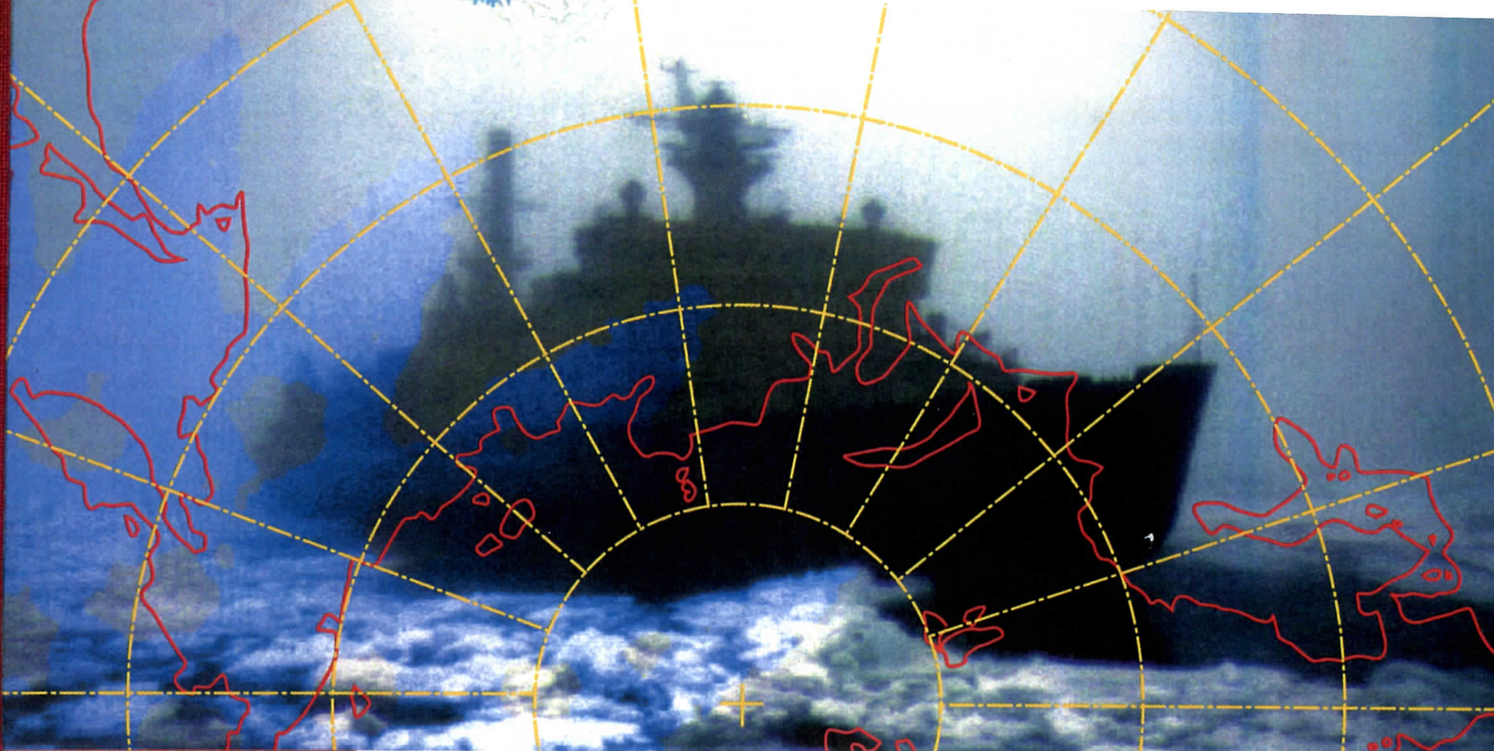


INSROP WORKING PAPER
NO. 59 - 1996, III.5.2

The NSR Transit Study (Part IV): The Economics of the NSR. A Feasability Study of the Northern Sea Route as an alternative to the International Shipping Market

Trond Ragnvald Ramsland & Svein Hedels

INSROP International Northern Sea Route Programme

Central Marine Research & Design Institute, Russia

The Fridtjof Nansen Institute, Norway

Ship and Ocean Foundation, Japan

International Northern Sea Route Programme (INSROP)

Central Marine Research & Design Institute, Russia

The Fridtjof Nansen Institute, Norway

Ship & Ocean Foundation, Japan

INSROP WORKING PAPER NO. 59-1996

Sub-programme III:	Trade and Commercial Shipping Aspects
Project III.5.2:	The NSR Transit Study (Previously named: "Trial Round-trip via NSR, Return Leg Europe-Japan")
Supervisor:	Trond Ramsland
Title:	**The NSR Transit Study (Part IV): The Economics of the NSR. A Feasability Study of the Northern Sea Route as an alternative to the International Shipping Market** (Parts I, II and III are due to be published later in this series)
Authors:	Trond Ragnvald Ramsland & Svein Hedels
Address :	Foundation for Research in Economic & Business Administration (SNF), Breiviken 2, 5035 Bergen-Sandviken, NORWAY
Date:	16 September 1996
Reviewed by:	Peter L. Wright, Oceans Institute of Canada, Vancouver, Canada

What is an INSROP Working Paper and how to handle it:

This publication forms part of a Working Paper series from the **International Northern Sea Route Programme - INSROP**. This Working Paper has been evaluated by a reviewer and can be circulated for comments both within and outside the INSROP team, as well as be published in parallel by the researching institution. A Working Paper will in some cases be the final documentation of a technical part of a project, and it can also sometimes be published as part of a more comprehensive INSROP Report. For any comments, please contact the authors of this Working Paper.

FOREWORD - INSROP WORKING PAPER

INSROP is a five-year multidisciplinary and multilateral research programme, the main phase of which commenced in June 1993. The three principal cooperating partners are **Central Marine Research & Design Institute (CNIIMF)**, St. Petersburg, Russia; **Ship and Ocean Foundation (SOF)**, Tokyo, Japan; and **Fridtjof Nansen Institute (FNI)**, Lysaker, Norway. The INSROP Secretariat is shared between CNIIMF and FNI and is located at FNI.

INSROP is split into four main projects: 1) Natural Conditions and Ice Navigation; 2) Environmental Factors; 3) Trade and Commercial Shipping Aspects of the NSR; and 4) Political, Legal and Strategic Factors. The aim of INSROP is to build up a knowledge base adequate to provide a foundation for long-term planning and decision-making by state agencies as well as private companies etc., for purposes of promoting rational decisionmaking concerning the use of the Northern Sea Route for transit and regional development.

INSROP is a direct result of the normalization of the international situation and the Murmansk initiatives of the former Soviet Union in 1987, when the readiness of the USSR to open the NSR for international shipping was officially declared. The Murmansk Initiatives enabled the continuation, expansion and intensification of traditional collaboration between the states in the Arctic, including safety and efficiency of shipping. Russia, being the successor state to the USSR, supports the Murmansk Initiatives. The initiatives stimulated contact and cooperation between CNIIMF and FNI in 1988 and resulted in a pilot study of the NSR in 1991. In 1992 SOF entered INSROP as a third partner on an equal basis with CNIIMF and FNI.

The complete series of publications may be obtained from the Fridtjof Nansen Institute.

SPONSORS FOR INSROP

- Nippon Foundation/Ship & Ocean Foundation, Japan
- The government of the Russian Federation
- The Norwegian Research Council
- The Norwegian Ministry of Foreign Affairs
- The Norwegian Ministry of Industry and Energy
- The Norwegian Ministry of the Environment
- State Industry and Regional Development Fund, Norway
- Norsk Hydro
- Norwegian Federation of Shipowners
- Fridtjof Nansen Institute
- Kværner a.s.

PROFESSIONAL ORGANISATIONS PERMANENTLY ATTACHED TO INSROP

- Ship & Ocean Foundation, Japan
- Central Marine Research & Design Institute, Russia
- Fridtjof Nansen Institute, Norway
- National Institute of Polar Research, Japan
- Ship Research Institute, Japan
- Murmansk Shipping Company, Russia
- Northern Sea Route Administration, Russia
- Arctic & Antarctic Research Institute, Russia
- ARTEC, Norway
- Norwegian Polar Research Institute
- Norwegian School of Economics and Business Administration
- SINTEF (Foundation for Scientific and Industrial Research - Civil and Environmental Engineering), Norway.

PROGRAMME COORDINATORS

- **Yury Ivanov, CNIIMF**
  Kavalergardskaya Str.6
  St. Petersburg 193015, Russia
  Tel: 7 812 271 5633
  Fax: 7 812 274 3864
  Telex: 12 14 58 CNIMF SU
- **Willy Østreng, FNI**
  P.O. Box 326
  N-1324 Lysaker, Norway
  Tel: 47 67 11 19 00
  Fax: 47 67 11 19 10
  E-mail: sentralbord@fni.no
- **Ken-ichi Maruyama, SOF**
  Senpaku Shinko Building
  15-16 Toranomon 1-chome
  Minato-ku, Tokyo 105, Japan
  Tel: 81 3 3502 2371
  Fax: 81 3 3502 2033
  Telex: J 23704

INSROP

SUB - PROGRAMME III

Project III.5.2

The NSR Transit Study

Part IV Final Report

THE ECONOMICS OF THE NSR

A Feasibility Study of the Northern Sea Route as an alternative to the International Shipping Market

Prepared by

Trond Ragnvald Ramsland, Msc & Svein Hedels

Foundation for Research in Economics & Business Administration (SNF)
Breiviken 2, 5035 Bergen - Sandviken, NORWAY
Tel : ++ 47 55 95 98 45 Fax : ++ 47 55 95 94 39 E.Mail : Trond.Ramsland@snf.no

TABLE OF CONTENT

4. THE ECONOMICS OF THE NORTHERN SEA ROUTE

4.1 Introduction

4.1.1 The Modelling Approach

An investor facing the choice of either investing in a highly ice classified vessel or a standard bluewater vessel, will need a few questions answered. The first question is which of the two cash flows will have the larger net present value. The objective of this project has been to compare a pair of cash flows generated by an ice-classified and a bluewater vessel of compatible cargo-carrying capacity. The cargo generating areas are Northwest Europe (NWE) and the Far East (FE).

4.1.2 Vessel Investment Costs.

A vessel with ice classification Ice 1-A Super or higher is according to Platou Shipbrokers (Sales & Purchase Division) 15-30 percent more expensive to build than a vessel with marginal ice classification. To justify such an investment, an ice classified vessel must be able to generate a cash flow that can finance the additional cost for the investor.

Its engine size and degree of ice - classification will vary according to design criteria. This analysis assumes that a 12 month NSR operation design criterion is not relevant until more specific data on natural conditions becomes available among others through INSROP sub-programme I. We also assume that the capital costs involved with passing the 6 months operational barrier (Ships built to Polar 10-30 class) are of a magnitude not realistic today for an independent investor.

4.1.3 Period and Area of Trading.

Ice conditions in parts of the Northern Searoute complicate the calculations. Due to heavy sea ice, the route is competitive with current technology from mid - summer and through December. During the rest of the operating year, the vessel is assumed to compete in the existing markets. It is uncertain whether the ice classification will lead to higher premiums in this period. A functional ice-classed market exists in the North-eastern Baltics, the Gulf of St.Lawrence and the Northern

Far East from January to late March early April. Still, we have assumed that the ice classified vessel only operates in ice covered waters for a six months period. During the winter and spring, the vessel competes with the bluewater fleet between bluewater ports.

4.1.4 Cash Flows.

The model compares the cash flows that are generated by an ice classified vessel trafficking the Northern Searoute (NSR) and a bluewater vessel using the Southern Searoute through the Suez Canal. The model considers revenues ($/tonnes equal - $/days differ), operating expenses (equal for the two vessels) and voyage costs (differ with route).

We have used the route between Hamburg and Yokohama as base case. The Northern Searoute between Hamburg and Yokohama is 35 per cent shorter than the Southern Searoute between these two ports. The Northern Searoute will in theory at mean fewer sailing days and lower voyage costs per trip. Due to the shorter distance and sailing time, more trips can be made, and annual revenues can increase without a corresponding increase in total costs.

4.1.5 Cash flows, Single Voyage - Timecharter Relationship[1].

The revenues a shipowner receives from his ships' activities is depending on the freight rates. Rates are set by the market. Freight rates are normally quoted in two ways, single voyage fixtures (USD/Tonnes) or time charter fixtures (USD/Day) partly used in different markets, partly in the same markets.

Single Voyage Fixture is normally used for irregular shipments, cargoes where the shipper is risk averse and wants to know a fixed rate for his cargo to a given destination. The operator or owner is also risk averse, and specifies the number of days allowed for cargo operations in port. If the vessel uses more time in port than specified, the shipper is liable to pay demurrage to the owner, a sum per day to compensate the owner for loss of vessel trading time. If the cargo operations move

[1] The profession of Chartering is highly complex, and for further detailed studies we refer to "*Shipbroking & Chartering Practice*" by Gorton, Ihre and Sandeværn, Lloyds of London Press 1990.

ahead faster than specified, the owner normally pays despatch to the shipper, usually ½ the demurrage rate per day, as he is free to trade his vessel earlier than stipulated.

Timecharters are normally used for larger volumes spread over time, or in a situation where the market coverage for an operator is better than for the owner. The operator chooses to "hire" the vessel and its crew for a specific rate and time. Timecharter covers operating and capital costs to the owner, but not voyage related costs, i.e Marine Diesel Oil & Marine Fuel Oil, Canal & Port Dues and Light Dues.

4.2 Variables

4.2.1 The vessels

The vessels compared are an ice classified and a bluewater bulk carrier. Pairs of vessels with the same cargo capacity are matched. The vessels operate at equal speeds in blue waters. The two vessels have the same cargo capacity. The capacity and particulars are identical to Westfal Larsen owned open hatch bulk carriers, Star XX. Maximum fuel consumption and fuel consumption at various speeds will be somewhat different between the two vessels. Modern ice - classed (Kværner Masa Yards, HSVA etc.) hull design techniques is likely to minimise these differences. To simplify, we have assumed that bunkers consumption is equal for a given speed. The sensitivity analyses will shed light on any differences.

The Northern Sea Route is limited by depth restrictions of the route, worst case if passing south of the New Siberian Islands, by 9 meters in the Laptev Strait or 13 meters in the Sannikov Strait. Beam limitation of ice-breakers (32 meters) is relevant when/if passing through medium to heavy ice. Only limited economies of scale can therefore be realised. Parcel size of shipments is therefore restricted to fit handysize/sub-panmax vessels, until larger wide body - shallow draft designs are operative.

