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Perceived Implications Of Privatization For Canadian Coast Guard Services, Principally Arctic Icebreaking

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**Perceived Implications Of Privatization For Canadian Coast Guard Services,
Principally Arctic Icebreaking**

by

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A thesis submitted to the University of Plymouth
in partial fulfilment for the degree of

DOCTOR OF PHILOSOPHY

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Abstract

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Perceived Implications Of Privatization For Canadian Coast Guard Services, Principally Arctic Icebreaking

Climate change, with the possibility of an ice free Arctic ocean by 2015, has generated a renewed interest in the Arctic. This interest is being driven by the possibility of easier access to the abundant supply of resources such as oil, gas, minerals, and fisheries. Interest in Arctic tourism is also growing. Retreating sea ice will provide opportunities to avail of shorter routes for maritime traffic to and from Asia, North America, and Asia via the Arctic Ocean and Northwest Passage. In addition, the rate of population growth of local inhabitants in the Canadian Arctic is the fastest in Canada and one of the fastest in the world. A growing population will increase the demand for sealift resupply to Canada's northern communities.

This work presents the first attempt to examine the role of privatization of icebreaking services in light of the present and projected shortages of infrastructure to support development in the Arctic. A unique combination of multiple methods within marine transportation, comprising of Delphi, grounded theory, and quantitative survey, is applied to investigate the potential for private involvement in the delivery of icebreaking services in the Canadian Arctic. This includes a novel application of Strauss and Corbin's Grounded Theory approach to develop hypotheses and relationships grounded in expert opinion.

Although the Arctic Ocean may be ice free during the summers, there is still the issue of winter freezing and the threat of lingering multi-year ice which will impede marine transportation especially during periods of darkness and fog. The research shows

that the future growth and development of the Canadian Arctic will undoubtedly require the use of designated icebreakers and ice strengthened vessels. However, Canada's fleet of Arctic icebreakers is ageing and considered unsuitable for future demands. While Canada has earmarked CAD \$750M for the construction of one new icebreaker scheduled for delivery in 2017, the research shows that icebreakers can be built outside of Canada for considerably less money and in less time. Also, the management and operation of the Canadian Coast Guard is under considerable security by the Auditor General of Canada. The research shows that not unlike others Arctic nations, there is potential for the creation of private-public partnerships in the delivery of Canadian Coast Guard services, principally icebreaking, in the Arctic.

Keywords: Northwest Passage, privatisation of ice-breaker services, Canadian Arctic, Delphi survey, grounded theory, exploratory factor analysis.

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Jim

St. John's, August 2009

Author's Declaration

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- 'Developing policies to manage Canada's icebreaking services: a grounded theory approach' was presented via video link at the University of Plymouth 2008 Postgraduate Symposium;
- 'Reconfiguring global supply chains: a strategic review of Canadian icebreaker services' was presented at the LRN2008 Conference in Liverpool, England.
- 'Northern opportunities: a strategic review of Canada's Arctic icebreaking services' was presented at the MARI-TECH 2009 Conference in St. John's , Newfoundland;
- Contributing author in the Arctic Council's Arctic Marine Shipping Assessment (AMSA) 2009 Report.

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- IceTech 2006 – Banff, Alberta;
- Canadian Arctic issues in a Changing Climate – Halifax, Nova Scotia;
- Vessels in Crisis – Hamilton, Ontario;
- Shipping in the Canadian Arctic: Challenges and Opportunities – Halifax, Nova Scotia;
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List of Abbreviations

AIRSS- Arctic Ice Regime Shipping System
AMSA- Arctic Maritime Shipping Assessment
APMO- Average Percent Majority Opinion
ARR- Active Response Rate
AWPPA- Arctic Waters Pollution Prevention Act
B- Billion
CAD- Canadian
CCCma- Canadian Centre for Climate Modelling and Analysis
CCG-Canadian Coast Guard
CFA- Common Factor Analysis
CFS- Canadian Forces Station
CMMC- Company of Master Mariners of Canada
CSA- Canada Shipping Act
DFO- Department of Fisheries and Oceans
DND- Department of National Defence
DWT- Dead Weight Tonnes
EFA- Exploratory Factor Analysis
FA- Factor Analysis
FESCO- Far East Shipping Company
FMA- Finnish Maritime Administration
FOC- Fisheries and Oceans Canada
FOB- Free On Board
GOCO- Government Owned Company Operated
g- Growth Rate of Profits
GTL- Gas-To-Liquids
IC- Invested Capital
IF- Image Factoring
JSC- Joint Stock Company
K- Thousand
KMO- Kaiser Meyer Olkin

LNG- Liquefied Natural Gas

LOS- Levels of Service

M- Million

ML- Maximum Likelihood

MOA- Memorandum of Agreement

MOU- Memorandum of Understanding

MP- Member of Parliament

MSC- Murmansk Shipping Company

NASA-National Aeronautics and Space Administration

NA- Not Able to Comment

NEP- Northeast Passage

NGO- Non Government Organization

NSF- National Science Foundation

NOPLAT- Net Operating Profits Less Adjusted Taxes

NORDREG- Arctic Canada Traffic Zone

NWP- Northwest Passage

OMB- Office of Management and Budget

P&I- Protection and Indemnity

PAF- Principal Axis Factoring

PCA- Principal Component Analysis

PPP- Private Public Partnership

PWGSC- Public Works & Government Services Canada

RFI- Request for Information

ROIC- Return on Invested Capital

SMA- Swedish Maritime Administration

SOA- Special Operating Agency

SPSS- Statistical Package for the Social Sciences

T- Trillion

TB- Treasury Board

TC- Transport Canada

TCF- Trillion Cubic feet

TRR- Total Response Rate

USA- United States of America

USCG- United States Coast Guard

UK- United Kingdom

Chapter 1 Introduction

1.1 Introduction

This chapter commences with some background information on the Arctic, the Northwest Passage (NWP), and the Canadian Coast Guard (CCG) noting why this research is timely and important to the development of the Arctic, Arctic inhabitants, and Canadian taxpayers. The chapter continues with the research aim and objectives. It concludes with a summary of the research project.

1.2 Background

For centuries explorers sought a route through the Arctic linking Europe and Asia. John Cabot proposed a NWP in 1490 and Roald Amundsen made the first ship transit in 1905 (Pharand, 1984, 38). Interest in the Arctic region, whether stemming from climate change or its abundance of natural resources, is high on the agenda of many nations. The annual extent of Arctic ice coverage is retreating at a notable rate and it is estimated that the Canadian Arctic will experience nearly ice-free summer seasons starting as early as 2050 but probably not before 2100 (Falkingham, 2004, A-5). However, things appear to be happening much faster in the Arctic and there is much debate and uncertainty as to when the Arctic will actually experience ice-free summers; it could be as early as 2015 (Leahy, 2008). National Aeronautics and Space Administration (NASA) data shows that Arctic perennial sea ice shrank abruptly by 14 percent between 2004 and 2005 (Hupp and Brown, 2006). It would be logical to think that less ice should increase the ease and mobility for ships currently working in Arctic regions and also for those ships that may be contemplating future activity. Milder sea ice conditions may present new merchant shipping opportunities by way of the shorter distances available to Europe-Asia and East Coast North America-Asia traffic. In terms of

marine transportation, increased activity will probably result in new and increased business as a virtuous circle of business and economic activity appears to be moving northward (National-Research-Council, 2005, 3).

On a global scale, Arctic regions are rich in natural resources, holding about 25 percent of the world's undiscovered petroleum resources (Ahlbrandt and McCabe, 2002). On a local scale, Canada's Arctic regions are estimated to hold one third of its remaining recoverable natural gas and one quarter of the remaining recoverable light crude oil (Indian-and-Northern-Affairs-Canada, 2006, 7). Cruise ship activity is increasing and fishing fleets have already begun to follow the fish stocks that migrate northward as the ice edge retreats (National-Research-Council, 2005, 24). Any increase in activity will increase the necessity to respond to accidents and create a greater need for law enforcement in ice margin areas, which will increase the need for ice-capable ships in the Arctic (ibid).

Canada's northern communities have one of the fastest growing populations in the world; with a population growth of 16 percent per decade, increased demands on destination and regional, and intra-Arctic traffic will continue to grow (Gorman and Paterson, 2004). Economic development and exploration of Canada and the Arctic has and will continue to be heavily dependent upon a reliable transportation infrastructure (Canada-Transportation-Act-Review-Panel, 2001). In the light of climate change and the continual decrease of Arctic ice (Flato and Boer, 2001; Falkingham, 2000; Falkingham, 2004; Hupp and Brown, 2006), Canada's involvement and activity in the Arctic is anticipated to increase (Department-of-Foreign-Affairs-and-International-Trade-Canada, 2007) and with this will come an anticipated greater demand for an efficient and effective transportation network. It would seem rather unlikely that significant economic development in the Canadian

Arctic and the Arctic in general will come about without the involvement of icebreakers and ice strengthened cargo vessels. The question could be asked: would the economic development of the Canadian Arctic be farther ahead than its current state if Canada had an extended season, or even a year-round presence, for its icebreakers operating in the Arctic? From an economic development perspective, it would seem rational for a country to first put supporting infrastructure in place in order for business to follow, a case of commerce following the flag. Unfortunately, with respect to current Arctic development, the CCG icebreaking fleet is not equipped to operate on a year round basis in the Canadian Arctic (Brigham, 2007; Haydon, 2007; Robertson, 2007).

The history of icebreaking with respect to the development of Canada dates back to the early-middle 1800's with the building of the "Chief Justice Robinson" in 1842 (Canadian-Coast-Guard, 2001). Self-governance, the beginning of independence from the United Kingdom, in the Dominion of Canada came about with the British North American Act of 1867 which conferred the authority for the icebreaking activities on the federal government (ibid). Since then, responsibility for icebreakers and icebreaking has been added and the responsibility has been transferred to different federal government departments, with the most recent transfer being to the Minister of Fisheries and Ocean, via the Oceans Act, in 1997 (ibid).

In 1994 a study was conducted by Consulting and Audit Canada, on behalf of the Department of Fisheries and Oceans (DFO) and CCG, then a part of Transport Canada (TC), to seek feasible ways of improving their efficiency in delivering services to the Canadian public. The study initially reviewed seven options before concluding that the creation of a Crown Corporation was the alternative offering

the largest potential savings and was most acceptable to the fleet management community (Consulting-and-Audit-Canada, 1994). While the establishment of a Crown Corporation was decided upon it has yet to be implemented (ibid).

Briefing notes prepared for Fisheries Minister Loyola Hearn early in 2006 (Department-of-Fisheries-and-Oceans-Canada, 2006) stated that:

- The CCG is currently experiencing a funding gap of about CAD \$55M;
- The CCG fleet of vessels is deteriorating at a rapid rate and consequently the vessels are increasingly less reliable;
- The CCG fleet experience frequent breakdowns resulting in loss of programme time and are more costly to operate and maintain which contributes to overall CCG funding pressures.

The briefing notes go on to state that a 25-year fleet recapitalization plan has been developed to replace the ageing CCG fleet and that due to the urgent need to replace other types of vessels before the icebreakers, the replacement of the icebreaker fleet is planned to commence in 2017 and finish in 2032; the briefing notes state that it could take up to ten years to design and build an icebreaker capable of operating efficiently in winter Arctic conditions, and that it could cost Canadian taxpayers in excess of CAD \$1B. The 2007 Report of the Auditor General of Canada states that the useful life of an icebreaker is 30 years and that in light of the planned icebreaker replacement schedule noted above, the current fleet of icebreakers will be between 40 and 48 years old when they are replaced (Auditor-General, 2007).

Given the possibility of limited future CCG involvement in the Arctic, even though economic activity is forecast to increase significantly, it would be fair to assume that any deficiencies in the provision of services being offered by government

organizations would be provided for by private interest. Consequently, it seems appropriate to undertake research looking into the implications of private involvement into the delivery of government services traditionally undertaken by the CCG. In Canada, Public-Private Partnerships (PPPs) are seen as a new way in which to deliver infrastructure and the associated projects. This research will highlight that while Canada is making significant progress in establishing a stable and efficient market for PPPs, there is still much needed work to be done by both the public and private sectors in attracting much needed interest to the dynamic PPP marketplace. Private sector involvement in the delivery of icebreaking services can be found in Finland, Sweden, Russia, and the United States. Sweden and Russia have, or had in the case of Russia, arrangements where state owned icebreakers are being managed and crewed by private companies. Such privatization arrangements may be a possibility for Canada to follow in the event that the entry barrier of obtaining significant icebreaking infrastructure proves too much for the prevention of a monopolistic situation in which a change of asset ownership may not bring about the greatest gains to society.

1.3 Research Aim and Objectives

The overall aim of the research is to conduct a strategic situational analysis of the CCG services, principally Arctic icebreaking, and to investigate which services, in terms of effectiveness and efficiency, may be suitable for private involvement. Research objectives are:

- 1) To synthesize experts' perceptions of future marine activity in the Canadian Arctic;
- 2) To compare experts' perceptions of the CCG services, principally Arctic icebreaking, in terms of their ongoing effectiveness and efficiency;

- 3) To analyze contiguous systems (including Swedish, Finnish, United States, and Russian) of private involvement in their icebreaking services in terms of funding and operations;
- 4) To analyse Canada's position with respect to private involvement practices in its marine transportation sector;
- 5) To analyse the importance of specific background factors with respect to private involvement in the delivery of CCG icebreaking services in the Arctic;
- 6) To identify and evaluate different models of privatization and the forms they might take in relation to CCG services in the Arctic, principally Arctic icebreaking.

1.4 Methodology

Any claims to be put forward as a result of this research will need to be able to stand up to the rigours of both academic and political scrutiny. The research outcomes will need to prove its relevance to the situation(s) being observed and explored and any propositions to be put forward will need to show that they are justifiable and attainable. The object of study in this research is the CCG and its operations in the Canadian Arctic, more specifically, the levels of service being currently carried out of which icebreaking plays a significant role. In terms of research choice or design, this research exploits the potential benefits of adopting multiple methods, more specifically mixed-method research. It will use more than one data collection technique and analysis procedure. Quantitative and qualitative techniques and procedures will be used in combination as well as primary and secondary data. Such a research choice or design is advocated within business and management research; collecting data in more than one way helps ensure all of the relevant issues are covered even if their initial importance is not fully appreciated.

This research report commences with a review of the literature so as to help generate and refine the research ideas. The literature review is constituted in chapters two, three, and four. In chapter two, the review explores the future growth potential for Arctic shipping given the current global resurgence of interest in the Arctic. The approaches to privatization and PPPs in the marine sector are examined in chapter three. While privatization usually results in users paying for a service which was originally free or cost very little after subsidization from taxpayers, a PPP arrangement in infrastructure is a cooperative venture between government and private entities to develop or improve public-purpose infrastructure. A critique of the CCG and the services it provides is carried out in chapter four. In chapters five and six the conceptual frameworks and methodologies are dealt with respectively. Chapters seven, eight, and nine deal with the primary research undertaken, Phases I, II, and III respectively. In chapter seven the Delphi exercise, Phase I, is covered. Three rounds of Delphi involving Arctic stakeholders and subject matter experts were carried out to identify further, and seek agreement on, the issues surrounding private involvement in the delivery of CCG icebreaking services in the Arctic and on matters related to the research aim and objectives. In chapter eight, the results of the Delphi exercise are presented as the basis for Phase II, which involved in-depth and semi-structured interviews which were analyzed in accordance with grounded theory methodology in attempting to identify key concepts and develop relationships between them to form new hypotheses. In the grounded theory analysis, the theory generation involved a process of research in which concepts and hypotheses were not only drawn from the data but were also systematically worked out in relation to the data. Phase III is dealt with in chapter nine, the development of the Likert style survey which was used to test and quantitatively analyse the relationships and

hypotheses developed during the grounded theory work. In chapter ten, the discussion and concluding chapter, practical recommendations for interested stakeholders and proposals for future research based on the implications of the work undertaken here are provided.

In fulfilling the important requirement of knowledge contribution, this research is the first attempt to explore the scope for privatization of icebreaking services in the Canadian Arctic. It exploits a novel application of Strauss and Corbin's approach to grounded theory in the field of marine transportation in the Canadian Arctic. Further, it avails of a particular combination of multi-methods to investigate the potential for private involvement in marine transportation.

1.5 Summary

While there is little doubt that the development of the Arctic will require more icebreaking hardware than is currently available, there is much uncertainty surrounding how this much needed hardware will be procured and whether it is the responsibility of public or private interest. In attempting to fulfil the research aim and objectives, the primary research for the work undertaken here is conducted in three phases. A Delphi exercise is carried out in Phase I, grounded theory work in Phase II, and quantitative survey work in Phase III. However, before reporting on the primary research work a review of the literature and a rationale for the conceptual framework and methodology is provided. The following chapter explores the future growth potential for Arctic shipping in light of retreating sea ice and the current global resurgence of interest in the resources the Arctic has to offer.

Chapter 2 Future Growth in Arctic Shipping

2.1 Introduction

The aims of this chapter are to delineate the activity of marine transportation in the Arctic, with particular emphasis on the Canadian Arctic, from current day to the year 2050; and to also highlight on some of the considerations that need to be taken into account when projecting future transportation activity. It will consider the current level of shipping activity in relation to the current economic situation in the Canadian Arctic and will also consider the impact that future natural resource exploitation will have on shipping activity in the area. In addition, it will look at the impact of climate change and how it is affecting current shipping activity in the Canadian Arctic and how things may be different in the years leading up to 2050, when, according to some climate modelling scientists, the Arctic could have ice free summers by as early as 2050 if the current warming trend continues (Falkingham, 2000; Flato and Boer, 2001).

Excluding the day-to-day travel of the local inhabitants of the Canadian Arctic, the bulk of marine transportation activity in the Canadian Arctic is comprised of the annual re-supply of goods to the approximately 41, geographically distant and sparsely populated, coastal settlements located north of 60 degrees latitude (Mariport-Group, 2007). In addition, there is some through transit traffic and fishing activity in the region during the warmer and less formidable summer months.

2.2 Climate Change Influences

For centuries explorers have tried to find a route through the Arctic linking Europe and Asia. John Cabot proposed a NWP as early as 1490 and attempted to find it in 1496. Throughout the centuries various attempts were made at finding a NWP and

it was not until 1854 that Robert McClure proved, through his land and sea expeditions, the existence of such a passage (Library-and-Archives-Canada, 2004). It took another 51 years for the first ship transit of the NWP to be made by Roald Amundsen in 1905 (Pharand, 1984, 38).

Interest in the Arctic region, whether stemming from climate change or its abundance of natural resources, seems to be very much in the minds of many countries of the world today, many of which belong to the Arctic Council. As noted by Carnaghan and Goody,

“Other countries, including the United States, Russia, Denmark, Japan, and Norway, as well as the European Union, have expressed increasing interest in the region and differing claims in relation to international law” (Carnaghan and Goody, 2006, 2).

The Arctic Council is an intergovernmental forum aimed at addressing the common concerns and challenges faced by the Arctic governments and the people of the Arctic (Arctic-Council-Secretariat, 2004). It is comprised of: Canada, Denmark, Finland, Iceland, Norway, the Russian Federation, Sweden, and the United States of America. Of these eight countries only Finland and Sweden do not have coastlines bordering on the Arctic Ocean.

Throughout history, it would be fair to suggest that climate has played a considerable role in the activities of humans. At present, Canadian regions north of the Arctic Circle are far less developed than those regions south of the Arctic Circle. It would also be fair to suggest that an inhospitable climate has played a role in this lack of development (Nunavut-Tunngavik-Incorporated, 2006). However, given its retreating ice cover the Canadian Arctic may now, or soon, be viewed by some as a more congenial place to carry on business than it has been in the past (Haydon, 2007, 3).

Canada's Arctic is sparsely populated. Shown in Figure 1, the northernmost permanently inhabited settlement in Canada, and the world, is the Canadian Forces Station (CFS) Alert, located at the northeast end of Ellsemere Island (Department-of-National-Defence, 2006). Alert's geographical coordinates are approximately 82° 30' North and 062° 20' West. The population of approximately 70 individuals at CFS Alert is comprised exclusively of military personnel, civilian employees of the Department of National Defence (DND), and employees of the Department of the Environment. With respect to the re-supplying of goods to CFS Alert by marine mode, it can be anticipated that the weather window is small and environmental conditions will need to be taken into account. Alert's average daily temperature ranges from -33.4°C in February to +3.3°C in July, and has no sunlight for approximately half of the year (Environment-Canada, 2002). The closest settlement to CFS Alert is the Inuit settlement of Grise Fjord which is located approximately 725 km to the south and is located on the southern end of Ellsemere Island. Located on the west coast of Ellsemere Island, approximately halfway between CFS Alert and Grise Fjord, is the Environment Canadian weather station at Eureka.

Becker (2006) has shown that the Arctic regions of the world, including the Canadian Arctic, are undergoing climate change and that ice conditions in the summer season are becoming less severe in terms of the extent of the ice coverage. With respect to the melting permafrost and the potential for problems that this could create with road, rail, and airport infrastructure, there may be greater demands put on the marine transport sector. Such demand could come from the transporting of new infrastructure into the Arctic to replace that which has been made inoperable or destroyed by the melting permafrost. In addition, given the instability of the permafrost, more land based infrastructure may be located

offshore on floating platforms so as not to be affected by the melting permafrost.

Such possibilities could include:

- Floating oil storage tanks;
- Floating dry bulk storage tanks;
- Floating runways;
- Floating factory and processing facilities;
- Floating accommodations.

NASA data show that the area of Arctic perennial sea ice shrunk abruptly by 14 percent between 2004 and 2005 (Hupp and Brown, 2006). Consequently, it would be logical to assume that less ice should increase the ease and mobility for ships currently working in Arctic regions and also for those ships that may be contemplating future activity in the Arctic regions. Milder sea ice conditions in the higher Arctic latitudes may present new merchant shipping opportunities by way of the shorter distances available to Europe-Asia and East Coast North America-Asia traffic (Somanathan et al., 2007, 325). In certain modelled situations, use of Arctic routes would allow vessels to conduct more round trips per year from St. John's to Yokohama than from New York to Yokohama via the Panama canal, consequently lowering the required freight freight on Arctic routes (Somanathan et al., 2006). In terms of marine transportation, an increase in activity will most likely result in the start up of new business and increase business activity for others already established and catering to the marine transportation sector. As most often is the case, business attracts other business. The National Research Council (NRC) has noted that,

"As a result of a number of factors, including the dramatic ice margin retreat over recent years, economic activity appears to be moving northward" (National-Research-Council, 2005, 3).

In an attempt to increase Canada's presence in the Arctic, Canada's Prime Minister, Stephen Harper, has promised to build a deep water port in Nunavut (CBC-News, 2006b). It would be expected that the construction of this deep-water port and its associated services will boost economic activity in the region and consequently attract additional business activity.

With almost a quarter of a million kilometers of coastline, and presently claiming jurisdiction over almost 6,000,000 km² of adjoining ocean, Canada has one of the largest ocean domains in the world (Haydon, 2007, 4). Geographically Canada is the second largest country in the world, Russia being the largest, and covers an area of 9,970,610 km² (Stanford, 1992). As of 1 July 2005, Canada's population, rounded to the nearest hundred, was 32,270,500 giving the country a population density of approximately 3.23 persons per km². Shown in Figure 1, Canada's three northern territories, Yukon Territory, Northwest Territories, and Nunavut, are sparsely populated with populations of 31K, 43K and 30K respectively (Statistics-Canada, 2006). The three territories cover a total area of 3,921,739 km² and account for 41 percent of Canada's land mass but only 0.3 percent of the country's population (Statistics-Canada, 2006). However, as noted by Gorman and Paterson

"Northern Canadian native communities have the fastest rate of population growth in Canada and one of the fastest in the world increasing at a rate of 16 percent per decade so the demand on the northern searift will continue to grow into the future. The boost in searift requirements will increase with the expected increase in mineral, oil and gas exploration in the north over the coming decades" (Gorman and Paterson, 2004, A-6).

The Arctic Ocean has been referred to as the earth's last frontier. The anticipated continued reduction in the Arctic Ocean sea ice could see this ocean being utilized as a viable option for marine transportation linking Europe and Asia. In addition to

the melting polar ice, Boswell (2006) reports that oil, gas and diamond revenues are expected to steadily accrue in Northern Canada this century.

There appears to be consensus that the Canadian Arctic ice is melting. However, the rate of ice melt and what this holds in store for the short and long term future is a contentious matter (Birchall, 2006, iii). The annual extent of Arctic ice coverage is retreating at a notable rate and considering the predictions of Global Climate Models, it is estimated that the Canadian Arctic will experience nearly ice free summer seasons starting as early as 2050 but probably not before 2100 if the current warming trend continues (Falkingham, 2000; Flato and Boer, 2001; Falkingham, 2004); this timeframe is somewhat strengthened by others scientist working with the Canadian Centre for Climate Modelling and Analysis (CCCma) who forecast that the Arctic will have ice-free summers by 2060 (Walsh and Timlin, 2003, 80). However, Serreze et al. (2007) make worthy mention that the results of climate model simulations are scattered and therefore contribute to the uncertainty regarding rates of Arctic ice loss through the 21st century. This uncertainty is bolstered by the more recent research finding of Professor David Barber who estimates that the Arctic sea should experience ice free summers around 2015 (Séguin, 2008). With respect to marine transport and the setting up of schedules and shipping routes, an important phenomenon to note here is that while there are observed increases in the total amount of accumulated open water throughout the Eastern and Western Canadian Arctic regions, there is still great annual variability in the actual ice conditions.

Further, a lack of thinner first- year ice and consequently more open water, allows for the migration of thicker, multi-year, ice predominately found in the Western

Canadian Arctic into the NWP and the Eastern Canadian Arctic (Stewart et al., 2007).

Figure 1 Map of Canada



Source: *Political Divisions* [online]. Available from: http://atlas.nrcan.gc.ca/site/english/maps/reference/national/can_politicaireferencemap_image_view [Accessed 23 October 2006].

This multi-year ice has the potential to impede shipping as individually it will pose a hazard to navigation and collectively it could create choke points in some of the narrower channels in and around the NWP. Regardless of the exact date when the Arctic will experience ice free summers, the recent retreat of summer ice in the Arctic has resulted in an earlier start and later finish of the annual summer navigation season in the Canadian Arctic. Shipping activity in the Canadian Arctic has increased as a direct result of this expanded navigational season. As can be

seen in Table 1, fishing vessel, bulk carrier, and oil tanker traffic currently make up the majority of the increased shipping activity being experienced in the Canadian Arctic.

Table 1 2004 Canadian Flagged Arctic Vessel Traffic

Vessel Type	Number of Transits
Barge	1
Bulk Carrier	18
Canadian Coast Guard Vessel	1
Fishing Vessel	44
General Cargo Ship	11
Government Icebreaker	5
Offshore Fishing vessel (>24m)	1
Other	1
Passenger Vessel	4
Passenger/Cruise Ship	8
Research Vessel	2
RORO Cargo	3
Tanker	15
Tug	4
Tug-Barge	1
Total	119

Source: Adapted from Cunningham, E. (nagtegaal@shaw.ca) 3 October 2006. ArcticShipping Activity. E-mail to J. Parsons (jim.parsons@mi.mun.ca).

2.3 Resources and Shipping Potential

It is commonly known that the Canadian Arctic is rich in natural resources. In support of this statement, Indian and Northern Affairs Canada state that

"Canada's Northwest Territories, Nunavut, and Arctic offshore hold an estimated 33 percent of Canada's remaining conventionally recoverable resources of natural gas and 25 percent of the remaining recoverable light crude oil" (Indian-and-Northern-Affairs-Canada, 2006, 7).

On a global scale, Arctic regions including the North Slope of Alaska, the Mackenzie Valley Corridor, the Mackenzie Delta, and the Beaufort Sea are rich in oil and natural gas resources (Pandey, 2008). More specifically, the combined

Helca and Drake Point discoveries on Melville Island have gas reserves estimated at almost nine trillion cubic feet (Tcf) (Chan et al., 2005; Harris, 2006, 238). In addition, proven reserves for the Western Sverdrup Basin are 17.5 Tcf of gas and 1.9B barrels of oil (Chen et al., 2000; Harris, 2006). Ahlbrandt and McCabe (2002) report that the Arctic basins hold about 25 percent of the undiscovered petroleum resources in the world.

Chan et al. (2005), in their evaluation report on the economics of high Arctic gas development, evaluated several delivery options for the Melville Island reserves:

- Delivery as Liquefied Natural Gas (LNG) directly to North America's north eastern seaboard using barge mounted liquefaction facilities and a fleet of up to nine icebreaking LNG tankers;
- Delivery as LNG with transshipment in West Greenland using five Arctic class tankers and two conventional type tankers;
- Delivery as Compressed Natural Gas to a Mackenzie Corridor pipeline using up to a minimum of eleven Arctic class carriers;
- Delivery as Gas-To-Liquids (GTL) to North America's north eastern seaboard using three ice strengthened Suezmax tankers.

Given the increase in global consumption for both energy and finished products, it is likely that resource exploration, recovery, and shipping activities will expand into previously inaccessible areas (National-Research-Council, 2005, 24). As an example, construction of the CAD \$7.5 B proposed Mackenzie Valley natural gas pipeline will likely begin in 2008 with first gas shipping in 2012 (Black et al., 2006). However, there have been some delays with the commencement of construction for the pipeline which could now begin in 2011 with gas flowing by 2015

(Oil_and_Gas_Inquirer, 2008). The delays are connected with environmental impact studies and the local inhabitants.

With respect to tourism in the Canadian Arctic, cruise ship activity has steadily increased since 1984 and it is expected to do so, in increasing numbers, in the future (Stewart et al., 2007). Of the 27 cruise ship transits through the NWP between 1984 and 2004, 14 were made by icebreakers and thirteen were made by ice strengthened vessels (ibid). While no cruise ships transited the NWP in 2005, there were five cruise ship visits to Nunavut and Nunavik (Mariport-Group, 2007, 82). Recently, the company Cruise North Expeditions has been established and will commence tours of the NWP in 2009. The company is owned and operated by the Inuit of Northern Québec (Cruise-North, 2009). The Norwegian company Cruise North has recently acquired the vessel "Fram" to carry out cruises along the west coast of Greenland (Cruise-Norway, 2009). Given the close proximity to Canada, it is conceivable that this vessel may venture into Canadian Arctic waters in the future. Without icebreaker assistance or ice strengthened cruise ships, the intrusion of multi-year ice into the Eastern Canadian Arctic, along with the variability in the annual sea ice conditions noted earlier, will most likely complicate the advance planning of an itinerary which is a pivotal component of the cruise ship business.

With respect to fishing operations, Arctic fishing fleets have already begun to follow the fish stocks that migrate northward as the ice edge retreats (National-Research-Council, 2005, 24). Recently, several vessels belonging to Nunavut corporations have begun to fish shrimp and turbot in the Davis Strait region between Baffin Island and Greenland.

With respect to mining activity, the Canadian Arctic is currently one of the largest producers of diamonds in the world. Helping with this status are the mines at Jericho, Diavik, Ekati, and Snap Lake (Natural-Resources-Canada, 2008). There is also the Raglan nickel mine at Deception Bay which is expected to ship 150K tonnes per year through to 2015 (Mariport-Group, 2007), and the Voisey's Bay nickel mine in Labrador. In the near future, the Mary River iron ore project on Baffin Island is expected to ship about 12M tonnes per year. Gold mines and prospects at Baker Lake, Meliadine, High Lake, Hope Bay and Ulu are expected to influence Arctic shipping as is the Kiggavik uranium prospect (ibid).

2.4 Current and Future Shipping Activity

Profitable shipping companies constructing new tonnage will almost certainly have some form of forecast of the expected future demand for their new tonnage. Depending on the performance requirements of the vessel, building ice strengthened vessels capable of navigating in Arctic waters can take years to construct. With reference to the building of icebreakers for the Canadian Arctic, these vessels can cost as much as CAD \$500M and take up to 10 years to build (CBC-News, 2006a). Discussed further in Chapter 3, the Canadian government recently earmarked CAD \$750M for the design and construction of a new icebreaker.

Ship building is a very labour and capital intensive undertaking and there are few shipyards in the world specializing in the construction of vessels capable of both icebreaking and significant cargo transport; ships built purely for icebreaking have very limited cargo carrying capacity. Aker Finnyards in Helsinki, Finland is on the cutting edge of technology in building vessels capable of both icebreaking and cargo transport.

It is reported that several companies exploring extensive oil and gas fields in the Arctic regions have begun to charter the majority of existing icebreakers and ice-strengthened ships for the foreseeable future (National-Research-Council, 2005, 25). According to Mikko Niini of Aker Arctic Technology, Inc., many orders for double-acting tankers have been placed and the demand for such vessels that can break ice and transport cargo is expected to grow (ibid).

Any increase in activity in the Arctic will increase the necessity to respond to accidents and create a greater need for law enforcement in ice margin areas, which will increase the need for ice-capable ships in the Arctic (ibid). A recent incident off Barrow, Alaska during August 2008 saw three vessels stuck in ice approximately 60 miles north of Point Barrow. While the United States Coast Guard icebreaker "Healy" was dispatched to help the stricken vessels, it was 400 miles away and would have taken two days to get on scene (Wong, 2008). The stricken vessels managed to free themselves from the ice before the "Healy" arrived. This incident resulted in Alaskan Senator Lisa Murkowski calling on the White House to endorse construction of more United States icebreakers (Murkowski, 2008). Many nations meet their needs for icebreaking services by relying on non-military operators as viable alternatives as a result of gains in efficiency of operation and improved continuity of staffing for this specialized activity (National-Research-Council, 2005, 31).

With respect to Canada's infrastructure resources, some believe that Canada presently has insufficient resources to enforce its sovereignty in the Canadian Arctic while others are of the opinion that Canada's effort in enforcing its

sovereignty in the region is sufficient (Carnaghan and Goody, 2006). According to Mr. George Da Pont, the new Canadian Coast Guard commissioner,

"while the Canadian Coast Guard already has a major role in the Arctic, nothing has been decided on whether it will play a larger part in the future" (Binkley, 2006, 9).

In addition, Da Pont also goes on to suggest that neither the Russians nor the Canadians have the commercial infrastructure in place to support increased vessel traffic in their respective Arctic waters.

2.5 Ice Strengthened New Builds

The Russian icebreaker "50 Years of Victory", under construction since 1989, was launched in April 2007. Exploitation of oil and gas resources in Russia's Arctic, in addition to increased traffic along the Northern Sea Route, will continue to place demands on the Russian icebreaker fleet and reports indicate that Russia will need between six and ten nuclear-powered icebreakers in the next 20 years (NOVOSTI, 2007). In addition to the increased number of required icebreakers, reports indicate that Russia will also have to build 55 ice resistant tankers and storage tankers plus 20 ice-resistant gas carriers (SIKU-News, 2007). Russian oil major Rosneft has recently put its first ice strengthened tanker into service and plans to add two more ice strengthened vessels to its fleet in 2009 (Barents-Observer, 2008b).

While the United States has not made public any immediate plans to construct or acquire new ice breakers, an assessment of the United States polar icebreaker needs identified gaps in their ability to fulfil Coast Guard missions in the Arctic and to ensure access to ice covered waters independent of ice conditions (National-

Research-Council, 2007, 81). Unlike the United States, Canada has earmarked CAD \$750M to replace its oldest icebreaker in 2017.

As discussed further in Chapter 3, companies such as ConocoPhillips and others are actively engaged in the construction of ice strengthened tankers and bulk carriers. Russia's mining and metallurgy giant Norilsk Nickel is another such company with a fleet of Arctic class vessels enabling self sustainability in ice covered waters and consequently the cutting of costs associated with availing of expensive icebreaker services from the state-owned nuclear powered fleet (Barents-Observer, 2008a).

2.6 Considerations for Planning Future Activity

In terms of forecasting accuracy, it is most often observed that the closer the forecasted date or period is to the current day situation the more accurate the forecast will be. With respect to maritime transportation, a major reason for this may be due to the fact that in the short term, say a day or a week, most influential factors are relatively constant and difficult to change. However, in the long term, say years or decades, the same influential factors would not be considered constant and thus liable to change. As an example, if the price of coal dropped significantly below that of diesel, ships burning diesel could change from diesel to coal but it would take weeks or months in order to change out the ships main engine. With respect to how sea ice in the Canadian Arctic will present itself in the future there are considerable variations in model applications and outcomes put forward by those studying such activity (Zhang et al., 1998). Needless to say, if the Federal Government of Canada knew exactly how the future ice conditions would present itself, the task of determining resource requirements and allocation in

terms of CCG icebreakers would be made easy. Stated simply, without ice, there would be no need for icebreakers.

With respect to forecasting distant transportation requirements, McDaniel (1972) notes three factors that need to be considered and taken into account:

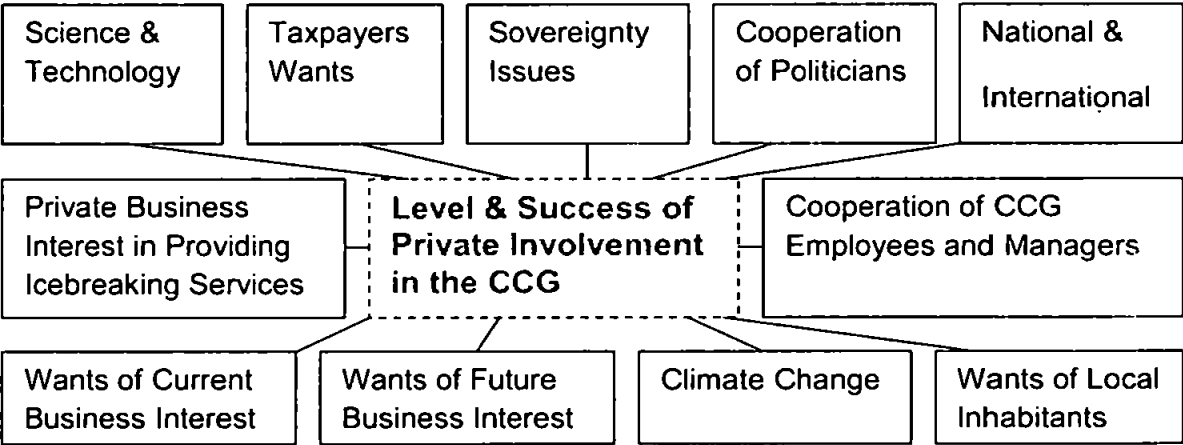
- The process of technical innovation;
- The general relationship among factors influencing change;
- That forecasting can only be undertaken in the context of transportation history.

With respect to technical innovation, if merchant cargo vessels can be economically built with the capability of Arctic Class icebreakers, whilst maintaining their respectful cargo carrying capacity, then the need for vessels constructed solely for the purpose of breaking ice in assisting other vessels would be rendered obsolete. Aker Finnyards Inc. located in Finland is on the cutting edge of technology with respect to building icebreaking cargo vessels. One of their more recent new builds was the Arctic container vessel "MS Norilskiy Nickel" which was delivered on 11 April 2006 to the Russian mining and metallurgical company Norilsk Nickel. The vessel is a prototype based on the double-acting ship concept developed by Aker Yards, capable of breaking 1.5 m ice and can navigate the ice-bound Arctic Ocean throughout the year without the assistance of ice breakers (Aker-Yards, 2006b).

In light of McDaniel's three factors noted above, it would be fair to suggest that Canadian Federal Government plans for CCG icebreaking services in the Arctic should heavily weight the general relationship among factors influencing change. Included in this would be any involvement of the private sector in terms of altering

the current role of the CCG in the region. Given that transportation is most often a means to an end, a complete forecast will need to give attention to each of the elements or factors influencing the process under consideration (McDaniel, 1972, 369). The framework shown in Figure 2 highlights many of the factors needing to be taken into account in ascertaining an appropriate level of future private involvement with respect to the role of the CCG in providing icebreaking services in the Canada Arctic.

Figure 2 Factors Influencing the Level and Success of Private Involvement in the CCG



Source: Author.

In light of the above, it would be deemed essential that in order to establish an economically viable maritime industry, as with most all industries, an integrated system of planning, development, and operations will need to be implemented (Moore and Pomrehn, 1971, 133).

2.7 Conclusion

While the exact date as to when the Canadian Arctic will experience ice free summers is uncertain, what is certain is that Arctic sea ice is retreating and the shipping seasons are becoming longer. However, seasonal variability of sea ice conditions will continue to impede Arctic navigation. Consequently, icebreakers and ice strengthened vessels will be required in the exploitation and safe transport

of the abundant supply of the Arctic's natural resources. While Russia and some private companies have commenced with the building of new icebreakers and ice strengthened vessels, the United States and Canada appear to lag behind. The CCG is unable to operate on a year round basis in the Canadian Arctic and the Canadian Government does not plan on replacing its oldest icebreaker until 2017. Regardless, some Canadian mining companies are planning to operate year round in the Arctic in the very near future. Therefore, these companies will need to be self sufficient in terms of ice breaking capabilities and thus will need to rely on private industry involvement when it comes to icebreaking services. The next chapter will report on precedents and best practice for private involvement, considering shifts in economies from public to private sectors and examples of countries that are availing themselves of the private sector in the provision of icebreaking services. Among other things, it will examine the administration of transportation and Arctic development in Canada.

Chapter 3 Approaches to Privatization and P3s in the Marine Sector

3.1 Introduction

As discussed in Chapter two, the development of the Arctic is expected to increase significantly in the near future. This rejuvenated interest in developing the Arctic is being spurred on by climate change and the recent retreat of Arctic sea ice, the growing population of the Arctic's indigenous peoples, and the global demand for minerals, oil, gas, fish and tourism. While the Canadian government appears to be interested in the future development of the Arctic, it is expected, as has been experienced in the past, that the private sector will be instrumental in leading the way. While it is anticipated that there will be an increased demand for icebreaking capability during the future development of the Arctic, Canada's fleet of Arctic icebreakers is old, inadequate and in desperate need of modernization (Auditor-General, 2007). The anticipated supply of icebreaking capability may have to be provided by the private sector.

In this chapter we look at one of Canada's earlier engagements of the private sector in helping with the provision of government marine services involving ice. We identify and look at the various views of shifting economies from public to private sectors and to delineate the areas of current and potential use of PPPs in Canada. We examine some of the barriers to the provision of icebreaking services and highlight examples of countries that are availing of the private sector in the provision of icebreaking services. In addition, we consider Canada's dependency on dependable transportation while at the same time identifying that little attention appears to be given to transportation technology research. We conclude by looking at government accountability, private versus public sector efficiency, and the administration of transportation and Arctic development in Canada.

3.2 The History of and Responsibility for Icebreaking in Canada

Self-governance, the beginning of independence from the United Kingdom, in the Dominion of Canada came about with the British North American Act of 1867 and with the 1867 Act came the authority for the icebreaking activities of the federal government (Canadian-Coast-Guard, 2001). Over the years, responsibility for icebreakers and icebreaking have been added and the responsibility has been transferred to different federal government departments with the most recent transfer being to the Minister of Fisheries and Ocean, via the Oceans Act, in 1997 (ibid). Canada's history in its geographically vast Arctic includes the establishment during the 1920's of regular patrols during the short Arctic summer season, the opening of the port of Churchill during the 1930's, and the re-supply of the Distant Early Warning Line in 1957(ibid).

As alluded to above, the history of icebreaking with respect to the development of Canada dates back to the early/middle 1800's with the building of the vessel "Chief Justice Robinson" in 1842 (ibid). The vessel was a commercially owned passenger steamer designed and used for icebreaking in the Great Lakes. Subsequently, in 1855 the government decided they had a role to play in the provision of services to shipping off the Dominion's east coast and from 1855 to 1859 thereby funded two vessels, the "Queen Victoria" and the "Napoleon III", to tow sailing ships between the ice floes whilst they were engaged in salvage work and supplying lighthouses (ibid). Although funded by the government, the two vessels were operated by a private contractor in return for fees of service until 1859 when the government took over operation of the two vessels as the user pay idea failed (ibid). In more recent times, and as discussed in further detail in Chapter four, a study was conducted in 1994 by Consulting and Audit Canada to seek feasible ways of improving the efficiency of DFO and TC in delivering services to the Canadian public. The study,

conducted on behalf of DFO and the CCG, then a part of TC, concluded that the creation of a crown corporation was the alternative offering the largest potential savings and most acceptable to the fleet management community (Consulting-and-Audit-Canada, 1994, 53). To date, this has not been done. The report also concluded that with respect to the option of privatising the ownership and operation of the fleet, which according to the report would take a long time to implement, it would first be necessary to establish a crown corporation to operate the combined fleet (ibid, 13).

3.3 The Public-Private Continuum

Privatization is a complex social reality, more of a concept than a definable undertaking or process. The word itself is said to have been coined by Drucker in the late 1960's (Chapman, 1990). While widely practised in varying forms during the reign of Thatcher and Reagan during the 1980's, in the UK and USA respectively, Punnett (1994, 375) informs that in the UK prior to the Conservative government of 1979 this course of government action was referred to as 'denationalization'. The UK and USA are widely documented as the forerunners of privatization. However, in 1974 Chile, in reaction to the socialist government, developed probably the most extensive privatization program in the world (Sader, 1993, 7). Deemed by many as the Father of Economics, Adam Smith helps to explain the concept and offers one of the earliest rationales for privatization (Skinner, 1974),

"In every great monarchy of Europe the sale of Crown lands would produce a very large sum of money, which, if applied to the payment of public debts, would deliver from mortgage much greater revenues than any which those lands have ever afforded the Crown"(Smith, 1776).

As alluded to in Smith's statement above, the keys elements of privatization are seen as the introduction and promotion of competition, and the transfer of

ownership for the production and procurement of goods and services; in the UK privatization is defined as the transfer of government-owned industries to the private sector while in the USA it often means the contracting out of government provided services to private firms (Beesley and Littlechild, 1983; Peacock, 1984; Posner, 1984; Dunleavy, 1986; Pirie, 1988).

The act of privatization pursued in the UK during the 1980's subsequently attracted significant global attention (Jones, 1991; Frydman and Rapaczynski, 1992; Poznanski, 1992; Ghosh, 1993; Steiger, 1995). While there appear to be many proponents with positive views towards privatization, there are those who argue that mass privatization is not a feasible option for many transitional economies or in situations where profitable public firms exist (Iyer, 1988; Anderson et al., 1997; Majumdar and Ahuja, 1997). Regardless, on a global scale it is reported that more than 15K state owned enterprises were privatized between 1980 and 1992 (Sader, 1993; McFetridge, 1997, 9). While 1995 was reported as a record year for privatizations, with state sell-offs estimated at US\$ 73B in at least 45 countries (Economist, 1996, 5) this record was more than doubled in 1997 with US\$ 157B raised from global privatization (Sader, 1993; Tynan, 2003).

While Federalism conjures up images of the welfare state carrying out the duties that proved impossible for the private sector to undertake, reprivatisation is fronted as the redoing of that which is now quite capable of being done by the private sector rather than federal, provincial or municipal governments (Drucker, 1969, 234). With respect to this redoing, it appears that advances in technology deserve the credit for reforming the transportation sector, technology has altered the supply side of the transport market (Estache and Rus, 2000, 7). Contemporary writers highlight privatization, unashamedly a policy movement initiated from political

origins and objectives, as a dominant feature of the 1980's and associate it heavily with neoconservative business elites and political leaders such as Thatcher and Reagan (Haque, 1996, 513; Hodge, 2000). Generally speaking, privatization usually results in users paying for a service which was originally free or cost very little after subsidization from taxpayers. Vickers and Yarrow (1988, 45) stress the difference between privatization and liberalization, characterising privatization as the transfer of ownership and liberalization as the unleashing of competitive forces. The word 'privatization' is comparatively new and was scarcely used in political or economic literature prior to 1979 (Pirie, 1998, 3). Despite its youth, the

Table 2 Definition of Privatization Activities

Group	Activities
Denationalization	Selling the whole enterprise (i.e., divestment) Selling complete parts of the enterprise Selling a portion of the enterprise Selling to the workforce "Giving" to the public "Giving" to the workforce Liquidation
Load Shedding	Encouraging exit from state provision Withdrawal Encouraging alternative institutions
Privatization of production	Contracting to the private sector Franchising Payment of grants to private suppliers Distribution of vouchers to private consumers Diluting the public sector Subsidizing private sector arrangements that undermine public sector provision
Deregulation/liberalization	Right to private substitution/competition Curbing state powers Repealing monopolies Encouraging small scale trials Buying out existing interest groups Deregulation via voluntary associations
Privatization of finance	Charging for previously non-priced goods and services (i.e., user pays) Voluntary provision of services

Source: (Hodge, 2000, 15).

concept of privatization conjures up a wide range of views, collaborations, and associated activities (Estache and Rus, 2000). With respect to activities, (Hodge, 2000, 15) provides various definitions of privatization activities as shown in Table 2. With respect to the process of transferring from public to private economy, Pirie (1998) examines 21 methods, many of which are similar to Hodge's activities, of dismantling the public sector and dealing with the issues put forward by the various interest groups, see Table 3.

Table 3 Methods of Dismantling the Public Sector

1)	Selling the whole by public share issue
2)	Selling a proportion of the whole operation
3)	Selling parts to private buyers
4)	Selling to workforce or management
5)	Giving to the workforce
6)	Contracting out the service to private business
7)	Diluting the public sector
8)	Buying out existing interest groups
9)	Charging for the service
10)	Setting up counter-groups
11)	Deregulation via private associations
12)	Encouraging alternate institutions
13)	Making small-scale trials
14)	Repealing monopolies to let competition grow
15)	Encouraging exit from state provision
16)	Using vouchers
17)	Admitting demand pressures
18)	Curbing state powers
19)	Applying closure proceedings
20)	Withdrawal from the activity
21)	The right to private substitution

Source: (Pirie, 1998).

Closer to the focus of this research, TC defines commercialization as the introduction of market discipline and business principles into traditional government activity; made possible through government agencies, of which the CCG became one on 1 April 2005, not-for-profit organizations, PPPs, crown corporations, and privatization (Transport-Canada, 2006).

The public-private continuum spans from fully public to fully private. Payson and Steckler (1996, 40) identify nine possible combinations in this continuum. They

are, commencing from the fully private side, operation and maintenance contract, super-turnkey development, wraparound addition, lease-develop-operate, temporary privatization, buy-build-operate, build-transfer-operate, build-operate-transfer, build-own-operate. They are described in detail in Table 4.

Table 4 Possible Combination of the Public-Private Continuum

1)	<i>Operation and Maintenance Contract (O&M)</i> - a public facility owned by the government is operated under contract by a private partner
2)	<i>Super-Turnkey Development</i> – the public sector defines the performance objectives of a facility which will subsequently be designed and constructed by a private partner who, upon completion, will be reimbursed by the public for the construction and will then commence operations of the facility under contract
3)	<i>Wraparound Addition</i> – the financing and construction of an addition to an existing public facility is carried out by a private developer who then operates both facilities for a specified time period or until the investment plus a reasonable return are made
4)	<i>Lease-Develop-Operate (LDO)</i> – in consideration for agreeing to invest in the improvements of an existing facility, a private developer is granted a long-term lease to operate and expand the facility until recovery of the investment plus a reasonable return over the term of the lease is made
5)	<i>Temporary Privatization</i> – in consideration for the renovation or expansion of an existing public facility by a private partner, the facility is transferred to the private partner who then owns and operates the facility for a specified time period or until the investment plus a reasonable return are made
6)	<i>Buy-Build-Operate (BBO)</i> – in consideration for renovating or expanding an existing public facility, the facility is transferred to a private partner who then owns and operates the facility in perpetuity
7)	<i>Build-Transfer-Operate (BTO)</i> – upon completion of a facility financed and built by a private developer, ownership of the facility is legally transferred back to the sponsoring government who in turn lease it back to the developer under a long-term lease during which the developer operates the facility and has the opportunity to recover its investment and a reasonable return through user fees and commercial enterprises
8)	<i>Build-Operate-Transfer (BOT)</i> – under a franchise agreement, a private developer will finance, build, operate, and collect user fees on a facility for a specified time period, after which ownership of the facility is transferred to the public sector
9)	<i>Build Own Operate (BOO)</i> – subject to possible regulatory constraints, a private developer will finance, build, own, and operate a facility in perpetuity

Source: (Payson and Steckler, 1996, 40).

3. 4 Current and Potential Public-Private Partnerships in Canada

Landry (1993, 344) informs that since 1984, the Federal Government of Canada sold 20 crown corporations and reduced employment in crown corporations by nearly 80K through various forms of privatization, restructuring, and productivity gains. With respect to Canadian private involvement in the provision of port and seaway services, as of 31 December 2000, TC had in various ways terminated or relinquished its interest in 382 of the 542 port facilities under its control (Canada-Transportation-Act-Review-Panel, 2001).

The St. Lawrence Seaway, gateway to the heartland of Canada, serves 15 international ports and some 50 regional ports in Canada and the United States. And, while Canada and the United States share management of the Seaway, the Canadian government transferred management and operations of its portion of the Seaway to a private-sector management group, the not-for-profit St. Lawrence Seaway Management Corporation, in October 1998 (Canada-Transportation-Act-Review-Panel, 2001; Great-Lakes-St.-Lawrence-Seaway-System, 2007).

A more recent Canadian example of a public-private partnership is that of RADARSAT-2; providing improved surveillance and monitoring capabilities that will provide critical data for the active management of natural resources and monitoring of the Arctic environment (Industry-Canada, 2007). The nature of this high technology partnership is indicative of what Landry (1993, 344) describes as quasi-public organizations engaged in applied industrial research and technology transfer of which governments have become involved owing to the assumption that market incentives were not satisfying the needs of the economy. An example of a successful PPP in the oil and gas industry is the Sierra Yoyo Desan Road

project in northern British Columbia (Van-Horne-Institute, 2007). In helping define PPPs, Payson and Steckler state that

“Public-private partnerships in infrastructure are cooperative ventures between governments and private entities to develop or improve public-purpose infrastructure. The infrastructure may be transportation-related.....,utility-related....., or related to one of many other government functions.....” (Payson and Steckler, 1996, 33).

In Canada, PPPs are seen as a new way in which to deliver infrastructure and the associated projects. A 2006 survey conducted by Ernst & Young Orenda Corporate Finance Inc., which interviewed 16 of Canada's leading decision makers in the PPP market, found that while Canada is making significant progress in establishing a stable and efficient market for PPPs, there is still much needed work to be done by both the public and private sectors in attracting much needed interest to the dynamic PPP marketplace (Philpotts, 2006). Going forward, it is expected that the government will increase the opportunity for such private involvement and in addition they will, with the help of the private sector, make availing of PPPs more desirable by standardizing the processes and documentation requirements.

According to Payson and Steckler (1996), the manner in which the public and private sectors share risks, responsibilities, and rewards helps define a PPP. As with most types of successful partnerships, in fostering a successful PPP, it will be paramount for the strengths of both entities to complement each other. The responsibilities attached to most public-private projects include:

- Project initiation and planning;
- Design;
- Financing;
- Construction;

- Ownership;
- Operation;
- Revenue collection.

The legal, political, and financial environments along with the unique circumstances of the project, such as the natural environmental challenges, will help dictate the appropriate public-private structure for the project. From a financial perspective, evolving financial models may make it easier to avail of foreign investment for the development of Arctic infrastructure (Van-Horne-Institute, 2007).

3.5 Barriers to Entry in the Icebreaker Sector

The more obvious barriers to entry with respect to the building of Arctic class icebreakers include:

- Significant financial cost;
- Skilled and unskilled labour requirements;
- Years required to build;
- Technology requirements needed to build;
- International classification requirements that need to be agreed upon and met.

As of February 2006 there were 50 Polar and Baltic class icebreakers in the world fleet (National-Research-Council, 2007, 59). With respect to the outright buying of a ship, especially an Arctic icebreaker, the undertaking is capital intensive and may require years to plan, design and construct. Icebreaker models vary and could take up to CAD \$500M and ten years to build (CBC-News, 2006a). The CCG icebreaker "Louis S. St-Laurent", built in 1969, was completed at a cost of

CAD \$80M at the time (Priestley, 2006). The Federal Government of Canada has earmarked CAD \$720M to design and build an icebreaker in Canada to replace the "Louis S. St-Laurent" in 2017. The amount of CAD \$720M was seen as a starting amount to open the door with Treasury Board and it was hoped that there would be more funding to follow (Jackson, 2008). This new icebreaker, to be named the "John G. Diefenbaker", is expected to take eight to ten years to design and build (Office-of-the-Prime-Minister, 2008) and will not be capable of year-round navigation in the Canadian Arctic (Jackson, 2008). The National Research Council in its assessment of polar icebreaker needs for the United States expected that the entire process of getting new icebreakers into service would take eight to ten years (National-Research-Council, 2007, 9).

With respect to decision making regarding the ideal model type, the technology to incorporate and where best to build an icebreaker, the procurement process for a private company may be shorter than that of a government agency. There will be less uncertainty as to who will be able to procure faster if, as may or may not be the case with Canada, the country does not have the ability to build ships of the desired type but there is public pressure to build locally regardless of the shipbuilding technology and capabilities outside of the domicile country. A private company will most likely be able to have an icebreaker built wherever it sees fit. In her 2007 Status Report, the Auditor General of Canada stated concerns pertaining to the CCG vessel replacement plan. The plan, formally referred to as Fleet Renewal Plan 2006 to 2030, was outdated and unrealistic in that it called for the building of ten vessels by 31 March 2011 when a minimum lead time of five years would be required to procure the vessels. Also, the plan made no mention of Arctic icebreakers but rather to offshore fishery research and patrol vessels (Auditor-General, 2007). In his case study on PPPs in Canada, Poschmann (2003) noted

that even when the managerial and technical issues of a project are similar the publically financed infrastructure project will take much longer to develop and complete. Table 5 below shows that the six CCG Arctic icebreakers currently in service were built in four different Canadian shipyards. While the rationale for building in four shipyards may have been political, one could postulate that yard efficiency would most likely have been improved had the icebreakers been built in fewer shipyards.

Table 5 Builders of the CCG Arctic Icebreaker Fleet

Name of Vessel	Built	Builder
Sir Wilfrid Laurier	1986	Port Weller Drydock, St. Catherines
Des Groseillers	1982	Port Weller Drydock, St. Catharines
Pierre Radisson	1978	Burrard Dry Docks, Vancouver
Louis S. St-Laurent	1969	Canadian Vickers, Montreal
Terry Fox	1983	Burrard Yarrows, Vancouver
Henry Larson	1987	Versatile Pacific Shipyards, Vancouver

Source: Author. Information provided by Singh, L. (singhl@dfo-mpo.gc.ca) 29 March 2006. CCG Arctic Budget. E-mail to J. Parsons (jim.parsons@mi.mun.ca).

Politics aside, it is not certain if Canada, given that it has not built an icebreaker since 1987 could be as competitive as the Finnish or Russian shipyards in the planning, designing and construction of an Arctic class icebreaker. Icebreaking technology is dynamic and constantly improving. Canada's latest involvement, of any significance, in shipyard work with icebreakers was the 2002 conversion of the de-commissioned "Sir John Franklin" into research vessel "Amundsen" and the rebuilding and re-commissioning of the "Louis S. St-Laurent" in 1993. During late 2006/early 2007 there were six icebreakers under construction in the world's shipyards, three in Finland and three in Russia (National-Research-Council, 2007, 62). With respect to icebreaking technology and icebreaker construction, the

Finnish company Aker Arctic Technology Inc. is currently one of the most active globally and has ties to over 70 years of history in icebreaker construction (Aker-Yards, 2006a; Hammer, 2006). With respect to the total production of icebreakers, Finland has built more than any other country (Jones, 2008, 55).

3.6 Using Competition to Overcome the Barrier of Capital Cost

Vickers and Yarrow (1986, 333) identify a way around the crucial entry barrier of huge capital cost when they state that privatization via franchising or contracting out, involving competitive tendering, has a greater impact on market structure than the outright sale of a public enterprise. This would be especially true in the case where public monopoly assets are sold only to one private company, i.e. the CCG icebreakers are sold to one private organization. Haarde (2008), having experienced situations where privatization went wrong, cautions against the privatization of natural monopolies. Vickers and Yarrow (1988) note that in the case of natural monopoly conditions, or where competition is impossible or undesirable and major externalities exist, it is possible to argue that public management may be better suited than private management in terms of doing a better job at economic efficiency. To the extent where regulators are unable to impose price caps on uncontrolled monopoly operators in the private sector, Estache and Rus (2000) would appear to support this stance; operators are considered inefficient when they intentionally keep the price much higher than the cost of providing services to a new user. Notwithstanding the above, McDavid and Schick (1987) in their study on municipality waste collection arrangements, one having periodic competition and the other a permanent public monopoly, in the Greater Vancouver area found that competitive pressure was a critical incentive to improve efficiency. Poschmann (2003, 4) also notes the important role that competition plays in successfully bringing internal functions to the outside market.

Without competition there is little incentive in the short term to cut cost and innovate (Pirie, 1998, 34). However, Poschmann (2003, 3) suggests that in the long term managers are not without incentives, since the likelihood of a poorly performing project, coming in over budget and behind schedule, may attract public attention and affect elections and subsequently the manager in charge of that project. However, on the premise that the general public can often soon forget, the refuge for the public manager may be that the project will take several months or years to develop and complete, during which time much could be purported as having influenced the project's poor performance.

In looking closer at competition and the market, Estache and Rus (2000) make clear distinctions between competition in the market and competition for the market, and infrastructure and superstructure. Competition in the market is portrayed as being analogous to the contestable market described above, in which there is free entry and exit, and can be accomplished by the vertical and horizontal unbundling and separation of infrastructure and superstructure. Such competition is considered effective in ensuring the long-run sustainability of efficiency gains. In light of this research, infrastructure may be viewed as a safe route through ice infested waters and superstructure being the icebreaker that created the route. Competition for the market has to be created by governments through an auction like process which results in potential monopolist competing against each other for the right to be the sole service provider. The aim of the auction is to create the same efficiencies associated inside a competitive market and to ensure that these efficiencies are passed on to the users. In terms of efficiency, Estache and Rus (ibid, 28) note the difference between static and dynamic efficiency. Static efficiency is characterized as minimizing costs and allocating resources for the

greatest societal yield, and dynamic efficiency aims for the right amount of innovation and investment to ensure that an operator can meet future demand.

3.7 Self Sufficiency of the Private Sector in Icebreaking Capability

Apart from dedicated icebreakers, merchant cargo vessels are also capable of being built to operate in ice covered waters. This was evident with the self sufficient icebreaking approach (i.e. Canadian Coast Guard icebreakers were not relied upon to assist in vessel operations) taken by Canadian Marine Drilling (Canmar), a wholly owned subsidiary of Dome Petroleum Ltd., when carrying out oil exploration in the Beaufort Sea during the 1980s. More recently in 2006, Fednav had the "Umiak 1", a 31,500 DWT icebreaking bulk carrier built in Japan (Fednav, 2007). The "Umiak 1", see Appendix 1, is the most powerful vessel ever built of its kind with approximately 29,500 HP and is only slightly less powerful than Canada's largest icebreaker the "Louis S. St-Laurent" with approximately 31,500 HP. The "Umiak 1" was built to operate in the Canadian Arctic without the assistance of a Canadian Coast Guard icebreaker.

In adding to this self sufficiency trend of operating independently of icebreaker assistance in ice covered waters to facilitate oil shipments from its Varandey project in Russia, ConocoPhillips have recently had built in Korea, three of the world's largest icebreaking oil tankers, see Appendix 1, at 92,000 tons displacement, and have also had built in Singapore two icebreaking support vessels, see Appendix 1, to assist with the Varandey project oil tankers (Noble, 2008). The Russian shipping company Norilsk Nickel is another example of self sufficiency in ice covered waters. The company expects to have five icebreaking cargo vessels in its fleet by 2009; aiming to cut shipping cost up to 30 percent by

securing independence from Russia's nuclear powered icebreakers (Barents-Observer, 2008a).

3.8 Private Involvement in the Provision of Icebreaking Services Globally

Drucker (1969), believing that governments were better suited for making decisions than they were at executing them, contended that decision making in public policy ought to be separated from the actual service provision which ought to be left to private interest. With respect to the challenges facing the ongoing global transformation of the transport sector, Estache and Rus (2000) see the new role of governments as regulators to be much tougher than attracting private sector interest. This relatively recent attention given to the private sector in the provision of public services may be buttressed given the modern advances in economic theory, the technological advances in many industries, and that the conditions of demand may have changed (Vickers and Yarrow, 1988). At a more microeconomic level, within private organizations the operation departments are almost always separated from the senior management; if one is busy doing then there is little or no time to think about tactical or strategic planning. As alluded to earlier, in any case where the government does decide to partner with private industry in a PPP arrangement, it is imperative that the rewards commensurate with the risks, that the arrangement be made vividly discernable to the public, and that contracts properly assign responsibilities and align incentives (Poschmann, 2003). This is also critically important in other situations of private sector involvement in the delivery of services that were exclusively provided for by government. In taking a closer look at contracts, and how best to design them so as to assist with the appropriate regulation of transport infrastructure, superstructure, and services, Estache and Rus (2000) provide details with respect

to the minimum requirement of contracts and identify the following as necessary elements that will need to be addressed:

- Description of the specific activity covered by the contractual agreement;
- Exclusivity;
- Asset ownership and valuation;
- Duration;
- Investment and other obligations;
- Revenue, tariffs, and regulatory regime;
- Control and sanctions;
- Renegotiations;
- Termination conditions.

Sweden and Russia have, or had in the case of Russia, arrangements where state owned icebreakers are being managed and crewed by private companies. Such privatization arrangements may be a possibility for Canada to follow in the event that the entry barrier of obtaining significant icebreaking infrastructure proves too much for the prevention of a monopolistic situation in which a change of asset ownership may not bring about the greatest gains to society. In consideration of barriers to entry which may allow for a natural monopoly, as may be possible in the situation of an outright sale of CCG icebreaker assets, Yarrow (1986, 331) warns that a natural monopolist in vigorous pursuit of profit may engage in anti-competitive practices that may not be in the greater interest of the public, the Canadian taxpayer in this case.

In the privatization arrangement involving icebreakers in Sweden, there are eight icebreakers involved. Through email communication with Mr. Mats Anderson (2007), Head of Ship Management with the Swedish Maritime Administration

(SMA), it is understood that five of the icebreakers are owned by the SMA and three by a private company, Viking Supply Ships AS. with which the SMA has a long-term charter party. A private Norwegian company, Oriental Ship Management out of its office in Gothenburg, Sweden is responsible for the supply of full technical and personnel management to the five icebreakers owned by the SMA (Anderson, 2007). Viking Supply Ships AS. is responsible for and undertakes the crewing and management of the three icebreakers it has on long-term charter to the SMA (Gullne, 2007).

In the case of Finland, the Finnish Maritime Administration (FMA) is responsible for, among other maritime matters, the development of Finland's icebreaking policy. While the policy is developed by the FMA, taking into account the requirements of its clients, the actual icebreaking services are procured from the Finnish state-owned enterprise, Finstaship, or other private companies (Finnish-Maritime-Administration, 2008). The FMA is also tasked with the gradual opening up of icebreaking services to competition from the private sector. With respect to financing, the FMA finances its services for merchant shipping through user fees in the form of fairway fees and finances the delivery of public services from allotted government budgets. With respect to Finstaship, this is a state-owned enterprise created in 2004 with, according to their 2005 annual report, valid contracts in place until the end of 2006 with the FMA (Mustamaki, 2005). Of particular interest is the fact that during the 2005-2006 icebreaking season the Finstaship icebreaker fleet was assisted by two foreign icebreakers, one from Sweden and one from Norway. The oldest vessel in Finstaship's fleet is the icebreaker "Voima", built in 1954, and the newest is the multipurpose icebreaker "Botnica", see Appendix 1, built in 1998. After 2006 the FMA incorporated competitive bidding in the procurement of icebreaking services. Although competitive bidding has been allowed for, it

appears that for now there is little in the way of serious competition for Finstaship since they were able to secure a contract with the FMA for the delivery of icebreaking services during the 2006-2007 icebreaking season and with it the option to extend the contract for the 2007-2008 icebreaking season (Mustamaki, 2006).

In the case of Russia the Murmansk Shipping Company (MSC) is a joint stock company (JSC) with joint ownership and is the successor of the state enterprise MSC founded in 1967 which was formerly the Murmansk State Sea Dry-cargo and Passenger Shipping Company founded in 1939. Included in the company fleet are the vessels belonging to JSC Northern Shipping Company and JSC Northern River Shipping Lines. Since 1994 the MSC, 25.5 percent owned by the Russian state, operated and managed a fleet of eight, state-owned, nuclear and diesel powered icebreakers (Khvochtinsky, 1997; RusNavy, 2008). On account of financial reasons, the MSC found itself unable to afford repairs or nuclear fuel for the icebreakers under its management. Consequently, in December 1998 Lukoil, the second largest oil company in Russia, bought MSC and as of October 2000, owned 55 percent of its shares (Nuclear-Threat-Initiative, 2002). On 27 August 2008 Atomflot, situated inside of the Russian Nuclear State Corporation Rosatom, took over the responsibility of the nuclear icebreaker fleet from the MSC (NOVOSTI, 2008; Nuclear.Ru, 2008). The reasons for the change in the management and operation of the nuclear icebreaker fleet were put forward as economic mismanagement to the disadvantage of Russian state interest, and that it was necessary for the assessment of the current fleet so as to help determine its development perspectives with the aim of strengthening Russia's position in the Arctic and along the Northern Sea Route (Barents+Observer, 2008; RusNavy, 2008). Russia sees the construction of a fleet of new generation nuclear

icebreakers, the first of three or four to be delivered by 2015, to be pivotal to its transportation and infrastructure programme. Contrary to the accusation of economic mismanagement, the MSC contended that federal authorities failed to invest in the fleet and consequently they were left responsible for all of the maintenance cost which they helped to pay for by using the icebreakers to carry tourists to the North Pole (RusNavy, 2008). Russia's newest icebreaker was launched in April 2007 and took 18 years to complete, see Appendix 1. During the 18 years, construction of the icebreaker was interrupted due to a lack of money (Zaitsev, 2007).

In the case of the United States, vessels are leased on an "as and when required" basis. For the fiscal year 2006, the Office of Management and Budget (OMB) in the USA recently assigned budget authority for the United States Coast Guard (USCG) polar icebreaking programme to the National Science Foundation (NSF) (O'Rourke, 2008). The USCG owns, operates, manages, and crews three Coast Guard icebreakers. They are the "Polar Star", "Polar Sea", and "Healey". In addition, the NSF has procured the use of the "Laurence M. Gould" and the "Nathaniel B. Palmer" through a private service contract, used to bypass the regulatory issues relating to long-term charters to a government agency, with Raytheon Polar Services Company, which charters the vessels from their owner Edison Chouest Offshore of Louisiana (National-Research-Council, 2007; O'Rourke, 2008). The "Nathaniel B. Palmer" was purpose built for the NSF in 1992 as a single-mission ship for Antarctic research purposes. The "Laurence M. Gould", a multi-disciplinary research platform designed for year-round polar operations, is used to support research and to resupply and transport researchers and staff between Palmer Station and South American ports. Both vessels were designed and built with input from the science community and were built under a

long-term lease agreement between Edison Chouest Offshore and the United States Federal Government (Arden L. Bement, 2006). In light of the above, long-term agreements were put in place for the procurement of these icebreaking research vessels. This is not surprising given the enormous resources required to design and build such speciality vessels. Further to the above mention of private involvement being availed of by the NSF, during the 2004-2005 and 2005-2006 austral summers the NSF chartered the use of the Russian icebreaker "Krasin", see Appendix 1, to break a channel to McMurdo Station, Antarctica (Arden L. Bement, 2006; National-Research-Council, 2007; National-Science-Foundation, 2007). The "Krasin" was chartered from the Far East Shipping Company (FESCO) and the estimated obligation for fiscal year 2006 was USA \$7.2M, with the actual amount adjusted to the final schedule and actual fuel consumption (National-Science-Foundation, 2007). Also, during the 2006-2007 austral summer the NSF contracted the use of the Swedish icebreaker "Oden", see Appendix 1, this is also the intention of the NSF for the 2007-2008 and 2008-2009 Antarctic seasons (ibid, 2008). In 2006 the NSF sent out a Request for Information (RFI) with respect to icebreaking services to assist with the re-supply of McMurdo Station. In its request, the NSF was interested in a long-term arrangement of ten years or more. In addition to the associated mobilization and de-mobilization periods, the annual work requirement would consist of approximately six to eight weeks of work in the Southern Ocean to open a channel to the McMurdo station pier and to escort a tanker and a freighter back and forth between the pier and the open ocean (ibid, 2006). In the RFI the NSF was not seeking binding offers at the time but depending on the information they received they were willing to initiate discussions, seek offers, and award a contract with an owner or operator.

