempt to destabilize her political stability or to defame her socialist framework at any possible cost. China sidelined her Arctic interest and relationships with Norway after that incident until very recent. Norwegian foreign minister Espen Barth Eide said at a meeting with foreign correspondents in Oslo that, "he is optimistic after more than two-and-a-half years of tension between the two countries. He added that China no longer is demanding an apology for the Peace Prize from the Norwegian government, which it wasn't about to get, and that Chinese officials now seem to accept that the Norwegian Nobel Committee is independent of government control" ("Chinese relations", 2013).

CHAPTER 7: SUMMARY & CONCLUSION

7.1 NSR Dilemma: A Perceived Threat Or An Opportunity

To judge our present actions we need to look ahead of time and then evaluate the scenario. An opportunity today may turn up into a threat in future. NSR can be a classic example to prove it. Different scholars have different perspectives on this subject making it more complex. However, we need to understand that the opportunity of NSR we are looking forward is derived from a threat.

Extensive human activities and maritime transportation in the NSR area will pollute the air, water, and land. Ship ballast also possesses a threat of invasive aquatic species introduction and migrations. Oil spills may occur from operational as well as accidental incidences. This will not only devastate or degrade the fragile Arctic flora and fauna but also interfere with the life of indigenous people living over there. Climatologists warn that the extraction of Arctic fossil fuels will contribute to global warming at a time when they believe nations should be paring back greenhouse gas emissions and pursuing alternative energy sources (The Emerging Arctic, n.d.). From an environmental perspective, it is a clear indication that by moving forward we are coming closer to a threat.

To build the route efficient enough of holding the projected traffic and allied activities, investment choices are prerequisite, risky and strategic decision for governments, Shipping companies, energy giants, and organizations. Because of the uncertainties involved owing to resistance from the environmentalist, Social workers, Non-Government organizations (NGO's) like Greenpeace, stringent requirements and regulations, willingness of the parties like the Shipowners etc. the financial recovery period can be slow and long. Any such decision is always gauged on financial parameters like the investment rate of return, internal rate of return, payback period etc. It may be considered as a short span business opening because at some point of time in future activities in the NSR need to be made restricted or perhaps closed to rheostat the thawing of the Arctic.

Today there is a need to understand that at what costs we are expecting to avail benefit from the NSR. Superficially it looks like an opportunity however, it is a threat for sure. A threat of possible intense commercial use of NSR leading to human invasion in the extremely delicate ecosystem of the high North causing interference with nature, accelerating the climatic warming at an alarming rate, increasing tensions between States due to their vested interests and perhaps to cold war situation. Promoting the notion of commercial use of NSR if annotated as suicidal is not an exaggeration.

7.2 NSR: Alluring or Repulsive Choice to link Europe with Far East Asia.

The quest for NSR is not only ruled by its inherent advantage of being the shortest but also for the fact that NSR and its surrounding areas can feed the world energy hunger and can provide various important natural resources. Undoubtedly the Arctic region including the NSR is a natural resource heaven but we need to understand the fact that owing to various unfavorable factors the production and transportation cost will be significantly higher thus making it a non-profitable and time-consuming business besides several environmental repercussions.

Firstly, Extreme climatic conditions are the main hurdle in fully utilizing the opportunity. Even after Arctic thawing, the operations can only be carried out on seasonal basis and requires costly and sophisticated machineries and skilled labor force, which either needs to be moved as and when required or permanently stationed in the location. In the latter case, it will stay ideal for a longer duration compared to its operations due to the halt in the production. Thus, it will be difficult to optimize the equipment's and personnel's effectively. The existing facilities and infrastructure in the area is very limited and not sufficient to support any further extension of the activities involved with natural resources exploration or exploitation. Hostile cold weather and ice possess severe safety issues making the insurance premium higher.

Supply chain network is almost near to non-existent. It is difficult to avail the benefit of

economies of scale in transportation through shipping, as there are bottleneck points along the route, it is highly risky and requires high-cost ice class ships and/or icebreaker facilities. Furthermore, the maritime framework in the region including the search & rescue, navigational aids, navigational-warnings, charts & publications, reporting procedures, contingency procedures, pollution response are not fully developed or relied upon absolutely.