The lower limitation to cargo capacity is set to 20.000 DWT. Smaller vessels can not realise economies of scale, and will not be competitive. Due to these limitations we have only compared bulk vessels in the following size segments:

INVESTMENT COSTS (000')			
DWT	Ice 1A*	Bluewater	Δ-%
20.000	$ 24.000	$ 20.000	20 %
30.000	$ 28.000	$ 23.000	21 %
40.000	$ 32.000	$ 26.000	23 %

As the table above indicates, the ice classified vessels are more expensive to build than the regular vessels.

4.2.2 Speed in blue waters

Whether the southern sea route through Suez or the NSR is used, speed in blue waters is set to 14,5 knots. This will depend on the general market conditions.

4.2.3 Speed in ice covered waters

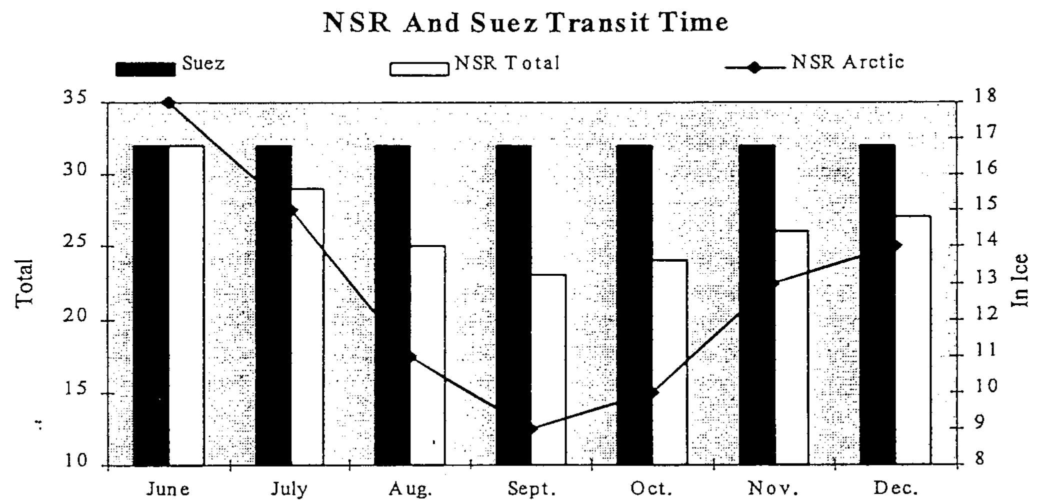
The leg between Karski Varota and Providenia on the Northern seaboard of Russia is covered by light to heavy ice most of the year. Vessels will follow different routes primarily to avoid ice, and the distance between the two ports will therefore vary somewhat. Speed and implicitly sailing time, will depend on the thickness and distribution of the sea ice. The shortest route will not necessarily be the fastest, due to the prevailing ice conditions at that particular point in time. Conditions vary from month to month. We have estimated average sailing times for the standard trade route on a monthly basis (Based on actual transits made by MSC vessels in 1992 and 1993).

A great circle route choosing a northernmost alternative, will be the shortest. The two main choices of NSR routes are north - south of Novaya Zemlya and the New Siberian islands. From INSROP GIS System[2] a northern route of 2,512 nautical miles and a coastal route 2,529 nautical miles are estimated, but marginally different. In the model, the distance is set to 2.530 nautical miles between the entry point at Karski Varota and exit point in the Bering Strait. On average, the distance between these two points can not be sailed at maximum speeds.

As the table and graph below show, the total sailing time through the NSR can be as much as 30 per cent shorter than the sailing time through the Southern sea route through Suez. The most favourable month is September. The average speed on

[2] INSROP Paper I.3.1, *Variability Analysis of Natural Conditions and Influence on NSR Sailings*, Vefsmo & Løvås, SINTEF March 1996.

the arctic leg is 8,9 knots, estimating the time in ice covered waters to 12,5 days and total transit time to 25,5 days.



Days	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
Suez	32	32	32	32	32	32	32	32
NSR Total	32	29	25	23	24	26	27	25
NSR Arctic	18	15	11	9	10	13	14	12
NSR Normal	13	13	13	13	13	13	13	13

4.2.4 Freight rates

Rates are decided by the market. We have based our calculations on average rates based on single voyage fixtures taken from the 1995 editions of Lloyds Shipping Economist.[3]

4.2.5 Price of bunkers

The price of bunkers is decided by the market. We have assumed that bunkers are purchased at Hamburg price irrespective of the choice of route. There is potential to develop supply of fuel in the port of Dudinka on the Northern seaboard of Russia. The price of bunkers in Dudinka could on fob-basis be 30 per cent below the price of bunkers in the western market. Russia could use this as an incentive for shipowners who want to traffic the route[4].

[3] See appendix

[4] Rotterdam selling price - Fob export price of Mazut from the Achinsk Refinery applied to MFO. 80 000 mt, were shipped out in 1994 by tankers from Arctic Shipping Services.

4.2.6 Operating Expenses - OPEX

Operating Expenses are the costs involved in the day-to-day running of the ship. Those costs are Manning, Victualling Stores & Lubricants, Hull & Machinery and Protection & Indemnity Insurance and Maintenance. These costs are incurred whatever trade the ship is engaged in. Opex is calculated on a monthly basis. The model is based on Opex figures from the 1995 editions of Lloyds Shipping Economist.

4.2.7 Ice Insurance Rate

Transit through light to heavy sea ice increases the risk of damages to the ship. Both H & M and P&I insurers thus demand an increased risk premium. This premium is normally calculated on the basis of the vessel's size measured in gross register tonnes (GRT). The shipowner pays an amount per GRT for every day the ship is exposed to sea ice. The insurance premium varies with the severity of the ice condititons and the vessel ice-classification. A vessel with high ice-class should normally pay a lower insurance premium than a vessel with low ice-class, in otherwise equal ice conditions (This is relevant for alternative trading of the ice-classed vessel in the period January to April, when potentially a premium freight rate can be obtained in the Gulf of St.Lawrence and the Baltics).

Today's insurance regime in the Canadian Arctic on which calculations are based, is primarily used by irregular traffic. Due to the demands to this type of shipping, a premium paid per day exposed is sensible.

A ship transiting the NSR, will be in transit between two points, and use of time is essential. An insurance system based on a daily fee, gives the shipowner an incentive to increase transit speed to minimise insurance costs. This makes the master of the vessel prone to become "risk seeking". From an environmental point of view, the structure of the Canadian insurance regime has an element not optimal for the NSR.

Today the insurers do not have complete access to necessary ice and damage data. This is necessary to estimate the risk, and implicitly the correct risk premium.

We have estimated cash flows on different risk premiums based on the Canadian regime, as the best available today.

The maximum insurance rate is set to USD 0,55 per GRT per day. This rate is set by Canadian Board of Marine Underwriters for vessels operating in the Canadian Northwest Passage, area 3 & 6[5]. This is the maximum rate in the Canadian Arctic for vessels classed Lloyds IA* or higher. We have used this rate as the upper limit when estimating the insurance costs on the NSR.

4.2.8 Suez Canal Fees[6]

The toll structure of the Suez Canal is based on two relatively unknown units of measurement, the Suez Canal Net Ton (SCNT) and Special Drawing Rights. Tariffs are calculated in terms of the SDRs per SCNT. The Suez Canal Net Tonnage of a vessel is based on late nineteenth-century rules that were intended to represent the vessels' capacity for earning a revenue. It corresponds to the holds below deck. SCNT is determined individually for each vessel by classification societies or the authorities themselves. For simplifying purposes it can be estimated for any given vessel by the following formula:

$$\mathbf{SCNT = ((GRT + NRT)/2) * 1{,}1}$$

where GRT and NRT are gross and net register tonnes respectively. Tariffs are calculated on the basis of SDRs per SCNT. Special Drawing Rights were chosen as the currency unit by the Canal Authorities in an attempt to avoid losses owing to fluctuations in exchange rates.

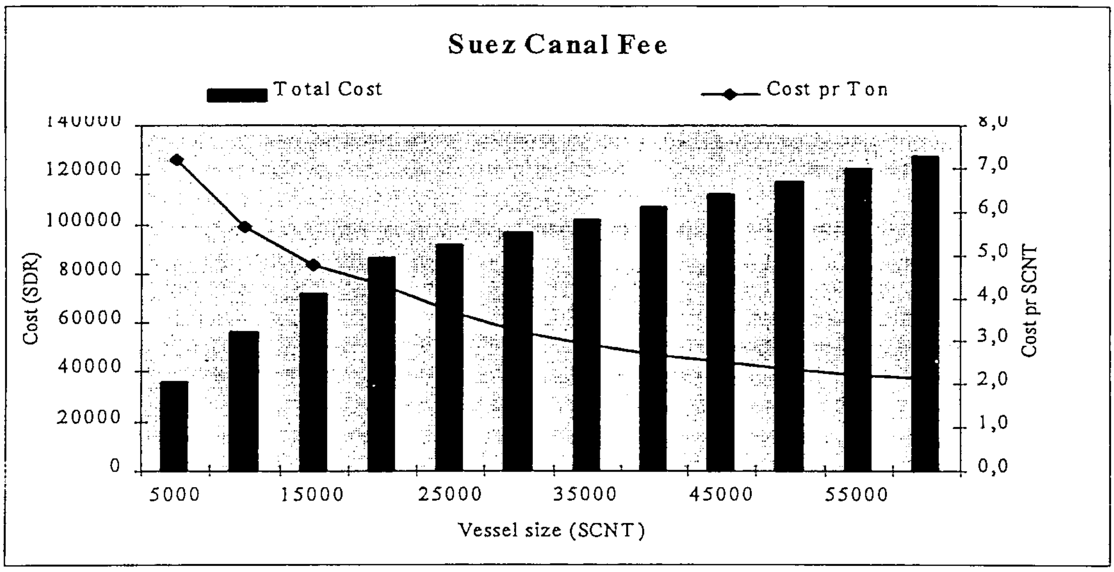
The marginal cost per ton decreases with vessel size. The cost per deadweight ton for a vessel in the 20.000 DWT segment is 2,49 SDR, while the cost per DWT for a vessel in the 40.000 DWT segment is 2,15 SDR. The cost per ton is reduced with 13,6 per cent. As the canal fee is paid in US dollars, we will discuss the impact of currency fluctuations later in this paper.

---

[5] Advisory Hull Rates for Arctic Voyages, circular January 15, 1985

[6] Based on Circular no 9/1994 Concerning Treansit Dues in Effect as from january 01.1995, by the Suez Canal Authority

DWT	GRT	NRT	SCNT	SDR	SDR/DWT
20.000	12.000	4.000	8.800	49.700	2,49
30.000	18.000	6.000	13.200	66.250	2,21
40.000	24.000	12.000	19.800	85.850	2,15



4.2.9 Currencies

The Suez Canal Fee is calculated in Special Drawing Rights (SDR). All other costs are measured in US Dollars. As SDR is a basket rather than a currency, the actual cost of transiting the Suez Canal will vary with the relationship between SDR and USD. Due to the facts that the USD is the most important part of the SDR, fluctuations will normally have a marginal effect on the ship owner's cash flow.

Currency	USD	DM	FFR	Yen	GBP
Weight	39,45%	20,91%	11,14%	17,50%	11,00%

4.3 Route variables

4.3.1 Revenues Per Day

In the model, rates are quoted in dollars per tonne and multiplied with the amount of cargo carried. The product is the total revenue from the trip. The revenue is then divided by the number of days in transit, which gives a rate per day[7]. If the owner of the cargo is indifferent when it comes to which route the shipowner uses,

[7] Fuel consumption, ice insurance (NSR) and canal fees (Suez) must be subtracted to arrive at TC equivalent rate per day as timecharters do not include voyage related costs.

the shipowner will choose the route that maximises rate per day. The route that maximises rate per day will, other things equal, be the shortest one. On the NSR this implies a higher rate per day than through Suez on a distance-only basis for the regions analysed. The conversion is as follows :

Dollar per ton * Cargo carried = Revenues

Revenues/Sailing time = Revenues per day

Revenues[8] per day -Voyage Costs per day = Adjusted TC equivalents

Time in transit is assumed to be the time between Hamburg and Yokohama as base case. Time consumed is dependent on the distance involved, and are calculated as follows :

Distance / (Speed (knots) * 24 (hrs/day)) = Sailing time

Distance fixed by geography, reduced sailing time also depends on speed in transit. Average speed chosen is 14,5 knots normal bulk vessel transit speed in a balanced market. This implies 32 days in transit between Hamburg and Yokohama through Suez.

From the shippers point of view, the rate converted to USD/Tonnes will be reduced as the time in transit is reduced. From the owners point of view, the daily revenue is increased as the distance through the NSR is shorter, and USD/Tonnes are spread over a reduced time interval. The total USD/Tonnes cargo generating capacity is maximised, more trips can be performed and a higher total revenue earned per year. From both these perspectives it is advantageous to reduce sailing time.

The model excludes port fees as these are assumed equal and we evaluate the differences that follow from choice of route and its related costs. Cargo handling costs and time are for practical reasons excluded. These are not influenced by route. Further we have estimated the time loss that follows the convoy traffic in the Suez Canal to 12 hours.

[8] The correct shipping term would be **total freight** or **total hire.**

4.3.2 Cost of bunkers per day

In operation, the amount of fuel used by a vessel depends on its engine size, its hull condition and the speed at which it is operated. When a ship is designed, the designers optimise the hull and power plant to a prescribed design speed (S_{max}). Operating the vessel at lower speeds results in fuel savings because of reduced water resistance. This reduction will be approximately proportional to the cube of the reduction in speed. The consumption of fuel (B_{s1}) at a given speed, S_1, can therefore be approximated with the formula.

$$B_{s1} = B_{max} * (S_1/S_{max})^a$$

S_1	=	Actual speed
B_{s1}	=	Actual fuel consumption (tons/day)
B_{max}	=	Design fuel consumption at maximum speed
S_{max}	=	Design/maximum speed
a	=	The exponent ***a*** varies, but has a value of about three for diesel engines and about two for steam turbines.

As shown by the graphs below, the consumption of bunkers will be reduced as the speed is decreased. Depending on the characteristics of the vessel, the relationship between speed and consumption will be more or less linear. As the exponent ***a*** approaches zero, the relationship between speed and consumption approaches linearity. If ***a*** approaches infinity, the relationship between speed and consumption becomes exponential.