3.9 Canada's Dependence on Transportation

Canada has a total of 9,970,610 km² of land and fresh water area (Stanford, 1992, 185) and 202,080 km of coastline (Central-Intelligence-Agency, 2007). Canadian exports in 2006 were estimated at CAD \$405B free on board (FOB) while imports were estimated at CAD \$353.2B FOB (ibid). Under FOB contract terms the seller is responsible for the cost of delivering the goods on board the vessel. As with any geographically vast country with an abundant endowment of natural resources and a relatively small population by comparison, estimated at 33,390,141 in 2007 (ibid), a transportation network providing the ability to export and import raw materials and or finished goods will be of paramount importance. Effective and efficient transportation, along with a strong naval force have been, and continue to be, critical to Canada's development and maintaining its place among the world's most advanced economies (Haydon, 2007, 6). While the *Canada Transportation Act* recognizes the principle of establishing effective and efficient transportation, many of the charges for government-provided transportation services and infrastructure do not reflect the actual costs incurred in providing such services (Canada-Transportation-Act-Review-Panel, 2001). Despite Canada's need for dependable and efficient transportation, a survey conducted by the Council of Canadian Academies' committee on The State of Science and Technology in Canada, reported that while 37 percent of respondents felt Canada was strong in terms of transport technologies, only 13 percent of respondents believed that Canada is gaining ground and trending up with respect to transport technologies (Council-of-Canadian-Academies, 2006). According to the Council, the survey was distributed through a network of contacts in universities, governments, private sector and in the Council's member academies. The Council estimated that the survey was distributed to roughly 5K individuals from whom 1,529 completions

were received. Canada's lack of investment in transportation research is cause for concern given its vast and diverse geography (Transport-Canada, 2008, 6).

Economic development and exploration of Canada, and the Arctic, has and will continue to be heavily dependent upon a reliable transportation infrastructure (Canada-Transportation-Act-Review-Panel, 2001). In light of climate change and the continual decrease of Arctic ice (Flato and Boer, 2001; Falkingham, 2000; Falkingham, 2004; Hupp and Brown, 2006), Canada's involvement and activity in the Arctic is anticipated to increase (Department-of-Foreign-Affairs-and-International-Trade-Canada, 2007) and with this will come an anticipated greater demand for the requirement of an efficient and effective transportation network. It would seem rather unlikely that significant economic development in the Canadian Arctic and the Arctic in general will come about without the involvement of icebreakers and ice strengthened cargo vessels. The question could be asked, would the economic development of the Canadian Arctic be farther ahead than its current state if Canada had had an extended season, or even a year round presence, for its icebreakers operating in the Arctic? From an economic development perspective, commerce usually follows the flag and not vice versa. As of 2007, the CCG with respect to its icebreaking capability is not equipped to operate on a year round basis in the Canadian Arctic (Brigham, 2007; Robertson, 2007; Haydon, 2007, 5). During general conversation with stakeholders at the outset of this research it was noted that, depending of the global state of the economy, Canada's Arctic will continue to be developed with or without the assistance of the Canadian government and the presence of the CCG.

3.10 Government Accountability and the Administration of Transportation

Throughout the world, and recently for the first time in Canada, private individuals and scholars appear to be disillusioned with the creditability of public administration and its bureaucracy (Landry, 1993, 337; Haque, 1996, 519). With respect to transportation, Hatzopoulou and Miller (2008, 154) note that while federal and provincial ministries address the issue of sustainable transportation, Canada suffers from both a lack of centralized transport-related authority and fragmented jurisdiction with respect to the economic, social, and environmental impacts of transport. Drucker (1969) stresses that with respect to not only transportation, welfare state governments are poor managers and are able to provide little more than incompetence. However, the Canadian Government does seem to be aware of the changing global transportation environment and that in the presence of market globalization, economic integration, new commercial strategies and new technologies, strong and viable private companies can be built to help overcome Canada's transportation challenges (Transport-Canada, 2006).

The performance strategy of a non-profit organization, such as a government, is somewhat different to that of a publicly traded enterprise as they are not in the business to make a profit. Haque (1996, 518) informs that the guiding norms of public administration include public accountability, representativeness, equality, responsiveness, and welfare. Nevertheless, and in light of a definition of economics stating that it is the study of the use of scarce resources to satisfy unlimited human wants (Lipsey et al., 1994, 3), taxpayers would expect governments to use their resources efficiently and operate effectively, and that those in charge set goals to measure their performance (Hill and Jones, 2007, 7). In the case of Canada, the inefficient use of public resources and government failure is well documented (Clemens et al., 2004; Clemens et al., 2005; Saul,

2008). In their 2005 report on Government Failure in Canada, Clemens et al. (2005, 7) note the following methods available to the government in reducing waste and overcoming institutional limitations:

- Rationalization – clearly defining roles and eliminating or restructuring activities that are not supportive of core functions;
- Privatization – changing the structure of program delivery through the sale of state-owned assets to the private sector for private operation;
- Public-private partnerships – allows for a complimentary role for government while at the same time maximizing the strengths of partners in developing infrastructure;
- Outsourcing – allowing competitive bidding in providing publicly financed goods or services;
- Internal control and monitoring mechanisms – increasing the resources of auditors, increasing the scope of audits, and mandatory audit compliance.

The profitability of a non-profit organization, such as a government, may be measured by its ability to operate within its budget or to have surpluses (Head and Horn, 1997, 2.9). Government could also aim to increase its level of service while not exceeding its allocated budget. While competition and profit are key to private sector efficiency models, neither of the two are possible with the Canadian Government (Saul, 2008, 264). Irrespective of how things are measured or justified, Boothroyd (1978, 129), in talking about handling disagreement and the lack of clarity, avails of the word profit as one pointing to such an enormous range of situations, and likewise associated characteristics, that it is virtually useless for conducting debates. The word profit, according to Drucker (1969, 146) has different meanings and is viewed as a measurement of the allocation of capital

resources in traditional economics, belonging to a moral category and having an ideological attitude, while it is viewed as the cost of uncertainty in growth economics. With reference to publicly traded organizations, the ultimate goal of strategy is to maximize the value of an organization to its shareholders (Hill and Jones, 2007, 40). Pirie (1998, 34) notes that without profit there is less incentive to improve efficiency and service quality. Return on invested capital (ROIC) and the growth rate of profits, g , are two main drivers of company valuation (Hill and Jones, 2007, 40). ROIC is taken to be the company's net operating profits less adjusted taxes (NOPLAT) over invested capital (IC).

Equation 1: $ROIC = NOPLAT / IC$.

Where

$NOPLAT = \text{revenues} - \text{cost of goods sold}$

- operating expense
- depreciation charges
- adjusted taxes

$IC = \text{value of shareholders' equity} + \text{value of debt}$

The growth rate of profits, g , is the percentage increase in net operating profits (NOPLAT) over a given time. Therefore,

Equation 2: $g = [(NOPLAT_{t+1} - NOPLAT_t) / NOPLAT_t] \times 100$

With reference to ROIC and g , three important points to consider are:

- Companies with an already high ROIC can create more value by increasing their profit growth rate rather than pushing for an even higher ROIC;
- Companies with low ROIC destroy value if they increase their profit growth rate;
- The ideal situation for a publicly traded company would be to maintain both a high ROIC and high profit growth.

Companies that have managed to maintain both a high ROIC and high profit growth have generally been able to fund their capital investments needs from internally generated cash flows and have not had to issue more shares to raise capital (Hill and Jones, 2007, 40). Funding capital investments from either internally generated cash flows or through the issuing of more shares would be regarded as equity financing as opposed to debt financing. However, with regards to the issuing of shares in order to fund capital investments a company will need to relinquish some control over how the business is operated.

While Drucker (1969) sees the main purpose of government being the making of fundamental decisions and governing, Hodge (2000, 5) provides seven traditionally functional areas of governments:

1. Provision of economic infrastructure;
2. Provision of various collective goods and services;
3. Resolution and adjustment of conflict groups;
4. Maintenance of completion;
5. Protection of natural resources;
6. Provision of minimum access by individuals to the goods and services of the economy;
7. Stabilization of the economy.

With respect to this research, areas 1, 2, 3 can be reflected in the services being provided for by the CCG in the Canadian Arctic.

Strategic planning, for any organization or level of government, poses difficult challenges including capital equipment investment decisions, the impact of rapidly changing technology, and the realization that equipment purchased now will have a service life of many years and that the acquisition of certain equipment today

can limit the policy options of future governments or organizations for many years to come (MacDonald, 2007, 4); "getting things right" the first time around is imperative. The capital investment challenge is evident with the current, March 2007, federally elected Conservative government. On 22 December 2005, while speaking on the campaign trail in Winnipeg, Conservative Stephen Harper announced his commitment to Arctic Canada by committing, among other projects, to build three new icebreakers and a deep water docking facility in the Iqualuit region. However, due in part to cost restraints these projects have been "pushed-back" (Huebert, 2007, 20) and as of 3 February 2007 the government is now talking about building six Arctic patrol vessels and a forward operating refuelling and berthing site with both projects costing less than the original two (Pugliese, 2007).

When compared to southern Canada, there are considerable disparities with respect to infrastructure, education, and standard of living for those inhabiting Canada's Northern communities (Saul, 2008). Linquist (1997, 61) warns of the economic and social disparity between those more favoured and those less favoured and that the chasm between the two may have to be widened, at which time it may be too late to prevent undesired occurrences, before those citizens who are more favoured come to recognize and believe that the plight of those less favoured impinges on their own interest and wellbeing. Suppressed people, with nothing to lose, will be likely to eventually create turmoil and unrest. In attempting to strengthen its case for Arctic sovereignty, Canada would be wise to pay attention to the development of its Arctic and to involve and keep the interest of northerners, and not southerners, first and foremost in mind during this development. Canada's Arctic strategy must be built from the ground up (Simon, 2008) .

Haque (1996) warns that contemporary public administration is being dominated by policy studies and policy analysis, both of which have evolved within an atmosphere of utilitarian market culture and theoretically based on a neoclassical economic public choice framework in which utility norms, economy and efficiency should be the main criterion for evaluating social, political, and economic policies. With respect to Canada, Landry (1993, 336) notes ambivalence with respect to the role of the state in a market economy. Landry also distinguishes those who claim that the state should foster increased efficiency of the market economy from those who claim that the policy instruments of the state should be used primarily to promote equity. We are inclined to look for efficiency in others while insisting on equity considerations for our own personal demands. Remillard (1999, 93) in his work on public policy and administration, while looking at the application of divestiture legislation on three small Quebec ports, concluded that while privatization exercises are unique to the enterprise and the country involved, the theoretical basis for privatization, attaining economic efficiency and saving money, held true in his study. Remillard's conclusions appear to be supported by Yarrow's assessment of public versus private ownership in which he comments that one form of ownership cannot be expected to be superior to the other in all industries and in all countries and that private firms tend to operate with lower cost (Yarrow, 1986, 332). Stigler and Friedland (1962) in their work on regulated utilities and nationalized industries suggest that by comparison private firms are more efficient. Pirie (1998, 34) in looking at problem areas for the public sector, advocates that the actual structure, organizational arrangements, and political externalities of the public sector actually bring about the exact opposite of what it was initially set up to do:

- Operate cheaper as there was no need for profit;

- Eliminate waste in the absence of duplication;
- Save cost as there was no need to advertise;
- Labour relations would be better as management and labour would be working together for society;
- Everyone would take care of public property;
- The responsiveness to needs would improve.

As discussed in further detail in Chapter four, a 1994 study was conducted by Consulting and Audit Canada, on behalf of DFO and the CCG, to seek feasible ways of improving their efficiency in delivering services to the Canadian public. The study concluded that the creation of a crown corporation was the alternative offering the largest potential savings and most acceptable to the fleet management community (Consulting-and-Audit-Canada, 1994, 53). To date, this has not been done. At the time of the study the CCG was part of TC.

Bos (1991, 33) states that in moving from nationalization to the privatization of public utilities several changes, leading to differences in incentives and efficiency in public and privatized firms, take place:

- The ownership objectives change from that of welfare maximization to profit maximization;
- There is a change in the information available to the owners in that shareholders are typically better informed about demand or cost conditions than public bureaucrats;
- Red-tape public bureaucrats are replaced with market-oriented technocrats.

However, private corporations are not immune to accountability and control problems, but legal and market instruments generally tend to generate stronger pressures for efficient performance than that experienced by public and not-for-profit organizations (Canada-Transportation-Act-Review-Panel, 2001). Vickers and Yarrow (1988, 37) suggest that privatization acts to strengthen managerial incentives to reduce cost and allows for easier monitoring of cost-reducing activities. Under what, if any, circumstances should the providers of marine transportation services, namely icebreaking by the CCG in the case of this research, be treated so differently from the providers of other commercial services that they warrant special financial treatment and a unique governance structure (Canada-Transportation-Act-Review-Panel, 2001)? However, Haque (1996, 521) suggests that it may not be fair to compare the performance and efficiency of the public service with that of the private service since the public service may be functioning and operating in areas where there are no private counterparts, i.e. national security, and may have less specified objectives, qualitative outputs, emphasis on distribution and equality, and accountability to different lobby and pressure groups. Landry (1993, 348) concludes that the goals of public bureaucracies are more ambiguous than private bureaucracies and that a large portion of government output is not easily measurable because it concerns the formulation and implementation of norms, not the production and delivery of goods. Taking the example of the CCG, it has to try and accommodate many different interests in the Arctic during a short summer season in which the demand for icebreaker services quite often conflict.

In light of the above, and given the previous and, to some extent, current lack of activity in the Canadian Arctic, it is doubtful if a private shipping company would

build or acquire an icebreaker to only sail around the Arctic looking for work of opportunity during the short summer season when ice conditions are tolerable and most all shipping activity takes place at the same time. Notwithstanding this, future shipping activity in the Arctic is most certainly expected to intensify. When this anticipated increase in shipping activity does come into being, some of it taking place on a year-round basis, there will undoubtedly be an increased demand for icebreaking services. And, even before the actual increase in shipping activity, shipping companies will need to consider appropriate icebreaking measures into their business plans. Either they will have to build in expensive icebreaking capabilities into their entire fleet(s) or they will need to arrange for adequate icebreaking services ahead of time. The latter may prove to be a key element in the competitive provision of icebreaking services in the Arctic and thus allow for the building of an icebreaker(s) by private industry.

Vickers and Yarrow (1988) put forward a notion with respect to the lack of discussion in most microeconomic textbooks on positive theories. To somewhat contradict this notion, Bos (1991, 65) with reference to the public monopoly and the positive theory describing how a public firm actually behaves, suggests that the impact of powerful trade unions operating in public firms result in public firm workers being typically well organized but at the expense of output and cost efficiency. It was noted during personal interviews for this research that this situation applies to the CCG. Sections 4.79 and 4.80 of the 2007 Status Report of the Auditor General of Canada point out that the CCG continues to have significant difficulty in effectively managing its human resources, which happen to be its biggest single expense (Auditor-General, 2007). The report goes on to state that collective agreements continue to be complex, consequently increasing cost and scheduling complexities, and that although managers want to make changes

they do not have the acceptance of the union and its members. According to Bos (1991, 3), privatization typically reduces the influence of trade unions. The CCG shore and fleet personnel are unionized.

The transition of government employees to a commercialized, corporate environment will usually require careful forward thinking and planning from a risk management, human resource perspective. Such transitions are possible and empirical evidence surrounding such transition has been collected over the past two decades during which time government enterprises worth over USA \$1 trillion have been corporatized or privatized globally (Poole and Butler, 2002, 13).

3.11 Conclusion

While private involvement in the delivery of government services is not a recent phenomenon, the term privatization is relatively new and conjures up various approaches to shifting economies from the public to the private sector. While there is a substantial continuum from fully public to fully private delivery of services, PPPs are a relatively new way for sharing the responsibility and delivery of services to the Canadian public. The development of Canada's Arctic has received considerable attention recently and while climate change is decreasing the thickness and extent of Arctic sea ice, icebreaking capacity in the marine transportation sector will be inevitable for the future development of the Arctic. While technological advancements have helped with shifting the delivery of public services to the private sector, the attraction may not be so evident with respect to icebreaking as the building of an icebreaker is a substantial financial investment and can take several years. Notwithstanding this, there are cases throughout the Arctic nations where the private sector provides icebreaking services on behalf of the government. This is currently not the case in Canada. However, given the

current status of the CCG icebreaker fleet and the alleged mismanagement of the CCG by the Auditor General, it may prove to be a viable alternative for the Canadian Government to consider with respect to future Arctic developments. The next chapter will therefore aim to identify the accountability and responsibilities of the CCG; to delineate the operational structure, involvement and activity of the CCG with particular emphasis on icebreaking and associated activities. It will also look at some of the details of the CCG icebreaker fleet in terms of ship particulars and their ability to operate in the Canadian Arctic.

Chapter 4 The Canadian Coast Guard and Icebreaking Operations

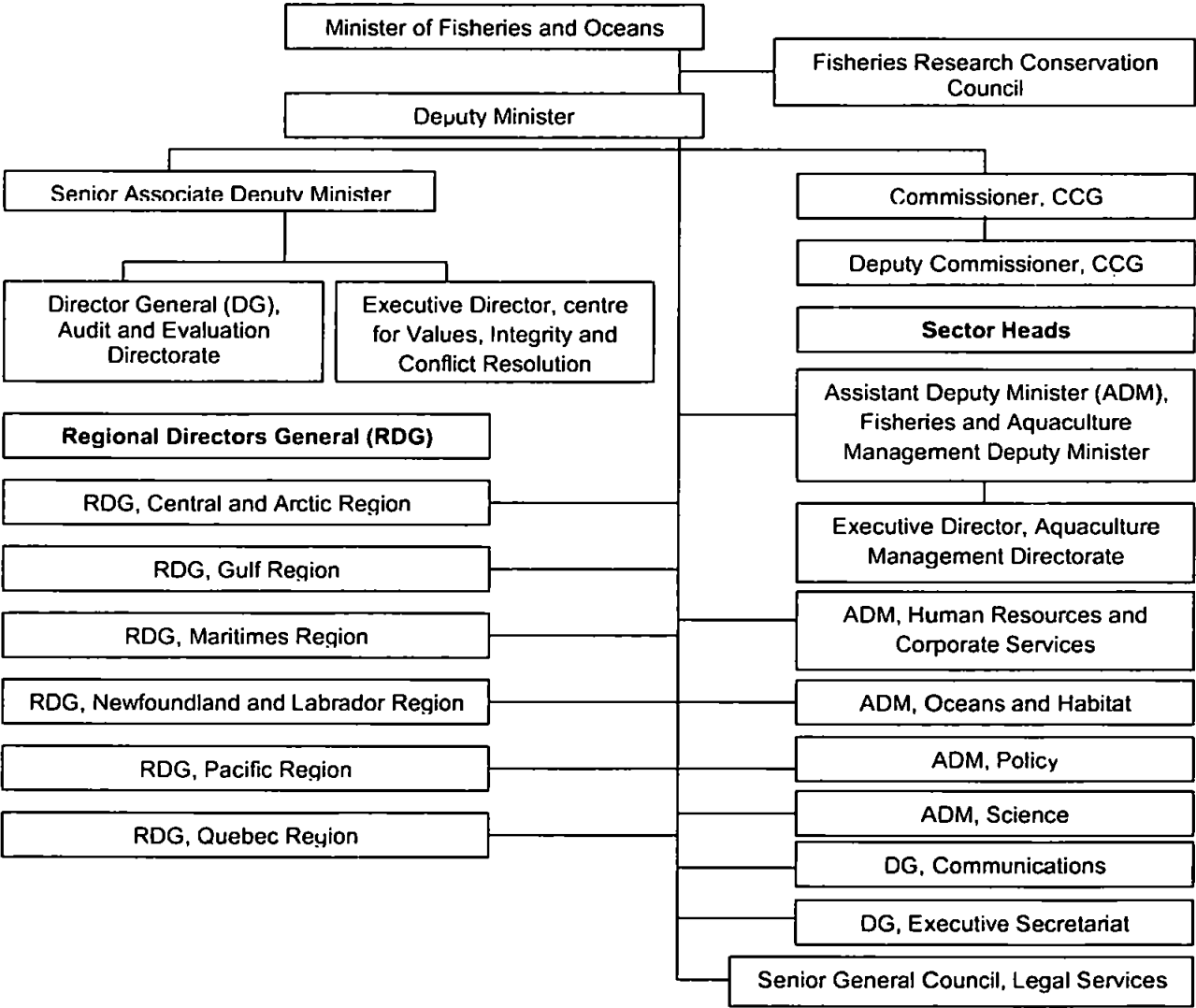
4.1 Introduction

The CCG operates a significant and diverse fleet of icebreakers, research and survey vessels, navigational aid tenders, and multi-task vessels from five geographic areas of Canada (Fisheries-and-Oceans-Canada, 2007a). While the six icebreakers used for Arctic operations are physically located in four regions, namely the Pacific, Quebec, Maritimes, and Newfoundland and Labrador the Central and Arctic region is responsible for the coordination of icebreaker activities in the Arctic (Canadian-Coast-Guard, 2006d). The CCG has many responsibilities including but not limited to maritime safety, protection of the marine environment, facilitation of maritime trade and commerce, supporting marine science, supporting Canada's federal maritime priorities, and being a visible symbol of Canada's sovereignty in the Arctic. The CCG operates under a multi-tasking approach in that it utilizes assets to their fullest potential (i.e. fleet vessels are constructed with the intention of being able to deliver a variety of programmes concurrently, and trains staff to handle multiple missions) (Canadian-Coast-Guard, 2006e). The aims of this chapter are to identify the accountability and responsibilities of the CCG; and to delineate the operational structure, involvement and activity of the CCG with particular emphasis on icebreaking and associated activities. The chapter will also look at some of the details of the CCG icebreaker fleet in terms of ship particulars and their ability to operate in the Canadian Arctic. Finally, the chapter will aim to identify the global status of icebreakers in terms of numbers, basic ship particulars, and ownership.

4.2 Canadian Coast Guard Accountability and Responsibilities

Figure 3 helps to illustrate the organizational structure of the Department of Fisheries and Oceans Canada (FOC) as of 6 February 2006. FOC consists of six regions spanning the west and east coasts of Canada and has its national headquarters in Ottawa (Fisheries-and-Oceans-Canada, 2006a). Although Figure 3 identifies six regions, the Gulf region does not appear to be specifically identified in any of the CCG web pages (Government-of-Canada, 2006).

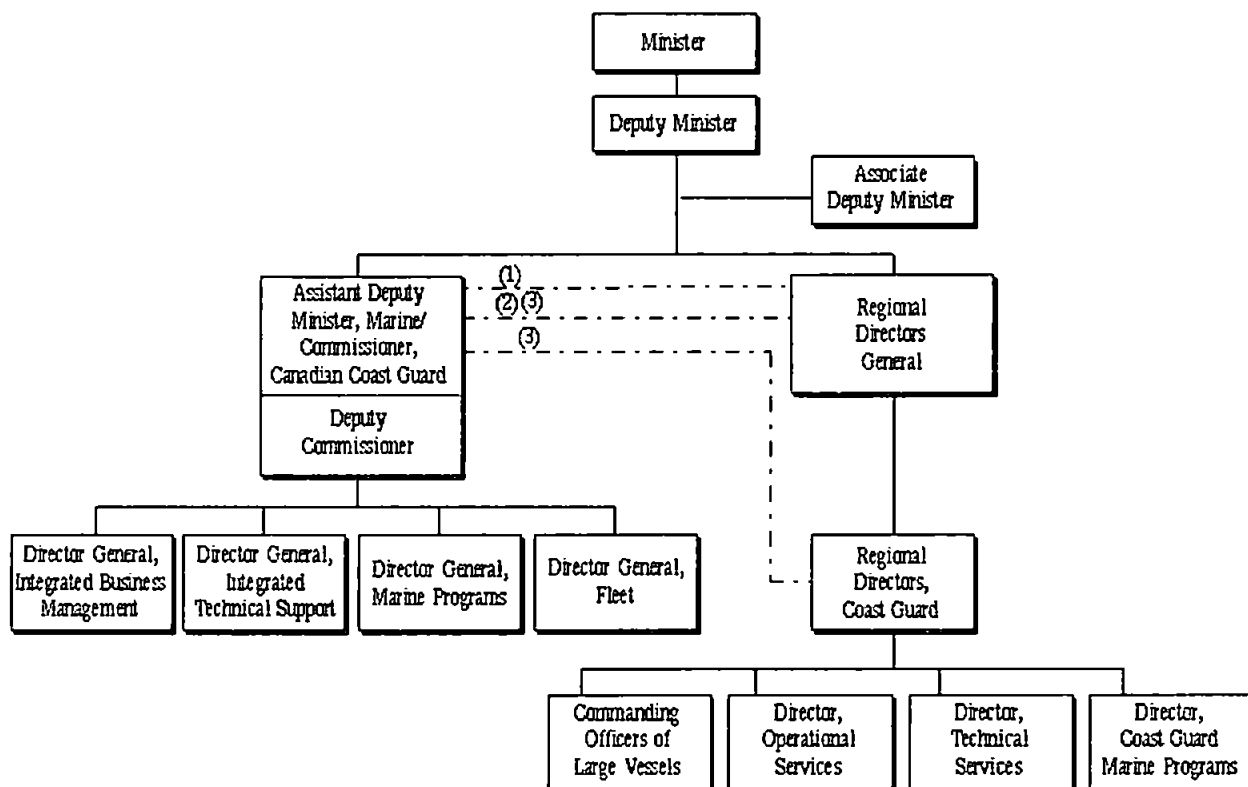
Figure 3 Organizational Chart of Fisheries and Oceans Canada



Source: Author. Adapted from Fisheries and Oceans Canada without permission [online]. Available from: http://www.dfo-mpo.gc.ca/organisation_e.htm [Accessed 2 May 2007].

Figure 4 identifies the reporting and accountability relationships for FOC fleet management as shown in Exhibit 31.5 of the December 2000 Auditor General's Report (Auditor-General, 2000).

Figure 4 Reporting and Accountability for FOC Fleet Management



¹ The Commissioner, in consultation with regional directors general, suggests resource allocation to regions based on regionally costed operational plans.

² The Commissioner, in collaboration with regional directors general, establishes a system to monitor performance and report on results.

³ The Commissioner provides functional direction to regional directors general (and regional directors) regarding the national policy framework and national standards.

Source: *Reporting and Accountability Relationships for Fleet Management* [online]. Available from: http://atlas.nrcan.gc.ca/site/english/maps/reference/national/can_politicaire/referencemap_image_view [Accessed 4 May 2007]

The CCG, through FOC, is mandated under Section 41 of the *Oceans Act* (1997) to provide a safe, economical, and efficient marine transportation system (Fisheries-and-Oceans-Canada, 2006b; Auditor-General, 2000). In addition to the responsibilities mandated under the *Oceans Act* (1997), the federal government is responsible under the Arctic Waters Pollution Prevention Act (AWPPA) (1970) for the provision of icebreaking and navigation through the Arctic Canada shipping

zones (Canadian-Coast-Guard, 2001). The creation of the AWPPA (1970) was in response to the 1969-1970 voyages of the USA tanker "SS Manhattan" through the Northwest Passage (Rothwell, 1995, 286). Furthermore, the Canada Shipping Act (CSA) also provides for the Minister of FOC to act as lead in situations dealing with search and rescue (Burke, 2006). Finally, it is the responsibility of the Minister FOC to ensure that the following services are provided in a cost effective manner (Fisheries-and-Oceans-Canada, 2006b; Government-of-Canada, 2006):

- Safe navigation (aids to navigation systems and services, marine communications and traffic management services, ice breaking and ice management services and channel maintenance);
- The marine component of the federal search and rescue programme;
- Pleasure craft safety, including the regulation of the construction, inspection, equipment and operation of pleasure craft;
- Pollution prevention and response;
- Support to other departments, boards and agencies of the Government of Canada.

In April 1995, responsibilities for the CCG were transferred from TC to DFO (Department-of-Fisheries-and-Oceans-Canada, 2006, 1) (note option C below and the subsequent comment on foreseen implementation difficulties). On 1 April 2005, the CCG became a Special Operating Agency (SOA) within the DFO (Department-of-Fisheries-and-Oceans-Canada, 2006, 1; Fisheries-and-Oceans-Canada, 2005) (note option D below and the subsequent comment on foreseen implementation difficulties). As of 30 September 2005, it was reported that the CCG had an overall operating budget of CAD \$500M and that it had 4,794 employees working in five regions throughout Canada and at headquarters in Ottawa (Department-of-Fisheries-and-Oceans-Canada, 2006, 2). With reference to

the creation of SOAs in Canada, Lindquist (1997, 51) informs that SOAs were one of two high profile pilot projects, in terms of public sector reform initiatives, created as part of the Public Service 2000 exercise initiated by the federal Progressive Conservative government of Brian Mulroney to improve management of financial and human resources and to introduce service quality precepts; the other pilot project was the adoption of single operating budgets. The two Canadian agencies used for pilot testing of the SOA organizational arrangement were the Telecommunications Agency and the Passports Office (Landry, 1993, 342). With reference to the SOA, the transforming of the CCG into a SOA as not brought about the desired effects of more autonomy and operational freedom (Hodgson, 2007). Lindquist (1997, 51) compares the creation of SOAs in Canada to the executive agency concept adopted in Britain and suggests that, unlike the British reporting structure, the lack of independence experienced by Canadian SOAs providing services on a cost-recovery basis is due to the direct reporting of a SOA to a deputy minister. In comparing the roles and responsibilities of government ministries and executive agencies in Britain, Leslie and Tilley (2004) highlight that when the design and delivery of government services are separated, the government ministries can concentrate on the development of policy while the executive agencies are free to focus solely on operations and can be more easily held accountable for their performance. With reference to politicians in Canada, Lindquist (1997, 57) mentions that business plans have no function in measuring the performance of deputy ministers, as they do for chief executive officers in British executive agencies and New Zealand state-owned enterprises. This sentiment was echoed during a personal interview with Arno Keinonen of AKAC Inc. who was of the opinion that big organizations like the CCG suffer from a lack of clearly identified responsibilities and accountability. In the Fourth Report of the Standing Senate Committee on Fisheries and Oceans, entitled '*The Coast Guard*

in Canada's Arctic: Interim Report', Senator William Rompkey clearly states that more thought needs to be given to the future role and capability of the Canadian Coast Guard (Standing-Senate-Committee-On-Fisheries-And-Oceans, 2008).

In light of the above, it is worth noting that a 1994 study conducted by Consulting and Audit Canada, on behalf of the DFO and CCG, then a part of TC, to seek feasible ways of improving their efficiency in delivering services to the Canadian public, concluded that the creation of a crown corporation was the alternative offering the largest potential savings and most acceptable to the fleet management community (Consulting-and-Audit-Canada, 1994, 53). This option was favoured whilst considering that the DFO and TC fleets would remain inside the Canadian Public Service, that existing DFO and TC mandates would not change, and that existing levels of programme delivery/service would be maintained or exceeded (ibid). However, it is worthy of mention that the 1994 study conducted by Consulting and Audit Canada (ibid, 13) initially reviewed seven options:

- A- Improve fleet efficiency within the existing departmental structures;
- B- As above with sharing of facilities and functions when additional efficiencies can be achieved;
- C- Integrate the two fleets under one department (DFO, CCG or Public Works & Government Services Canada);
- D- Establish an independent Maritime Fleet Operating Agency to manage and operate the combined fleet;
- E- Establish a Crown corporation to operate the combined fleet;
- F- Establish a Government Owned Company Operated (GOCO) organization in which the integrated fleet would be operated by a private company;
- G- Privatise the ownership and operation of the fleet.

Of the seven options offered above, only A, B, and E were further analysed in the 1994 study. Option E was shown to offer by far the most efficiency (ibid, 15 and in terms of net present value of savings and capital recapture over the lifecycle, exceeded option A by CAD \$496,445,000 and option B by CAD \$389,192,000 (ibid, 38). However, option E has not been implemented to date. The 1994 report noted that options C and D may be difficult to implement; options F and G would take a long time to implement and would probably require option E as a necessary intermediate step (ibid, 13).

Canada's transportation system is heavily subsidized. During 2006, Canadian taxpayers subsidized the transportation system to the amount of CAD \$2.3B, of which CAD \$385M went to the CCG aids to navigation and icebreaking services (Transport-Canada, 2006). The CCG provides free icebreaking services north of 60 degrees latitude at the expense of Canadian taxpayers and on average spends in the range of CAD \$40M-\$42M annually in Arctic icebreaking services (Canadian-Coast-Guard, 2001; Canadian-Coast-Guard, 2006a; Canadian-Coast-Guard, 2006b; Wallace, 2006; Transport-Canada, 2007). With respect to the delivery of fuel and cargo to Arctic communities, otherwise known as Northern Re-supply, the CCG icebreaker fleet carries out this service on a cost-recovery basis when commercial ice capable vessels are unavailable (Canadian-Coast-Guard, 2004). There are currently, and have been for several years, delays in the service being provided to commercial vessels beset in ice, by CCG icebreakers (Williams, 2006). Although priority is given to vessels participating in the voluntary Arctic Canada Traffic Zone (NORDREG) vessel reporting system, vessels not participating in NORDREG will be given icebreaker assistance but such assistance may not be available on short notice (Transport-Canada, 2007). CCG icebreakers operate only during the summer navigational season from late June to October, in

the Canadian Arctic (Canadian-Coast-Guard, 2001; Burke, 2006; Singh, 2007). Not all Arctic shipping companies are happy with the current dates of operation and representatives from OmniTRAX and Nunavut Eastern Arctic Shipping Inc. would like to see an extension of the operating season and more flexibility in the scheduling of icebreakers in the Arctic (MaCafee, 2007). The 'Block Commitment' dates and geographical areas are shown in Table 6 and Figure 5 respectively (Canadian-Coast-Guard, 2001; Canadian-Coast-Guard, 2006c). The 'Block Commitment' system divides the Canadian Arctic into 12 service areas for the provision of the primary levels of service offered by the CCG during stipulated periods throughout the summer season.

Table 6 Icebreaker Service Dates for the Canadian Arctic

Area Number	Area Name	Period day/month
A01	Hudson Bay	03/07 - 24/10
A02	Foxe Basin	20/08 - 15/09
A03	Hudson Strait	03/07 - 24/10
A04	East Baffin	14/08 - 18/09
A05	Parry Channel East	10/08 - 15/10
A06	Parry Channel West	10/08 - 15/10
A07	Pelly	12/08 - 13/10
A08	Elesmere	24/08 - 05/09
A09	Victoria	12/08 - 13/10
A10	Beaufort	25/07 - 25/09
A11	Barrow	25/07 - 25/09
A12	West Greenland	05/07 - 15/08

Source: Canadian Coast Guard [online]. Available from:

http://www.ccg-gcc.gc.ca/ice-gla/dates_e.htm [Accessed 6 October 2006].

Six of Canada's 17 icebreakers spend the summer months engaged in activities in the Arctic and the winter months engaged in activities along the east and west

coasts of Canada and the St. Lawrence. The Canadian icebreaking fleet is ageing and the first icebreaking vessel scheduled for replacement is the "Louis S. St. Laurent" in the year 2017 (Robertson, 2006). It is calculated that it will cost CAD \$2-3B to rebuild the current Canadian icebreaking capability and that it will cost CAD \$10B to build the icebreaking potential required to meet anticipated future demand (Robertson, 2006). The CCG is currently experiencing a funding gap of about CAD \$55M (Department-of-Fisheries-and-Oceans-Canada, 2006). Reports from the office of the Auditor General of Canada from 1997 to February 2004 inform that there is a lack of adequate and effective management of capital and human resources by the DFO in fleet management of icebreakers in the Maritimes Region of Canada (Clemens et al., 2004, 5). These issues are not new. As a spin-off from the 1990 Osbaldeston Study of Canada's federal marine fleets, Consulting and Auditing Canada undertook a study in 1994 on behalf of the DFO and CCG, then a part of TC, to seek feasible ways of improving their efficiency in delivering services to the Canadian public (Consulting-and-Audit-Canada, 1994, i).

Under a 2005 memorandum of agreement (MOA) between the USCG and the NSF the USCG has agreed to support Canadian logistical requests in the Western Arctic, scheduled on a situational basis and in accordance with an annual advance planning process, to gain Canadian icebreaker support of USA facilities in the Eastern Arctic (National-Research-Council, 2005, 21). As of 2005, the CCG was responsible for re-supplying the USA Thule Air Force Base in Greenland in exchange for ice-breaking services provided by the USCG in the Western Arctic (National-Research-Council, 2005, 13).

Figure 5 Icebreaker Service Areas for the Canadian Arctic



Source: Canadian Coast Guard [online]. Available from: http://www.ccg-gcc.gc.ca/ice-gla/dates_e.htm [Accessed 6 October 2006].

4.3 Canadian Coast Guard Levels of Service (LOS)

With respect to icebreaking operations, the CCG provides six levels of service (LOS) (Canadian-Coast-Guard, 2001):

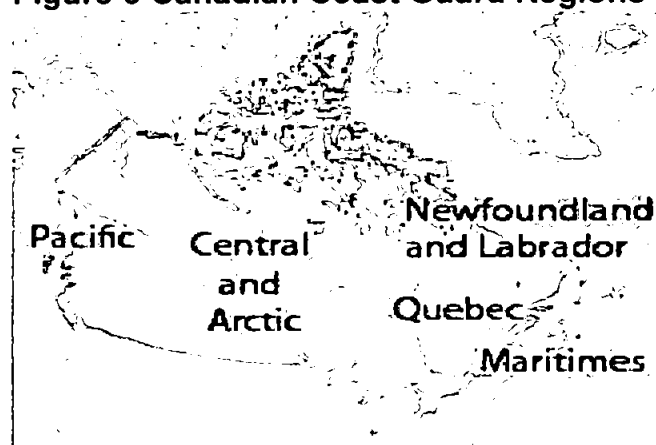
- Route assistance;
- Ice routing and information services;
- Harbour breakout;
- Flood control and ice management;
- Northern re-supply;
- Sovereignty.

Figure 7 identifies, in addition to key activities and outputs, the mission and objectives of the CCG. The LOS provided for by the CCG in the Canadian Arctic constitute five of the six key activities identified in Figure 7 (ibid). The level of service or key activity not conducted by the CCG in the Arctic is that of ice management or flood control which is exclusive to the St. Lawrence River (Canadian-Coast-Guard, 2006e). In addition, comments provided from general conversations with Arctic stakeholders indicate that, excluding the community of Iqaluit in Frobisher Bay, the CCG does little in the way of harbour breakout in the Canadian Arctic.

4.4 Canadian Coast Guard Regions

Shown in Figure 6, the CCG is divided into five regions: Pacific, Central and Arctic, Quebec, Maritimes, and Newfoundland. With respect to the Arctic icebreakers, the six CCG icebreakers used for Arctic operations are operated out of four regions: Pacific, Quebec, Maritimes, and Newfoundland & Labrador. The fifth region, Central and Arctic, however is responsible for coordination of ice breaking activities in the Arctic (Canadian-Coast-Guard, 2006d). This decentralization of fleet operations results in ineffective interregional communication and consequently underutilization of vessel use in the Arctic (Auditor-General, 2007).

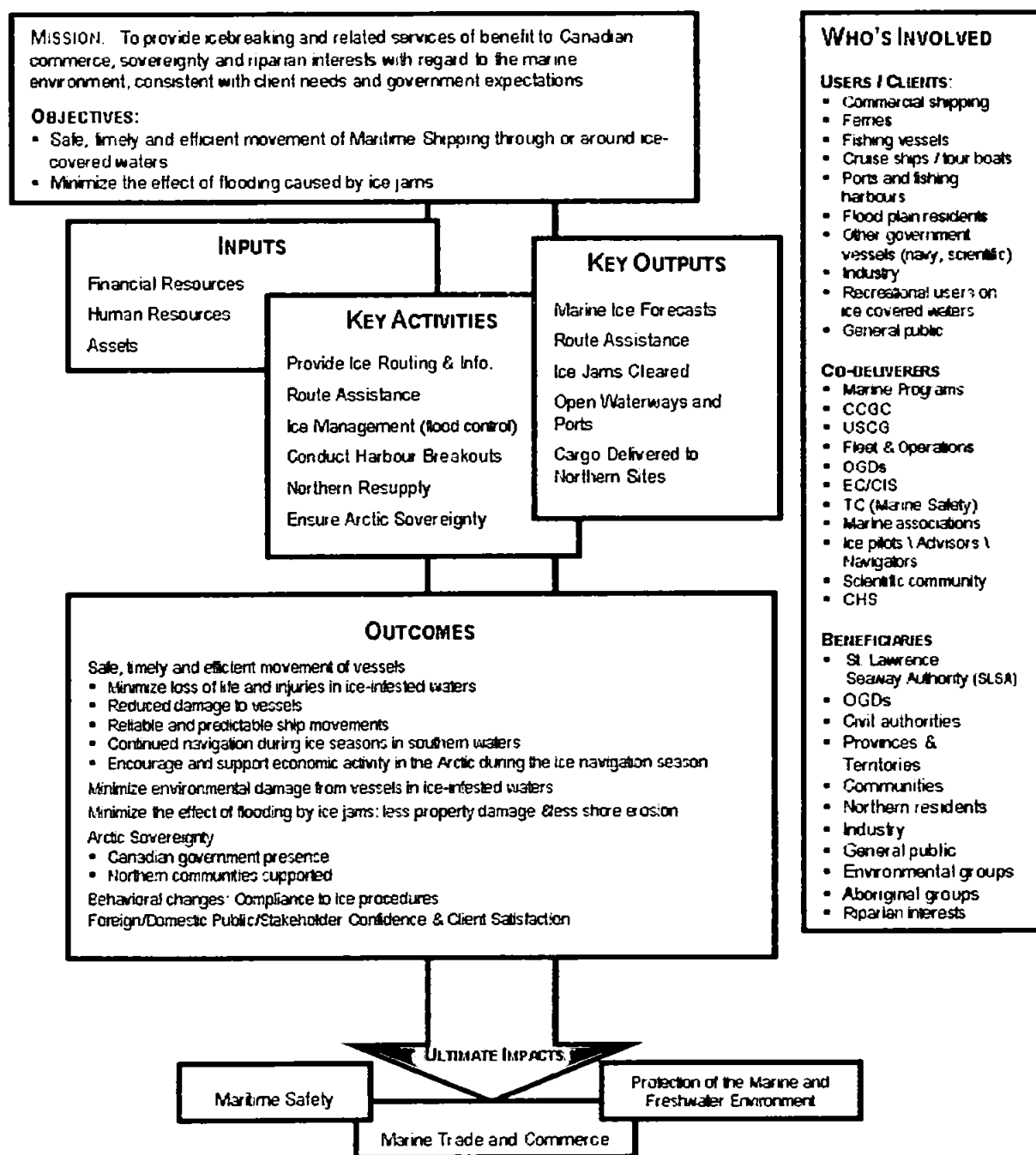
Figure 6 Canadian Coast Guard Regions



Source: Canadian Coast Guard [online]. Available from: <http://www.ccg-gcc.gc.ca/eng/CCG/Icebreaking> [Accessed 24 October 2008].

In an April 2007 news release from FOC, Minister Loyola Hearn announced that in an attempt to avoid significant additional infrastructure cost in the Maritimes region the "Terry Fox" will be relocated to the Newfoundland and Labrador region in April 2008 and the "Louis S. St-Laurent" will follow in April 2009 (Fisheries-and-Oceans-Canada, 2007b).

**Figure 7 Canadian Coast Guard Icebreaking Overview
OVERVIEW – LOGIC MODEL**



Source: Canadian Coast Guard [online]. Available from: http://www.ccg-gcc.gc.ca/mp-pm/docs/03-04/pr/ice_e.htm [Accessed 24 April 2007].

FOC civilian fleet of CCG vessels, approximately 107 vessels as of 2005, are deployed, maintained and operated by five regions spread across Canada (Department-of-Fisheries-and-Oceans-Canada, 2006). Each region operates according to its own practices and management preferences. This decentralization of fleet operations results in overall significant duplication of human resource efforts within FOC with respect to operations in the Arctic (Auditor-General, 2007).

4.5 The CCG Arctic Icebreaking Fleet

As shown in Table 7, Canada has six icebreakers that are utilised for Arctic operations during the months of July to October, normally. The youngest icebreaker is the "Henry Larson" built in 1987. Detailed vessel particulars are shown in Appendix 2. The CCG does not operate year round in the Arctic and does not have, or never had, the ability to do so even if desired (Robertson, 2007).

Table 7 Home Regions for the CCG Arctic Icebreaker Fleet as of 2007

Name of Vessel	Home Region	Built
Sir Wilfrid Laurier	Pacific	1986
Des Groseillers	Quebec	1982
Pierre Radisson	Quebec	1978
Louis S. St-Laurent	Maritimes	1969
Terry Fox	Maritimes	1983
Henry Larson	Newfoundland and Labrador	1987

Source: Author.

Briefing notes prepared for Fisheries Minister Loyola Hearn early in 2006 stated that the CCG is currently experiencing a funding gap of about CAD \$55M, that the CCG fleet of vessels is deteriorating at a rapid rate and consequently the vessels are increasingly less reliable, experience frequent breakdowns resulting in loss of

programme time and are more costly to operate and maintain which contributes to overall CCG funding pressures (Department-of-Fisheries-and-Oceans-Canada, 2006). The briefing notes go on to state that a 25-year fleet recapitalization plan has been developed to replace the ageing CCG fleet and that due to the urgent need to replace other types of vessels before the icebreakers, the replacement of the icebreaker fleet is planned to commence in 2017 and finish in 2032; the briefing notes state that it could take up to ten years to design and build an icebreaker capable of operating efficiently in winter Arctic conditions, and that it could cost Canadian taxpayers in excess of CAD \$1B. The 2007 Report of the Auditor General of Canada states that the useful life of an icebreaker is 30 years and that in light of the planned icebreaker replacement schedule noted above, the current fleet of icebreakers will be between 40 and 48 years old when they are replaced (Auditor-General, 2007). Between February 2006 and April 2007, the federal government announced spending in the order of CAD \$750M on the CCG for the replacement of 11 ageing vessels and the addition of five new vessels, but no mention of new icebreakers for Arctic operations was made (CBC-News, 2007). From a review of the literature to date and in general conversations with Arctic stakeholders, it is felt that icebreakers of greater size and horsepower in relation to those of the current fleet will be required in assisting with the exploitation of the Canadian Arctic in terms of natural resources before 2027. An earlier 1980's federal government initiative to design and build a Polar 8 icebreaker, capable of year round navigation in the Canadian, was dropped in 1990 due to federal budget restraints (Wilson, 1990). For comparison purposes, Table 8 identifies Canada's Arctic icebreaker fleet against the global icebreaker fleet of 50 as of February 2006.

Table 8 Global Fleet of Polar and Baltic Icebreakers as of February 2006

Ship Name	Country	Year	Propulsion Plant	Operations
ARKTIKA	Russia	1975	N:75,000	NSR
ROSSIYA	Russia	1985	N:75,000	NSR
SOVETSKIY SOYUZ	Russia	1990	N:75,000	NSR; Arctic tourism
YAMAL	Russia	1993	N:75,000	NSR; Arctic tourism
50 LET POBEDY	Russia	2006	(est.)N:75,000	Not yet operational
TAYMYR	Russia	1989	N:47,600	NSR
VAYGACH	Russia	1990	N:47,600	NSR
KRASIN	Russia	1976	DE:36,000	NSR; Antarctic
VLADIMIR IGNATYUK	Russia	1977	D:23,200	Arctic escort
KAPITIN SOROKIN	Russia	1977	DE:22,000	NSR; Baltic escort
KAPITIN NIKOLAYEV	Russia	1978	DE:22,000	NSR
KAPITIN DRANITSYN	Russia	1980	DE:22,000	NSR; Arctic/Antarctic tourism
KAPITIN KHBLEBNIKOV	Russia	1981	DE:22,000	NSR; Arctic/Antarctic tourism
AKADEMIK FEDOROV	Russia	1987	DE:18,000	Arctic/Antarctic research/logistics
FESCO SAKHALIN	Russia	2005	DE:17,500	Standby or supply vessel, Sakhalin
SMIT SAKHALIN	Netherlands- Russia charter	1983	D:14,500	Beaufort Sea; Sea of Okhotsk; Sakhalin Island
SMIT SEBU	Netherlands- Island	1983	D:14,500	Beaufort Sea; Sea of Okhotsk; Russia charter; Sakhalin
MUDYUG	Russia	1982	D:10,000	NSR coastal
MAGADAN	Russia	1982	D:10,000	NSR Pacific coastal
DIKSON	Russia	1983	D:10,000	NSR coastal
URHO	Finland	1975	DE:21,400	Baltic escort
SISU	Finland	1976	DE:21,400	Baltic escort
OTSO	Finland	1986	DE: 20,400	Baltic escort
KONTIO	Finland	1987	DE: 20,400	Baltic escort
FENNICA	Finland	1993	DE:20,000	Baltic escort
NORDICA	Finland	1994	DE:20,000	Arctic offshore/Baltic escort
BOTNIKA	Finland	1998	DE:13,000	Arctic offshore/Baltic escort
LOUIS ST. LAURENT	Canada	1969, 1993a	DE:30,000	Arctic research/ escort
TERRY FOX	Canada	1983	D:23,200	Arctic escort and logistics
HENRY LARSEN	Canada	1988	DE:16,000	Arctic escort and logistics
AMUNDSEN	Canada	1982, 2002b	DE:15,000	Research
PIERRE RADISSON	Canada	1978	DE:13,400	Arctic escort and logistics
DES GROSSELIERS	Canada	1983	DE:13,400	Arctic research and escort
ODEN	Sweden	1989	D:23,200	Arctic research/Baltic escort
ATLE	Sweden	1974	DE:22,000	Baltic escort
YMER	Sweden	1977	DE:22,000	Baltic escort
FREJ	Sweden	1975	DE:22,000	Baltic escort
TOR VIKING	Sweden	2000-2001	DE:18,000	Baltic escort
BALDERR VIKING	Sweden	2000-2001	DE:18,000	Baltic escort
VIDAR VIKING	Sweden	2000-2001	DE:18,000	Baltic escort/Arctic research
POLAR STAR	US	1976	GT:60,000DE:18,000	Arctic/Antarctic research/logistics
POLAR SEA	US	1977	GT:60,000DE:18,000	Arctic/Antarctic research/logistics
HEALY	US	2000	DE:30,000	Arctic research/response
NATHANIEL B. PALMER	US	1992	D:12,700	Antarctic research/logistics
SHIRASE	Japan	1982	DE:30,000	Antarctic research/logistics
POLARSTERN	Germany	1982	D:17,200	Arctic and Antarctic research/logistics
KIGORIAK	Netherlands	1979	DE:16,600	Offshore support
ALMIRANTE IRIZAR	Argentina	1978	DE:16,000	Antarctic research/logistics
SVALBARD	Norway	2002	DE:13,500	Patrol
AURORA AUSTRALIS	Australia ¹	990	D:12,000	Antarctic research/logistics

NOTE: D = Geared Diesel; DE = Diesel-Electric; GT= Gas Turbine; N= Nuclear; NSR = North Sea Route. Ships of at least 10,000 propulsion horsepower are listed.

aLOUIS ST. LAURENT in service in 1969 was rebuilt and recommissioned in 1993.

bAMUNDSEN in service in 1982 as SIR JOHN FRANKLIN was converted and returned to service in 2002.

Source: Council (2007) *Polar icebreakers in a changing world: an assessment of U.S. needs*, National Research Council.

When designing vessels for Arctic areas, economic principles need to be taken into account. Ice cover will vary from open water, free of ice, to total ice cover. For most sea voyages utilizing the Arctic waters, regardless of the time of year, the voyage will usually involve the vessel having to navigate in a range of sea conditions varying from ice free conditions to 10/10ths ice cover. Consequently,

the economics of the transportation must take into account both the icebreaking performance of the vessel and the open water performance of the vessel. From an economical perspective, an efficient cargo vessel, working in ice conditions, has to be optimized for both ice and open water, which may result in compromises that are not really efficient in any condition (Juurmaa, 2004). As of April 2007 there were 68 ice class tankers on the order books for the Baltic Sea trade (Patterson, 2007).

4.6 Conclusion

Although the CCG operates a large and diversified fleet of vessels, Arctic operations during the summer months are limited to six of its larger icebreaking vessels. The Arctic icebreakers are old and, by most accounts, in need of replacement. The CCG does not have the infrastructure capacity to operate year round in the Canadian Arctic. The time periods of CCG operations in the Arctic are usually planned ahead via the block commitment system, which is usually decided upon in light of the projected activities of private operators working in the Arctic. The CCG is geographically dispersed into five operational regions and has its headquarters in Ottawa. The CCG has four home regions for its six Arctic icebreakers, and provides six key services, of which only five are conducted in the Arctic. The CCG is mandated under Section 41 of the *Oceans Act* (1997) to provide a safe, economical, and efficient marine transportation system and, in addition, is responsible under the AWPPA (1970) for the provision of icebreaking and navigation through the Arctic Canada shipping zones. During April 1995, CCG responsibilities were transferred from TC to FOC and on 1 April 2005 the CCG became a SOA within FOC.

The next chapter develops and presents a conceptual framework which distils the literature reviewed to date, and which will guide the processes of designing empirical data collection and analysis.

Chapter 5 The Conceptual Framework

5.1 Introduction

This chapter aims to identify the underpinnings found in the literature review that surround the development of the conceptual framework. It notes that a careful literature review assists in the development of the conceptual framework and that conceptual model development is a dynamic and somewhat incessant process undertaken before, during, and after the literature review. The chapter informs of the relationships among models, theories and frameworks and discusses the tradeoffs of tight versus loose conceptual designs in the broad spectrum of qualitative research. The chapter concludes with some advice on the various phases and questions that a researcher ought to keep in mind during the development of the conceptual model.

5.2 Foundations for the Conceptual Model

Strauss and Corbin (1990, 35) note that stimuli to investigate a research problem may originate from the technical literature or from personal and professional experience. The research undertaken for this project stemmed from experience and interests associated with such areas as:

- The Arctic;
- Climate Change;
- Maritime Transportation;
- New Technology;
- Ageing Infrastructure;
- Risk Management;
- Marine Insurance;

- Logistics;
- Privatization;
- Bureaucracy;
- Efficiency;
- Effectiveness.

A literature review has revealed that there is little public information with respect to academic research on the privatization of CCG services, principally icebreaking, in the Canadian Arctic. However, while the idea of privatizing the CCG is not new, it still remains hypothetical. In such a research situation, when few studies have been conducted and little is known about the situation at hand, an exploratory study may be necessary before more rigorous research can proceed (Sekaran, 2003, 119). Saunders et al. (2007, 133) describe exploratory research as being initially broad and then becoming progressively narrower, or coming to the realization that the research is not worth pursuing further, as a result of any or a combination of the following: a literature review, the interviewing of experts in the subject area, and conducting focus group interviews. In comparison with a grounded theory methodology and the initial research question, Strauss and Corbin (1990, 38) note that while at the outset of research the question(s) and approach may be broad, it ultimately becomes narrowed and focused. Although a researcher may have theoretical conceptions in mind at the outset of a research project, it may prove advantageous not to structure data gathering too tightly at the commencement of research (Strauss and Corbin, 1998, 206).

A review of the literature concerning the issue of privatization of public services in Canada, details of which are contained in chapter three, and more specifically the services of the CCG, details of which are contained in chapter four, has identified

that private involvement in the delivery of icebreaking services dates back to 1855. For the moment however, and staying with the 21st Century, a November 2006 survey on the issues facing the Canadian market for PPPs states that Canada is making significant progress in establishing a stable and efficient market for PPPs but that there is still room for improvement of the procurement technique (Philpotts, 2006, 8). The survey goes on to state that some sources have estimated that the infrastructure deficit facing all levels of government in Canada will total CAD \$300B over the next 20 years (ibid, 5). On somewhat of a global comparison, opportunities for private sector investment in public-transportation infrastructure through PPPs is likely to exceed CAD \$330B from 2005 to 2010 (Cheatham and Oblin, 2007).

In looking at the status of the CCG and its strategic plan going forward, the 2007 Status Report from the office of the Auditor General of Canada, in addition to the audits of 1983, 2000 and 2002, identified many outstanding issues concerning the operation, organizational structure, human resources, and ageing infrastructure of the CCG (Auditor-General, 2000; Auditor-General, 2007). Many of these issues were discussed in detail throughout earlier chapters. Further, the Canadian Transportation Act Review Panel (2001) inform that with respect to commercialization and decentralization in Canada, changes at the federal level of government in Canada during the last two decades of the 20th century have resulted in changes to transportation including:

- Reduced regulation;
- Substantial cutbacks in subsidies;
- Greater emphasis on user payments;
- Reduction of the federal government's direct involvement.

In recent years, larger privatization acts in Canada include those of Air Canada in 1989 and Canadian National Railway in 1995. In addition, some east coast ferries have been privatized, while others have been turned over to provincial governments or replaced by other means of transportation. In Canada, the major components of air and marine infrastructure are largely managed by independent not-for-profit organizations (Canada-Transportation-Act-Review-Panel, 2001). Canada has opted for the use of the word "commercialization" instead of the freely used but seldom specific term of privatization, and considers privatization to be but one form of commercialization; accepting that commercialization will take place, Canada has turned its attention to the implementation details (Brooks, 1995, 4). On a global scale, Canada is not alone in introducing major changes to the management of transportation infrastructure. These changes are being driven by governments responding to pressure to control deficits, limit borrowing, and improve efficiency (Butler and Starr, 1992, 993; Landry, 1993, 337; Lindquist, 1997, 46; Canada-Transportation-Act-Review-Panel, 2001). Finally, with reference to the Canada Transportation Act of 1 July 1996 and its continued trend of deregulation and commercialization, Recommendation 18.7 by the Canadian Transportation Act Review Panel states that the Canadian government needs to increase its support for transportation research (Canada-Transportation-Act-Review-Panel, 2001). It appears as though Recommendation 18.7 stems from the belief of the review panel that there is a potential shortage in transportation researchers in Canada, given the scope and complexity of current and emerging transport policy issues and concerns including: competition, financial viability and sustainable development; and that ultimately, good policy decisions will depend in part on the understanding that research is able to provide (ibid).

In addition to personal email communications with Mr. Ulf Gullne and Mats Andersson of the Swedish Maritime Administration regarding privatization in the maritime sector, chapter three identifies that on a global scale, private sector involvement in the provision of icebreaking services is common and can be found in many countries of the world including: Sweden, Finland, Russia, Latvia, Lithuania, Poland, Germany, Denmark and the USA (Arden L. Bement, 2006; Management, 2006). Also, personal email communications with Captain Ian Marr and Mr. Dick Hodgson, former CCG managers, have identified that privatization of the CCG has been considered in the past (Hodgson, 2007; Marr, 2007). To a lesser extent than outright privatization, the chartering of commercial vessels with icebreaking capacity for operations in the western Arctic were considered by the CCG for the 1997 Arctic summer season; an idea contemplated as a result of plans by the cash-strapped federal agency, the CCG, to scrap the Pacific based "Sir Wilfred Laurier" and subsequently free up one of the five eastern Arctic icebreakers on an as-needed basis to perform icebreaking duties in the western Arctic (Wilkin, 1997). Notwithstanding the above, during personal communication with the Federal Minister of Fisheries and Oceans, Minister Loyola Hearn informed that the Federal Government of Canada has no current intentions of privatizing CCG activities (Hearn, 2006).

5.3 Models, Theories and Frameworks

Pidd (2003, 1) characterises models as artificial representations deliberately created by researchers to help in their quest of understanding the possible consequences of their particular actions. He also suggests that a role for modelling is the attempt to make sense of strategic vision, and that it is a way of coping with change and turbulence. The environmental and geopolitical Arctic is currently undergoing considerable change and geopolitical turbulence. Strategic

management is no simple task in a world where uncertainty, complexity, and ambiguity dominate. In such an unstable environment, even the most carefully laid out strategic plans may be rendered useless by rapid and unforeseen change, especially that associated with technological advancements (Hill and Jones, 2007, 21). In deciding upon efficient and effective icebreaking capability for Canada's future, and given it could take three to five years to build an icebreaker, the CCG will need to pay very close attention to the latest advancements in icebreaking technology. Strategic management is an emergent and dynamic process and should not be left only, per se, to an annual review. There are many definitions of strategic management. Ansoff (2001, 21) implies that it is seen as an activity that will both discern the external possibilities, and bring about the appropriate capability changes. Others define it as a set of decisions and actions resulting in the formulation and implementation of plans designed to achieve an organization's objectives (Pearce and Richard B. Robinson, 2005, 3). Regardless of its definition, with respect to strategy formulation managers should not preconceive strategies but should keep one eye open to emergent strategies and the other open to the convergence and divergence of established strategies; managers should be able to appreciate when to exploit an established strategy and when to encourage new strains to flush out the old (Mintzberg and McHugh, 1985, 196). Managers at the CCG should not be exempt from this line of thinking. Research into maritime policy and management can help the viability and prosperity of maritime organizations that are pressured into creating and implementing new strategies and policies that allow them to meet the public demands of operating more effectively and efficiently (Panayides, 2006). As with the quest for conceptual model building for this research, and whether or not the CCG's provision of services in the Arctic should be open to private intervention and if so at what level, the words emergent, convergence, and divergence are pervasive.

Irrespective of the conceptual model developed in conducting research, one cannot help but reflect on the words of Boothroyd (1978, 126) when he suggested that given the variation between individuals, and within individuals over time, each individual will be affected in three general ways with respect to conceptualization. First of all, given a lifetime of social interaction and reflection, there is a large collection of unexamined concepts and articulations of uncertain pedigree. This may be due in some part to the fact that humans are mentally challenged at processing large amounts of information and therefore our cognitive tendency often results in either reducing complex information into selective and simplified gestalts or drastically overweighing vivid information (Miles and Huberman, 1994, 11). Secondly, as a result of some degree of coherent instruction, there is a more orderly collection of concepts. Finally, as with this research, there are a few concepts which an individual will have given thorough examination. In light of the above, it would seem fitting to introduce Robson's (2002, 21) ideology that, contrary to the positivist belief that science becomes credible and possible because every scientist looking at the same piece of reality sees the same thing, the characteristics noticed by an observer are wholly determined by the characteristics of what is actually being observed in conjunction with the characteristics and perspective of the observer. In defending case studies as a strategy of inquiry, Stake (2000, 442) notes that enduring meanings come from encounter and that repeated encounter, whether in the form of actual experience or being told of things, results in modifying and reinforcing the meaning.

As with the outset of most research, the researcher must begin by giving some consideration to the issues at hand, the cases to be studied, the data to be collected, and how best to manage and analyze the data (Miles and Huberman, 1994, 16). As with most plans, irrespective of their context, it is not uncommon for

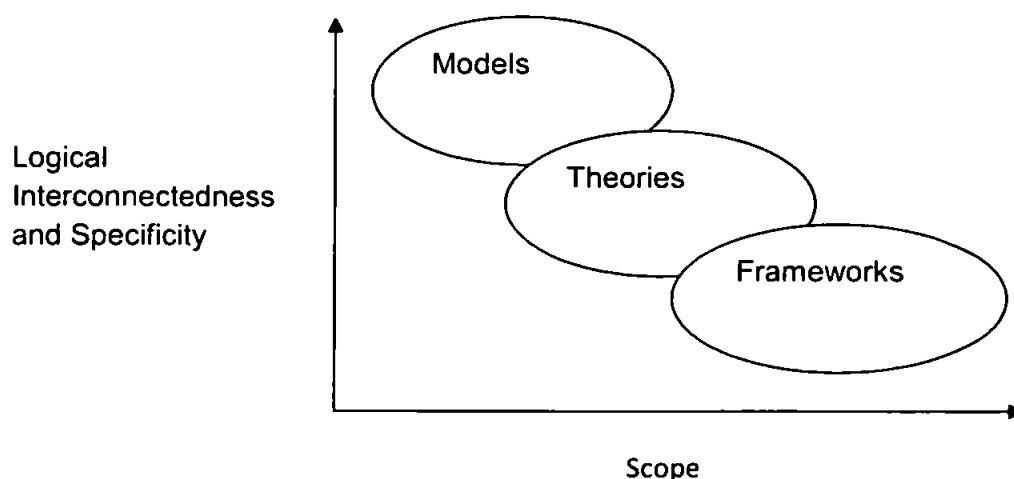
them to be altered by way of additions, deletions or rearrangement of the initial content. Miles and Huberman (1994) discuss the tradeoffs of tight versus loose conceptual designs in the broad spectrum of qualitative research and, as applicable to the current research situation, suggest that a tighter conceptual framework design may better suit a novice researcher given the clarity and focus it can provide. It would be fair to state that in every facet of life there are trade-offs if one inquires deep enough. If a framework is allowed to be referred to as an outline or the basis of something and a concept is allowed to be referred to as some form of abstract idea or way of thinking, then by means of deduction it would be fair to conclude that a conceptual framework is merely a non-concrete, outline of a researcher's ideology (Stevenson et al., 2002).

As with grounded theory, there was no initial theoretical framework developed at the outset of this research, and the hypotheses developed were generated from the data during the course of the research (Glaser and Strauss, 1967, 6; Saunders et al., 2007, 142). With respect to frameworks, Kumar (2005, 37) points out that the theoretical framework is the precursor to the conceptual framework which becomes the basis of a researcher's inquiry. With respect to the incessant review of the literature, *ibid* (2005, 38) notes the paradox in which a researcher struggles to effectively conduct a review of the literature until the research problem has been formulated, yet the literature review is valuable in helping formulate the research problem. Separated by convention the conceptual model, although conceived at the early stages of the research study, follows the narrative of the introduction and literature review respectfully. A careful literature review provides evidence for the significance of the study for practice and policy and for contributing to knowledge, and it identifies important intellectual traditions aiding in the development of the conceptual framework (Marshall and Rossman, 2006, 26). Allowing for flexibility in

the conceptual framework is crucial keeping in mind that the literature may disclose ideas and issues not contemplated during the infancy stages of the research design. Sekaran (2003, 87) informs that the conceptual model, central to examining the problem under investigation, theorizes or makes sense of the interrelationships among the variables that are deemed to be integral to the dynamics of the situation being investigated and thus helps the researcher to improve his or her understanding of the dynamics of the situation.

In light of the work of Elinor Ostrom, Sabatier (1999, 6) connects models, theories and frameworks in terms of their logical interconnectedness and scope and conceptualizes them, as shown in Figure 8, as operating along a continuum involving increasing logical interconnectedness and specificity, but decreasing in scope. An important strength of theory is that it can be used to exercise control with respect to action(s) that may be taken in respect of the observed phenomenon (Strauss and Corbin, 1990, 23, 38). This research will focus on the CCG to ascertain the attitudes of Canadian Arctic stakeholders with respect to the observed phenomenon of privatization and its various models currently being incorporated with respect to icebreaking in other regions of the world.

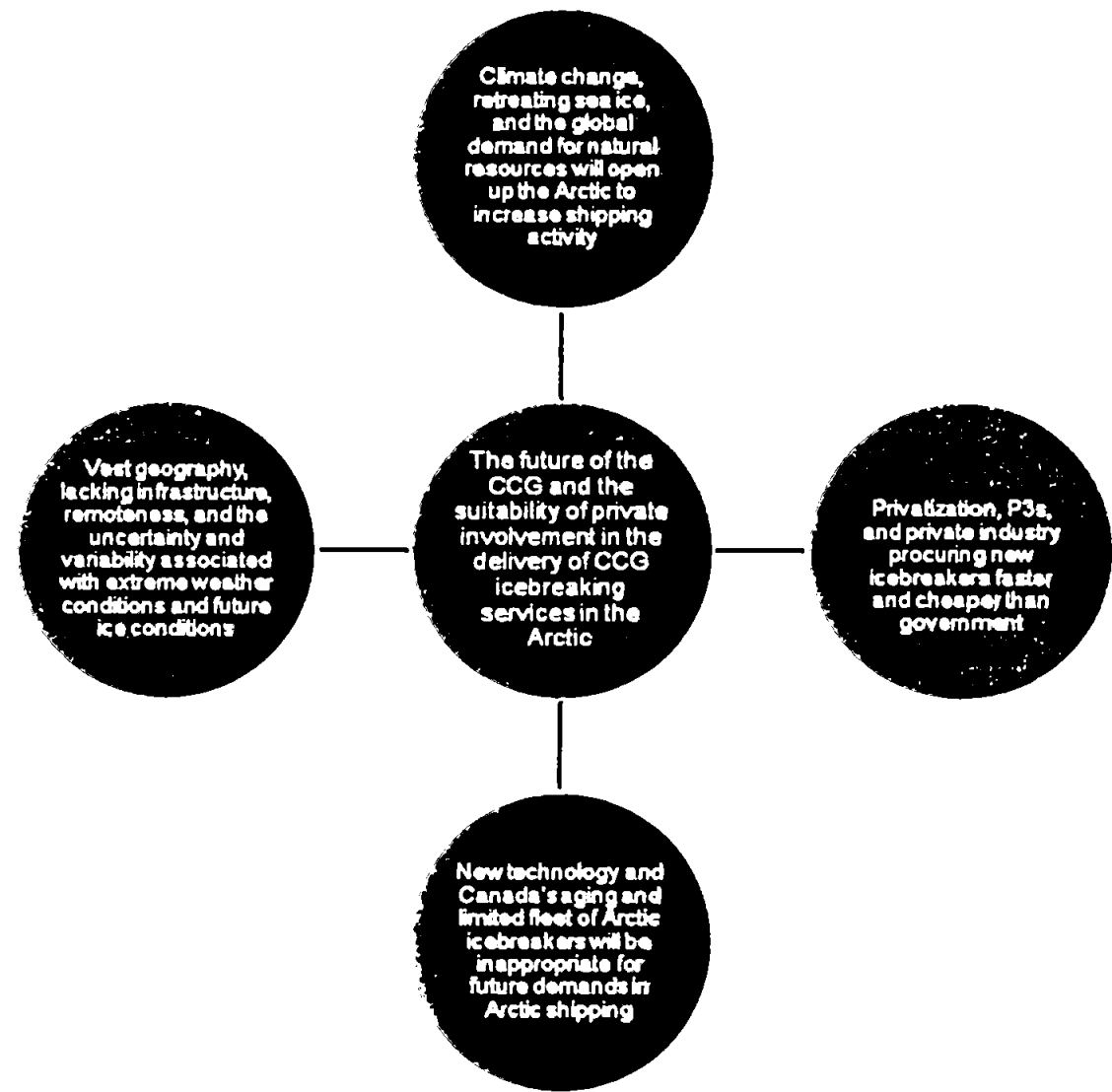
Figure 8 The Relationship among Models, Theories and Frameworks



Source: Author. (Adapted from Sabatier 1999, 6).

Conceptual models, identifying the things to be considered and most likely studied during the research, can be sets of equations presented in the narrative or graphically (i.e. the sorting of discrete events and behaviours into categorizing intellectual “bins” and the identification of their interrelationships) (Miles and Huberman, 1994, 18-22). See Figure 9.

Figure 9 The Conceptual Framework



Source: Author.

Conceptual model designs are as varied as the creativity of the researchers (Sharp and Howard, 1996, 113). Sekaran (2003, 97) suggests four phases to approach the development of a conceptual model:

- Identify the problems and issues through in-depth literature review and

purposeful interviews;

- Identify the variables contributing to the research problem through in-depth literature review and purposeful interviews;
- Analysis of the associations among variables once they are identified;
- Develop relevant hypothesis and subsequently test to help ascertain the extent to which the problem can be solved.