Geopolitical conflicts, legal regimes of the Arctic States and claims of Non-Arctic States are making the scenario further complex. The extent of increases in Arctic activities in near future is still doubtful and under strong resistance from environmentalist, who believe that any such actions will increase the carbon footprints in the area and holds severe risk to the fragile ecological balance. Some of the scientific studies and scholars finding regarding the same are contradictory in nature making the picture more blurred to understand.

There is also an uncertainty in the financial support required to overcome the above-mentioned hurdles. In a readily available finance scenario also, considerable time is required to establish the route fully. Policy making and acceptable competitive fee structure for the services rendered will make this task more time consuming,

The word open waters means as areas where the ice covers are less than one-tenth of the surface, for the purpose of navigation (as per definitions by world meteorological organization). No simulation till date predicted Arctic area to be completely in the liquid state with zero floating or drifting ice. The navigation in NSR is feasible seasonally but still not completely ice-free thus not possible for ships to traverse with full speed. Some of the channels in the NSR is narrow and lacks drafts making it impossible for bigger ships to navigate along the route. Any attempt for dredging will be extremely expensive and may cause potential irreversible damage to the sensitive Arctic environment and eco-system.

Even the distance advantage of the NSR is under denunciation. We need to understand

that the maritime routes are very dynamic in nature and ruled by market demand and supply curves. Ports, which are used in studies and claimed to be reached, in a shorter time frame by using NSR are always subjected to volume fluctuations and changes over the years. Cargo imbalances and volumes, the location of transshipment hubs, refineries, markets and other facilities will also guide the route preference. Owing to uncertainties and delays it is difficult to use the route for time sensitive cargo or for liner service regardless of being shorter than other routes as it cannot guarantee the reliability.

It is hard to imagine that NSR can be used as a replacement for established maritime routes like Suez Canal or Panama Canal however, it will definitely can be used as a seasonal alternative (4 -5 months in a year) for specific routes and cargo types and by specific ship type and services. Although NSR will continue to be used for domestic transportation and activities like cruising and research. The military presence in the area is very likely to increase owing to border and interest disputes between States.

Today we have skills, technology, equipment's and personnel's, which can win over the odd of the Arctic or NSR region for sure, but it is not just all about winning the game. Such a move is tactically significant and is not an easy one; it requires a thorough analysis of facts and figures, taking into view its impact and profitability. We should be well aware of the fact that "NSR" cannot be a panacea for all of our problems.

In order to have a clear picture of our challenges and possible solutions of them as identified through chapter 5 are tabulated in Table 7.1. These undesirable elements will add up to the cost involved in using NSR and thus further strengthened the writer's notion that NSR is more repulsive choice than alluring. To transmute it into an attractive option considerable work and time is required on top of the capital, willingness and co-operation from different parties.

Table 7.1: - NSR conclusive analysis

Section	Obstacles	Potential solutions
5.1	Environmental – Harsh and Hostile / Unpredictable / Unique	
	Sub-freezing temperatures, bathymetry, Winds, Current, Ice moments/extent &	More advanced and ice-resistant ships which are cost efficient,

	thickness, Visibility, Remoteness Icing on structures and installations Shorter navigational period, slows down the navigational speed Occupational and health hazards	Further studies to evaluate Arctic environmental condition and measure to counteract cold weather health & occupational hazards. Accurate, up-to-date and frequent weather updates / broadcasts with additional stations in the area.
5.1.1	Pollution – Gravest challenge	
	Threat to sensitive marine eco-system Issues with containment, recovery and restoration process Enforcement and monitoring of laws	Strict legal and financial liabilities (Domestic and International) Transparency in defining procedures, authorities and responsibilities Increased monitoring, and emergency response, training Comprehensive easy to understand and practical contingency plan Further studies similar to INSROP II6.1 Special status to Arctic in conventions like MARPOL similar to Antarctica region
5.1.2	Eco-system – Exceptional and Fragile	
	Invasion/Migration of Species Shrinking fisheries and vegetation Prone to inevitable damage	Ecosystem-based management Sustainable development Control on greenhouse gas emission
5.2	Legal framework – Complex and lacks transparency	
	No Single legal regime for the Area Numerous disputes, and conflicts Complex and lacks transparency but also suffers from heavy bureaucratic procedures.	Single legal instrument covering Arctic waters. Global co-operations and mutual understanding More transparent (easy to comprehend) laws