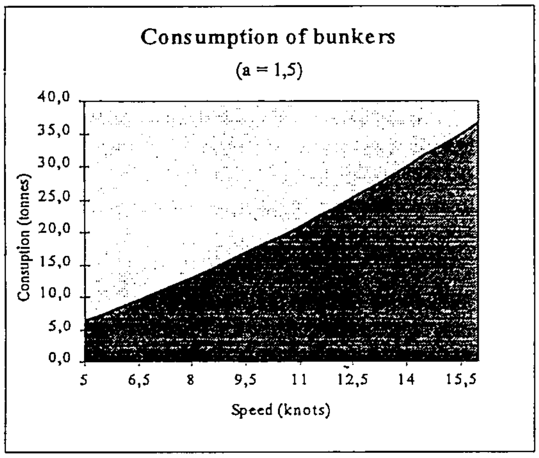
The price of bunkers is determined by the price of oil, which is set by the supply and demand in the market. The price will vary somewhat when it comes to point of delivery. In the model, the price of bunkers in Hamburg is used.

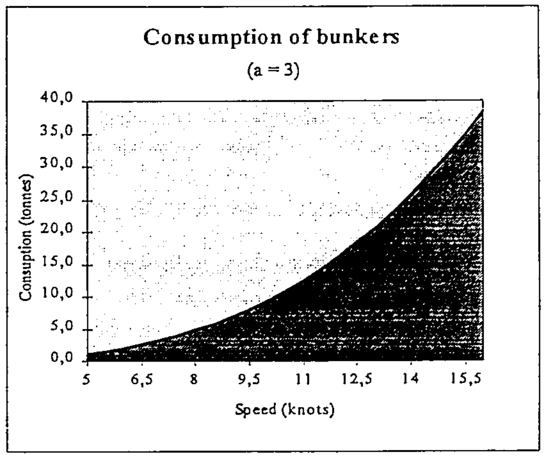
As stated, there is a potential for developing fuel supplies in Dudinka in Russia. This supply will be developed by barges alternatively river tankers[9] from Krasnoyarsk - Leseosibirsk, the fuel originating from nearby refineries. The price in this port should be Platt's daily Rotterdam quote (the current market) less

[9] INSROP Paper III.1.3, *The NSR and the Rivers Ob-Irtysh & Yenisey*, Trond R Ramsland 1995.

transportation, and sold with a substantial refund. Bunkers cost per day is given by the following equation:

$$B_{cost} = B_{s1} * B_{price}$$





4.3.3 OPEX per Day and Trip

Daily operating costs, Manning, Stores & lubricants, Repairs & maintenance, Insurance (Blue water) and Administration are monthly figures based on Lloyds Shipping Economists data. By dividing by a factor of 30,416 (365/12), daily costs are found. Daily costs are equal for both alternatives. However, time in transit varies, OPEX per trip thus varies. A reduction of OPEX per trip means, other things equal, less costs incurred per carried tonne of cargo.

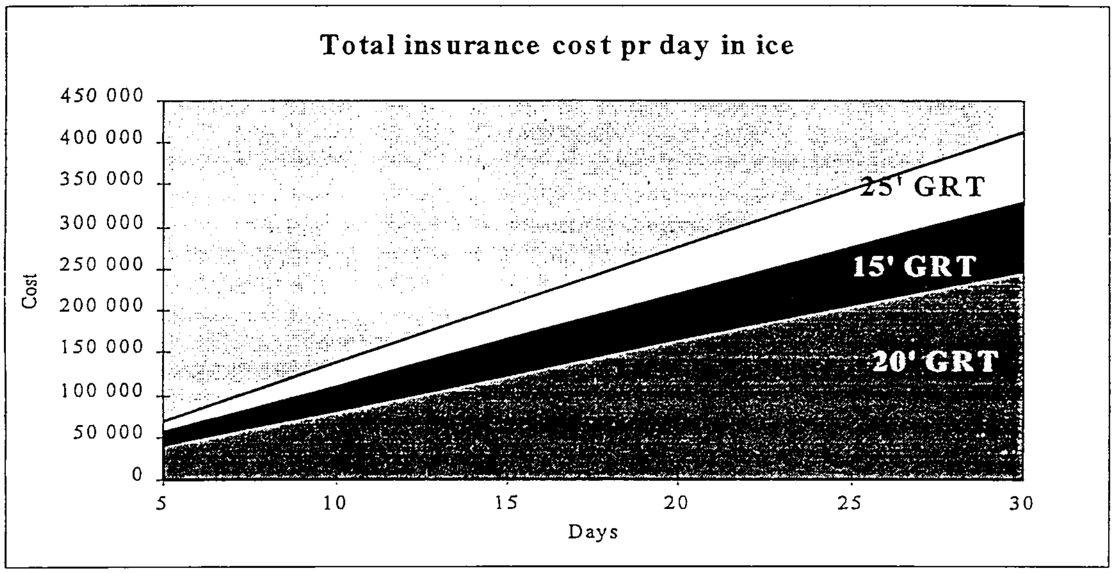
4.3.4 Suez Canal fee per day and trip

Canal Fees are normally incurred at time of transiting the Canal. For all practical purposes these costs are spread over the period to facilitate the comparison of costs per trip and per day, equally with costs connected to the particular use of the NSR.

4.3.5 Ice Insurance per Day

Ice Insurance is calculated per day exposed to ice. The total costs related to insurance are spread over the whole period. As ice conditions change, average sailing time through ice covered waters will change. Sailing time through blue waters, set to 12,2 days on the standard route Hamburg - Yokohama, does not involve ice insurance.

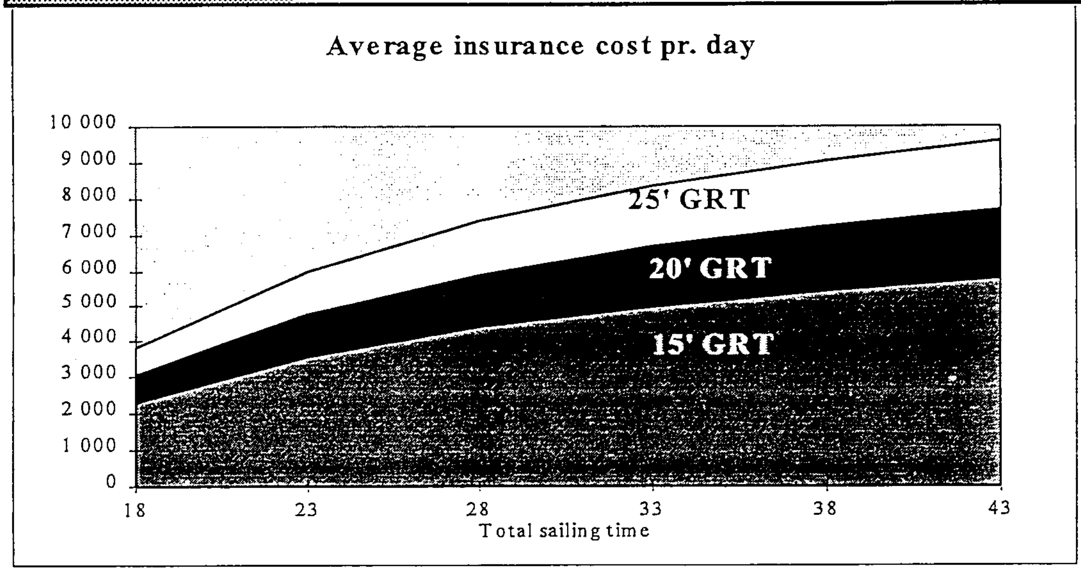
The first table and graph below shows the trip costs related to ice insurance for three different vessel sizes over the relevant range of days (5 to 30) exposed to ice on the NSR (based on 0,55 USD/GRT). Total number of days sailed is listed on the horizontal axis. The number of days sailed in ice equals the total minus the days in normal waters. Because ice insurance is a large part of the overall operating costs, any increase in sailing time through ice covered waters will reduce the operating income.



Total cost (000')	5	10	15	20	25	30
15' GRT	$41	$82	$123	$165	$206	$247
20' GRT	$55	$110	$165	$220	$275	$330
25' GRT	$68	$137	$206	$275	$343	$412

The second table and graph below show the ice insurance per trip on the NSR converted to a daily ice insurance cost. Worst case it accrues to nearly USD 10.000 per day over the total period. This almost equals the current timecharter for a dry bulk vessel of the relevant size. Among other things, this illustrates the importance of access to reliable accident statistics and time series related to ice conditions from Russian authorities. This information must satisfy the needs of the international insurance markets. To bring the insurance costs related to the NSR down, is a precondition both for current tonnage and investments in the potentially new tonnage.

Cost per day (000')	18/5	23/10	28/15	33/20	38/25	43/30
15' GRT	$23	$35	$44	$50	$54	$57
20' GRT	$30	$47	$58	$66	$72	$76
25' GRT	$38	$59	$73	$83	$90	$95



4.4 Sensitivity Analyses (Figures in US $ 000')

The following sensitivity analyses are based on comparisons of dry bulk carriers with a cargo carrying capacity of 40.000 DWT. The vessel transiting the NSR is ice classified, while the ship trafficking the southern Searoute is a bluewater bulk carrier.

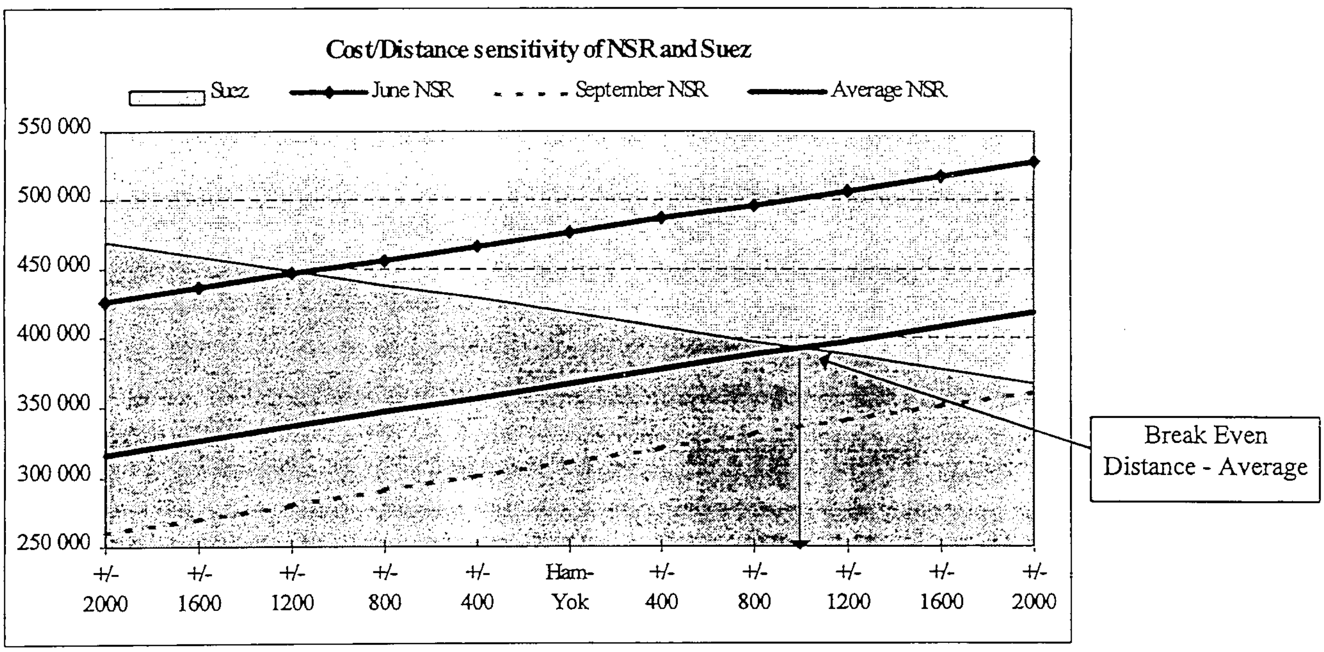
4.4.1 Distance sensitivity

While an eastbound vessel using the NSR will approach its destination from the North, a vessel transiting through Suez will approach the port from the South. Due to this, the relative profitability of the different routes will change along a north-south axis. If the destination is a port north of Yokohama, NSR will be more favourable. Conversely, if the destination is a port south of Yokohama, NSR will be less favourable.

To evaluate the NSR versus Suez as a transit route, it is necessary to evaluate the route's sensitivity to changes in distance. The results must be held against the cargo segments identified, and their point of origin & destination. The table below shows the distances between ports depending on where (on a north-south axis) the destination port lies. The distance between Hamburg and Yokohama is used as zenith. If the port lies 2.000 nautical miles to the South, the NSR will be almost as long as the route through Suez.

Distance	N 2000	N 1200	N 400	Ham-Yok	S 400	S 1200	S 2000
Distance NSR	4.763	5.563	6.363	6.763	7.163	7.963	8.763
Distance Suez	13.188	12.388	11.588	11.188	10.788	9.988	9.188

Subject to the Arctic leg of the NSR and the Suez route requiring the same amount of time for a given period, the number of days used between departure and arrival can be seen as a function of change in distance. The table below shows the days needed as a function of the distance. Due to the changing ice conditions in the Arctic leg of the NSR, sensitivity is calculated on the basis of the average transit times and the transit times under the best (September) and worst (June) conditions in the 6 month period.



Days needed	N 2000	N 1200	N 400	Ham-Yok	S 400	S 1200	S 2000
June NSR	24,0	26,3	28,6	29,7	30,9	33,2	35,5
Sept. NSR	15,2	17,5	19,8	21,0	22,1	24,4	26,7
Average NSR	18,3	20,6	22,9	24,6	25,2	27,5	29,8
Suez	37,9	35,6	33,3	32,6	31,0	28,7	26,4

BunkerCosts	N 2000	N 1200	N 400	Ham-Yok	S 400	S 1200	S 2000
June NSR	$48	$58	$68	$73	$78	$88	$98
Sept. NSR	$56	$66	$76	$81	$86	$96	$106
Average NSR	$52	$62	$72	$77	$82	$92	$102

Suez	$165	$155	$145	$140	$135	$125	$115
Ice Insurance Canal Fees -	N 2000	N 1200	N 400	Ham-Yok	S 400	S 1200	S 2000
June NSR	$270	$270	$270	$270	$270	$270	$270
Sept. NSR	$135	$135	$135	$135	$135	$135	$135
Average NSR	$182	$182	$182	$182	$182	$182	$182
Canal Fee	$134	$134	$134	$134	$134	$134	$134

OPEX	N 2000	N 1200	N 400	Ham-Yok	S 400	S 1200	S 2000
June NSR	$106	$117	$127	$132	$137	$147	$158
Sept. NSR	$67	$77	$88	$93	$98	$108	$118
Average NSR	$81	$91	$101	$106	$112	$122	$132
Suez	$168	$158	$148	$143	$138	$127	$117

Total Costs	N 2000	N 1200	N 400	Ham-Yok	S 400	S 1200	S 2000
June NSR	$425	$446	$466	$476	$486	$506	$527
Sept. NSR	$259	$280	$300	$310	$320	$340	$361
Average NSR	$316	$336	$357	$367	$377	$397	$417
Suez	$468	$448	$428	$417	$407	$387	$367

The cost - distance breakeven point is slightly above 1000 nm increased distance from the base scenario, average costs based on Canadian Insurance Rates (0,55 US$/GRT) and current Suez Canal Fees.