With reference to the conceptual framework, Marshall and Rossman (2006, 31) identify the following questions for the researcher to stay focussed on whilst moving back and forth through the various stages of the research:

- What is the specific focus?
- What are useful and/or creative questions?
- How is the literature connected to real-life observations?

Miles and Huberman (1994, 17), agree that the conceptual framework should be allowed to emerge during the course of study and that the important research questions will gradually clarify as the study progresses. They make note however, that tighter research designs have their advantages and may be better suited to provide clarity and focus for beginning researchers worried about diffuseness and overload.

5.4 Conclusion

The development of a conceptual framework, theory or model is a varied and dynamic process, and heavily dependent upon the literature review. Upon reflection of the description provided above concerning exploratory research, the realization that the research was not worth pursuing did not come to fruition. Rather, initial exploratory research in the form of a literature review and personal

communications with experts and stakeholders concerning the privatization of icebreaking services and the CCG, has shown that looking into the suitability of private involvement in the delivery of CCG services is worthy of further, more rigorous research. In flowing toward research methodology and how research should be undertaken, a review of the literature also helps the researcher decide the most appropriate way to go about the research project. The following chapter deals with research methodology and identifies the methods required to undertake the more rigorous research needed to fulfil the aim and objectives of this research project.

Chapter 6 Research Methodology

6.1 Introduction

The main aim of this chapter is to identify and support the rationale for the choice and order of methods selected to help fulfil the aim and objectives of this research. The chapter commences with a careful look at the theory of research methodology and paradigms and identifies that trade-offs exist in the various methodologies. The chapter continues by looking at the interplay among research, politics and public policy, both globally and from a Canadian perspective, and how this affects the selection of tactful research methods. It also looks at the role and biases of technical experts, academia, and politicians in policy development and implementation. The chapter concludes by identifying and supporting the choice of multiple research methods intended to be used with this research.

6.2 Methodological Approach

Saunders et al. (2007, 102) discuss research philosophy with respect to the assumptions of epistemology, ontology, and axiology. Tashakkori and Teddlie (1998), depending on which paradigm they are referring to, utilize the assumptions of method(s), logic, causal linkages, and generalizations. In addition, Collis and Hussey (2003, 49) incorporate the assumption of rhetoric.

In comparison to exploratory or descriptive research, more rigorous explanatory or hypothesis testing research, or case study analysis, involves the development of some level of theory (Saunders et al., 2007; Sekaran, 2003). The theory can be developed at various junctures of the research depending on the nature of the research and how it is approached (Dinwoodie and Xu, 2008). However, regardless of when a theory may be developed, Collier (1994, 23) notes that no

theory is unsusceptible to revision and improvement. With respect to grounded theory, Glaser and Strauss (1967, 6) note that the generation of a theory involves a process of research in which hypotheses and concepts not only come from the data but are systematically worked out in relation to the data. In the case of an inductive approach the researcher observes phenomena which, according to Collier (1994, 73), may sometimes be difficult to notice, and collects data so as to subsequently arrive at conclusions, or develop theory, based on the data analysis. In the case of a deductive approach, a theory is first developed and followed by a hypothesis (or hypotheses) which are subsequently tested using a well designed research strategy; it is possible and often advantageous to utilize both deductive and inductive approaches to the same piece of research (Saunders et al., 2007, 119). The systematic utilization of both inductive and deductive reasoning in research can be observed in Tashakkori and Teddlie's (1998, 25) research cycle of scientific methodology.

Much has been written on the paradigms and politics of research (Lincoln and Guba, 1985; Tashakkori and Teddlie, 1998; Lincoln and Guba, 2000; Robson, 2002; Collis and Hussey, 2003; Creswell, 2007; Dinwoodie and Xu, 2008). Paradigm or worldview beliefs are dynamic and the use of multiple paradigms in qualitative research is possible (Creswell, 2007, 19). The stance that one research approach is better than another may not be the most opportune way to approach research; researchers may gain more from taking the stance that trade-offs exist in research methodologies, as they do in practically all facets of life and that panaceas may only exist in our imagination, and that some methodologies are better suited for doing different things than others (Saunders et al., 2007, 116). Haque (1996, 512) in highlighting the interdisciplinary nature of public administration noted that with respect to its methodological shortcomings, many

scholars are more concerned with the domination of the positivist empirical method than they are with the lack of empirical method and emphasize the need for interpretive and critical modes of research in the field. Haas (2004) makes note of a new consensus emerging amongst social scientists in that a procedural or discursive model of policy process is normatively superior to the former policy analytical approach associated with cost benefit analysis and analytical efforts to identify the best policy solutions; a constructivist approach suggests that influential science must be developed authoritatively, autonomously, and independent of policy, and subsequently delivered to politicians by credible and trusted sources. Notwithstanding the above, Haque (1996, 518) notes that through the theoretical framework of public choice theory, policy studies and policy analysis tend to infuse market norms such as productivity and efficiency into public administration and gradually replace the public norms of accountability and responsiveness. Whatever approach is taken, the researcher must be able to make inferences that are internally valid, trustworthy and based on the results; triangulation techniques provide the lynchpin for improving the quality of such inferences (Tashakkori and Teddlie, 1998, 168-169).

The positivism paradigm is concerned with surface events or appearances, is atomistic, establishes meaning operationally, sees its central purpose to be prediction, is deterministic, and bent on certainty (Lincoln and Guba, 1985, 30). The purpose of this research is to ascertain whether or not CCG activities in the Canadian Arctic, and possibly other maritime regions of Canada, are suitable for private involvement, and if so at what level. Also, privatization, a worldwide phenomenon (Butler and Starr, 1992, 993; Haque, 1996, 512) and truly international (Pirie, 1998, 295; Hodge, 2000, 14), of marine activities, is currently active in such countries as Russia, United States, and Sweden and confirmed as

being successful in Sweden (Anderson, 2007). Therefore, one could take a positivist stance and deduce that privatization in Canada should prove to be successful as long as there are contextual similarities between the CCG levels of services and the privatized marine services being provided in other countries. Contrary to the positivist ideology that deductions can be made about specific phenomena by observing correlations between variables which are conveniently available, the realist will look beneath perceived data for a deeper level of explanation (Lane, 1996). In light of a grounded theory methodology, Strauss and Corbin (1990, 45) suggest that a researcher needs to maintain an attitude of scepticism; hypotheses made from comparisons ought to be treated as provisional until supported by actual data.

6.3 Research, Politics and Public Policy

With respect to competitive advantages, Landry (1993, 337) comments that successful policy innovations tend to be rapidly imitated by others, especially neighbours. However, Vickers and Yarrow (1988, 1) note that with reference to microeconomic textbooks, little or no discussion of positivist theories of public enterprise is provided. Further, Sabatier (1999, 3) notes that the public policy process can be complicated and often involves an extremely complex set of interacting elements over a span of time. In addition, Fischer (2003, 2) notes that the question of precisely what public policy is, is not an easy one to answer. This is true in terms of the CCG and any efforts to privatize the public services that it provides, notably the icebreaking component of its services.

“The process of public policymaking includes the manner in which problems get conceptualized and brought to government for solutions; governmental institutions formulate alternatives and select policy solutions; and those solutions get implemented, evaluated, and revised” (Carnaghan and Goody, 2006).

Notwithstanding the above, Hatzopoulou and Miller (2008, 150) state that Canada lacks an adequate framework for integrated transport policies and it remains unclear whether positive action is being taken to deal with the complex decision making environment and integrating the decisions of the various federal, provincial, and municipal ministries. Roe (2008) notes that while maritime transportation has been the cornerstone of globalization, those governing the maritime sector are doomed to follow the inappropriate state-centric, hierarchical model of policymaking and will inappropriately engage in the critically necessary networking and inclusivity of the various stakeholders of the maritime sector.

Haque (1996, 513) warns that while privatization as an “objective” policy is not problematic, its reification into a global ideology, as a panacea for all socioeconomic problems, has activated public opinion against the public service and influenced policy making in many countries. The task of trying to ascertain the attitudes towards the suitability of private involvement with respect to the level of services, with particular emphasis on ice breaking operations, carried out by the CCG in Arctic Canada, is not anticipated to be an easy one. Haydon (2007, 1) informs that the reason why no historical records have been kept with respect to public opinion concerning naval and maritime issues in Canada, has to do with the fact that the majority of Canadians live between Montreal and Vancouver and have no vested interest in maritime matters because the oceans have little direct impact on their daily lives. In talking about the lack of attention given to the maritime ideals of Canada, Saul (2008, 299) strongly attributes this to the obsession of Canada’s elite, centrally located and adjacent to the southern border, with Washington and the United States, and a lack of northern vision and focus by Canada’s policy makers. However, Vickers and Yarrow (1988, 2) believe that ideas, analysis, and evidence do, ultimately, have a substantive bearing on the

evolution of public policy. Information is power. As a public taxpayer, one would assume that a well informed decision maker or politician would or should objectively make policy decisions for the betterment of society. Who does an objective decision maker take advice from? Lasswell (1951, 13) notes the important contribution of the experience of men of action in active policy making, and points out that academic specialists could contribute more to the policy sciences by systematizing and evaluating some of the ideas of these men of action. Haas (2004) in describing 'usable knowledge' as having a substantive core that makes it usable for policy makers, and a procedural dimension that provides a mechanism for transmitting knowledge from the scientific community to the policy world, informs that such knowledge is accurate information that is of use to politicians and policy-makers and it frequently exceeds the mastery of any individual disciplinary approach. As with this research, the systematization and evaluation of the ideas, opinions, and experiences of key industry stakeholders is needed in order to fulfil the research aim and objectives. Policy matters may relate to past, present or future situations. Hyman (1951, 205) notes that in the case of anticipations about the future, inferences can only be made through the personal documentation of an individual's thoughts and that interviewing is an effective method of capturing such thoughts. Likert (1951, 249) notes that while the wisdom of public experience and thinking can help focus the general policy to be pursued, the help of technical experts is often required to devise the best method of implementing the will of the public. However, awareness and caution may be required in today's capitalist societies where the autonomous public sphere, once used by interactive and discursive private individuals to discuss issues of common concern and form public opinion, has now become a venue for advertising and legitimizing the state and corporate interests through the media; without such critical public space the diversified aggregate of the fragmented public will be

unable to inform the public (Calhoun, 1992, 26; Haque, 1996, 526). With respect to Canada, Saul (2008, 270) criticizes the toothless approach to media concentration, and warns of the slow and intentional erosion by government, during the last two decades, of intelligent arm's-length public information, independent thought, and debate; leaders intentionally prevent the discussion of ideas and expect civil servants to do the same, speaking up and debating issues are seen as signs of disloyalty.

Rothwell (1951, ix) identifies four steps in the formulation and execution of policy:

- Clarification of goals;
- Exhaustive evaluation of the situation;
- Selection of a course of action after weighing the probable consequences of various alternatives;
- Determination of optimum means for carrying out the action decided upon.

Sabatier (1999, 3) identifies five reasons why the policy process involves the interacting of complex elements over time:

- The values, perceptions and policy preferences of the many actors in the various governmental, legislative, research, journalist, and other interest groups can be potentially very diverse;
- The time span required from the emergence of a problem through sufficient experience with implementation to render a reasonable fair evaluation of program impact can take a decade or more;
- The given policy domain with its potential for many different actors and programmes is not clearly delineated;

- Policy debates typically involve very technical disputes over the severity of a problem, its causes, and the probable impact of alternative policy solutions;
- The level of personal interest, gain, and sacrifice will vary for the many actors involved and thus the many disputes, unlike polite academic debate, will most likely be tempted to selectively distort the situation at hand.

In light of Sabatier's last point, Curran and Blackburn (2001, 163) warn of the chasm between the academic researcher seeking to advance knowledge on social and economic activities for its own sake and the adversarial politician trying to promote the quality of his or her own policies over those of their opponents. They also warn that, while researchers have values and are committed to honesty in conducting their research, any idea of purely objective research, linked closely to rationally based, evidence-driven policy-making and implementation, is unlikely in any modern society.

Although the views and ideas of a theorist and a practitioner are quite often worlds apart, this work aims to consider both simultaneously in the search for a synergy. Merton and Lerner (1951, 306) suggest that theoretical and empirical emphases work better in a reciprocal relationship than either of them does in isolation. To help set the stage for the research methodology and methods exploited in this research it may be helpful to avail of a truism that the acts of privatization and nationalization are not new, and that both should be viewed as government actions tied closely to the political and economic belief(s) at the time (Hakim et al., 1996, 4); Canada is no exception (Landry, 1993). Vickers and Yarrow (1988, 1) note that the differences in attitudes towards public and private ownership are frequently the main distinguishing characteristics of political parties. Bos (1991, 2) states that large scale privatization, the sale of public assets in his sense of the

meaning, leads to a new distribution of power between the private and public sectors with decisions on prices, investment, and technology being taken out of the domain of public bureaucrats and policy-makers and placed in the care of market-oriented technocrats responsible to private shareholders. Hodge (2000, 14) provides several definitions of privatization, one of them being a policy movement initiated from political origins or objectives. Burton (2006) references the attempts being made by the USA and UK governments to 'modernise government' and improve the process of policy making. Hass (2004, 575) describes policy making as a process rather than a fixed set of analytical techniques and thus sees policies as experiments that participants monitor, evaluate, and improve over time. Fischer (2003, 2) notes that in today's complex technological society it is imperative that, when policy decisions combine sophisticated technical knowledge with intricate and often subtle social and political realities, decision makers be provided with relevant information. Merton and Lerner (1951, 289) make an effort to distinguish among policy advisers, policy makers, decision makers, and executive agencies. Policy advisers are seen as those who supply policy makers with the knowledge upon which planning and intelligent policy formation must be based, while decision makers apply policy, which they may help to formulate, to the solution of current and specific problems. In the view of *ibid* (1951) the semi-autonomous executive agency is described as a government institution which can adjudicate the semi-permanent conflicts between public and private interest on a basis of knowledge, skill, and impartiality, rather than "mere politics." The future intention of this research is to provide evidence to the policy makers of the Canadian federal government with respect to the possible outcomes of private involvement in CCG activities being carried out in the Canadian Arctic. Today's complex society is continually changing and being changed by technology and as such intensifies the information requirements of

those civil servants in decisions making positions (Fischer, 2003, 2). Technology advancements, abundant Arctic resources, self- governance of Arctic inhabitants, and climate change will have profound effects on the nature of policy and on the processes of policy making (Burton, 2006, 173) in Canada. Merton and Lerner (1951, 299) note two functions of research originated by social scientist:

- Sensitizing policy makers to new types of achievable goals;
- Sensitizing policy makers to more effective means of reaching established goals.

The commonality of the two is the sensitization of policy makers to a wider range of realizable potentialities.

Regardless of the outcome and any associated recommendations or conclusions that may be put forward as a result of this research, adhering to the status quo or fully privatizing the CCG operations in the Arctic will impact stakeholders differently. There are numerous stakeholders involved with, and affected by, the actions of the CCG in Arctic Canada and it is doubtful if any decision will be accepted or viewed by all in the same way. Regardless of the decision, it is expected that some stakeholders will feel they have gained or benefited while others will feel they have lost out or suffered. Owing in part to sometimes complex factor interactions, decisions pertaining to public policy usually involve various groups of individuals who often construe the same situation differently (Panayides, 2006, 96). Such complex interactions demand better connected policy responses based on more sophisticated and robust analysis of underlying causes and possible solutions (Burton, 2006, 173). Central to this research is the Pareto optimum and the belief that any policy decision should maximize public utility for the taxpayers of Canada. Globally, a fundamental and central economic problem is the scarcity of society's resources (Lipsey et al., 1994, 3). With references to

this research, the limited resource is ultimately seen as the tax dollars given by the Canadian taxpayers. Canadians are not noted for generous giving; indicated by the groundswell of resentment by citizens and business owners with respect to the imposition of the June 1987 tax reform and its broad reaching goods and service tax (GST) (Lindquist, 1997, 50-59). Attaining the desires, wants and needs of all taxpayers may therefore be viewed as a daunting undertaking. In consideration of what would be good to do versus what one should do, a result of the scarcity of goods and resources, policy claims may be necessary (Green, 1982, 153; Smith, 1987, 312). Smith (1987, 309) states that the justification of claims in the practice of evaluation research is not easy given that there are several types of claims commonly made:

- Policy claims;
- Research claims;
- Evaluation claims;
- Management claims.

6.4 Research Methods

Any claims to be put forward as a result of this research will need to be able to stand up to the rigours of both academic and political scrutiny. The following eight characteristics are considered by Sekaran (2003, 22) as the hallmarks of scientific research:

- Purposiveness – the research has aim and purposive focus;
- Rigor – a solid theoretical base and a carefully thought-out methodology enables the researcher to collect the right kind of information from an appropriate sample with the minimum degree of bias and helps facilitate suitable analysis of gathered data;

- **Testability** – testing logically developed hypotheses to see whether or not the data support the educated conjectures or hypotheses that are developed after a careful study of the problem situation;
- **Replicability** – the hypothesis is reflective of the true state of affairs in the population and the same results will be replicated when the same type of research is repeated in other similar circumstances;
- **Precision and Confidence** – research designed to provide accurate precision and high confidence levels helps ensure that research findings are as close to the true state of affairs as possible;
- **Objectivity** – while initial research may commence with some subjective values and bias, the interpretation of data should be stripped of personal values and bias and conclusions ought to be based on the facts of the findings derived from the actual data;
- **Generalizability** - while a wide scope of applicability of research findings is desirable with respect to its usefulness, cost concerns usually confine most applied research to the organization where the problem arises;
- **Parsimony** – with respect to the economy of research models, meaningful and parsimonious models are preferred over elaborate and cumbersome ones.

The research outcomes will need to prove its relevance to the situations being observed and explored and any propositions to be put forward will need to show that they are justifiable and attainable (Dinwoodie and Xu, 2008). Unlike the ultimate measure of significance for basic research, its contribution to theory and disciplinary knowledge, applied research helps people to make decisions and is generally directed toward informing others of possible consequences of policy options; these consequences may be determined retrospectively as in evaluation

research (Chambers, 2000, 851). Smith (1987, 309) characterizes evaluation research as the making of justifiable claims, an assertion that a particular question-answer proposition is both meaningful and valid, with regards to the object of study and that inquiry is the core of such research. The object of study in this research is the CCG and its operations in the Canadian Arctic, more specifically, the levels of service being currently carried out of which icebreaking plays a significant role. Ibid (1987) suggests that evaluation research involves research claims, policy claims, evaluation claims (the defining characteristics differentiating evaluation research from other forms of applied social research), and management claims (though not directly a part of evaluation research, they represent the ultimate ends to which the others claims are usually directed) and that all claims stem from appropriately categorized questions that are given sufficient attention to bring about a desirable question-answer connection. Relevant to the inquiry of CCG operations in the Canadian Arctic are a list of question types categorized by ibid (1987, 311) and consist of:

- Causal-Research;
- Noncausal-Research;
- Noncausal-Policy;
- Noncausal-Evaluation;
- Noncausal-Management.

Table 9 provides examples of questions relating to this research in accordance with Smith's taxonomy above. Smith does comment on the overlapping among the questions in the various categories.

Mitroff and Turoff (1975), in discussing the philosophical and methodological foundations of Delphi, state that there is no one "*single best way*" for ensuring the understanding of the content of a communication or for ascribing validity to a

communication, and that the real question is not how we can determine or agree on the meaning of “truth” with “perfect or complete certainty” but how can we justify what we think we can know.

Table 9 Sample Research Questions Using Smith’s Taxonomy

Causal-Research	Is economic development in Canada’s Arctic dependent upon the services of the CCG in the Arctic?
Noncausal-Research	What is the present level of service being offered by the CCG in Arctic Canada?
Noncausal-Policy	What are the possible consequences of privatizing CCG operations in the Arctic?
Noncausal-Evaluation	How do Canadian Arctic stakeholders view and judge the current level of service being provided by the CCG?
Noncausal-Management	What are the benefits to Canadian taxpayers of private involvement in CCG operations in the Arctic?

Source: Author.

With respect to accepting a proposition as valid or as true, *ibid* (1975) state that underlying *any* scientific technique, theory, or hypothesis there is always *some* philosophical basis about the nature of the world upon which that technique, theory, or hypothesis fundamentally rests or depends and that the criterion of the various philosophical or inquiring systems dictate the characteristic questions which would have to be answered before accepting the proposition as valid or as true.

In terms of research choice or design, it is the intention of this research to exploit the potential benefits of adopting multiple methods, more specifically mixed-method research (Saunders et al., 2007, 145-146). It will use more than one data collection technique and analysis procedure. Quantitative and qualitative techniques and procedures will be used in combination as well as primary and secondary data. Such a research choice or design is advocated within business and management research; collecting data in more than one way helps ensure all of the issues relevant to the research are covered even if their initial importance is

not fully appreciated by the researcher (Curran and Blackburn, 2001, 72). Accepting that the various research methodologies each have their own strengths and weaknesses, Mangan et al. (2004, 569) note that research availing of both data and methodological triangulation can compensate for the flaws, and leverage the strengths, of the available research methodologies.

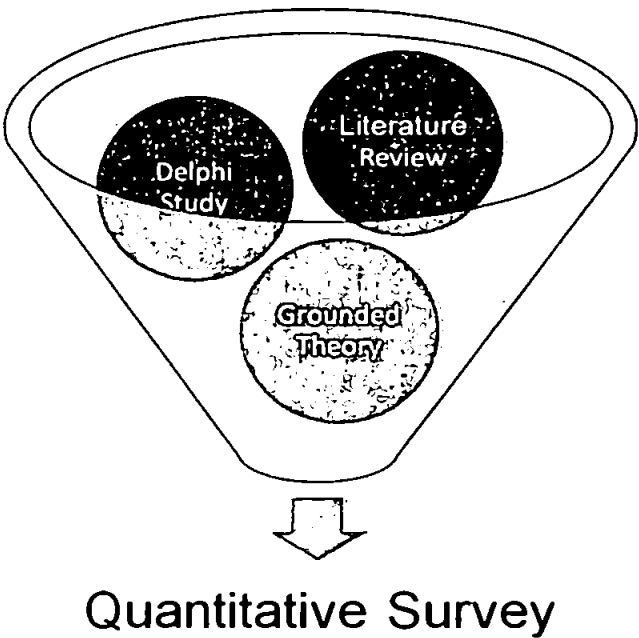
With respect to the exploitation of multiple methods in a research project, Saunders et al. (2007, 146-147) identify two major advantages, different methods can be availed of for different purposes, and mixed methods enable triangulation. According to Fontana and Frey (2000, 647), triangulation dates back to 1886 with the start of a study by Charles Booth resulting in the published work *Life and Labour of the People of London* (1902-1903); survey research was triangulated with unstructured interviews and ethnographic observations. Robson (2002, 174-175) characterizes triangulation as the use of multiple sources to enhance the rigour of the research and to help counter all of the threats to validity. Tashakkori and Teddlie (2003, 673-674) suggest that although the word triangulation is associated with mixed methods by most researchers, the word has been so broadly defined and overused that it may mean nothing unless mixed methodologist specify how it is specifically defined in their research. In light of the advice of Tashakkori and Teddlie above, and availing of the first advantage identified by Saunders et al. above; with respect to the research undertaken for this PhD, a multi-method qualitative study will be utilized at the onset. A survey, in the form of a Delphi study in Phase I, will act as a scoping exercise and will follow a sequential, mixed-method, and predominately qualitative approach (Saunders et al., 2007, 145-146). In terms of qualitative or quantitative approaches to research, the Delphi method can incorporate elements of both types of techniques (Meyrick, 2003, 8). The Delphi exercise will be used to ascertain the ideas and beliefs of an

expert panel of participants familiar, in varying degrees and extent, with the organizational structure, state and condition of infrastructure, and levels of services of the CCG especially with respect to Arctic operations. Strauss and Corbin (1990, 52) inform that a review of the literature can help generate questions to ask of research participants and to guide initial observations.

In light of the advice in the preceding chapter from Saunders et al. (2007) regarding exploratory research, and Sekaran (2003) regarding the approach to conceptual model development, it seems appropriate that further exploratory research in the form of a scoping study, and subsequent explanatory research carried out through purposeful interviews and the testing of hypotheses be conducted in attempting to fulfil the research aim and objectives. As depicted in Figure 10, it is therefore proposed that the scoping study, in the form of a Delphi exercise, be carried out to identify further, and seek agreement on, the issues surrounding private involvement in the delivery of CCG icebreaking services in the Arctic. The Delphi exercise, unlike what the literature review was thoroughly unable to do, will hear first hand from experts and stakeholders on matters related to the research aim and objectives. Subsequently, the results of the Delphi exercise will be brought forward as the basis for conducting in-depth and semi-structured interviews in Phase II which will be analyzed in accordance with grounded theory methodology in attempting to develop hypotheses and relationships. As noted earlier, Glaser and Strauss (1967, 6) in discussing grounded theory analysis, note that the generation of a theory involves a process of research in which hypothesis and concepts not only come from the data but are systematically worked out in relation to the data. Unlike quantitative researchers utilizing large samples sizes in seeking statistical significance, one of the key features of qualitative sampling according to Miles and Huberman (1994, 27) is

the careful selection and use of a small number of contextually nested people who are studied in-depth. As with most probabilities, random sampling of a small population cohort could lend itself to biased results. Ibid (1994, 36) note that in the case of an applied, evaluation, or policy study the focus is tighter and the instrumentation is closely keyed to the variables of interest; instrumentation should be a function of the conceptual focus, research questions, and sampling criteria. During data coding and analysis, patterns and relationships in the data will hopefully be revealed for which hypotheses can be developed to test such connectedness in the data (Saunders et al., 2007, 482).

Figure 10 Research Methods and Approach



Source: Author.

The initial, Phase II, interviews will be for the most part exploratory but will have a central theme focused on the appropriateness and suitability, for the CCG, of already identified models of private involvement in icebreaking services. At this time, data gathered in the initial interviews will be categorised according to terms used by the participants, terms emerging from the data, and /or terms already in place with respect to privatization (Strauss and Corbin, 1998). It is anticipated that

the early stages of data organization and category building will be dynamic and that a funnelling process will tighten the data analysis. Major ideas and issues common in the initial interviews will serve as the main theme(s) and assist in the development of key questions for subsequent interviews. In subsequent interviews respondents will be given the freedom to introduce new ideas and issues central to the context of private involvement in the provision of CCG services. Data gathered in these subsequent interviews will be further categorised in light of the categories identified during the initial interviews. The hypotheses or propositions inductively emerging from earlier interviews will be tested in later interviews. Testing of such hypothesis or propositions will allow movement toward formulating valid conclusions and an explanatory theory, if only a simple one (Miles and Huberman, 1994). Keeping in mind that association between variables may not be enough to infer a connection between them (Dey, 1993, 48) but that an intervening variable may offer more in terms of association between variables (Saunders et al., 2007, 483).

The research approach will incorporate both inductive and deductive analysis. Earlier interviews are expected to follow the inductive approach while subsequent interviews are expected to follow the deductive approach. Tashakkori and Teddlie (1998, 25) put forward the Cycle of Scientific Methodology. Thus, it is anticipated that inductive reasoning of the observations, facts and evidence collected in earlier rounds will lead to generalization, abstraction, and possible theory upon which further prediction, expectation, and hypotheses may be made. These will be reasoned deductively in subsequent interviews to deliver evidence or facts pertaining to possible private involvement in the delivery of CCG services, principally Arctic icebreaking. If required, in order to fulfil the research aim and

objectives, any hypotheses and relationships developed during the grounded theory component of the research might be tested and quantitatively analyzed.

6.5 Conclusion

Given that trade-offs exists in the choice of research methodologies, the researcher will need to be cognizant of them when deciding how a research project ought to be best approached and conducted. Whatever approach is taken, the researcher must be able to make inferences that are internally valid, trustworthy and based on the results. While triangulation provides the lynchpin for improving the quality of such inferences, the researcher needs to clearly define its meaning and be specific about its implementation.

Any privatization or public involvement with the delivery of CCG icebreaking services will almost certainly arouse public debate, and will be subjected to the complicated public policy process in which the various players all have their own agendas. However, there is an important role for applied research in the capacity of a policy advisor between the technical men of action and the policy or decision makers.

The next chapter will explore the views and ideas of stakeholders and experts, on Arctic matters and private involvement in the delivery of CCG services in the Canadian Arctic.

Chapter 7 The Delphi Exercise

7.1 Introduction

Private involvement in the CCG activities carried out in the Canadian Arctic has the potential for far reaching consequences in terms of accountability, border control, defence, dependability, environmental protection, feasibility, liability, reliability, resource management, and sovereignty for the many stakeholders involved. As with any plan, the economical, environmental, political, and social matters will need to be addressed and evaluated. In light of the above, it is felt that the contributions or inputs of the many stakeholders, directly or indirectly involved or affected by the possibility of some level of private involvement, should be taken into consideration and weighed appropriately. In this chapter, stakeholder contribution and input with respect to the development of transportation policy and infrastructure will be garnered through a Delphi exercise, noted as Phase I. As a nation's transportation facilities and policies develop, so follows the shape of the nation (Slavin and Devine, 1973, 241). The chapter commences with discussing the rationale for utilizing Delphi. This is followed by examining the processes used in the selection of Delphi participants and the first round of questions. Subsequently, the response to and observations of the Delphi exercise are discussed. The chapter concludes with the results of the exercise in terms of themes and consensus.

7.2 Rationale for Utilizing Delphi

Initial investigation of research objectives 1 and 2, to synthesize experts' perceptions of future marine activity in the Canadian Arctic and to compare experts' perceptions of CCG services, principally Arctic icebreaking, in terms of their ongoing effectiveness and efficiency, revealed that a Delphi study was

required to analyse the perceptions of experts relating to these objectives. Delphi solicits expert opinions and allows powerful insight into developing and complex topics (Islam et al., 2006, 579).

Since its inception in the early 1950's by the Rand Corporation for defence purposes, Delphi has been applied in various ways in business, transportation, education, health, and government. In terms of qualitative or quantitative approaches to research, the Delphi method can incorporate elements of both types of techniques (Meyrick, 2003, 8). Delphi, according to Lindstone and Turoff (1975, 4), is seen by some as a way of forecasting while others see it as an appropriate method to:

- Gather data not accurately known or available;
- Evaluate possible budget allocations;
- Explore planning options;
- Delineate the pros and cons associated with potential policy options;
- Develop causal relationships in complex economic or social phenomena;
- Distinguish and clarify real and perceived human motivations;
- Expose priorities of personal values and social goals.

Accepting that technology is changing at an unprecedented rate, the ability for a particular individual to totally comprehend its full effect on an entire interconnected system will decrease with time as newer technology becomes available (Slavin and Devine, 1973, 250). In defending the utilization of Delphi with respect to the aims of the research for this PhD, the Canadian Arctic is a geographically large place with various groups of stakeholders interested in the region. Ship construction and icebreaking technology is changing. Climate change is affecting

the area causing decreased annual ice coverage during summer months. The issues and concerns facing Canadian taxpayers and politicians are constantly shifting in the face of limited tax dollars. The demands of the entire planet in terms of natural resource exploitation are dynamic.

"Delphi may be characterized as a method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem" (Linstone and Turoff, 1975, 3).

Practical problems are often complex and multi-faceted. Therefore, democratic analysis should examine the problem from the perspectives of the various disciplines with experience and expert knowledge in the problem area. Merton and Lerner (1951, 300) note that policy makers are starting to relinquish the notion that a practical problem is invariably in the orbit of one specialized body of science. Given the dynamics of the Arctic region and the uncertainty of the effects of private involvement in CCG activities in the region, it would seem prudent to involve as many of the stakeholders with an interest in the Canadian Arctic as possible. Therefore, a conventional Delphi exercise would seem appropriate for the task at hand. Appropriate use of Delphi can help the researcher obtain a reading on the values or goals held by the various stakeholders (Schneider, 1972, 497). In addition, it can help capture a wide range of interrelated variables and multidimensional features common to most complex problems (Gupta and Clarke, 1996, 186). Further rationale for using Delphi can be found in the work of Lynch et al., (1994, 97) who point out that Delphi allows the researcher to design a questionnaire to meet the particular objectives of the situation at hand and is also able to accommodate the wide geographical disbursement of the participants involved in the questionnaire.

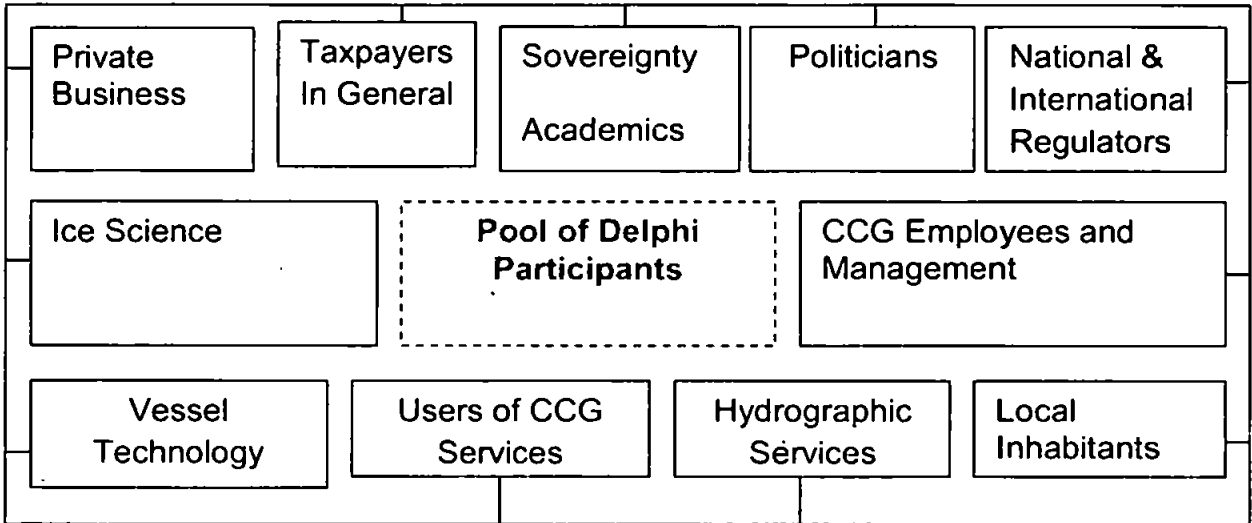
7.3 Selection of Delphi Participants and First Round of Questions

The selection of participants chosen for the Delphi exercise was given careful consideration. In light of the varying spectrum of stakeholders associated with the Arctic it was felt that representation from as many different disciplines as possible should be involved. Czinkota and Ronkainen (1997) suggest that it is critical to secure the participation of the right kinds of experts and that they represent a substantial variety of viewpoints. It is also important that the participants have interest in and knowledge of the research issue (Meyrick, 2003). Figure 11 illustrates the background diversity of the chosen participants. The actual selection of participants within the groups were identified in the literature review, from attending two conferences related to the research topic, and from personally known individuals with some form of connection to Arctic matters. Availing of a synergistic approach, tapping into the knowledge and experience from a broad range of disciplines should enable a researcher to gain new insights that would otherwise not be obtainable through individual exploitation of the same disciplines (Saunders et al., 2007, 6).

With respect to participant, and question, selection for the first round of Delphi there was acknowledgement, appreciation and constant reminder that bias has the ability to threaten any evaluation and the inferences drawn from information and data can only be as good as the native cognitive mechanism, the brain, allow (Sadler, 2002, 126). Throughout the research there was continual reflection, and attempted elimination or reduction, of Sadler's (2002, 124) three broad groups of bias, namely: *ethical compromises* or distortions due to the possibility of payoffs and penalties, *value inertias* or the background experience and idiosyncratic trappings brought forward by the evaluator, and the 13 *cognitive limitations* in human information processing ranging from data overload to consistency in

judgment. In reference to the comments of participants stating that some of the questions were subjective, subjectivity according to Sadler (2002, 125) is a natural and necessary element of evaluation, which calls for no apology.

Figure 11 The Arena of Delphi Participants



Source: Author.

The initial response from the first round of Delphi showed that the vast majority of participants, some of which were personally contacted prior to distribution of the first round of questioning and who agreed to participate, employed with TC and DFO simply did not respond or reneged on their earlier commitment to participate. One stakeholder from the CCG did not participate as it was felt that the questions were looking for opinions and not facts. Another stakeholder from DFO, who earlier agreed to participate, subsequently informed that they could not participate on orders from headquarters in Ottawa. Some participants commented that the questions were biased, subjective and even absurd.

The questions put forward in the first round of Delphi were founded on the results of a thorough literature review focused mainly on:

- Current and future CCG levels of services;
- Arctic climate change and its affect on transportation in the Arctic regions;

- New icebreaking technology;
- Privatization;
- The growing demand for natural resources in politically stable but rather remote and harsh environments.

Several of the questions, including those concerning the organizations structure, were based on the findings of the December 2000 Report from the Office of the Auditor General in which Section 31.1 of the Main Points states:

"In our opinion, Fisheries and Oceans is not managing its fleet in a cost-effective manner. There is a wide variation in practices and procedures employed by the five regions where the fleet operations are controlled. With each region having its own operating practices, procedures and support, the Department is missing opportunities for greater flexibility in sharing resources and for better productivity in providing the fleet service" (Auditor-General, 2000).

7.4 Delphi Responses

With respect to the first round of questioning, Delphi No.1, and in light of Section 7.3, the questionnaire was emailed out to 72 individuals around the world with the majority of individuals coming from across Canada. The rationale for utilizing email stems from its flexibility and convenience in that it enables the message to follow the recipient who can then wait for a convenient time to respond to it (Meyrick, 2003, 10). Of the 72 individuals, 32 responded before the twice postponed cut off date and two others responded shortly after the cut off date and thus too late to be used in the Delphi exercise. The questionnaire was officially sent out on 31 January 2007 and individuals were asked to return the questionnaire within two weeks. Prior to the end of the two-week cut off date some individuals replied informing they were experiencing difficulty downloading the free version of Adobe Reader 8. Consequently, the questionnaire was resent as an MS Word document to the entire list of individuals that had not returned their questionnaire to date. In addition, and also at the request of some individuals, the cut off date for the return

of the questionnaire was extended to the 6 March 2007. Of the 32 individuals that responded, 11 had previously been met and were asked if they would be interested in participating, 11 had previously been met and the questionnaire was sent without prior notice, six were asked via email if they would be interested in participating and were subsequently sent the questionnaire, and four of the participants were referrals who had been forwarded the questionnaire by other individuals. A detailed account is provided in Appendix 3. Table 10 provides a summary of the Delphi exercise.

Table 10 Summary of the Delphi Exercise

	Round 1	Round 2	Round 3
Participants	32	27 of 32	23 of 27
Questions	32	44	21
APMO (%)	49.3	41.9	37.2

Source: Author.

With respect to the second round of questioning, Delphi No.2, the questionnaire was emailed out to the 32 individuals that had responded to the first round of questioning. In light of the technical difficulties experienced with Adobe Reader 8 in the first round of questioning, the second round of questioning was emailed out as an MS Word document. Of the 32, 27 responded before the twice postponed cut off date, one responded shortly after the cut off date and thus too late to be used in the Delphi exercise, one responded before the initial cut off date to inform they would be dropping out as they did not have the time to commit, and three others did not reply at all. The questionnaire was officially sent out on 16 March 2007 and individuals were asked to return the questionnaire within two weeks. By 30 March 2007, the initial cut off date, 13 had replied. Given the low response rate, a reminder was sent at the end of day on 30 March 2007 that the response period would be extended and the cut off date would be postponed until 13 April 2007. By 13 April 2007 another nine individuals had responded. Knowing that some very

interested individuals had not yet responded, presumed to be incommunicado or busy, another reminder was sent out on 13 April 2007 to inform that the cut off date was now extended to 18 April 2007. Five more individuals responded before the final cut off date.

With respect to the third round of questioning, Delphi No.3, the questionnaire was emailed out to the 27 individuals that had responded to the second round of questioning. As with the second round of questioning, the third round was emailed out as an MS Word document. Of the 27, 23 responded before the twice postponed cut off date, one responded but with no response document attached; a reminder was sent to this participant but no subsequent reply was ever received, three did not respond at all, and one individual who was travelling responded shortly after the final cut off date and was accepted given this was the final round of questioning and analysis had not yet commenced. The questionnaire was officially sent out on 30 April 2007 and individuals were asked to return the questionnaire within one week. By 7 May 2007, the initial cut off date, seven individuals had replied. Given the low response rate, a reminder was sent at the end of day on 8 May 2007 that the response period would be extended and that the cut off date would be postponed until 11 May 2007. By 11 May 2007 another ten individuals had responded. Knowing that some very interested participants had not yet responded, presumed to be incommunicado or busy, another reminder was sent out on 16 May 2007 and the cut off date was now extended to 18 May 2007. Five more individuals responded before the final cut off date of 18 May 2007 and one last individual responded on 24 May 2007. This concluded the Delphi study. Details of the final results of the three rounds of questioning are shown in Appendix 4.

7.5 Observations of the Delphi Study

Throughout the three rounds of questioning there were numerous examples where answers were agreed to, or were left blank, but comments were still provided; individuals were instructed to comment only if they disagreed with the statement provided.

With respect to the number of blank responses, the first round of questioning, administered in both an electronic questionnaire Adobe 8 Reader format and an MS Word document format with the majority of responses being returned in the Adobe format, had 0.5 percent blank responses. The second round of questioning, administered entirely as an MS Word document, had 3.8 percent blank responses. The third round of questioning, administered entirely as an MS Word document, had 1.4 percent blank responses. With respect to the high levels of "unable to comment" answers, 19.7 percent of total opinions expressed in the first round of questioning, this was anticipated given the broad range of topics put forward in the first round of questioning. There were also examples noted where it appeared that individuals contradicted, in later rounds of questioning, their own comments which were provided in earlier rounds of questioning.

With reference to all three rounds of questioning the Average Percent Majority Opinion (APMO) (Abdel-Fattah et al., 1999; Makukha and Grey, 2004; Islam et al., 2006), whereby the $((\text{Aggregate of Majority Agreements} + \text{Aggregate of Majority Disagreements}) / \text{Total Opinion expressed} \times 100)$, was used to determine whether consensus was or was not reached on the statement provided. In the first round of questioning a decision was made to go with an APMO of 49.3 percent, resulting in 44 statements for the second round of questioning. The rationale being, in trying to keep the number of statements/questions to a reasonable level which would not

deter individuals from participating in future rounds, that an APMO of 66.7 percent would have resulted in 141 statements for the second round of questioning, an APMO of 75 percent would have resulted in 160, and an APMO of 85 percent would have resulted in 181 statements. While the reasons may vary, the message with respect to survey length is fairly consistent. Shorter surveys with interesting content tend to motivate participants and consequently produce better response rates and quality than longer surveys in excess of one hundred questions (Burchell and Marsh, 2007; Herzog and Bachman, 2007; Saunders et al., 2007). The APMO for the second round of questioning was 41.9 percent, resulting in 21 statements for the third round of questioning. An APMO of 66.7 percent would have resulted in 88 statements for the second round of questioning. As 88 statements were considered excessive, no attempt was made to determine the number of statements that would have resulted from an APMO of 75 percent. The APMO for the third round of questioning was 37.2 percent, resulting in consensus being attained on 17 of the 21 statements, or 80.9 percent.

7.6 Delphi Themes and Consensus

Nine major issues summarise the findings of the Delphi study relating to future ice conditions, transit traffic, icebreaker capabilities, CCG services and organisation, vessel movements, icebreaker deployments, privatization and resource issues.

Future ice conditions in Arctic waters (original statement no. 3)

Considerable uncertainty surrounds the extent to which perennial Arctic ice will retreat in terms of geographic location and when the Arctic Ocean may experience ice free summers. However, 12.5 percent more panellists agreed that the Arctic Ocean will experience ice free summers before the NWP. Of those panellists who disagreed, many agreed that parts of the Arctic Ocean along the Russian NEP

would be free of summer ice before the NWP. Also, many panellists found it hard to believe that if the Arctic Ocean were to become ice-free, the NWP might not do so. There was strong agreement with the view that as the annual Arctic sea ice reduces it will make it easier for perennial Arctic Ocean ice to move south through the Canadian archipelago and thus block the many straits that vessels would have to transit in traversing the NWP or operating within the archipelago, thus impeding shipping movements.

Transit traffic through the NWP (original statements no. 1, 2)

With respect to vessel traffic traversing the NWP, there was consensus that Panama size vessels of approximately 60K DWT would not be able to do so for nine months of the year with icebreaker assistance by 2020. However, it was expected that such vessels would be able to do so by 2050.

Arctic traffic and icebreaker capabilities (original statements no. 4, 5, 6, 25, 26)

In comparing 2006 traffic volumes with anticipated volumes in 2020, there was significant agreement that traffic volumes will more than double in all Arctic regions. In terms of icebreaking capabilities, while the vast majority of panellists agreed that the current capabilities of the CCG are suitable for current Arctic shipping activity, they do not believe that Canada or other Arctic nations currently have the capabilities to meet the anticipated Arctic shipping demands of 2020.

CCG levels of service (original statements no. 7, 8, 9, 10, 11)

Although panellists agreed overall that the current level of ice routing and information service would be suitable for Arctic shipping activity in 2020, they did

not agree that the current level of route assistance service would be suitable for shipping activity in the Arctic in 2020.

With respect to harbour breakout service, panellists felt that while the CCG does have the capacity to meet current demands, it will require more icebreakers to meet future demands. Further to this, panellists strongly believed that more hydrographic survey work is required in the Arctic and that some harbours will require dredging.

Regarding the limited demands currently made on the CCG in terms of the northern resupply service, panellists agreed that the CCG would be able to satisfactorily continue this service up to 2020 with the icebreaking fleet currently available. However, they did not agree that the same would be true in terms of the sovereignty service.

Organizational and operational aspects of the CCG (original statements no. 16, 17, 18, 22, 23, 27)

On 1 April 2005, the CCG became a SOA within FOC. Half of the panellists were unable to comment on whether SOA status would significantly increase the level of services being currently provided in the Arctic, but 43.6 percent of the remaining panellists agreed that it would not. The reasons noted for this included an unchanged CCG budget, that CCG has not displayed any ability to operate in a more efficient manner, and a lack of funding for the CCG. Notwithstanding the above, panellists did agree that the level of service has remained the same. Panellists also agreed with the statement that the reason why the CCG was made a SOA was to address the marine transportation issue and ensure that CCG funding goes to where the allocation was intended rather than FOC imperatives.

However, three times as many panellists agreed that the focus is actually being taken further away from transportation issues.

Considering the funding of icebreakers, panellists agreed that this is inadequate both in Canada and globally. With respect to user service fees, there was overall agreement that the CCG should charge icebreaker service fees north of 60 degrees latitude.

The CCG civilian fleet of approximately 107 vessels is deployed, maintained and operated by five regions spread across Canada with each region operating according to its own practices and management preferences. With respect to this decentralization of fleet operations, approximately 6 percent more panellists agreed that it resulted in overall significant duplication of human resource effort within FOC with respect to Arctic operations. However, there was significant agreement among panellists that the regions exist to meet the specific needs of distinctly different geographic areas and that since the officers are in a pool and the fleet is multi-tasked the regional approach is probably most effective. In terms of national standards, of the slightly less than 50 percent of the panellists who commented, all but two agreed that the icebreaker fleet is currently being managed with national standards and the regions are well coordinated. Despite the aforementioned, of the panellists that commented, more agreed that the regions generally ignore national standards where they do exist, national standards are incomplete, there is no internal audit process visible for these standards, and there is still little coordination among the regions. With respect to standardization of practices for the icebreaker fleet and the CCG following the USCG operational structure of being viewed as a unique asset, of the 52 percent of panellists who commented, approximately four times as many agreed with this

view. However, there was significant overall agreement that Canada needs the best, most effective and responsive system for its icebreaker fleet and not one that necessarily matches the USCG. Despite many of the panellists agreeing with the view that the CCG needs to standardize its practices and be viewed as a unique asset, there was overall agreement that the actual USCG structure is not an example for Canada to follow and that it is even less effective than the CCG structure.

The six CCG icebreakers used for Arctic operations are operated out of four regions: Pacific, Quebec, Maritimes, and Newfoundland and Labrador. The fifth region, Central and Arctic, however is responsible for icebreaking in the Arctic. While there was no overall agreement that this decentralization of fleet operations results in ineffective interregional communication and consequently underutilization of vessels in the Arctic, slightly more panellists agreed that it did lead to icebreaker underutilization. Notwithstanding the above, there was overall agreement that vessel utilization is more a function of budget and less of organization, and Arctic deployments of icebreakers are reasonably well coordinated. In addition, there was even greater overall agreement with the view that from an operations perspective a central control point is important for the coordination of six icebreakers operating in a harsh northern environment.

Merchant vessel movement in the Canadian Arctic (original statements no. 12, 13)

The movement of merchant vessel traffic is controlled by two conventions. An older and more rigid 'Zone/Date Shipping Safety Control Scheme', based on rigid controls stipulating the dates that vessels of various ice strengthening may navigate within the sixteen shipping safety control zones of the Canadian Arctic

underpins a more flexible 'Arctic Ice Regime Shipping System' (AIRSS) framework indicating whether or not a given set of ice conditions will be safe for a particular vessel. Panellists strongly agree that the Zone/Date system is inappropriate for current day Arctic shipping activity, due to less severe ice conditions during recent summer seasons, and that the AIRSS system is more appropriate. Vessels are currently allowed to exploit both systems to their advantage when operating in the Canadian Arctic.

Icebreaker deployment in the Canadian Arctic (original statements no. 14, 15, 21)

The geographic expanse of the Canadian Arctic is divided into 12 service areas for the provision of the primary levels of service, noted earlier, offered by the CCG throughout the summer season. This system is referred to as the 'Block Commitment' system. While half of the first round panellists were unable to comment on the effectiveness of this system, three times as many of those who did comment agreed that the system was effective. However, a significant number agreed that the system was outdated and needed to have greater flexibility and updating given the changing environmental condition in the Arctic. It is also important to note that during subsequent rounds, panellists agreed that the system itself is the result of a limited number of icebreakers and thus not very effective from a service point of view.

All CCG vessels are multi-tasked. Six of the 17 icebreakers spend the summer months engaged in activities in the Arctic and the winter months engaged in activities along the east and west coasts of Canada. While approximately 10 percent more panellists agreed that year round utilization of these six icebreakers costs Canadian taxpayers more than only utilizing them during the winter months,

there was strong agreement among the panellists that it was best to utilize the hardware and human resource all year round. There was strong agreement that CCG undoubtedly faced high fixed capital and operational costs.

Whilst there was no overall agreement that Canada should immediately acquire icebreaking capability for year-round winter navigation in the Arctic, more panellists agreed with the statement than disagreed. However, while there was overall agreement that operating icebreakers year-round in the Arctic would be very expensive and that currently there are no commercial clients or compelling sovereignty arguments for year-round operations, panellists also agreed that Canada should have this capability by no later than 2015. There was also agreement that the technical requirements for year-round navigation in the Arctic are non-trivial, probably beyond present reach, and that Canada should adopt a staged approach to this. There was also overall agreement that Canada should build more vessels of moderate capacity than one very powerful and costly icebreaker and that icebreakers are needed where commercial vessels will go.

Privatization of CCG services in the Arctic (original statements no. 19, 20)

The CCG offers a wide range of services in the Arctic. Even though Canadian taxpayers are burdened with the high financial cost associated with the construction and maintenance of ice breaking vessels, there was overall agreement that it would not be appropriate for the ice breaking component of the CCG range of services, in the Arctic, to be privatized. Notwithstanding this there was overall agreement that private involvement in carrying out the level of services currently provided for by the CCG in the Arctic would not weaken Canada's position with respect to sovereignty in the Arctic.

Arctic hardware and human resources (original statements no. 24, 28, 29, 30, 31, 32)

There was overall agreement among panellists that the vast geography of the Arctic poses significant challenges to Canada and other maritime nations in terms of human resource management on board their icebreakers working in the Arctic. In addition, there was overall agreement that by 2020 maritime operations in the Arctic will involve a wide range of services, and that given the relatively small human presence stationed on land in the Arctic most of these services will be conducted from mobile floating platforms.

With respect to global icebreaking capacity, there was overall strong agreement that there was no need for all maritime nations of the world to immediately acquire icebreaking capability for either summer or year-round navigation in the Arctic. Further to this, there was overall agreement that while Russia currently has icebreaking capability for year-round navigation in the Arctic, it was not necessary for the seven remaining nations of the Arctic Council to immediately acquire icebreaking capability for year-round navigation in the Arctic.

7.7 Conclusion

The APMOs were accepted as being low. However, with respect to the first round of questioning, the results identified 41.6 percent agreement with the 32 statements provided, 38.7 percent disagreement, and 19.7 percent unable to comment. It is anticipated that had more of the statements in the first round of questioning been presented in a negative form, the percentage of results in agreement would have been larger, but at the expense of valuable comments from which to gain a deeper understanding of the situation.

Likert (1951, 238) informs that consistent evidence has been obtained showing that questions on complex issues have different meanings for different people who are called upon to answer them. With reference to the philosophical and methodological foundations of Delphi, Mitroff and Turoff (1975) state there is no one "*single best way*" for ensuring the understanding of the content of a communication or for ascribing validity to a communication. The issues of uncertainty of content and validity to some of the responses provided by some of the Delphi participants was evident in the Delphi exercise conducted as part of this research. After close examination of the responses provided by Delphi participants, it would be fair to suggest that with some questions there appeared to be varying interpretations, a corollary being the level of *true* consensus or lack thereof. In support of the above, Saunders et al. (2007, 108) in discussing various research philosophies suggest that with respect to ontology and the aspect of subjectivism, individuals will perceive different situations in varying ways as a consequence of their own view of the world around them. Subjectivism surfaces in two ways here, first via the Delphi participants in the remarks they provided and second via the researcher in distilling the remarks for subsequent rounds.

Currently, the Arctic regions of Canada, and for the most part the entire Arctic region north of 60 degrees latitude, are not conducive to year-round navigation of merchant vessels and to some degree even government owned icebreakers. While future Arctic shipping activity is anticipated to significantly increase with the retreat of perennial Arctic sea ice, the infrastructure required to support global supply chains is notably lacking. While icebreaker capabilities are considered suitable for current merchant shipping activity, they are not suited to the anticipated shipping activity of 2020 and beyond. Much of the Arctic is poorly charted and in some areas no navigational charts are available. Navigational aids

are sparse and often only provided seasonally. Vessel repair facilities are sparse and limited in their scope of work. Emergency response capabilities are limited and geographically challenged. Finally, the impact of year-round Arctic shipping activity on the livelihoods of native inhabitants has not been fully addressed. Through a mix of unilateral and multilateral actions, Canada and other Arctic Council nations need to quickly decide upon and begin to develop, install and enhance relevant infrastructure comprising modern icebreaking capabilities, deepwater ports, repair and refuelling facilities, aids to navigation, and emergency response organizations. Involving the local inhabitants will be imperative.

The results of three rounds of Delphi in Phase I have identified areas of interest worthy of further in-depth investigation in ascertaining if the levels of service provided by the CCG in the Arctic are suitable for some form of private involvement ranging from the status quo of services being totally provided for by the Canadian federal government, to outright privatization of the CCG Arctic icebreaker fleet and associated levels of service. Further research is required to canvas the in-depth opinions of local experts relating to various models which may underpin the ownership, organisation and management of relevant infrastructure. This further in-depth investigation adopts a grounded theory methodology and takes the form of personal interviews involving retired CCG personnel previously involved with looking at the idea of privatizing the CCG, academics previously involved with looking at the idea of privatizing the CCG, private business currently involved in looking at private involvement with respect to CCG operations in the Arctic, and private business involved in providing new icebreaking vessels and technology to the CCG.

Chapter 8 Grounded Theory Methodology

8.1 Introduction

This chapter commences with a presentation of the rationale for using the grounded theory methodology of data analysis in helping fulfil research objectives five and six noted in the introductory chapter. It then informs of the approach taken towards identification of interviewees and the development of the in-depth and semi-structured interview guide. The chapter continues with information on the coding of interviews in light of Phase II data analysis and the conceptual model that was developed. The later part of the chapter delivers the results of the interviews that were conducted, analyzed, and coded in accordance with the grounded theory methodology.

8.2 The Rationale for Choosing Grounded Theory

While the literature review and Delphi exercise dealt with some of the research objectives and raised awareness with respect to issues associated with climate change, the increased demand for Arctic resources, the CCG and its ageing fleet of icebreakers, and the lack of transportation infrastructure in the Arctic, they did little in terms of offering solutions to the issues. With respect to this research, the main issues being raised are that the CCG is poorly managed and underfunded, and the CCG icebreaking fleet needs to be renewed and enhanced. To understand why the current situation is as it is and how best to resolve these issues, both effectively and efficiently with the Canadian taxpayer in mind, qualitative research in the form of in-depth and semi-structured interviews with stakeholders conversant of the issues mentioned was undertaken. Policy matters may relate to past, present or future situations. Hyman (1951, 205) notes that in the case of anticipations about the future, inferences can only be made through

the personal documentation of an individual's thoughts and that interviewing is an effective method of capturing such thoughts. Grounded theory is well suited for qualitative research using interviews (Robson, 2002, 191). It is a constant comparative analysis process in which data are collected, transcribed, and subsequently subjected to both micro and macro analysis and coding for the purposes of developing categories and saturating them with respect to their properties and dimensions. It is a systematic, rigorous, and formalized approach to data analysis (Strauss and Corbin, 1998).

While a theory can be developed at various junctures of the research depending on the nature of which the research is approached, Collier (1994, 23) notes that no theory is unsusceptible to revision and improvement, and that it is continually in process (Glaser and Strauss, 1967, 114). Ibid (1967, 6) note that the generation of a theory involves a process of research in which hypothesis and concepts not only come from the data but are systematically worked out in relation to the data. With respect to grounded theory methodology, while a researcher may have theoretical conceptions in mind at the outset of a research project, it may prove advantageous not to structure data gathering too tightly at the commencement of research (Strauss and Corbin, 1998, 206). Consequently, the first in-depth, and to a degree, semi-structured, interview involved an interviewee identified by a Delphi participant; a non-probability sampling technique known as snowball sampling (Saunders et al., 2007, 228). The interviewee had previously been a manager at CCG and had been tasked with looking into ways in which the CCG may be operated more efficiently and effectively. The interview was arranged in two parts. During the first part of the interview the interviewee informed of his previous work noted above. During the second part, a list of questions, generated from the literature review and Delphi study, was used as a guide to help focus the interview.

As with all subsequent interviews, the first interview was recorded, transcribed, and subjected to an initial analysis. Initial results were used to identify potential new interviewees, and to develop questions. Subsequent interviewees were identified using a combination of snowball and theoretical sampling techniques. Theoretical sampling is the process of allowing emerging theories, stemming from the coding and analysis of previously collected data, to guide subsequent data collection, coding, and analysis (Glaser and Strauss, 1967, 45). In addition, theoretical sampling of previously collecting data is accepted in the grounded theory methodology *ibid* (1967, 71) and as such, the Delphi results and literature review serve as "slices of data" to help with the development and saturation of categories *ibid* (1967, 65). Eight interviews were conducted. Table 11 highlights some of the information pertaining to the interviews.

Table 11 Details of Interview Subjects

Interviewee	Position	Date (2007)	Interview Format	Sampling Technique
1	Retired CCG Manager	06/07	In Person	Snowball
2	Retired CCG Manager	26/07	Telephone	Snowball
3	Retired CCG Manager	31/08	Email	Snowball
4	Vice-President ENFOTEC	13/09	Telephone	Theoretical
5	Director of Science AKAK	25/09	Telephone	Theoretical
6	Gibson Marine Consultants	15/10	Telephone	Theoretical
7	CCG Commanding Officer	23/10	In Person	Theoretical
8	Retired CCG Manager / Current Marine Consultant	24/10	Telephone	Theoretical/Snowball

Source: Author.

8.3 Analysis and Coding of Interviews in Light of the Conceptual Model

Discussed earlier in this research, Sekaran (2003, 97) suggested four phases to approach the development of a conceptual model:

- Identify the problems and issues through in-depth literature review and purposeful interviews;
- Identify the variables contributing to the research problem through in-depth literature review and purposeful interviews;
- Analyse the associations among variables once they are identified;
- Develop relevant hypothesis and subsequently test to help ascertain the extent to which the problem can be solved.

A general analysis of each interview was undertaken before proceeding with further interviews, and in keeping with the constant comparative analysis of grounded theory methodology, interviews, literature review, and Delphi results were analysed at micro and macro levels during subsequent data analysis and coding.

Memos, in both note and diagram form, accompany data analysis. The collection of data in more than one way helps to ensure that all of the issues relevant to the research are covered even if their initial importance is not fully appreciated by the researcher (Curran and Blackburn, 2001, 72).

Strauss and Corbin (1990, 62) characterize the grounded theory methodology as being both inductive and deductive; the process of analyzing data, otherwise known as coding, allows for assumptions about phenomena to be deductively made which then in turn calls for questioning of these assumptions leading inductively to new discoveries. Collis and Hussey (2003, 73) refer to the

phenomenological, grounded theory methodology as one in which a researcher commences with an inductive approach to gain insight, subsequently exploits a deductive approach to generate hypotheses, and finally returns to induction for the testing of the generated hypotheses. While Strauss and Corbin make hypothesis testing integral to the constant comparison method of grounded theory methodology, Glaser disputes such within-analysis testing and asserts that the testing and verification of hypotheses is to be done subsequent to the development of a grounded theory (Rennie, 1998). With respect to moving between induction and deduction, Strauss and Corbin (1998, 137) make note of the interplay between the two during data analysis and coding. Coding is central to grounded theory and, as previously noted, occurs at both micro and macro levels. While micro analysis is a combination of open and axial coding, it is not intended to be done in the absence of macro analysis. Open coding concerns itself with the identification of conceptual categories and the subsequent discovery of a category's properties and dimensions, and axial coding looks at the process of relating categories to their subcategories (ibid). An example of open and axial coding of an interview is shown in Appendix 5. This approach to coding was repeated for all eight interviews. The conglomeration of which helped with the selective coding shown in Appendix 6 and the development of the conceptual model shown in Appendix 7. Higher level selective coding is used for the integration and refinement of theory evolving from open and axial coding. Hypothesis are typically presented at the selective coding level (Robson, 2002, 194). Open, axial, and selective coding were conducted on all interviews. Selective coding was used for further integration of the hypotheses and relationships, developed under open and axial coding, identified in the final version of the conceptual model depicted in Appendix 7. Development of the conceptual model is discussed below. All eight interviews were analyzed and coded in consideration of

the conceptual model developed, and each interview resulted in its own set of relationships and theories. The amalgamation of the eight sets of relationships and theories is shown in Appendix 6; they formed the basis of Part B of the quantitative survey discussed in detail in the following chapter.

In light of the different views noted above as to when hypotheses testing should be carried out and with respect to the research undertaken, within-analysis hypotheses testing was carried out but only to the extent of the somewhat limited number of interviewees and other 'data slices'. Given the potential for this research to impact on policy decision making, it was felt that subsequent testing of hypotheses and relationships would help triangulate results and enhance such research hallmarks as testability, precision and confidence. Therefore, in attempting to add precision and confidence to the research work via attitude measurement of critical hypotheses and relationships, the exploitation of a quantitative survey in the form of a Likert scale was developed. Discussed in detail in Chapter nine, the quantitative survey was administered by email to a pool of experts and stakeholders conversant in Arctic affairs. The pool of experts and stakeholders was compiled, for the most part, from the lists of individuals attending conferences and seminars on Arctic matters, personal contacts, and the pool of participants identified in the Delphi exercise.

Grounded theory integrates structure (or conditions) and process (denoting action/interaction strategies over time) with the use of an analytical tool referred to as the paradigm (Strauss and Corbin, 1998, 127). The paradigm is not a standalone tool of analysis, and is intended to be used in conjunction with a coding device referred to by *ibid* (1998, 182) as the matrix. Whilst the paradigm concerns itself with conditions, action/interaction strategies, and possible consequences, the

matrix guides the analyst in looking at conditions and consequences on both macro and micro levels. The conceptual model depicted in Appendix 7 highlights the combination of both the paradigm and the matrix applied to the eight interviews.

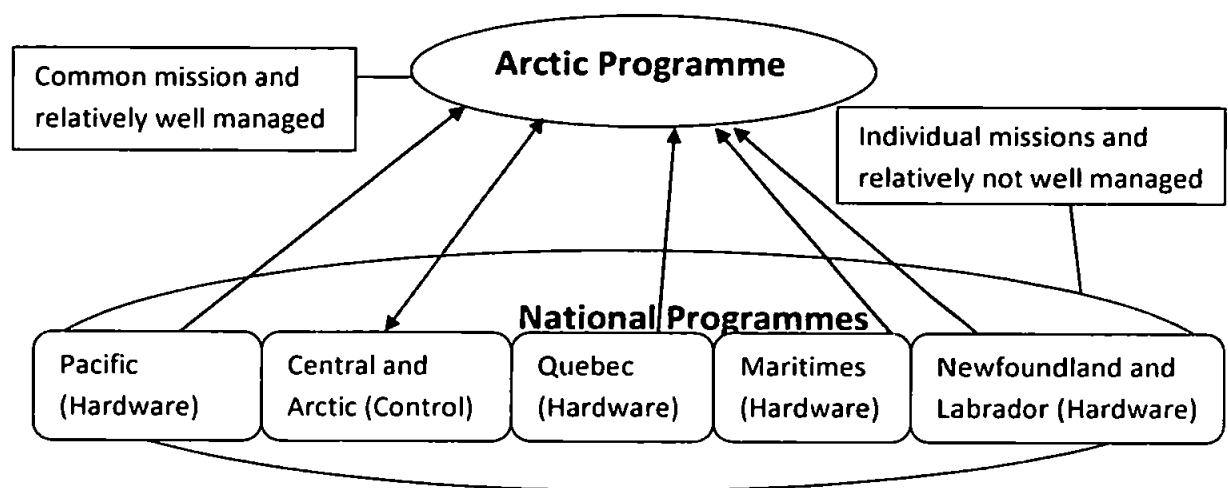
8.4 Results of Grounded Theory

Analysis of the results of the interviews confirms that the grounded theory strategy was effective. Category saturation was evident, and diminishing returns with respect to data collection was noted. This was particularly evident in the subcategories of private management and icebreaker design/construction. However, it is worthy of mention that Strauss and Corbin (1998, 136) refer to saturation as a matter of degree, and if a researcher were to investigate long and hard enough new properties and dimensions would be discovered.

With respect to signs of an emerging theory, research indicates that CCG Arctic operations are suitable for private involvement and that private management of the CCG fleet is the option offering the greatest potential in terms of increased efficiency and effectiveness. Research indicates that while on a national basis the CCG is poorly managed, the Arctic programme runs relatively much smoother than so called national programmes in southern latitudes of the country. The underlying difference between the two programmes is that the region in control of Arctic operations does not allocate any of its hardware (i.e. icebreakers) to Arctic operations, see Figure 12. On the contrary, with respect to national programmes in the south, individual regions are responsible for the operation of icebreakers and control of local programmes. Therefore, to improve on the issues with Arctic operations as noted in the Delphi results with respect to the decentralization of fleet operations resulting in ineffective interregional communication and

consequently underutilization of vessel use in the Arctic, it may be that the CCG should have a fleet of icebreakers allocated specifically to year round Arctic operations and most importantly, that they be managed by private interest involving local stakeholders.

Figure 12 Regional Inputs into the Arctic Programme



Source: Author.

A distillation of the views of the eight interviewees in relation to research objective five, to analyse the importance of specific background factors with respect to private involvement in the delivery of CCG icebreaking services in the Arctic, is shown below. The distillation follows the order of open and axial coding with respect to categories and subcategories:

Category

Politics- While Canadian policy currently allows for privatization, Canada does not appear to be enthusiastic in implementing it. However, the CCG and DFO have made minor moves in this regard with respect to such services as navigational aids and icebreaking service fees in the Gulf of St. Lawrence. Current policy has also allowed for the move of the CCG into a SOA although with minimal change to

its management and operations. The biggest obstacle to privatizing the CCG would not be operational but rather political, as both unions and the CCG itself would oppose such a radically viewed move. Practically all interviewees felt that the status quo is inappropriate, policy needs to change, and it is unacceptable for the Canadian government to expect shipping companies operating in the Arctic to be self sufficient while at the same time the CCG fleet is limited in its ability to operate there. With respect to icebreaking, interviewees felt disparities exist in policy and in the icebreaking services being offered to the Gulf of St. Lawrence, the Arctic, and other regions of Canada. For the most part, there are small user fees for icebreaking services in the Gulf of St. Lawrence while there are no user fees for similar services in the Arctic. Even within the Arctic, the services being provided for by the CCG are not deemed equal throughout the regions.

Canada is a physically huge, sparsely populated, culturally diverse, and politically diverse country with most of its population living in southern Ontario and Quebec, far removed from the Arctic. Unlike Canada, geographically smaller countries appear more oriented toward the future and more effective and efficient in their political undertakings. Many Canadians are unaware of the Arctic and the issues surrounding it. Canada is not a maritime nation and there is low public interest in marine matters. This lack of interest may stem from the suggestion that the Canadian public is not informed or educated on marine matters. Change is needed, the Arctic is quickly becoming politically controversial and Canadian taxpayers need to be informed of the critical role that icebreakers play with respect to much needed Arctic development, which should undoubtedly involve the utilization of the Arctic's indigenous people. While Ottawa has said that it will support Arctic development, and while the CCG has been operating in the Arctic for 50 years and continues to do so, the government is typically slow in taking

action in the Arctic and the area is currently underdeveloped due to a lack of regular and consistent icebreaking support. Unlike government, industry would be proactive towards Arctic development and therefore Canada needs to immediately commence with the building of new icebreakers capable of year round operations in the Arctic. In comparison with southern Canadians, interviewees felt that Arctic inhabitants receive relatively poor service from Ottawa. It is important to appreciate that the federal, provincial, territorial, and municipal levels of power have considerable influence in shaping the face of Canadian politics. Canada, like most countries, has limited public funds which are politically connected. The current level of subsidization of Arctic infrastructure may not be required as much in the future as the region becomes more promoted, developed and consequently independent. Taxpayers will be inclined to approve of any government, and its policies, which aim to save them money.

Canadian maritime roles and responsibilities need to be clearly defined and the government needs to provide a clear mandate in terms of maritime administration. In Canada, and most of the world, ocean access is imperative for trade and national development.

With respect to emergency response and environmental monitoring, the Canadian maritime administration needs to be able to get to areas of the Arctic where shipping activity is currently ongoing or planned. In addition, a Canadian maritime presence in the Arctic on a year round basis will help bolster Canada's sovereignty claim in the Arctic. Despite the need however, Canada cannot afford to have separate civilian and military fleets of vessels in the Arctic and a multipurpose fleet is thus a viable option.

The design and construction of an icebreaker can take up to several years for dormant and inexperienced shipbuilding nations. Shipbuilding requires significant financial, technological, industrial, and human resources, all of which Canada is currently lacking. More specifically, Canada is lacking in naval architecture and shipyard facilities that are able to provide competitive icebreaker design and construction. However, with respect to self sufficiency Canada needs to be at the forefront when it comes to icebreaking technology and vessel construction. Designing and building icebreakers with naval capabilities in Canada would help address security issues with respect to system designs being penetrated by terrorists. Presently, government bureaucracy complicates the building of government owned vessels and thus the same vessel will cost more than if built for private interest. In addition, the Treasury Board (TB), in control of the finances for such undertakings as building government vessels, lacks skilled marine contract negotiators and there are internal struggles between the TB and CCG Technical Services, those more knowledgeable of the icebreaker fleet. In addition to being hampered by having to negotiate building contracts through the TB, interviewees felt that the CCG is hampered in its operational abilities as a result of the bureaucracy of DFO and the fact that DFO is too large of an organization for the CCG to be effectively managed inside of.

Shipbuilding creates significant employment and in doing so can strengthen the political campaign of incumbent politicians. In securing voter confidence, politicians will therefore want to build icebreakers in Canada. If this is to be the case then Canada needs to change its shipbuilding strategy in order to raise its quality capabilities. Unfortunately however, Canada appears to lack political direction in terms of its shipbuilding policy. Politicians are often not in a position to fully understand the issues with respect to building icebreakers and, feeling

obliged to listen to all stakeholders when undertaking such capital expenditure, will be forced to compromise on the design and construction.