		Dispute resolution within the powers of international body framework and with a time frame Domestic laws should be in accordance with International laws and requirements
5.3	Arctic Infrastructure – Insufficient to support future needs	
	Lack facilities, particularly icebreakers Publications, Charts, Nav-aids and communications do not cover entire area. Capital incentive Fee structure of facilities Long lead times for projects	More investment Use of latest and more advanced methodology. Additional fleet of ice class vessels and ice breakers Appraisal as per future predicted demands
5.4	Technical requirements – Not uniform	
	Mostly soft laws-Guidelines Increases ship building and maintenance cost Requires qualified and experienced personnel's to operate	Compulsory uniform requirements are needed Focused on simpler and cost effective technology Skilled personnel's to operate safely and efficiently
5.5	Human element – Lack of qualified personnel's	
	Difficult to address all aspects as it vary on a case-to-case basis and dependent on diverse number of factors Lack of qualified and experienced personnel's Scarcity of training institutes Difficulty in quality assurance and regulation enforcements Lack of enthusiasm Harsh working environment (fatigue)	Training and research Holistic approach covering practical and theoretical aspect Financial support to maritime education institutes Quality control with inspection and certification Motivating young professionals Checks on working conditions and ensure ILO work rest hours

5.6	Safety	
	Polar code still not in force Emergency preparedness, response, medical response, recuse operations and facilities etc. are unorganized Cold weather damages to LSA-FFA, and critical equipment's Stability issues from ship-icing, ballast Negative ice-numeral	Early enforcement of the Polar code Maintenance and checks of equipment's as per manufactures instructions Establishing and ensuring risk management techniques like checklists, training
5.7	Risk Management – Insurance aspect only	
	High insurance premium, Don't cover certain risks which are very prominent in the NSR To much option may cause confusion and difficulty in decision making	Comprehensive insurance policies and covers Restricting and regulating insurance market

There are mixed reactions and conclusions drawn on NSR future commercial prospects by researchers in their studies. We need to understand that there are several restrictions imposed and certain parameters are ignored for the theoretical purpose like reliability. The ground reality is that even after NSR is being claimed to be profitable and commercially viable under certain circumstances by different models suggested by researchers, Ship owners are not showing equivalent enthusiasm towards NSR. This notion is also endorsed by Frédéric Lasserre and Sébastien Pelletier case studies on Ship owner's intentions towards NSR shipping based on a sample of 98 companies. Effective commercial use of Artic routes requires an international framework, co-operations and monitoring with joint efforts from stakeholders. Before we can explore the existing opportunities it is important to address the challenges to turn it into a reality. Massive investments and commitments are required on infrastructure to establish a safe and secure logistic corridor with least environmental impact. We may assertively conclude that even today, commercially NSR future is uncertain and environmentally it embraces

negative persona.

7.3 NSR & China

Chinese elevating interest for NSR is very apparent for a country like her, which is a home ground for about twenty percent of world population and which is moving forward rapidly to become the world economic and political center. Chinese policies and laws for NSR or for the Arctic region particularly are still under process. She is required to address it very diplomatically as being a Non-Arctic State her supremacy and jurisdictions are somehow very narrowed and sometimes she is also involved with conflicts with Arctic States. Besides this China needs to adopt a holistic approach, as although NSR increased commercial use will benefit Chinese ports geographically closer to the Russia but on the same time it will affect the performance of ports on other side, as China possess an exceptionally long coastline. China is also facing fierce competition with her immediate neighbors like India, Japan, and South Korea whose intentions are somewhat similar to Chinese.