4.4.2 Bunker Costs

When calculating the two routes' sensitivity towards changes in the price of bunkers, an average sailing time in the NSR of 24,6 days is used. Roughly half of the transit period, will be in ice covered waters.

The route through the Suez Canal can be expressed as follows:

$$\mathbf{((B_{max} * D_{Suez}) * (S_1/S_{max})^{a}) * B_{price}}$$

$$((45 * 32{,}6) * (14{,}5/15{,}5)^{1{,}5}) * B_{price}$$

$$(1467 * (0{,}935)^{1{,}5}) * B_{price}$$

$$(1467 * (0{,}904)) * B_{price}$$

$$(1326) * B_{price}$$

$$\mathbf{1326\ B_{price}}$$

S_1	=	Actual speed
B_{max}	=	Design fuel consumption at maximum speed
S_{max}	=	Design/maximum speed
B_{price}	=	Bunker price in Hamburg
D_{Suez}	=	Distance (in days) between Hamburg and Yokohama

The NSR bunker consumption function can be expressed as follows :

$$(((\mathbf{B}_{max} * \mathbf{D}_{Bluewater}) * (\mathbf{S}_1/\mathbf{S}_{max})^{a}) + (\mathbf{B}_{max} * \mathbf{D}_{Arctic}) * (\mathbf{S}_2/\mathbf{S}_{max})^{a})) * \mathbf{B}_{price}$$

$$(((45 * 12{,}2) * (14{,}5/15{,}5)^{1,5}) + ((45 * 12{,}4) * (8{,}9/15{,}5)^{1,5})) * B_{price}$$

$$((558 * (0{,}935)^{1,5}) + (549 * (0{,}632)^{1,5})) * B_{price}$$

$$((558 * 0{,}904) + (549 * 0{,}503)) * B_{price}$$

$$(496{,}3+280{,}7) * B_{price}$$

$$(777) * B_{price}$$

$$\mathbf{777\ B}_{price}$$

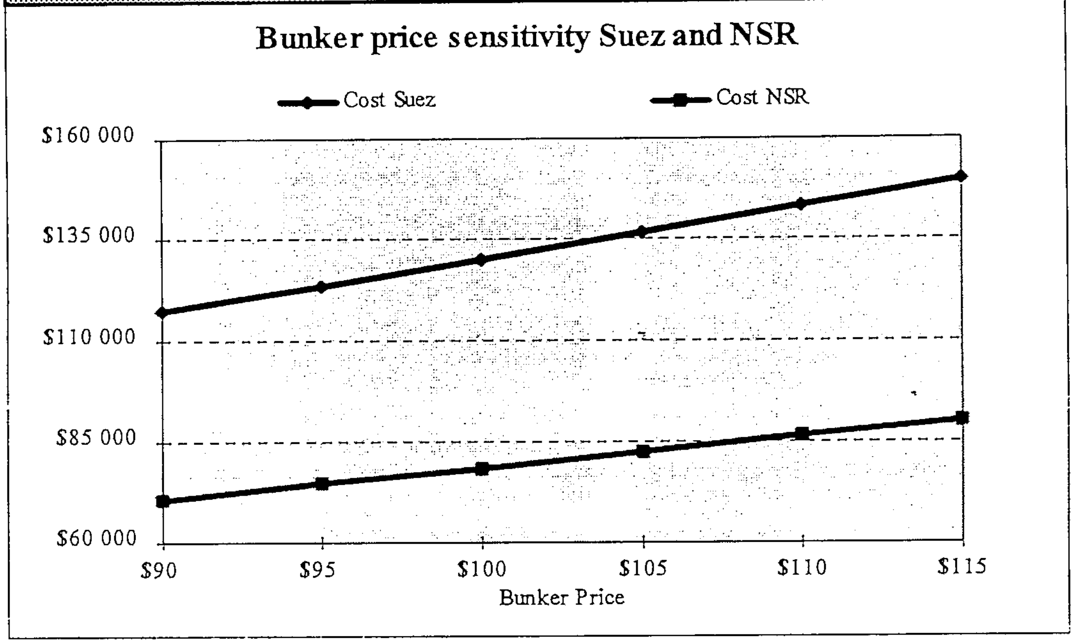
$D_{Bluewater}$	=	sailing time in blue waters speed 14,5 knots
D_{Arctic}	=	average sailing time in the arctic leg
S_2	=	average arctic leg speed of 8,9 knots

Letting Suez bunker cost denote NSR bunker cost, the fuel cost of sailing through the NSR can be expressed by the following equation :

$$\mathbf{B}_{NSR} = \mathbf{(0{,}586) * B}_{Suez}$$

As is evident the NSR alternative results in lower bunkers consumption than the Suez Canal. Irrespective of bunkers (MDO/MFO) costs in general terms, the total bunkers costs using the NSR will be reduced by 41 %. Thus it is also less sensitive to price increases/reductions than the Suez alternative which has a steeper slope.

Bunker price	$ 90	$ 95	$ 100	$ 105	$ 110
Suez cost	$ 119	$ 126	$ 132	$ 139	$ 145
NSR cost	$ 69	$ 73	$ 77	$ 81	$ 85



If fuel is sold at "subsidised" rate in Dudinka, the cost of bunkers can be reduced further. If a transportation cost of 30 per cent is used, the cost function will be as follows:

$$B_{NSR} = 777\ B_{price} * (1\text{-}0{,}3)$$

$$B_{NSR} = 777\ B_{price} * (0{,}7)$$

$$B_{NSR} = 544\ B_{price}$$

$$\mathbf{B_{NSR} = (0{,}409) * B_{suez}}$$

As the equation above shows, the attractiveness of the NSR could be enhanced by fuel "subsidies" at Dudinka, subject to the refinery in Achinsk or Omsk accepting the same internal price as of today, and Yenisey River Shipping Company accepting quoted rates of 12 USD/Tonnes for shipments from Lesosibirsk to Dudinka. The ship owner/operators will be compensated for some of the increased capital costs and risk when building the vessel to higher ice - class. This will also reflect on the shippers, who can be offered reductions in the freight rates.

Vessel characteristics	NSR	Suez
Cargo carrying capacity	40.000	40.000
Consumption at max. speed	45	45
Max. speed; Sm (knots)	15,5	15,5
Total distance (nm)	6.800	11.200
Ice distance (nm)	2.530	0

The regional complexes in the Upper Yenisey basin, mainly centred on Norilsk - Dundinka, could see some increased traffic, some revenues from oil products tank farm operations, but primarily improved logistic services to support their mainstream activities. It will also bring synergies to improve the general supply situation in the Russian Far North.

4.4.3 Ice Insurance Costs

Specific Ice insurance costs are incurred by the shipowner to compensate the insurance companies for an assumed higher risk of operation on the NSR. The insurance is thus route specific, it follows from the choice of route and is part of the voyage costs associated with this specific route.

Vessel characteristics	NSR	Suez
Gross register tonnes	28.000	28.000
Ice distance nautical miles	2530	0
Maximum ice exposure (days)	17,6	0
Minimum ice exposure (days)	8,8	0
Average ice exposure (days)	12,4	0

The insurance cost can be expressed as follows :

$$\mathbf{I_i = (P_i * (GRT_i)) * D_i}$$

where :

I_i The total insurance cost for the shipowner.

P_i Ice insurance rate set by the H&M and P&I insurers.

GRT_i Ship measure

D_i The number of days the vessel is exposed to ice

Days exposed to sea ice, D_i, can be seen as a product of distance and speed.

$$\mathbf{D_i = S_i / (V_i*24)}$$

S_i	=	Ice covered distance measured in nautical miles
V_i	=	Speed measured in knots (nautical miles)
(V_i*24)	=	Distance covered per 24 hour period.

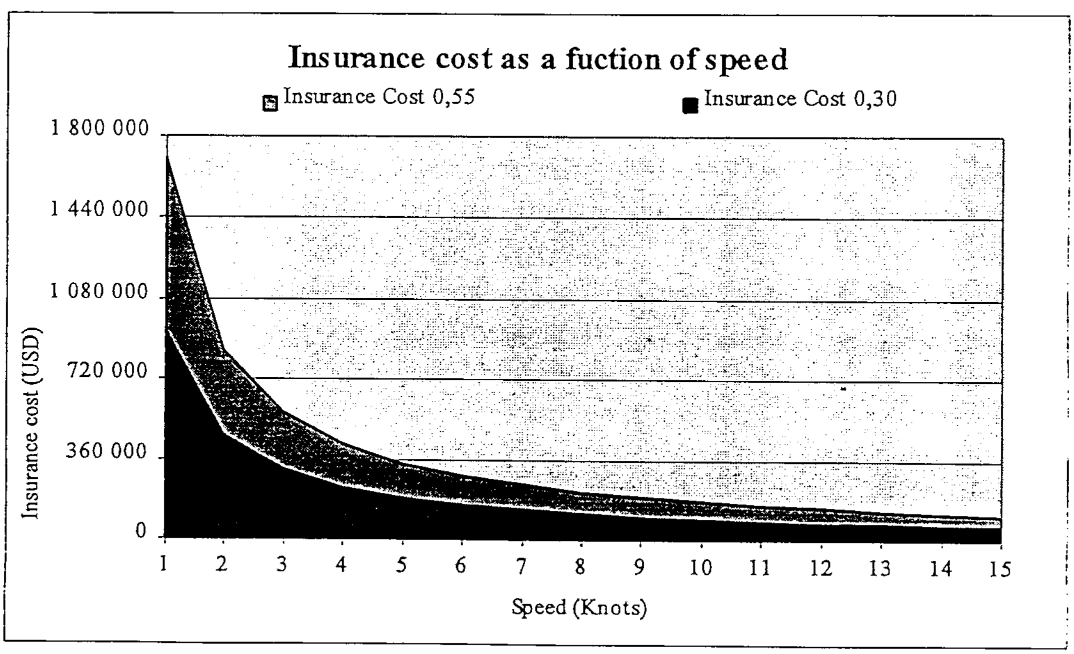
$$\mathbf{I_i = (P_i * (GRT_i))* (S_i / (V_i*24))}$$

The ships' measure in GRT is given. The distance of the Arctic leg will vary due to ice conditions. Manipulating the above function we can express insurance cost as a product of speed. The distance in ice affected area will vary by the prevailing ice condition at that specific point in time and varies by year and season. For simplicity we use average figures. The function that follows is :

$$\mathbf{I_i = (P_i * (28.000))* (2530 / (V_i*24))}$$

$$I_i =((28.000* 2530) * P_i) / (V_i*24)$$
$$I_i =(2951667 * P_i) / (V_i)$$

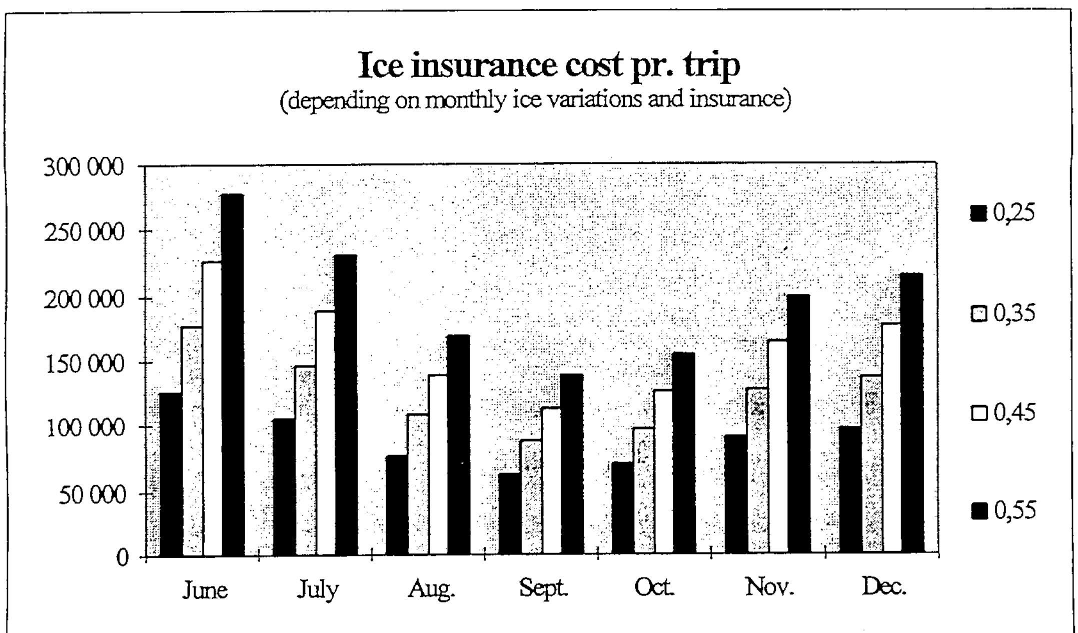
$$\mathbf{I_i = (2951667\ P_i) / V_i}$$



As the equation above shows, insurance cost is reduced when transit time is shortened (Increased V_i). Ice conditions sets an operational upper limit for the maximum speed, which varies from month to month.

Other things equal, the insurance price mechanism used in the Canadian Arctic gives the owner or the master of the vessel incentives to maintain maximum possible speed on the NSR. This could be an incentive to increase the overall risk. The table and graph above shows the results of insurance costs being a function of varied speed. Two different rates are used, USD 0,30 & 0,55.

The graph and table below shows the insurance costs for single transits month by month at different rates (Canadian rates). Insurance cost is lowest in September which follows from less ice and quick transit. For a highly ice - classed vessel one can argue that the protection inherent in its design should take account for risk in the mild period. In the future we might see that in mild periods, extra ice - insurance is not to be levied by the market, or only to a marginal degree. Institute Warranty Limits may also be extended to cover parts of the NSR for its standard policy clauses.