Interviewees felt that Canada's proliferation of marine consultant types will want to be involved in the design and construction of new icebreakers and in doing so doubted the appropriateness of some consultants giving advice to politicians on Arctic matters.

Subcategories:

Canadian Coast Guard –The CCG has a huge human and physical asset base with a diversified fleet of vessels. It has a national mission and is used to deliver programmes whilst operating and maintaining its fleet of vessels. It offers many services and programmes and as such it is a complex organization. As a maritime department it is considered by some interviewees to be somewhat of a line organization and does not fit the typical public service profile. However, during a current period of waning popularity and lack of visual public support the mission, identity, and role of the CCG appear unclear. Interviewees expressed concern that the CCG lacks clear organizational leadership and accountability from within and that its objective, function, and purpose are also unclear. While the CCG is viewed as experienced in Arctic issues and is respected there, interviewees thought that the CCG is better suited as an end user of icebreakers and thus should focus on defining its operations and better organizing its needs; they are not seen as being efficient at designing, building or retrofitting icebreakers. While change is deemed necessary and there are future options deemed worthy of study, the organization is considered slow to change. Interviewees felt that while studies have and continue to be conducted, many with a focus on new forms of administration and direction, the outcomes are never implemented and that the studies undertaken

depend on the views of the commissionaire(s). They also felt that the CCG is in need of a fresher way of doing things and that privatization, if only on a partial basis, is one way forward.

Auditor General's reports from 1997 to 2004 have criticized the CCG in terms of its management, funding, and operations. In addition, recent reports from the Standing Senate Committee on Fisheries and Oceans are informing the federal government that the CCG needs to be better prepared, mandated, and funded to meet future challenges in a rapidly changing Arctic. While a national organization with more centralized control and standardized operating procedures across the regions is deemed necessary, the CCG is seen by interviewees as having national standard operating procedures on paper only. However, interviewees commented that the Arctic operations programme, which utilizes icebreakers from four regions: Pacific, Quebec, Maritimes, and Newfoundland & Labrador, with a fifth region, Central and Arctic, which is responsible for the actual coordination of ice breaking activities in the Arctic, is the only true national programme dealing with icebreaking. Struggles between the national and regional divisions are evident and there is diversity throughout the five regions. Interviewees note there is too much regional bureaucracy and duplication of effort. Regions are possessive of their own resources and reluctant to change. It appears that this has become more evident since the merger of the CCG with DFO. Fleet officers are regional rather than national, and labour issues are hampering efficiency. While accountable to the public, the CCG is considered by some interviewees to operate at the whims of federal politicians and to be low priority on the MPs' list of political matters; the CCG is very bureaucratic and many of its issues stem from a lack of focus and clarity on the part of the federal government. Since the merger of the CCG with DFO the CCG is seen as fragmented and tensions exist between them. The CCG

is viewed as having different responsibilities to those of other government-owned vessels such as DFO and DND and as such, DFO should presently not be controlling them. In addition, interviewees felt that the CCG should not be allowed to come under the control of DND; the CCG want to run their ships. As a SOA the CCG needs to be outside of DFO, as being inside has resulted in identity loss and lower effectiveness and efficiency. Interviewees felt that the current SOA arrangement that CCG has inside of DFO does not allow for the level of autonomy required by the CCG; an effective and proper SOA set up, with separate office administration ashore, would allow the CCG to move away from current/typical public service type of operations. However, one benefit seen as a result of the CCG becoming a SOA inside of DFO is that it has helped secure core funding for its fleet. The policy perspective of the federal government with respect to the positioning of the CCG needs to change and interviewees felt that the lack of federal direction leads to more expensive operations in the long run and that politics is draining management's capacity to operate efficiently and effectively. Dealing with political matters requires a substantial workforce. The CCG suffers from a lack of funding and funding requests are made through the federal Treasury Board. In addition to the internal politics connected with the Treasury Board, the CCG has to struggle politically with the Department of PWGSC with respect to vessel maintenance and repair work. Having to procure vessel dry dock work through PWGSC, which is lacking in critical contract experience in such undertakings, results in more expensive and wasteful repair and maintenance work being carried out on an ageing and obsolete fleet of icebreakers.

Whether or not the CCG is able to have a year round presence in the Arctic will not deprive the Arctic of commercial activity and development, and will not deter the private sector from developing and operating in the region if such development

is deemed necessary for the survival of private commercial interest. The CCG fleet is antiquated and relatively small in terms of physical size and power, limited in its Arctic capabilities, and will not be suitable for the escorting of new cargo vessels which will most often be wider than the current CCG fleet. The extreme breadth of Canada's largest icebreaker, the Louis S. St. Laurent, is 24.46 metres while that of a Panamax vessel is 32.3 metres. In addition, the current CCG fleet is unable to operate on a year round basis in the Arctic while private shipping companies are intending to operate in the Arctic on a year round basis. To date, there have been reports of CCG icebreakers unable to assist some Canadian vessels operating in the Arctic and of some industry requests being ignored. While the Canadian government stresses that private ship owners should operate ice-class ships in the Arctic and therefore should not need to rely on CCG icebreakers for escort services, it would seem prudent for the Canadian government to be able to monitor and support all shipping activity in the Arctic and respond to a situation or crisis if need be. CCG icebreakers should be capable of following where private icebreaking vessels go. Icebreakers are critical to the development of the Arctic and usually (although there have been exceptions), probe ahead of new commercial interest to see if shipping is feasible. Interviewees felt that the CCG is currently not fully utilizing its fleet on an annual basis. Any new icebreakers acquired by the CCG need to be capable of year round operations in the Arctic and any new icebreaker design should consider year round utilization either inside or outside of government usage.

In terms of a closer examination of the management of the CCG, interviewees noted several important observations:

- The CCG is strong on icebreaking operations but weak on management;

- The organization lacks real world business and fleet experience beyond itself and needs to get a handle on total cost throughout the life of a vessel(s);
- It is unable to achieve commercial like efficiencies;
- It has limited resources and while it needs more funding it also needs to better utilize current funding;
- It is plagued with labour issues and needs to sort out its crewing policy, which is deemed inefficient in terms of helping to control costs;
- Careers are not well marketed and the CCG is seen to be losing its Arctic expertise through personnel retirements;
- The biggest part of the vessel operating cost is crew, and the CCG is seen as having the biggest icebreaker crews in the world;
- Strong union contracts, negotiated through the PWGSC, are increasing labour costs;
- While the shore fleet personnel have been streamlined to a more basic unit, the administration and maintenance/engineering sides of the CCG are too large, bureaucratic, and focused on matters not relevant to efficient and effective fleet operations;
- Accounting is difficult to follow and understand due to a lack of appreciation for what is going on inside the entire organization;
- Shore management costs are factored into overall fleet cost while capital, insurance, and shore personnel costs are not factored into the operating costs of vessels in particular;
- While there is basic cost funding for the fleet there is also programme funding from other DFO divisions via a user pay arrangement;

- The CCG currently leases its icebreakers internally to other government departments (aka covering ship time cost) with considerable internal arguing and difference of opinions in terms of costs allocations;
- Budgets must be spent, sometimes wasted, by fiscal year end or otherwise they will be cut in the upcoming year.

It has been reported that icebreakers have been kept in the Arctic when not required by the private sector so as to use and not lose budgets. Interviewees also felt that the CCG was better suited to operating the icebreakers and not managing them.

Part of the work done by the CCG in the Arctic involves the delivery of supplies to certain areas that the commercial fleet is not interested in due to potential liability claims. The terrorist attacks on the World Trade Centre on 11 September 2001 have affected the CCG. Since the attacks the work focus has shifted more towards security matters. In addition, more attention is currently being given to new sovereignty and science matters. A positive outcome of adding the security component to the CCG's duties is that it has helped keep the vessels running, since more funding for fuel has been allocated.

Navy- When compared to the CCG, the Canadian Navy has different interest, requirements, risk management approaches, and vessel standards. Consequently, interviewees strongly felt that the Canadian Navy should be kept separate from the CCG in terms of management. When compared to the Navy, the CCG was considered to be more capable in terms of maintenance, operations, and management. It was thought that CCG priorities would change if controlled by the Navy. Some interviewees commented that the CCG is of a civilian nature with B type personalities while the Navy has type A personalities. Consequently, there

would need to be more than just a hardware (e.g. using firearms) change for B types if the two were merged. The Navy has little or no experience with CCG operations other than search and rescue work and has no experience in ice management. With respect to labour issues associated with the crewing of its vessels, the Navy does not have the same challenges as the CCG and finds this easier since there is no trades union involvement on board Navy vessels. However, the four year total service time with respect to crew rotations on board Navy ships is not conducive to building the level of expertise required on board CCG icebreakers.

It was noted that mixing of the CCG and Navy may be politically favourable and that the CCG is capable of cooperating effectively with the Navy and can provide support when and where necessary. The two fleets could have some multi-mission capability, could share coastal patrol, and could even share a command and control structure, with the CCG being a separate division of the Navy. This would however require a clear MOU between the two.

The New Canadian Arctic Fleet- The need to establish a new maritime organization to care for all CCG, DFO, and DND roles and responsibilities in the Arctic was deemed worthy by some interviewees. The rationale for such an organization stems from the idea that it would require fewer vessels than would having entirely separate DFO, CCG and DND fleets working in the Arctic. It would be less expensive to build a flexible modular fleet than to build a fleet of icebreaking vessels fully equipped for all duties at all times. In such an organization ship personnel would be cross trained to execute their assigned duties. Designing and building such modular type vessels in Canada would result in massive employment opportunities across Canada.

Unions- Labour issues are seen as hampering the efficiency of the CCG. Skilful union negotiators have secured generous collective agreements for CCG employees and have responded effectively to DFO cost cutting measures so as to prevent crew layoffs when ships were being tied up. With respect to organizational changes inside of the CCG, unions may not want to see the CCG become a powerful SOA, will want high employee numbers, and will look after and strongly bargain for any displaced members. It is felt that privatization of CCG services, resulting in possible job changes and large scale lay-offs, will not be taken favourably by the unions representing CCG employees. Until recently, CCG licensed ship officers had a different license structure than licensed ship officers in Canada and it was felt that this would complicate the transferring of CCG marine personnel to the private sector for employment on board merchant vessels. With respect to contract negotiations, the TB, while outside of the CCG, negotiates on behalf of the CCG and this arrangement is inappropriate. The TB is less skilful than the unions representing CCG employees and unions are not dealt with strongly enough.

Monopolies- For various reasons, liability issues being a significant one, it was felt that there could possibly be very few Canadian shipping companies interested in providing the full range of services that the CCG currently provides in the Arctic. Consequently, subsidized government types of services such as icebreaking may lead to monopoly situations. Icebreakers are expensive to build. And given the significant financial investment that would most likely be required by Canadian shipping companies interested in delivering CCG services in the Arctic, it was felt that long term contracts would be needed in order to encourage the private sector to proceed with the huge initial investment. Unfortunately, long term contracts

would be more prone to result in a monopoly situation, which would subsequently lead to inefficiencies. Excluding the experience factor and learning curve, the ideal situation was seen to be one in which there was plenty of competition from the private sector for carrying out icebreaking services in the Arctic and thus short term contracts could be offered.

Maritime Administration- It was deemed important that a new maritime administration be set up to look after marine affairs in Canada. Currently there are CCG programmes and DFO programmes with the CCG fleet executing both. While DFO contracts with the CCG for ship services, there is a slightly incestuous relationship with respect to the CCG fleet carrying out CCG programmes. The fact that the CCG fleet and CCG services are the responsibility of the CCG was viewed as a messy situation. The CCG is seen as a service organization and as such it cannot operate in a functional capacity. While there is federal legislation for CCG services, there is no legislation stating what the CCG fleet is supposed to do or be. The CCG should act as ship operators only and be used to execute Canada's maritime administration functions.

CCG Commissioners and Personal Biases- It appears that the individual in power at the CCG, the commissioner, decides unilaterally what studies will be undertaken of the CCG and how they will be interpreted. With respect to reviews of the CCG, there is often a lack of clarity in terms of purpose, methodology, terms of reference, and results. The CCG does not generate its own leaders, commissioners, and whoever has been in charge has always been appointed from outside. Leaders of the CCG are always appointed by federal ministers. It has often been the case that the commissioner, despite recommendations otherwise from a 2003 report by the DFO standing committee, has little or no marine

background or experience. The CCG is thought to be internally biased toward thinking that it does not need to change. The CCG is not going to come forward and openly say that it is inefficient and therefore it should be privatized. CCG employees will most likely be reluctant to offer any suggestions with respect to change if they suspect it may lead to privatization.

New Public Management- In order for the CCG to operate more effectively and efficiently it needs to separate its business side from its operations side. Consequently, there need to be thinkers and doers with respect to services. The CCG fleet (i.e. hardware) should be separated from the services they provide. Hardware is to be looked at in terms of efficiency, age, capabilities, operational time, endurance, mobility, cost, and size. Services are to be looked at in terms of economics, unification, variability, public provision, and private provision. Resultantly, there would be greater accountability from single entities adhering to business like tactics.

Interviewees suggested that the CCG should be a vessel operator only and that it should have a fleet of icebreakers and other vessels ready and able to do work for various other government departments, and industry, at a cost. Icebreaking was seen as an economic service and not so much a safety obligation. Ships get stuck in ice and they cannot move their cargoes. Such impediments to shipping were viewed as business concerns and not safety issues.

Fleet Replacement Plans- The TB controls the release of funds for federal public projects such as shipbuilding. Funds are politically attached and federal organizations will only pay attention if not doing so will cost them more. The CCG is in competition for limited funds with health care, roads, and other public

necessities. In terms of securing funding it was felt that small regular requests, to the TB, as would be the case with a lease arrangement for the procurement of new icebreaking vessels, may be more effective than the large demands that would be required for the design and construction of a new icebreaker fleet. Government contracts for the replacements of icebreakers would have to go through PWGSC and consequently there would be longer building times attached to any new vessel construction. Considerable funding would be required for the construction and maintenance of a new fleet of CCG vessels. In light of the highly publicized Arctic sovereignty issue, the timing for the request of such financial resources may be now.

Crewing Regimes- Some interviewees felt that the current crew contract arrangements in place at the CCG are not well negotiated and strongly in favour of union employees. The CCG is in need of a national relief system with equal time on and off the fleet. Currently there are various regional systems and crew changing, especially in the Arctic, is a major expense for the CCG. The current arrangements for crew changing in the Arctic result in significantly more fuel cost and lost operational time for the icebreakers.

Following is the distillation of the views of the eight interviewees in relation to research objective six, to evaluate different models of privatization and the forms they might take in relation to CCG services in the Arctic, principally Arctic icebreaking. The distillation follows the order of open and axial coding with respect to categories and subcategories:

Category

Privatization- Privatization exists in the global community in various forms and to varying extents. It is reflective of political philosophy and is thus party driven, with

Conservatives placing stronger emphasis on it than Liberals. Interviewees felt there would be major political obstacles involved in privatization of the CCG and privatization of public services generally in Canada. Additionally, there would be significant opposition put forward by the CCG unions and the employees they represent. Opposition may also come from PWGSC, as their role would be diminished or excluded in some cases. The public in general could also object as they may view CCG privatization as a blow to a national organization and that the bottom line would be on profit rather than service. Some interviewees felt that privatization would negatively affect sovereignty issues and would send the wrong message to the Canadian public; it would be a challenge. Any efforts to privatize the CCG, or parts of it, would require political and organizational will and resolve, the availability of both of which was doubted. It was also believed that if the CCG was to be privatized then all of it would have to be privatized. However, it was felt that national issues would complicate trying to fully privatize the CCG. With respect to the Arctic, it was pointed out that if only icebreaking is privatized, the CCG will still have to provide other services to the Arctic communities.

While it was mentioned that the status quo may be best for Canada and the CCG, interviewees noted there are various international models dealing with privatizing icebreaking services in the marine sector and that icebreakers are used as a problem solver to fulfil various political agendas. Therefore, it is felt possible that CCG ship delivered services could be privatized and that clients would be supportive if it resulted in improved service provision. Tax payers would also not care if change means less tax and equal efficiency. Privatization would help in the creation of cost centres and would allow for a shift in operational decisions. Consequently, this would help bring about more flexibility in asset management, and major cost savings would therefore be expected. In looking at the Finnish

model of private involvement in the delivery of icebreaking services in the Baltic, separating the service provider from the vessel operator allows for the vessel operator to establish a cost centre. It is common practice for the federal government to position various icebreakers throughout certain regions of Canada for the sole purpose of creating shore based employment stemming from the servicing of the vessels. Positives for the idea of privatization were seen as:

- A significant freeing up of human resources in fleet management, with fleet management being able to escape political intervention;
- There would be less of a requirement for public accountability and thus less human resources needed;
- A private company providing icebreaking services exclusively in the Arctic would not have to respond to political, ice related, concerns in the rest of the country and therefore could be run more effectively and efficiently than the CCG.

In addition, given the high cost associated with the current CCG crewing regime, privatization could result in a single crew system which could help strengthen human resource management. Finally, privatization would result in significant savings, especially during dry-dockings, since the CCG is unable to put rigid demands on the vessel repair yards. Conversely, it was noted that privatization may result in less thorough management of some aspects of CCG services and that it may make dealing with security matters more difficult. Also, a monopoly situation might arise where the private firm may be better skilled than government negotiators at contract negotiations, and thus they could possibly exploit the government. Consequently, privatization would require sound leadership in preparation of contracts with a private firm and thus the CCG/DFO need to know exactly what is required before privatization can take place. Further, given that icebreaking is highly subsidized in Canada, privatization would mean the

implementation of user fees in the Arctic and an increase in user fees in other parts of the country. Such changes were seen as deterrents to privatization since users of icebreaking services are used to and expect icebreaking to be highly subsidized and will not want to pay for better services if what they have is sufficient and already subsidized. Further, given that Arctic operations fall under a national programme with other government departments, it was felt that these other departments currently availing of the CCG icebreakers might not want to pay a private firm if they were previously free to use the icebreaker.

With respect to the current CCG fleet, it was built to be manned by CCG crew and thus a private industry operator might not be able to operate it any better than the CCG. Privatization would have to deal with existing CCG manpower and would require a transition period from CCG personnel to private personnel as the CCG vessels are specialized and multi-mission capable, while private industry companies might not be. Further, some interviewees noted that privatization of the current icebreaking fleet might not work as the fleet is antiquated and no private company operator would want them or the associated CCG leave system. Finally, some private vessel operators might not be interested in carrying out icebreaking services in the Arctic due to the potential bad press in the event that something went wrong. However, with respect to multi-mission capability, some interviewees felt that the privatization of a new, multi-purpose, fleet of icebreaking vessels could be used to establish Canadian presence in the Arctic while offering platforms on which the CCG, DND, and oil companies could base their operations and work from. This would result in significant icebreaking capacity in the Arctic and the icebreakers would be there sooner than waiting for the Canadian government to put them there unilaterally.

Irrespective of what was viewed as justification for privatization, interviewees felt that there would still be a need for any operator delivering a public service to have to deal with some level of political intervention and therefore the government would need a link to private operators. Hence, a private company would, for the most part, need to become an arm of the CCG/DFO.

Subcategories:

Private Management and Crewing – Models of private management and crewing arrangements with respect to icebreaking vessels are currently in place around the world. In Finland for example, the FMA is the service provider for icebreaking while Finstaship are the vessel operators.

While government tends to focus on service so as to appease the public, private industry tends to focus on profit in order to satisfy shareholders and/or to stay in business. When looking at the option of a private company managing the CCG fleet, some interviewees commented that with respect to capital investment and the residual value of a vessel, a private company might not be interested in caring for or maintaining CCG ships as they would their own, since they would not be able to sell them at a later date if so desired. To extend this view, private management companies might not like to be told by government how to go about their business and might not be so enthusiastic about carrying out some of CCG's responsibilities when personnel or ships are at risk of injury or damage. Notwithstanding the above, experienced and knowledgeable private management companies might be able to rein in cost and run ships more efficiently than the CCG. Thus, private management companies may all want to be involved in this potential new business opportunity and government may have to accommodate this. However, it was felt that any arrangement for private management would need to have a long-term commitment so as to help ensure accountability, plus it

would require a clear contract outlining such management's relationship with the CCG. To add to the efficiency view, a private company would have tighter human resource management structures, thereby eliminating the current CCG management redundancies ashore. It would also have more control over the costly crew changes (e.g. chartering of planes and the rerouting of the icebreakers to accommodate an entire crew change) than the CCG currently have in the Arctic. Further, private companies would help with better management of CCG budgets and thus would not keep icebreakers positioned in the Arctic, when not needed there, for the sole purpose of using up a budget so that it would not be cut in subsequent years.

In terms of available seafarers with Arctic experience, private crewing companies might require the experience of existing CCG personnel. If so, salaries and benefits might become an issue with existing CCG personnel switching from a government employer to a private employer. This idea was viewed by some interviewees as controversial, suggesting that such a transition might be difficult to execute. It was also noted that private crewing might lead to lower wages for crew and thus continuity of core personnel to maintain the icebreaker fleet might not be there. With respect to an earlier idea of a new multipurpose fleet of icebreaking vessels to be built by private interest and leased to the CCG, DFO, DND and the oil companies having Arctic interests, the idea put forward was that crew and shipping concerns would be managed privately while other named organizations would manage their own businesses on board. There would thus be a mix of mostly private and some government personnel on board and the private crew component would be paid by the government if the ships were to get requisitioned by the government for emergency measures. With respect to the building of new vessels, old labour standards are not properly suited for new technologically

advanced vessels and thus anticipated gains in crew efficiency might not be achieved. Another source of valuable and essential Arctic seafarers comes from local inhabitants. Availing of local inhabitants to crew and manage CCG or privately owned icebreakers is a way to enhance stewardship and strengthen Canada's sovereignty claim in the Arctic. Some interviewees did note, however, that as it currently stands, the local inhabitants of the Arctic would require training with respect to the management and operations of commercially or CCG owned icebreakers.

Icebreaker Design/Construction- Icebreaker design and construction requires enormous human, financial, and technical resources. Given the potential for substantial employment, a situation Canada would welcome, vessel construction could become very political and consequently very inefficient. Also, the persistence of lobbying naval architecture firms closely associated with influential politicians could jeopardize the free market competition of building ships. On the global scale, there is considerable experience in the design and construction of icebreaking vessels and such vessels could be procured as a turn-key operation at a much lower cost by using an already proven design from reputable shipyards in Finland or Japan. Canada, however, has no recent experience in the construction of icebreakers and would first need to build a shipyard capable of building icebreakers. A learning curve would also need to be factored in. Currently, there is only one shipyard in Canada able to service Canada's largest icebreaker, the Louis S. St. Laurent. Some interviewees informed that a lack of competition for service can often result in relatively expensive and poor quality work. Further, shipyard monopoly could possibly increase the cost of building new icebreakers. Interviewees also felt that while Canadian shipyards have skill sets adequate to building icebreakers, they:

- Lack personnel;
- Lack technological and organizational efficiency;
- Have inefficient capacity;
- Are relatively inefficient when compared to European and Asian shipyards.

Consequently, the minimum of five years that it would take to design and construct an icebreaker in Canada would be significantly longer than would be designing and constructing one in Finland or Japan. However, interviewees pointed out that Davie shipyard, located in Lévis, Quebec, was currently building smaller ice class supply vessels.

From a taxpayer's perspective, the best way for Canada to acquire new icebreakers would be to compete internationally for their design and construction. This was re-emphasized given that the strong Canadian dollar has eliminated the disadvantage of building vessels overseas. However, interviewees strongly felt that there would be no political will to let that happen. With respect to Canada, as there are no government shipyards, all vessel construction would have to be done by private yards. It needs to be noted again that the current CCG fleet of icebreakers are multi-mission capable, catering to the many government departments that may avail of the vessels as platforms to perform some of their work, and that such flexibility comes at an added cost. To keep construction cost down the vessel would need to be as specialized as possible rather than being everything for everybody. Adding to the increased cost of building in Canada would be the involvement of the many consultants and civil servants associated with the government procurement process. Unlike government, private industry is able to reduce the number of individuals and firms involved in vessel procurement and therefore are able to build specialized icebreakers cheaper than the CCG multi-purpose icebreakers. With respect to operations, a vessel needs to be

designed for maximum, year round utilization and built to fulfil its operation requirements, both of which, goals would be best left to the respective groups after the vessel's requirements have been provided by the operator. Interviewees suggested that the CCG and federal government should stay out of the shipbuilding business and the best way forward for Canada with respect to the acquisition of modern icebreakers would be for the CCG to develop their statement of operating requirements and then go to public tender for the design and construction work. Unfortunately, the current procurement of hardware by the CCG involves the input of their Technical Services Department, which lacks the marine experience required and are often taken advantage of by opportunistic suppliers. Added to this, it was felt that the TB and PWGSC also need to be excluded from the affairs of the CCG with respect to the procurement of a modern fleet of Arctic icebreakers. In light of the above, sound contract management would be an essential part of any procurement process; shipyards would need to meet their promised design specifications or else be in breach of contract and thus accountable for any additional cost. Privatization would better ensure that operational requirements are met with less bureaucracy.

Contrary to the above views, interviewees pointed out that while it currently may be less expensive to procure modern Arctic class icebreaking vessels outside of Canada, there were advantages to building these vessels in Canada and that in the long run it would be cheaper to do so. In the anticipation that more icebreakers will be needed for future operations in the Arctic, potentially creating enough shipbuilding demand for Canadian shipyards to become competitive, they should be built locally. In failing to do so, Canada will forever be dependent on other countries for the supply of its Arctic icebreakers. Also, if Canadian yards are not involved in the construction, vessel maintenance may need to be done overseas

and this would result in the icebreakers being further from the field of operation and for longer periods of downtime. Added to this view was the belief that it would be easier to deal with Canadians than other nationals.

As noted in the private management/crewing section above with respect to a new multipurpose fleet of icebreaking vessels to be built by private interest and leased to the CCG, DFO, DND and the oil companies having Arctic interests, these vessels would be identical and the various named organizations would design their own modules to be fitted on board the vessels when used by them. The modules would be light in weight so as to be flown to the vessels in the Arctic. With respect to vessel repair facilities in the Arctic, interviewees noted that during exploration in the Beaufort Sea in the 1980s floating dry docks were used and that this approach could be used again so as to eliminate the need for the construction of the much talked about deep water ports.

Leasing/Chartering- In light of Canada's strong economy and the fact that leasing is largely political financing, interviewees felt that the current federal government would not be partial towards the leasing of icebreakers. However, it was strongly agreed that leasing had many financial benefits, such as:

- Less need for initial capital expenditure;
- Less overhead cost;
- The provision of level acquisition cost;
- Easier justification of smaller expenditures to the TB;
- No maintenance cost.

Leasing would allow for the benefits of a turn-key operation. It would also provide much needed flexibility in terms of matching icebreaker capabilities with the uncertainty of future Arctic ice conditions and could therefore provide Canada

quicker access to more suited icebreakers. It would also avoid using CCG Technical Services and other government departments which are currently involved in icebreaker issues but are often not suited for such work.

Contrary to the above, mention was given to some of the concerns associated with leasing. Interviewees felt that clear and detailed contracts dealing with lifetime cost, which may get high, would need to be put in place, and that this in itself might prove difficult for the CCG given their lack of experience in such matters. It was also felt that leasing could prove to be more expensive in the long run as a result of the added cost of profit over capital cost. This would then require more tax dollars and prove unfavourable for the politicians. Leasing would also require prior commitment and possible long term arrangements so as to help ensure that the icebreakers are readily available.

With respect to chartering, this could be done with an experienced private firm charging a daily rate to the CCG, which would also pay for fuel. Chartering would require detailed contracts and long term time charters. The private firm would look after the entire management of the icebreaker(s), which would be made available to the CCG as requested.

8.5 Conclusion

From an organizational perspective, the CCG is hindered by bureaucracy, inefficient, and ineffectively managed. The CCG requires new management. The current situation with the CCG fleet of icebreakers, in terms of icebreaking capabilities in the Arctic, is limited and the current fleet will not be able to respond to the future demands of Arctic shipping activity. Canada will require new and increased Arctic icebreaking capabilities. In addition, Canada currently lacks the

ability to build Arctic icebreakers on a competitive basis with other nations. Consequently, construction of icebreaking tonnage in Canada will cost taxpayers considerably more than if built on a globally competitive basis. Further, it will take considerably longer to construct icebreaking tonnage in Canada than it would elsewhere in more technologically advanced shipyards. Unless Canada is going to significantly increase the development of its Arctic and locally construct a fleet of icebreaking vessels capable of meeting future Arctic shipping needs, it may be in the best interest of Canadian taxpayers to have a modern day Arctic icebreaker built in Europe or the Far East and to have it managed by sound private shipping interests.

The following chapter reports on the Phase III work based on a Likert style quantitative survey developed as a means to help triangulate the results and test the hypotheses and relationships developed in accordance with the conceptual model, Phase II grounded theory work, and Phase I Delphi exercise.

Chapter 9 Quantitative Survey

9.1 Introduction

This chapter explains the rationale behind the development and execution of the Likert style quantitative survey, Phase III, in an attempt to triangulate and expand on research findings. The survey was carried out from June 2008 to January 2009.

The main aim of the survey was to test the incidence of some of the hypotheses and relationships developed in the earlier Phase II work and to a lesser extent the Phase I work. Part A of the questionnaire was used to capture demographics, a respondent profile, and subject risk profiles. It was also used to test Phase II findings dealing with contract durations and to help triangulate Phase I results dealing with the retreat of ice in the NWP. First, 21 questions from Part B of the survey will be analysed to report on the attitude of survey subjects with respect to grounded theory hypotheses and relationships surrounding private management and crewing of CCG icebreakers, private involvement in the design and construction of CCG icebreakers, and the leasing and chartering of privately owned icebreakers to the CGG. Finally, all questions from Part B of the survey will be analysed on a multivariate basis in an attempt to identify any undiscovered latent structure.

The chapter will also look at the topic of survey work in light of the quantitative survey carried out as part of the overall research and will report on some of the survey outcomes in terms of non-response rates and survey findings. Finally, the chapter will explain why non-parametric statistics and principal component analysis were availed of.

9.2 Sample Size, Techniques and Selection Strategy

Population, elements, population framework, sample and subjects are all terms associated with sampling. Sampling, according to Stephan and McCarthy (1965, 12), allows for a compromise between the time and financial pressures associated with a census, an extreme case of sampling. While in probability sampling the elements of the population have some known chance or probability of being selected as a sample subject, this is not usually so in non-probability sampling (Sekaran, 2003). Probability sampling, when properly conducted, will allow confident generalization about the population under study. Non-probability sampling avails of sample subjects that are rich in information and more appropriately suited to the research topic (Patton, 1990, 169). However, with respect to the sample interview survey commonly used in public opinion research, direct answers to direct questions cannot be taken at face value and therefore an indirect approach of asking several related questions ought to be considered. Data gathered from such surveys, when analyzed quantitatively, will supplement existing knowledge with a body of systematic information based on accurate measurements (Likert, 1951).

There are numerous sampling techniques available to a researcher. However, Lee (1993) warns that while the two main aims of sampling are representativeness and cost-effectiveness, neither may be easily attainable when researching sensitive or politically controversial topics. Unlike quantitative researchers utilizing large sample sizes in seeking statistical significance, one of the key features of qualitative sampling according to Miles and Huberman (1994, 27) is the careful selection and use of a small number of contextually nested people who are studied in-depth. In research dealing with political and or social issues that are not widely acknowledge, Lee (1993, 61) warns of the difficulties in

trying to generate statistically adequate samples and that the subsequent use of non-probability sampling may result in the research not being taken seriously. In terms of the best sampling method or technique, Stephan and McCarthy (1965) suggest that there is no need to copy exactly the approach of others but rather it is more important to meet the particular needs of the researcher. This idea is supported by Patton (1990) who notes that the key to deciding on the unit of analysis for a study is ultimately influenced by the amount of authority that the researcher wishes to proclaim. A respondent profile is shown in Table 12. While Table 12 groups the background of respondents into nine classes, some analysis of the survey findings using the Statistical Package for the Social Sciences (SPSS) groups the respondents in four prime classes, namely Academia, Business, Government, and Mariner; or two prime classes, namely Mariner or Non-Mariner. While a large sample size is often sought after, Stephan and McCarthy (1965, 103) suggest that in some cases a small sample may be more representative than a large sample and the more information the sampler has about the population the more effective survey efforts should be. In the case of this research, where there was no sample or population frame available and therefore non-probability sampling is called for (Saunders et al., 2007, 235), the sample consisted of a relatively small number of experts and stakeholders in Arctic matters. Given the subject matter of the research, it was expected that there would be a varying extent of expertise and stakeholder interest amongst the sample subjects. With respect to survey non-response, Neuman (2007, 186) warns of the sampling bias, and problems with generalizing results, that can be introduced when high proportions of a particular group, or strata, of the sample subjects do not respond. Research dealing with political issues may be seen by some groups as sensitive or threatening and consequently they may decline to participate (Lee, 1993).

Table 12 Respondent Profile for the 110 Survey Participants

Profile	Percentage of Total
Age	
20-30	10.0
31-40	11.8
41-50	32.7
Over 50	45.5
Gender	
Female	3.6
Male	96.4
Place of Residence	
Western Canada	17.3
Central Canada	18.3
Eastern Canada	50.9
Northern Canada	3.6
Other	9.9
Years dealing with Arctic Matters	
<6	37.9
6-10	9.8
11-15	6.8
16-20	15.5
>20	30.0
Working in a Private or Public Organization	
Private	55.0
Public	45.0
Background	
Academia	8.2
Business	26.4
Government	8.2
Mariner	10.0
Mariner & Academia	13.6
Mariner & Business	18.2
Mariner & Business & ex Canadian Coast Guard	3.6
Mariner & Government & Canadian Coast Guard	5.4
Other Combinations	6.4

Source: Author.

As it was experienced in the earlier Delphi exercise, CCG personnel were instructed by Fleet Directorate not to participate in the survey (see Appendix 8). However, despite the instruction, two employees did take part in the survey. With respect to retired CCG personnel, there was a marked increase in their response rate. Willimack et al. (2002, 215) note that with respect to business type surveys, university researchers tend to experience higher non-response rates than do government agencies. Saunders et al. (2007, 213) note the need to report survey

response rates; the total response rate for this survey was 34.1 percent while the active response rate was 39.7 percent.

While there are qualitative and quantitative approaches to sampling (Patton, 1990), there are also varying versions and descriptions to many of the more commonly named sampling techniques (Lee, 1993; Davis, 1996; Robson, 2002; Sekaran, 2003; Neuman, 2007; Saunders et al., 2007). Saunders et al. (2007, 235) note that some research projects will call for a combination of sampling techniques and strategies. This approach to sampling may also be availed of in the case of hidden populations where potential subjects are not visible, accessible, rare or deviant (Lee, 1993; Neuman, 2007). In the case of this research, the researcher knew of Arctic experts that were inaccessible given the associated time and financial restraints. Non-probability sampling provides the researcher with the opportunity to purposively select sample subjects and to reach information rich subjects who would be difficult to reach using probability sampling techniques (Saunders et al., 2007). Neuman (2007, 143) notes three cases where it would be appropriate to use purposive or judgemental sampling:

- In selecting unique cases that are especially informative;
- In selecting members of a difficult-to-reach or specialized population;
- When a researcher wants to identify particular types of cases for in-depth investigation and deeper understanding.

Lee (1993, 61) lists the following sampling strategies which may be used, singly or in combination, for sampling special populations:

- List sampling;
- Multi-purposing;
- Screening;

- Networking;
- Outcropping;
- Advertising;
- Servicing.

With respect to list sampling, a list of all Canadian mariners is held with TC in Ottawa. However, other than the number of certain licensed groups of mariners and their province of residence (see Appendix 9), contact information is not made available to the public. In terms of multi-purposing and outcropping, where lists or groups of individuals are collected or gathered respectively, there is no way to ensure that the sample selected will have the expertise or interest required for them to be considered eligible survey participants. Consequently, as was experienced in this survey, this could result in higher than normal non-response rates. The email contact information for numerous members of the sample population was obtained from Lloyd's 2008 Maritime Directory and from the list of participants at several Arctic related conferences and seminars. Lastly, while advertising allows for a wide coverage area, there is little control over the eligibility of those who respond. While the survey was posted on the home page of the Company of Master Mariners of Canada (CMMC) webpage for several weeks, only three individuals participated in the survey through this means; all three participants were considered eligible to participate.

The purposeful sampling techniques availed of in this research include:

- Stratified sampling (even though no sampling frame was readily accessible);
- Purposeful sampling (maximum variation strategy);
- Snowball sampling;

- Self-selection sampling (via the CMMC website).

The use of targeted respondent selection methods to identify information rich subjects, with knowledge appropriate to the research topic, has been shown to improve survey response rates (Willimack et al., 2002, 215). While considerable efforts were made in trying to identify and reach as many Arctic experts and stakeholders as possible to take part in the survey, as noted above it is certain that some were unintentionally excluded. The main reason being there was no way of contacting potential subjects. Sample subjects were identified through the following means:

- Literature review;
- Attending Arctic related events such as conferences and seminars;
- Individuals previously known to the researcher;
- Colleagues;
- Personal contacts;
- Lloyd's Maritime Directory 2008 (Canada only, under the following groups).
 - Shipowners/Managers/Operators;
 - Banking and Finance;
 - Associations;
 - Classification Societies;
 - Marine Consultants and Surveyors;
 - Insurance and P&I Clubs;
 - Ship Management Services;
 - Maritime Solicitors and Lawyers

Miles and Huberman (1994, 36) note that in the case of an applied, evaluation, or policy study the focus is tighter and the instrumentation is closely keyed to the

variables of interest; instrumentation should be a function of the conceptual focus, research questions, and sampling criteria.

9.3 Survey Rationale and Arrangement

In an attempt to triangulate the outcomes of Phase I and Phase II work conducted earlier, a Likert style survey, Phase III was constructed to measure the attitudes of Arctic experts and stakeholders against these earlier results. Presser (1984, 95) defines a survey as any data gathering process in which the aggregates of human response, and not that of particular individuals, is of interest. A copy of the survey questionnaire is attached in Appendix 10. The survey was broken into two parts. Part A of the survey was used to try and gain insight with respect to the varying levels of business risk that survey participants were willing to accept. Three scenarios, each having different probabilities, and three contracts were offered. Survey participants were asked to prioritize the selection of the three contracts. In subsequent questions, the contract conditions were altered slightly and the participants were again asked to prioritize the selection of the three contracts. The answers to Part A were subjected to Hurwicz criterion as shown in Appendix 11; the processing of imprecise risk information in which a decision value is the weighted sum of its pessimistic and optimistic evaluation (Jaffray and Jeleva, 2007). This was done to see if the participants did in fact match up with the risk profile they chose in Question 1 of Part A of the survey. Part B of the survey comprised of 45 statements that were founded on the relationships and hypotheses developed during Phase II of the research as shown in Appendix 6. With respect to the length of a survey negatively affecting response rates and quality, in surveys which exceed 100 questions, motivating the respondents via more interesting survey contents has been found to have a very high relative

impact (Burchell and Marsh, 2007; Herzog and Bachman, 2007; Saunders et al., 2007).

9.4 Pilot Testing

It is important that data collection tools be tested or piloted before being used in a full scale survey (Robson, 2002; Collis and Hussey, 2003; Kumar, 2005; Saunders et al., 2007). The pilot study should, if possible, include representation from the major variations of the population which data will be collected from. Pilot testing allows for questions to be refined so that they are understandable and unambiguous. It also provides an opportunity for any technical glitches associated with the physical capturing, and subsequent analysis, of the data to be resolved (Neuman, 2007, 189). Electronic submission, faxing, and sending by post were the options offered to the participants of the quantitative survey. Finally, piloting will help ensure content validity, data reliability, and that the researcher is conceptually on track; that the constant comparative analysis of in-depth and semi-structured interviews from Phase II work was captured appropriately and likewise presented in the questionnaire. The questionnaire was sent out to a mix of 20 industry and academic professionals. Eleven of the 20 responded in varying degrees and throughout various stages of the piloting. The piloting occurred during June, July and August of 2008. The majority of the comments from the piloting surrounded Part A of the survey. Pilot subjects were initially unclear about the setup and presentation of Part A and were looking for more clarity and information surrounding the three contract choices. The main comments regarding Part B of the survey concerned the number of questions and that some appeared to be double barrelled (i.e., asking the respondent to comment on two ideas at once). The piloting concluded after 12 updates of the survey.

9.5 Survey Etiquette

A pre-survey contact letter (Saunders et al., 2007, 390), shown in Appendix 12, was sent out to most of the subjects during the early stages of administering the questionnaire. Neuman (2007, 186) suggests that survey response rates can be improved when pre-survey contact letters are used. In light of time and resource constraints, the pre-survey contact letter was not sent out to subjects that were personally known to the researcher or were identified towards the later stages of data collection. In the case of non-probability sampling, the researcher is afforded the option of gradually selecting subjects if they can add clarity and help deepen the understanding of the research (Neuman, 2007, 141). A covering email, shown in Appendix 13, was also sent out with the questionnaire (ibid). Survey follow-ups (ibid) were carried out at various time intervals throughout the data collection process. A positive correlation was experienced between the survey reminders and the overall number of returned surveys. There was a negative correlation experienced between the time from sending a survey reminder and the number of surveys returned before a subsequent reminder.

9.6 Response Bias, Non-response Bias and Non-substantive Responses

Neuman (2007, 130) defines response bias as the tendency for some individuals, participating in long survey questionnaires, to answer numerous items with the same response, usually agreeing. This action may stem from an urgency to complete the questionnaire or a psychological predisposition. As was the case with this survey, response bias can be dealt with by wording statements in alternating directions (ibid).

Questionnaire, or unit, non-response and item non-response are different sources of non-response bias associated with surveys administered by post or

electronically and have different causes (Dillman et al., 2002; Collis and Hussey, 2003). Questionnaire non-response from certain individuals or groups of individuals will bias the generalization from the sample to the population under study. Saunders et al. (2007, 213) note four interrelated problems affecting questionnaire non-response:

- Refusal to respond;
- Ineligibility to respond;
- Inability to locate respondent;
- Respondent located but unable to make contact.

As mentioned earlier, there is a need with respect to sample representativeness to report the total response rate (TRR) and active response rate (ARR) for a survey (ibid):

Equation 1: **TRR** = total number of responses / (total number in sample – ineligible)

With respect to this survey: **TRR** = 110 / (406 – 83) = 34.1 percent

Equation 2: **ARR** = total number of responses / ((total number in sample – (ineligible + unreachable))

With respect to this survey: **ARR** = 110 / ((406 – (83 + 46)) = 39.7 percent

With respect to the issue of non-response on the part of survey respondents to individual survey questions or items, de Vaus (2004, 3) identifies four contributing causes:

- Was not required to answer;
- Simply refused;
- Provided an illegible answer;

- Responded 'don't know'.

In addition, Dillman et al. (2002, 13) identify the following as contributing causes with item non-response in self-administered questionnaires:

- Poor visual layout and design;
- Question structures such as open-ended questions, multiple part questions, and questions having branching instructions;
- Questions that are too difficult to answer;
- Institutional requirements or policies with respect to proprietary information;
- Respondent attributes such as age, education, and reluctant or converted refusals.

Beatty and Herrmann (2002) also offer reasons why individuals may decide not to answer survey items and fundamentally group these decisions into matters of cognition and motivation.

On the topic of non-substantive responses, much attention has been given to the problems of non-committal, or non-substantive, unit responses in questionnaires and that non-attitudes may be hidden among substantive responses when there is no non-substantive unit response offered (Smith, 1984; Dillman et al., 2002; Vaus, 2004; Neuman, 2007). Examples of non-substantive responses may be 'no opinion', 'don't know', 'unable to decide', or 'not able to comment'. Smith (1984, 228) and de Vaus (2004, 73) summarize the interpretations of non-substantive response as follows:

- Ambivalent attitudes – an in-between or even neutral position between two sides of an attitude position;

- Non-Attitudes – the subject genuinely has no view on the matter;
- Social desirability – a person holds an unacceptable view but hides this by giving a non-substantive response;
- Failure to assert the true attitude due to a lack of confidence, shyness, etc.;
- Concealing the true attitude due to sense of privacy;
- Stalling responses while the person considers the issue.

In an attempt not to complicate the appearance of the questionnaire and possibly confuse survey subjects (Neuman, 2007, 130), unit response options for Part B of the questionnaire were restricted to five: strongly agree (SA), agree (A), disagree (D), strongly disagree (SD), and not able to comment (NA). de Vaus (2004) notes that while there is no limit to the number of unit responses that may be offered on a Likert scale, it is usually kept to four or five; fewer categories also make it easier when it comes to reading graphs. In attempting to ensure reliability and validity of the survey questions, all non-substantive responses were eventually treated as missing values. de Vaus (2004, 73) confirms that this is a reasonable and conservative approach when the sample is large and there are not a lot of non-substantive responses. It is also a 'safe' method in that genuine non-attitudes who have selected a non-substantive response will not be given an attitude position (ibid). With respect to the occurrence of non-attitude responses in surveys, Smith (1984, 218) informs that low levels of non-attitude responses are experienced when people are aware of the issues or topics, the questions are simple to understand and concrete, and the issues are of importance to those taking part in the survey.

In Part A of the survey there were 114 missing, blank, unit responses out of a possible 770, giving a missing response rate of 14.8 percent. This is not surprising

given that questions with long explanations, more than 30 words of prefatory explanation, and questions requiring some sort of future projection are associated with higher rates of 'don't know' or 'no opinion' results (Converse, 1976, 519). Part A of the survey contained both of the elements noted above. In Part B of the survey there were 38 missing, blank, unit responses out of a possible 5,830, giving a missing response rate of 0.7 percent; there were 541 non-substantive, not able to comment (NA) and eventually treated as missing, unit responses out of a possible 5,830, giving a non-substantive response rate of 9.27 percent.

9.7 Validity, Reliability and the Measurement of Conceptual Variables

Validity, whether face, content or criterion, and reliability are central issues in the measurement of conceptual variables developed or stemming from conceptual indicators (Babbie et al., 2007; Neuman, 2007). These conceptual variables often range in their levels of statistical sophistication and are commonly measured in the following four ways (ibid):

- Nominal- the lowest level of precision which simply distinguished that there is a difference among groups or categories;
- Ordinal – a higher level of precision where the groups or categories are both distinguished and ranked;
- Interval – improves on the ordinal level of precision by specifying the amount of distance between the groups or categories;
- Ratio – while often considered the same as interval, it offers a true zero and thus allows relationships to be stated in terms of ratios or proportions.

Quantitative data is the result of measuring variables on an ordinal, ratio, or interval scale (Foster, 2001, 7). Part A of the questionnaire consisted of nominal, ordinal, and interval scales of measurement. With respect to the ordinal level

variables constituting Part B of the questionnaire, their validity and reliability are not in question as they originated from the hypotheses and relationships developed during Phase II work. With the addition of Phase I, the same can be said for Part A.

9.8 Parametric, Nonparametric, Descriptive and Inferential Statistics

Test and analysis using the more powerful parametric statistics are intended to be used with interval or ratio measurements scales (ibid); normal distributions having zero skewness and kurtosis, and a symmetrical distribution with the same mean and median (de Vaus, 2004). Foster (2001, 11) refers to such distributions as being perfect. Such precise parametric requirements were not observed in the vast majority of distributions associated with this quantitative survey. Notwithstanding the above, Evans (2007, 60) notes that coefficients of skewness having an absolute value between 0.5 and 1 are only moderately skewed and that coefficients between 0.5 and -0.5 indicate relative symmetry. For this survey, 64 percent of the distributions displayed skewness coefficients between 0.5 and -0.5. de Vaus (2004, 76) suggests that as a rule of thumb, a distribution experiencing a skewness coefficient absolute value of less than 1.0 is indicative of symmetry. Looking further into the criteria for normal distributions, *Kolmogorov-Smirnov Z* test testing for normality conducted on the observed frequency distributions for the 27 variables identified in Tables 13, 14, 15, and 16 showed values ranging from 3.4 to 5.7, indicating with at least 99 percent confidence that these distributions were not normal. However, in bolstering the use of parametric statistics with non-normal distributions, the central limit theorem allows for this in the case of large sample sizes of 100 or more, as was the case with this survey where there were 110 subjects (ibid). Neuman (2007, 149) however, associates the central limit theorem with random sampling, which was not the case in this survey. Foster

(2001, 7) suggests the use of non-parametric tests when using an ordinal measurement scale.

Descriptive statistics avails of quantitative measures to describe data and include frequency distributions and histograms, measures of central tendency, and measures of dispersion (Evans, 2007, 47). It allows for description and summary of the data or the relationships between variables in the data (Babbie et al., 2007, 270). Analysis of the 21 questions, noted earlier, to help fulfil research objective six with respect to the evaluation of different models of privatization and the forms they might take, will rely heavily on descriptive statistics. Inferential statistics allows for the generalization or drawing of conclusions from a sample to a wider population (Foster, 2001, 6). However, in order to make such statistical inferences, Saunders et al. (2007, 207) stress the need for probability sampling, while non-probability sampling techniques were availed of in this survey.

9.9 Survey Findings

The low response frequency in many of the statements may suggest that subjects had difficulty in taking a position on some of the issues and ideas put forward. This is not surprising given the wide range of statements and the diversity of the sample. In Part B of the questionnaire, there was a strong positive correlation noted between the statements having higher frequencies, 105 and higher, and the number of subjects expressing strong agreement. The statement frequencies ranged from a low of 79 to the maximum possible of 110; the average was 99.

Question four in Part A and statements 28 and 44 in Part B deal with the issue of contract durations. During Phase II, it was hypothesized that the Canadian Government would need to engage in long-term contracts with the private sector

when it came to the chartering of icebreaker services in the Arctic. Statements 28 and 44, presented below, show that the survey sample had a positive attitude toward this issue. However, this positive attitude is not clearly discernable in Part A. In fact, given the uncertainty of the future ice conditions, some subjects appeared to reject longer duration contracts that were not flexible with the environmental conditions.

The summary of statements and descriptive statistics shown in Table 13 are taken from Part B of the questionnaire and test general attitudes towards Canada's military and civilian roles in the Arctic, CCG terms of reference, Canadian Arctic expertise, involving local residents in Arctic development, and private involvement in delivering CCG services. Following the table are general comments on each individual statement followed by an overall section summary. With respect to the mean shown in Tables 13, 14, 15, and 16 1=Strongly Disagree, 2=Disagree, 3=Agree, 4=Strongly Agree.

Table 13 Summary of Survey Statements Testing General Attitudes Towards the Canadian Government and Arctic Development

No.	Survey Statement	Count	% Agree	% Disagree	Mean
1a	Canada's military and civilian roles in the Arctic should be combined.	102	42.2	57.8	2.30
1b	Canada's military and civilian roles in the Arctic should be managed by a newly created maritime organization.	98	34.7	65.3	2.15
2	Separating CCG Hardware from CCG Services will aid in setting clearer terms of reference for the CCG.	93	43.0	57.0	2.26
11	Canada's Arctic would develop sooner if greater I/B capability were available on a year round basis.	108	74.1	25.9	2.97
21	Canada needs to enhance its Arctic expertise.	110	96.4	3.6	3.57
22	The local residents of Arctic regions need to be significantly involved in future Arctic developments.	109	95.4	4.6	3.39
27	Private involvement in the delivery of CCG services in the Arctic will result in less tax dollar spending.	100	67.0	33.0	2.76
30	The Canadian public in general will object to only privatizing icebreaking services in the north and not in the south.	92	44.6	55.4	2.49

Source: Author.

The mean for statements 1a and 1b indicates that overall, respondents expressed a negative desire to combine Canada's military and civilian roles in the Arctic, and for these roles to be managed by a newly created maritime organization. Closer analysis using SPSS crosstabs between Mariner and Non-Mariner prime classes showed that relatively, the greater percentage of disagreement in statements 1a and 1b came from the Non-Mariner class, the Government prime class to be more specific. Private involvement in the delivery of CCG services in the Arctic is expected to result in less tax dollar spending and respondents felt that Canadians in general would not object to privatizing icebreaking services in the north only. Closer crosstab analysis of statements 27 and 30 showed that the overall view of the Government class was opposite that of the Academic, Business, and Mariner classes. Relatively speaking, the vast majority of the Government class disagreed with private involvement and agreed that the public would object to privatizing icebreaking services in the north and not in the south.

Overall, most respondents disagreed that separating CCG Hardware and Services would assist in setting clearer terms of reference for it. The high number of strongly disagree responses, and current joint operation of hardware and services may suggest that defining clearer terms of reference for the CCG has nothing to do with private involvement and that a closer focus on the role of the organization may need to come from government. Closer analysis between Mariner and Non-Mariner prime classes showed that relatively, the greater percentage of disagreement in statement 2 came from the Non-Mariner class, the Government class to be more specific.

Respondents expressed a very strong belief that Canada needs to enhance its Arctic expertise. Crosstab analysis showed that while 96.4 percent of participants

agreed with statement 21, 2.7 percent of the Business prime class and 0.9 percent of the Mariner prime class disagreed. In terms of expediting Canadian Arctic development via greater icebreaking capability on a year round basis, the mean for statement 11 shows that respondents were strongly in favour of this approach. Respondents also felt strongly towards Arctic development that called for increased involvement of local residents. Interestingly, with respect to the 4.6 percent disagreement in statement 22, crosstab analysis showed that 3.7 percent of it came from the Mariner class and 0.9 percent from the Non-mariner class.

In summary, the above results indicate that Canada should continue to keep its military and civilian roles separate in the Arctic. Canada also needs to avail of its local Arctic residents whilst enhancing its Arctic expertise, and there is support for private involvement in the delivery of CCG services in the Arctic. It could be suggested that, if Arctic icebreaking services were to be privatized, this might lead to a greater presence of private shipping activity. This in itself would result in the enhancing of Arctic expertise over time and it could be supplemented by availing of the knowledge and experience of local residents given the current issues surrounding the shortages of qualified maritime human resources.

The summary of statements and descriptive statistics shown in Table 14 are taken from Part B of the questionnaire and test general attitudes towards private management and private crewing of CCG icebreakers. Following the table are general comments on each individual statement followed by an overall section summary.

Table 14 Summary of Survey Statements Testing General Attitudes Towards Private Management and Crewing of CCG Icebreakers

No.	Survey Statement	Count	% Agree	% Disagree	Mean
23a	Private ship management companies operating in the Arctic would be more cost efficient than government.	102	87.3	12.7	3.15
23b	Private ship management companies operating in the Arctic would be more risk averse than government.	102	54.9	45.1	2.62
24	Private firms are able to manage CCG I/Bs more efficiently than the CCG through Public Works & Treasury Board.	95	65.3	34.7	2.82
25	Private management of the CCG fleet will resolve critical manning issues.	98	45.9	54.1	2.46
42	Canada's Arctic development would best be accomplished by having a private local company to manage and crew I/Bs that are built outside of Canada and leased to the CCG for year round operations in the Arctic.	100	49.0	51.0	2.49
45	Canadian taxpayers would benefit from having a fleet of competitively built, in Canada, Polar Class I/Bs that will be managed by competitive private firms.	99	64.6	35.4	2.75

Source: Author.

In statement 23a, respondents were quite strongly in favour of the notion that private ship management companies operating in the Arctic would be more cost efficient than government. Of the 12.7 percent disagreement in statement 23a, 5.9 percent came from the Government class. With respect to Canadian taxpayers benefiting from having a fleet of icebreakers built competitively in Canada, to be managed by competitive private firms, respondents were less in favour of this idea. This marginally positive attitude in statement 45 is somewhat contrary of the stronger positive attitudes exhibited in statements 34, 37, 38a, 38b, and 40 in Table 15 with respect to designing and building icebreakers in Europe or the Far East. Thus, it may be suggested that taxpayers will benefit from competition. Crosstab analysis showed the general view of the Government class, who largely disagreed with statement 45, was contrary to the Academic, Business, and Mariner classes.

Respondents marginally felt that private companies would be more risk averse than government when operating in the Arctic. Throughout the research, the issue arose as to whether a private ship management company operating in the Arctic would risk its assets during the dangerous situations that may often arise. Given a mean of 2.62 and the relatively small numbers of subjects who expressed strong disagreement (7) or strong agreement (14) with statement 23b, the issue of risk aversion on the part of private interest would probably not be viewed as a major deterrent towards private involvement in the delivery of CCG services in the Arctic. Relatively, crosstab analysis showed the Academic and Mariner classes to be more in agreement with this statement than the Business and Government classes. It would seem prudent that private service contracts would need to address the issue of dealing with higher than normal risk situations.

In statement 24, respondents generally felt that private firms would be able to manage CCG icebreakers more efficiently than the CCG through PWGSC and the TB. Crosstab analysis showed the general view of the Government class, who largely disagreed with statement 24, was contrary to the Academic, Business, and Mariner classes. The low count (95) suggests that this statement proved difficult for some participants to take a position on. This is not surprising since some participants would likely have never had any dealings with PWGSC and the TB. Notwithstanding the above, respondents generally felt that private management of the CCG fleet would not resolve critical manning issues. Again disagreeing, the general view of the Government class in statement 25 was contrary to the Academic, Business, and Mariner classes. CCG employees belong to large and influential unions. It may be that, unless the CCG fleet is crewed privately the critical manning issues may not be resolved. Looking at it differently, it may be that private management will not worsen an already critical situation.

Although marginal, respondents did not feel that Canada's Arctic development would best be accomplished by having a private local company manage and crew icebreakers built outside of Canada that would be leased to the CCG for year round operations in the Arctic. However, in light of the positive attitudes with respect to increased icebreaker capabilities on a year round basis, the efficiency of private companies, and the shipbuilding capabilities of foreign countries, exhibited in statements 11, 23a, 24, 38a, and 38b, it would appear that the negative attitude in statement 42 is connected with the leasing of the icebreakers to the CCG. Crosstab analysis of statement 42 showed the Academic and Government classes mainly disagreeing while the Business and Mariner classes were mainly agreeing.

In summary, the above results indicate that while a private ship management firm may be a little more reluctant than the government in deploying a ship into an high risk situation, the same firm would be more efficient at managing, and possibly crewing, CCG or privately owned icebreakers.

The summary of statements and descriptive statistics shown in Table 15 are taken from Part B of the questionnaire and test general attitudes towards icebreaker design and construction. Following the table are general comments on each individual statement followed by an overall section summary.

Overall, respondents felt strongly that experienced shipyards in European and the Far East were able to build an icebreaker faster and with greater efficiency and effectiveness than Canadian shipyards. Respondents felt that private firms were able to procure icebreakers more efficiently and effectively than the CCG through

Public Works. They also felt that the CCG would be better off using a proven icebreaker design than they would be at having a new design created in Canada.

Table 15 Summary of Survey Statements Testing General Attitudes Towards Icebreaker Design and Construction

No.	Survey Statement	Count	% Agree	% Disagree	Mean
34	It would be more efficient for the CCG to use a proven I/B design than to have a new I/B designed in Canada.	104	74.0	26.0	2.90
36	Private firms are able to design & build I/Bs more efficiently and effectively than the CCG through Public Works.	100	91.0	9.0	3.30
37	Canadian shipyards are unable to build a I/B as quickly as other experienced shipyards in Europe and the Far East.	100	83.0	17.0	3.13
38a	Other countries are able to build an I/B more effectively than Canada.	100	71.0	29.0	2.90
38b	Other countries are able to build an I/B more efficiently than Canada.	101	87.1	12.9	3.15
40	Unless Canada decides to build a substantial fleet of Polar Class I/Bs, it will cost less to have them designed and built in European or Far East yards.	98	90.8	9.2	3.18
43	The CCG would benefit from the acquisition of I/Bs designed and built by European or Far East yards to manage themselves.	102	59.8	40.2	2.64

Source: Author.

With a mean of 3.18, respondents felt strongly in statement 40 that unless Canada decides to invest in and build a substantial fleet of Polar Class icebreakers, thereby allowing for the flattening of learning curves and exploiting possible economies of scale and scope, taxpayers would benefit by having icebreakers built in foreign yards. In light of a mean of 2.90 in statement 38a, stating that other countries are able to build an icebreaker more effectively than Canada, respondents may be implying that Canada is more inept at building icebreakers than designing them.

The mean for statement 43 indicates that overall, the respondents were only slightly in favour of the CCG acquiring icebreakers from foreign shipyards to manage themselves. However, given the higher positive attitudes, means greater

than 2.64, exhibited in some of the above statements dealing with the acquisition of icebreakers designed and built competitively outside of Canada, the sampled responses may be suggesting that the CCG would be unable to extract the same gains as private industry in availing of shipyards outside of Canada. This may be connected with the fact that the CCG procure through public works and consequently lack the negotiating skills required in dealing directly with the shipbuilding industry.

In summary, the above results indicate that with respect to the interests of expediting Arctic development and spending less Canadian tax dollars, icebreakers should be procured by private firms availing of proven vessel designs and European or Far Eastern shipyards. Crosstab analysis of the statements in Table 15 showed the trends in general attitude to be similar across the Academic, Business, Government, and Mariner classes.

The summary of statements and descriptive statistics shown in Table 16 are taken from Part B of the questionnaire and test general attitudes towards the leasing and chartering of icebreakers. Following the table are general comments on each individual statement followed by an overall section summary.

The mean for statements 26a, 26b, and 39 indicates that overall, respondents felt Canada would increase its presence, and its taxpayers would benefit, from the private Canadian ownership of a fleet of multifunctional ice class vessels to be used by the CCG, Canadian military, and oil companies operating in the Arctic. Crosstab analysis showed that while the Academic, Business, and Mariner classes tended to mainly agree with these three statements, the Government class mainly disagreed.

Table 16 Summary of Survey Statements Testing General Attitudes Towards the Leasing and Chartering of Icebreakers

No.	Survey Statement	Count	% Agree	% Disagree	Mean
26a	Private Canadian ownership of a fleet of vessels used by CCG, Canadian Military, and oil companies in the Arctic will increase Canadian presence.	105	63.8	36.2	2.72
26b	Private Canadian ownership of a fleet of vessels used by CCG, Canadian Military, and oil companies in the Arctic will not jeopardise Canada's sovereignty.	102	67.6	32.4	2.78
28	Chartering out of private I/Bs to the Canadian Government will necessitate long term time charters.	100	89.0	11.0	3.16
39	Canadian taxpayers would benefit from the CCG and the military committing to charter a fleet of newly constructed and privately owned multi-functional ice class vessels that have the modular capability to meet their particular interest and will be time shared with oil companies operating in the Arctic.	98	69.4	30.6	2.85
41	In the absence of increased funding for the CCG, Canada's maritime requirements would be better served by setting up a Maritime Administration office which would be responsible for the development of CCG and DFO programmes and would avail of the existing CCG fleet, the leasing of private hardware and/or the contracting out of services.	93	64.5	35.5	2.67
44	Without its own fleet of Polar Class I/Bs the CCG will need to engage in a long term time charter for I/B services in the Arctic.	100	85.0	15.0	3.00

Source: Author.

In statements 28 and 44, respondents expressed a positive attitude towards the notion that any chartering out of private icebreaking services to the Canadian Government will necessitate long-term time charters. Crosstab analysis showed that while there was relatively little disagreement with statement 28 from the Academic, Business, and Mariner classes, there was no disagreement from the Government class. In statement 44 there was no disagreement from the Mariner class.

Respondents were in favour of creating a new maritime office or organization to deal with Canada's maritime requirements. Crosstab analysis showed the view of

the Government class, mainly disagreeing with statement 41, to be contrary to the other classes.

In summary, the above results indicate that Canada's presence and sovereignty in the Arctic could be bolstered by the CCG, military, and oil companies availing of a privately owned fleet of multi-functional icebreakers on a long-term contractual basis. While this idea is somewhat contrary to the negative attitudes exhibited in statements 1a and 1b, which suggest that Canada's military and civilian roles in the Arctic should be combined and managed by a newly created maritime organization, it does follow along the lines of creating a new maritime office to deal with Canada's maritime requirements. This idea was supported by respondents, in statement 41.

9.10 Measures of Frequency, Central Tendency and Correlations

In attempting to gain further insight and clearer understanding of the opinions expressed by the prime classes with respect to the possible forms of private involvement in Arctic icebreaking services, all 27 statements noted in the four tables above were analysed using appropriate *Chi-Square*, *Mann-Whitney*, and *Kruskal Wallis* statistical testing. Academic, Business, Government, and Mariner prime classes were compared in the *Chi-Square* and *Kruskal Wallis* tests. Mariner and Non-Mariner prime classes were compared in the *Mann-Whitney* test. For this research, *Chi-Square* was used to test whether the frequency distributions of the prime classes were independent of each other. Independence means that the proportion of individuals who chose to agree or disagree would be essentially the same, no matter what prime class the individual belonged to, with a null hypothesis that the variables are independent and there is no association between them. The *Kruskal Wallis* test was used to compare multiple group

measures of central tendency between Academic, Business, Government, and Mariner prime classes, the null hypothesis being that the group distributions are drawn from a common population. The *Mann-Whitney* test was used to compare measures of central tendency in two group distributions, namely Mariner and Non-Mariner prime classes. In these tests, the null hypothesis would be rejected in the case of a p-value <0.05. Hypotheses showing only that there is a difference, and no prediction as to where the difference lays, are referred to as non-directional (two-tailed) hypotheses (Collis and Hussey, 2003, 231). Alpha or significance values <0.05 for the various tests and statements are shown in Table 17. With respect to statistical analysis, Foster (2001, 14) informs that in the event there is less than a 5 percent probability that the difference between groups is due to random, unexplained chance variation, then we assume that any difference noted between the groups is real or statistically significant. The caveat being that when assigning a p-value <0.05, there is up to a 5 percent chance of making a type 1 error. A type I error occurs when rejecting a null hypothesis which is actually true. A type II error occurs with failing to reject a null hypothesis when it is false.

Table 17 Summary of Significant Values

	Statements												
Test	1b	2	23b	24	25	26a	26b	27	30	39	41	42	45
Chi-Square	0.014	0.015	0.015	0.018			0.015	0.001	0.043	0.009	0.000	0.005	0.006
Kruskal													
Wallis	0.015	0.016	0.016	0.019			0.016	0.001	0.045	0.010	0.000	0.005	0.006
Mann-Whitney			0.002		0.048	0.038		0.038		0.034	0.003	0.008	0.019

Source: Author.

In attempting to further explore the survey results and identify any relationships between survey statements, other than those subjectively grouped in the four tables shown in Section 9.9, the *Spearman rho* test, most often associated with ordinal data, was used to ascertain if there were correlations only, between

variables. These correlations will help with triangulation by identifying if the statements grouped in the tables in Section 9.9 are appropriately positioned. Correlation does not imply causation (Foster, 2001, 205). Positive and negative correlations vary from +1.00 to -1.00 respectively. A correlation of 0.00 is indicative of no simple linear relationship between variables. Adhering to the statements in Tables 13, 14, 15, and 16 the *Spearman rho* test was used to compare the variables on a bivariate basis; participant risk profiles of risk taker, risk neutral, and risk averse were added to the analysis to identify if certain risk types held different opinions with regards to the survey statements. With respect to participant risk profiles, weak negative correlations at the 95 percent level, -.215 and -.203, were noted in statements 34 and 37 respectively. Other significant correlations at the 95 percent level are shown in Table 18.

9.11 Simplifying Complex Matrices

The researcher felt that earlier analyses, noted above and conducted on a bivariate basis, did not offer enough insight into what the survey participants as a whole considered to be important with respect to furthering private involvement in the delivery of icebreaking services in the Canadian Arctic. Also, earlier analysis reduced the 53 survey statements to 27 and grouped these into four general topics which stemmed from the results of Phase I and Phase II work. Therefore, exploratory factor analysis (EFA) and principal component analysis (PCA) was conducted on the results of the quantitative survey in order to triangulate the results of earlier work and to try and gain further insight into what the survey participants considered important in terms of private involvement in the delivery of icebreaking services in the Canadian Arctic.

Table 18 Summary of Significant Values in Spearman rho Test

Statements																					
	1a	1b	2	11	21	23a	23b	24	25	26a	26b	27	28	34	36	37	38a	38b	39	40	41
1b	0.469																				
2	0.332	0.530																			
11	0.314	0.299																			
21				0.327																	
22					0.275																
23b						0.272															
24						0.543															
25						0.332	0.205	0.605													
26b										0.646											
27		0.415	0.337																		
30												-0.278									
36														0.244							
37														0.214	0.234						
38a														0.336	0.293	0.732					
38b														0.225	0.448	0.801	0.723				
39										0.510	0.576										
40														0.268	0.270	0.600	0.609	0.570			
41										0.385	0.366								0.406		
42						0.255		0.496	0.322												
43														0.360		0.259	0.346	0.257		0.483	
44										0.363	0.297		0.304						0.307		0.403
45								0.356	0.367												

Source: Author.

Tabachnick and Fidell (2001, 25) inform of empirical and theoretical approaches in trying to identify underlying latent structure in a set of variables; principal component analysis (PCA) being the empirical approach while factor analysis (FA) and structural equation modelling belong to the theoretical approach. Both approaches involve statistical techniques aimed at reducing complex sets of correlation matrices by determining which correlated variables belong to homogenous subsets that are largely independent of each other (Kim and Mueller, 1978; Kline, 1994; Cudeck, 2000; Foster, 2001; Tabachnick and Fidell, 2001; Stevens, 2009). FA may take the form of either exploratory or confirmatory, with exploratory being the most common (Foster, 2001, 232). Warner (2008, 753) informs that FA consists of a group of related analytic methods including PCA, and Stevens (2009, 345) informs that PCA is a form of exploratory factor analysis (EFA). However, Cudeck (2000, 274) stresses that PCA is often incorrectly used as a kind of FA and warns that some statistical packages used PCA as their default method of FA. This research will look at EFA and PCA. Kline (1994) informs that one of the aims of EFA is to explore a topic and to try and discover the latent constructs or dimensions that were previously unknown. It also aims to explain the correlation matrix in as few factors as possible and to ascertain which variables are deemed most important by those participating in a survey (Foster, 2001, 232).

Various rules are offered with respect to the suitability of sample size and whether factors or components are reliable (Yates, 1987; Foster, 2001; Child, 2006; Stevens, 2009). In consideration of the advice provided by Stevens (2009, 333), sample size and factor reliability for this survey are deemed appropriate. In determining sample adequacy, the Kaiser-Meyer-Olkin (KMO) and Bartlett's Test,

and the Anti-image matrices were run and analyzed. The initial and final KMO and Bartlett's Tests are shown in Table 19.

Table 19 KMO and Bartlett's Test
Initial KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.599
Bartlett's Test of Approx. Chi-Square	3049.863
df	1378
Sig.	.000

Final KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.758
Bartlett's Test of Approx. Chi-Square	2309.510
df	780
Sig.	.000

Source: Author.

KMO values less than .50 are unacceptable and should be removed from further analysis (Kaiser, 1974, 35; Child, 2006, 55). Thirteen variables identified along the diagonal of the Anti-image correlation matrix with KMO values less than 0.5 were removed from subsequent analysis and are shown in Table 20. The analysis involved 110 participants, 40 of 53 initial variables, and eight components.