It's not only the food or energy security that's forcing Chinese diplomats to visualize NSR as an opening and to frame rules and laws in a visionary way. For China, NSR can be used as an instrument to reshape the traditional maritime route and global trade pattern benefiting China's overall development and redefining Chinese status as a power center of the world. Millions of Yuan can be saved by using this shorter route with immense employment opportunity for the Chinese shipping companies and cost effective logistic corridors to fulfill the other sectors demand for raw material and easy access to the market for their finish goods. Arctic research is a way to understand the climate change effects and how it affects Chinese agricultural output or possible environmental / Climatic repercussions for Chinese society.

There is a veiled threat of conflicts over the NSR. China will going to be an active player, as she will definitely push ahead her theories and claims to safeguard her vested interest and need. However in an era of globalization, it is always hard for any State to

follow a policy of aggressiveness or hot pursuit. As a State China, will certainly want not to block her current or possible future market or suffer any sanctions consequential of her foreign policies. On the contrary, such developments may also result in stronger ties and cooperation with her neighbor, Russia and Nordic countries particularly. Today it is extremely hard to judge, as it will depend upon the situation and on the stand and temperament of the Chinese government.

China knows the ground reality that she is not in a position to survive standalone over NSR and lacks certain rights, privileged to the Arctic States only. Therefore, she will continue to invest in Arctic research and exploration projects and will collaborate with other potential Arctic partners. She will try to adopt a soft stand and to avoid any possible conflicts. To put forward her stand strongly she will attempt to use its existing economic and political power to lobby countries in her favor at international forums like IMO or United Nations. By pointing out the need to redefine the rights of the sovereign States as per the UNCLOS, she had already initiated it. She strongly believes that non-Arctic or to be more precise near-Arctic States (as defined by Chinese scholars) will play a more critical role in Arctic policy making in near future. These believe forced China to try hard to attain its observer status at the Arctic council also. Putting forward the notion that Arctic is for humankind, it needs to be protected and it belongs to the world community, not to an individual state, will be her main agenda and perhaps the future policy towards the region. NSR being a crucial part of the entire Arctic region due to its inherent advantages will stay focused and lighted until the region is thawing and looked upon with anticipations by different stakeholders.

Although, China is still struggling to formulate and officially declare her policy on matters concerning to Arctic and NSR area. Such policies will take into account the Challenges and opportunities for China as listed below in Table 7.2

Table 7.2: - NSR Opportunities and challenges for China

China and NSR
Opportunities:
China can establish its supremacy over the region and in the world
Boost in business for Chinese ports nearer to NSR area
Share boundaries with most strategic Arctic nation-Russia; and closer to the NSR
Opportunity for Chinese Shipping companies / Industry
Cheap and shorter logistic corridor for Chinese industrial sector
Shorter maritime access for Chinese products to Europeans and American markets
Natural resource heaven to foster China's future energy needs
Arctic fisheries reserve may serves as food security
Scientific research base to understand climate change and its affect
Immense possibility for Chinese Cruise industry
Challenges:
China is not an Arctic State thus her powers and right are limited
Fierce competition from neighbors like Japan, S. Korea having similar interests
Diplomatic ways to establish her presence and importance
To formulate an official policy on Arctic and NSR
Extending Co-operation and maintaining cordial relationship with other States / agencies /organization on Arctic issues
Military presence may result in conflicts, disputes and perhaps cold war situation
China lacks technicality in Shipbuilding with its immediate rival and world topmost Shipbuilding nation South Korea
Possible conflicts and disputes over boundaries and jurisdictions
China's does not holds a positive image as a quality manufacture hub in Western world
Negative impact on port turnover for Chinese ports far away from NSR area
Ways to contest Internationals laws in favors of Chinese interest
Lobbying countries in support of Chinese stance

From above discussion, it is quite evident that China is definitely going to benefit from this emerging NSR proceeds thus she will try her best to realize them. These benefits are fourfold: bringing China closer to Arctic natural resources, Cheap and shorter market access thus huge business and investment opportunity for Chinese enterprises, understanding Arctic environment through research and studies to keep China ready for any potential environmental threat and to establish China as political and economic world power. To avail this she need to address her challenges in a diplomatic way to avoid potential conflicts and will stress on mutual understandings and co-operation among Arctic stockholders.

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