Premium	June	July	Aug	Sept	Oct	Nov	Dec	Average
$ 0,55	$ 271	$ 224	$ 168	$ 135	$ 154	$ 191	$ 199	$ 192
$ 0,45	$ 221	$ 183	$ 137	$ 111	$ 126	$ 156	$ 163	$ 157
$ 0,35	$ 172	$ 142	$ 107	$ 86	$ 98	$ 122	$ 127	$ 122
$ 0,25	$ 123	$ 102	$ 76	$ 62	$ 70	$ 87	$ 91	$ 87

This will be subject to the appropriate information being delivered by the Russian scientific institutions to enable a free and open risk assessment by the same insurance market. Such information includes damage statistics from operations on the NSR by Murmansk, Northern, Far Eastern and Primorsk Shipping Companies. It also includes non - interrupted time series on natural conditions, ice drift, thickness, age, composition, temperatures, salinity, polynas etc.

The premium should be developed on a transit basis for a given point in time as a function of , but not directly calculated by, the number of days in transit. This will eliminate a negative incentive leading the master of the vessel to seek higher risks than necessary to save costs associated with direct time in ice area. A consistent press towards higher speeds to reduce time is not wanted from an environmental point of view.

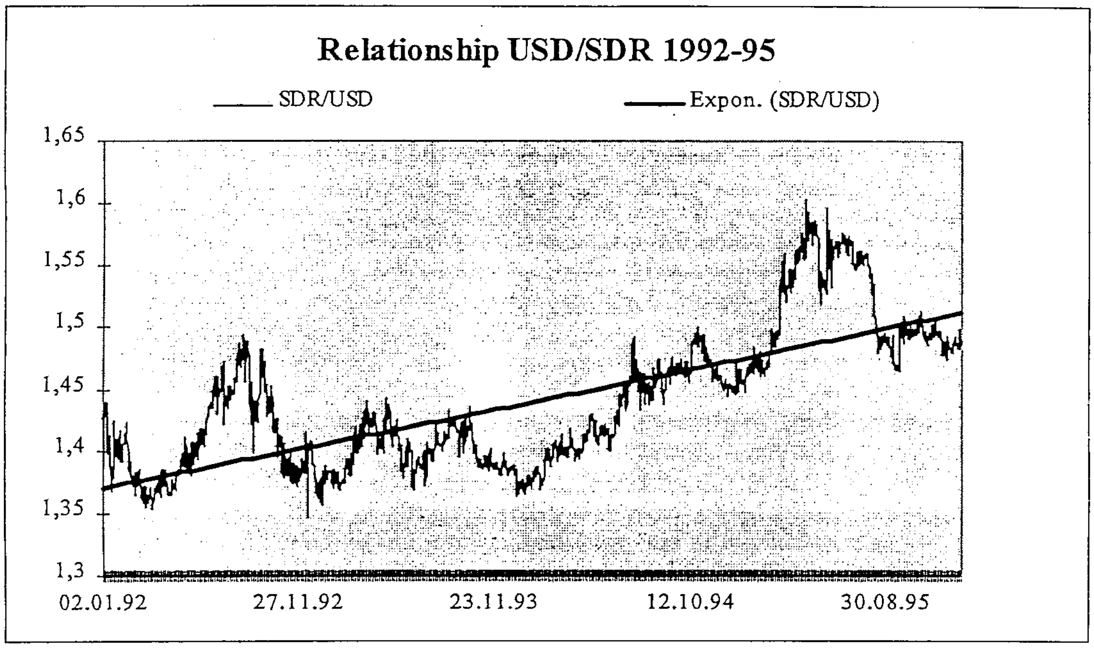
4.4.4 Foreign Exchange Sensitivity

Historically, the relationship between SDR and US dollar has been a stable one. It should be noted though, that a large change in the relative differences between the currencies, will change this relationship. An eventual strong appreciation of USD combined with a depreciation of the other currencies would lead to lower costs in Suez, which would improve its competitive position.

Currency	USD	SDR	SDR/USD
Average	6,67	9,60	1,44
Stan. Deviation	0,49	0,58	0,06
Covariance	0,24	0,33	0,24
Correlation	1,00	1,00	0,85

The historical relationship between USD and SDR is shown below. We have found the relationship by using currency prices found in the NHH currency database. The average price of Special Drawing Rights measured in US dollars is 1,44. With a standard deviation of six cents, the price of SDRs will seldom be above USD 1,5. In the period we have examined, the years 1992, 1993, 1994 and 1995, the price of SDRs expressed in US dollars has only once exceeded USD 1,6.

Due to the stability of the relationship between USD and SDR, we believe that currency fluctuations will not influence the comparative profitability of the two routes. If currency fluctuations are large, the shipowner can reduce risk through currency hedging. Currency fluctuations is therefore not an important issue when comparing the Southern and Northern sea route.



4.5 *Route Variable Results*

4.5.1 Introduction

The pairs of vessels compared have a cargo carrying capacity of 20,000, 30,000 and 40,000 dead weight tons respectively. Firstly we present incoming cash flows (revenues) per day and trip for the different projects. Second, the negative cash flows related to the cost segments for the different routes are presented. Due to seasonal changes in the NSR, we have presented the route related costs for the different months and an average cost calculated on the basis of seasonal changes.

4.5.2 Cash flow per day and per trip

The tables below show cash flow per day and per trip between Hamburg and Yokohama for the different pairs of vessels. All sums are in US dollars. Revenues per trip depend on the freight rates, and revenues for rates in the interval between USD 15 and USD 40 per ton is calculated. Rates above USD 40 or below USD 15 per ton are considered not too likely.

Pr day NSR	$ 15	$ 20	$ 25	$ 30	$ 40	Average
20.000 DWT	$ 12.192	$ 16.256	$ 20.320	$ 24.384	$ 32.512	$ 21.133
30.000 DWT	$ 18.288	$ 24.384	$ 30.480	$ 36.576	$ 48.768	$ 31.699
40.000 DWT	$ 24.384	$ 32.512	$ 40.640	$ 48.768	$ 65.024	$ 42.266

Pr day Suez	$ 15	$ 20	$ 25	$ 30	$ 40	Average
20.000 DWT	$ 9.189	$ 12.251	$ 15.314	$ 18.377	$ 24.503	$ 15.927
30.000 DWT	$ 13.783	$ 18.377	$ 22.971	$ 27.566	$ 36.754	$ 23.890
40.000 DWT	$ 18.377	$ 24.503	$ 30.628	$ 36.754	$ 49.005	$ 31.854

Per trip	$ 15	$ 20	$ 25	$ 30	$ 40	Average
20.000 DWT	$ 300.000	$ 400.000	$ 500.000	$ 600.000	$ 700.000	$ 500.000
30.000 DWT	$ 450.000	$ 600.000	$ 750.000	$ 900.000	$ 1.050.000	$ 750.000
40.000 DWT	$ 600.000	$ 800.000	$ 1.000.000	$ 1.200.000	$ 1.400.000	$ 1.000.000

Although the positive revenue per trip is unaffected by the choice of route, income per day is affected by the trip time. As NSR is considerably shorter than the southern sea route, the daily cash flow is higher.

4.5.3 Bunkers consumption and bunkers cost per day and trip

Bunkers consumption (and therefore cost) per day and trip is unaffected by seasonal changes when transiting through Suez. When using the NSR, the consumption will be subject to seasonal variations in the Arctic leg of the route. We have therefore split the total bunker cost into a bluewater and Arctic segment.

Bunkers consumption per day in Arctic waters (tons)

Arctic	June	September	October	December	Average	Suez
20.000	5	14	11	8	9	0
30.000	8	24	20	13	15	0
40.000	11	31	25	17	20	0

Bunkers consumption per day in blue waters (tons)

Bluewater	June	September	October	December	Average	Suez
20.000	18	18	18	18	18	18
30.000	32	32	32	32	32	32
40.000	41	41	41	41	41	41

Average bunkers consumption per day (tons)

Average	June	September	October	December	Average	Suez
20.000	10	16	15	13	13	18
30.000	18	28	26	22	23	32
40.000	23	36	34	29	30	41

Average bunker cost per day

Per day	June	September	October	December	Average	Suez
20.000	$ 1.097	$ 1.735	$ 1.607	$ 1.359	$ 1.424	$ 1.936
30.000	$ 1.919	$ 3.036	$ 2.813	$ 2.378	$ 2.493	$ 3.388
40.000	$ 2.468	$ 3.903	$ 3.617	$ 3.058	$ 3.205	$ 4.357

Bunker cost per trip

Per trip	June	September	October	December	Average	Suez
20.000	$ 32.608	$ 36.353	$ 35.574	$ 34.106	$ 34.505	$ 63.218
30.000	$ 57.064	$ 63.617	$ 62.255	$ 59.686	$ 60.383	$ 110.632
40.000	$ 73.367	$ 81.793	$ 80.042	$ 76.739	$ 77.635	$ 142.241

As the tables above clearly show, the bunker cost is always lower when utilising the NSR.

4.5.4 OPEX per day and trip

Operating expenses are calculated on a monthly basis and will lead to a negative cash flow whether the vessel is in activity or not. The cost per day is unaffected by choice of route, but the cost per trip will decline as transit time is shortened.

OPEX	Suez	NSR
Per day	$ 4.455	$ 4.455

OPEX	June	September	October	December	Average	Suez
Per trip	$ 132.458	$ 93.360	$ 98.597	$ 111.810	$ 109.619	$ 145.526

When using the Suez route, OPEX is unaffected by seasonal changes. In NSR, OPEX will vary considerably, but OPEX per trip will always be lower in the NSR.

4.5.5 Ice insurance cost per day and trip

The ice insurance rate is the most important cost segment when comparing the two routes. A slight increase in the rate per GRT per day in ice exposed waters will reduce the operating cash flow considerably. We have therefore calculated the insurance cost depending on different insurance rates. As the tables below show, the changes in the insurance rate will have a considerable impact on the profitability of the NSR.

Average insurance cost per day

$ 0,55/GRT	June	September	October	December	Average	Suez
20.000	$ 3.900	$ 2.769	$ 2.973	$ 3.401	$ 3.298	$ 0
30.000	$ 5.850	$ 4.154	$ 4.459	$ 5.102	$ 4.947	$ 0
40.000	$ 7.800	$ 5.538	$ 5.945	$ 6.803	$ 6.596	$ 0

$ 0,30/GRT	June	September	October	December	Average	Suez
20.000	$ 2.127	$ 1.510	$ 1.621	$ 1.855	$ 1.799	$ 0
30.000	$ 3.191	$ 2.266	$ 2.432	$ 2.783	$ 2.698	$ 0
40.000	$ 4.254	$ 3.021	$ 3.243	$ 3.711	$ 3.598	$ 0

Average insurance cost per trip

$ 0,55/GRT	June	September	October	December	Average	Suez
20.000	$ 115.958	$ 58.033	$ 65.792	$ 85.368	$ 82.121	$ 0
30.000	$ 173.938	$ 87.049	$ 98.688	$ 128.052	$ 123.181	$ 0
40.000	$ 231.917	$ 116.066	$ 131.584	$ 170.736	$ 164.241	$ 0

$ 0,30/GRT	June	September	October	December	Average	Suez
20.000	$ 39.205	$ 31.654	$ 35.887	$ 46.564	$ 44.793	$ 0
30.000	$ 58.807	$ 47.481	$ 53.830	$ 69.847	$ 67.190	$ 0
40.000	$ 78.409	$ 63.309	$ 71.773	$ 93.129	$ 89.586	$ 0

4.5.6 Suez Canal Fee per day and per trip

The Suez Canal Fee can be compared to the ice insurance cost of the NSR. The canal cost per trip will, depending on the ice insurance rate, be equal to the insurance cost when transiting through the NSR.

Suez Canal Fee	20.000 DWT	30.000 DWT	40.000 DWT
Per day	$ 2.329	$ 2.980	$ 3.862
Per trip	$ 76.055	$ 97.311	$ 126.101

4.6 Final results

4.6.1 Cash flows

Cash flow per day before capital cost is equal to operating income. The operating income determines the profitability of the project. If the operating income is negative the project is not able to pay the costs needed for the daily running of it. A project with a negative operating income should therefore not be considered. In the following operating income will be denoted as operating cash flow. Below we have listed the operating cash flow per day, trip and year at different freight rates. We have listed the cash flow for NSR projects depending on different insurance rates.

4.6.2 Operating cash flow per day

0,55/GRT	$ 10	$ 15	$ 20	$ 25	$ 30	$ 35	$ 40
40.000	$ 2	$ 10	$ 18	$ 26	$ 34	$ 43	$ 51
30.000	$ 0	$ 6	$ 12	$ 19	$ 25	$ 31	$ 37
20.000	($ 1)	$ 3	$ 7	$ 11	$ 15	$ 19	$ 23

0,30/GRT	$ 10	$ 15	$ 20	$ 25	$ 30	$ 35	$ 40
40.000	$ 5	$ 13	$ 21	$ 29	$ 38	$ 46	$ 54
30.000	$ 3	$ 9	$ 15	$ 21	$ 27	$ 33	$ 39
20.000	$ 0	$ 5	$ 9	$ 13	$ 17	$ 21	$ 25

0,00/GRT	$ 10	$ 15	$ 20	$ 25	$ 30	$ 35	$ 40
40.000	$ 9	$ 17	$ 25	$ 33	$ 41	$ 49	$ 57
30.000	$ 5	$ 11	$ 17	$ 24	$ 30	$ 36	$ 42
20.000	$ 2	$ 6	$ 10	$ 14	$ 19	$ 23	$ 27

Suez	$ 10	$ 15	$ 20	$ 25	$ 30	$ 35	$ 40
40.000	($ 0)	$ 6	$ 12	$ 18	$ 24	$ 30	$ 36
30.000	($ 2)	$ 3	$ 8	$ 12	$ 17	$ 21	$ 26
20.000	($ 3)	$ 0	$ 4	$ 7	$ 10	$ 13	$ 16

4.6.3 Operating cash flow per trip

0,55/GRT	$ 10	$ 15	$ 20	$ 25	$ 30	$ 35	$ 40
40.000	$ 49	$ 249	$ 449	$ 649	$ 849	$ 1.049	$ 1.249
30.000	$ 7	$ 157	$ 307	$ 457	$ 607	$ 757	$ 907
20.000	($ 26)	$ 74	$ 174	$ 274	$ 374	$ 474	$ 574

0,30/GRT	$ 10	$ 15	$ 20	$ 25	$ 30	$ 35	$ 40
40.000	$ 123	$ 323	$ 523	$ 723	$ 923	$ 1.123	$ 1.323
30.000	$ 63	$ 213	$ 363	$ 513	$ 663	$ 813	$ 963
20.000	$ 11	$ 111	$ 211	$ 311	$ 411	$ 511	$ 611

0,00/GRT	$ 10	$ 15	$ 20	$ 25	$ 30	$ 35	$ 40
40.000	$ 213	$ 413	$ 613	$ 813	$ 1.013	$ 1.213	$ 1.413
30.000	$ 130	$ 280	$ 430	$ 580	$ 730	$ 880	$ 1.030
20.000	$ 56	$ 156	$ 256	$ 356	$ 456	$ 556	$ 656

Suez	$ 10	$ 15	$ 20	$ 25	$ 30	$ 35	$ 40
40.000	($ 14)	$ 186	$ 386	$ 586	$ 786	$ 986	$ 1.186
30.000	($ 53)	$ 97	$ 247	$ 397	$ 547	$ 697	$ 847
20.000	($ 85)	$ 15	$ 115	$ 215	$ 315	$ 415	$ 515

As the tables show, at comparable freight rates, the operating cash flow per day and trip is higher when transiting the NSR than when utilising the southern route through Suez.