Table 20 Variables with KMO Values <0.5

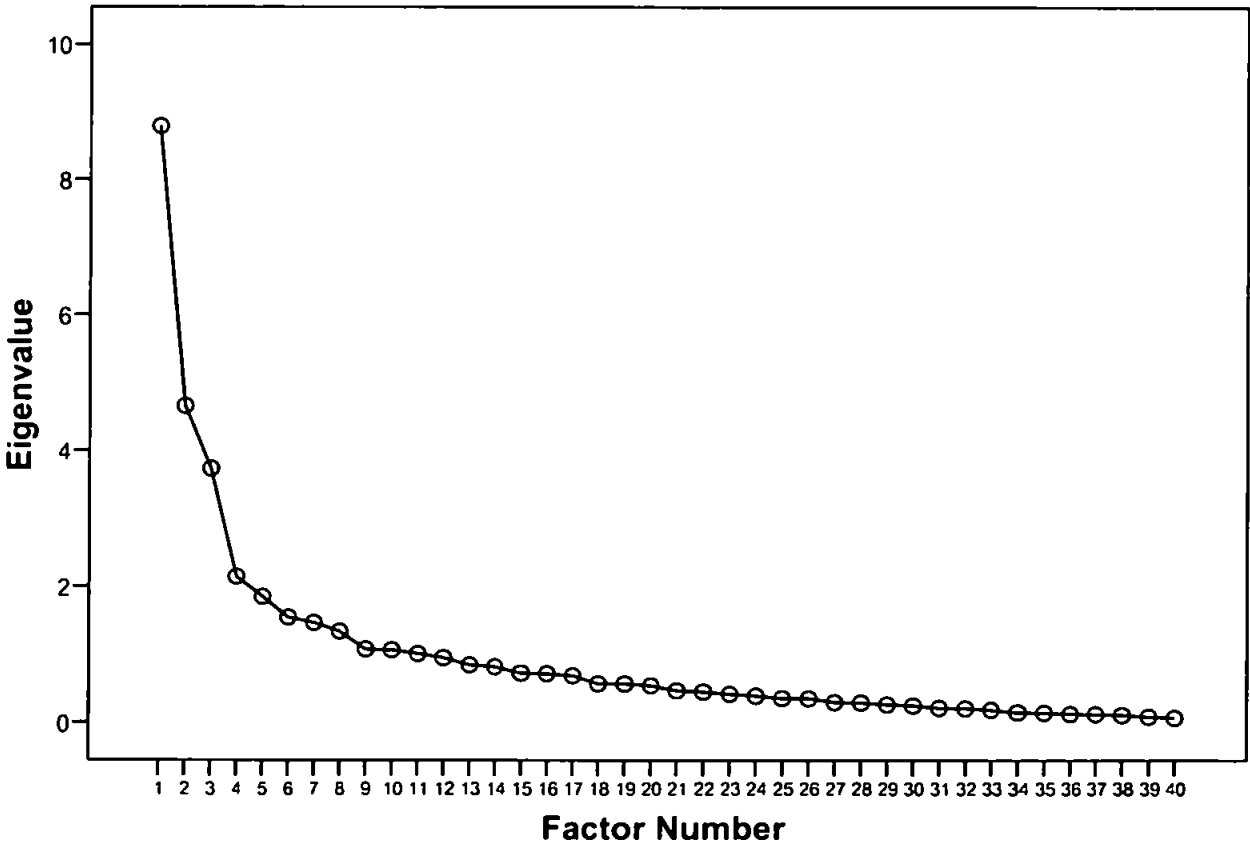
Survey Statement	6	7	8	12	16	22	23	28	29	30	34	35	43
KMO Value	.262	.368	.495	.445	.463	.244	.310	.471	.425	.320	.359	.418	.431

Source: Author.

Stevens (2009, 328) identifies four methods used in determining the number of components to extract or retain; eigenvalues greater than one, scree test, statistical significance test, and retain only enough factors or components to account for 70 percent of the total variance. He goes on to highlight several studies supporting the accuracy of the scree test and that in some cases the scree test and the Kaiser eigenvalues will yield the same results in terms of true factors.

Child (2006, 58) informs of methods used in helping to determine the appropriate number of factors to extract but notes that eigenvalues greater than one and the scree test are the most common. Johnson and Wichern (2007, 445) inform that the scree plot is a useful aid in helping to determine the appropriate number of factors to extract and that the user needs to look for a bend in the elbow of the plot to determine the actual number to use. The scree plot is somewhat subjective but can even be used when conditions are not ideal such as low sample and communality values (Tabachnick and Fidell, 2001, 621). For this research the scree plot, shown in Figure 13, proved better in terms of acquiring simple structure. The scree plot resulted in the extraction of eight components. In dealing with a participant's missing data, analysis was conducted using pair wise exclusion, resulting in varying sample sizes for some variables, of cases (Child, 2006, 68).

Figure 13 Scree Plot



Source: Author.

While PCA and common factor analysis (CFA) are substantially different, they do often yield similar results in terms of the PCA weights obtained in analysis and the estimated regression coefficients in CFA (Cudeck, 2000, 275; Child, 2006, 48; Stevens, 2009, 325). While Stevens (2009, 343-344) notes that FA and PCA are different, with factors estimated in FA but not in PCA and communalities less than one are used in the main diagonal of the correlation matrix in FA but not in PCA, he highlights several cases where the choice of analysis does little to affect the final outcome. However, he does note that outcomes can differ in cases with less than 20 variables. Child (2006, 58) provides advice on using PCA to prepare for CFA analysis. He goes on to explain that the results of PCA should be compared with other CFA, such as Principal Axis Factoring (PAF) and Maximum Likelihood (ML), to see which method, when rotated, provides simple structure. Yates (1987, 3) informs that rotation is a transformation phase aimed at bringing about simple structure in which the variables are assigned to the factors. For this research, PCA, PAF, ML, and Image Factoring (IF) were conducted and subjected to both orthogonal and oblique factor rotation. The combination of analysis and rotation providing the best in terms of simple structure was PCA with orthogonal varimax rotation. The rotated component matrix is shown in Table 21. The rotated component matrix with the survey statements included is shown in Table 22. As noted above, PCA was conducted on the results of the quantitative survey in an attempt to triangulate the results of Phase I and Phase II work and to try and gain further insight into what the survey participants considered important in terms of private involvement in the delivery of icebreaking services in the Canadian Arctic. While PCA turned out to be an interesting exercise, it did not help with the triangulation of earlier results. However, it did prove useful into deeper probing of the entire quantitative survey results as only 27 of the 53 Phase III survey statements, selectively chosen by the researcher, were analysed using

Table 21 Rotated Component Matrix

State ment No.	Components						
	Privatization	Resources	Politics	Shipbuilding	Development	SOA	Administration Services
27	0.787						
24	0.785						
26a	0.758						
26b	0.707						
23a	0.683						
25	0.658						
39	0.652						
42	0.614						
32		0.767					
33		0.766					
20	0.335	0.725					
31		0.585					
45	0.427	0.502					
15c	0.315	0.488	0.458				0.348
44	0.305	0.382			0.367		
13			0.800				
14			0.799				
15a			0.760				
15b	0.314	0.361	0.555		-0.325		0.315
19	0.301		0.459				
21			0.417				
38b				0.835			
38a				0.826			
37				0.817			
40				0.747			
36	0.454			0.483			
9					0.777		
10					0.761		
11					0.739		
12b					0.492		
4a						0.858	
5						0.795	
4b						0.721	
1b							0.748
1a							0.682
41	0.361	0.396					0.440
2	0.373					0.346	0.425
18							0.721
17							0.541
3						0.381	0.357
							-0.526

Source: Author.

appropriate *Chi-Square, Man-Whitney, and Kruskal Wallis* statistical testing. PCA also proved valuable in simplifying the data matrix with respect to discerning what survey participants felt was important in terms of private involvement in the delivery of CCG icebreaking services. This simplification of the matrix to discern the views of survey participants was valuable in triangulating the grouping of the survey statements in Tables 13, 14, 15 and 16.

Table 22 Rotated Component Matrix with Survey Statements Included

No.	Loading	Components with Statements
Privatization		
27	0.787	Private involvement in the delivery of CCG services in the Arctic will result in less tax dollar spending.
24	0.785	Private firms are able to manage CCG I/Bs more efficiently than the CCG through Public Works & Treasury Board.
26a	0.758	Private Canadian ownership of a fleet of vessels used by CCG, Canadian Military, and oil companies in the Arctic will increase Canadian presence.
26b	0.707	Private Canadian ownership of a fleet of vessels used by CCG, Canadian Military, and oil companies in the Arctic will not jeopardise Canada's sovereignty.
23a	0.683	Private ship management companies operating in the Arctic would be more cost efficient than government.
25	0.658	Private management of the CCG fleet will resolve critical manning issues.
39	0.652	Canadian taxpayers would benefit from the CCG and the military committing to charter a fleet of newly constructed and privately owned multi-functional ice class vessels that have the modular capability to meet their particular interest and will be time shared with oil companies operating in the Arctic.
42	0.614	Canada's Arctic development would best be accomplished by having a private local company to manage and crew I/Bs that are built outside of Canada and leased to the CCG for year round operations in the Arctic.
Resources		
32	0.767	Canada needs to be at the forefront of icebreaking technology.
33	0.766	Canada would benefit from regaining its expertise in designing and building I/Bs and becoming less dependent on other shipbuilding nations.
20	0.725	Due to Canada's geographical expanse and ensuing political bureaucracy the CCG fleet is grossly inefficient and underutilized.
31	0.585	Canada is capable of building ice strengthened supply vessels.
45	0.502	Canadian taxpayers would benefit from having a fleet of competitively built, in Canada, Polar Class I/Bs that will be managed by competitive private firms.
15c	0.488	Limited attention from Federal MPs has resulted in the CCG's poor operation.
44	0.382	Without its own fleet of Polar Class I/Bs the CCG will need to engage in a long term time charter for I/B services in the Arctic.
Politics		
13	0.800	Canada's low public interest in marine matters has contributed to the low public profile of the CCG.
14	0.799	The low public profile of the CCG results in very limited attention being given to it by Federal Members of Parliament.
15a	0.760	Limited attention from Federal MPs has resulted in the CCG's low funding.
15b	0.555	Limited attention from Federal MPs has resulted in the CCG's poor management.
19	0.459	Political intervention impedes the CCG from achieving more commercial-like efficiencies.
21	0.417	Canada needs to enhance its Arctic expertise.
Shipbuilding		
38b	0.835	Other countries are able to build an I/B more efficiently than Canada.

38a	0.826	Other countries are able to build an I/B more effectively than Canada.
37	0.817	Canadian shipyards are unable to build a I/B as quickly as other experienced shipyards in Europe and the Far East.
40	0.747	Unless Canada decides to build a substantial fleet of Polar Class I/Bs, it will cost less to have them designed and built in European or Far East yards.
36	0.483	Private firms are able to design & build I/Bs more efficiently and effectively than the CCG through Public Works.

Development

9	0.777	I/B support will be necessary for the development of the Arctic region.
10	0.761	Political will and I/B support will be necessary to expedite future development of the Arctic region.
11	0.739	Canada's Arctic would develop sooner if greater I/B capability were available on a year round basis.
12b	0.492	Canada's Arctic sovereignty claim and environmental stewardship would be bolstered if CCG I/Bs were stationed in the Arctic on a year round basis.

Special Operating Agency (SOA)

4a	0.858	Separating the CCG from the Department of Fisheries & Oceans (DFO) will strengthen its Special Operating Agency (SOA) status.
5	0.795	As a SOA, outside of DFO, the CCG would have more flexibility to operate more efficiently and effectively in the Arctic.
4b	0.721	Separating the CCG from the Department of Fisheries & Oceans (DFO) will help reduce crewing cost.

Administration

1b	0.748	Canada's military and civilian roles in the Arctic should be should be managed by a newly created maritime organization.
1a	0.682	Canada's military and civilian roles in the Arctic should be combined. In the absence of increased funding for the CCG, Canada's maritime requirements would be better served by setting up a Maritime Administration office which would be responsible for the development of CCG and DFO programmes and would avail of the existing CCG fleet, the leasing of private hardware and/or the
41	0.440	contracting out of services.
2	0.425	Separating Canadian Coast Guard (CCG) Hardware from CCG Services will aid in setting clearer terms of reference for the CCG.

Services

18	0.721	Increased political demands on the CCG have resulted in the CCG neglecting private sector service requests.
17	0.541	New southern security and science matters are shifting the workload of the CCG away from icebreaking in the Arctic.
3	-0.526	A single national organizational approach would reduce CCG crewing costs.

9.12 Conclusion

Although surveys are a popular research strategy in social science research, they demand considerable attention on the part of the researcher if results are to be meaningful. While various survey scales can be used to measure constructs, they must ensure both validity and reliability with respect to the overall research aims and objectives. Also, creative ways of identifying and reaching an information rich sample population are required when sampling frames are not readily available and the research topic is viewed as political or intrusive.

The selection of questionnaire statements and descriptive statistical analysis have identified that Canada needs to pay more attention to Arctic development. Also, there is significant potential for the private sector to be involved in this development with respect to the management and crewing of CCG icebreakers, the design and construction of icebreakers for the CCG, and the leasing and/or chartering of icebreakers to the Canadian government or other interested groups involved in Arctic operations. While there was a positive attitude toward longer term leasing and/or chartering contracts, it was noted that some respondents were not in favour of longer term contracts that would not be flexible with respect to the changing and uncertain future ice conditions.

PCA helped reaffirm the results of non-parametric analyses via highlighting the numerous potential benefits that could possibly be achieved from increased private involvement in developing the Canadian Arctic and that the current and future availability, and appropriate use, of resources will be paramount to such development. It also identified that political and administrative challenges are hindering Arctic development and the level of services that the CCG is capable of providing as a SOA. Further, given the status quo, the taxpayers of Canada would

benefit from the construction of new, and much needed, icebreaking capacity outside of Canada.

Finally, there was uncertainty, with respect to future ice conditions in the NWP. This uncertainty corroborates findings from the work conducted in Phase I.

The next chapter concludes the research work undertaken. It provides a brief background of the circumstances which influenced this research and then draws together the findings from Phases I, II, and III. It identifies subsequent reports from the Arctic Council and the Standing Senate Committee on Fisheries and Oceans Canada which help triangulate the results of this research. The chapter critiques the choice of methods and sampling used, and the validity and reliability of the research. It concludes with recommendations and the potential for further research.

Chapter 10 Conclusion

10.1 Introduction

After reviewing the research aims, this chapter begins with a brief summary of the background circumstances which influenced and helped shape this research. In drawing together findings from the three phases of research, it shows that Canada's Arctic icebreaking capabilities are currently fully tasked, will be inadequate for future shipping demands, and that there is potential for private involvement with respect to the construction, crewing, and management of the CCG Arctic icebreakers. It will also identify recent reports from the Arctic Council and the Standing Senate Committee on Fisheries and Oceans Canada which support and help triangulate the results of this research. The chapter goes on to critique the choice of methods and sampling used, and the validity and reliability of the research. The chapter concludes with recommendations and the potential for further research.

10.2 Research Aim, Background Summary and Specific Results

The overall aim of this research was to conduct a strategic situational analysis of the CCG services, principally Arctic icebreaking, and to investigate which services, in terms of effectiveness and efficiency, may be suitable for private involvement. A breakdown of the services offered by the CCG in the Arctic consist of:

- Route assistance;
- Ice routing and information services;
- Harbour breakout;
- Flood control and ice management;
- Northern re-supply;
- Sovereignty.

We live in an interdependent global economy where trade proliferates and there is a limited supply of natural, financial, and human resources. Recent trends in climate change have sparked a renewed interest in the Arctic and what it has to offer. The Arctic regions contain much of the world's reserves of minerals, gas, and oil. They also hold abundant fish stocks. Retreating sea ice also provides the opportunity for Arctic tourism and shorter shipping routes between Asia and Europe and parts of North America. The indigenous population of the Arctic is one of the fastest growing on the planet and its dependency on destination shipping, from southern Canada and other parts of the world, and intra-Arctic shipping, will continue to grow.

Privatization is a global phenomenon and there are numerous cases throughout the global maritime community where private industry is involved in the delivery of icebreaking services. As noted in detail in chapter three, Sweden and Russia have, or had in the case of Russia, arrangements where state owned icebreakers are being managed and crewed by private companies. In Finland, while the FMA is responsible for the development of its icebreaking policy the actual icebreaking services are procured from the Finnish state-owned enterprise, Finstaship, or other private companies. In the case of the United States, vessels are leased as and when required.

More pointed, the 2000 and 2007 Reports of the Auditor General of Canada are critical of the CCG (Auditor-General, 2007). This research, as discussed below, generally tends to support the Auditor General's reports. In addition to the major issues of crewing and fleet management, the reports go on to note the following human resource and organizational issues, which are also discussed respectively in light of the research:

- There is no integrated human resource plan;
 - The CCG fleet is deployed, maintained and operated by five regions spread across Canada with each region operating according to its own practices and management preferences. With respect to this decentralization of fleet operations, results of Phase I show that more Delphi panellists agree that it resulted in overall significant duplication of human resource effort within FOC with respect to Arctic operations. The majority of panellists also felt that regional control increases the operational costs of the entire CCG fleet due to duplication of services. Interviewees in Phase II felt that careers in the CCG are not well marketed and the CCG is seen to be losing its Arctic expertise through personnel retirements. Interviewees also felt that there is too much regional bureaucracy and duplication of effort.
- Collective agreements continue to be complex. A 2000 arbitration award doubled the leave entitlement of ships officers, thus increasing costs and scheduling complexity. In 2003, the CCG issued detailed administrative guidelines to ensure consistent administration and interpretation of the ships officers' collective agreement;
 - Over 84 percent of Delphi panellists in Phase I agreed that crew training and retention costs are undoubtedly high;
 - Interviewees in Phase II agreed that the biggest part of the CCG vessel operating cost was crew, and the CCG was seen as having the biggest icebreaker crews in the world;
 - Interviewees also felt that strong union contracts, negotiated through the PWGSC, are increasing CCG labour costs;

- 61 percent of the participants in the Phase III quantitative survey, used to test the relationships and hypotheses developed from the Phase II work, agreed that a single national organizational approach would reduce CCG crewing costs.
- Vessel crewing practices have remained largely the same. Managers want to make changes, but implementing them would require the union and members to accept them. The CCG has not yet developed a strategy aimed at ensuring that employees understand and accept the reasons for changes in vessel crew complements;
 - Results of the Phase II work identified that the biggest obstacle to privatizing the CCG would not be operational but rather political, as both unions and the CCG itself would oppose such a radically viewed move. Interviewees felt that the CCG is plagued with labour issues and needs to sort out its crewing policy, which is deemed inefficient in terms of helping to control costs.
- The amount of shore-based support to the fleet has not changed significantly since 2000;
 - Interviewees in Phase II felt that while the shore fleet personnel have been streamlined to a more basic unit, the administration and maintenance/engineering sides of the CCG are too large, bureaucratic, and focused on matters not relevant to efficient and effective fleet operations.
- The CCG's past executive staff performance agreements were not structured to ensure that managers were accountable for achieving the organization's objectives, plans, and priorities. By 30 June 2006, three

months after the start of the fiscal year, the CCG had not finalized 2006–2007 performance agreements;

- In Phase I, twice as many panellists agreed rather than disagreed that: the regions generally ignore national standards where they do exist, national standards are incomplete, there is no internal audit process visible for these standards, and there is still little coordination among the regions. Over 63 percent of panellists agreed that standardization of equipment and procedures is an important aspect of an efficiently operating fleet and that too much regional autonomy results in situations where icebreakers are not able to standardize on “best practices”. Further, the majority of Delphi panellists agreed that the CCG has not displayed any ability to operate in a more efficient manner even though they now have SOA status;
- In Phase II, interviewees felt that the CCG lacks real world business and fleet experience beyond itself and needs to get a handle on total cost throughout the life of a vessel(s). This results in the organization being unable to achieve commercial like efficiencies;
- Interviewees also felt that the organization's accounting is difficult to follow and understand due to a lack of appreciation for what is going on inside the entire organization;
- Interviewees expressed concern that the CCG lacks clear organizational leadership and accountability from within and that its objective, function, and purpose are also unclear
- Interviewees felt that the current SOA arrangement that CCG has inside of DFO does not allow for the level of autonomy required by the CCG. They felt that an effective and proper SOA set up, with

separate office administration ashore, would allow the CCG to move away from current public service type of operations.

In rebutting some of the CCG criticisms provided in the Auditor General's reports noted above, it is important to report that:

- While accountable to the public, the CCG is considered by some interviewees to operate at the whims of federal politicians and to be low priority on the MPs' list of political matters;
- The CCG is very bureaucratic and many of its issues stem from a lack of focus and clarity on the part of the federal government;
- Since the merger of the CCG with DFO the CCG is seen as fragmented and tensions exist between them;
 - The results of Phase III show that 77 percent of survey participants agreed that as a SOA, outside of DFO, the CCG would have more flexibility to operate more efficiently and effectively in the Arctic;
 - 75 percent agreed that separating the CCG from DFO would strengthen its SOA status.
- In looking closer at Canadian politics and the CCG:
 - 70 percent of Phase III participants agree that the role of Canada's maritime administration is not clearly delineated;
 - 76 percent of the participants agreed that political intervention impedes the CCG from achieving more commercial like efficiencies;
 - 70 percent agreed that due to Canada's geographical expanse and ensuing political bureaucracy the CCG fleet is grossly inefficient and underutilized. This is undoubtedly supported by 88 percent who agreed that Canada's low public interest in marine matters has contributed to the low public profile of the CCG, and 91 percent who

agreed that the low public profile of the CCG results in very limited attention being given to it by federal MPs.

- PCA identified that political and administrative challenges are hindering Arctic development and the level of services that the CCG is capable of providing as a SOA.

It appears that until the majority of Canadians deem the CCG to be a vital part of Canadian nationalism, it will continue to function in a quandary of political bureaucracy and suffer from a lack of federal attention and support. So, the question that begs answering is, "Do Canadians holistically feel that the CCG is vital to Canadian nationalism?" With respect to further research, a Canadian wide survey canvassing the general public views of the role and importance of the CCG would be valuable. Equally valuable would be the views of all DFO employees and federal MPs with respect to such things as:

- CCG positioning and organizational structure;
- The level and extent of federal, provincial, and organizational bureaucracy that the CCG feels it is involved in or subjected to;
- The value and impact of the general public's perception of, and appreciation for, the CCG in terms of securing much needed federal attention and support.

Knowledge of the above would help determine if the CCG is properly positioned or not. If determined to be properly positioned, then a deeper look at the current management and structure would be in order. If not properly positioned, then a deeper look at where and why it should be repositioned would be required. However, the resources required to conduct work on this scale extend far beyond

those available in a single doctoral study. This is discussed further in the recommendations for further research.

10.3 Research Results in General

The use of mixed methods proved useful in addressing the overall research aim and objectives. This is shown in Sections 10.2 and 10.4. More explicitly, the six research objectives are listed and were addressed as follows:

- To synthesize experts' perceptions of future marine activity in the Canadian Arctic. This was addressed mainly in Phase I and to a lesser extent in Phases II and III;
- To compare experts' perceptions of the CCG services, principally Arctic icebreaking, in terms of their ongoing effectiveness and efficiency. Addressed mainly in Phase I, it was also dealt with to a lesser extent in Phases II and III;
- To analyze contiguous systems (including Swedish, Finnish, United States, and Russian) of private involvement in their icebreaking services in terms of funding and operations. This was addressed mainly throughout the literature review. While the literature review is not a research method, it is an integral part of the PhD process. This objective was also addressed during personal communications with members of the SMA;
- To analyse Canada's position with respect to private involvement practices in its marine transportation sector. While addressed with mainly in the literature review, it was addressed during the personal interviews conducted in Phase II and also in Phase III;
- To analyse the importance of specific background factors with respect to private involvement in the delivery of CCG icebreaking services in the

Arctic. While this objective was addressed throughout the entire research project, it was dealt with most in Phase II;

- To identify and evaluate different models of privatization and the forms they might take in relation to CCG services in the Arctic, principally Arctic icebreaking. While the identification component was addressed in the literature review, Phase I, and Phase II, the evaluation component was dealt with explicitly in Phase III.

Work in all three phases of the research will be discussed further in the context of the supporting works in Section 10.4.

Distilled from the work conducted in Phase I, the Arctic regions of Canada, and for the most part the entire Arctic region north of 60 degrees latitude, are currently not conducive to year-round navigation of merchant vessels and to some degree even government owned icebreakers. While future Arctic shipping activity is anticipated to significantly increase with the retreat of perennial Arctic sea ice, the infrastructure required to support global supply chains is notably lacking. While icebreaker capabilities are considered suitable for current merchant shipping activity, they are not suited to the anticipated shipping activity of 2020 and beyond. Much of the Arctic is poorly charted and in some areas no navigational charts are available. Navigational aids are sparse and often only provided seasonally. Vessel repair facilities are sparse and limited in their scope of work. Emergency response capabilities are limited and geographically challenged. Finally, the impact of year-round Arctic shipping activity on the livelihoods of native inhabitants has not been fully addressed. Through a mix of unilateral and multilateral actions, Canada and other Arctic Council nations need to quickly decide upon and begin to develop, install and enhance relevant infrastructure comprising modern icebreaking

capabilities, deepwater ports, repair and refuelling facilities, aids to navigation, and emergency response organizations. Involving the local inhabitants will be imperative.

Predicated on the interviews conducted during Phase II, interviewees felt that the CCG is badly in need of a more appropriate way of operating and that privatization, if only on a partial basis, is one way forward. The following approaches were viewed as possible ways of privatization or a PPP arrangement with respect to Canada and the involvement of private interest in the delivery of icebreaking services:

- Privatization of the entire CCG fleet which would then be chartered back to DFO;
- Contracting out of the services currently being delivered by the CCG;
- Private fleet management;
- Government owned and company operated;
- Privatization of vessel design and construction;
- Privatization of crewing.

With respect to the above, the approach seen by most interviewees as offering the greatest financial saving of taxpayer's dollars was that of the privatization of crewing, this was closely followed by the privatization of fleet management. This general view of privatization is supported by Iacobacci and Schulman (2009, 37) in their June 2009 report on the productivity and performance of Canada's transportation sector which notes one of the factors attributed to the strong productivity in the transportation markets results from changes in governance and ownership structure. The report highlights that privatization of Crown corporations and the devolution of direct state controlled organizations have led to more commercially orientated management of self-financing entities specialized and

focused on the provision of infrastructure services. Interviewees informed of reports that icebreakers had been kept in the Arctic when they were not required by the private sector. This was done to ensure annual budgets were expended and to help secure future budget request. Interviewees also felt that the CCG was better suited to operating icebreakers and not managing them. In addressing the issue of crewing noted earlier, both the 2000 and 2007 Reports of the Auditor General of Canada state that human resource management remains a problem with the CCG and that its biggest single expense is in human resources (Auditor-General, 2007). In terms of fleet management, the 2007 Auditor General's Report notes that the CCG has not yet developed standardized maintenance procedures and manuals for its fleet, and unexpected equipment failures for significant periods of time have forced vessels out of service and have left the fleet unable to meet some client requirements (ibid).

Pirie (1998, 23) highlights several reasons, most notably the flexible use of labour in terms of time and skills, why private labour costs can be less expensive than public labour costs and that these savings are often the key to increased private sector efficiency. Each of the approaches noted above have different cost and risk sharing arrangements and there are pros and cons to all of them. To be effective, it is also necessary for there to be enough private sector interest in Canada so as to prevent an abusive monopoly situation by a private sector company.

In testing the hypotheses and relationships developed during Phase II in Phase III the following approaches towards private involvement in the delivery of icebreaking services in the Canadian Arctic were observed:

- Canada should continue to keep its military and civilian roles separate in the Arctic. Canada also needs to avail of its local Arctic residents whilst

enhancing its Arctic expertise, and there is support for private involvement in the delivery of CCG services in the Arctic;

- While a private ship management firm may be a little more reluctant than the government in deploying a ship into an high risk situation, the same firm would be more efficient at managing, and possibly crewing, CCG or privately owned icebreakers;
- With respect to the interests of expediting Arctic development and spending less Canadian tax dollars, I/Bs should be procured by private firms availing of proven vessel designs and European or Far East shipyards;
- Canada's presence and sovereignty in the Arctic could be bolstered by the CCG, military, and oil companies availing of a privately owned fleet of multi-functional icebreakers on a long term contractual basis.

The policy advisers, policy makers, decision makers, executive agencies, and ultimately the taxpayers of Canada need to be informed of these observations. On being made aware of these observations, prudent and diligent individuals and agencies would inquire and probe further into testing the feasibility of these observations. This is discussed further in the recommendations for further research below.

10.4 Supporting Works

The following are key sections and findings from the AMSA 2009 Report (Arctic-Council, 2009) that help triangulate the results of this research:

- Arctic Marine Geography, Climate and Sea Ice:
 - Arctic sea ice is decreasing in extent and thickness and is expected to continue doing so;
 - Winter sea ice cover will remain;

- The Arctic Ocean could be ice free for a short period in summer as early as 2015;
- While there may be greater marine access and longer navigation seasons, there will still be difficult ice conditions for marine operators during winter.

With respect to the research, the results of Phase I concluded that there is considerable uncertainty surrounding the extent to which perennial Arctic ice will retreat in terms of geographic location and when the Arctic Ocean may experience ice free summers. However, more Delphi panellists agreed that the Arctic Ocean will experience ice free summers before the Northwest Passage. There was strong agreement that as the annual Arctic sea ice reduces it will make it easier for perennial Arctic Ocean ice to move south through the Canadian archipelago and thus block the many straits that vessels would have to transit in traversing the NWP or operating within the archipelago, thus impeding shipping movements.

With respect to Figure 2 and the factors having the greatest influence on the level of success of private involvement in the CCG, the research has identified that climate change will have the greatest impact. For, without less sea ice, longer shipping seasons, and less severe environmental challenges an increase in future shipping activity in the Arctic regions will not be seen as a viable option. Science and technology will also play a pivotal role as it will allow for more capable icebreakers and ice strengthened cargo vessels be built faster and less costly, this will aid with the business feasibility requirement. Another essential factor from Figure 2 will be the cooperation of CCG employees and managers as without their approval, private involvement in the CCG will be an arduous task. CCG employees belong to large and powerful unions that have proven to be very effective in

looking after the security and interest of their members during contract negotiations with the Federal Government.

- History of Arctic Marine Transport:
 - Previous Arctic marine transport studies have significant relevance to developing any future regulatory framework for the Arctic Ocean;
 - Most of these past studies involved public-private partnerships.

Both Phase II and Phase III, supported by PCA, identified that public-private partnerships with the CCG will benefit Canadian taxpayers in terms of future Arctic exploration and development.

- Scenarios, Future and Regional Futures to 2020:
 - Arctic natural resource development in the form of hydrocarbons, hard minerals, and fisheries and regional trade are the key drivers of future Arctic marine activity;
 - Future Arctic marine activity will include many non-Arctic stakeholders, multiple users in Arctic waterways and potential overlap of new operations with indigenous uses;
 - Arctic voyages through 2020 will be overwhelmingly destination, not trans-Arctic;
 - A lack of major ports and other critical infrastructure will pose significant limitations for future Arctic marine operations;
 - The NWP is not expected to become a viable trans-Arctic route through 2020, but destination shipping within the Arctic is anticipated to increase.

With respect to the views of Delphi panellists in this research:

- 84.4 percent agreed that compared with 2006 the number of ships operating in the Arctic will more than double by 2020;
- 71.9 percent agreed that the current capabilities of the CCG icebreakers will not be suitable for Arctic shipping activity in 2020;
- 65 percent agreed that the current capabilities of icebreakers globally will not be suitable for Arctic shipping activity in 2020.

With respect to the views of participants in Phase III of this research:

- 96.4 percent agreed that Canada needs to enhance its Arctic expertise;
 - 74.1 percent agreed that the Canadian Arctic would develop sooner if greater icebreaking capability was available throughout the entire year;
 - 86 percent agreed that political will and icebreaker support will be necessary to expedite future development of the Arctic region.
- Human Dimensions:
 - Constructive and early engagement of local residents in planned Arctic marine development projects can help to reduce negative impacts and to increase positive benefits.

This research noted that 71 percent of Delphi panellists in Phase I agreed that the vast geography of the Arctic poses significant challenges to all maritime nations in terms of human resource management on board their icebreakers working in the Arctic. Also, 95.4 percent of Phase III participants agreed that the local residents of Arctic regions need to be significantly involved in future Arctic developments. However, only 26.9 percent of participants agreed that Canada's Arctic sovereignty claim and environmental stewardship would be bolstered if CCG icebreakers were crewed and operated by Arctic residents. It may take some time for the integration and transitioning of the Arctic's indigenous people into the CCG.

While earlier attempts at such integration were reported by one interviewee in Phase II to have failed on account of drug and alcohol abuse, it would be valuable from a ship crewing and management perspective to conduct more thorough research into why this actually happened and to see if such integration would be successful.

- Environmental Considerations and Impacts:

- The most significant threat to the Arctic marine environment is the release of oil through accidental or illegal discharge.

This research noted that 81.3 percent of participants in Phase III agreed that Canada's Arctic sovereignty claim and environmental stewardship would be bolstered if CCG icebreakers were stationed in the Arctic on a year round basis. Also, 56 percent of Delphi panellists agreed that Canada needs to have enough icebreaking capabilities to go where commercial vessels will go.

- Arctic Marine Infrastructure:

- There is a general lack of marine infrastructure in the Arctic;
- Safe operations in the Arctic will need the same suite of meteorological and oceanographic data, products and services as in other oceans, plus comprehensive information on sea ice and icebergs;
- Except in limited areas of the Arctic, there is a lack of emergency response capacity for saving lives and for pollution mitigation;
- There are serious limitations to communication and vessel tracking systems;
- The current lack of marine infrastructure, coupled with the vastness and harshness of the environment, makes conduct of emergency response significantly more difficult in the Arctic.

While the lack of infrastructure and challenges posed by the Arctic's vastness and remoteness were noted above, 74.1 percent of Delphi panellists agreed that the Arctic requires more detailed hydrographic surveys and dredging. Also, 77.8 percent of panellists agreed that the service scheme offered by the CCG needs to be more flexible. To further the views of the Delphi panellists with respect to the services being provided by the CCG in the Arctic:

- 59.4 percent agreed that the current level of route assistance service will not be satisfactory for Arctic shipping activity in 2020;
- 65.6 percent agreed that the current level of sovereignty service will not be satisfactory for Arctic shipping activity in 2020;
- 56.3 percent agreed that private involvement in carrying out CCG services will not weaken Canada's position with respect to sovereignty in the Arctic.

In addition to the AMSA findings above, following is a list of recommendations from the April 2009 Report of the Standing Senate Committee on Fisheries and Oceans titled *Rising To The Arctic Challenge: Report On The Canadian Coast Guard* (Standing-Senate-Committee-On-Fisheries-And-Oceans, 2009) that help triangulate the results of this research. The list is in order of relevance to this research and not the order in which the recommendations are listed in the report:

- 1) The committee recommends the deployment of multi-mission polar icebreakers operated by the CCG as a cost-effective solution to Canada's surveillance and sovereignty patrol needs in the Arctic;
 - While not owned by the CCG, 63.8 percent of Phase III participants agreed that private Canadian ownership of a fleet of vessels used by CCG, Canadian Military, and oil companies in the Arctic will increase

Canadian presence. Using PCA this statement had a matrix factor score of 0.758;

- 67.6 percent of participants agreed that the suggested utilization of vessels noted above would not jeopardise Canada's sovereignty.

This statement had a matrix factor score of 0.707.

2) The committee recommends that Canada develop a long-term plan for the acquisition of new multi-purpose heavy icebreakers made in Canada and capable of operating year-round in its Arctic archipelago and on the continental shelf as part of an integrated approach to vessel procurement recognizing the complementarity of Coast Guard and naval vessels;

- 86.9 percent of Phase III participants agree that Canada would benefit from regaining its expertise in designing and building icebreakers and becoming less dependent on other shipbuilding nations. This statement had a matrix factor score of 0.766;
- 69.4 percent of participants agree that Canadian taxpayers would benefit from the CCG and the military committing to charter a fleet of newly constructed and privately owned multi-functional ice class vessels that have the modular capability to meet their particular interest and will be time shared with oil companies operating in the Arctic. This statement had a matrix factor score of 0.652;
- As noted earlier, 74.1 percent agreed that the Canadian Arctic would develop sooner if greater icebreaking capability was available on a year-round basis. This statement had a matrix factor score of 0.739;
- However, with respect to the committee recommendation of building the icebreakers in Canada, 90.8 percent of participants agree that

unless Canada decides to build a substantial fleet of Polar Class icebreakers, it will cost less to have them designed and built in European or Far Eastern yards;

- 64.6 percent agreed that Canadian taxpayers would benefit from having a fleet of competitively built, in Canada, polar class I/Bs that will be managed by competitive private firms. This statement had a matrix factor score of 0.502.

3) The committee recommends that Canada develop a much stronger year round, national presence and enforcement capability to show the world that Canada is serious about controlling the NWP, protecting Canadian interests and Canada's northern residents, and making the waterway a safe and efficient shipping route;

- 93.5 percent agreed that Canada needs to be at the forefront of icebreaking technology;
- 85 percent agreed that without its own fleet of polar class icebreakers the CCG will need to engage in a long term time charter for icebreaking services in the Arctic;
- The benefit of having icebreakers stationed in the Arctic on a year-round basis is noted above.

4) The committee recommends that Inuit, with their unique knowledge of the region, be recruited for the Coast Guard whenever possible;

- Noted earlier, 95.4 percent of Phase III participants agreed that the local residents of Arctic regions need to be significantly involved in future Arctic developments.

- 5) The committee recommends that the Coast Guard, as the expert agency on the maritime situation facing Canada in the Arctic, formulate and implement a long-term strategic vision to guide it for the future;
- 64.5 percent of Phase III participants agreed that in the absence of increased funding for the CCG, Canada's maritime requirements would be better served by setting up a Maritime Administration office which would be responsible for the development of CCG and DFO programmes and would avail of the existing CCG fleet, the leasing of private hardware and/or the contracting out of services.
- 6) The committee recommends that the Government of Canada establish an Arctic Strategy Advisory Committee, led by Indian and Northern Affairs Canada, to monitor and to advise in the development and implementation of an effective and integrated strategy for the North. The new Arctic Strategy Advisory Committee should comprise representatives from the federal government departments and agencies with a mandate in the Arctic, with particular emphasis on the Coast Guard, the various Aboriginal/Inuit groups in the region, and the three territorial governments;
- 68.2 percent of Delphi panellists agreed that in terms of Arctic development, the best that could happen would be for Arctic initiatives to be raised to a higher profile, longer term and not form part of FOC;
 - The need for the involvement of local residents was noted above.

10.5 Critique of the Research

This section commences with a critique of each phase of the research.

The Delphi survey was constructed and administered using Adobe Reader 8 as this was the version loaded on the computer at the time of developing the survey, and free downloads of Adobe Reader 8 were available on the internet. However, during the first round of Delphi some individuals experienced difficulty downloading the free version of Adobe Reader 8 which was required in order to complete the survey. Consequently, the questionnaire was resent as an MS Word document to the entire list of individuals that had not returned the questionnaire. The difficulty experienced with downloading the free version of Adobe Reader 8 may have been attributable to the generally older age of the participants and possible computer illiteracy, and possibly limitations of the computer systems which participants were using. Higher levels of blank responses were experienced when the survey was administered in the MS Word format than the Adobe 8 Reader format. With respect to the high levels of unable to comment answers, the highest at approximately 20 percent of total opinions express in the first round of questioning, this was not surprising given the diverse range of topics put forward in the first round of questioning. It was also noted that some individuals appeared to contradict themselves in later rounds of questioning.

With respect to the APMOs in all three rounds of questioning, whereby the $((\text{Aggregate of Majority Agreements} + \text{Aggregate of Majority Disagreements}) / \text{Total Opinion expressed} \times 100)$, was used to determine whether consensus was or was not reached on the statement provided, they were accepted as being low. Strictly in terms of percentages, the results of the first round of questioning identified 41.6 percent agreement with the 32 statements, 38.7 percent

disagreement, and 19.7 percent unable to comment. It is anticipated that had more of the statements in the first round of questioning been presented in a negative form, the percentage of results in agreement would have been larger, but at the expense of valuable comments from which to gain a deeper understanding of the situation. In the first round of questioning a decision was made to go with an APMO of 49.4 percent, resulting in 44 statements for the second round of questioning. This was done to try and keep the number of statements/questions to a reasonable level so as not to deter individuals from participating in future rounds. Using an APMO of 66.7 percent would have resulted in 141 statements for the second round of questioning. The APMO for the second round of questioning was 41.9 percent, resulting in 21 statements for the third round of questioning. An APMO of 66.7 percent would have resulted in 88 statements for the second round of questioning. As 88 statements were considered excessive, no attempt was made to determine the number of statements that would have resulted from an APMO of 75 percent. The APMO for the third round of questioning was 37.2 percent, resulting in consensus being attained on 17 of the 21 statements, or 80.9 percent.

Thirty-two of 72 participants, approximately 44 percent, responded to the first round of the Delphi survey. Survey participants were identified in the literature review, from attending two conferences related to the research topic, and from being personally known individuals with some form of connection to Arctic matters. The initial response from the first round of Delphi showed that the vast majority of participants, some of whom were personally contacted prior to distribution of the first round of questioning and who agreed to participate, simply did not respond or reneged on their earlier commitment to participate. Some participants commented that some of the questions were subjective. One stakeholder from the CCG did not

participate as it was felt that the questions were looking for opinions and not facts. Another stakeholder from DFO, who earlier agreed to participate, subsequently informed that they could not participate on orders from headquarters in Ottawa. Some participants commented that the questions were biased, subjective and even absurd. However, subjectivity according to Sadler (2002, 125) is a natural and necessary element of evaluation and calls for no apology.

Using Likert's (1951, 238) criteria, consistent evidence has been obtained given that questions on complex issues have different meanings for different people who are called upon to answer them. With reference to the philosophical and methodological foundations of Delphi, Mitroff and Turoff (1975) state there is no one "*single best way*" for ensuring the understanding of the content of a communication or for ascribing validity to a communication. The issues of uncertainty of content and validity to some of the responses provided by some of the Delphi participants was evident in the Delphi exercise conducted as part of this research. After close examination of the responses provided by Delphi participants, it would be fair to suggest that with some questions there appeared to be varying interpretations, a corollary being the level of *true* consensus or lack thereof. In support of the above, Saunders et al. (2007, 108) in discussing various research philosophies suggest that with respect to ontology and the aspect of subjectivism, individuals will perceive different situations in varying ways as a consequence of their own view of the world around them. Subjectivism surfaces in two ways here, first via the Delphi participant and second via the researcher.

Critiquing the grounded theory work focuses on if and when generated hypothesis should be tested. While Strauss and Corbin make hypothesis testing integral to the constant comparison method of grounded theory methodology, Glaser disputes

such within-analysis testing and asserts that the testing and verification of hypotheses is to be done subsequent to the development of a grounded theory (Rennie, 1998). With respect to the research undertaken, within-analysis hypotheses testing was carried out but only to the extent of the somewhat limited number of interviewees and other 'data slices' associated with the literature review and Delphi exercise. However, given the potential for this research to impact on policy decision making, it was felt that subsequent testing of hypotheses and relationships would help triangulate results and enhance such research hallmarks as testability, precision and confidence. Therefore, in attempting to add precision and confidence to the research work via attitude measurement of critical hypotheses and relationships, the exploitation of a quantitative survey in the form of a Likert scale was developed. Analysis of the results of the interviews confirms that the grounded theory strategy was effective. Category saturation was evident, and diminishing returns with respect to data collection was noted. This was particularly evident in the subcategories of private management and icebreaker design/construction. However, Strauss and Corbin (1998, 136) refer to saturation as a matter of degree, and if a researcher were to investigate long and hard enough new properties and dimensions would be discovered; Pareto's law of diminishing returns comes into effect and the resources of time and money are limited. Had current managers of the CCG been allowed to participate in the research, new properties and dimensions would undoubtedly have been discovered.

One problem associated with the quantitative survey was attributed to there being no sample or population frame available and therefore probability sampling could not be availed of. The final sample consisted of a relatively small number, 110 to be exact, of experts and stakeholders in Arctic matters. Given the subject matter of

the research, it was expected that there would be a varying extent of expertise and stakeholder interest amongst the sample subjects. Another problem was survey non-response. Neuman (2007, 186) warns of the sampling bias, and problems with generalizing results, that can be introduced when high proportions of a particular group, or strata, of the sample subjects do not respond. Questionnaire non-response from certain individuals or groups of individuals will bias the generalization from the sample to the population under study. The total response rate was 34.1 percent and the active response rate was 39.7 percent. The response rates may well be attributed to the political nature of the research. Research dealing with political issues may be seen by some groups as sensitive or threatening and consequently they may decline to participate (Lee, 1993). As it was experienced in the earlier Delphi exercise, CCG personnel were instructed by Fleet Directorate not to participate in the survey. Participation by CCG would undoubtedly have resulted in different survey outcomes. While considerable efforts were made in trying to identify and reach as many Arctic experts and stakeholders as possible to take part in the survey, it is certain that some were unintentionally excluded. The main reason being that there was no way of contacting potential subjects.

Part A of the survey proved challenging to some participants and this was explicitly noted in the comments section of the survey. While several participants completed only portions of Part A, some participants skipped Part A entirely and only completed Part B. In Part A of the survey there were 114 missing, blank, unit responses out of a possible 770, giving a missing response rate of 14.8 percent. This is not surprising given that questions with long explanations, more than thirty words of prefatory explanation, and questions requiring some sort of future projection are associated with higher rates of 'don't know' or 'no opinion' results.

Part A of the survey was used to try and gain insight with respect to the varying levels of business risk that survey participants were willing to accept. Three scenarios, each having different probabilities, and three contracts were offered. Survey participants were asked to prioritize in the selection of three contracts. In subsequent questions, the contract conditions were altered slightly and the participants were again asked to prioritize the selection of the three contracts. The answers to Part A were subjected to Hurwicz criterion. This was done to see if the participants did in fact match up with the risk profile they chose in Question 1 of Part A of the survey. The Hurwicz criterion exercise did not produce the anticipated results as only two participants perfectly matched their chosen risk profile. While there is potential for deeper probing of the Hurwicz criterion exercise from a risk perspective interest, it was decided that the extra resources required would offer little in the way of fulfilling the research objectives; Pareto's law of diminishing returns was anticipated to come into effect.

Validity, whether face, content or criterion, and reliability are central issues in the measurement of conceptual variables developed or stemming from conceptual indicators (Babbie et al., 2007; Neuman, 2007). These conceptual variables often range in their levels of statistical sophistication and are commonly measured using nominal, ordinal, interval, and ratio scales of measurement. Quantitative data is the result of measuring variables on an ordinal, ratio, or interval scale (Foster, 2001, 7). Part A of the questionnaire consisted of nominal, ordinal, and interval scales of measurement. With respect to the ordinal level variables constituting Part B of the questionnaire, their validity and reliability are not in question as they originated from the hypotheses and relationships developed during earlier grounded theory work. However, apart from incorporating the findings of the

Delphi exercise, the same cannot be said for Part A of the questionnaire as it did not stem directly from the grounded theory work.

With respect to the PCA of the survey results, Stevens (2009, 328) identifies the scree test as one of four methods used in determining the number of components to extract or retain. However, Tabachnick and Fidell (2001, 621) inform that the scree plot is somewhat subjective in determining the actual number of factors used. The subjectivity stems from the researcher looking at the bend in the elbow of the plot to determine the actual number of factors to use; the bend in the elbow can sometimes be hard to discern.

While the public-private continuum was discussed in chapter three, much of it appears to deal with land based projects and infrastructure that already exists. Little is offered with respect to successful ways of dismantling the maritime public sector. As the CCG Arctic icebreaking fleet is ageing and in need of urgent replacement using modern icebreaking technology, many of the possible combinations of the public-private continuum identified in Table 4 would not work, as they deal with the expansion or upgrading of existing public facilities. Table 23 is a modification of Table 4 identifying public-private arrangements that could possibly work with respect to the CCG Arctic icebreaking fleet.

Phase I results show that 71.9 percent of participants agreed that the current capabilities of the CCG icebreakers will not be suitable for Arctic shipping activity in 2020. Thus, any PPP would most likely result in the construction of new icebreaking infrastructure. However, in the interim, it may be possible to enter into an operation and maintenance contract, similar to the SMA arrangement, in which a CCG icebreaker is operated under contract by a private partner. With respect to

the construction of new icebreakers, possible PPP arrangements could include super-turnkey development, build-transfer-operate, and build-own-operate.

Table 23 Possible Combinations of PPP for the CCG Arctic Icebreaking Fleet

1)	<i>Super-Turnkey Development</i> – the public sector defines the performance objectives of a facility which will subsequently be designed and constructed by a private partner who, upon completion, will be reimbursed by the public for the construction and will then commence operations of the facility under contract
2)	<i>Build-Transfer-Operate (BTO)</i> – upon completion of a facility financed and built by a private developer, ownership of the facility is legally transferred back to the sponsoring government who in turn lease it back to the developer under a long-term lease during which the developer operates the facility and has the opportunity to recover its investment and a reasonable return through user fees and commercial enterprises
3)	<i>Build Own Operate (BOO)</i> – subject to possible regulatory constraints, a private developer will finance, build, own, and operate a facility in perpetuity

Source: Author. (Adapted from Payson and Steckler, 1996, 40).

In a super-turnkey development the CCG would define the performance objectives of a new icebreaker which would subsequently be designed and constructed by a private partner who, upon completion, would be reimbursed by TC for the construction and will then commence operations of the icebreaker under contract. In a build-transfer-operate arrangement, upon completion of an icebreaker financed and built by a private developer, ownership of the vessel would be legally transferred back to TC who in turn would lease it back to the developer under a long-term lease during which the developer operates the vessel and has the opportunity to recover its investment and a reasonable return through user fees and commercial enterprises. Finally, in a build-own-operate arrangement a private developer will finance, build, own, and operate an icebreaker in perpetuity. A barrier to entry in this arrangement may be the huge initial outlay of cash required on the part of the private developer. This could possibly lead to monopolistic situations occurring in the delivery of icebreaking services.

10.6 Recommendations for Further Research

While having reached saturation and closure in terms of the limits feasible for a single PhD researcher, there are outstanding issues which remain to be addressed. However, having gone beyond the exploratory phase, any further progress would require formal government systematic funded research. The major limitations in the research undertaken were the lack of formal involvement on the part of DFO, namely the CCG, and, to a lesser extent, the inaccessibility of some private Arctic experts and stakeholders. Reaching these groups formally was beyond the authority of a PhD study, and a formal state commissioned survey would be required to guarantee access to them. However, the opinions gleaned from some former CCG employees and other experts are indicative and appropriate to this exploratory study. Future research in other studies could usefully be undertaken to engage a wider range of experts and stakeholders involved in Canada's Arctic affairs. This work would canvas the in-depth opinions relating to various models, identified in this research, which may underpin the ownership, organisation and management of relevant infrastructure. Of specific academic interest would be the testing and results of:

- Combining Canada's military and civilian roles in the Arctic to determine whether or not it would bring about greater effectiveness and efficiency and ultimately require less from Canadian taxpayers;
- Providing the opportunity for private ship management firms to manage and crew CCG icebreakers;
- Providing the opportunity for private shipping firms to lease their icebreakers to DFO.

Such research goes beyond simple market research or a feasibility study for a private developer and will require more government involvement at all levels, including the CCG and Canadian Navy, and may well be supported by a

quantitative survey to triangulate the findings and estimate the extent of support for new initiatives. However, it will also require a resource base far beyond what is available to a single doctoral researcher. These findings will need to be put forward for the benefit of policy advisers, policy makers, decision makers, executive agencies, and ultimately the taxpayers of Canada. However, in order to facilitate this future research the DFO, namely the CCG, will need to grant permission for meticulous internal scrutiny of its current operations and be willing to purposefully participate in research aimed at achieving greater effectiveness and efficiency. This may not bode well with some CCG employees belonging to strong labour unions. It may also not be well received by some policy and decision makers as the importance of the Canadian Arctic may not be fully appreciated or seen to enhance their political profiles. This is put forward with respect to the view that many Canadians voters are not well versed on Arctic matters and have little or no interest in it. Regardless, the taxpayers of Canada should insist on further systematic funded academic investigation and research into the noted observations as their tax dollars are limited and compete to support other ageing infrastructure and public services such as healthcare, education, and public transport.

The main academic questions left unanswered are whether or not the federal government of Canada really prioritises enhancing the effectiveness and efficiency with respect to CCG operations, how serious are they in developing the Arctic, and which model of PPP would work best in the future delivery of Arctic icebreaking. With respect to enhancing effectiveness and efficiency, it may be that the federal government sees any spending of money by the CCG in terms of ship construction and repair as a way of creating employment in some of the rural areas of Canada where unemployment rates would otherwise be prolific. The research has shown

that icebreakers can be designed and built at less cost outside of Canada. Therefore, is Canada as a whole better off by spending more money than necessary while keeping people employed in shipyards or by having them stay at home and receiving financial aid via unemployment insurance? With respect to the federal government's desire to develop the Canadian Arctic and Canada as a whole, would it be more appropriate to provide free icebreaking services and thus possibly entice more business activity or should those exploiting the resources of the Arctic, and other ice restricted area of Canada such as the Gulf of St. Lawrence, pay as they prosper. Finally, with respect to determining the most appropriate PPP arrangement to enter into, this will require careful examination by all involved in terms of their individual business plans. The appropriate arrangement will need to create a synergy where all parties share the rewards, responsibilities, and risks. Arrangements for revisiting the PPP so as to deal with changing environmental conditions must be ensured.

Instrumental in all future Arctic operations will be the close monitoring of the retreat and thinning of Arctic sea ice and the melting of multi-year Arctic sea ice. The disappearance of Arctic sea ice will expedite the global desire to extract and further explore the vast energy and food resources of this vast geographical and remote region of our planet. This, in addition to the increasing local population, the quest for shorter sea routes and the growing interest in Arctic adventure tourism, will constitute the major driving forces shaping all future Arctic operations including icebreaking.

Appendices

Appendix 1 Pictures of icebreakers and ice strengthened cargo vessels

“Umiak 1” entering Voisey’s Bay



Source: Author.

Varandey oil tanker



Source: Peter Noble.

Varandey oil tanker loading in the field



Source: Peter Noble.

Varandy icebreaker support vessel



Source: Peter Noble.

Multipurpose icebreaker "Botnica"



Source: Finstaship [online]. Available from: <http://www.finstaship.fi/en/?c=1&p=1>
[Accessed 26 November 2008].

Russian icebreaker “50 Years of Victory”



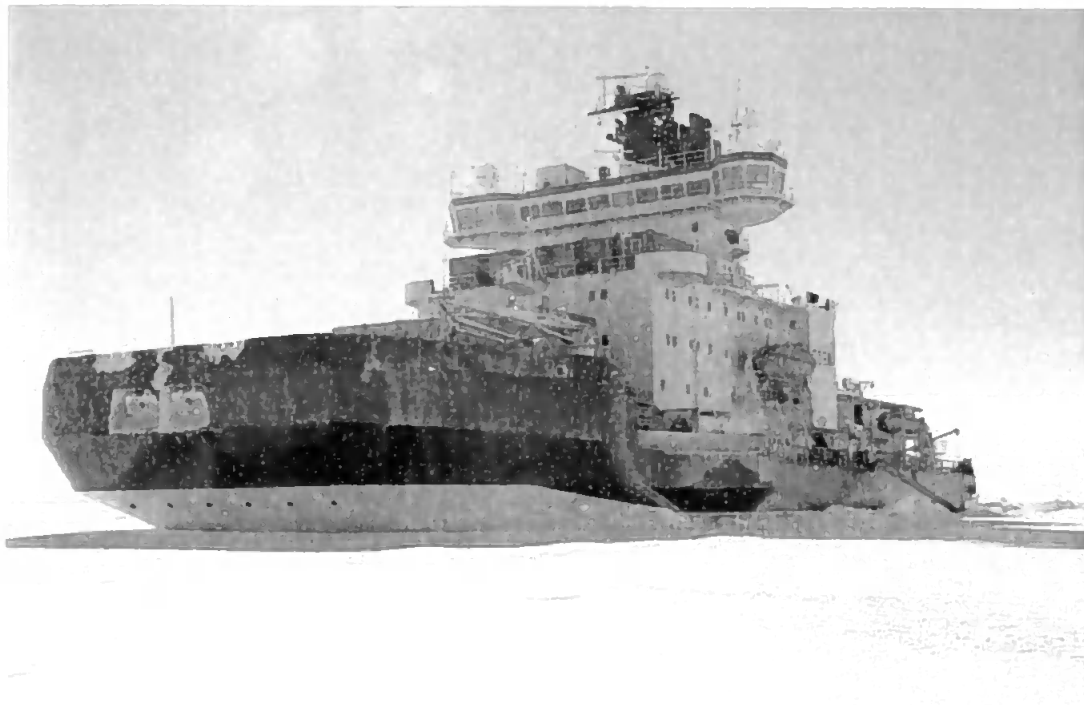
Source: Dark Roasted Blend [online]. Available from:
<http://www.darkroastedblend.com/2008/03/russian-nuclear-icebreakers-to-north.html> [Accessed 27 November 2008].

Russian icebreaker “Krasin”



Source: Wikipedia [online]. Available from:
http://upload.wikimedia.org/wikipedia/commons/thumb/3/33/NSF_picture_of_Krasin_on_its_way_to_McMurdo.jpg/300px-NSF_picture_of_Krasin_on_its_way_to_McMurdo.jpg [Accessed 27 November 2008].

Swedish icebreaker "Oden"



Source: Polar Trec [online]. Available from:
<http://www.bisd.us/hanna/physics04/ice/Photos/Icebreaker%20Oden%20Antarctica.JPG> [Accessed 27 November 2008].

Appendix 2 Email from Lorne Singh with details of CCG Arctic icebreakers

Jim:

I've attached a spreadsheet detailing the information you requested below. As well as information sheets on each of the vessels listed on the spreadsheet.

Please note the following:

-There are 6 vessels deployed primarily for Arctic Operations - Operations carried out north of the 60° parallel.

-All CCG vessels are multi-tasked. Therefore the costs identified in the report are only for Arctic Operations, and in the case of the CCGS Sir Wilfred Laurier, for Ocean Science as well.

-These are Planned costs (not budgets as you requested), based on the planned activities for the particular vessel.

-The information sheets on each vessel will give you an idea of size of vessel and crew which has an impact on the cost.

Here is a synopsis of each category of vessel

- Heavy Arctic Icebreakers - CCGS Louis S. St. Laurent, CCGS Terry Fox

Large powerful icebreaker approximately 130 metres long and is capable of sustained operations in the Canadian Arctic with minimal support, for the period of early June to mid-November, and for escort operation in the Gulf of St-Lawrence and East Coast of Newfoundland in the winter.

- Arctic Icebreakers - CCGS Pierre Radisson, CCGS Des Groseilliers, CCGS Henry Larsen

Large icebreaker of approximately 100 metres in length capable of sustained ice breaking and escort operations in the Arctic during the summer, and in the Gulf, St. Lawrence River and the Atlantic Coast in winter. It is also capable conducting scientific missions, has a small cargo carrying capacity and can carry a helicopter if needed.

- CG Program Vessels - CCGS Sir Wilfred Laurier

Large multi-taskable vessels approximately 85 metres long, with an icebreaking capability that allows them to work mainly in southern waters and in the western Arctic.

Please let me know if this is adequate information or if I can assist further.

Sincerely,
Lorene Singh
Budgeting and Resource Allocation Analyst
Operational & Financial Planning
CCG - Fleet Directorate
Telephone: 613-990-5920
Fax: 613-995-4700



CCG Louis & St-Laurent



Official Number: 328055

Call sign: CGBX

Ship Details		Continuing	
Vessel Type:	Heavy Arctic Icebreakers	Class of Voyage:	Home Trade
Port of Registry:	Ottawa	Ice Class:	100 A
Region:	Maritime	MARPOL:	Yes
Home Port:	Dartmouth, NS, Canada	IMO:	8705937
Year Built:	1965		
Material:	Steel		
Builder:	Canadian Vickers, Montreal, QC, QC, Canada		
Modernized:	1993 - Halifax Shipyard & 2002 new engine		
Complement:	Officers 13 Crew 33		
Total:	46		
Creating Regime:	Lay Day		
Avail Berths:	53		
Holds and Decks			
Holds 1:	500 m3 Hatch Size 3.5 m x 3 m		
Holds 2:	36 m3 Hatch Size 3.5 m x 3 m		
Main Deck Area:	320 m2		
Boat Deck Area:	216 m2		
Foreale Deck Area:	N/A		
Aft Deck Area:	120 m2		
Propulsion			
Propulsion:	Diesel Electric AC/DC		
Description:	5 - Kvaip Max 16MVA 3C, 3 - GE DC Motor		
Power:	35142		
Propellers:	3-4-1ed pitch		
Generator 1:	2 - Knipp Max 6MVA @ 1150V		
Generator 2:			
Generator 3:			
Emergency Gen:	1 - Caterpillar 2425 BDI		
Translators:	See No. 2 Gen: No		
UPS:	No		
Communications			
VHF FM:	5 - Galor RT 146, 1 - Motorola MTS 2200		
VHF AM:	1 - Collins VHF 251		
HF:	1 - Rockwell HF80, 2 - Motorola Mcom X, 1 - CTR100RIG		
SatComm:	1 - Westinghouse D-1200 MGAL, 1 - Nera 300-B		
Weather Fax:	1 - Ice Vu, 1 - Furuno Fax 205		
Deck Equipment			
Main Mast:	1 - Crane		
Other Crane:	2 - HIAS Crane		
Other Crane:			
Towing Equip:	1 - Winch		
Workboat 1:	Lifboat/Workboat Davits		
Workboat 2:	Lifboat/Workboat Davits		
Workboat 3:	PRC Zodiac RH1 Crane		
Workboat 4:	LCM Crane		
Flight Deck			
Flight Deck:	360 m2		
Hangar:	132 m2		
Storage:	Yes		
Fuel:	40 m3		

Other Info: Container 300s - 2025 foot CTD labs & 1/12 foot Camper Lab Starboard Flight Deck, 4 cool/cold rooms - 2 of approx 90m2 each & 2 of approx 20m2 each.

Source: (Lorene Singh, 2007).



CCGS TERRY FOX



Official Number: 803579

Call Sign: CGTF

Ship Details

Vessel Type: heavy Arctic icebreakers
Port of Registry: Ottawa
Region: Maritime
Home Port: Dartmouth, N.S., Canada
Year Built: 1993
Material: Steel
Builder: Burnard Yachts Corporation, Vancouver, BC, BC, Canada
Modernized:
Complement: Officers 10 Crew 14
Total: 24
Crewing Regime: Lay Day
Avail Berths: 10

Certification

Class of Voyage: Home Trade
Ice Class: Arctic Class J
MARPOL: Yes
IMO: 8127756

Essential Equipment

LAH: No

Sounders: No
Power on Deck: hydraulic: Yes Electrical: Yes
Cont. Capacity: 7 - 40 ft

Propulsion Equipment

Propulsion: Diesel with reduction gear box
Description: 4 - Stern - Westport STM 410,
Power: 17300
Propellers: 3-controllable pitch
Generator 1: 2 - Caterpillar V12 @ 750 kW
Generator 2: 2 - shaft generator @ 1000 kW
Generator 3:
Emergency Gen:
Thrusters: Bow No Stern Yes
UPS: 24V & 12 V D.C

Holds and Decks

Holds: 490 m³ Hatch Size 3 m X 2 m
Holds: 0 m³ Hatch Size
Main Deck Area: 468 m²
Boat Deck Area: 64 m²
Forecastle Deck Area: 265 m²
After Deck Area: N/A

Navigation

Auto Pilot: 1 - Anschütz Autopilot
Depth Sounder: 2 - Eas LAZ 72 (30-m)
GPS: 1 - Trimble NavTrac
GPS: 1 - Magnavox MA200
Gyro: 2 - Anschütz STD 4
LORAN: 1 - Furuno LC 90 Mark 2
MF DF: 1 - JMC 52215
Navigation - Other: 1 - NavLink
Navigation - Other: 1 - Intera Starvue
Radar: 1 - Furuno FCR1411 Mk 2
Radar: 1 - Decca Radar ARFA - X Band
Radar: 1 - Decca Radar ARFA 1630 D Band
Radar: 1 - Decca Radar Bridgemaster Conrad
Speed Log: 1 - Sperry Rascall SRD-301
VHF DF: 1 - Simrad Tallyo

Deck Equipment

Main Hoist: 1 - Heavy Lift Crane
Other Crane: 1 - Cargo crane
Other Cranes
Towing Equip: 1 - Van Der Giesen
Workboat 1: RHI Zodiac - Hydraulic Crane
Workboat 2: RHI Zodiac - Crane
Workboat 3: J/reboat/Workboat - Davits

Communications

VHF FM: 4 - Spisbury PMX-555
VHF AM: 2 - Collins Comm 251
DATAHSL: 1 - Toshiba T1600
HF: 1 - Siant TRP 84025
SatComm: 1 - Westinghouse D-1000 MCat, 1 - Nera G5-B
Weather Fax: 1 - Furuno Fax 200

Deck Area

Flight Deck: 331 m²

Fuel: Drums

Other Info

Source: (Lorene Singh, 2007).



CCGS HENRY LARSEN



Official Number: 809731

Call Sign: CGHL

Ship Details

Vessel Type: Arctic Icebreakers
 Port of Registry: Ottawa
 Region: Newfoundland
 Home Port: St. John's, NL, Canada
 Year Built: 1987
 Material: Steel
 Builder: Vantage Pacific Shipyards Ltd.,
 Vancouver, BC, BC, Canada
 Modernized:
 Complement: Officers 11 Crew 20
 Total: 31
 Crewing Regime: Lay Day
 Avail Berths: 40

Certificates

Class of Voyage: Home Trade I
 Ice Class: Arctic Class 4
 MARPOL: Yes
 IMO: 84093329

Scientific Equipment

Laboratory Type: 1 - Special chart room 34 m2

LAN: Yes

Engineering Equipment

Propulsion: Diesel Electric AC/AC
 Description: 3 - Wärtsila VASA 16x32.2 - GE AC,
 12174
 Power:
 Propellers: 2-fixed pitch
 Generator 1: 1 - Wärtsila VASA 6L20 @ 924kw
 Generator 2: 1 - Caterpillar 3512 @ 604kw
 Generator 3:
 Emergency Gen: 1 - Caterpillar 3508 @ 350kw
 Thrusters: Bow No Stern No
 UPS:

Holds and Decks

Hold#1: 372 m3 Hatch Size 2 m X 2 m
 Hold#2: 165 m3 Hatch Size 1.5 m X 1.5 m
 Main Deck Area: 220 m2
 Boat Deck Area: 124 m2
 Foreale Deck Area: 120 m2
 After Deck Area: 160 m2

Sounders: No
 Power on Deck: Hydraulic No Electrical Yes
 Cont. Capacity: 3 - 20 ft

Deck Equipment

Main Hoist: 1 - Jacob Seacrane
 Other Crane: 2 - Jacob Seacrane
 Other Crane:
 Towing Equip: 1 - Hyltec Winch
 Workboat 1: GP Barge Crane
 Workboat 2: Lifeboat/Workboat Davits
 Workboat 3: Lifeboat/Workboat Davits
 Workboat 4: Zodiac Mar II Crane

Communications

VHF FM: 5 - Sailor RT 145
 VHF AM: 1 - Collins VHF 251
 HF: 2 - Rockwell HF80, 1 - Motorola Microm
 SatComm: 2 - Westinghouse D-1000 MSat, 1 - Nera
 Inmarsat B
 Weather Fax: 1 - Furuno Fax 250

Navigation

Auto Pilot: 1 - Sperry Rascar ADG
 Depth Sounder: 1 - Elec LAZ (50Hz)
 Depth Sounder: 1 - Elec LAZ 72 (20Hz)
 Elec Charts: 1 - Regulus RCD5
 GPS: 1 - Trimble NavTrac
 GPS: 1 - Magnavox Mk200
 Gyro: 2 - Anschutz STD 4
 LORAN: 1 - Intermav LC 360
 MF DF: 1 - Tayco 5121 ATS
 Radar: 1 - Decca Raca Bridgmaster Conrad
 Radar: 1 - Decca Raca Bridgmaster II - S
 Band
 Radar: 1 - Decca Raca Bridgmaster II - A
 Band
 Speed Log: 1 - Yihnen NMD-3
 Speed Log: 1 - Sperry Rascar SRD-331
 VHF DF: 1 - GAR 325 E

Helicopter

Flight Deck: 310 m2
 Hangar: 97 m2
 Storage: Yes
 Fuel: 24 m3

Other Info: Vessel equipped with Wärtsila Air Butler System that is used as Bow Thruster as well

Source: (Lorene Singh, 2007).



CCGS PIERRE RADISSON



Official Number: 383326

Call Sign: CGSB

Ship Details

Vessel Type:	Arctic Icebreakers
Port of Registry:	Ottawa
Region:	Québec
Home Port:	Québec, QC, Canada
Year Built:	1978
Material:	Steel
Builder:	Buttard Dry Docks Co. Ltd., Vancouver, BC, BC, Canada
Modernized:	1995, 1996, & 1997
Complement:	Officers 12, Crew 26
Total:	38
Crewing Regime:	Conventional
Avail. Berths:	26

Certificates

Class of Voyage:	Home Trade I
Ice Class:	100 A
MARPOL:	Yes
IMO:	7510834

Scientific Equipment

Laboratory Type:	1 - Photo 4 m2
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Engine Room Equipment

Propulsion:	Diesel electric AC/DC
Description:	6 - Bombardier M251F-16v9
Power:	10142
Propellers:	2-fixed pitch
Generator 1:	3 - Bombardier MLV251F 8V @ 750kw
Generator 2:	
Generator 3:	
Emergency Gen:	1 - Caterpillar D356 @ 350kw
Thrusters:	5kw No. Stern No
UPS:	partial

Holds and Decks

Hold#1:	500 m3 Hatch Size 4.9 m X 3.6 m
Hold#2:	5 m3 Hatch Size
Main Deck Area:	152.7 m2
Boat Deck Area:	82.25 m2
Forecastle Deck Area:	N/A
Aft Deck Area:	82.25 m2

LAN: No

Sounders: No

Cont. Capacity: 6 - 20 ft

Deck Equipment

Main Hoist:	2 - HEPBURN Heptum
Other Crane:	2 - HEPBURN Heptum
Other Crane:	
Towing Equip.:	1 - Winch
Workboat 1:	GP Barge - Davits
Workboat 2:	GP Barge - Davits
Workboat 3:	FRC Zodiac m-733 - Miranda Davit
Workboat 4:	Hurricane 530 - Crane

Communications

VHF FM:	3 - Galor RT 146
VHF AM:	2 - Collins VMP 251
HF:	1 - Motorola Modem K, 1 - Collins MR1000A
SatComm:	1 - Westinghouse D-1000 MSat, 1 - Nera STD-B
Weather Fax:	1 - Futaba Fax 202

Navigation

Auto Pilot:	1 - Wagner Autonav A-1500
Depth Sounder:	2 - Eac LAZ 72 (30Hz)
Elec. Charts:	1 - PING HP 9000
GPS:	1 - Magnavox MA200
Gyro:	2 - Sperry Rascar Mk 37
LORAN:	1 - Intenav LC 360
MF DF:	1 - Tayo C338-HC
Navigation - Other:	1 - NavLink
Radar:	1 - Sperry Rascar 3400 - D Band
Radar:	1 - Sperry Rascar 3400 - X Band
Radar:	1 - Decca Raca Bridgemaster Conrad
Speed Log:	1 - Sperry Rascar SRD-331
VHF DF:	1 - OAR 320 E

Hangar

Flight Deck:	137 m2
Hangar:	42.6 m2

Storage: Yes
Fuel: 29.5 m3

Other Info: Orpheus Mini Sub

Source: (Lorene Singh, 2007).