4.6.4 Operating cash flow per year

In the tables below, the operating cash flow per year is listed. The calculation of operating cash flow per year is based on the following constraints:

- The ice classified vessels make 11 trips per year; 6 through NSR and 5 through Suez.
- The bluewater vessels make 10 trips through Suez per year.

As the ice classified vessel will have to utilise the southern sea route part of the year, the average operating cash flow per trip is lower than when only transiting through the NSR. This is partly compensated through making more trips per year.

0,55/GRT	$ 10	$ 15	$ 20	$ 25	$ 30	$ 35	$ 40
40.000	$ 222	$ 2.422	$ 4.622	$ 6.822	$ 9.022	$ 11.222	$ 13.422
30.000	($ 226)	$ 1.424	$ 3.074	$ 4.724	$ 6.374	$ 8.024	$ 9.674
20.000	($ 581)	$ 519	$ 1.619	$ 2.719	$ 3.819	$ 4.919	$ 6.019

0,30/GRT	$ 10	$ 15	$ 20	$ 25	$ 30	$ 35	$ 40
40.000	$ 671	$ 2.871	$ 5.071	$ 7.271	$ 9.471	$ 11.671	$ 13.871
30.000	$ 108	$ 1.758	$ 3.408	$ 5.058	$ 6.708	$ 8.358	$ 10.008
20.000	($ 358)	$ 742	$ 1.842	$ 2.942	$ 4.042	$ 5.142	$ 6.242

0,00/GRT	$ 10	$ 15	$ 20	$ 25	$ 30	$ 35	$ 40
40.000	$ 1.206	$ 3.406	$ 5.606	$ 7.806	$ 10.006	$ 12.206	$ 14.406
30.000	$ 512	$ 2.162	$ 3.812	$ 5.462	$ 7.112	$ 8.762	$ 10.412
20.000	($ 89)	$ 1.011	$ 2.111	$ 3.211	$ 4.311	$ 5.411	$ 6.511

Suez	$ 10	$ 15	$ 20	$ 25	$ 30	$ 35	$ 40
40.000	($ 139)	$ 1.861	$ 3.861	$ 5.861	$ 7.861	$ 9.861	$ 11.861
30.000	($ 535)	$ 965	$ 2.465	$ 3.965	$ 5.465	$ 6.965	$ 8.465
20.000	($ 848)	$ 152	$ 1.152	$ 2.152	$ 3.152	$ 4.152	$ 5.152

4.6.5 Gross cash flow per year

The best way to estimate the different projects' profitability is to discount their gross cash flow at the correct discount rate. The relevant discount rate is the Weighted Average Cost of Capital (WACC), which will be explained and estimated later. The gross cash flow per year is equal to operating income per year less taxes, plus non cash charges like depreciation less investments in working capital, property, plant and equipment. It does not incorporate any financing-related cash flow such as interest expenses or shareholder dividends.

The free cash flow can be seen as the project's true cash flow. It is the total after-tax cash flow generated by the project that is available to all providers of capital, both creditors and shareholders. The free cash flow is generally not affected by the financial structure of the project. It can be defined by the following calculation:

Free cash flow

=	Revenues
÷	Operating costs
=	Operating income/cash flow
÷	Depreciation
=	Earnings before interest and taxes (EBIT)
÷	Taxes on EBIT
+	Change in deferred taxes
=	Net operating profit less adjusted taxes (NOPLAT)
+	Depreciation
=	Gross cash flow
÷	Gross investment
=	**Free cash flow from operations**

As our only investment will take place in year nil, there will only be one negative cash flow following the gross investments. Therefore, free cash flow will be equal to gross cash flow in the following years. The revenues created by the different projects are already found, as are operating costs and income. Depreciation is set to today's Norwegian standard depreciation rate for vessels, 20 per cent. The marginal tax rate on earnings is 28 per cent, the standard Norwegian corporate tax rate. For simplicity, change in deferred taxes is set to be equal for the two projects and is therefore not of interest. The tables below show the different cash flows for the 40.000 DWT projects. The insurance rate equals USD 0,3 per GRT and the freight rate equals USD 30 per ton.

Cash flow NSR	0	1	5	10	20
Revenues		$ 13.200	$ 13.200	$ 13.200	$ 13.200
-Operating expenses		$ 3.729	$ 3.729	$ 3.729	$ 3.729
=Operating income		$ 9.471	$ 9.471	$ 9.471	$ 9.471
-Depreciation		$ 6.400	$ 2.621	$ 859	$ 92
=EBIT		$ 3.071	$ 6.850	$ 8.612	$ 9.379
-Taxes		$ 860	$ 1.918	$ 2.411	$ 2.626
=NOPLAT		$ 2.211	$ 4.932	$ 6.201	$ 6.753
+Depreciation		$ 6.400	$ 2.621	$ 859	$ 92
=Gross/free cash flow	($ 32.000)	$ 8.611	$ 7.553	$ 7.060	$ 6.845

Cash flow Suez	0	1	5	10	20
Revenues		$ 12.000	$ 12.000	$ 12.000	$ 12.000
-Operating expenses		$ 4.139	$ 4.139	$ 4.139	$ 4.139
=Operating income		$ 7.861	$ 7.861	$ 7.861	$ 7.861
-Depreciation		$ 5.200	$ 2.130	$ 698	$ 698
=EBIT		$ 2.661	$ 5.731	$ 7.163	$ 7.163
-Taxes		$ 745	$ 1.605	$ 2.006	$ 2.006
=NOPLAT		$ 1.916	$ 4.127	$ 5.158	$ 5.158
+Depreciation		$ 5.200	$ 2.130	$ 698	$ 75
=Gross/free cash flow	($ 26.000)	$ 7.116	$ 6.257	$ 5.856	$ 5.233

Difference	0	1	5	10	20
Revenues		$ 1.200	$ 1.200	$ 1.200	$ 1.200
-Operating expenses		($ 410)	($ 410)	($ 410)	($ 410)
=Operating income		$ 1.610	$ 1.610	$ 1.610	$ 1.610
-Depreciation		$ 1.200	$ 492	$ 161	($ 606)
=EBIT		$ 410	$ 1.118	$ 1.449	$ 2.216
-Taxes		$ 115	$ 313	$ 406	$ 620
=NOPLAT		$ 295	$ 805	$ 1.043	$ 1.595
+Depreciation		$ 1.200	$ 492	$ 161	$ 17
=Gross/free cash flow	($ 6.000)	$ 1.495	$ 1.297	$ 1.204	$ 1.612

In year nil the investment is made and paid. In the following years the vessel creates a positive cash flow. The question of interest is whether the positive cash flows in the years 1 through 20 will pay back the investment made in year nil and give the investors the demanded return on invested capital. As one can see from the tables above, the NSR project generates higher revenues and lower operating costs per year. The operating income is therefore higher. Depreciation is also higher, but this is a non-payable cost. The gross investment in year nil is the main problem. This investment is considerably higher for an ice classified vessel than for a regular bluewater vessel, and the question is whether the extra investment will give an acceptable return.

4.7 Net present value of cash flows

To calculate the present value of free cash flows after interest and taxes, the cost of the different types of capital and the effects of depreciation and taxes will have to be taken into consideration. According to Copeland, Koller and Murrin[6]), the estimated cost of capital must:

- comprise a weighted average of the costs of all sources of capital since the free cash flow represents the cash available to all providers of capital;
- be computed after corporate taxes, since free cash flow is stated after taxes;
- use nominal rates of return because cash flow is expressed in nominal terms
- adjust for the systematic risk borne by each provider of capital, since each expects a return that compensates for the risk taken

in order to be consistent with the free cash flow approach. For simplicity, we have taken it for granted that the project is financed with equal parts of equity and non-equity capital.

4.7.1 The cost of capital

Newbuilding prices are as listed in the table below. The interest payments associated with the investments will vary with the interest rate. The interest rate for liabilities is set to be equal for the different investments, while the cost of equity capital is somewhat higher for the NSR investment. In the calculations, the following constraints are used:

- An ice classified vessel makes 6 trips through NSR and 5 trips through Suez per year.
- A bluewater vessel makes 10 trips through Suez per year.
- Operating results are shown at rates between 15 and 40 USD per ton.
- Each investment has a life span of 20 years
- The cost of capital is set by the capital market

4.7.2 The formula for estimating WACC

The general formula for estimating the after-tax WACC is as follows:

$$\mathbf{WACC = K_b\,(1\text{-}T_c) * (D/T) + K_p\,(E/T)}$$

where

K_b	=	the pre-tax market expected yield to maturity on the default (risk) free nonconvertible debt
T_C	=	the marginal tax rate for the project being valued
D	=	the value of interest-bearing debt
E	=	the value of the equity being valued
T	=	the value of debt and equity
K_p	=	the market-determined opportunity cost of equity capital

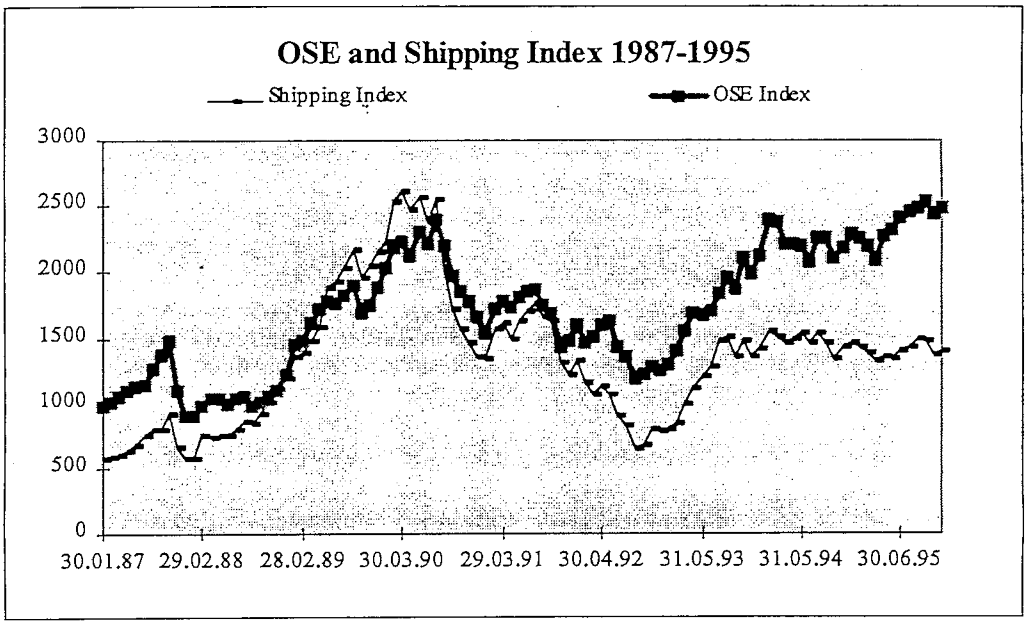
4.7.3 The cost of nonequity financing

In the model the interest rate on non equity capital is set to be equal to the risk free rate of interest on capital. In Norway, there are two appropriate approximations to the risk free rate of interest. These are the rates on short term and long term government securities.

The short term securities are Government certificates, and the long term securities are ten-year treasury bonds. The average rate of return on certificates are 5,4 per cent, while the average rate of return on the ten-year bonds with the highest duration is 6,75 per cent. As our project has a life span of twenty years, the ideal interest rate would be the rate on twenty year bonds. As there are no default free bonds with a duration of twenty years in Norway, we have set the rate of return on non equity capital equal to the 6,75 per cent of the ten year bonds. After taxes the rate of interest is 4,9 per cent

4.7.4 The cost of equity capital

We have used the Capital Asset Pricing Model (CAPM) to set the cost of equity capital. The cost of equity capital for a specific security or project can be estimated by finding the return on capital in the stock market and multiplying the return with the project's risk or β-factor. The β-factor is defined as the response or systematic risk of a given security's returns to changes in the rates of return in the market portfolio. As the market portfolio is composed of all risky investments in the economic system, it is impossible to calculate the exact rate of return. As an approximation we have used the Oslo Stock Exchange's total index (OSE) and the shipping index. OSE will serve as an approximation of the market, while the shipping index will serve as an approximation of the risk of a given shipping project.



Year	Shipping Index	Average return	Total Index	Average return
1988	847	21,9%	1022	-10,5%
1989	1827	115,7%	1715	67,7%
1990	2160	18,3%	2095	22,2%
1991	1556	-28,0%	1720	-17,9%
1992	951	-38,9%	1401	-18,5%
1993	1218	28,0%	1753	25,1%
1994	1457	19,6%	2200	25,5%
1995	1408	-3,4%	2373	7,9%
Average	1347	16,7%	1713	12,7%

Based on index data from the NHH Stock Exchange database, we have estimated the yearly average annual return on the Shipping Index of Oslo Stock Exchange to 16,7 per cent in the period 1987 - 1995. In the same period the yearly average annual return on the OSE has been 12,7 per cent.

According to CAPM, the risk of a given security versus the risk of the market can be approximated with the following equation:

$$K_s = r_f + (E(r_m) - r_f)\ (\beta)$$

where

r_f	=	the risk-free rate of return
K_s	=	the rate of return on the security or project
$E(r_m)$	=	the expected rate of return on the overall market portfolio
$E(r_m) - r_f$	=	the market risk premium
β	=	the beta factor or systematic risk of the equity; defined by the following equation:

$$\beta = \mathrm{Covar}(K_s : r_m) / \mathrm{Var}(r_m)$$

The covariance between OSE and the shipping Index was estimated to 167955 while the variance of the OSE itself was 218153. The β-factor for the shipping index is therefore 0,77. The capital cost for equity of a given shipping project should therefore be:

$$K_s = r_f + ((E(r_m) - r_f)\ \beta)$$
$$K_s = 6{,}75 + ((12{,}7 - 6{,}75) * 0{,}77)$$
$$K_s = 6{,}75 + ((12{,}7 - 6{,}75) * 0{,}77)$$
$$K_s = 11{,}\ 3315$$

In the following calculations we have set the cost of equity capital to 11,33 per cent for the bluewater project, and 12 per cent for the ice classified project. This to compensate for the slightly higher risk. The types of capital are weighted equally giving the following Weighted Average Cost of Capital for the NSR project:

$$WACC_{Bluewater} = K_b\ (1 - T_c) * (D/T) + K_p\ (E/T)$$

$$WACC_{Bluewater} = 6{,}75 * (1-0{,}28) * (1/2) + (11{,}33) * (1/2)$$

$$WACC_{Bluewater} = 2{,}43 + 5{,}67$$

$$WACC_{Bluewater} \approx 8{,}0\ \%$$

$$WACC_{NSR} = K_b\ (1-T_c) * (D/T) + K_p\ (E/T)$$

$$WACC_{NSR} = 6{,}75 * (1-0{,}28) * (1/2) + (12) * (1/2)$$

$$WACC_{NSR} = 2{,}43 + 6$$

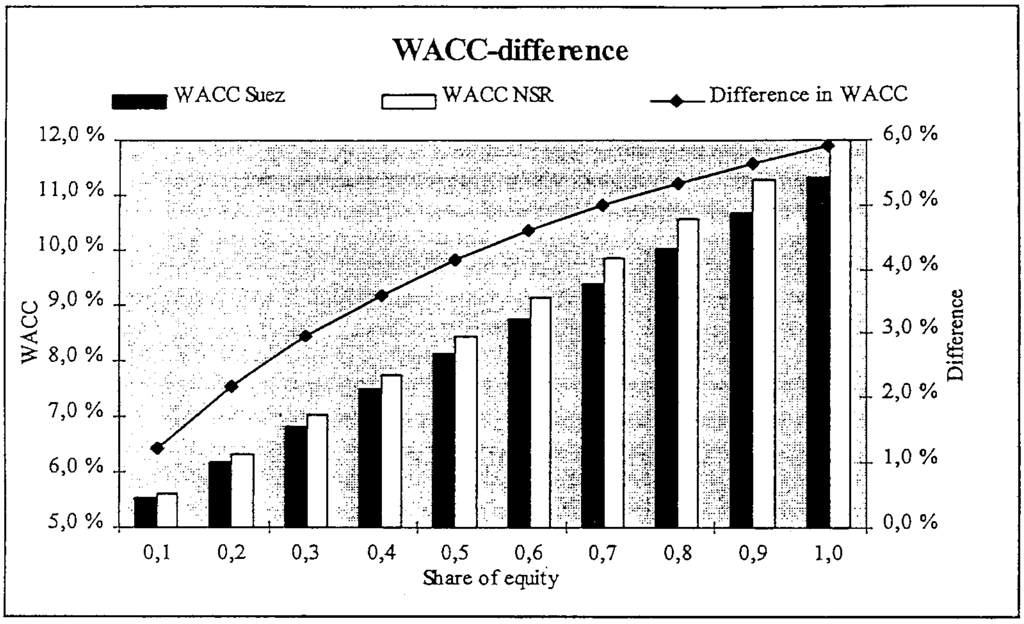
$$WACC_{NSR} \approx 8{,}5\ \%$$

The WACC will change as the weighting of equity and debt change. A project fully debt financed will have a weighted average cost of capital equal to the debt rate of interest after taxes. Conversely, a project fully financed by equity will have a cost of capital equal to the rate of return on equity.

Share of equity	0 %	20 %	40 %	60 %	80 %	100 %
Interest on debt	4,9 %	4,9 %	4,9 %	4,9 %	4,9 %	4,9 %
Equity capital cost	12,0 %	12,0 %	12,0 %	12,0 %	12,0 %	12,0 %
WACC NSR	4,9 %	6,3 %	7,7 %	9,2 %	10,6 %	12,0 %

Share of equity	0 %	20 %	40 %	60 %	80 %	100 %
Interest on debt	4,9 %	4,9 %	4,9 %	4,9 %	4,9 %	4,9 %
Equity capital cost	11,3 %	11,3 %	11,3 %	11,3 %	11,3 %	11,3 %
WACC Suez	4,9 %	6,2 %	7,5 %	8,8 %	10,0 %	11,3 %

When comparing the tables above, it is obvious that the Weighted Average Capital Cost will always be higher for an ice classified vessel operating in the NSR than for a bluewater bulker operating in normal waters. The difference between the two WACC's will increase as the share of equity in the project is increased. The table and graph below show the increasing difference in WACC as a function of the share of equity capital.



Share of equity	0%	20%	40%	60%	80%	100%
WACC NSR	4,9%	6,3%	7,7%	9,2%	10,6%	12,0%
WACC Suez	4,9%	6,2%	7,5%	8,8%	10,0%	11,3%
Absolute difference	0,0%	0,1%	0,2%	0,4%	0,6%	0,7%
Relative difference	0,0%	2,2%	3,6%	4,6%	5,3%	5,9%

As the graph and table above clearly show an investment in an ice classified vessel becomes comparatively more costly as the share of equity is increased.

Net present value of the project is found by discounting the cash flows with the relevant discount factor. This factor is the Weighted Average Cost of Capital, which was estimated previously. The net present value can be calculated using the following formula:

$$\mathbf{NPV = CF_0/(1+W)^0 + CF_1/(1+W)^1 + \ldots + CF_{n-1}/(1+W)^{n-1} + CF_n/(1+W)^n}$$

where

CF_i = Cash flow in year $_i$

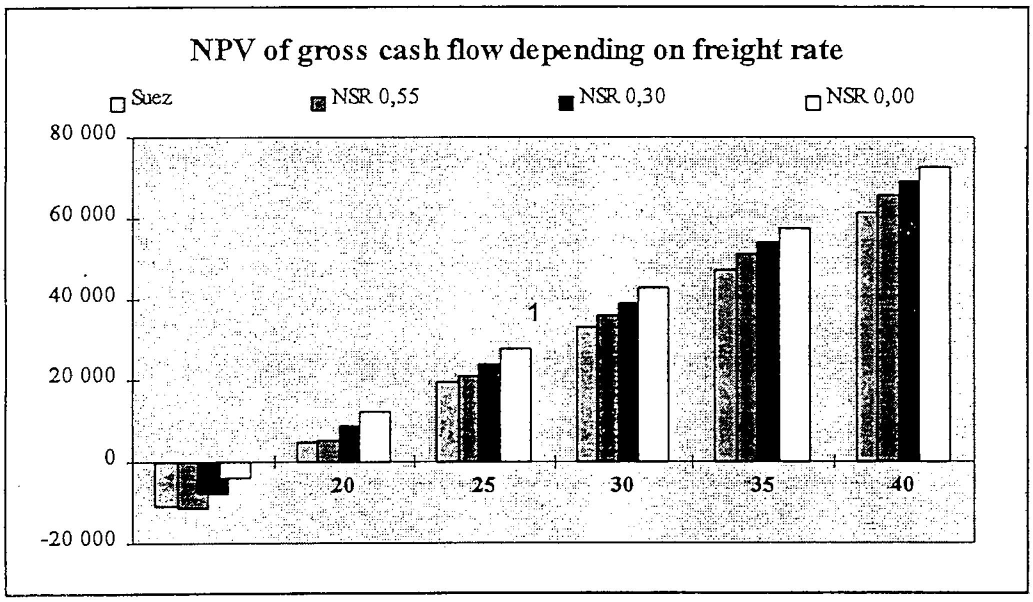
W = Discount factor; the Weighted Average Cost of Capital

4.8 NPV depending on freight rates and insurance

The revenues needed to finance the different projects are dependent on the freight rates set by the market. The most important variable is therefore outside the shipowner's control. We have therefore computed the net present value of the projects depending on freight rates in the interval between USD 20 and USD 45.

4.8.1 DWT

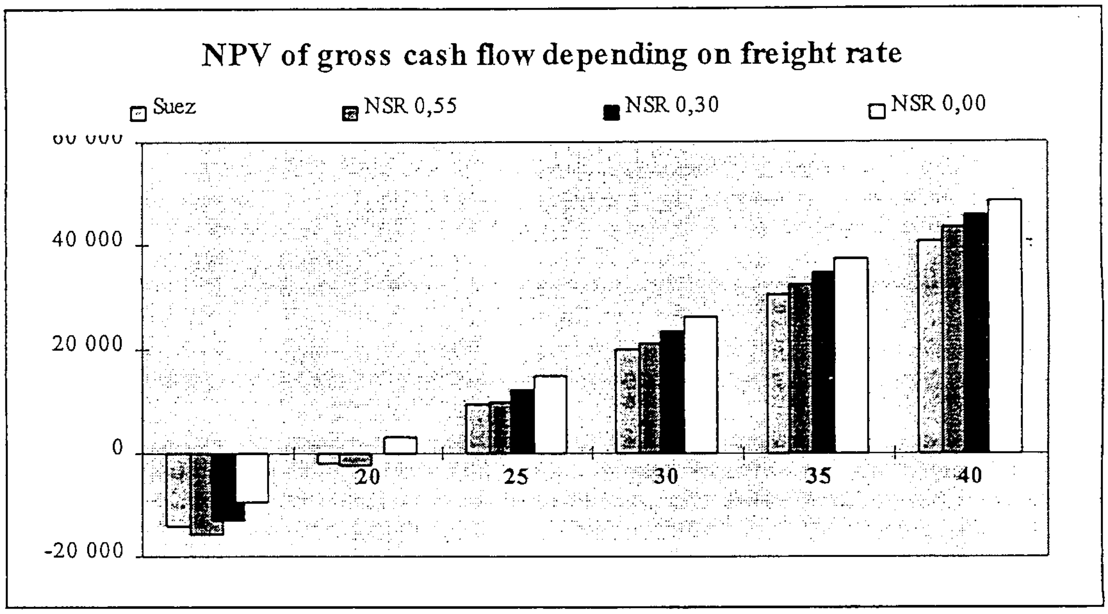
In the 40.000 DWT segment, the break even rate is USD 18,4 per ton with the current cost of capital if the insurance rate is USD 0,55 per ton. If the insurance rate is 0,30 per ton, the break even rate is 17,3 per ton. Whatever insurance rate, the breakeven rate for a bluewater bulker operating i southern waters is USD 18,4 per ton.



Freight Rate	$15	$20	$25	$30	$35	$40
NSR 0,55	($ 11.402)	$ 5.312	$ 20.934	$ 35.979	$ 51.024	$ 66.068
NSR 0,30	($ 7.879)	$ 8.609	$ 24.008	$ 39.053	$ 54.097	$ 69.142
NSR 0,00	($ 3.759)	$ 12.414	$ 27.664	$ 42.708	$ 57.753	$ 72.797
Suez	($ 10.657)	$ 4.898	$ 19.334	$ 33.352	$ 47.370	$ 61.388

4.8.2 30.000 DWT

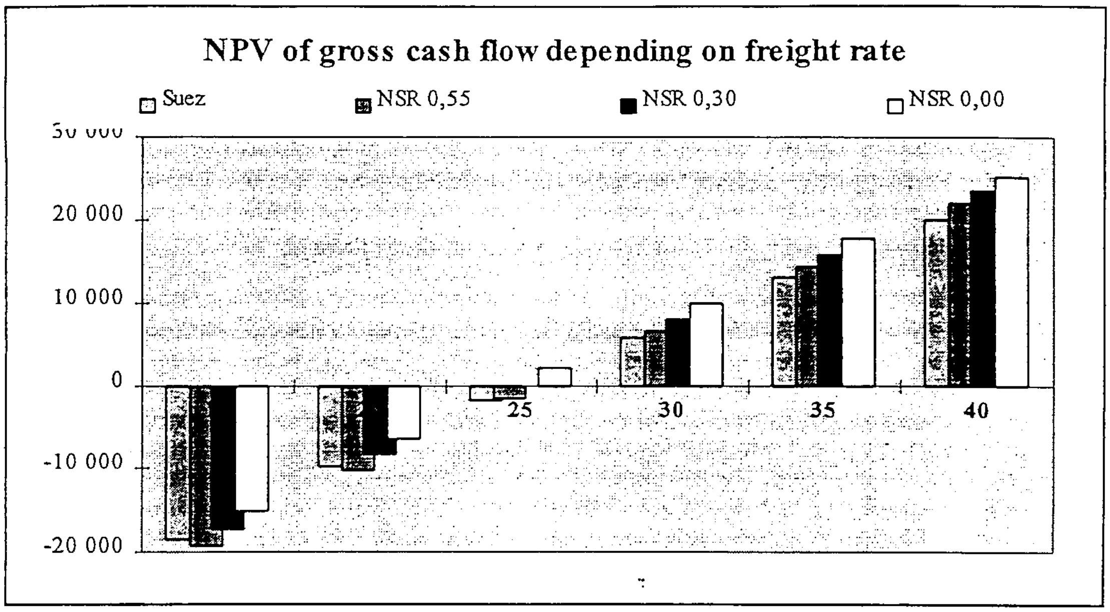
In the 30.000 DWT segment, the results are less favourable. The breakeven rate is USD 21 per ton at an insurance rate of 0,55 and USD 20 at an insurance rate of 0,3. The comparable breakeven rate for a vessel in southern waters is USD 20,9 per ton.



Freight Rate	$15	$20	$25	$30	$35	$40
NSR 0,55	($ 15.579)	($ 2.582)	$ 9.575	$ 21.084	$ 32.368	$ 43.651
NSR 0,30	($ 12.854)	($ 52)	$ 11.951	$ 23.374	$ 34.658	$ 45.941
NSR 0,00	($ 9.639)	$ 2.943	$ 14.812	$ 26.131	$ 37.415	$ 48.698
Suez	($ 14.287)	($ 2.101)	$ 9.198	$ 19.876	$ 30.390	$ 40.903

4.8.3 20.000 DWT

The 20.000 DWT segment is, other things equal, the least interesting. For the net present value of the free cash flow of the NSR to be positive, the freight rate must exceed USD 25,9 per ton when the insurance is set to 0,55 per GRT. The Suez project will need a rate of USD 26,1 per ton.