CCGS DES GROSEILLIERS



Official Number: 802160

Call Sign: CGDX

Ship Details

Vessel Type:	Arctic Icebreakers
Port of Registry:	Ottawa
Region:	Quebec
Home Port:	Quebec, QC, Canada
Year Built:	1982
Material:	Steel
Builder:	Port Weller Drydock Ltd., St. Catharines, ON, Canada
Modernized:	
Complement:	Officers 10 Crew 26
Total:	36
Crewing Regime:	Lay Day
Avail. Berths:	40

Certificates

Class of Voyage:	Home Trade 1
Ice Class:	100 A
MARPOL:	No
IMO:	8006355

Scientific Equipment

Laboratory Type:	1 - Photo 4 m2
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Engineering Equipment

Propulsion:	Diesel electric AC/DC
Description:	6 - Bombardier M251F-16V9
Power:	10142
Propellers:	2-fixed pitch
Generator 1:	3 - Bombardier MLW251F 5V @ 750va
Generator 2:	
Generator 3:	
Emergency Gen.:	1 - Caterpillar D358 @ 350va
Thrusters:	Bow No Stern No
UPS:	No

Communications

VHF FM :	1 - Giant 3000 ACN, 1 - Sailor RT 145
VHF AM :	1 - Collins VHF 251
HF :	1 - Motorola M3000 A, 2 - Collins MR1000
SatComm :	1 - Westinghouse D-1000 MSat, 1 - Nera Sio-B
Weather Fax :	1 - Furuno Fax 205A

Holds and Decks

Hold#1:	150 m3 Hatch Size 3.9 m X 3.6 m
Hold#2:	100 m3 Hatch Size 3.5 m X 2.6 m
Main Deck Area:	152.7 m2
Boat Deck Area:	52.25 m2
Foreale Deck Area:	N/A
Afters Deck Area:	52.25 m2

Navigation

Auto Pilot :	1 - Wagner Mk 4
Depth Sounder :	1 - Capper GDS 101 200 khz
Depth Sounder :	1 - Capper GDS 101 50 khz
Elec. Charts :	1 - ECRING Vs 2.1 & M
GPS :	3 - Magnavox MX200
Gyro :	2 - Anschutz Standard 20
LORAN :	1 - Furuno LC 90 Mark 2
MF DF :	1 - Taiyo TD-C338 Mark 2
Navigation - Other :	1 - NavLinx
Radar :	1 - Sperry Rascall - S band
Radar :	1 - Sperry Rascall - X band
Radar :	1 - Decca Rada - Bridgemaster Conrad
Speed Log :	1 - Sperry Rascall CRD-331
VHF DF :	1 - OAR 220 E

LAN

Yes

Sounders:

No

Power on Deck:

Hydraulic: Yes Electrical: Yes

Cont. Capacity:

6 - 20 ft

Deck Equipment

Main Hoist:	2 - HIAS Crane
Other Crane:	
Other Crane:	
Towing Equip.:	1 - Winch
Workboat 1:	FRC Zodiac 735 - Miranda Davit
Workboat 2:	SP Barge - Davits
Workboat 3:	SP Barge - Davits
Workboat 4:	Zodiac 530 - Crane

Helicopter

Flight Deck:	187 m2
Hanger:	43.6 m2
Storage:	Yes
Fuel:	25.6 m3

Other Info: Hospital / Sick Bay

Source: (Lorene Singh, 2007).



CCGS SIR WILFRID LAURIER

Official Number: 807638

Call Sign: CGJK

**Ship Details**

Vessel Type: CG Program Vessels
 Port of Registry: Ottawa
 Region: Pacific
 Home Port: Victoria, BC, Canada
 Year Built: 1986
 Material: Steel
 Builder: Ben. Weber Drydock Ltd. St. Catharines, ON, ON, Canada
 Modernized:
 Complement: Officers 10 Crew 16
 Total: 26
 Crewing Regime: Lay Day
 Avail. Berths: 25

Certificates

Class of Voyage: Home Trade
 Ice Class: Arctic Class 2
 MARPOL: Yes
 IMO: 8320456

Schedule Equipment

Laboratory Type: 1 - Dry 42 m²
 Laboratory Type: 1 - Wet 15 m²

LAN: No
 Winches: 1 - 50000
 Sounders: EM 500
 Power on Deck: hydraulic No Electrical Yes
 Cont. Capacity: 2 - 20 h

Deck Equipment

Main Hoist: 1 - Derrica
 Other Crane: 2 - HIAB Crane
 Other Crane:
 Towing Equip: 1 - Winch
 Workboat 1: RH Zodiac Davits
 Workboat 2: SP Barge Davits
 Workboat 3: Lifeboat/Workboat Davits

Holdover

Flight Deck: 250 m²
 Hangar: 90 m²
 Storage: Yes
 Fuel: 20 m³

Engineering Equipment

Propulsion: Diesel Electric AC/AC
 Description: 3 - Alco 251-16V,
 Power: 5250
 Propellers: 2-Fixed pitch
 Generator 1: 1 - Caterpillar 3508TA @ 500kVA
 Generator 2:
 Generator 3:
 Emergency Gen: 1 - Caterpillar 3306T @ 100kW
 Thrusters: Bow No Stern No
 UPS: Yes

Holds and Decks

Hold#1: 980 m³ Hatch Size 5.4 m X 4.6 m
 Hold#2: 2 m³ Hatch Size
 Main Deck Area: 239 m²
 Boat Deck Area: 169 m²
 Foredeck Area: 78 m²
 After Deck Area: 133 m²

Navigation

Auto Pilot: 1 - Wagner Mk 6
 Depth Sounder: 1 - Stetex CUS 108
 Depth Sounder: 1 - Eac LAZ 72 (20m)
 Elec. Charts: 1 - Eopins 600
 GPS: 1 - Northstar 9414/DGPS
 GPS: 1 - Magnavox MX 200
 Gyro: 2 - Sperry Rascall Mk 378
 LORAN: 1 - Intermav LC 360
 MF DF: 1 - Taito TD-C335 Mark 2
 Navigation - Other: 1 - Maxlink
 Navigation - Other: 1 - Naute ND 50CR R/C beacon
 Radar: 1 - Desca Radar BridgeMaster J - X Band
 Speed Log: 1 - Sperry Rascall SRD-301
 VHF DF: 1 - OAR 320 E

Communications

VHF FM: 1 - Sailor RT 145
 VHF AM: 1 - Collins VHF 251
 DATAHAIL: 1 -
 HF: 1 - Rockwell HF80, 1 - Motorola Mocom
 SatComm: 1 - Westinghouse G-1000 MDAT MX 211 & auto tel.
 Weather Fax: 1 - Furuno Fax 206

Other Info:

Source: (Lorene Singh, 2007).

Appendix 3 Pool of Delphi participants

Situation	Name	Position	Organization
Sent Cold	Andrew Kendrick		Fleet Technologies
Met	Arno Keinonen	President	AKAC Inc.
Met	Barry Sheppard	Principal Surveyor	Lloyd's Register North America, Inc.
Referral	Ben Johansson	Proprietor	Vision and Polar Innovations
Met	Bob Derks	Manager	Wagenborg Shipping B.V.
Sent Cold	Bonnie Hrycyk	Manager	Polar Continental Shelf project
Met & Asked	Bud Streeter	Vice President	Lloyd's Register North America, Inc.
Met & Asked	Capt. Allen MacIntyre	Pilot	Atlantic Pilotage Authority
Met	Capt. Angus McDonald	Retired	Company of Master Mariners of Canada
Met & Asked	Capt. Anne Miller	Marine Superintendent	CCG
Met	Capt. Anthony Patterson	Director	Marine Institute CMS
Met & Asked	Capt. Chris Hearn	Marine Superintendent	IT International Telecom Inc.
Asked	Capt. David Snider	President	Martech Polar
Met & Asked	Capt. Drew McNeill	Icebreaker Captain	Canadian Coast Guard
Asked	Capt. Georges Tousignant	VP Operations	Nunavut Eastern Arctic Shipping Inc.
Met & Asked	Capt. Gordon Williams	Lecturer	Marine Institute
Asked	Capt. Ian Marr	Past National Master	Company of Master Mariners of Canada
Met & Asked	Capt. Mario Bonenfant	Operations	PetroNav
Met & Asked	Capt. Peter Turner	Consultant	MarTrans
Met	Capt. Sean Sheppard	Lecturer	Marine Institute
Met & Asked	Capt. Todd Nicholls	Director Operations	IT International Telecom Inc.
Met	Capt. Wade Spurrell	Director	CCG
Met	Chris Hill	President	CANATEC
Met & Asked	Chris King	Manager	PetroNav
Sent Cold	Dr. Arden L.Bement, Jr.	Director	National Science Foundation
Asked	Dr. Donat Pharand	Professor	University of Ottawa
Sent Cold	Dr. Doug Bland	Defenc Analyst	Queen's University
Met	Dr. Emmanuel Guy	Professor	Quebec University Rimouski
Asked	Dr. Humphrey Melling	Ice Scientist	DFO
Met	Dr. John Dinwoodie	Reader	University of Plymouth
Met	Dr. Lawson Brigham	Deputy Director	USARC
Asked	Dr. Michael Byers	Professor	UBC
Met	Dr. Rob Huebert	Associate Professor	University of Calgary

Met & Asked	Dr. Ronald Pelot	Associate Professor	Dalhousie
Met	Ester Cunningham	Inspector	Transport Canada
Met	Fiona Robertson	Acting Manager	CCG
Met	Gabriel Tam	Manager	ABS Americas Division
Met	Goran Liljestrom	Naval Architect	SM Safety Inspectorate
Met	Goran Wilkman	Manager	Aker Arctic
Asked	Graham Thomas	Director	BP Exploration
Asked	Ian Soady	Manager	BP Shipping
Asked	Jacinthe Lacroix	Senior Science Adviser	Environment Canada
Asked	Jayleen Philips	Transportation Planner	Transport Canada
Asked	Jean Ouellet	Arctic Planner	CCG
Met	Jeremy Young	President	Flight Marine Environmental
Met & Asked	John Falkingham	Operations Manager	Environment Canada
Referral	Karl Erb	Director	National Science Foundation OPP
Asked	Kathleen Nadeau	Senior Analyst	Transport Canada
Asked	Keith Weaver	Acting Director	Canadian Hydrographic Service
Met	Kimmo Juurmaa	Director	Delta Marin
Asked	Lyle Fetterly	General Manager	Hudson Bay Port Co.
Met & Asked	Martin Karlsen	President	Karlsen Shipping
Sent Cold	Nadene Kennedy	Polar Coordination Specialist	National Science Foundation OPP
Asked	Nina Oding	Researcher	Leontief Centre
Sent Cold	Paul Ghaleb	Sales/Marketing	NEAS Inc.
Asked	Paul Kaludjak	President	Nunavut Tunngavik Inc.
Met	Peter Noble	Manager	ConocoPhillips
Sent Cold	Philippe Desgagnes	Manager	Transarctic
Asked	Rick Cran	Manager Marketing/Sales	First Airlines
Met & Asked	Robert B. Taylor	Coastal Geomorphologist	Natural Resources Canada
Asked	Robert Poole	Director	Reason Public Policy Institute
Referral	Robin Browne	President	R.P. Browne Marine Consultants Ltd.
Met & Asked	Rod Stright	President	Canadian Marine Safety Services Inc.
Asked	Ron Lemieux	Minister of Infra & Transport	Province of Manitoba
Met	Ross MacDonald	Manager	Transport Canada
Met	Suzanne Lalonde	Professor	University de Montreal
Met & Asked	Thomas Zagon	Applications Specialist	Enfotec
Met	Victor Santos-Pedro	Director	Transport Canada

Asked		Canadian North Airlines	
Asked		Northern Transportation Company Ltd.	
Referral	Alymer Gribble	President	Gibson Marine Consultants Ltd.
Referral	Hans Stoger	Chairman	Gibson Canadian & Global Inc.

Legend

	32	Completed the 1st round of Delphi (4 Referrals, 11 Met, 11 Met & Asked, 6 Asked)
	11	Responded but did not participate for reasons provided
	4	Informed they would participate in the questionnaire but did not
	23	No response at all
	2	Late response

Appendix 4 Details of Delphi results

Details of results from Delphi No.1

No.	Statements in Delphi No.1	A	D	UC	Total	Percent
1	It will be possible for Panamax size ships of approximately 60k dwt to traverse the Northwest Passage with icebreaker assistance for 9 months of the year in 2020.	6	20	6	32	62.50 D
2	It will be possible for Panamax size ships of approximately 60k dwt to traverse the Northwest Passage with icebreaker assistance for 9 months of the year in 2050.	21	5	6	32	65.63 A
3	The Arctic Ocean will experience ice-free summers before the Northwest Passage does.	14	10	8	32	43.75 A 31.25 D
4	Compared with 2006, the number of ships operating in the Arctic will more than double by 2020.	22	6	4	32	68.75 A
5	The current capabilities of Canadian Coast Guard (CCG) icebreakers are suitable for current Arctic shipping activity.	21	8	3	32	65.63 A
6	The current capabilities of the CCG icebreakers will be suitable for Arctic shipping activity in 2020.	4	23	5	32	71.88 D
7	The current level of Route Assistance service provided by the CCG in the Arctic will be satisfactory for Arctic shipping activity in 2020.	7	19	6	32	59.38 D
8	The current level of Ice Routing and Information service provided by the CCG in the Arctic will be satisfactory for Arctic shipping activity in 2020.	17	5	10	32	53.13 A
9	The current level of Harbour Breakout service provided by the CCG in the Arctic will be satisfactory for Arctic shipping activity in 2020.	9	12	11	32	37.50 D 28.13 A
10	The current level of Northern Re-supply service provided by the CCG in the Arctic will be satisfactory for Arctic shipping activity in 2020.	19	7	6	32	59.38 A

11	The current level of Arctic Sovereignty service provided by the CCG in the Arctic will be satisfactory for Arctic shipping activity in 2020.	8	21	3	32	65.63 D
12	The 'Zone/Date Shipping Safety Control Scheme', which is based on rigid controls of stipulating the dates that vessels of various ice strengthening may navigate within the 16 shipping safety control zones of Arctic Canada, is appropriate for current day Arctic shipping activity.	6	21	5	32	65.63 D
13	The new 'Arctic Ice Regime Shipping System', a flexible framework indicating whether or not a given set of ice conditions will be safe for a particular vessel, is more appropriate than the Zone/Date Shipping Safety Control Scheme for current day Arctic shipping activity.	26	2	4	32	81.25 A
14	The 'Block Commitment' system, which divides the Canadian Arctic into 12 service areas for the provision of the primary levels of service offered by the CCG during stipulated periods throughout the summer season, is an effective system in deciding Arctic icebreaker deployment.	12	4	16	32	37.50 A 12.50 D
15	Six of Canada's 17 icebreakers spend the summer months engaged in activities in the Arctic and the winter months engaged in activities along the east and west coasts of Canada and the St. Lawrence. Utilization of these six icebreakers during both summer and winter months costs Canadian taxpayers more than only utilizing the six icebreakers during the winter months.	14	11	7	32	43.75 A 34.38 D

16	On 1 April 2005, the CCG became a Special Operating Agency within Fisheries and Oceans Canada (FOC). The positioning of the CCG as a Special Operating Agency within FOC will significantly increase the level of services being currently provided for in the Arctic.	2	14	16	32	43.75 D 6.25 A
17	FOC civilian fleet of CCG vessels, approximately 107 vessels as of 2005, are deployed, maintained and operated by five regions spread across Canada with each region operating according to its own practices and management preferences. This decentralization of fleet operations results in overall significant duplication of human resource efforts within FOC with respect to operations in the Arctic.	10	8	14	32	31.25 A 25.00 D
18	The six CCG icebreakers used for Arctic operations are operated out of four regions: Pacific, Quebec, Maritimes, and Newfoundland & Labrador. The fifth region, Central and Arctic, however is responsible for ice breaking in the Arctic. This decentralization of fleet operations results in ineffective interregional communication and consequently underutilization of vessel use in the Arctic.	10	9	12	31	32.26 A 29.03 D
19	The CCG offers a wide range of services. Given the high financial burden associated with the construction and maintenance of ice breaking vessels, it would be appropriate for the ice breaking component of the CCG range of services, in the Arctic, to be privatized.	10	18	4	32	56.25 D
20	Private involvement in carrying out the level of services currently provided for by the CCG in the Arctic will weaken Canada's position with respect to sovereignty in the Arctic.	13	18	1	32	56.25 D

21	Canada should immediately acquire icebreaking capability for year-round winter navigation in the Arctic.	15	14	3	32	46.88 A 43.75 D
22	It is appropriate for the CCG not to have icebreaking service fees north of 60° N latitude.	8	19	5	32	59.38 D
23	Funding for FOC civilian fleet of CCG icebreakers operating in the Arctic is inadequate.	17	3	12	32	53.13 A
24	The vast geography of the Arctic poses significant challenges to the CCG in terms of human resource management on board icebreakers working in the Arctic.	26	6	0	32	81.25 A
25	Compared with 2006, the number of ships operating in the Arctic will more than double by 2020.	27	3	2	32	84.38 A
26	The current capabilities of icebreakers globally will be suitable for Arctic shipping activity in 2020.	6	21	5	32	65.63 D
27	Funding for icebreakers globally is inadequate.	17	4	11	32	53.13 A
28	The vast geography of the Arctic poses significant challenges to all maritime nations in terms of human resource management on board their icebreakers working in the Arctic.	23	7	2	32	71.88 A
29	By 2020, maritime operations in the Arctic will involve a wide range of services. Given the relatively small human presence stationed on land in the Arctic most of these services will be conducted from mobile floating platforms.	16	6	10	32	50.00 A 18.75 D
30	All maritime nations of the world should immediately acquire icebreaking capability for summer navigation in the Arctic.	4	26	2	32	81.25 D
31	All maritime nations of the world should immediately acquire icebreaking capability for year-round winter navigation in the Arctic.	3	27	0	30	90.00 D

32	Accepting that Russia currently has icebreaking capability for year-round winter navigation in the Arctic, only the seven remaining nations of the Arctic Council should immediately acquire icebreaking capability for year-round winter navigation in the Arctic.	11	17	2	30	56.67 D
Total Opinion Expressed		424	394	201	1019	
% of Total Opinions		41.61	38.67	19.73		

Key: A – Agree D – Disagree UC – Unable to Comment

Details of results from Delphi No.2

No.	Statements in Delphi No.2	A	D	UC	Total	Percent
1.1	Not the entire Arctic Ocean but some parts along the Russian North East Passage may.	17	4	6	27	62.96 A
1.2	Depends on your absolute definition of 'ice free', and 'NW Passage', but it is hard to believe that there would be no ice in the Arctic Ocean but ice in the Northwest Passage.	17	6	3	26	65.38 A
1.3	The last of the Arctic ice is likely north of Greenland, thus in the Arctic Ocean. Thus the Northwest Passage should be, for shipping purposes, ice free sooner.	15	9	2	26	57.69 A
1.4	Multi-year ice may not drift into the Northwest Passage after the winter freeze but will still be predominant in the Western Arctic (Beaufort Sea).	10	10	5	25	40 A 40 D
1.5	Extrapolating too far into the future.	12	8	2	22	54.55 A
1.6	Descending multi- year ice will block the straits.	16	2	5	23	69.57 A
2.1	CCG don't do harbour breakout now.	11	5	10	26	42.31 A
2.2	Some harbours require more detailed hydrographic surveys and dredging (e.g. Cambridge Bay, Resolute).	20	0	7	27	74.07 A
2.3	Currently there are not enough icebreakers to break out harbours early enough in the season.	8	11	7	26	42.31 D

2.4	The number of icebreakers will be insufficient.	14	7	5	26	53.85 A
3.1	It is as outdated as the zone/date system.	12	6	9	27	44.44 A
3.2	In changing environmental conditions globally this needs continuous updating.	21	2	4	27	77.78 A
3.3	The level of service scheme needs to be more flexible.	21	0	6	27	77.78 A
3.4	It's the result of a limited number of icebreakers and not very effective from a service point of view.	13	6	8	27	48.15 A
4.1	All CCG ships are multi tasked. Most I/B are also buoy tenders. The Primary I/B are the only ones able to work the Arctic & heavy ice years south.	20	3	4	27	74.07 A
4.2	Some cost recovery for route assistance.	12	5	10	27	44.44 A
4.3	Best to utilize the equipment and manpower all year around.	21	2	4	27	77.78 A
4.4	It depends on actual need, which must be well established. It may be that less ice in Arctic does not warrant these vessels there in summer.	15	7	4	26	57.69 A
4.5	Fixed capital & operational (e.g. crew training & retention) costs are undoubtedly high.	22	1	3	26	84.62 A
4.6	Icebreakers are fully funded for year round operation (re; Officers & crew). Fuel costs not a factor when you compare ice conditions.	6	8	13	27	22.22 A 29.63 D
4.7	The summer use of icebreakers is always beneficial.	15	4	6	25	60 A
4.8	Ships earn their keep when they are at sea doing their jobs. Laying the Arctic icebreakers up for half a year would not double their lifetime.	21	4	2	27	77.78 A
5.1	Their budget didn't change. The best that can happen is that LOS won't decrease due to budget cuts in FOC.	11	5	11	27	40.74 A 18.52 D
5.2	CCG has not displayed any ability to operate in a more efficient manner, as permitted by SOA status, that might permit increased services.	14	4	9	27	51.85 A

5.3	It doesn't matter where it fits in government organizational charts, what matters is funding.	19	5	2	26	73.08 A
5.4	Focus is brought further away from transport issues.	9	3	13	25	36 A 12 D
5.5	The level of services is mostly limited by the capacity of the assets - declaring CCG and SOA does not provide more assets nor the ability to get them.	16	3	6	25	64 A
6.1	The regions exist to meet specific needs of distinctly different geographic areas. Each region provides ships to the Central & Arctic region which controls arctic operations.	19	1	7	27	70.37 A
6.2	The I/B offices in the regions are very small. Since the officers are in a pool & the fleet is multi-tasked the regional approach is probably most effective.	15	2	9	26	57.69 A
6.3	Arctic deployments are reasonably well-coordinated.	16	1	10	27	59.26 A
6.4	The USCG has a decentralized fleet ops structure although the icebreakers are viewed as unique assets; practices should be standardized.	11	3	13	27	40.74 A 11.11 D
6.5	Regional vessels on Arctic operations are controlled from a single centre.	13	1	13	27	48.15 A
7.1	Vessel utilization is more a function of budget and less of organization.	12	6	8	26	46.15 A
7.2	Arctic deployments are reasonably well-coordinated.	17	0	9	26	65.38 A
7.3	Central & Arctic Region is delegated operational control of all CCG icebreakers while Logistical Support is maintained by the Home Region.	14	0	13	27	51.85 A
7.4	Source of a single control point doesn't matter- generally icebreakers respond to service demands.	9	6	10	25	36 A 24 D

7.5	This may have been true in the past but in recent years, the fleet is managed with national standards and the Regions are well coordinated.	9	2	14	25	36 A 8 D
7.6	Each region have their own particularities and the centralization of the operations will not be a good thing.	6	8	11	25	24 A 32 D
8.1	There is no immediate need. It would be a waste of an asset to have it deployed away from other operations in the winter. Would also be very expensive to operate.	18	7	0	25	72 A
8.2	It must be a private exercise as the CCG has proven beyond any doubt that it cannot deal with such a large project.	7	11	7	25	44 D
8.3	No commercial clients or compelling sovereignty arguments for year-round service at this time.	16	8	1	25	64 A
8.4	The technical requirements for year-round navigation are non-trivial & probably beyond present reach. Adopt a staged approach (not necessarily ships).	16	7	2	25	64 A
8.5	More vessels of moderate capacity is best then one very costly powerful unit: we need icebreakers where commercial vessels will go.	14	8	3	25	56 A
8.6	Not necessary to acquire "immediately" - but should start the procurement process to have a capability no later than 2015.	18	5	3	26	69.23 A
Total Opinion Expressed		638	206	299	1143	
% of Total Opinions		55.82	18.02	26.16		

Key: A – Agree D – Disagree UC – Unable to Comment

Details of results from Delphi No.3

No.	Statements in Delphi No.3	A	D	UC	Total	Percent
1.1	"MYI" is unlikely to be "predominant" in the Western Arctic due to increased and substantial annual melting.	8	8	5	21	38.10 A 38.10 D
1.2	Based on current trends, the Beaufort Sea (south of latitude 80N) will be free of MYI before the NWP, which will still be affected by MYI drifting southward through the archipelago from the Arctic Ocean north of (about) 80N.	10	7	6	23	43.48 A
1.3	As the Arctic warms the present ice flow analysis/models will be of little or no use in predicting the flow of the MYI as the ice cap breaks up.	6	10	6	22	45.45 D
2.1	Fuel costs are a variable that the CCG has a most difficult time managing.	13	5	5	23	56.52 A
3.1	Funding directly to the CCG is now in effect without reallocation, by the DM, to other Fisheries issues.	6	2	15	23	26.09 A 8.70 D
3.2	The best that could happen would be for Arctic initiatives to be raised to a higher profile, longer term and not part of FOC.	15	1	6	22	68.18 A
3.3	The CCG Budget did and is continuing to improve.	5	4	14	23	21.74 A 17.39 D
4.1	The reason why the CCG was made a Special Operating Agency (SOA) was to address the marine transportation issue and ensure that CCG funding goes to where the allocation was intended.	13	1	9	23	56.52 A
4.2	The SOA allows CCG to focus more on transportation, rather than on FOC imperatives.	8	5	8	21	38.10 A
4.3	The LOS has remained the same.	9	1	13	23	39.13 A
5.1	We need the best, most effective and responsive system for Canada, not just one that matches up with the USCG.	20	1	2	23	86.96 A

5.2	The USCG structure is not an example for Canada to follow; it is even less efficient than the CCG structure.	10	2	11	23	43.48 A
6.1	Operationally a central control point in the harsh northern environment is important.	20	0	3	23	86.96 A
6.2	I/Bs do respond to service demands but you need one region in charge of the Arctic and not two or three regions operating I/Bs independently.	20	0	3	23	86.96 A
6.3	A single point of control is important for coordination of the six I/B operation.	20	0	3	23	86.96 A
7.1	The regions generally ignore national standards where they exist. National standards are incomplete. There is no internal audit process visible for these standards.	6	3	14	23	26.09 A 13.04 D
7.2	There is still little coordination among the regions.	8	4	11	23	34.78 A 17.39 D
8.1	Regional control increases the operational costs of the entire Fleet due to duplication of services.	12	4	7	23	52.17 A
8.2	Centralization is OK, the quality of the staffing/personal is more important.	18	1	4	23	78.26 A
8.3	You cannot completely centralize operations control.	12	3	8	23	52.17 A
8.4	Standardization of equipment and procedures is an important aspect of an efficiently operating fleet. Too much regional autonomy results in situations where I/Bs are not able to standardize on "best practices".	14	3	5	22	63.64 A
	Total Opinion Expressed	253	65	158	476	
	% of Total Opinions	53.15	13.66	33.19		

Key: A – Agree D – Disagree UC – Unable to Comment

Appendix 5 An example of open/axial coding concepts from interview No. 4

<p><u><i>Politics(Cat)</i></u></p> <ul style="list-style-type: none"> • Many Canadians unaware of the Arctic • Will want to build I/Bs in Canada • Taxpayers will be happy if you are saving them money • Consultants will want a piece of the action • Public will jump to lay blame if things are changed and something goes wrong • Taxpayers need to be informed of the role of I/Bs in developing the Arctic • Uncertainty re the appropriateness of individuals giving advice to politicians re Arctic matters • Canada hasn't got the stomach for privatization • Politicians will feel obliged to listen to all stakeholders when building I/Bs and thus will be forced to compromise on the design and construction • Arctic needs to be further promoted • Canada needs to put at least two new year round capable I/Bs in the Arctic to escort tonnage and also wave the sovereignty flag • Arctic not developed to potential due to lack of regular and consistent I/B support • Canada needs to commence building new I/Bs immediately • Politicians don't understand the issues re building I/Bs • Local inhabitants if Arctic receiving relatively poor service for Ottawa 	<p><u><i>CCG(Subcat)</i></u></p> <ul style="list-style-type: none"> • Does not incorporate capital, insurance, and shore personnel cost into its operating cost • Stress that private ship owners operate ice-class ships in the Arctic and thus do not have to rely on CCG for I/B escort • Better suited to only operating the I/Bs • Not efficient at designing, building or retrofitting • Needs to be better organized • Identity lost within FOC/TC • Keep outside of the Navy • Lack of resources/ships • I/B fleet is old, inefficient and small • Unable to assist some Canadian ships working in the Arctic • Careers are not well marketed • Expensive and wasteful dry-dockings • Excessive shore staff looking after a few ships • Poor contract negotiations with repair yards • Keeping I/Bs in the Arctic when not required by private sector so as to use and not lose budgets 	<p><u><i>Navy(Subcat)</i></u></p> <ul style="list-style-type: none"> • Keep separated from CCG <p><u><i>Unions(Subcat)</i></u></p> <ul style="list-style-type: none"> • Large layoffs if privatized • CCG officers have different license structure which may cause problems in transferring to private sector
	<p><u><i>Privatization(Cat)</i></u></p> <ul style="list-style-type: none"> • Private firms would not want the current I/B fleet and associated CCG leave system • Private firms could operate I/B more efficiently than CCG • Would result in significant savings especially during dry-dockings since CCG unable to put rigid demands on the repair yards • Private firms may not be interested due to potential bad press if something went wrong • CCG does not account for capital, insurance or shore maintenance personnel cost 	<p><u><i>Chartering(Subcat)</i></u></p> <ul style="list-style-type: none"> • Could be done with an experienced private firm • Charge daily rate to CCG • Long term time charter will be required • I/Bs would be made available to CCG as they requested • Would require detailed contracts • CCG would pay for fuel • Private firm would look after the I/Bs <p><u><i>I/B Design/Construction(Subcat)</i></u></p> <ul style="list-style-type: none"> • Yards will meet their promised design spec or else be in breach of contract and thus accountable for added cost • Cheaper and quicker to build outside of Canada • Canadian yards are relatively inefficient • Canadian yards have inefficient capacity • Canadian yards have skill sets but lack personnel • Minimum of five years to build in Canada • Cost in Canada will be considerably higher due to added cost of all the involved consultants and civil servants • Proven designs readily available but Canada will try to reinvent the wheel • Best to take a proved design and get the I/B built in Japan or Finland • Get an I/B straight from the yard using one of their own designs <p><u><i>Private Management/Crewing(Subcat)</i></u></p> <ul style="list-style-type: none"> • With respect to residual value, private management firms may not be interested in caring for CCG ships like they would their own • Private firms will need to make a profit • More efficient if done privately • More control over costly crew changes in the Arctic • CCG keeping I/Bs in the Arctic when not required by private sector so as to use and not lose budgets • Private firms may not like to be told by government how to go about their business • Private firms may all want a piece of the action and government may have to accommodate this

Appendix 6 Grounded theory hypotheses, themes, and relationships

The hypotheses are grouped in central themes and shown in lighter text while the relationships are identified at the end in bold text. These hypothesis and relationships were used in the development of the quantitative survey

Private management companies may be more cost efficient but would be more risk averse than government in dangerous situations.

Private firms are able to manage CCG I/Bs more efficiently than the CCG through Public Works & Treasury Board.

Private management of the CCG fleet will help resolve critical manning issues.

Private Canadian ownership of a fleet of vessels used by CCG, DND, and oil companies in the Arctic will increase Canadian presence and not jeopardise Canada's sovereignty.

Private involvement in the delivery of CCG services will result in less tax dollar spending.

Chartering out of private I/Bs to DFO will necessitate long term time charters.

Inefficient monopoly situations will occur when trying to privatize government services such as those of the CCG.

The Canadian public in general will object to only privatizing icebreaking services in the north and not in the south.

A national organizational approach would reduce CCG crewing costs.

Separating the CCG from DFO will strengthen its SOA status and help reduce crewing cost.

As a SOA, outside of DFO, the CCG would have more flexibility to operate more efficiently and effectively in the Arctic.

The role of Canada's Maritime Administration needs to be clearly delineated.

Canada's Arctic will be developed regardless of the presence and assistance of the CCG or DND.

CCG I/B support and monitoring will be necessary to ensure sustainable future development of the Arctic region.

I/B support will be necessary for the development of the Arctic region.

Political will and I/B support will be necessary to expedite future development of the Arctic region.

Canada's Arctic would develop sooner if greater I/B capability were available on a year round basis.

Canada's Arctic sovereignty claim and environmental stewardship would be bolstered if CCG I/Bs were crewed and operated by local Arctic inhabitants and the I/Bs were stationed in the Arctic on a year round basis.

Canada is capable of building ice strengthened supply vessels.

Canada needs to be at the forefront of icebreaking technology and would benefit from regaining its expertise in designing and building I/Bs and becoming less dependent on other shipbuilding nations.

It would be more efficient for the CCG to use a proven I/B design than to have a new I/B designed in Canada.

Limited shipyard capabilities to service CCG I/Bs eliminates competition thus adding to fleet maintenance cost.

Private firms are able to design & build I/Bs more efficiently and effectively than the CCG through Public Works.

Canadian shipyards are unable to build a I/B as quickly as other experienced shipyards in Europe and the Far East.

Other countries are able to design and build I/Bs more effectively and efficiently than Canada.

Canada's low public interest in marine matters has contributed to the low public profile of the CCG.

The low public profile of the CCG results in very limited attention being given to it by Federal MPs.

Limited attention from Federal MPs has resulted in the CCG's low funding, poor management and poor operation.

Small and regular funding requests to Treasury Board are more likely to be approved over large irregular request.

New security, science, and sovereignty matters are shifting the workload of the CCG.

Increased political demands on the CCG have resulted in the CCG neglecting private sector service requests.

Political intervention impedes the CCG from achieving more commercial-like efficiencies.

Due to Canada's geographical expanse and ensuing political bureaucracy the CCG fleet is grossly inefficient and underutilized.

Canada needs to enhance its Arctic expertise and the local inhabitants of Arctic regions need to be significantly involved in future developments.

The uniqueness of Canada's Arctic requires new ways of managing its development.

Canadian taxpayers would benefit from the CCG and DND committing to charter a fleet of newly constructed and privately owned multi-functional ice class vessels that have the modular capability to meet their particular interest and will be time shared with oil companies operating in the Arctic.

Unless Canada decides to build a substantial fleet of Polar Class I/Bs, it will cost less to have them designed and built in European or Far East yards.

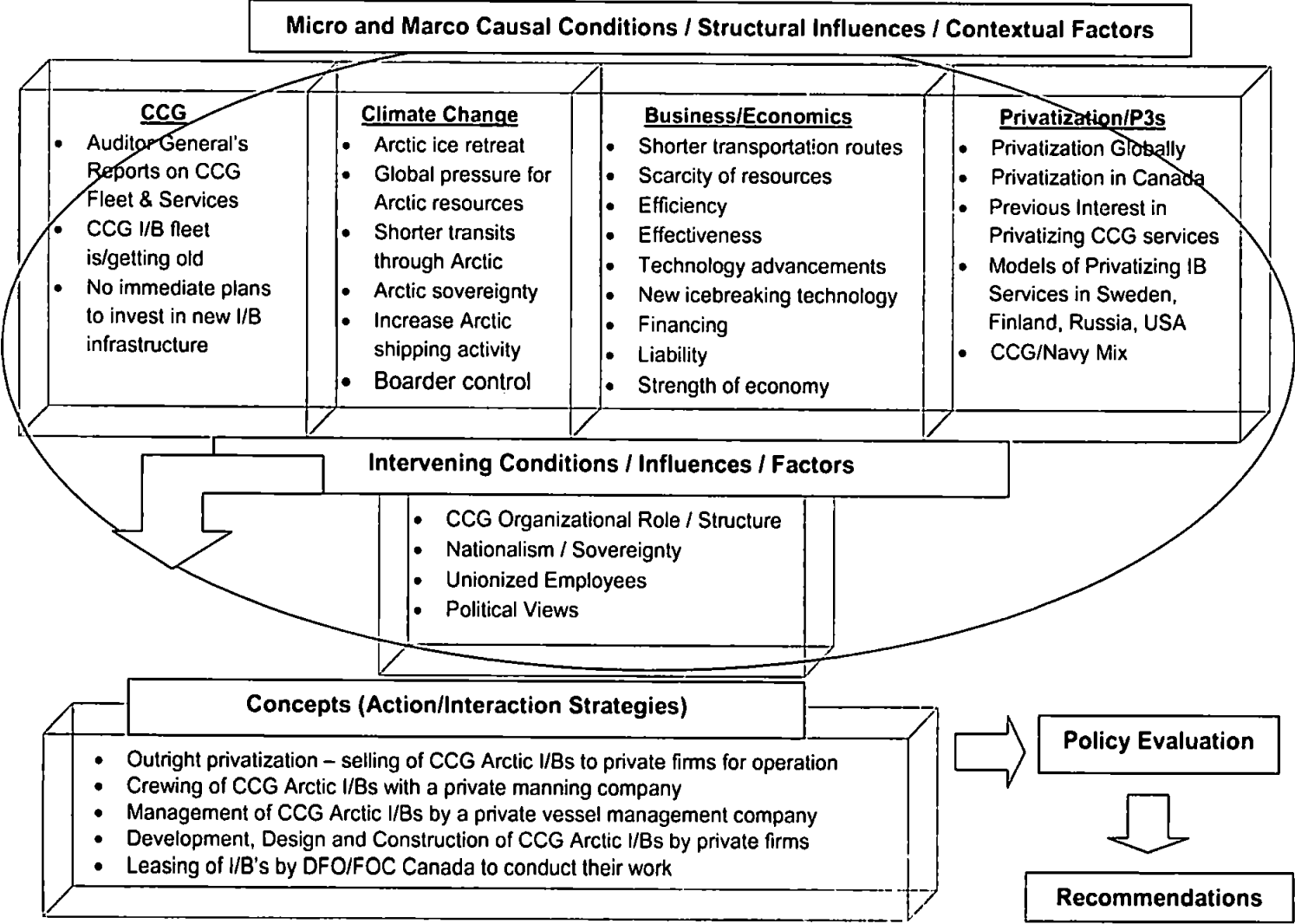
In the absence of increased funding for the CCG, Canada's maritime requirements would be better served by setting up a Maritime Administration office, responsible for the development of CCG and DFO programmes, which avails of the existing CCG fleet, the leasing of private hardware and/or the contracting out of services.

Canada's Arctic development would best be accomplished by having a private local company to manage and crew I/Bs that are built outside of Canada and leased to the CCG for year round operations in the Arctic.

The CCG would benefit from the acquisition of I/Bs designed and built by European or Far East yards to manage themselves OR they will need to engage in a long term time charter for I/B services in the Arctic.

Canadian taxpayers would benefit from having a fleet of competitively built, in Canadian, Polar Class I/Bs that will be managed by competitive private firms.

Appendix 7 Conceptual Model at the end of grounded theory interviews



Source: Author.

Appendix 8 Official response from CCG informing of non-response to survey questionnaire

Good afternoon Jim,

Your request was passed to Fleet Directorate.

The Canadian Coast Guard will not participate in this survey.

Sincerely,

Stephen Peck

***Please note new e-mail address /
Veuillez noter la nouvelle adresse électronique:***

steve.peck@dfo-mpo.gc.ca

*Director, Marine Personnel
Fleet Directorate
Canadian Coast Guard
Department of Fisheries and Oceans*

*Directeur, Personnel maritime
Direction générale de la Flotte
Garde côtière canadienne
Ministère des Pêches et des Océans*

*200 Kent Street / 200, rue Kent
Station 6S007
Ottawa, Ontario
K1A 0E6*

*Tel: (613) 998-1662
FAX: (613) 993-2725*

Appendix 9 A requested list of Canadian master mariners provided by Transport Canada

Mr. Parsons:

I apologize for the delay in relaying the information you have requested.

Please find below an Excel spreadsheet document providing you with the number of Master Mariners that are "active" or non-active" and which include individuals with addresses outside of Canada.

Should you have any questions or concerns, I may be reached at (613) 998-0698.

Paul Gauthier
Marine Safety / Sécurité maritime
Tel / Tél (613) 998-0698 / gauthpa@tc.gc.ca
Facsimile / télécopieur (613) 990-1538
Transport Canada / Place de Ville (AMSP), Ottawa, Ontario, K1A 0N8
Transports Canada / Place de Ville (AMSP), Ottawa (Ontario) K1A 0N8
Government of Canada / Gouvernement du Canada

-----Original Message-----
From: Jim Parsons [mailto:Jim.Parsons@mi.mun.ca]
Sent: Wednesday, August 13, 2008 12:36 PM
To: Gauthier, Paul
Cc: St-Laurent, Jules
Subject: Number of Master mariners in Canada

Dear Mr. Gauthier;

As part on my ongoing PhD research in Shipping and Logistics at the University of Plymouth, England I am inquiring as to the number of Master Mariners there are in Canada as of the most current update. If possible, a breakdown of their place/province of residence and age would be helpful.

Merci;

Jim Parsons

"province"	#	
	seafarers	avg. age
.	2	68.5
Ab	2	63.5
Alberta	1	42
B.c.	4	56
BC	30	54.3
Bc	47	57
Ca Usa 92203	1	47
Florida	1	40
Hungary	1	44
MB	2	56.5
Mb	1	53
NB	7	52.2
NL	20	44
NS	6	48

Nb	5	51.2
New Brunswick	1	55
Nf	39	46.1
Nl	5	45
Nova Scotia	1	38
Ns	31	48.8
ON	9	56.1
On	35	51.3
Ontario	5	54.8
PE	1	45
Pei	8	47.1
Pq	30	47.3
QC	45	43.8
Quebec	1	36
United Kingdom	1	59

29 rows selected.

Appendix 10 A copy of the survey questionnaire

Potential for private involvement in Canadian icebreaking services

Thank you for taking this survey. Click the "Submit by Email" button to submit the survey.



Name:

Age:

Province/Territory:

Email:

Gender: ☐ Male ☐ Female

Would you like to receive a copy of the executive summary?

☐ Yes ☐ No

Any other comments:

Company Name:

Private or Public Ownership:

☐ Private ☐ Public

Role in Organization:

Years in current role:

Years dealing with Arctic matters:

PART A

1. In terms of how you see yourself when taking business risks please tick one box to say whether you are:

☐ Very Cautious ☐ Cautious ☐ Average ☐ Adventurous ☐ Very Adventurous

Question 2, 3 and 4 below are based on the following basic background information:

Assume you have the opportunity to provide, for twelve months of the year, all of the icebreaking and associated services that are currently being provided for by the Canadian Coast Guard in the Canadian Arctic. Three contracts (A, B & C) are offered to you. Assume, in general terms, Contract A is a lump sum payment from government, Contract B is a smaller lump sum payment from government with limits on your possible gains and losses, and Contract C is a fee for service arrangement between your company and those requesting the service. You are to commence service provision on 1 July 2012. While some multi-year sea ice remains in the Canadian archipelago, the Northwest Passage (NWP) was free of first-year ice for 3 months during the previous summer. However, ice forecasters are uncertain as to whether the NWP will be free of first-year ice for 6 months, 2 months, or not at all during the coming summer season as noted in Scenarios 1, 2, & 3 in the table below. Depending on the scenario that unfolds, the possible annual gains (+) and losses (-) in Canadian dollars for Contracts A, B & C are shown in the table below.

	Scenario 1	Scenario 2	Scenario 3
	NWP ice free for at least 6 months Probability: 0.5	NWP ice free for at least 2 months Probability: 0.3	Light ice conditions in NWP throughout summer months Probability: 0.2
Contract A	+\$10,000,000	+\$2,000,000	-\$12,000,000
Contract B	+\$6,000,000	\$0	-\$4,000,000
Contract C	-\$10,000,000	+\$4,000,000	+\$13,000,000

2. In light of the above information, my choice of contracts would be:

- 1st choice:
- ☐ Contract A ☐ Contract B ☐ Contract C
- 2nd choice:
- ☐ Contract A ☐ Contract B ☐ Contract C

Why have you ranked them in this order?

3. Now assume that the wording in Contract B happens to be somewhat ambiguous, especially with the ability to terminate the contract, my choice of contracts would now be:

- 1st choice:
- ☐ Contract A ☐ Contract B ☐ Contract C
- 2nd choice:
- ☐ Contract A ☐ Contract B ☐ Contract C

Why have you ranked them in this order?

4. Now assume that the duration of Contract B happens to be twice that of Contracts A and C, my choice would now be:

- 1st choice:
- ☐ Contract A ☐ Contract B ☐ Contract C
- 2nd choice:
- ☐ Contract A ☐ Contract B ☐ Contract C

Why have you ranked them in this order?

PART B

Please select to indicate how far you agree with each of the following statements. Your response might be.

- SA = Strongly Agree
A = Agree
D = Disagree
SD = Strongly Disagree
NA = Not able to comment

- | | | | | | |
|---|--------------------------|-------------------------|-------------------------|--------------------------|--------------------------|
| 1. Canada's military and civilian roles in the Arctic. | | | | | |
| a) Should be combined | <input type="radio"/> SA | <input type="radio"/> A | <input type="radio"/> D | <input type="radio"/> SD | <input type="radio"/> NA |
| b) Should be managed by a newly created maritime organization | <input type="radio"/> SA | <input type="radio"/> A | <input type="radio"/> D | <input type="radio"/> SD | <input type="radio"/> NA |
| <hr/> | | | | | |
| 2. Separating Canadian Coast Guard (CCG) Hardware from CCG Services will aid in setting clearer terms of reference for the CCG. | | | | | |
| | <input type="radio"/> SA | <input type="radio"/> A | <input type="radio"/> D | <input type="radio"/> SD | <input type="radio"/> NA |
| <hr/> | | | | | |
| 3. A single national organizational approach would reduce CCG crewing costs. | | | | | |
| | <input type="radio"/> SA | <input type="radio"/> A | <input type="radio"/> D | <input type="radio"/> SD | <input type="radio"/> NA |
| <hr/> | | | | | |
| 4. Separating the CCG from the Department of Fisheries & Oceans (DFO) will: | | | | | |
| a) strengthen its Special Operating Agency (SOA) status | <input type="radio"/> SA | <input type="radio"/> A | <input type="radio"/> D | <input type="radio"/> SD | <input type="radio"/> NA |
| b) help reduce crewing cost | <input type="radio"/> SA | <input type="radio"/> A | <input type="radio"/> D | <input type="radio"/> SD | <input type="radio"/> NA |

5. As a SOA, outside of DFO, the CCG would have more flexibility to operate more efficiently and effectively in the Arctic.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
6. The role of Canada's Maritime Administration is clearly delineated.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
7. Canada's Arctic will be developed regardless of the presence and assistance of the CCG.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
8. CCG Icebreaker (I/B) support and monitoring will be necessary to ensure sustainable future development of the Arctic region.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
9. I/B support will be necessary for the development of the Arctic region.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
10. Political will and I/B support will be necessary to expedite future development of the Arctic region.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
11. Canada's Arctic would develop sooner if greater I/B capability were available on a year round basis.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
12. Canada's Arctic sovereignty claim and environmental stewardship would be bolstered if CCG I/Bs were:					
a) crewed and operated by Arctic residents	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
b) stationed in the Arctic on a year round basis	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
13. Canada's low public interest in marine matters has contributed to the low public profile of the CCG.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
14. The low public profile of the CCG results in very limited attention being given to it by Federal Members of Parliament (MPs).	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
15. Limited attention from Federal MPs has resulted in the CCG's:					
a) low funding	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
b) poor management	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
c) poor operation	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
16. Small and regular funding requests to Treasury Board are more likely to be approved over large irregular request.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
17. New southern security and science matters are shifting the workload of the CCG away from icebreaking in the Arctic.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA

18. Increased political demands on the CCG have resulted in the CCG neglecting private sector service requests.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
19. Political intervention impedes the CCG from achieving more commercial-like efficiencies.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
20. Due to Canada's geographical expanse and ensuing political bureaucracy the CCG fleet is grossly inefficient and underutilized.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
21. Canada needs to enhance its Arctic expertise.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
22. The local residents of Arctic regions need to be significantly involved in future Arctic developments.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
23. Private ship management companies operating in the Arctic would:					
a) be more cost efficient than government	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
b) be more risk averse than government	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
24. Private firms are able to manage CCG I/Bs more efficiently than the CCG through Public Works & Treasury Board.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
25. Private management of the CCG fleet will resolve critical manning issues.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
26. Private Canadian ownership of a fleet of vessels used by CCG, Canadian Military, and oil companies in the Arctic will:					
a) increase Canadian presence	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
b) not jeopardise Canada's sovereignty	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
27. Private involvement in the delivery of CCG services in the Arctic will result in less tax dollar spending.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
28. Chartering out of private I/Bs to the Canadian Government will necessitate long term time charters.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
29. Inefficient monopoly situations will occur when trying to privatize government services such as those of the CCG.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
30. The Canadian public in general will object to only privatizing icebreaking services in the north and not in the south.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA

31. Canada is capable of building ice strengthened supply vessels.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
32. Canada needs to be at the forefront of icebreaking technology.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
33. Canada would benefit from regaining its expertise in designing and building I/Bs and becoming less dependent on other shipbuilding nations.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
34. It would be more efficient for the CCG to use a proven I/B design than to have a new I/B designed in Canada.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
35. Limited shipyard capabilities to service CCG I/Bs in Canada eliminates competition thus adding to fleet maintenance cost.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
36. Private firms are able to design & build I/Bs more efficiently and effectively than the CCG through Public Works.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
37. Canadian shipyards are unable to build a I/B as quickly as other experienced shipyards in Europe and the Far East.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
38. Other countries are able to build an I/B more:					
a) effectively than Canada	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
b) efficiently than Canada	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
39. Canadian taxpayers would benefit from the CCG and the military committing to charter a fleet of newly constructed and privately owned multi-functional ice class vessels that have the modular capability to meet their particular interest and will be time shared with oil companies operating in the Arctic.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
40. Unless Canada decides to build a substantial fleet of Polar Class I/Bs, it will cost less to have them designed and built in European or Far East yards.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA
41. In the absence of increased funding for the CCG, Canada's maritime requirements would be better served by setting up a Maritime Administration office which would be responsible for the development of CCG and DFO programmes and would avail of the existing CCG fleet, the leasing of private hardware and/or the contracting out of services.	<input type="radio"/> SA	<input type="radio"/> A	<input type="radio"/> D	<input type="radio"/> SD	<input type="radio"/> NA

42. Canada's Arctic development would best be accomplished by having a private local company to manage and crew I/Bs that are built outside of Canada and leased to the CCG for year round operations in the Arctic.

☐ SA ☐ A ☐ D ☐ SD ☐ NA

43. The CCG would benefit from the acquisition of I/Bs designed and built by European or Far East yards to manage themselves.

☐ SA ☐ A ☐ D ☐ SD ☐ NA

44. Without its own fleet of Polar Class I/Bs the CCG will need to engage in a long term time charter for I/B services in the Arctic.

☐ SA ☐ A ☐ D ☐ SD ☐ NA

45. Canadian taxpayers would benefit from having a fleet of competitively built, in Canada, Polar Class I/Bs that will be managed by competitive private firms.

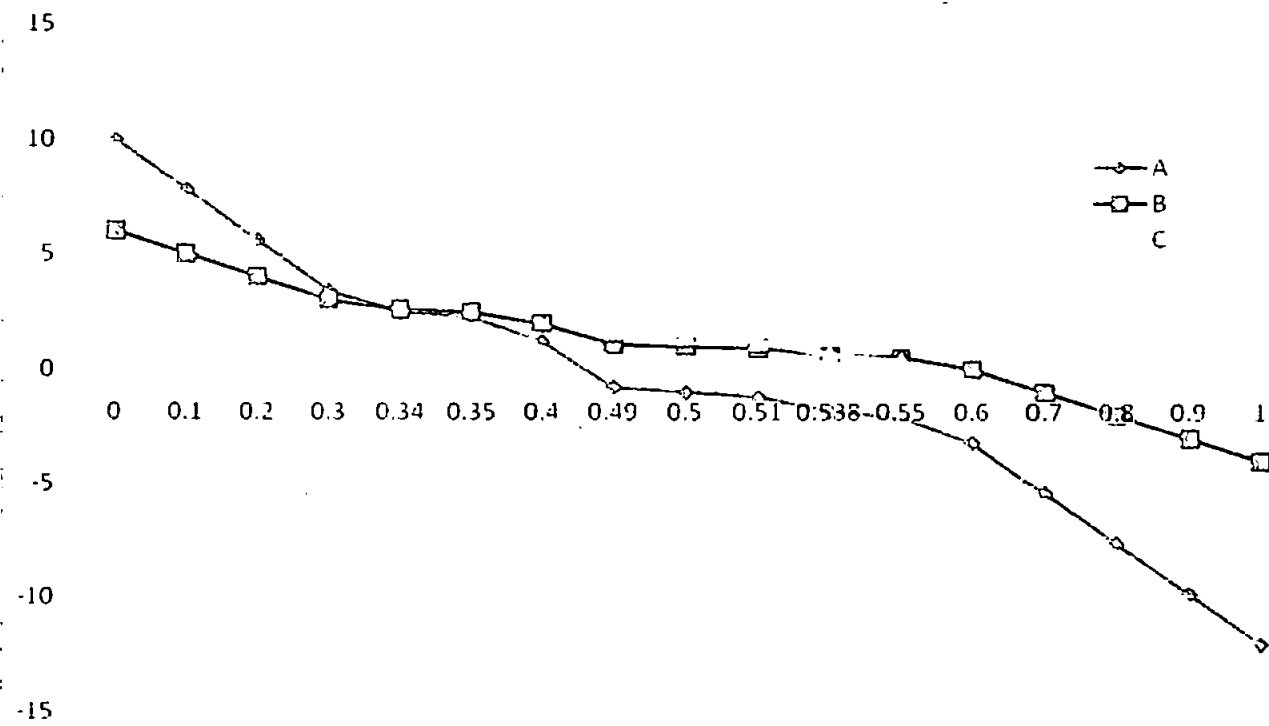
☐ SA ☐ A ☐ D ☐ SD ☐ NA

Thank you for submitting this form electronically. If you have difficulties submitting, please print this form and return by post or fax to:

Jim Parsons
Marine Institute, School of Maritime Studies
P. O. Box 4920,
St. John's, Newfoundland
Canada A1C 5R3

or fax to Jim Parsons at 1 (709) 778-0659.

Appendix 11 Graph of Hurwicz Criterion results for contracts A, B, and C



A cautious decision maker will set $a=1$ which reduces the Hurwicz criterion to the maximin criterion. An adventurous decision maker will set $a=0$ which reduces the Hurwicz criterion to the maximax criterion.

Hurwicz

0	0.1	0.2	0.3	0.34	0.35	0.4	0.49	0.5	0.51	0.538	0.55	0.6	0.7	0.8	0.9	1
10	7.8	5.6	3.4	2.52	2.3	1.2	-0.78	-1	1.22	-1.836	-2.1	-3.2	5.4	7.6	9.8	-12
6	5	4	3	2.6	2.5	2	1.1	1	0.9	0.62	0.5	0	-1	-2	-3	-4
13	10.7	8.4	6.1	5.18	4.95	3.8	1.73	1.5	1.27	0.626	0.35	-0.8	3.1	5.4	7.7	-10
cab				cba	cba	cba	cba	cba	cba	cba	bca					
Risk Taker				Risk Neutral						Risk Averse						

Appendix 12 A copy of the pre-survey contact letter

Dear ????

I am currently undertaking PhD research dealing with Arctic icebreaking services. Given your expertise/interest in this area, I would very much value and appreciate your input. If you are interested in contributing to this research, I shall forward to you within a few days a copy of my survey which can be completed and submitted online easily.

Thank you for your time.

Sincerely,

Jim Parsons

Appendix 13 Covering email sent with the quantitative survey

James R. Parsons, PhD Researcher
International Shipping & Logistics
University of Plymouth
Plymouth, Devon
United Kingdom



Canada Contact Information:
Marine Institute, School of Maritime Studies
P. O. Box 4920,
St. John's, Newfoundland
Canada A1C 5R3

Examining the potential for private involvement in Canadian icebreaking services

This survey is part of my PhD research investigating the extent to which the Canadian Coast Guard (CCG) services, principally icebreaking, being provided in the Arctic are suitable for some level of private involvement/partnership.

As a stakeholder and/or expert in this area, your assistance in this work is invaluable, and will contribute significantly to the usefulness of the research findings. I very much hope that you will be able to take part in the survey and look forward to receiving your reply.

The survey is in two parts. Part A is attempting to establish a level of business risk tolerance using some basic information provided. The purpose of Part B is to gather stakeholder and expert opinions on hypotheses and relationships generated in earlier stages of my research.

All responses are strictly confidential and no names of individuals or organizations will be published or provided to any third parties, although the aggregate results of the survey may eventually be published. An executive summary of the results of the survey can be provided to you.

If you have any questions or would like further details, please do not hesitate to contact me.

Email address: Jim.parsons@mi.mun.ca

Telephone: 001 709 778-0684

Sincerely,

James Parsons

References

- ABDEL-FATTAH, N., GREY, R. & CULLINANE, S. (1999) *Road freight and privatisation: the case of Egypt*. Ashgate.
- AHLBRANDT, T. S. & MCCABE, P. J. (2002) Global petroleum resources: a view to the future. *Geotimes*, **47**, (11) 14-20.
- AKER-YARDS (2006a) *Company profile* [online]. Available From: <http://www.akeryards.com/?page=95>. [Accessed 3 May 2007].
- AKER-YARDS (2006b) *Ice Going Vessels* [online]. Available From: <http://www.akerfinnyards.com/icebreakers.cfm>. [Accessed 27 October 2006].
- ANDERSON, M. (mats.andersson@sjofartsverket.se) 25 April 2007 *Private involvement with icebreaking in Sweden/Finland*. e-Mail to J. Parsons (JIM.PARSONS@MI.MUN.CA)
- ANDERSON, S. P., PALMA, A. D. & THISSE, J.-F. (1997) Privatization and efficiency in a differentiated industry [online]. *European Economic Review* **41**, (9) 1635-1654. [http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6V64-3SX4N3X-2&_user=1069227&_coverDate=12%2F31%2F1997&_rdoc=2&_orig=browse&_srch=doc-info\(%23toc%235804%231997%23999589990%2313090%23FLP%23display%23Volume\)&_cdi=5804&_sort=d&_docanchor=&_ct=15&_acct=C000051267&_version=1&_urlVersion=0&_userid=1069227&_fmt=full&md5=98a73c6005eb43ef289e1573af782062#bibl1](http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6V64-3SX4N3X-2&_user=1069227&_coverDate=12%2F31%2F1997&_rdoc=2&_orig=browse&_srch=doc-info(%23toc%235804%231997%23999589990%2313090%23FLP%23display%23Volume)&_cdi=5804&_sort=d&_docanchor=&_ct=15&_acct=C000051267&_version=1&_urlVersion=0&_userid=1069227&_fmt=full&md5=98a73c6005eb43ef289e1573af782062#bibl1). [Accessed 21 December 2009].
- ANSOFF, H. I. (2001) The shapers and movers. IN MOORE, J. I. (Ed.) *Writers on strategy and strategic management: the theory of strategy and the practice of strategic management at enterprise, corporate, business and functional levels*. 2nd ed. London, Penguin.
- ARCTIC-COUNCIL-SECRETARIAT (2004) *Russian Chairmanship of the Arctic Council* [online]. Available From: <http://www.arctic-council.org/>. [Accessed 10 October 2006].
- ARCTIC-COUNCIL (2009) *Arctic Marine Shipping Assessment* [online]. Available From: <http://arcticportal.org/en/pame/amsa-2009-report>. [Accessed 4 June 2009].
- ARDEN L. BEMENT, J. (2006) *National Academy of Sciences Report on Federal Icebreaking Missions* [online]. Available From: http://www.nsf.gov/about/congress/109/alb_icebreaker_092606.jsp#top. [Accessed 9 April 2007].
- AUDITOR-GENERAL (2000) Fisheries and Oceans - Fleet Management. IN CANADA, O. O. T. A. G. O. (Ed.) Her Majesty the Queen in Right of Canada.
- AUDITOR-GENERAL (2007) Managing the Coast Guard Fleet and Marine Navigational Services—Fisheries and Oceans Canada IN CANADA, O. O. T. A. G. O. (Ed.) Her Majesty the Queen in Right of Canada.
- BABBIE, E., HALLEY, F. & ZAINO, J. (2007) *Adventures in social research: data analysis using SPSS 14.0 and 15.0 for Windows*. 6th. Thousand Oaks, Pine Forge Press.
- BARENTS-OBSERVER (2008a) *Icebreaking independence for Norilsk Nickel* [online]. Available From: <http://www.barentsobserver.com/index.php?id=4500262>. [Accessed 12 December 2008].
- BARENTS-OBSERVER (2008b) *Rosneft's first arctic tanker in operation* [online]. Available From: <http://www.barentsobserver.com/rosnefts-first-arctic-tanker-in-operation.4536845-16149.html>. [Accessed 22 December 2008].

- BARENTS+OBSERVER (2008) *Russia to build new icebreakers* [online]. Available from: <http://www.barentsobserver.com/russia-to-build-new-icebreakers.4519572-16149.html>. [Accessed 23 October 2008].
- BEATTY, P. & HERRMANN, D. (2002) To answer or not to answer, decision process related to survey item nonresponse. IN GROVES, R. M., DILLMAN, D. A., ELTINGE, J. L. & LITTLE, R. J. A. (Eds.) *Survey nonresponse*. New York, John Wiley & Sons, Inc.
- BECKER, M. (2006) *The ice is melting incredibly Fast* [online]. Available from: <http://www.spiegel.de/international/spiegel/1,1518,403967,00.html>. [Accessed 3 October 2006].
- BEESELY, M. E. & LITTLECHILD, S. C. (1983) *Privatisation principles, problems and priorities* [online]. Available from: <http://lib.mylibrary.com/services/page/output/5f145fa8480c9bc/print.htm>. [Accessed 4 January 2010].
- BINKLEY, A. (2006) New Coast Guard commissioner wants agency, shipping industry to reopen dialogue. *Canadian Sailing*.
- BIRCHALL, J. (2006) Canadian sovereignty: climate change and politics in the Arctic [online]. *Arctic 59*, (2) iii-iv. <http://pubs.aina.ucalgary.ca/arctic/Arctic59-2-iii.pdf>. [Accessed 3 October 2006].
- BLACK, D., GILLILAND, B., KANGLES, N., MACWILLIAM, A., MAHMUD, K., PITTMAN, M., MILLER, R., HURLEY, J., BENOIT, R., FARRELL, J. & STUBER, R. (2006) Canada: FMC's Overview of Significant Developments in the Canadian Energy Industry [online]. 3. <http://www.mondaq.com/article.asp?articleid=E42934&rss=E0>. [Accessed 27 September 2006].
- BOOTHROYD, H. (1978) *Articulate intervention*. London, Taylor & Francis.
- BOS, D. (1991) *Privatization: a theoretical treatment*. Oxford, Clarendon Press.
- BOSWELL, R. (2006) *From sea to sea to sea* [online]. Available from: <http://www.canada.com/ottawacitizen/news/story.html?id=6498270-1d8c-4d99-97bc-f5194059a6d&k=20859&p=2>. [Accessed 5 October 2006].
- BRIGHAM, L. 10 May 2007 CCG ability to operate year round in the Arctic. e-Mail to J. Parsons (PARSONS, J.)
- BROOKS, M. R. (1995) The privatization of ship safety. Halifax, Dalhousie University.
- BURCHELL, B. & MARSH, C. (2007) The effect of questionnaire length on survey response. IN VAUS, D. D. (Ed.) *Social Surveys 2: Volume 2 Survey Instruments and Data Sources*. Los Angeles, Sage Publications.
- BURKE, S. D. (BurkeSo@DFO-MPO.GC.CA) 26 September 2006 *Suitability of the Canadian Arctic Icebreaking Service for Private Involvement*. e-Mail to J. Parsons (JIM.PARSONS@MI.MUN.CA)
- BURTON, P. (2006) Modernizing the policy process: making policy research more significant? [online]. *Policy Studies 27*, (3) 173-195.
- BUTLER, S. B. & STARR, P. (1992) Does privatization improve services and lower costs? *CC Researcher*, 13, (2) 993.
- CALHOUN, C. (1992) Introduction: Habermas and the public sphere. IN CALHOUN, C. (Ed.) *Habermas and the public sphere*. Cambridge, MIT Press.
- CANADA-TRANSPORTATION-ACT-REVIEW-PANEL (2001) *Canada Transportation Act Review: Final Report* [online]. Available from: <http://www.reviewcta-examenilc.gc.ca/english/pages/final/tablee.htm>. [Accessed 7 May 2007].
- CANADIAN-COAST-GUARD (2001) *Icebreaking Operations Levels of Service* [online]. Available from: http://www.ccg-gcc.gc.ca/lc-gla/los2001_e.htm#HISTORY. [Accessed 1 December 2006].

- CANADIAN-COAST-GUARD (2004) *Marine Programs' National Performance Report for 2003-2004* [online]. Available From: http://www.ccg-gcc.gc.ca/mp-pm/docs/03-04/pr/ice_e.htm. [Accessed 1 February 2007].
- CANADIAN-COAST-GUARD (2006a) Backgrounder for Icebreaking Services Fee - Revised Fee Structure Proposal [online]. http://www.ccg-gcc.gc.ca/msf-dsm/news/dec-98iceprop_e.htm. [Accessed 3 October 2006].
- CANADIAN-COAST-GUARD (2006b) *Icebreaking Service Fee Schedule December 21, 1998* [online]. Available From: http://www.ccg-gcc.gc.ca/msf-dsm/news/ISFDec98FEESchedule_e.htm. [Accessed 10 November 2006].
- CANADIAN-COAST-GUARD (2006c) Operations Service Dates [online]. http://www.ccg-gcc.gc.ca/ice-gla/dates_e.htm. [Accessed 6 October 2006].
- CANADIAN-COAST-GUARD (2006d) *Regions* [online]. Available From: http://www.ccg-gcc.gc.ca/regions_e.htm. [Accessed 2 January 2007].
- CANADIAN-COAST-GUARD (2006e) *Roles and Responsibilities* [online]. Available From: http://www.ccg-gcc.gc.ca/overview-apercu/roles_e.htm. [Accessed 10 May 2006].
- CARNAGHAN, M. & GOODY, A. (2006) *Canadian Arctic Sovereignty* [online]. Available From: <http://www.parl.gc.ca/information/library/PRBpubs/prb0561-e.htm>. [Accessed 20 July 2007].
- CBC-NEWS (2006a) *Arctic icebreakers aging, new ones to cost billions: Coast Guard* [online]. Available From: <http://www.cbc.ca/canada/north/story/2006/10/02/icebreakers-new.html?ref=rss>. [Accessed 5 October 2006].
- CBC-NEWS (2006b) *Harper promises to defend Arctic sovereignty* [online]. Available From: <http://www.cbc.ca/canada/story/2006/08/12/harper-northwest.html>. [Accessed 10 October 2006].
- CBC-NEWS (2007) Ottawa spends \$324M for 6 coast guard vessels. *CBC.ca*.
- CENTRAL-INTELLIGENCE-AGENCY (2007) *The World Factbook* [online]. Available From: <https://www.cia.gov/cia/publications/factbook/geos/ca.html#Econ>. [Accessed 7 May 2007].
- CHAMBERS, E. (2000) *Applied ethnography*. 2nd. Thousand Oaks, Sage Publications, Inc.
- CHAN, L., EYNON, G. & MCCOLL, D. (2005) The economics of high Arctic gas development: expanded sensitivity analysis. Calgary, Canadian Energy Research Institute.
- CHAPMAN, C. (1990) *Selling the family silver: has privatization worked?* London, Hutchinson Business Books.
- CHEATHAM, B. & OBLIN, W. (2007) Private-investment opportunities for public transport [online]. *The McKinsey Quarterly*. http://www.mckinseyquarterly.com/article_page.aspx?ar=1987&L2=19&L3=69&srid=17&gp=0. [Accessed 17 April 2007].
- CHEN, Z., OSADETZ, K. G., EMBRY, A. F., GAO, H. & HANNIGAN, P. K. (2000) Petroleum potential in western Sverdrup Basin, Canadian Arctic Archipelago *Bullitin of Canadian Petroleum Geology*, **48**, (4) 323-338.
- CHILD, D. (2006) *The essentials of factor analysis*. 3rd. New York, Continuum.
- CLEMENS, J., MULLINS, M., VELDHIUS, N. & GLOVER, C. (2004) Government failure in Canada, 1997-2004: a survey of reports from the Auditor General. *Public Policy Sources*. Vancouver, The Fraser Institute.
- CLEMENS, J., MULLINS, M., VELDHIUS, N. & GLOVER, C. (2005) Government failure in Canada, 2005 Report: a review of the Auditor General's reports, 1992-2005. Vancouver, Fraser Institute.
- COLLIER, A. (1994) *Critical realism: an introduction to Roy Bhaskar's philosophy*. London, Verso.

- COLLIS, J. & HUSSEY, R. (2003) *Business research: a practical guide for undergraduate and postgraduate students*. Second. Houndmills, Palgrave Macmillan.
- CONSULTING-AND-AUDIT-CANADA (1994) Study of the CCG and DFO maritime fleets. Ottawa,
- CONVERSE, J. M. (1976) Predicting no opinion in the polls [online]. *Public Opinion Quarterly* **40**, (4) 515-530.
<http://web.ebscohost.com/ehost/detail?vid=3&hid=112&sid=0cf85490-39ba-43e0-8aac-e86e95b68295%40sessionmgr109&bdata=JnNpdGU9ZWwhvc3QtbGl2ZSZzY29wZT1zaXRl#db=bth&AN=5413393#db=bth&AN=5413393>. [Accessed 5 February 2009].
- COUNCIL-OF-CANADIAN-ACADEMIES (2006) The state of science and technology in Canada. Ottawa, Council of Canadian Academies.
- CRESWELL, J. W. (2007) *Qualitative inquiry & research design: choosing among five approaches*. 2nd. Thousand Oaks, Sage Publications, Inc.
- CRUISE-NORTH (2009) *About us* [online]. Available From: <http://www.cruisenorthexpeditions.com/homepage.aspx?area=homepage§ion=aboutus>. [Accessed 8 January 2009].
- CRUISE-NORWAY (2009) *Home* [online]. Available From: <http://www.cruisenorway.com/index.html>. [Accessed 8 January 2009].
- CUDECK, R. (2000) Exploratory factor analysis. IN TINSLEY, H. E. A. & BROWN, S. D. (Eds.) *Handbook of applied multivariate and mathematical modeling*. San Diego, Academic Press.
- CURRAN, J. & BLACKBURN, R. A. (2001) *Researching the small enterprise*. Thousand Oaks, Sage Publications Inc.
- CZINKOTA, M. R. & RONKAINEN, I. A. (1997) International business and trade in the next decade: report from a delphi study. *Journal of International Business Studies*, **28**, (4) 827-844.
- DAVIS, D. (1996) *Business research for decision making*. 4th. London, Wadsworth Publishing.
- DEPARTMENT-OF-FISHERIES-AND-OCEANS-CANADA (2006) Canadian Coast Guard - A Special Operating Agency. Ottawa,
- DEPARTMENT-OF-FOREIGN-AFFAIRS-AND-INTERNATIONAL-TRADE-CANADA (2007) *Northern Foreign Policy* [online]. Available From: <http://www.dfait-maeci.gc.ca/circumpolar/nfp-en.asp>. [Accessed 9 May 2007].
- DEPARTMENT-OF-NATIONAL-DEFENCE (2006) *Canadian Forces Station (CFS) Alert* [online]. Available From: http://www.img.forces.gc.ca/org/cfiog/alert_e.asp. [Accessed 10 October 2006].
- DEY, I. (1993) *Qualitative data analysis: a user-friendly guide for social scientists*. London, Routledge.
- DILLMAN, D. A., ELTINGE, J. L., GROVES, R. M. & LITTLE, R. J. A. (2002) Survey nonresponse in design, data collection, and analysis. IN GROVES, R. M., DILLMAN, D. A., ELTINGE, J. L. & LITTLE, R. J. A. (Eds.) *Survey nonresponse*. New York, John Wiley & Sons, Inc.
- DINWOODIE, J. & XU, J. (2008) Case studies in logistics: a review and tentative taxonomy. *International Journal of Logistics Research and Applications*, **11**, (5) 393-408.
- DRUCKER, P. F. (1969) *The age of discontinuity*. 1st. New York, Harper & Row Publishers.
- DUNLEAVY, P. (1986) Explaining the privatisation boom: public choice versus radical approaches [online]. **64**, (1) 13-34.