Freight Rate	$15	$20	$25	$30	$35	$40
NSR 0,55	($ 19.285)	($ 10.122)	($ 1.578)	$ 6.568	$ 14.349	$ 21.871
NSR 0,30	($ 17.359)	($ 8.349)	$ 108	$ 8.157	$ 15.875	$ 23.398
NSR 0,00	($ 15.088)	($ 6.241)	$ 2.108	$ 10.064	$ 17.713	$ 25.236
Suez	($ 18.539)	($ 9.795)	($ 1.763)	$ 5.835	$ 13.075	$ 20.084

4.8.4 Break-even cash flow

As the projects' have different operational and capital cost functions, the break-even freight rate is different for the two types of projects. The first table below shows the break-even freight rate, revenue and net present value of the NSR project and the net present value of the Suez project at the same freight rates. The second table shows the break-even freight rate, revenue and net present value of the Suez project and the net present value of the NSR project at the same freight rates.

Suez	Freight rate	Revenue	NPV CF
20.000	$ 26,140	$ 523.000	$ 0
30.000	$ 20,906	$ 627.000	$ 0
40.000	$ 18,378	$ 735.000	$ 0
NSR 0,00	**Freight rate**	**Revenue**	**NPV CF**
20.000	$ 23,713	$ 474.000	$ 0
30.000	$ 18,799	$ 564.000	$ 0
40.000	$ 16,131	$ 645.000	$ 0
NSR 0,30	**Freight rate**	**Revenue**	**NPV CF**
20.000	$ 24,935	$ 499.000	$ 0
30.000	$ 20,021	$ 601.000	$ 0
40.000	$ 17,346	$ 694.000	$ 0
NSR 0,55	**Freight rate**	**Revenue**	**NPV CF**
20.000	$ 25,949	$ 519.000	$ 0
30.000	$ 21,036	$ 631.000	$ 0
40.000	$ 18,367	$ 735.000	$ 0

As the tables show, the Suez project's cash flow will have a positive net present value when the net present value of the NSR project is nil. Furthermore, the net present value of the NSR is negative when the present value of the Suez alternative is nil. One can see that the breakeven rate for the Suez project is lower than the comparable rate for the NSR project.

4.8.5 Alternative cost

An investor facing the choice of two investments of different cost, will have to take into consideration the alternative cost of capital. If he has to choose between a project with an investment of USD ***X*** million and generating a cash flow of USD ***Y*** million and a project with an investment of USD ***X+A*** million generating a cash flow of USD ***Y+B*** million, the project with the additional investment (***A***) is only interesting if the additional cash flow generated (***B***) is greater than the return given by the capital markets.

If the additional cash flow (***B***) is less than the cash flow generated by the market, an investor choosing the project with the larger investment would gain less than if he chose the smaller investment and put the rest of his capital to work in the capital market. This is the concept of alternative cost.

In the tables below we have listed the net present value of the additional cash flow when invested in the capital markets (denoted "Capital markets") and the net present value of the additional cash flows generated by the NSR projects at different insurance and freight rates.

Net P. Value	$ 20	$ 25	$ 30	$ 35	$ 40
40.000/0,55	$ 1.087	$ 2616	$ 3.984	$ 5352	$ 6.719
40.000/0,30	$ 4.384	$ 5.690	$ 7.057	$ 8.425	$ 9.793
40.000/0,00	$ 8.189	$ 9.345	$ 10.713	$ 12.081	$ 13.448
Capital markets	$ 3.400	$ 3.400	$ 3.400	$ 3.400	$ 3.400
Net P. Value	**$ 20**	**$ 25**	**$ 30**	**$ 35**	**$ 40**
30.000/0,55	($ 12)	$ 1.105	$.2.193	$.3.219	$ 4.245
30.000/0,30	$ 2.517	$ 3.481	$.4.483	$ 5.509	$ 6.534
30.000/0,00	$ 5.513	$ 6.342	$.7.240	$ 8.266	$ 9.291
Capital markets	$ 2.834	$ 2.834	$ 2.834	$ 2.834	$ 2.834
Net P. Value	**$ 20**	**$ 25**	**$ 30**	**$ 35**	**$ 40**
20.000/0,55	($ 97)	$ 594	$ 1.315	$ 2.027	$ 2.711
20.000/0,30	$ 1.677	$ 2.280	$ 2.905	$ 3.554	$ 4.238
20.000/0,00	$ 3.784	$ 4.280	$ 4.812	$ 5.392	$ 6.076
Capital markets	$ 2.267	$ 2.267	$ 2.267	$ 2.267	$ 2.267

At a given freight rate, as the insurance rate decreases, the net present value of the additional cash flow increases. For a NSR project to be profitable the two following constraints will have to be satisfied:

1. The net present value of the additional capital invested in the NSR project must exceed the net present value of the capital market's return on this capital
2. The freight rate must exceed the breakeven rate.

The first constraint is the concept of alternative cost, while the reason for the second constraint is: For the concept of alternative cost to be relevant, there must be a positive return in the first place. It is of course interesting to compare deficits, but hardly meaningful.

When comparing the additional cash flow generated by the ice classified vessel with the return generated in the capital market, the market return must be discounted. The first table below shows the break even rates for the different NSR projects at different insurance rates. The second table shows the alternative cost rates; the minimum rates required to secure a higher return in the NSR.

Break even rate	20.000	30.000	40.000
NSR (Insurance 0,00)	$23,7	$18,8	$16,1
NSR (Insurance 0,30)	$24,9	$20,0	$17,3
NSR (Insurance 0,55)	$25,9	$21,0	$18,4

Alternative cost rate	20.000	30.000	40.000
NSR (Insurance 0,00)	$ 25	$ 19	$ 19
NSR (Insurance 0,30)	$ 25	$ 22	$ 20
NSR (Insurance 0,55)	$ 37	$ 32	$ 27

4.9 Conclusions

In this paper we have analysed the profitability of an ice classified vessel trafficking the NSR versus the profitability of a regular vessel transiting through Suez. Our findings can be summed up as follows:

- Given today's level of freight rates, revenues per year will be higher for the NSR alternative than for the Suez alternative. Operational costs will be lower and operational income and free cash flow higher. The current ice - classified fleet, Ice 1 A Super or higher, could potentially make significantly increased revenues on operations on the NSR. This is subject to cargo availability.

- Cargo availability between Europe and the Far East depends to a large degree on Russian cargoes being channeled through the Baltic and the Black Sea Ports.

- The increased operational income and free cash flow, will not be sufficient to give an acceptable return on the increased capital costs that are needed to finance the NSR project. Net present value of the NSR project are therefore lower than for the Suez project, subject to equal freight rates for the period january - june.

- Our calculations have thus led us to believe that the potential of operations on the Northern sea route will not be sufficient to justify investments in newbuildings on a stand-alone basis. This is subject to risk perceptions and insurance rates in the Arctic[10]. Consequently above market freight rates must be likely in the standard ice season Jan - April, and cargo quantities must be sufficent for the hire of vessels in ice premium waters in this period.

- Ice Premium waters, are to a large degree Russian Ports in the Baltic Sea, the inner Black Sea & the Sea of Azov, The White Sea and the Russian Far East.

[10] See reviewers' comments on Insurance. Concrete information on ice and accidents (the lack of) could significantly alter this picture.

4.10 Notes

1. INSROP Paper 172
"Requirements for Ice Performance of large ships with shallow drafts"

2 Analysis of LSE shipment reports show that average parcel size is 31 440 tons of cargo. See part 1.2. 3. of the project paper.

3 Source: Murmansk Shipping Company. Se appendix Insrop paper III, 51 "Monitoring Commercial Trips along the NSR"

4 See appendix

5. See INSROP Paper III13 "The NSR and the Rivers Ob and Yenisey"

6 See "Valuation; Measuring and Managing the Value of Companies" by Copeland, Koller and Murrin, Wiley 1990

Oceans
Institute
of Canada

Institut
canadien
des océans

August 13, 1996

Trond R Ramsland, Esq.
Coordinator INSROP Sub-Program III
SNF
Bergen-Sandviken
Norway

Fax 011 47 55 95 94 39

Dear Mr Ramsland

RE: INSROP

Firstly, I must apologize for the long delay in following-up on my letter dated May 2, 1996.

My schedule has been unusually active recently and I also undertook an informative trip to Tokyo in June which involved the Marine Insurance aspect of the INSROP Project.

As mentioned in my letter of May 2, I wanted to discuss your report with my colleagues before I responded fully to your fax and this has now been done.

Firstly, we find your report to be most informative and useful. In the absence of any real accident data you have managed to propose a very practical approach to the subject of projected insurance costs.

1) Hopefully, Protection and Indemnity Insurers will not require large additional premiums for operations within the proposed waters. From our discussions, we have been led to understand that there have not been any particularly adverse experiences in the projected trip area. Generally, our understanding is that P & I Insurers will take into

1880 ST. DENIS PL., WEST VANCOUVER, B.C., CANADA V7V 3W0 FAX. AND TEL. (604) 922-1395

consideration a particular area of trading when formulating the initial call (based on GRT) but will not require daily additional. Supplementary calls, if any, could still apply.

Hull and Machinery and related insurances, however, in the light of all known experience (which is extremely limited in the NSR at the present time), will require additional premiums on either a daily or a voyage basis for operations in heavy ice conditions which may be based on:

- areas and dates somewhat similar to the Canadian Arctic Rating Scale or;
- daily additionals for breach of Institute Warranties or;
- some other method of calculation to be worked out specifically for the NSR.

2) The comparison between additional premiums and charges made for travelling through the Suez Canal seems to be a very logical approach.

3) The point is made that SDR'S and US Dollars remain generally in sync with each other. One suggestion has been made that US Dollars could be considered, making any exchange for SDR'S if necessary.

4) Regarding time of transit, it may well be that that the speed of vessels transiting the NSR will be governed by the authorities or alternatively by the speed of the escorting vessels.

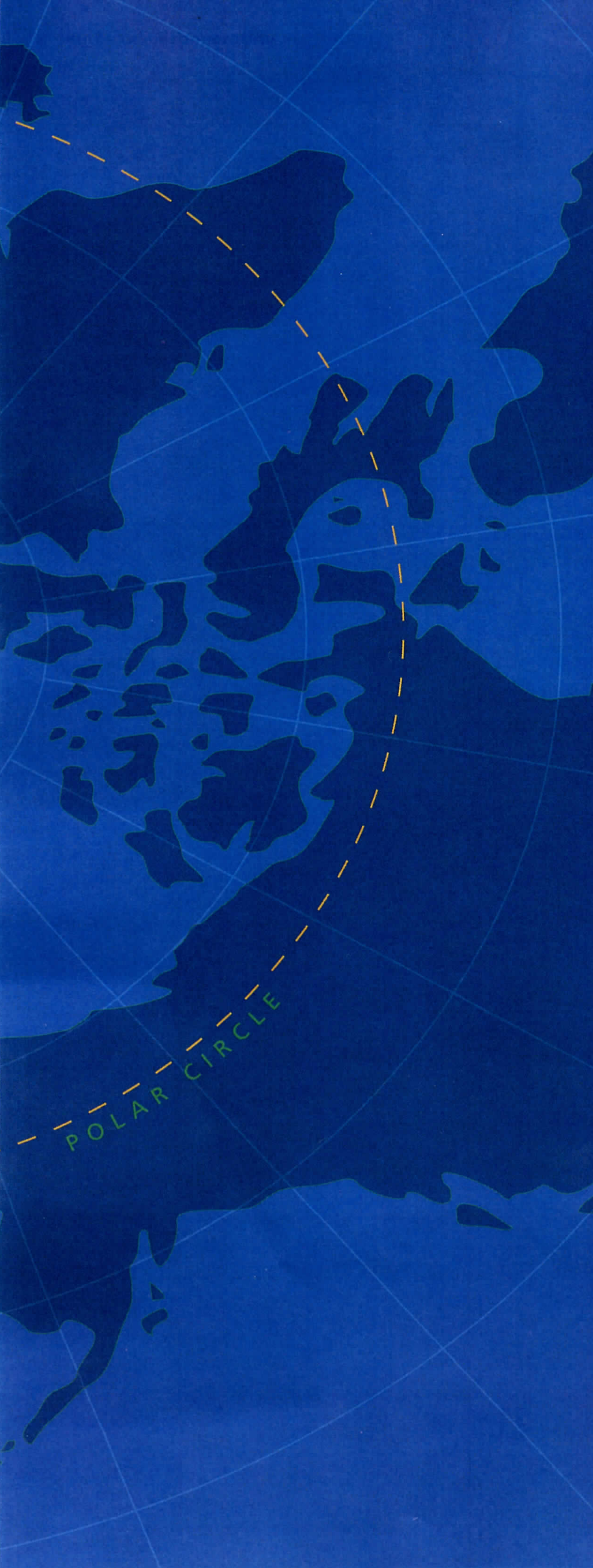
In summary, it is our opinion that your report is extremely practical and effective.

Incidentally. I understand from information that I received in Tokyo, that another experimental voyage may be undertaken in the NSR in 1998 at which time the insurance could be placed in the open market. This could be an excellent time to test out various marine insurance markets with the knowledge that we are presently accumulating.

Please do not hesitate to contact me if I can supply further information or answer any questions.

With kind regards

Peter Wright



The three main cooperating institutions of INSROP

Ship & Ocean Foundation (SOF), Tokyo, Japan.
SOF was established in 1975 as a non-profit organization to advance modernization and rationalization of Japan's shipbuilding and related industries, and to give assistance to non-profit organizations associated with these industries. SOF is provided with operation funds by the Sasakawa Foundation, the world's largest foundation operated with revenue from motorboat racing. An integral part of SOF, the Tsukuba Institute, carries out experimental research into ocean environment protection and ocean development.

Central Marine Research & Design Institute (CNIIMF), St. Petersburg, Russia.
CNIIMF was founded in 1929. The institute's research focus is applied and technological with four main goals: the improvment of merchant fleet efficiency; shipping safety; technical development of the merchant fleet; and design support for future fleet development. CNIIMF was a Russian state institution up to 1993, when it was converted into a stock-holding company.

The Fridtjof Nansen Institute (FNI), Lysaker, Norway.
FNI was founded in 1958 and is based at Polhøgda, the home of Fridtjof Nansen, famous Norwegian polar explorer, scientist, humanist and statesman. The institute spesializes in applied social science research, with special focus on international resource and environmental management. In addition to INSROP, the research is organized in six integrated programmes. Typical of FNI research is a multidisciplinary approach, entailing extensive cooperation with other research institutions both at home and abroad. The INSROP Secretariat is located at FNI.