- <http://web.ebscohost.com/ehost/detail?vid=3&hid=113&sid=b1fdc08b-e11e-49e3-b32e-71edf995126f%40sessionmgr113&bdata=JnNpdGU9ZWZWhvc3QtbGl2ZSZzY29wZT1zaXRl#db=heh&AN=4552330#db=heh&AN=4552330>. [Accessed 22 December 2009].
- ECONOMIST (1996) Business and Finance [online]. *Economist* 338, (7948) 5-5. <http://web.ebscohost.com/ehost/detail?vid=7&hid=7&sid=ad0c8ea5-ad9c-4812-b106-2bda89ac1963%40sessionmgr112&bdata=JnNpdGU9ZWZWhvc3QtbGl2ZSZzY29wZT1zaXRl#db=aph&AN=9601167784#db=aph&AN=9601167784>. [Accessed 22 December 2009].
- ENVIRONMENT-CANADA (2002) *Canadian Climate Normals 1971-2000* [online]. Available From: http://www.climate.weatheroffice.ec.gc.ca/climate_normals/results_e.html?Province=ALL&StationName=alert&SearchType=BeginsWith&LocateBy=Province&Proximity=25&ProximityFrom=City&StationNumber=&IDType=MSC&CityName=&ParkName=&LatitudeDegrees=&LatitudeMinutes=&LongitudeDegrees=&LongitudeMinutes=&NormalsClass=A&SelNormals=&StnId=1731&. [Accessed 10 October 2006].
- ESTACHE, A. & RUS, G. D. (Eds.) (2000) *Privatization and regulation of transport infrastructure: guidelines for policymakers and regulators*. Washington, The World Bank.
- EVANS, J. R. (2007) *Statistics, data analysis, and decision modeling*. 3rd. Upper Saddle River, Pearson Prentice Hall.
- FALKINGHAM, J. (2004) *Sea ice in the Canadian Arctic* Arctic Marine Transport Workshop, 49. http://www.arctic.gov/files/AMTW_book.pdf#search=%22arctic%20ice%20free%20summers%20john%20falkingham%22. [Accessed 3 October 2006].
- FALKINGHAM, J. C. (2000) *Sea ice in the Canadian Arctic in the 21st century* [online]. Available From: http://www.yukon.taiga.net/knowledge/resources/seaice_printable.html. [Accessed 16 November 2006].
- FEDNAV (2007) *Umiak 1* [online]. Available From: http://www.fednav.com/anglais/umiaki_en.html. [Accessed 26 November 2008].
- FINNISH-MARITIME-ADMINISTRATION (2008) *Winter navigation* [online]. Available From: http://www.fma.fi/e/functions/winter_navigation/. [Accessed 16 October 2008].
- FISCHER, F. (2003) *Reframing public policy: discursive politics and deliberative practices*. Oxford, Oxford.
- FISHERIES-AND-OCEANS-CANADA (2005) *SPECIAL OPERATING AGENCY (SOA) STATUS FOR CANADIAN COAST GUARD (CCG)* [online]. Available From: http://www.dfo-mpo.gc.ca/media/backgrou/2005/hq-ac12a_e.htm. [Accessed 10 November 2006].
- FISHERIES-AND-OCEANS-CANADA (2006a) *Organizational Structure* [online]. Available From: http://www.dfo-mpo.gc.ca/organisation_e.htm. [Accessed 1 May 2007].
- FISHERIES-AND-OCEANS-CANADA (2006b) *Part III: Consolidation of Federal Responsibilities for Canada's Oceans* [online]. Available From: http://www.pac.dfo-mpo.gc.ca/oceans/OceansAct/OAPart3_e.htm. [Accessed 13 October 2006].

- FISHERIES-AND-OCEANS-CANADA (2007a) *Commissioned Vessels, Aircraft, and Hovercraft* [online]. Available From: http://www.ccg-gcc.gc.ca/fleet-flotte/vessels-navires/main_e.asp. [Accessed 30 April 2007].
- FISHERIES-AND-OCEANS-CANADA (2007b) *Minister Hearn Releases Details of Canada's New Government Investment in Coast Guard Fleet* [online]. Available From: http://www.dfo-mpo.gc.ca/media/newsrel/2007/hq-ac15_e.htm?template=print. [Accessed 1 May 2007].
- FLATO, G. M. & BOER, G. J. (2001) Warming asymmetry in climate change simulations. *Geophysical Research Letters*, **28**, (1) 195-198.
- FONTANA, A. & FREY, J. H. (2000) The Interview: from structured questions to negotiated text. IN DENZIN, N. K. & LINCOLN, Y. S. (Eds.) *Handbook of qualitative research*. Thousand Oaks, Sage Publications, Inc.
- FOSTER, J. J. (2001) *Data analysis using SPSS for Windows versions 8 to 10*. London, Sage Publications.
- FRYDMAN, R. & RAPACZYNSKI, A. (1992) Mass privatisation proposals in eastern Europe: ownership and the structure of control. IN TARGETTI, F. (Ed.) *Privatization in Europe: west and east experiences*. Aldershot, Dartmouth.
- GHOSH, A. (1993) Public goods and rush for privatisation [online]. *Economic and Political Weekly* **28**, (41) 2181-2182. <http://www.jstor.org/stable/4400249>. [Accessed 22 December 2009].
- GLASER, B. G. & STRAUSS, A. L. (1967) *The discovery of grounded theory: strategies for qualitative research*. New York, Aldine Publishing Company.
- GORMAN, B. & PATERSON, T. (2004) *Future of Canadian Arctic Shipping Arctic Marine Transport Workshop*, 49. http://www.institutenorth.org/PDF/AMTW_book.pdf#search=%22Arctic%20Marine%20Transportation%20Workshop%22. [Accessed 3 October 2006].
- GOVERNMENT-OF-CANADA (2006) *Fisheries and Oceans Canada* [online]. Available From: http://www.infosource.gc.ca/inst/dfo/fed04_e.asp. [Accessed 8 May 2007].
- GREAT-LAKES-ST.-LAWRENCE-SEAWAY-SYSTEM (2007) *The St. Lawrence Seaway Management Corporation* [online]. Available From: <http://www.greatlakes-seaway.com/en/aboutus/slsmc.html>. [Accessed 11 May 2007].
- GREEN, T. F. (1982) Policy and evaluation: a conceptual study. IN SMITH, N. L. & CAULLEY, D. N. (Eds.) *The interaction of evaluation and policy: case reports from state education agencies*. Portland, Northwest Regional Educational Laboratory.
- GULLNE, U. 10 April 2007 *Private Involvement with Icebreaking in Sweden/Finland*. e-Mail to J. Parsons (JIM.PARSONS@MI.MUN.CA, J. P.)
- GUPTA, U. G. & CLARKE, R. E. (1996) Theory and applications of the delphi technique (1975-1994) *Technological Forecasting and Social Change*, **53**, 185-211.
- HAARDE, G. H. 15 April 2008 *Personal Communication*. e-Mail to J. Parsons (PARSONS, J.)
- HAAS, P. M. (2004) When does power listen to truth? A constructivist approach to the policy process [online]. *Journal of European Public Policy* **11**, (4) 569-592. <http://docserver.ingentaconnect.com/deliver/connect/routledq/13501763/v11n4/s1.pdf?expires=1192646953&id=40056223&titleid=461&accname=Memorial+University+of+Newfoundland&checksum=CB2C3335F5B8227863620AFBA726A0ED>. [Accessed 17 October 2006].
- HAKIM, S., SEIDENSTAT, P. & BOWMAN, G. W. (1996) Review and analysis of privatization efforts in transportation. IN HAKIM, S., SEIDENSTAT, P. &

- BOWMAN, G. W. (Eds.) *Privatizing transportation systems*. Westport, Praeger.
- HAMMER, M. (2006) The polar road to riches. *New Scientist*, **189**, 24-25.
- HAQUE, M. S. (1996) The intellectual crises in public administration in the current epoch of privatization [online]. *Administration & Society* **27**, (4) 510-536. [Accessed 4 November 2007].
- HARRIS, C. (2006) Industry perspectives on barriers, hurdles, and irritants preventing development of frontier energy in Canada's Arctic islands [online]. *Arctic* **59**, (2) 238-243.
<http://proquest.umi.com/pqdlink?index=12&did=1074435901&SrchMode=3&sid=9&Fmt=3&VInst=PROD&VType=PQD&RQT=309&VName=PQD&TS=1230914290&clientId=23&aid=1>. [Accessed 2 January 2009].
- HATZOPOULOU, M. & MILLER, E. J. (2008) Institutional integration for sustainable transportation policy in Canada. *Transport Policy*, **15**, (3) 149-162.
- HAYDON, P. T. (2007) *Why does Canada still need a navy?* [online]. Available From: http://centreforforeignpolicystudies.dal.ca/pdf/marsec_working/WhyCanadaNeedsaNavy.pdf. [Accessed 15 October 2007].
- HEAD, G. L. & HORN, S. (1997) *Essentials of risk management*. 3. Malvern, American Institute for Chartered Property Casualty Underwriters/Insurance Institute of America.
- HEARN, L. 9 November 2006 *Reply to you email dated September 5, 2006*. e-Mail to J. Parsons (JIM.PARSONS@MI.MUN.CA)
- HERZOG, A. R. & BACHMAN, J. G. (2007) Effects of questionnaire length on response quality. IN VAUS, D. D. (Ed.) *Social Surveys 2: Volume 2 Survey Instruments and Data Sources*. Los Angeles, Sage Publications.
- HILL, C. W. L. & JONES, G. R. (2007) *Strategic management: an integrated approach*. 7. Boston, Houghton Mifflin Company.
- HODGE, G. A. (2000) *Privatization: an international review of performance*. Oxford, Westview Press.
- HODGSON, D. 4 April 2007 *Study on the Privatization of the CCG*. e-Mail to J. Parsons (JIM.PARSONS@MI.MUN.CA)
- HUEBERT, R. (2007) The rise and fall (and rise?) of Canadian arctic security. IN MACDONALD, B. (Ed.) *Defence requirements for Canada's arctic*. Ottawa, Conference of Defence Associations Institute.
- HUPP, E. & BROWN, D. (2006) *NASA Sees Rapid Changes in Arctic Sea Ice* [online]. Available From: http://www.nasa.gov/home/hqnews/2006/sep/HQ_06315_sea_ice.html. [Accessed 10 October 2006].
- HYMAN, H. (1951) Interviewing as a scientific procedure. IN LERNER, D. & LASSWELL, H. D. (Eds.) *The policy sciences: recent developments in scope and method*. Stanford, Stanford University Press.
- IACOBACCI, M. & SCHULMAN, J. (2009) The productivity performance of Canada's transportation sector: market forces and governance matter. Ottawa, The Conference Board of Canada.
- INDIAN-AND-NORTHERN-AFFAIRS-CANADA (2006) *Northern oil and gas annual report 2005* [online]. Available From: http://www.ainc-inac.gc.ca/oil/Pdf/report05_e.PDF. [Accessed 3 October 2006].
- INDUSTRY-CANADA (2007) *RADARSAT-2: safeguarding Canada's sovereignty in the Arctic* [online]. Available From: <http://news.gc.ca/web/view/en/index.jsp?articleid=357029&categoryid=16>. [Accessed 30 October 2007].
- ISLAM, D. M. Z., DINWOODIE, J. & ROE, M. (2006) Promoting development through multimodal freight transport in Bangladesh [online]. *Transport Reviews* **26**, (5)

- 571-591. <http://web.ebscohost.com/ehost/pdf?vid=3&hid=115&sid=a69cd517-c5c3-456b-ab00-567cad9381b%40sessionmgr102>. [Accessed 5 March 2008].
- IYER, R. R. (1988) The privatization argument [online]. *Economic and Political Weekly* 23, (11) 554-556. <http://www.jstor.org/stable/4378238>. [Accessed 22 December 2009].
- JACKSON, D. (2008) *The Canadian Coast Guard in the Arctic: past, present and future*. Arctic Shipping North America, 21 October 2008, Montreal.
- JAFFRAY, J.-Y. & JELEVA, M. (2007) *Information processing under imprecise risk with the Hurwicz criterion* [online]. Available From: <http://www.sipta.org/isipta07/proceedings/>. [Accessed 4 May 2009].
- JOHNSON, R. A. & WICHERN, D. W. (2007) *Applied multivariate statistical analysis*. 6th. Upper Saddle River, Pearson.
- JONES, S. J. (2008) A history of icebreaking ships. *The Journal of Ocean Technology*, 3, (1) 54-74.
- JONES, S. K. (1991) The road to privatisation: the issues involved and some lessons from New Zealand's experience [online]. *Finance and Development* 28, (1) 39-41. [http://pao.chadwyck.com/articles/displayItem.do?QueryType=articles&QueryIndex=journal&ResultsID=1251D087E58A505A6&ItemNumber=13&BackTo=journalid&BackToParam=QueryType=journals|ItemID=e355|issue=28:1%20\(1991:Mar.\)&journalID=e355](http://pao.chadwyck.com/articles/displayItem.do?QueryType=articles&QueryIndex=journal&ResultsID=1251D087E58A505A6&ItemNumber=13&BackTo=journalid&BackToParam=QueryType=journals|ItemID=e355|issue=28:1%20(1991:Mar.)&journalID=e355). [Accessed 22 December 2009].
- JUURMAA, K. (2004) *Future Arctic Cargo Vessels Arctic Marine Transport Workshop*, A-10, A-11. http://www.institutenorth.org/PDF/AMTW_book.pdf#search=%22Arctic%20Marine%20Transportation%20Workshop%22. [Accessed 3 October 2006].
- KAISER, H. F. (1974) An index of factorial simplicity [online]. *Psychometrika* 39, (1) 31-36. http://www.springerlink.com/content/112911/?sortorder=asc&p_o=121. [Accessed 24 April 2009].
- KHVOCHTCINSKY, N. (1997) *Sailors and the Arctic nowadays* International Willem Barentsz Symposium 1997, 45-47. [Accessed 15 May 2007].
- KIM, J.-O. & MUELLER, C. W. (1978) *Introduction to factor analysis: what is is and how it works*. Beverly Hills, Sage Publications.
- KLINE, P. (1994) *An easy guide to factor analysis*. London, Routledge.
- KUMAR, R. (2005) *Research methodology: a step-by-step guide for beginners*. 2nd. London, Sage Publications.
- LANDRY, R. (1993) Administrative reform and political control in Canada [online]. *International Political Science Review* 14, (4) 335-349. <http://ips.sagepub.com/cgi/reprint/14/4/335>. [Accessed 15 May 2007].
- LANE, R. (1996) Positivism, scientific realism and political science: recent developments in the philosophy of science [online]. *Journal of Theoretical Politics* 8, (3) 361-382. http://www-ca2.csa.com/ids70/view_record.php?id=5&recnum=2&log=from_toc&SID=f0596b84867709a1ceb7817a7c12f9e1&mark_id=cache%3A2%2C0%2C6. [Accessed 7 January 2008].
- LASSWELL, H. D. (1951) The policy orientation. IN LERNER, D. & LASSWELL, H. D. (Eds.) *The policy sciences: recent developments in scope and method*. Stanford, Stanford University Press.
- LEAHY, S. (2008) *Climate change: "Things happen much faster in the Arctic"* [online]. Available From: <http://ipsnews.net/print.asp?idnews=45102>. [Accessed 30 April 2009].
- LEE, R. M. (1993) *Doing research on sensitive topics*. London, Sage Publications.

- LESLIE, K. & TILLEY, C. (2004) Organizing for effectiveness in the public sector [online]. *McKinsey Quarterly* 2004, (4) 104-113.
<http://web.ebscohost.com/ehost/detail?vid=3&hid=101&sid=b5520a9d-16a5-417f-8c85-eb377ed84a89%40sessionmgr8>. [Accessed 4 October 2007].
- LIBRARY-AND-ARCHIVES-CANADA (2004) *Robert McClure finds the Northwest Passage* [online]. Available From:
<http://www.collectionscanada.gc.ca/explorers/h24-1840-e.html>. [Accessed 9 January 2009].
- LIKERT, R. (1951) The sample interview survey as a tool of research and policy formation. IN LERNER, D. & LASSWELL, H. D. (Eds.) *The policy sciences: recent developments in scope and method*. Stanford, Stanford University Press.
- LINCOLN, Y. S. & GUBA, E. G. (1985) *Naturalistic inquiry*. Beverly Hills, Sage Publications, Inc.
- LINCOLN, Y. S. & GUBA, E. G. (2000) Paradigmatic controversies, contradictions, and emerging confluences IN DENZIN, N. K. & LINCOLN, Y. S. (Eds.) *Handbook of qualitative research*. 2nd ed. Thousand Oaks, Sage Publications, Inc.
- LINDQUIST, E. A. (1997) The bewildering pace of public sector reform in Canada. IN LANR, J.-E. (Ed.) *Public sector reform: rationale, trends and problems*. London, Sage Publications.
- LINSTONE, H. A. & TUROFF, M. (1975) Introduction. IN LINSTONE, H. A. & TUROFF, M. (Eds.) *The delphi method techniques and applications* Reading, Addison-Wesley Publishing Company.
- LIPSEY, R. G., COURANT, P. N. & PURVIS, D. D. (1994) *Macroeconomics*. 8. New York, Harper Collins.
- LYNCH, M. E., IMADA, S. J. & BOOKBINDER, J. H. (1994) The future of logistics in Canada: a delphi-based forecast. *Logistics and Transportation Review*, 30, (1) 95-112.
- MACAFEE, M. (2007) *Shipping companies say more flexibility needed in Arctic icebreaker schedule* [online]. Available From:
<http://www.cbc.ca/cp/business/070111/b0111115A.html>. [Accessed 12 January 2007].
- MACDONALD, B. (2007) Introduction. IN MACDONALD, B. (Ed.) *Defence requirements for Canada's arctic*. Ottawa, Conference of Defence Associations Institute.
- MAJUMDAR, S. K. & AHUJA, G. (1997) Privatisation: an exegesis of key ideas [online]. *Economic and Political Weekly* 32, (27) 1590-1595.
<http://www.jstor.org/stable/4405592>. [Accessed 22 December 2009].
- MAKUKHA, K. & GREY, R. (2004) Logistics partnerships between shippers and logistics service providers: the relevance of strategy [online]. *International Journal of Logistics: Research and Applications* 7, (4) 361-377. [Accessed 6 March 2008].
- MANAGEMENT, B. I. (2006) Baltic Sea Icebreaking Report 2005-2006. Tallinn,
- MANGAN, J., LALWANI, C. & GARDNER, B. (2004) Combining quantitative and qualitative methodologies in logistics research [online]. *International Journal of Physical Distribution & Logistics Management* 34, (7) 565-578. [Accessed 10 December 2007].
- MARIPORT-GROUP (2007) Canadian Arctic shipping assessment. Digby, The Mariport Group Ltd.
- MARR, I. 2 February 2007 *Arctic Survey Data*. e-Mail to J. Parsons
- MARSHALL, C. & ROSSMAN, G. B. (2006) *Designing qualitative research*. 4th. Thousand Oaks, Sage.

- MCDANIEL, D. E. (1972) Transportation forecasting: a review. *Technological Forecasting And Social Change*, **3**, 367-389.
- MCDAVID, J. C. & SCHICK, G. K. (1987) privatization versus union-management cooperation: the effects of competition on service efficiency in municipalities. *Canadian Public Administration*, **30**, (3) 472-488.
- MCFETRIDGE, D. G. (1997) *The Economics of Privatization*. Toronto, C.D Howe Institute.
- MERTON, R. K. & LERNER, D. (1951) Social scientist and research policy. IN LERNER, D. & LASSWELL, H. D. (Eds.) *The policy sciences: recent developments in scope and method*. Stanford, Stanford University Press.
- MEYRICK, J. D. (2003) The delphi method and health research. *Health Education*, **103**, (1) 7-16.
- MILES, M. B. & HUBERMAN, A. M. (1994) *Qualitative data analysis: an expanded sourcebook*. 2nd. Thousand Oaks, Sage Publications.
- MINTZBERG, H. & MCHUGH, A. (1985) Strategy formation in an adhocracy. *Administrative Science Quarterly*, **30**, 160-197.
- MITROFF, I. I. & TUROFF, M. (1975) Philosophical and methodological foundations of delphi. IN LINSTONE, H. A. & TUFOFF, M. (Eds.) *The delphi method: techniques and applications*. London, Addison-Wesley Publishing Company.
- MOORE, C. G. & POMREHN, H. P. (1971) Technological forecast of marine transportation systems 1970.to 2000. *Technological Forecasting And Social Change*, **3**, 99-135.
- MURKOWSKI, L. (2008) *Senator Murkowski calls on the White House to endorse construction of more icebreakers* [online]. Available From: http://murkowski.senate.gov/public/index.cfm?FuseAction=PressOffice.PressReleases&ContentRecord_id=bd31f315-f35d-73ea-4aba-d9b957b03108&Region_id=&Issue_id=. [Accessed 2 January 2009].
- MUSTAMAKI, E. (2005) *Finstaship annual report for 2005* [online]. Available From: <http://www.finstaship.fi/en/?c=3>. [Accessed 17 October 2008].
- MUSTAMAKI, E. (2006) *Annual report for 2006 Finstaship* [online]. Available From: <http://www.finstaship.fi/en/?c=2>. [Accessed 17 October 2008].
- NATIONAL-RESEARCH-COUNCIL (2005) *Polar icebreaker roles and U.S. future needs: a preliminary assessment*. Washington, The National Academies Press.
- NATIONAL-RESEARCH-COUNCIL (2007) *Polar icebreakers in a changing world: an assessment of U.S. needs*. Washington, The National Academies Press.
- NATIONAL-SCIENCE-FOUNDATION (2007) *Far East Shipping Company-provision of icebreaker services for the U.S. Antarctic programme-Russian icebreaker KRASIN* [online]. Available From: <http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=0551909>. [Accessed 26 November 2008].
- NATURAL-RESOURCES-CANADA (2008) *Canada: a diamond producing nation* [online]. Available From: <http://www.nrcan-rncan.gc.ca/mms-smm/busi-indu/dpn-npd-eng.htm>. [Accessed 8 January 2009].
- NEUMAN, W. L. (2007) *Basics of social research: qualitative and quantitative approaches*. 2nd. Boston, Pearson.
- NOBLE, P. 21 November 2008 *Varendy project - icebreakers*. e-Mail to J. Parsons (JIM.PARSONS@MI.MUN.CA)
- NOVOSTI (2007) *Nuclear icebreaker returns to Arctic after refit* [online]. Available From: <http://en.rian.ru/russia/20070404/63097958.html>. [Accessed 4 April 2007].

- NOVOSTI (2008) *new Russian nuclear icebreaker 'will be built by 2015'* [online]. Available From: <http://en.rian.ru/russia/20080609/109670225.html>. [Accessed 11 June 2008].
- NUCLEAR-THREAT-INITIATIVE (2002) *Russia: Atomflot (Murmansk Shipping Company)* [online]. Available From: <http://www.nti.org/db/nisprofs/russia/naval/nucflt/norflt/atomflot.htm>. [Accessed 5 October 2007].
- NUCLEAR.RU (2008) *Russian nuclear icebreakers transferred to Rosatom* [online]. Available From: http://www.nuclear.ru/eng/press/other_news/2110408/?print_version=1. [Accessed 1 September 2008].
- NUNAVUT-TUNNGAVIK-INCORPORATED (2006) *About Nunavut Tunngavik Incorporated* [online]. Available From: <http://www.tunngavik.com/english/about.html>. [Accessed 10 October 2006].
- O'ROURKE, R. (2008) *Coast Guard polar icebreaker modernization: background, issues, and options for Congress* [online]. Available From: <http://www.google.ca/search?hl=en&sa=X&oi=spell&resnum=0&ct=result&cd=1&q=Office+of+Management+and+Budget+recently+signed+budget+authority+for+the+USCG+polar+icebreaking+program+to+the+National+Science+Foun+dation&spell=1>. [Accessed 28 October 2008].
- OFFICE-OF-THE-PRIME-MINISTER (2008) *Backgrounder - the John G. Diefenbaker national icebreaker project* [online]. Available From: <http://pm.gc.ca/eng/media.asp?id=2252>. [Accessed 25 November 2008].
- OIL_AND_GAS_INQUIRER (2008) Northwest Territories cabinet minister continues to promote Arctic natural gas pipeline. *Oil and Gas Inquirer*.
- PANAYIDES, P. M. (2006) Maritime policy, management and research: role and potential [online]. *Maritime Policy & Management* 33, (2) 95-105. <http://www.informaworld.com/smpp/content?content=10.1080/03088830600678757>. [Accessed 27 August 2007].
- PANDEY, A. K. (2008) Arctic shipping and commercial viability of the North West Passage. *Maritime Economics & Logistics* Rotterdam, Erasmus.
- PATTERSON, A. 27 April 2007 *Trip report - 3rd annual Arctic shipping conference*. e-Mail to J. Parsons (PARSONS, J.)
- PATTON, M. Q. (1990) *Qualitative evaluation and research methods*. 2nd. London, Sage Publications.
- PAYSON, W. H. & STECKLER, S. A. (1996) Developing public-private partnerships in infrastructure IN HAKIM, S., SEIDENSTAT, P. & BOWMAN, G. W. (Eds.) *Privatizing transportation systems*. Westport, Praeger.
- PEACOCK, A. (1984) Privatisation in perspective [online]. *Three Banks Review* Dec, 3-25. <http://relaisasin.com/posttoweb/servlet/DownloadDocument?PCF-47260934.pdf>. [Accessed 5 January 2010].
- PEARCE, J. A. & RICHARD B. ROBINSON, J. (2005) *Formulation, implememtation, and control of competitive strategy*. 9. New York, McGraw-Hill.
- PHARAND, D. (1984) *The Northwest Passage: Arctic straits*. Dordrecht, Martinus Nijhoff
- PHILPOTTS, T. (2006) Canadian P3 Survey: Issues Facing the Canadian P3 Market Vancouver, Ernst & Young Orenda Corportae Finance Inc.
- PIDD, M. (2003) *Tools for thinking: modelling in management science*. 2nd. Chichester, Wiley.
- PIRIE, M. (1988) *Privatization*. Aldershot, Wildwood House Limited.

- POOLE, R., JR & BUTLER, V. (2002) Nav Canada a model for commercializing public enterprises [online]. *Frontier Centre for Public Policy*, (11) 16. <http://www.fcpp.org/pdf/series11.pdf>. [Accessed 3 October 2006].
- POSCHMANN, F. (2003) *Private means to public ends: the future of public-private partnerships* [online]. Available From: http://newfirstsearch.oclc.org/WebZ/FSPage?pagetype=return_frameset:sessionid=fsapp13-34378-fmz63hyz-myqr6x:entitypagenum=12:0:entityframedurl=http%3A%2F%2Fwww.tac-atc.ca%2Fenglish%2Finformation%2Fod-librarycatalogue-search.cfm:entityframedtitle=TRANSPORTATION+ASN+OF+CANADA::entityopenTitle=Private%20means%20to%20public%20ends%20...:entityopenAuthor=Author%3A%20Poschmann,%20Finn:entityopenNumber=ISBN%3A%20088806599X:entityframedtimeout=15:clearopen=false:linktype=opac. [Accessed 30 October 2008].
- POSNER, M. (1984) Privatisation: the frontier between public and private [online]. *Policy Studies* 5, (1) 22-32. <http://www.informaworld.com/smpp/content~content=a787294261&db=all>. [Accessed 22 December 2009].
- POZNANSKI, K. Z. (1992) Privatisation of the Polish economy: problems of transition [online]. *Soviet Studies* 44, (4) 641-664. <http://web.ebscohost.com/ehost/detail?vid=4&hid=108&sid=8d473e5a-63fe-4d25-ad05-718f27700bfe%40sessionmgr10&bdata=JnNpdGU9ZWZWhvc3QtbGl2ZS5zY29wZT1zaXRl#db=aph&AN=9710132160#db=aph&AN=9710132160>. [Accessed 22 December 2009].
- PRESSER, S. (1984) The use of survey data in basic research in the social sciences. IN TURNER, C. F. & MARTIN, E. (Eds.) *Surveying subjective phenomena*. New York, Russell Sage Foundation.
- PRIESTLEY, S. (2006) *Armed Icebreakers and Arctic Ports for Canada's North? Costing Three New Canadian Heavy Armed Icebreakers* [online]. Available From: <http://www.sfu.ca/casr/id-igaluitport3.htm>. [Accessed 3 May 2007].
- PUGLIESE, D. (2007) Deep-water naval port in Arctic in doubt. *National Post*. Ottawa,
- PUNNETT, R. M. (1994) *British government and politics*. 6th. Aldershot, Dartmouth.
- REMILLARD, C. (1999) A CASE STUDY OF THE APPLICATION OF DIVESTITURE LEGISLATION ON THREE SMALL QUEBEC PORTS. *Geography*. Montreal, Concordia.
- RENNIE, D. L. (1998) Grounder theory methodology: the pressing need for a coherent logic of justification. *Theory & Psychology*, 8, (1) 101-119.
- ROBERTSON, F. (2006) *The mission of the Canadian Coast Guard in the Arctic*. ICETECH 2006 International Conference and Exhibition on Performance of Ships and Structures in Ice, July 16-19, 2006, Banff, Alberta.
- ROBERTSON, F. (RobertsonF@DFO-MPO.GC.CA) 16 June 2007 *Question on CCG capability*. e-Mail to J. Parsons (JIM.PARSONS@MI.MUN.CA)
- ROBSON, C. (2002) *Real world research: a resource for social scientist and practitioner-researchers*. 2nd. Oxford, Blackwell Publishers Ltd.
- ROE, M. (2008) *State versus the stake-holder; the governance of the maritime sector*. International Association of Maritime Economist 2008, 2 - 4 April 2008, Dalian
- ROTHWELL, C. E. (1951) Foreword. IN LERNER, D. & LASSWELL, H. D. (Eds.) *The policy sciences: recent developments in scope and method*. Stanford, Stanford University Press.

- ROTHWELL, D. R. (1995) International law and the protection of the Arctic environment. *The International and Comparative Law Quarterly*, 44, (2) 280-312.
- RUSNAVY (2008) *Will Rosatom cope with the nuclear-powered icebreakers?* [online]. Available From: http://rusnavy.com/news/newsofday/index.php?ELEMENT_ID=5629. [Accessed 27 October 2008].
- SABATIER, P. A. (1999) *Theories of the policy process*. Oxford, Westview Press.
- SADER, F. (1993) *Privatisation and investment in the developing world* [online]. Available From: http://www-wds.worldbank.org/external/default/WDSContentServer/IW3P/IB/1993/10/01/00009265_3961005100739/Rendered/PDF/multi_page.pdf. [Accessed 22 December 2009].
- SADLER, D. R. (2002) Intuitive data processing as a potential source of bias in naturalistic evaluations. IN HUBERMAN, A. M. & MILES, M. B. (Eds.) *The qualitative researcher's companion*. London, Sage Publications, Inc.
- SAUL, J. R. (2008) *A fair country: telling truths about Canada*. Toronto, Penguin Group.
- SAUNDERS, M., LEWIS, P. & THORNHILL, A. (2007) *Research methods for business students*. Harlow, Prentice Hall.
- SCHNEIDER, J. B. (1972) The policy delphi: a regional planning application. *Technological Forecasting And Social Change*, 3, 481-497.
- SÉGUIN, R. (2008) *Scientists predict seasonal ice-free Arctic by 2015* [online]. Available From: <http://www.theglobeandmail.com/servlet/story/RTGAM.20081212.warctic12/BNStory/National/home>. [Accessed 12 December 2008].
- SEKARAN, U. (2003) *Research methods for business: a skill-building approach*. 4th. Hoboken, John Wiley & Sons, Inc.
- SERREZE, M. C., HOLLAND, M. M. & STROEVE, J. (2007) Perspectives on the Arctic's shrinking sea-ice cover [online]. *Science* 315, (5818) 1533-1536. <http://www.sciencemag.org/cgi/reprint/315/5818/1533.pdf>. [Accessed 21 March 2007].
- SHARP, J. A. & HOWARD, K. (1996) *The management of a student research project*. 2nd. Brookfield, Gower
- SIKU-NEWS (2007) *Russia beefs up icebreaker program* [online]. Available From: <http://www.sikunews.com/art.html?catid=12&artid=2928>. [Accessed 12 April 2007].
- SIMON, M. (2008) *Does Ottawa's northern focus look backwards?* [online]. Available From: <http://www.nunatsiaq.com/opinionEditorial/opinions.html>. [Accessed 26 November 2008].
- SINGH, L. (SinghL@DFO-MPO.GC.CA) 4 April 2007 CCG Arctic Budget Spreadsheet Info. e-Mail to J. Parsons (JIM.PARSONS@MI.MUN.CA)
- SKINNER, A. (Ed.) (1974) *The wealth of nations: books I-III*. Harmondsworth, Penguin.
- SLAVIN, R. H. & DEVINE, E. J. (1973) Multi-discipline design teams for transportation facilities. *Land Economics*, XLIX, (3) 241-250.
- SMITH, A. (1776) *An inquiry into the nature and causes of the wealth of nations* [online]. Available From: <http://www.adamsmith.org/smith/won-b5-c2-pt-1.htm>. [Accessed 8 Jan 2010].
- SMITH, N. L. (1987) Toward the justification of claims in evaluation research. *Evaluation and Program Planning*, 10, (4) 309-314.

- SMITH, T. W. (1984) Nonattitudes: a review and evaluation. IN TURNER, C. F. & MARTIN, E. (Eds.) *Surveying subjective phenomena*. The Russell Sage Foundation.
- SOMANATHAN, S., FLYNN, P. C. & SZYMANSKI, J. (2006) *The Northwest Passage: a simulation* Winter Simulation Conference, 1578-1585. <http://www.informs-sim.org/wsc06papers/200.pdf>. [Accessed 12 March 2008].
- SOMANATHAN, S., FLYNN, P. C. & SZYMANSKI, J. K. (2007) Feasibility of a sea route through the Canadian arctic [online]. *Maritime Economics & Logistics* 9, (4) 324-334. <http://www.palgrave-journals.com/mel/journal/v9/n4/index.html>. [Accessed 10 March 2008].
- STAKE, R. E. (2000) Case studies. IN DENZIN, N. K. & LINCOLN, Y. S. (Eds.) *Handbook of qualitative research*. 2nd ed. Thousand Oaks, sage Publications, Inc.
- STANDING-SENATE-COMMITTEE-ON-FISHERIES-AND-OCEANS (2008) The Coast Guard in Canada's Arctic: interim report. Ottawa, Government of Canada.
- STANDING-SENATE-COMMITTEE-ON-FISHERIES-AND-OCEANS (2009) *Rising to the Arctic challenge: report on the Canadian Coast Guard* [online]. Available From: <http://www.parl.gc.ca/40/2/parlbus/commbus/senate/Com-e/fish-e/subsitemay09-e/reports-e.htm>. [Accessed 4 June 2009].
- STANFORD, Q. H. (Ed.) (1992) *Canadian Oxford world atlas* Toronto, Oxford University Press.
- STATISTICS-CANADA (2006) *Population by year, by province and territory* [online]. Available From: <http://www40.statcan.ca/l01/cst01/demo02.htm>. [Accessed 9 October 2006].
- STEIGER, S. (1995) Problems of 'Voucher Privatisation' [online]. *Economic and Political Weekly* 30, (50) 3206. <http://www.jstor.org/stable/4403563><http://www.jstor.org/stable/4403563>. [Accessed 22 December 2009].
- STEPHAN, F. F. & MCCARTHY, P. J. (1965) *Sampling opinions: an analysis of survey procedure*. New York, John Wiley & Sons, Inc.
- STEVENS, J. P. (2009) *Applied multivariate statistics for the social sciences*. 5th. New York, Routledge.
- STEVENSON, A., ELLIOTT, J. & JONES, R. (Eds.) (2002) *Colour Oxford english dictionary*. Oxford, Oxford University Press.
- STEWART, E. J., HOWELL, S. E. L., DRAPER, D., YACKEL, J. & TIVY, A. (2007) Sea ice in Canada's Arctic: implications for cruise tourism. *Arctic*, 60, (4) 370-380.
- STIGLER, G. J. & FRIEDLAND, C. (1962) What can regulators regulate? the case of electricity. *Journal of Law and Economics*, 5, 1-16.
- STRAUSS, A. & CORBIN, J. (1990) *Basics of qualitative research: grounded theory procedures and techniques*. Newbury Park, Sage Publications.
- STRAUSS, A. & CORBIN, J. (1998) *Basics of qualitative research: techniques and procedures for developing grounded theory*. Second. Thousand Oaks, Sage Publications.
- TABACHNICK, B. G. & FIDELL, L. S. (2001) *Using multivariate statistics*. 4th. Boston, Allyn and Bacon.
- TASHAKKORI, A. & TEDDLIE, C. (1998) *Mixed methodologies: combining qualitative and quantitative approaches*. Thousand Oaks, Sage Publications.
- TASHAKKORI, A. & TEDDLIE, C. (2003) The past and future of mixed methods research: from data triangulation to mixed model designs. IN TASHAKKORI, A. & TEDDLIE, C. (Eds.) *Handbook of mixed methods in social & behavioral research*. Thousand Oaks, Sage Publications.

- TRANSPORT-CANADA (2006) *New direction for transportation in Canada* [online]. Available From: <http://www.tc.gc.ca/programs/airports/policy/nap/Directions.htm>. [Accessed 10 November 2008].
- TRANSPORT-CANADA (2007) *5.0 Department of Fisheries and Oceans - Canadian Coast Guard* [online]. Available From: <http://www.tc.gc.ca/marinesafety/tp/tp13670/DFOCCG.htm>. [Accessed 1 May 2007].
- TRANSPORT-CANADA (2008) Northern transportation research workshop paper.
- TYNAN, N. (2003) The rise and fall of state-owned enterprises in the Western World [online]. *Journal of Economic Behaviour and Organization* 52, 421-425. http://www.sciencedirect.com/science?_ob=MIimg&_imagekey=B6V8F-49F856X-1-1&_cdi=5869&_user=1069227&_orig=search&_coverDate=11%2F30%2F2003&_sk=999479996&_view=c&_wchp=dGLbVtz-zSkzS&_md5=101a876c904ca8c1dba2790919e1514e&_ie=/sdarticle.pdf. [Accessed 23 December 2009].
- VAN-HORNE-INSTITUTE (2007) Advantage North. Whitehorse, Van Horne Institute and Westac.
- VAUS, D. D. (2004) *Analyzing social science data: 50 key problems in data analysis*. London, Sage Publications.
- VICKERS, J. & YARROW, G. (1988) *Privatization: an economic analysis*. Cambridge, Massachusetts Institute of Technology.
- WALLACE, T. 11 October 2006 *Arctic Icebreaking Service Fees*. e-Mail to J. Parsons
- WALSH, J. E. & TIMLIN, M. S. (2003) Northern Hemisphere sea ice simulations by global climate models. *Polar Research*, 22, (1) 75-82.
- WARNER, R. M. (2008) *Applies statistics: from bivariate through multivariate techniques*. Los Angeles, Sage Publications.
- WILKIN, D. (1997) Shippers mull over self-help icebreaking plan. *Nunatsiaq News*. Iqaluit,
- WILLIAMS, G. 27 September 2006 e-Mail to J. Parsons
- WILLIMACK, D. K., NICHOLS, E. & SUDMAN, S. (2002) Understanding unit and item nonresponse in business surveys. IN GROVES, R. M., DILLMAN, D. A., ELTINGE, J. L. & LITTLE, R. J. A. (Eds.) *Survey Nonresponse*. New York, John Wiley & Sons, Inc.
- WILSON, M. (1990) *The Budget*. Toronto, The Empire Club Foundation.
- WONG, Q. (2008) *In Arctic 'cold war,' Russia plows ahead* [online]. Available From: <http://www.mcclatchydc.com/226/story/46477.html>. [Accessed 2 January 2009].
- YARROW, G. (1986) Privatization in theory and practice *Economic Policy*, 1, (2) 323-377.
- YATES, A. (1987) *Multivariate exploratory data analysis: a perspective on exploratory factor analysis*. Albany, State University of New York Press.
- ZAITSEV, Y. (2007) *Russia set to overhaul its Arctic fleet* [online]. Available From: <http://en.rian.ru/analysis/20070409/63375060.html>. [Accessed 27 November 2008].
- ZHANG, J., III, W. D. H., STEELE, M. & ROTHROCK, D. A. (1998) Arctic ice-ocean modeling with and without climate restoring. *Journal of Physical Oceanography*, 28, (2) 191-217.

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Developing policies to manage Canada's icebreaking services: a grounded theory approach

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Abstract

Empirical evidence has shown that summer ice conditions in the Arctic have become less severe in recent years. However, fluctuations year on year, combined with persistent winter ice will continue to impede maritime shipping activity in the Arctic. This region is abundant in natural resources and tourism is increasing. Arctic shipping activity is expected to continue to increase significantly.

Reports from the office of the Auditor General of Canada noted a lack of adequate and effective management of capital and human resources in the fleet management of Canadian Coast Guard (CCG) icebreakers. The ageing CCG fleet of Arctic icebreakers is limited in its ability to operate year round in the Arctic and vessel replacement will be necessary in the near future. Canadian shipyards are currently unable to build Arctic icebreakers competitively in the global market. While a lack of Arctic icebreaking capability is not only a Canadian phenomenon, other Arctic Council nations avail themselves of private involvement in the delivery of their icebreaking services.

This paper reports on the research completed to date, discusses the decision to adopt a grounded theory methodology and presents some preliminary results. The overall aim of the research is to conduct a strategic situational analysis of the CCG services, principally Arctic icebreaking, and to investigate which services, in terms of effectiveness and efficiency, may be suitable for private involvement. Research objectives are:

- 1) To synthesize experts' perceptions of future marine activity in the Canadian Arctic;*
- 2) To compare experts' perceptions of the CCG services, principally Arctic icebreaking, in terms of their ongoing effectiveness and efficiency;*
- 3) To analyze contiguous systems (including Swedish, Finnish, United States, and Russian) of private involvement in their icebreaking services in terms of funding and operations;*
- 4) To analyse Canada's position with respect to private involvement practices in its marine transportation sector;*
- 5) To analyse the importance of specific background factors with respect to private involvement in the delivery of CCG icebreaking services in the Arctic;*
- 6) To identify and evaluate different models of privatization and the forms they might take in relation to CCG services in the Arctic, principally Arctic icebreaking.*

A literature review and a scoping exercise consisting of three rounds of Delphi have been completed. Also, in-depth and semi-structured interviews have been conducted and analysis is partially completed using inductive and deductive analysis adhering to the constant comparative method of grounded theory methodology in developing a substantive theory. With respect to different "slices of

data”, Delphi results will also be subjected to inductive analysis. Finally, in attempting to triangulate research findings, hypotheses formulated from inductive analysis may be tested, outside of the grounded theory methodology, using a quantitative survey.

While initial research findings have highlighted that outright privatization of CCG services, a monopolistic situation, may not be the key to increased efficiency, there are potential gains in efficiency from private management of the Arctic icebreaking fleet.

Keywords: Arctic shipping, icebreaking, Delphi, grounded theory, privatization and policy formulation

1 Introduction

For centuries explorers have tried to find a route through the Arctic linking Europe and Asia, see Figure 1. John Cabot proposed a Northwest Passage as early as 1490 and attempted to find it in 1496. As efforts continued throughout the centuries, it was not until 1854 that Robert McClure proved the existence of such a passage. It took another 51 years for the first ship transit of the Northwest Passage to be made by Roald Amundsen in 1905 (Pharand, 1984).

Interest in the Arctic region, whether stemming from climate change or its abundance of natural resources, is high on the agenda of many nations. The annual extent of Arctic ice coverage is retreating at a notable rate and it is estimated that the Canadian Arctic will experience nearly ice-free summer seasons starting as early as 2050 but probably not before 2100 (Falkingham, 2004). NASA data shows that Arctic perennial sea ice shrank abruptly by 14 percent between 2004 and 2005 (Hupp and Brown, 2006). Consequently, it would be logical to assume that less ice should increase the ease and mobility for ships currently working in Arctic regions and also for those ships that may be contemplating future activity in the Arctic regions. Milder sea ice conditions in the higher Arctic latitudes may present new merchant shipping opportunities by way of the shorter distances available to Europe-Asia and East Coast North America-Asia traffic. In terms of marine transportation, an increase in activity will most likely result in the startup of new business and increase business activity for others already established and catering to the marine transportation sector. A virtuous circle of business and economic activity appears to be moving northward (National-Research-Council, 2005).

On a global scale, Arctic regions are rich in natural resources. Arctic basins hold about 25 percent of the world’s undiscovered petroleum resources (Ahlbrandt and McCabe, 2002). On a local scale, Canada’s Arctic regions are estimated to hold 33 percent of its remaining recoverable natural gas and 25 percent of the remaining recoverable light crude oil (Indian-and-Northern-Affairs-Canada, 2006).

Cruise ship activity is increasing in Arctic waters and Arctic fishing fleets have already begun to follow the fish stocks that migrate northward as the ice edge retreats (National-Research-Council, 2005). Any increase in activity will increase the necessity to respond to accidents and create a greater need for law enforcement in ice margin areas, which will increase the need for ice-capable ships in the Arctic (National-Research-Council, 2005).

Figure 1 Map of Canada



Source: Adapted from *Political Divisions* [online]. Available from: http://atlas.nrcan.gc.ca/site/english/maps/reference/national/can_politica/referencemap_image_view [Accessed 23 October 2006].

With respect to Canada's sovereignty and adequate resources to enforce it, Carnaghan and Goody (2006) conclude that the views of Canadian academics differ; while Huebert (2003) believes Canada presently has insufficient resources to enforce its sovereignty in the Canadian Arctic, Griffiths (2003) believes that Canada's effort in enforcing its sovereignty in the region is sufficient. CCG commissioner Mr. George Da Pont states that, while the CCG currently plays a significant role in the Arctic, nothing is certain as to the extent of its role in the future (Binkley, 2006). In addition, Da Pont notes that neither the Russians nor the Canadians have the commercial infrastructure in place to support increased vessel traffic in their respective Arctic waters.

Table 1 illustrates that the Canadian Arctic icebreaking fleet is aging. The first icebreaking vessel scheduled for replacement is the LOUIS S. St-LAURENT in the year 2017 (Robertson, 2006). She has only 20000 kilowatts of power, limiting her use in terms of year round Arctic operations. Arctic icebreaking vessels constitute a significant financial investment. It is calculated that it will cost \$CAD 2B to 3B to rebuild the current Canadian icebreaking capability and that it will cost \$CAD 10B

to build the icebreaking potential required to meet anticipated future demand (Robertson, 2006). Securing such monies may not be easy for the CCG as it is currently experiencing a funding gap of about \$CAD 55M (Department-of-Fisheries-and-Oceans-Canada, 2006). Reports from the office of the Auditor General of Canada from 1997 to February 2004 state that there is a lack of adequate and effective management of capital and human resources by the Department of Fisheries and Oceans (DFO) in fleet management of icebreakers in the Maritimes Region of Canada (Clemens et al., 2004). These issues are not new and changes are needed.

Cutting edge icebreaking technology is being implemented in new tonnage currently under construction in European and Far East ship yards, for operations in the Arctic regions of the world. Arctic nations such as Sweden, Finland, Russia, and the United States are currently availing themselves of private involvement in the execution of their icebreaking operations.

Table 1 CCG Arctic Icebreaking Fleet

Name of Vessel	Home Region	Built
Sir Wilfrid Laurier	Pacific	1986
Des Groseillers	Quebec	1982
Pierre Radisson	Quebec	1978
Louis S. St-Laurent	Maritimes	1969
Terry Fox	Maritimes	1983
Henry Larson	Newfoundland and Labrador	1987

Source: Author

2 Background

The history of icebreaking with respect to the development of Canada dates back to the early-middle 1800's with the building of the CHIEF JUSTICE ROBINSON in 1842 (Canadian-Coast-Guard, 2001). Self-governance, the beginning of independence from the United Kingdom, in the Dominion of Canada came about with the British North American Act of 1867 which conferred the authority for the icebreaking activities on the federal government (Canadian-Coast-Guard, 2001). Since then, responsibility for icebreakers and icebreaking has been added and the responsibility has been transferred to different federal government departments, with the most recent transfer being to the Minister of Fisheries and Ocean, via the Oceans Act, in 1997 (Canadian-Coast-Guard, 2001).

In 1994 a study was conducted by Consulting and Audit Canada, on behalf of DFO and CCG, then a part of Transport Canada (TC), to seek feasible ways of improving their efficiency in delivering services to the Canadian public. The study initially reviewed seven options before concluding that the creation of a Crown Corporation was the alternative offering the largest potential savings and was most acceptable to the fleet management community (Consulting-and-Audit-Canada, 1994). The seven options considered were as follows:

- A- Improve fleet efficiency within the existing departmental structures
- B- As above with sharing of facilities and functions when additional efficiencies can be achieved
- C- Integrate the two fleets under one department (DFO, CCG or Public Works & Government Services Canada)

- D- Establish an independent Maritime Fleet Operating Agency to manage and operate the combined fleet
- E- Establish a Crown corporation to operate the combined fleet
- F- Establish a Government Owned Company Operated (GOCO) organization in which the integrated fleet would be operated by a private company
- G- Privatise the ownership and operation of the fleet

The study determined that options A and B would be too expensive, options C and D would be too difficult to implement, and F and G would take too long to put into place. While option E, the establishment of a Crown Corporation, was decided upon, it has yet to be implemented (Consulting-and-Audit-Canada, 1994).

Canada's northern communities have one of the fastest growing populations in the world; with a population growth of 16 percent per decade, increased demands on destination and regional, and intra-Arctic traffic will continue to grow (Gorman and Paterson, 2004). Economic development and exploration of Canada and the Arctic has and will continue to be heavily dependant upon a reliable transportation infrastructure (Canada-Transportation-Act-Review-Panel, 2001). In the light of climate change and the continual decrease of Arctic ice (Flato and Boer, 2001; Falkingham, 2000; Falkingham, 2004; Hupp and Brown, 2006), Canada's involvement and activity in the Arctic is anticipated to increase (Department-of-Foreign-Affairs-and-International-Trade-Canada, 2007) and with this will come an anticipated greater demand for an efficient and effective transportation network. It would seem rather unlikely that significant economic development in the Canadian Arctic and the Arctic in general will come about without the involvement of icebreakers and ice strengthened cargo vessels. The question could be asked: would the economic development of the Canadian Arctic be farther ahead than its current state if Canada had an extended season, or even a year-round presence, for its icebreakers operating in the Arctic? From an economic development perspective, it would seem rational for a country to first put supporting infrastructure in place in order for business to follow, a case of commerce following the flag. Unfortunately, with respect to current Arctic development, the CCG icebreaking fleet is not equipped to operate on a year round basis in the Canadian Arctic (Brigham, 2007; Robertson, 2007; Haydon, 2007).

Given the possibility of limited future CCG involvement in the Arctic, even though economic activity is forecast to increase significantly, it would be fair to assume that any deficiencies in the provision of services being offered by government organizations would be provided for by private interest. Consequently, it seems appropriate to undertake research looking into the implications of private involvement into the delivery of government services traditionally undertaken by the CCG.

3 Methodology

3.1 Literature Review

The initial review of literature was focused on the major themes of Arctic maritime transportation, Arctic resources, climate change, icebreaking technology, the CCG, the Arctic Council, privatization, risk management, and insurance. Saunders et al. (2007) describe exploratory research as being initially broad and then becoming progressively narrower as a result of any, or a combination of the

following: a literature review, the interviewing of experts in the subject area, and conducting focus group interviews.

Subsequent to the literature review, a Delphi exercise consisting of three rounds of questioning was conducted to enhance research sensitivity. The questions put forward in the first round of Delphi were founded on the results of the literature review and focused mainly on current and future CCG levels of services, Arctic climate change and its affect on transportation in the Arctic regions, new icebreaking technology, the global status of Arctic icebreakers, privatization, and the growing demand for natural resources in politically stable but rather remote and harsh environments. Potential participants were identified through the literature review, as well as from personal meetings at conferences related to the research topic. The exercise was carried out independently by participants using an e-mail based survey. Table 2 identifies the number of participants and questions in the Delphi exercise.

Table 2 Summary of Delphi Exercise

	Round 1	Round 2	Round 3
Participants	32	27 of 32	23 of 27
Questions	32	44	21

Source: Author.

Delphi, according to Lindstone and Turoff (1975), is seen as an appropriate method to gather data not previously gathered, know or available.

3.2 Grounded Theory

While the literature review and Delphi exercise raised awareness with respect to issues associated with climate change, the increased demand for Arctic resources, the CCG and its aging fleet of icebreakers, and the lack of transportation infrastructure in the Arctic, they did little in terms of offering solutions to the issues. With respect to this research, the main issues being raised are that the CCG is poorly managed and underfunded, and the CCG icebreaking fleet needs to be renewed and enhanced. In attempting to understand why the current situation is as it is and how best to resolve these issues, both effectively and efficiently with the Canadian taxpayer in mind, it would be reasonable to avail of qualitative research in the form of in-depth and semi-structured interviews with stakeholders conversant of the issues mentioned. Policy matters may relate to past, present or future situations. Hyman (1951) notes that in the case of anticipations about the future, inferences can only be made through the personal documentation of an individual's thoughts and that interviewing is an effective method of capturing such thoughts.

Grounded theory is well suited for qualitative research using interviews (Robson, 2002). It is a constant comparative analysis process in which data are collected, transcribed, and subsequently subjected to both micro and macro analysis and coding for the purposes of developing categories and saturating them with respect to their properties and dimensions. It is a systematic, rigorous, and formalized approach to data analysis (Strauss and Corbin, 1998).

While a theory can be developed at various junctures of the research depending on the nature of which the research is approached, Collier (1994) notes that no theory is unsusceptible to revision and improvement, and that it is continually in

process (Glaser and Strauss, 1967). Glaser and Strauss (1967) note that the generation of a theory involves a process of research in which hypothesis and concepts not only come from the data but are systematically worked out in relation to the data.

With respect to grounded theory methodology, while a researcher may have theoretical conceptions in mind at the outset of a research project, it may prove advantageous not to structure data gathering too tightly at the commencement of research (Strauss and Corbin, 1998). Consequently, the first in-depth, and to a degree, semi-structured, interview involved an interviewee identified by a Delphi participant; a non-probability sampling technique known as snowball sampling (Saunders et al., 2007). The interviewee had previously been a manager at CCG and had been tasked with looking into ways in which the CCG may be operated more efficiently and effectively. The interview was arranged in two parts. During the first part of the interview the interviewee informed of his previous work noted above. During the second part, a list of questions, generated from the literature review and Delphi study, was used as a guide to help focus the interview. As with all subsequent interviews, the first interview was recorded, transcribed, and subjected to an initial analysis. Initial results were used to identify potential new interviewees, and to develop questions. Subsequent interviewees were identified using a combination of snowball and theoretical sampling techniques. Theoretical sampling is the process of allowing emerging theories, stemming from the coding and analysis of previously collected data, to guide subsequent data collection, coding, and analysis (Glaser and Strauss, 1967). In addition, theoretical sampling of previously collecting data is accepted in the grounded theory methodology (Glaser and Strauss, 1967) and as such, the Delphi results and literature review serve as "slices of data" to help with the development and saturation of categories (Glaser and Strauss, 1967; Linstone and Turoff, 1975).

To date, eight interviews have been conducted. Table 3 highlights some of the information pertaining to the interviews.

A general analysis of each interview was undertaken before proceeding with further interviews, and in keeping with the constant comparative analysis of grounded theory methodology, interviews, literature review, and Delphi results were, and continue to be, analysed at micro and macro levels during subsequent data analysis and coding. Memos, in both note and diagram form, accompany data analysis. The collection of data in more than one way helps ensure all of the issues relevant to the research are covered even if their initial importance is not fully appreciated by the researcher (Curran and Blackburn, 2001).

Strauss and Corbin (1990) characterize the grounded theory methodology as being both inductive and deductive; the process of analyzing data, otherwise known as coding, allows for assumptions about phenomena to be deductively made which then in turn calls for questioning of these assumptions leading inductively to new discoveries. Coding is central to grounded theory and, as previously noted, occurs at both micro and macro levels. While micro analysis is a combination of open and axial coding, it is not intended to be done in the absence of macro analysis. Open coding concerns itself with the identification of conceptual categories and the subsequent discovery of a category's properties and dimensions, and axial coding looks at the process of relating categories to their subcategories (Strauss and Corbin, 1998).

Table 3 Details of Interview Subjects

Interviewee	Position	Date	Interview Format	Sampling Technique
1	Retired CCG Manager	06/07/07	In Person	Snowball
2	Retired CCG Manager	26/07/07	Telephone	Snowball
3	Retired CCG Manager	31/08/07	Email	Snowball
4	Vice-President ENFOTEC	13/09/07	Telephone	Theoretical
5	Director of Science AKAK	25/09/07	Telephone	Theoretical
6	Gibson Marine Consultants	15/10/07	Telephone	Theoretical
7	CCG Commanding Officer	23/10/07	In Person	Theoretical
8	Retired CCG Manager / Current Marine Consultant	24/10/07	Telephone	Theoretical/Snowball

Source: Author.

Higher level selective coding is used for the integration and refinement of theory evolving from open and axial coding. Hypothesis are typically presented at the selective coding level (Robson, 2002). To date, open, axial, and selective coding have taken place. Selective coding will continue to be used for further integration of the hypotheses and relationships, developed under open and axial coding, identified in the conceptual model depicted in Figure 3. Development of the conceptual model is discussed below. To date, seven of the eight interviews have been analyzed and coded in consideration of the conceptual model developed.

Grounded theory integrates structure (or conditions) and process (denoting action/interaction strategies over time), with the use of an analytical tool referred to as the paradigm (Strauss and Corbin, 1998). The paradigm is not a standalone tool of analysis, and is intended to be used in conjunction with a coding device referred to by Strauss and Corbin (1998) as the matrix. Whilst the paradigm concerns itself with conditions, action/interaction strategies, and possible consequences, the matrix guides the analyst in looking at conditions and consequences on both macro and micro levels. The conceptual model depicted in Figure 3 highlights the combination of both the paradigm and the matrix applied to seven of the eight interviews to date.

4 Results

4.1 Results of the Literature Review and Delphi

A review of the literature revealed that there is little public information with respect to research on the privatization of CCG services in the Canadian Arctic, and that privatization is successfully being used in the icebreaking services of other Arctic nations. In addition, the CCG icebreaking fleet is aging and will soon require replacement as global interest in Arctic regions continues to increase with the

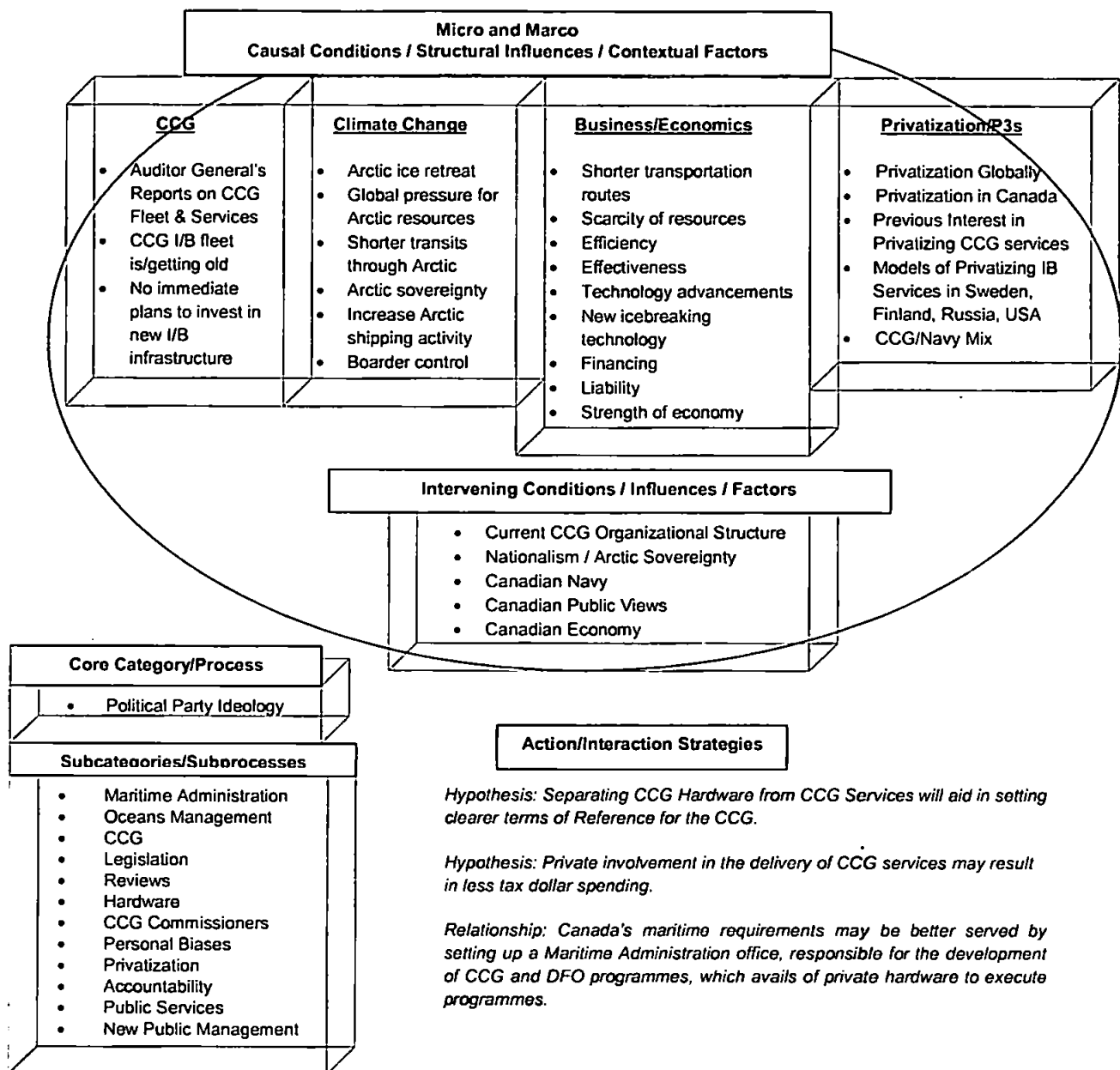
melting of Arctic ice. Further, there is considerable uncertainty as to when Arctic regions will experience totally ice-free conditions. Finally, while there are major management issues with respect to the overall operation of the CCG, Arctic operations appear to be managed more effectively when compared to the more autonomous regional operations. Arctic operations have been noted by some Delphi participants as the only CCG operations that show some signs of a national programme. It is important to note here that while the six CCG icebreakers used for Arctic operations are operated out of the Pacific, Quebec, Maritimes, and Newfoundland & Labrador regions, the Central and Arctic region is responsible for coordination of ice breaking activities in the Arctic (Canadian-Coast-Guard, 2006). In consideration of the above, it is also important to note while Arctic operations may appear to run relatively smoother, Delphi participants have commented that this decentralization of fleet operations results in ineffective interregional communication and consequently underutilization of vessel use in the Arctic (Auditor-General, 2007).

4.2 Preliminary Results of Grounded Theory

Although analysis of personal interviews is not complete, preliminary results confirm that the grounded theory strategy is effective in that category saturation is evident and diminishing returns with respect to data collection is being noted. This is particularly evident in the subcategories of private management and icebreaker design/construction. However, it is worthy of mention that Strauss and Corbin (1998) refer to saturation as a matter of degree, and if a researcher were to investigate long and hard enough new properties and dimensions would be discovered.

With respect to signs of an emerging theory, research indicates that CCG Arctic operations are suitable for private involvement and that private management of the CCG fleet is the option offering the greatest potential in terms of increased efficiency and effectiveness. Research indicates that while on a national basis the CCG is poorly managed, the Arctic programme runs relatively much smoother than so called national programmes in southern latitudes of the country. The underlying difference between the two programmes is that the region in control of Arctic operations does not allocate any of its hardware i.e. icebreakers, to Arctic operations, see Figure 4. To the contrary, with respect to national programmes in the south, individual regions are responsible for the operation of icebreakers and control of local programmes. Therefore, to improve on the issues with Arctic operations as noted in the Delphi results with respect to the decentralization of fleet operations resulting in ineffective interregional communication and consequently underutilization of vessel use in the Arctic, it may be that the CCG should have a fleet of icebreakers allocated specifically to year round Arctic operations and most importantly, that they be managed by private interest involving local stakeholders.

Figure 3 Conceptual Model



Source: Author.

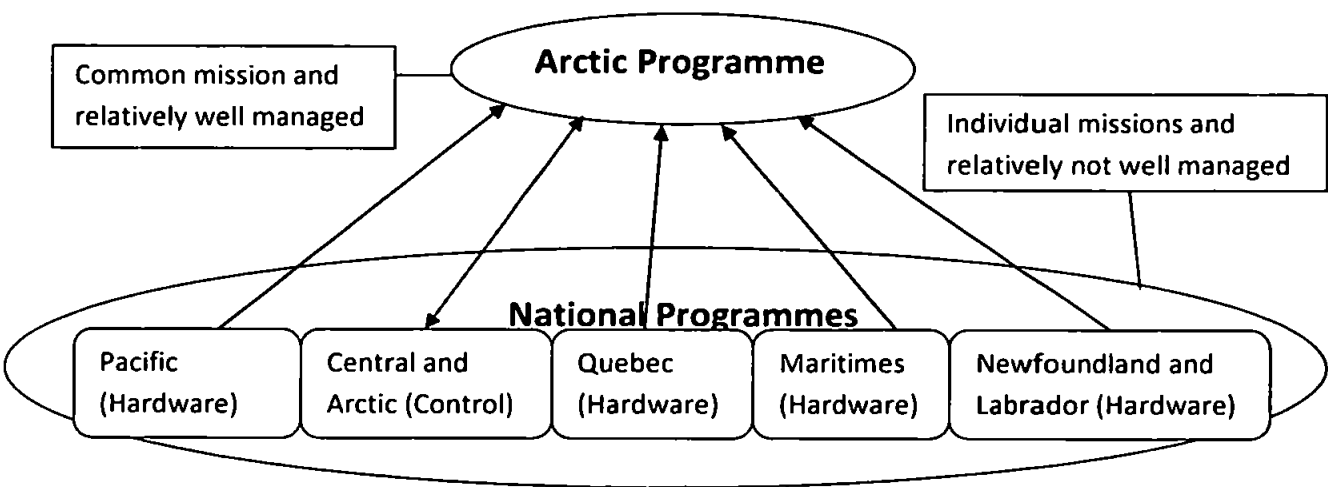
5 Conclusion

From an organizational perspective, the CCG is hindered by bureaucracy, inefficient, and ineffectively managed. The CCG requires new management. The current situation with the CCG fleet of icebreakers, in terms of icebreaking capabilities in the Arctic, is limited and the current fleet will not be able to respond to the future demands of Arctic shipping activity. Canada will require new and increased Arctic icebreaking capabilities. In addition, Canada currently lacks the ability to build Arctic icebreakers on a competitive basis with other nations. Consequently, construction of icebreaking tonnage in Canada will cost taxpayers considerably more than if built on a globally competitive basis. Further, it will take considerably longer to construct icebreaking tonnage in Canada than it would elsewhere in more technologically advanced shipyards.

Unless Canada is going to significantly increase the development of its Arctic and locally construct a fleet of icebreaking vessels capable of meeting future Arctic shipping needs, it may be in the best interest of Canadian taxpayers to have a modern day Arctic icebreaker built in Europe or the Far East and to have it managed by sound private shipping interest.

With respect to advice for future researchers, during the first round of Delphi some participants experienced difficulty downloading the free version of Adobe Reader 8 required to complete the questionnaire. Consequently, the questionnaire was resent as an MS Word document to those individuals that had not returned their questionnaire up to that time. Subsequent Delphi questionnaires were administered using the MS Word format only.

Figure 4 Regional Inputs into the Arctic Programme



Source: Author

6 Future Directions

Further coding and analysis of all data collected to date, following the grounded theory strategy, will be necessary to facilitate the development of any form of substantive theory. In addition, feedback is welcomed on the idea of devising a quantitative survey, most probably a Likert approach, in an attempt to triangulate results and test the hypotheses developed in accordance with the conceptual model.

References

- AHLBRANDT, T. S. & MCCABE, P. J. (2002) Global petroleum resources: a view to the future. *Geotimes*, **47**, (11) 14-20.
- AUDITOR-GENERAL (2007) Managing the Coast Guard Fleet and Marine Navigational Services—Fisheries and Oceans Canada IN CANADA, O. O. T. A. G. O. (Ed.) Her Majesty the Queen in Right of Canada.
- BINKLEY, A. (2006) New Coast Guard commissioner wants agency, shipping industry to reopen dialogue. *Canadian Sailings*.
- BRIGHAM, L. 10 May 2007 *CCG ability to operate year round in the Arctic*. e-Mail to J. Parsons (PARSONS, J.)
- CANADA-TRANSPORTATION-ACT-REVIEW-PANEL (2001) *Canada Transportation Act Review: Final Report* [online]. Available From: <http://www.reviewcta-examenltc.gc.ca/english/pages/final/tablee.htm>. [Accessed 7 May 2007].
- CANADIAN-COAST-GUARD (2001) *Icebreaking Operations Levels of Service* [online]. Available From: http://www.ccg-gcc.gc.ca/ice-gla/los2001_e.htm#HISTORY. [Accessed 1 December 2006].
- CANADIAN-COAST-GUARD (2006) *Regions* [online]. Available From: http://www.ccg-gcc.gc.ca/regions_e.htm. [Accessed 2 January 2007].
- CARNAGHAN, M. & GOODY, A. (2006) *Canadian Arctic Sovereignty* [online]. Available From: <http://www.parl.gc.ca/information/library/PRBpubs/prb0561-e.htm>. [Accessed 20 July 2007].
- CLEMENS, J., MULLINS, M., VELDHUIS, N. & GLOVER, C. (2004) Government failure in Canada, 1997-2004: a survey of reports from the Auditor General. *Public Policy Sources*. Vancouver, The Fraser Institute.
- COLLIER, A. (1994) *Critical realism: an introduction to Roy Bhaskar's philosophy*. London, Verso.
- CONSULTING-AND-AUDIT-CANADA (1994) Study of the CCG and DFO maritime fleets. Ottawa,
- CURRAN, J. & BLACKBURN, R. A. (2001) *Researching the small enterprise*. Thousand Oaks, Sage Publications Inc.
- DEPARTMENT-OF-FISHERIES-AND-OCEANS-CANADA (2006) Canadian Coast Guard - A Special Operating Agency. Ottawa,
- DEPARTMENT-OF-FOREIGN-AFFAIRS-AND-INTERNATIONAL-TRADE-CANADA (2007) *Northern Foreign Policy* [online]. Available From: <http://www.dfait-maeci.gc.ca/circumpolar/nfp-en.asp>. [Accessed 9 May 2007].
- FALKINGHAM, J. (2004) *Sea ice in the Canadian Arctic* Arctic Marine Transport Workshop, 49. http://www.arctic.gov/files/AMTW_book.pdf#search=%22arctic%20ice%20free%20summers%20john%20falkingham%22. [Accessed 3 October 2006].
- FALKINGHAM, J. C. (2000) *Sea ice in the Canadian Arctic in the 21st century* [online]. Available From: http://www.yukon.taiga.net/knowledge/resources/seaice_printable.html. [Accessed 16 November 2006].
- FLATO, G. M. & BOER, G. J. (2001) Warming asymmetry in climate change simulations. *Geophysical Research Letters*, **28**, (1) 195-198.
- GLASER, B. G. & STRAUSS, A. L. (1967) *The discovery of grounded theory: strategies for qualitative research*. New York, Aldine Publishing Company.
- GORMAN, B. & PATERSON, T. (2004) *Future of Canadian Arctic Shipping* Arctic Marine Transport Workshop, 49.

- http://www.institutenorth.org/PDF/AMTW_book.pdf#search=%22Arctic%20Marine%20Transportation%20Workshop%22. [Accessed 3 October 2006].
- GRIFFITHS, F. (2003) The shipping news: Canada's Arctic sovereignty not on thinning ice [online]. *International Journal* **58**, (2) n/a.
<http://proquest.umi.com/pqdlink?index=17&did=545429251&SrchMode=3&sid=2&Fmt=3&VInst=PROD&VType=PQD&RQT=309&VName=PQD&TS=1208954823&clientId=65114&aid=1>. [Accessed 23 April 2007].
- HAYDON, P. T. (2007) *Why does Canada still need a navy?* [online]. Available From:
http://centreforforeignpolicystudies.dal.ca/pdf/marsec_working/WhyCanadaNeedsaNavy.pdf. [Accessed 15 October 2007].
- HUEBERT, R. (2003) The shipping news part II: how Canada's Arctic sovereignty is on thinning ice [online]. *International Journal* **58**, (3) n/a.
<http://proquest.umi.com/pqdlink?index=17&did=545429251&SrchMode=3&sid=2&Fmt=3&VInst=PROD&VType=PQD&RQT=309&VName=PQD&TS=1208954823&clientId=65114&aid=1>. [Accessed 23 April 2007].
- HUPP, E. & BROWN, D. (2006) *NASA Sees Rapid Changes in Arctic Sea Ice* [online]. Available From:
http://www.nasa.gov/home/hqnews/2006/sep/HQ_06315_sea_ice.html. [Accessed 10 October 2006].
- HYMAN, H. (1951) Interviewing as a scientific procedure. IN LERNER, D. & LASSWELL, H. D. (Eds.) *The policy sciences: recent developments in scope and method*. Stanford, Stanford University Press.
- INDIAN-AND-NORTHERN-AFFAIRS-CANADA (2006) *Northern oil and gas annual report 2005* [online]. Available From: http://www.ainc-inac.gc.ca/oil/Pdf/report05_e.PDF. [Accessed 3 October 2006].
- LINSTONE, H. A. & TUROFF, M. (1975) Introduction. IN LINSTONE, H. A. & TUROFF, M. (Eds.) *The delphi method techniques and applications*. Reading, Addison-Wesley Publishing Company.
- NATIONAL-RESEARCH-COUNCIL (2005) *Polar icebreaker roles and U.S. future needs: a preliminary assessment*. Washington, The National Academies Press.
- PHARAND, D. (1984) *The Northwest Passage: Arctic straits*. Dordrecht, Martinus Nijhoff
- ROBERTSON, F. (2006) *The mission of the Canadian Coast Guard in the Arctic*. ICETECH 2006 International Conference and Exhibition on Performance of Ships and Structures in Ice, July 16-19, 2006, Banff, Alberta.
- ROBERTSON, F. (RobertsonF@DFO-MPO.GC.CA) 16 June 2007 *Question on CCG capability*. e-Mail to J. Parsons (JIM.PARSONS@MI.MUN.CA)
- ROBSON, C. (2002) *Real world research: a resource for social scientist and practitioner-researchers*. 2nd. Oxford, Blackwell Publishers Ltd.
- SAUNDERS, M., LEWIS, P. & THORNHILL, A. (2007) *Research methods for business students*. Harlow, Prentice Hall.
- STRAUSS, A. & CORBIN, J. (1990) *Basics of qualitative research: grounded theory procedures and techniques*. Newbury Park, Sage Publications.
- STRAUSS, A. & CORBIN, J. (1998) *Basics of qualitative research: techniques and procedures for developing grounded theory*. Second. Thousand Oaks, Sage Publications.

RECONFIGURING GLOBAL SUPPLY CHAINS: A STRATEGIC REVIEW OF CANADIAN ICEBREAKER SERVICES

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Abstract

Global warming presages increasingly ice-free waters in the Canadian Arctic and scope for a fundamental reconfiguration of Asia-Europe and Asia-US East Coast supply chain networks. Despite retreating perennial Arctic sea ice the vast geography of the Arctic poses significant challenges in supplying support networks in remote locations. To support future developments, the capabilities of the Canadian Coast Guard (CCG) icebreaker fleet will be crucial. This paper reports on research which aimed to synthesize experts' perceptions of future marine activity in the Canadian Arctic and to analyze CCG services, principally Arctic icebreaking, in terms of their effectiveness and efficiency in the past, present, and future. A Delphi survey of expert opinions distilled the results of a literature review focused on current and future CCG services, Arctic climate change and its effect on transportation in the region, new icebreaking technology, privatization, and the growing demand for natural resources. The paper concludes by highlighting the requirements needed to ensure timely and uninterrupted marine transportation from vessels operating in these waters.

Keywords: global supply chain strategy, Northwest Passage, privatisation of ice-breaker services, Canadian Arctic, Delphi survey

Introduction

For centuries explorers sought a route through the Arctic linking Europe and Asia. John Cabot proposed a Northwest Passage in 1490 and Roald Amundsen made the first ship transit in 1905 (Pharand, 1984, 38). Interest in the Arctic region, whether stemming from climate change or its abundance of natural resources, is high on the agenda of many nations. The annual extent of Arctic ice coverage is retreating at a notable rate and it is estimated that the Canadian Arctic will experience nearly ice-free summer seasons starting as early as 2050 but probably not before 2100 (Falkingham, 2004, A-5). NASA data shows that Arctic perennial sea ice shrank abruptly by 14% between 2004 and 2005 (Hupp and Brown, 2006). It would be logical to think that less ice should increase the ease and mobility for ships currently working in Arctic regions and also for those ships that may be contemplating future activity. Milder sea ice conditions may present new merchant shipping opportunities by way of the shorter distances available to Europe-Asia and East Coast North America-Asia traffic. In terms of marine transportation, increased activity will probably result in new and increased business as a virtuous circle of business and economic activity appears to be moving northward (National-Research-Council, 2005, 3).

On a global scale, Arctic regions are rich in natural resources, holding about 25% of the world's undiscovered petroleum resources (Ahlbrandt and McCabe, 2002). On a local scale, Canada's Arctic regions are estimated to hold one third of its remaining recoverable natural gas and one quarter of the remaining recoverable light crude oil (Indian-and-Northern-Affairs-Canada, 2006, 7). Cruise ship activity is increasing and fishing fleets have already begun to follow the fish stocks that migrate northward as the ice edge retreats (National-Research-Council, 2005, 24). Any increase in activity will increase the necessity to respond to accidents and create a greater need for law enforcement in ice margin areas, which will increase the need for ice-capable ships in the Arctic (National-Research-Council, 2005, 25).

Literature Review

With respect to Canada's sovereignty and adequate resources to enforce it, Carnaghan and Goody (2006) concluded that the views of Canadian academics differ. Huebert's (2003) view that Canada presently has insufficient resources to enforce its sovereignty in the Canadian Arctic contrasts with Griffiths' (2003) view that Canada's effort in enforcing its sovereignty in the region is sufficient. CCG commissioner G. Da Pont states that, while the CCG currently plays a significant role in the Arctic, nothing is certain as to the extent of its role in the future (Binkley, 2006, 9). He considered that neither Russians nor Canadians have the commercial infrastructure in place to support increased vessel traffic in their respective Arctic waters. Arctic icebreaking vessels constitute a significant financial investment. To rebuild the current Canadian icebreaking capability will cost \$CAD 2-3B and to build the fleet required to meet anticipated future demand will cost \$CAD 10B (Robertson, 2006). Securing such monies may not be easy for the CCG as it is currently experiencing a funding gap of about \$CAD 55M (Department-of-Fisheries-and-Oceans-Canada,

2006). Reports from the office of the Auditor General from 1997 to February 2004 note a lack of adequate and effective management of capital and human resources by the Department of Fisheries and Oceans (DFO) in fleet management of icebreakers in the Maritimes Region of Canada (Clemens et al., 2004, 5). These issues are not new and changes are needed. Cutting edge icebreaking technology is being implemented in new tonnage currently under construction in European and Far East ship yards, for operations in the Arctic regions of the world. Arctic nations such as Sweden, Finland, Russia, and the United States are currently availing themselves of private involvement in the execution of their icebreaking operations.

Saunders *et al.* (2007) describe exploratory research as being initially broad but becoming progressively narrower as a result of any, or a combination, of a literature review, the interviewing of experts, and conducting focus group interviews. Our initial review of literature focused on the major themes of Arctic maritime transportation, Arctic resources, climate change, icebreaking technology, the CCG, the Arctic Council, privatization, risk management, and insurance. As a next step, Delphi methods are appropriate to gather data not previously gathered, known or available (Linstone and Turoff, 1975).

Delphi study

A Delphi exercise consisting of three rounds of questioning was conducted to enhance research sensitivity. The questions posed in the first round were founded on the results of the literature review and focused mainly on current and future CCG levels of services, Arctic climate change and its affect on transportation in the Arctic regions, new icebreaking technology, the global status of Arctic icebreakers, privatization, and the growing demand for natural resources in politically stable but rather remote and harsh environments. Potential panellists were identified through the literature review, as well as from personal meetings at conferences related to the research topic. The exercise was carried out independently by panellists using an e-mail based survey. Table 1 shows the number of panellists, questions and the average percentage of majority opinion (APMO) in the Delphi exercise.

	Round 1	Round 2	Round 3
Participants	32	27 of 32	23 of 27
Questions	32	44	21
APMO (%)	49.26	41.90	37.18

Table 1: Summary of Delphi Exercise

The Average Percentage Majority Opinion (APMO) (Abdel-Fattah et al., 1999; Makukha and Grey, 2004; Islam et al., 2006), enumerated as the ((Aggregate of Majority Agreements + Aggregate of Majority Disagreements)/ Total Opinion expressed x 100), was used to determine whether consensus was reached on each statement provided. In the first round of questioning the APMO of 49.26% generated 44 statements for the second round. At 66.6%, 75% and 85% respectively, 144, 160 and 181 statements would have been generated, deterring most individuals from participating further. The round two APMO of 41.90% generated 21 statements for round three. With an APMO of 37.18%, consensus was attained on 17 of the 21 statements.

Results

Nine major issues summarise the findings of the Delphi study relating to future ice conditions, transit traffic, icebreaker capabilities, CCG services and organisation, vessel movements, icebreaker deployments, privatization and resource issues.

Future ice conditions in Arctic waters (original statement no. 3)

Considerable uncertainty surrounds the extent to which perennial Arctic ice will retreat in terms of geographic location and when the Arctic Ocean may experience ice free summers. However, 12.5% more panellists agreed that the Arctic Ocean will experience ice free summers before the Northwest Passage (NWP). Of those panellists who disagreed, many agreed that parts of the Arctic Ocean along the Russian Northeast Passage (NEP) would be free of summer ice before the NWP. Also, many panellists found it hard to believe that if the Arctic Ocean were to become ice-free, the NWP might not do so. There was strong agreement with the view that as the annual Arctic sea ice reduces it will make it easier for perennial Arctic Ocean ice to move south through the Canadian archipelago and thus block the many straits that vessels would have to transit in traversing the NWP or operating within the archipelago, thus impeding shipping movements.

Transit traffic through the NWP (original statements no. 1, 2)

With respect to vessel traffic traversing the NWP, there was consensus that panama size vessels of approximately 60K DWT would not be able to do so for nine months of the year with icebreaker assistance by 2020. However, it was expected that such vessels would be able to do so by 2050.

Arctic traffic and icebreaker capabilities (original statements no. 4, 5, 6, 25, 26)

In comparing 2006 traffic volumes with anticipated volumes in 2020, there was significant agreement that traffic volumes will more than double in all Arctic regions. In terms of icebreaking capabilities, while the vast majority of panellists agreed that the current capabilities of the Canadian Coast Guard (CCG) are suitable for current Arctic shipping activity, they do not believe that Canada or other Arctic nations currently have the capabilities to meet the anticipated Arctic shipping demands of 2020.

CCG levels of service (original statements no. 7, 8, 9, 10, 11)

Although panellists agreed overall that the current level of ice routing and information service would be suitable for Arctic shipping activity in 2020, they did not agree that the current level of route assistance service would be suitable for shipping activity in the Arctic in 2020.

With respect to harbour breakout service, panellists felt that while the CCG does have the capacity to meet current demands, it will require more icebreakers to meet future demands. Further to this, panellists strongly believed that more hydrographic survey work is required in the Arctic and that some harbours will require dredging.

Regarding the limited demands currently made on the CCG in terms of the northern resupply service, panellists agreed that the CCG would be able to satisfactorily continue this service up to 2020 with the icebreaking fleet currently available. However, they did not agree that the same would be true in terms of the sovereignty service.

Organizational and operational aspects of the CCG (original statements no. 16, 17, 18, 22, 23, 27)

On 1 April 2005, the CCG became a Special Operating Agency (SOA) within Fisheries and Oceans Canada (FOC). Half of the panellists were unable to comment on whether SOA status would significantly increase the level of services being currently provided in the Arctic, but 43.75% of the remaining panellists agreed that it would not. The reasons noted for this included an unchanged CCG budget, that CCG has not displayed any ability to operate in a more efficient manner, and a lack of funding for the CCG. Notwithstanding the above, panellists did agree that the level of service has remained the same. Panellists also agreed with the statement that the reason why the CCG was made a SOA was to address the marine transportation issue and ensure that CCG funding goes to where the allocation was intended rather than FOC imperatives. However, three times as many panellists agreed that the focus is actually being taken further away from transportation issues.

Considering the funding of icebreakers, panellists agreed that this is inadequate both in Canada and globally. With respect to user service fees, there was overall agreement that the CCG should charge icebreaker service fees north of 60 degrees latitude.

The CCG civilian fleet of approximately 107 vessels is deployed, maintained and operated by five regions spread across Canada with each region operating according to its own practices and management preferences. With respect to this decentralization of fleet operations, approximately 6% more panellists agreed that it resulted in overall significant duplication of human resource effort within FOC with respect to Arctic operations. However, there was significant agreement among panellists that the regions exist to meet the specific needs of distinctly different geographic areas and that since the officers are in a pool and the fleet is multi-tasked the regional approach is probably most effective. In terms of national standards, of the slightly less than 50% of the panellists who commented, all but two agreed that the icebreaker fleet is currently being managed with national standards and the regions are well coordinated. Despite the aforementioned, of the panellists that commented, more agreed that the regions generally ignore national standards where they do exist, national standards are incomplete, there is no internal audit process visible for these standards, and there is still little coordination among the regions. With respect to standardization of practices for the icebreaker fleet and the CCG following the United States Coast Guard (USCG) operational structure of being viewed as a unique asset, of 52% of panellists who commented, approximately four times as many agreed with this view. However, there was significant overall agreement that Canada needs the best, most effective and responsive system for its icebreaker fleet and not one that necessarily matches the USCG. Despite many of the panellists agreeing with the view that the CCG needs to standardize its practices and be viewed as a unique asset, there

was overall agreement that the actual USCG structure is not an example for Canada to follow and that it is even less effective than the CCG structure.

The six CCG icebreakers used for Arctic operations are operated out of four regions: Pacific, Quebec, Maritimes, and Newfoundland and Labrador. The fifth region, Central and Arctic, however is responsible for icebreaking in the Arctic. While there was no overall agreement that this decentralization of fleet operations results in ineffective interregional communication and consequently underutilization of vessels in the Arctic, slightly more panellists agreed that it did lead to icebreaker underutilization. Notwithstanding the above, there was overall agreement that vessel utilization is more a function of budget and less of organization, and Arctic deployments of icebreakers are reasonably well coordinated. In addition, there was even greater overall agreement with the view that from an operations perspective a central control point is important for the coordination of six icebreakers operating in a harsh northern environment.

Merchant vessel movement in the Canadian Arctic (original statements no. 12, 13)

The movement of merchant vessel traffic is controlled by two conventions. An older and more rigid 'Zone/Date Shipping Safety Control Scheme', based on rigid controls stipulating the dates that vessels of various ice strengthening may navigate within the sixteen shipping safety control zones of the Canadian Arctic underpins a more flexible 'Arctic Ice Regime Shipping System' (AIRSS) framework indicating whether or not a given set of ice conditions will be safe for a particular vessel. Panellists strongly agree that the Zone/Date system is inappropriate for current day Arctic shipping activity, due to less severe ice conditions during recent summer seasons, and that the AIRSS system is more appropriate. Vessels are currently allowed to exploit both systems to their advantage when operating in the Canadian Arctic.

Icebreaker deployment in the Canadian Arctic (original statements no. 14, 15, 21)

The geographic expanse of the Canadian Arctic is divided into twelve service areas for the provision of the primary levels of service, noted earlier, offered by the CCG throughout the summer season. This system is referred to as the 'Block Commitment' system. While half of the first round panellists were unable to comment on the effectiveness of this system, three times as many of those who did comment agreed that the system was effective. However, a significant number agreed that the system was outdated and needed to have greater flexibility and updating given the changing environmental condition in the Arctic. It is also important to note that during subsequent rounds, panellists agreed that the system itself is the result of a limited number of icebreakers and thus not very effective from a service point of view.

All CCG vessels are multi-tasked. Six of the 17 icebreakers spend the summer months engaged in activities in the Arctic and the winter months engaged in activities along the east and west coasts of Canada. While approximately 10% more panellists agreed that year round utilization of these six icebreakers costs Canadian taxpayers more than only utilizing them during the winter months, there was strong agreement among the panellists that it was best to utilize the hardware and human resource all year round. There was strong agreement that CCG undoubtedly faced high fixed capital and operational costs.

Whilst there was no overall agreement that Canada should immediately acquire icebreaking capability for year-round winter navigation in the Arctic, more panellists agreed with the statement than disagreed. However, while there was overall agreement that operating icebreakers year-round in the Arctic would be very expensive and that currently there are no commercial clients or compelling sovereignty arguments for year-round operations, panellists also agreed that Canada should have this capability by no later than 2015. There was also agreement that the technical requirements for year-round navigation in the Arctic are non-trivial, probably beyond present reach, and that Canada should adopt a staged approach to this. There was also overall agreement that Canada should build more vessels of moderate capacity than one very powerful and costly icebreaker and that icebreakers are needed where commercial vessels will go.

Privatization of CCG services in the Arctic (original statements no. 19, 20)

The CCG offers a wide range of services in the Arctic. Even though Canadian taxpayers are burdened with the high financial cost associated with the construction and maintenance of ice breaking vessels, there was overall agreement that it would not be appropriate for the ice breaking component of the CCG range of services, in the Arctic, to be privatized. Notwithstanding this there was overall agreement that private involvement in carrying out the level of services currently provided for by the CCG in the Arctic would not weaken Canada's position with respect to sovereignty in the Arctic.

Arctic hardware and human resources (original statements no. 24, 28, 29, 30, 31, 32)

There was overall agreement among panellists that the vast geography of the Arctic poses significant challenges to Canada and other maritime nations in terms of human resource management on board their icebreakers working in the Arctic. In addition, there was overall agreement that by 2020 maritime operations in the Arctic will involve a wide range of services, and that given the relatively small human presence stationed on land in the Arctic most of these services will be conducted from mobile floating platforms.

With respect to global icebreaking capacity, there was overall strong agreement that there was no need for all maritime nations of the world to immediately acquire icebreaking capability for either summer or year-round navigation in the Arctic. Further to this, there was overall agreement that while Russia currently has icebreaking capability for year-round navigation in the Arctic, it was not necessary for the seven remaining nations of the Arctic Council to immediately acquire icebreaking capability for year-round navigation in the Arctic.

Conclusions and Recommendations

Currently, the Arctic regions of Canada, and for the most part the entire Arctic region north of 60 degrees latitude, are not conducive to year-round navigation of merchant vessels and to some degree even government owned icebreakers. While future Arctic shipping activity is anticipated to significantly increase with the retreat of perennial Arctic sea ice, the infrastructure required to support global supply chains is notably lacking. While icebreaker capabilities are considered suitable for current merchant shipping activity, they are not suited to the anticipated shipping activity of 2020 and beyond. Much of the Arctic is poorly charted and in some areas no navigational charts are available. Navigational aids are sparse and often only provided seasonally. Vessel repair facilities are sparse and limited in their scope of work. Emergency response capabilities are limited and geographically challenged. Finally, the impact of year-round Arctic shipping activity on the livelihoods of native inhabitants has not been fully addressed. Through a mix of unilateral and multilateral actions, Canada and other Arctic Council nations need to quickly decide upon and begin to develop, install and enhance relevant infrastructure comprising modern icebreaking capabilities, deepwater ports, repair and refuelling facilities, aids to navigation, and emergency response organizations. Involving the local inhabitants will be imperative.

Further research is required to canvas the in-depth opinions of local experts relating to various models which may underpin the ownership, organisation and management of relevant infrastructure. This research, although initially qualitative and based on grounded theory approaches will require mixed methods supported by a quantitative survey to triangulate the findings and estimate the extent of support for new initiatives.

References

- Abdel-fattah, N., Grey, R. & Cullinane, S. (1999) *Road freight and privatisation: the case of Egypt*. Ashgate.
- Ahlbrandt, T. S. & McCabe, P. J. (2002) Global petroleum resources: a view to the future. *Geotimes*, 47, (11) 14-20.
- Binkley, A. (2006) New Coast Guard commissioner wants agency, shipping industry to reopen dialogue. *Canadian Sailings*.
- Carnaghan, M. & Goody, A. (2006) *Canadian Arctic Sovereignty* [online]. Available From: <http://www.parl.gc.ca/information/library/PRBpubs/prb0561-e.htm>. [Accessed 20 July 2007].
- Clemens, J., Mullins, M., Veldhius, N. & Glover, C. (2004) Government Failure in Canada, 1997-2004. *Public Policy Sources*. Vancouver, The Fraser Institute.
- Department of fisheries and oceans Canada (2006) Canadian Coast Guard - A Special Operating Agency. Ottawa,
- Falkingham, J. (2004) *Sea Ice in the Canadian Arctic*. Arctic Marine Transport Workshop, 49.
- Griffiths, F. (2003) The shipping news: Canada's Arctic sovereignty not on thinning ice. *International Journal*, 58, (2) 257-282.
- Huebert, R. (2003) The shipping news part II: how Canada's Arctic sovereignty is on thinning ice. *International Journal*, 58, (3) n/a.
- Hupp, E. & Brown, D. (2006) *NASA Sees Rapid Changes in Arctic Sea Ice* [online]. Available From: http://www.nasa.gov/home/hqnews/2006/sep/HQ_06315_sea_ice.html. [Accessed 10 October 2006].
- Indian and northern affairs Canada (2006) *Northern oil and gas annual report 2005* [online]. Available From: http://www.aicn-inac.gc.ca/oil/Pdf/report05_e.PDF. [Accessed 3 October 2006].
- Islam, D. M. Z., Dinwoodie, J. & Roe, M. (2006) Promoting development through multimodal freight transport in Bangladesh. *Transport Reviews* 26, (5) 571-591.

- Linstone, H. A. & Turoff, M. (1975) Introduction. IN LINSTONE, H. A. & TUROFF, M. (Eds.) *The delphi method techniques and applications* Reading, Addison-Wesley Publishing Company.
- Makukha, K. & Grey, R. (2004) Logistics partnerships between shippers and logistics service providers: the relevance of strategy. *International Journal of Logistics: Research and Applications*, 7, (4) 361-377.
- National research council (2005) *Polar icebreaker roles and U.S. future needs: a preliminary assessment*. Washington, The National Academies Press.
- Pharand, D. (1984) *The Northwest Passage: Arctic straits*. Dordrecht, Martinus Nijhoff
- Robertson, F. (2006) *The mission of the Canadian Coast Guard in the Arctic*. ICETECH 2006 International Conference and Exhibition on Performance of Ships and Structures in Ice, July 16-19, 2006, Banff, Alberta.
- Saunders, M., Lewis, P. & Thornhill, A. (2007) *Research methods for business students*. Harlow, Prentice Hall.

Northern opportunities: a strategic review of Canada's Arctic icebreaking services

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Abstract

Climate change presages increasingly ice-free waters in the Canadian Arctic and scope for a fundamental reconfiguration of Asia-Europe and Asia-US East Coast supply chain networks via the Northwest Passage and other Arctic routes. Retreating sea ice will also impact the annual re-supply of goods to northern communities, the development of natural resource projects, cruise ship and adventure tourism activity, and the fishing industry. A review of the infrastructure required to support expectations of increased Arctic shipping and Panamax ships traversing the Canadian Arctic is imperative. Even today, the vast geography of the Arctic poses significant challenges in supplying support networks in remote locations. To support future developments, the capabilities of the Canadian Coast Guard (CCG) icebreaker fleet and the private sector will be crucial. This paper will report on research which aimed to synthesize experts' perceptions of future marine activity in the Canadian Arctic and to analyze CCG services, principally Arctic icebreaking, in terms of their effectiveness and efficiency in the past, present, and future. It will also report on the identification and evaluation of possible private involvement in the delivery of CCG services, principally icebreaking, in the Arctic. The paper concludes by highlighting the requirements needed to ensure timely and uninterrupted marine transportation from vessels operating in these waters.

Introduction

For centuries explorers sought a route through the Arctic linking Europe and Asia. John Cabot proposed a Northwest Passage in 1490 and Roald Amundsen made the first ship transit in 1905 (Pharand, 1984, 38). Interest in the Arctic region, whether stemming from climate change or its abundance of natural resources, is high on the agenda of many nations. The annual extent of Arctic ice coverage is retreating at a notable rate and it is estimated that the Canadian Arctic will experience nearly ice-free summer seasons starting as early as 2050 but probably not before 2100 (Falkingham, 2004, A-5). However, things appear to be happening much faster in the Arctic and there is much debate and uncertainty as to when the Arctic will actually experience ice-free summers, it could be as early as 2015 (Leahy, 2008). NASA data shows that Arctic perennial sea ice shrank abruptly by 14% between 2004 and 2005 (Hupp and Brown, 2006). It would be logical to think that less ice should increase the ease and mobility for ships currently working in Arctic regions and also for those ships that may be contemplating future activity. Milder sea ice conditions may present new merchant shipping opportunities by way of the shorter distances available to Europe-Asia and East Coast North America-Asia traffic. In terms of marine transportation, increased activity will probably result in new and increased business as a virtuous circle of business

and economic activity appears to be moving northward (National-Research-Council, 2005, 3).

On a global scale, Arctic regions are rich in natural resources, holding about 25% of the world's undiscovered petroleum resources (Ahlbrandt and McCabe, 2002). On a local scale, Canada's Arctic regions are estimated to hold one third of its remaining recoverable natural gas and one quarter of the remaining recoverable light crude oil (Indian-and-Northern-Affairs-Canada, 2006, 7). Cruise ship activity is increasing and fishing fleets have already begun to follow the fish stocks that migrate northward as the ice edge retreats (National-Research-Council, 2005, 24). Any increase in activity will increase the necessity to respond to accidents and create a greater need for law enforcement in ice margin areas, which will increase the need for ice-capable ships in the Arctic (National-Research-Council, 2005, 25).

Literature Review, Delphi Exercise and Grounded Theory

A literature review and a scoping exercise consisting of three rounds of Delphi with 32 initial participants have been completed. It was concluded that there is considerable uncertainty with respect to the future state of Arctic sea ice but there will undoubtedly be increased shipping activity. The CCG is currently not capable of dealing with the anticipated increase in future demand, and currently the Arctic suffers from a significant shortage of supporting infrastructure and services demanded of a global supply chain network. Subsequently, in-depth and semi-structured interviews with eight participants, inspired by the Delphi results, were conducted and analysed using inductive and deductive analysis adhering to the constant comparative method of grounded theory methodology in developing a substantive theory. Some of the hypotheses and relationships formulated suggest that: Canada's Arctic will be developed regardless of the presence and assistance of the CCG, Canada would benefit from regaining its expertise in designing and building icebreakers and becoming less dependent on other shipbuilding nations, and private involvement in the delivery of CCG services in the Arctic will result in less tax dollar spending. In attempting to triangulate the research findings noted above, the hypotheses and relationships formulated from inductive and deductive analysis have been tested using a Likert style quantitative survey with 110 participants and were subjected to quantitative analysis.

Survey Aim

The main aim of the survey was to test the incidence of some of the hypotheses and relationships developed in the earlier grounded theory work and to a lesser extent the Delphi exercise. Part A of the questionnaire was used to capture demographics, a respondent profile, and subject risk profiles. It was also used to test grounded theory findings dealing with contract durations and to help triangulate Delphi results dealing with the retreat of ice in the Northwest Passage. First, twenty one questions from Part B of the survey were analysed to report on the attitude of survey subjects with respect to grounded theory hypotheses and relationships surrounding private management and crewing of CCG icebreakers, private involvement in the design and construction of CCG icebreakers, and the leasing and chartering of privately owned icebreakers to the CCG. Finally, all questions from Part B of the survey were analysed on a multivariate basis in an attempt to identify any undiscovered latent structure.

Sample Size, Techniques and Selection Strategy

Population, elements, population framework, sample and subjects are all terms associated with sampling. Sampling, according to Stephan and McCarthy (1965, 12), allows for a compromise between the time and financial pressures associated with a census, an extreme case of sampling. Non-probability sampling, as was conducted in this survey, avails of sample subjects that are rich in information and more appropriately suited to the research topic (Patton, 1990, 169).

There are numerous sampling techniques available to a researcher. However, Lee (1993) warns that while the two main aims of sampling are representativeness and cost-effectiveness, neither may be easily attainable when researching sensitive or politically controversial topics. Unlike quantitative researchers utilizing large samples sizes in seeking statistical significance, one of the key features of qualitative sampling according to Miles and Huberman (1994, 27) is the careful selection and use of a small number of contextually nested people who are studied in-depth. In research dealing with political and or social issues that are not widely acknowledge, Lee (1993, 61) warns of the difficulties in trying to generate statistically adequate samples and that the subsequent use of non-probability sampling may result in the research not being taken seriously. Regardless, it is felt by the researcher that a start has to be made in bringing these less known matters to public attention. In terms of the best sampling method or technique, Stephan and McCarthy (1965) suggest that there is no need to copy exactly the approach of others but rather it is more important to meet the particular needs of the researcher. This idea is supported by Patton (1990) who notes that the key to deciding on the unit of analysis for a study is ultimately influenced by the amount of authority that the researcher wishes to proclaim. A respondent profile is shown in Table 1.

While Table 1 groups the background of respondents into nine classes, some analysis of the survey findings using the Statistical Package for the Social Sciences (SPSS) groups the respondents in four prime classes, namely Academia, Business, Government, and Mariner; or two prime classes, namely Mariner or Non-Mariner. While a large sample size is often sought after, Stephan and McCarthy (1965, 103) suggest that in some cases a small sample may be more representative than a large sample and the more information the sampler has about the population the more effective survey efforts should be. In the case of this research, where there was no sample or population frame available and therefore non-probability sampling is called for (Saunders et al., 2007, 235), the sample consisted of a relatively small number of experts and stakeholders in Arctic matters. Given the subject matter of the research, it was expected that there would be a varying extent of expertise and stakeholder interest amongst the sample subjects. With respect to survey non-response, Neuman (2007, 186) warns of the sampling bias, and problems with generalizing results, that can be introduced when high proportions of a particular group, or strata, of the sample subjects do not respond. Research dealing with political issues may be seen by some groups as sensitive or threatening and consequently they may decline to participate (Lee, 1993). As it was experienced in the earlier Delphi exercise, CCG personnel were instructed by Fleet Directorate not to participate in the survey. Willimack et al. (2002, 215) note that with respect to business type surveys, university researchers tend to experience higher non-response rates than do government agencies. Saunders et al. (2007, 213) note the need to report survey response rates; the total response rate for this survey was 34.05 percent while the active response rate was 39.71 percent.

Table 1 Respondent profile for the 110 survey participants

Profile	Percentage of Total
Age	
20-30	10.0
31-40	11.8
41-50	32.7
Over 50	45.5
Gender	
Female	3.6
Male	96.4
Place of Residence	
Western Canada	17.3
Central Canada	18.3
Eastern Canada	50.9
Northern Canada	3.6
Other	9.9
Years dealing with Arctic Matters	
<6	37.9
6-10	9.8
11-15	6.8
16-20	15.5
>20	30.0
Working in a Private or Public Organization	
Private	55.0
Public	45.0
Background	
Academia	8.2
Business	26.4
Government	8.2
Mariner	10.0
Mariner & Academia	13.6
Mariner & Business	18.2
Mariner & Business & ex Canadian Coast Guard	3.6
Mariner & Government & Canadian Coast Guard	5.4
Other Combinations	6.4

Equation 1: **TRR** = total number of responses / (total number in sample – ineligible)

With respect to this survey: **TRR** = 110 / (406 – 83) = 34.05%

Equation 2: **ARR** = total number of responses / ((total number in sample – (ineligible + unreachable))

With respect to this survey: **ARR** = 110 / ((406 – (83 + 46)) = 39.71%

Sample subjects were identified through the following means:

- Literature review;
- Attending Arctic related events such as conferences and seminars;
- Individuals previously known to the researcher;
- Colleagues;
- Personal contacts;
- Lloyd's Maritime Directory 2008 (Canada only, under the following groups).
 - Shipowners/Managers/Operators;
 - Banking and Finance;
 - Associations;
 - Classification Societies;
 - Marine Consultants and Surveyors;

- Insurance and P&I Clubs;
- Ship Management Services;
- Maritime Solicitors and Lawyers

Miles and Huberman (1994, 36) note that in the case of an applied, evaluation, or policy study the focus is tighter and the instrumentation is closely keyed to the variables of interest; instrumentation should be a function of the conceptual focus, research questions, and sampling criteria.

Survey Rationale and Arrangement

In an attempt to triangulate the outcomes of the Delphi and grounded theory work conducted earlier, a Likert style survey was constructed to measure the attitudes of Arctic experts and stakeholders against these earlier results. Presser (1984, 95) defines a survey as any data gathering process in which the aggregates of human response, and not that of particular individuals, is of interest. The survey was broken into two parts. While Part A of the survey is not the main focus of this paper, Part A of the survey was used to try and gain insight with respect to the varying levels of business risk that survey participants were willing to accept. Three scenarios, each having different probabilities, and three contracts were offered. Survey participants were asked to prioritize in the selection of the three contracts. In subsequent questions, the contract conditions were altered slightly and the participants were again asked to prioritize the selection of the three contracts. The answers to Part A were subjected to Hurwicz criterion; the processing of imprecise risk information in which a decision value is the weighted sum of its pessimistic and optimistic evaluation (Jaffray and Jeleva, 2007). This was done to see if the participants did in fact match up with the risk profile they chose in Question 1 of Part A of the survey. Part B of the survey, the main focus of this paper, comprised of 45 statements that were founded on the hypotheses and relationships developed during the earlier grounded theory component of the research.

Parametric, Non-parametric, Descriptive, and Inferential Statistics

Test and analysis using the more powerful parametric statistics are intended to be used with interval or ratio measurements scales (Foster, 2001, 7); normal distributions having zero skewness and kurtosis, a symmetrical distribution with the same mean and median, and a *Kolmogorov-Smirnov Z* test yielding a confidence level of 0.05 or higher (de Vaus, 2004). Foster (2001, 11) refers to such distributions as being perfect. Such precise parametric requirements were not experienced in the vast majority of distributions associated with this quantitative survey. Notwithstanding the above, Evans (2007, 60) notes that coefficients of skewness having an absolute value between 0.5 and 1 are only moderately skewed and that coefficients between 0.5 and -0.5 indicate relative symmetry. For this survey, 64 percent of the distributions had skewness coefficients between 0.5 and -0.5. de Vaus (2004, 76) suggest that as a rule of thumb, a distribution experiencing a skewness coefficient absolute value of less than 1.0 is indicative of symmetry. *Kolmogorov-Smirnov Z* tests conducted on 27 variables, shown in tables 2, 3, 4 and 5 below, showed values ranging from 3.4 to 5.7, and all with significance values of 0.00. In bolstering the use of parametric statistics with non-normal distributions, the central limit theorem allows for this in the case of large sample sizes of 100 or more, as was the case with this survey where there were 110 subjects (Ibid). Neuman (2007, 149) however, associates the central limit theorem with random sampling, which was not the case in this survey. Foster (2001, 7) suggest the use of non-parametric tests when using an ordinal measurement scale.

Descriptive statistics avails of quantitative measures to describe data and include frequency distributions and histograms, measures of central tendency, and measures of dispersion (Evans, 2007, 47). It allows for description and summary of the data or the relationships between variables in the data (Babbie et al., 2007, 270). Analysis of the twenty seven questions, noted earlier, to help fulfil research objective six with respect to the evaluation of different models of privatization and the forms they might take, will rely heavily on descriptive statistics. Inferential statistics allows for the generalization or drawing of conclusions from a sample to a wider population (Foster, 2001, 6). However, in order to make such statistical inferences, Saunders et al. (2007, 207) stress the need for probability sampling, while non-probability sampling techniques were availed of in this survey.

Survey Findings

The relatively low count in many of the statements in tables 2, 3, 4 and 5 may suggest that subjects had difficulty in taking a position on some of the issues and ideas put forward. This is not surprising given the wide range of statements and the diversity of the sample. In Part B of the questionnaire, there was a strong positive correlation noted between the statements having higher counts, 105 and higher, and the number of subjects expressing strong agreement. The statement counts ranged from a low of 79 to the maximum possible of 110; the average count was 99.

Question 4 in Part A and statements 28 and 44 in Part B deal with the issue of contract durations. It was hypothesized in the grounded theory work that the Canadian Government would need to engage in long term contracts with the private sector when it came to the chartering of icebreaker services in the Arctic. Statements 28 and 44, presented below, show that the survey sample had a positive attitude toward this issue. However, this positive attitude was not clearly discernable in the results of Part A. In fact, given the uncertainty of future ice conditions, some subjects appeared to reject longer duration contracts that were not flexible with the environmental conditions.

The summary of statements and descriptive statistics shown in Table 2 are taken from Part B of the questionnaire and test general attitudes towards Canada's military and civilian roles in the Arctic, CCG terms of reference, Canadian Arctic expertise, involving local residents in Arctic development, and private involvement in delivering CCG services. Following the table are general comments on each individual statement followed by an overall section summary. With respect to the mean shown in Tables 2, 3, 4 and 5, 1=Strongly Disagree, 2=Disagree, 3=Agree, 4=Strongly Agree.

The mean for statements 1a and 1b indicates that overall, respondents expressed a negative desire to combine Canada's military and civilian roles in the Arctic, and for these roles to be managed by a newly created maritime organization. Closer analysis using SPSS crosstabs between Mariner and Non-Mariner prime classes showed that relatively, the greater percentage of disagreement in statements 1a and 1b came from the Non-Mariner class, the Government prime class to be more specific. Private involvement in the delivery of CCG services in the Arctic is expected to result in less tax dollar spending and respondents felt that Canadians in general would not object to privatizing icebreaking services in the north only. Closer crosstab analysis of statements 27 and 30 showed that the overall view of the Government class was opposite that of the Academic, Business, and Mariner classes. Relatively speaking, the vast majority of the Government class disagreed

with private involvement and agreed that the public would object to privatizing icebreaking services in the north and not in the south.

Table 2 Summary of survey statements testing general attitudes towards the Canadian Government and Arctic development

No.	Survey Statement	Count	% Agree	% Disagree	Mean
1a	Canada's military and civilian roles in the Arctic should be combined.	102	42.2	57.8	2.30
1b	Canada's military and civilian roles in the Arctic should be managed by a newly created maritime organization.	98	34.7	65.3	2.15
2	Separating CCG Hardware from CCG Services will aid in setting clearer terms of reference for the CCG.	93	43.0	57.0	2.26
11	Canada's Arctic would develop sooner if greater I/B capability were available on a year round basis.	108	74.1	25.9	2.97
21	Canada needs to enhance its Arctic expertise.	110	96.4	3.6	3.57
22	The local residents of Arctic regions need to be significantly involved in future Arctic developments.	109	95.4	4.6	3.39
27	Private involvement in the delivery of CCG services in the Arctic will result in less tax dollar spending.	100	67.0	33.0	2.76
30	The Canadian public in general will object to only privatizing icebreaking services in the north and not in the south.	92	44.6	55.4	2.49

Overall, most respondents disagreed that separating CCG Hardware and Services would assist in setting clearer terms of reference for it. The high number of strongly disagree responses, and current joint operation of hardware and services may suggest that defining clearer terms of reference for the CCG has nothing to do with private involvement and that a closer focus on the role of the organization may need to come from government. Closer analysis between Mariner and Non-Mariner prime classes showed that relatively, the greater percentage of disagreement in statement 2 came from the Non-Mariner class, the Government class to be more specific.

Respondents expressed a very strong belief that Canada needs to enhance its Arctic expertise. Crosstab analysis showed that while 96.4 percent of participants agreed with statement 21, 2.7 percent of the Business prime class and 0.9 percent of the Mariner prime class disagreed. In terms of expediting Canadian Arctic development via greater icebreaking capability on a year round basis, the mean for statement 11 shows that respondents were strongly in favour of this approach. Respondents also felt strongly towards Arctic development that called for increased involvement of local residents. Interestingly, with respect to the 4.6 percent disagreement in statement 22, crosstab analysis showed that 3.7 percent of it came from the Mariner class and 0.9 percent from the Non-mariner class.

In summary, the above results indicate that Canada should continue to keep its military and civilian roles separate in the Arctic. Canada also needs to avail of its local Arctic residents whilst enhancing its Arctic expertise, and there is support for private involvement in the delivery of CCG services in the Arctic. It could be suggested that, if Arctic icebreaking services were to be privatized, this might lead to a greater presence of private shipping activity. This in itself would result in the enhancing of Arctic expertise over time and it could be supplemented by availing of

the knowledge and experience of local residents given the current issues surrounding the shortages of qualified maritime human resources.

The summary of statements and descriptive statistics shown in Table 3 are taken from Part B of the questionnaire and test general attitudes towards private management and private crewing of CCG icebreakers. Following the table are general comments on each individual statement followed by an overall section summary.

Table 3 Summary of survey statements testing general attitudes towards private management and crewing of CCG icebreakers

No.	Survey Statement	Count	% Agree	% Disagree	Mean
23a	Private ship management companies operating in the Arctic would be more cost efficient than government.	102	87.3	12.7	3.15
23b	Private ship management companies operating in the Arctic would be more risk averse than government.	102	54.9	45.1	2.62
24	Private firms are able to manage CCG I/Bs more efficiently than the CCG through Public Works & Treasury Board.	95	65.3	34.7	2.82
25	Private management of the CCG fleet will resolve critical manning issues.	98	45.9	54.1	2.46
42	Canada's Arctic development would best be accomplished by having a private local company to manage and crew I/Bs that are built outside of Canada and leased to the CCG for year round operations in the Arctic.	100	49.0	51.0	2.49
45	Canadian taxpayers would benefit from having a fleet of competitively built, in Canada, Polar Class I/Bs that will be managed by competitive private firms.	99	64.6	35.4	2.75

In statement 23a, respondents were quite strongly in favour of the notion that private ship management companies operating in the Arctic would be more cost efficient than government. Of the 12.7 percent disagreement in statement 23a, 5.9 percent came from the Government class. With respect to Canadian taxpayers benefiting from having a fleet of icebreakers built competitively in Canada, to be managed by competitive private firms, respondents were less in favour of this idea. This marginally positive attitude in statement 45 is somewhat contrary of the stronger positive attitudes exhibited in statements 37, 34, 38a, 38b, and 40 with respect to designing and building icebreakers in Europe or the Far East. Thus, it may be suggested that taxpayers will benefit from competition. Crosstab analysis showed the general view of the Government class, who largely disagreed with statement 45, was contrary to the Academic, Business, and Mariner classes.

Respondents marginally felt that private companies would be more risk averse than government when operating in the Arctic. Throughout the research, the issue arose as to whether a private ship management company operating in the Arctic would risk its assets during the dangerous situations which may often arise. Given a mean of 2.62 and the relatively small numbers of subjects who expressed strong disagreement (7) or strong agreement (14) with statement 23b, the issue of risk aversion on the part of private interest would probably not be viewed as a major deterrent towards private involvement in the delivery of CCG services in the Arctic. Relatively, crosstab analysis showed the Academic and Mariner classes to be more in agreement with this statement than the Business and Government classes. It would seem prudent that private service contracts would need to address the issue of dealing with higher than normal risk situations.

In statement 24, respondents generally felt that private firms would be able to manage CCG icebreakers more efficiently than the CCG through Public Works & Treasury Board. Crosstab analysis showed the general view of the Government class, who largely disagreed with statement 24, was contrary to the Academic, Business, and Mariner classes. The low count (95) suggests that this statement proved difficult for some participants to take a position on. This is not surprising since some participants would likely have never had any dealings with Public Works and the Treasury Board. Notwithstanding the above, respondents generally felt that private management of the CCG fleet would not resolve critical manning issues. Again disagreeing, the general view of the Government class in statement 25 was contrary to the Academic, Business, and Mariner classes. CCG employees belong to large and influential unions. It may be that, unless the CCG fleet is crewed privately the critical manning issues may not be resolved. Looking at it differently, it may be that private management will not worsen an already critical situation.

Although marginal, respondents did not feel that Canada's Arctic development would best be accomplished by having a private local company manage and crew icebreakers built outside of Canada that would be leased to the CCG for year round operations in the Arctic. However, in light of the positive attitudes with respect to increased icebreaker capabilities on a year round basis, the efficiency of private companies, and the shipbuilding capabilities of foreign countries, exhibited in statements 11, 23a, 24, 38a, and 38b, it would appear that the negative attitude in statement 42 is connected with the leasing of the icebreakers to the CCG. Crosstab analysis of statement 42 showed the Academic and Government classes mainly disagreeing while the Business and Mariner classes were mainly agreeing.

In summary, the above results indicate that while a private ship management firm may be a little more reluctant than the government in deploying a ship into a high risk situation, the same firm would be more efficient at managing, and possibly crewing, CCG or privately owned icebreakers.

The summary of statements and descriptive statistics shown in Table 4 are taken from Part B of the questionnaire and test general attitudes towards icebreaker design and construction. Following the table are general comments on each individual statement followed by an overall section summary.

Overall, respondents felt strongly that experienced shipyards in European and the Far East were able to build an icebreaker faster and with greater efficiency and effectiveness than Canadian shipyards. Respondents felt that private firm were able to procure icebreakers more efficiently and effectively than the CCG through Public Works. They also felt that the CCG would be better off using a proven icebreaker design than they would be at having a new design created in Canada.

With a mean of 3.18, respondents felt strongly in statement 40 that unless Canada decides to invest in and build a substantial fleet of Polar Class icebreakers, thereby allowing for the flattening of learning curves and exploiting possible economies of scale and scope, taxpayers would benefit by having icebreakers built in foreign yards. In light of a mean of 2.90 in statement 38a, stating that other countries are able to build an icebreaker more effectively than Canada, respondents may be implying that Canada is more inept at building icebreakers than designing them.

Table 4 Summary of survey statements testing general attitudes towards icebreaker design and construction

No.	Survey Statement	Count	% Agree	% Disagree	Mean
34	It would be more efficient for the CCG to use a proven I/B design than to have a new I/B designed in Canada.	104	74.0	26.0	2.90
36	Private firms are able to design & build I/Bs more efficiently and effectively than the CCG through Public Works.	100	91.0	9.0	3.30
37	Canadian shipyards are unable to build a I/B as quickly as other experienced shipyards in Europe and the Far East.	100	83.0	17.0	3.13
38a	Other countries are able to build an I/B more effectively than Canada.	100	71.0	29.0	2.90
38b	Other countries are able to build an I/B more efficiently than Canada.	101	87.1	12.9	3.15
40	Unless Canada decides to build a substantial fleet of Polar Class I/Bs, it will cost less to have them designed and built in European or Far East yards.	98	90.8	9.2	3.18
43	The CCG would benefit from the acquisition of I/Bs designed and built by European or Far East yards to manage themselves.	102	59.8	40.2	2.64

The mean for statement 43 indicates that overall, the respondents were only slightly in favour of the CCG acquiring icebreakers from foreign shipyards to manage themselves. However, given the higher positive attitudes, means greater than 2.64, exhibited in some of the above statements dealing with the acquisition of I/Bs designed and built competitively outside of Canada, the sample may be suggesting that the CCG would be unable to extract the same gains as private industry in availing of shipyards outside of Canada. This may be connected with the fact that the CCG procure through public works and consequently lack the negotiating skills required in dealing directly with the shipbuilding industry.

In summary, the above results indicate that with respect to the interests of expediting Arctic development and spending less Canadian tax dollars, I/Bs should be procured by private firms availing of proven vessel designs and European or Far East shipyards. Crosstab analysis of the statements in Table 4 showed the trends in general attitude to be similar across the Academic, Business, Government, and Mariner classes.

The summary of statements and descriptive statistics shown in Table 5 are taken from Part B of the questionnaire and test general attitudes towards the leasing and chartering of icebreakers. Following the table are general comments on each individual statement followed by an overall section summary.

The mean for statements 26a, 26b, and 39 indicates that overall, respondents felt Canada would increase its presence, and its taxpayers would benefit, from the private Canadian ownership of a fleet of multifunctional ice class vessels to be used by the CCG, Canadian Military, and oil companies operating in the Arctic. Crosstab analysis showed that while the Academic, Business, and Mariner classes tended to mainly agree with these three statements, the Government class mainly disagreed.

Table 5 Summary of survey statements testing general attitudes towards the leasing and chartering of icebreakers

No.	Survey Statement	Count	% Agree	% Disagree	Mean
26a	Private Canadian ownership of a fleet of vessels used by CCG, Canadian Military, and oil companies in the Arctic will increase Canadian presence.	105	63.8	36.2	2.72
26b	Private Canadian ownership of a fleet of vessels used by CCG, Canadian Military, and oil companies in the Arctic will not jeopardise Canada's sovereignty.	102	67.6	32.4	2.78
28	Chartering out of private I/Bs to the Canadian Government will necessitate long term time charters.	100	89.0	11.0	3.16
39	Canadian taxpayers would benefit from the CCG and the military committing to charter a fleet of newly constructed and privately owned multi-functional ice class vessels that have the modular capability to meet their particular interest and will be time shared with oil companies operating in the Arctic.	98	69.4	30.6	2.85
41	In the absence of increased funding for the CCG, Canada's maritime requirements would be better served by setting up a Maritime Administration office which would be responsible for the development of CCG and DFO programmes and would avail of the existing CCG fleet, the leasing of private hardware and/or the contracting out of services.	93	64.5	35.5	2.67
44	Without its own fleet of Polar Class I/Bs the CCG will need to engage in a long term time charter for I/B services in the Arctic.	100	85.0	15.0	3.00

In statements 28 and 44, respondents expressed a positive attitude towards the notion that any chartering out of private icebreaking services to the Canadian Government will necessitate long term time charters. Crosstab analysis showed that while there was relatively little disagreement with statement 28 from the Academic, Business, and Mariner classes, there was no disagreement from the Government class. In statement 44 there was no disagreement from the Mariner class.

Respondents were in favour of creating a new maritime office or organization to deal with Canada's maritime requirements. Crosstab analysis showed the view of the Government class, mainly disagreeing with statement 41, to be contrary to the other classes.

In summary, the above results indicate that Canada's presence and sovereignty in the Arctic could be bolstered by the CCG, military, and oil companies availing of a privately owned fleet of multi-functional icebreakers on a long term contractual basis. While this idea is somewhat contrary to the negative attitudes exhibited in statements 1a and 1b, which suggest that Canada's military and civilian roles in the Arctic should be combined and managed by a newly created maritime organization, it does follow along the lines of creating a new maritime office to deal with Canada's maritime requirements. This idea was supported by respondents, in statement 41.

Measures of Frequency, Central Tendency and Correlations

In attempting to gain further insight and clearer understanding of the opinions expressed by the prime classes with respect to the possible forms of private involvement in Arctic icebreaking services, all twenty seven statements noted in the

four tables above were subjected to *Chi-Square*, *Mann-Whitney*, and *Kruskal Wallis* testing. Such testing was also availed of in an attempt to triangulate the survey findings above. Academic, Business, Government, and Mariner prime classes were compared in the *Chi-Square* and *Kruskal Wallis* tests. Mariner and Non-Mariner prime classes were compared in the *Mann-Whitney* test. For this research, *Chi-Square* was used to test whether the frequency distributions of the prime classes were independent of each other. Independence meaning that the proportion of individuals who chose to agree or disagree would be essentially the same no matter what prime class the individual belonged to. The null hypothesis being that the variables are independent. The *Kruskal Wallis* test was used to compare medians of Academic, Business, Government, and Mariner prime classes. The null hypothesis being that the medians are equal. The *Mann-Whitney* test was used to compare medians of Mariner and Non-Mariner prime classes. In these tests, the null hypothesis would be rejected in the case of a p-value <0.05. Hypotheses showing only that there is a difference, and no prediction as to where the difference lays, are referred to as non-directional (two-tailed) hypotheses (Collis and Hussey, 2003, 231). Alpha or significant values <0.05 for the various test and statements are shown in Table 6. With respect to statistical analysis, Foster (2001, 14) informs that in the event there is less than a 5 percent probability that the difference between groups is due to random, unexplained chance variation, then we assume that any difference noted between the groups is real or statistically significant. The caveat being that when assigning a p-value <0.05, there is up to a 5 percent chance of making a type 1 error. A type I error occurs when rejecting a null hypothesis which is actually true. A type II error occurs with failing to reject a null hypothesis when it is false.

Table 6 Summary of significant values

Test	Statements												
	1b	2	23b	24	25	26a	26b	27	30	39	41	42	45
Chi-Square	0.014	0.015	0.015	0.018			0.015	0.001	0.043	0.009	0.000	0.005	0.006
Kruskal Wallis	0.015	0.016	0.016	0.019			0.016	0.001	0.045	0.010	0.000	0.005	0.006
Mann-Whitney			0.002		0.048	0.038		0.038		0.034	0.003	0.008	0.019

In attempting to further explore the survey results and identify any relationships between survey statements, other than those founded on grounded theory and identified in Tables 2, 3, 4 and 5, the *Spearman rho* test, most often associated with ordinal data, was used to ascertain if there were correlations only, between variables. These correlations will help with triangulation by identifying if the statements grouped in Tables 2, 3, 4 and 5 are appropriately positioned. Correlation does not imply causation (Foster, 2001, 205). Positive and negative correlations vary from +1.00 to -1.00 respectively. A correlation of 0.00 is indicative of no simple linear relationship between variables. Adhering to the statements in Tables 2, 3, 4 and 5, the *Spearman rho* test was used to compare the variables on a bivariate basis; participant risk profiles of risk taker, risk neutral, and risk averse were added to the analysis to identify if certain risk types held different opinions with regards to the survey statements. With respect to participant risk profiles, weak negative correlations at the 95 percent level, -.215 and -.203, were noted in statements 34 and 37 respectively. Other significant correlations at the 95 percent level are shown in Table 7. T2 notes Table 2 statements, T3 Table 3, T4 Table 4, and T5 Table 5.

Table 7 Summary of significant values in *Spearman rho* test

Statements from Tables 2, 3, 4, and 5																					
	1a T2	1b T2	2 T2	11 T2	21 T2	23a T3	23b T3	24 T3	25 T3	26a T5	26b T5	27 T2	28 T5	34 T4	36 T4	37 T4	38a T4	38b T4	39 T5	40 T4	41 T5
0 2	0.47																				
2	0.33	0.53																			
1 2	0.31	0.30																			
1 2				0.33																	
2 2					0.27																
b 3						0.27															
4 3						0.54															
5 3						0.33	0.21	0.61													
b 5										0.65											
7 2		0.41	0.34																		
0 2												-0.28									
5 4														0.24							
7 4														0.21	0.23						
a 4														0.34	0.29	0.73					
b 4														0.22	0.45	0.80	0.72				
9 5										0.51	0.58										
0 4														0.27	0.27	0.60	0.61	0.57			
1 6										0.38	0.37								0.41		
2 4						0.25		0.50	0.32												
3 4														0.36		0.26	0.35	0.26		0.48	
4 6										0.36	0.30		0.30						0.31		0.4
5 6								0.36	0.37												

The significance and values of the correlations noted in Table 7 help bolster the appropriate placement of the twenty seven survey statements into their respective tables.

Simplifying Complex Matrices

It was felt by the researcher that earlier analysis was still lacking insight as to what the survey participants holistically considered to be important with respect to furthering private involvement in the delivery of icebreaking services in the Canadian Arctic. Also, earlier analysis reduced the forty five, fifty three in total when accounting for some statements having more than one part, survey statements to twenty seven and grouped these into four general topics which stemmed from the results of earlier Delphi and grounded theory work. In order to probe further, and attempt to triangulate earlier findings, factor analysis (FA) and

principal component analysis (PCA) was conducted on the results of the quantitative survey.

Tabachnick and Fidell (2001, 25) inform of empirical and theoretical approaches in trying to identify underlying latent structure in a set of variables; PCA being the empirical approach while FA and structural equation modelling belong to the theoretical approach. Both approaches involve statistical techniques aimed at reducing complex sets of correlation matrices by determining which correlated variables belong to homogenous subsets that are largely independent of each other (Kim and Mueller, 1978; Kline, 1994; Cudeck, 2000; Foster, 2001; Tabachnick and Fidell, 2001; Stevens, 2009). FA may take the form of either exploratory or confirmatory, with exploratory being the most common (Foster, 2001, 232). Warner (2008, 753) informs that FA consists of a group of related analytic methods including PCA, and Stevens (2009, 345) informs that PCA is a form of exploratory factor analysis (EFA). However, Cudeck (2000, 274) stresses that PCA is often incorrectly used as a kind of FA and warns that some statistical packages used PCA as their default method of FA. This research looks at EFA and PCA. Kline (1994) informs that one of the aims of EFA is to explore a topic and to try and discover the latent constructs or dimensions that were previously unknown. It also aims to explain the correlation matrix in as few factors or components as possible and to ascertain which variables are deemed most important by those participating in a survey (Foster, 2001, 232).

Various rules are offered with respect to the suitability of sample size and whether factors or components are reliable (Yates, 1987; Foster, 2001; Child, 2006; Stevens, 2009). In consideration of the advise provided by Stevens (2009, 333), sample size and factor reliability for this survey are deemed appropriate. In determining sample adequacy, the Kaiser-Meyer-Olkin (KMO) and Bartlett's Test, and the Anti-image matrices were run and analyzed. The initial and final KMO and Bartlett's Tests are shown in Table 8.

Table 8 KMO and Bartlett's Test

Initial KMO and Bartlett's Test			
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.			.599
Bartlett's Test of Sphericity	Approx. Chi-Square	3049.863	
	df	1378	
	Sig.	.000	
Final KMO and Bartlett's Test			
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.			.758
Bartlett's Test of Sphericity	Approx. Chi-Square	2309.510	
	df	780	
	Sig.	.000	

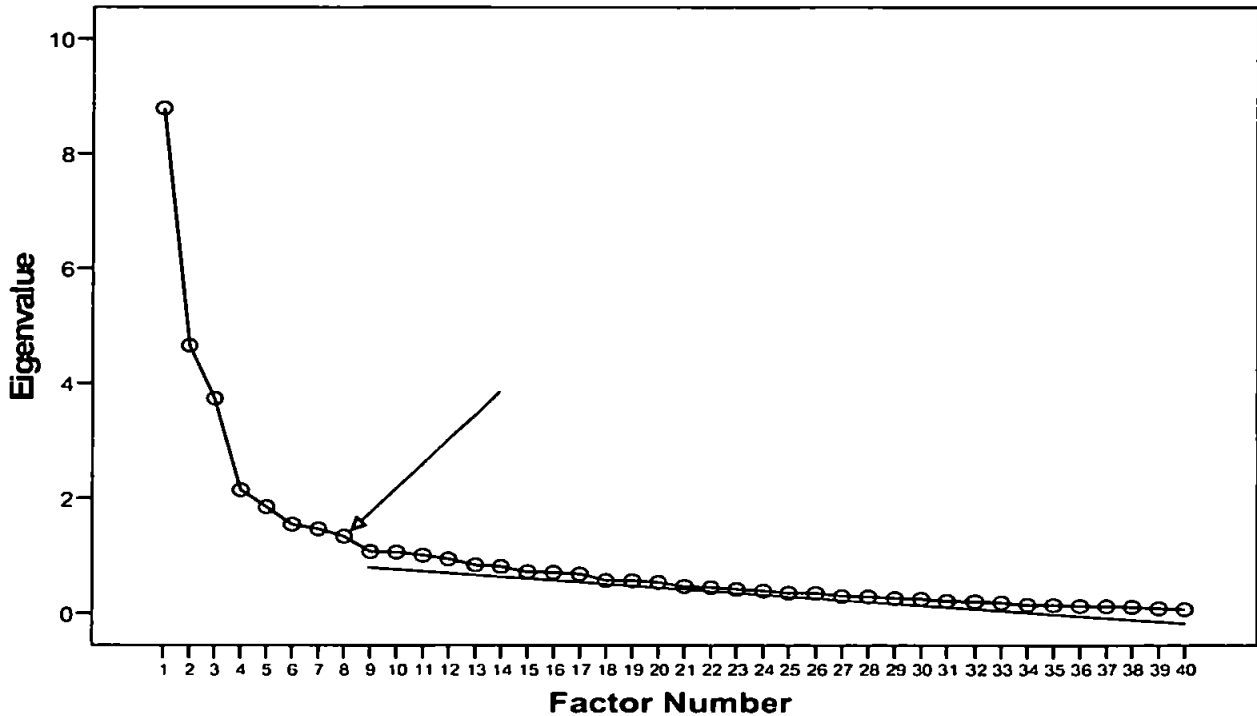
KMO values less than .50 are unacceptable and should be removed from further analysis (Kaiser, 1974, 35; Child, 2006, 55). Thirteen variables identified along the diagonal of the Anti-image correlation matrix with KMO values less than 0.5 were removed from subsequent analysis and are shown in Table 9. The analysis involved 110 participants, forty of fifty three initial variables, and eight components.

Table 9 Variables with KMO values <0.5

Survey Statement	6	7	8	12	16	22	23	28	29	30	34	35	43
KMO Value	0.262	0.368	0.495	0.445	0.463	0.244	0.310	0.471	0.425	0.320	0.359	0.418	0.431

Stevens (2009, 328) identifies four methods used in determining the number of components to extract or retain; eigenvalues greater than one, scree test, statistical significance test, and retain only enough factors or components to account for 70 percent of the total variance. He goes on to highlight several studies supporting the accuracy of the scree test and that in some cases the scree test and the Kaiser eigenvalues will yield the same results in terms of true factors. Child (2006, 58) informs of methods use in helping to determine the appropriate number of factors to extract but notes that eigenvalues greater than one and the scree test are the most common. Johnson and Wichern (2007, 445) inform that the scree plot is a useful aid in helping determine the appropriate number of factors to extract and that the user needs to look for a bend in the elbow of the plot to determine the actual number to use. The scree plot is somewhat subjective but can even be used when conditions are not ideal such as low sample and communality values (Tabachnick and Fidell, 2001, 621). For this research the scree plot, shown in Table 10, proved better in terms of acquiring simple structure. The scree plot resulted in the extraction of eight components. In dealing with a participant's missing data, analysis was conducted using pairwise exclusion, resulting in varying sample sizes for some variables, of cases (Child, 2006, 68).

Figure 1 Scree Plot



While PCA and FA are substantially different, they do often yield similar results in terms of the PCA weights obtained in analysis and the estimated regression coefficients in FA (Cudeck, 2000, 275; Child, 2006, 48; Stevens, 2009, 325). While Stevens (2009, 343-344) notes that FA and PCA are different, with factors estimated in FA but not in PCA and communalities less than one are used in the main diagonal of the correlation matrix in FA but not in PCA, he highlights several cases where the choice of analysis does little to affect the final outcome. However,

he does note that outcomes can differ in cases with less than twenty variables. Child (2006, 58) provides advice on using PCA to prepare for FA. He goes on to explain that the results of PCA should be compared with other FA, such as Principal Axis Factoring (PAF) and Maximum Likelihood (ML), to see which method, when rotated, provides simple structure. Yates (1987, 3) informs that rotation is a transformation phase aimed at bringing about simple structure in which the variables are assigned to the factors. For this research, PCA, PAF, ML, and Image Factoring (IF) were conducted and subjected to both orthogonal and oblique factor rotation.

The combination of analysis and rotation providing the best in terms of simple structure was PCA with orthogonal varimax rotation. The rotated component matrix is shown in Table 11. The component titles are founded on the content of the highest loading survey statements they include. Appendix 1 shows the rotated factor matrix with the survey statements included.

Table 11 Rotated Factor Matrix

State ment No.	Components						
	Privatization	Resources	Politics	Shipbuilding	Development	SOA	Administration Services
27	0.787						
24	0.785						
26a	0.758						
26b	0.707						
23a	0.683						
25	0.658						
39	0.652						
42	0.614						
32		0.767					
33		0.766					
20	0.335	0.725					
31		0.585					
45	0.427	0.502					
15c	0.315	0.488	0.458				0.348
44	0.305	0.382			0.367		
13			0.800				
14			0.799				
15a			0.760				
15b	0.314	0.361	0.555		-0.325		0.315
19	0.301		0.459				
21			0.417				
38b				0.835			
38a				0.826			
37				0.817			
40				0.747			
36	0.454			0.483			
9					0.777		
10					0.761		
11					0.739		
12b					0.492		
4a						0.858	
5						0.795	
4b						0.721	
1b							0.748
1a							0.682
41	0.361	0.396					0.440
2	0.373					0.346	0.425
18							0.721
17							0.541
3						0.381	0.357
							-0.526

Conclusion

Although surveys are a popular research strategy in social science research, they demand considerable attention on the part of the researcher if results are to be meaningful. While various survey scales can be used to measure constructs, they must ensure both validity and reliability with respect to the overall research aims and objectives. Also, creative ways of identifying and reaching an information rich sample population are required when sampling frames are not readily available and the research topic is viewed as political or intrusive.

The selection of questionnaire statements and descriptive statistical analysis have identified that Canada needs to pay more attention to Arctic development. Also, there is significant potential for the private sector to be involved in this development with respect to the management and crewing of CCG icebreakers, the design and construction of icebreakers for the CCG, and the leasing and/or chartering of icebreakers to the Canadian government or other interested groups involved in Arctic operations. While there was a positive attitude toward longer term leasing and/or chartering contracts, it was noted that some respondents were not in favour of longer term contracts that would not be flexible with respect to the changing and uncertain future ice conditions.

PCA helped triangulate the results of non-parametric analysis via highlighting the numerous potential benefits that could possibly be achieved from increased private involvement in developing the Canadian Arctic and that the current and future availability, and appropriate use, of resources will be paramount to such development. It also identified that political and administrative challenges are hindering Arctic development and the level of services that the CCG is capable of providing as a SOA. Further, given the status quo, the taxpayers of Canada would benefit from the construction of new, and much needed, icebreaking capacity outside of Canada.

Finally, there was uncertainty, with respect to future ice conditions in the Northwest Passage. This uncertainty corroborates findings from the Delphi exercise.

Further research involving more of Canada's Arctic stakeholders is required to canvas the in-depth opinions of local experts relating to various models which may underpin the ownership, organisation and management of relevant infrastructure. This research will require more government involvement at all levels and may well be supported by a quantitative survey to triangulate the findings and estimate the extent of support for new initiatives.

Appendix 1

No.	Loading	Components with Statements
Privatization		
27	0.787	Private involvement in the delivery of CCG services in the Arctic will result in less tax dollar spending.
24	0.785	Private firms are able to manage CCG I/Bs more efficiently than the CCG through Public Works & Treasury Board.
26a	0.758	Private Canadian ownership of a fleet of vessels used by CCG, Canadian Military, and oil companies in the Arctic will increase Canadian presence.
26b	0.707	Private Canadian ownership of a fleet of vessels used by CCG, Canadian Military, and oil companies in the Arctic will not jeopardise Canada's sovereignty.
23a	0.683	Private ship management companies operating in the Arctic would be more cost efficient than government.
25	0.658	Private management of the CCG fleet will resolve critical manning issues.
39	0.652	Canadian taxpayers would benefit from the CCG and the military committing to charter a fleet of newly constructed and privately owned multi-functional ice class vessels that have the modular capability to meet their particular interest and will be time shared with oil companies operating in the Arctic.
42	0.614	Canada's Arctic development would best be accomplished by having a private local company to manage and crew I/Bs that are built outside of Canada and leased to the CCG for year round operations in the Arctic.
Resources		
32	0.767	Canada needs to be at the forefront of icebreaking technology.
33	0.766	Canada would benefit from regaining its expertise in designing and building I/Bs and becoming less dependent on other shipbuilding nations.
20	0.725	Due to Canada's geographical expanse and ensuing political bureaucracy the CCG fleet is grossly inefficient and underutilized.
31	0.585	Canada is capable of building ice strengthened supply vessels.
45	0.502	Canadian taxpayers would benefit from having a fleet of competitively built, in Canada, Polar Class I/Bs that will be managed by competitive private firms.
15c	0.488	Limited attention from Federal MPs has resulted in the CCG's poor operation.
44	0.382	Without its own fleet of Polar Class I/Bs the CCG will need to engage in a long term time charter for I/B services in the Arctic.
Politics		
13	0.800	Canada's low public interest in marine matters has contributed to the low public profile of the CCG.
14	0.799	The low public profile of the CCG results in very limited attention being given to it by Federal Members of Parliament.
15a	0.760	Limited attention from Federal MPs has resulted in the CCG's low funding.
15b	0.555	Limited attention from Federal MPs has resulted in the CCG's poor management.
19	0.459	Political intervention impedes the CCG from achieving more commercial-like efficiencies.
21	0.417	Canada needs to enhance its Arctic expertise.
Shipbuilding		
38b	0.835	Other countries are able to build an I/B more efficiently than Canada.

38a	0.826	Other countries are able to build an I/B more effectively than Canada.
37	0.817	Canadian shipyards are unable to build a I/B as quickly as other experienced shipyards in Europe and the Far East.
40	0.747	Unless Canada decides to build a substantial fleet of Polar Class I/Bs, it will cost less to have them designed and built in European or Far East yards.
36	0.483	Private firms are able to design & build I/Bs more efficiently and effectively than the CCG through Public Works.

Development

9	0.777	I/B support will be necessary for the development of the Arctic region.
10	0.761	Political will and I/B support will be necessary to expedite future development of the Arctic region.
11	0.739	Canada's Arctic would develop sooner if greater I/B capability were available on a year round basis.
12b	0.492	Canada's Arctic sovereignty claim and environmental stewardship would be bolstered if CCG I/Bs were stationed in the Arctic on a year round basis.

Special Operating Agency (SOA)

4a	0.858	Separating the CCG from the Department of Fisheries & Oceans (DFO) will strengthen its Special Operating Agency (SOA) status.
5	0.795	As a SOA, outside of DFO, the CCG would have more flexibility to operate more efficiently and effectively in the Arctic.
4b	0.721	Separating the CCG from the Department of Fisheries & Oceans (DFO) will help reduce crewing cost.

Administration

1b	0.748	Canada's military and civilian roles in the Arctic should be should be managed by a newly created maritime organization.
1a	0.682	Canada's military and civilian roles in the Arctic should be combined.
		In the absence of increased funding for the CCG, Canada's maritime requirements would be better served by setting up a Maritime Administration office which would be responsible for the development of CCG and DFO programmes and would avail of the existing CCG fleet, the leasing of private hardware and/or the contracting out of services.
41	0.440	
2	0.425	Separating Canadian Coast Guard (CCG) Hardware from CCG Services will aid in setting clearer terms of reference for the CCG.

Services

18	0.721	Increased political demands on the CCG have resulted in the CCG neglecting private sector service requests.
17	0.541	New southern security and science matters are shifting the workload of the CCG away from icebreaking in the Arctic.
3	-0.526	A single national organizational approach would reduce CCG crewing costs.

References

- AHLBRANDT, T. S. & MCCABE, P. J. (2002) Global petroleum resources: a view to the future. *Geotimes*, 47, (11) 14-20.
- BABBIE, E., HALLEY, F. & ZAINO, J. (2007) *Adventures in social research: data analysis using SPSS 14.0 and 15.0 for Windows*. 6th. Thousand Oaks, Pine Forge Press.
- CHILD, D. (2006) *The essentials of factor analysis*. 3rd. New York, Continuum.
- COLLIS, J. & HUSSEY, R. (2003) *Business research: a practical guide for undergraduate and postgraduate students*. Second. Houndmills, Palgrave Macmillan.
- CUDECK, R. (2000) Exploratory factor analysis. IN TINSLEY, H. E. A. & BROWN, S. D. (Eds.) *Handbook of applied multivariate and mathematical modeling*. San Diego, Academic Press.
- EVANS, J. R. (2007) *Statistics, data analysis, and decision modeling*. 3rd. Upper Saddle River, Pearson Prentice Hall.
- FALKINGHAM, J. (2004) *Sea ice in the Canadian Arctic* Arctic Marine Transport Workshop, 49.
http://www.arctic.gov/files/AMTW_book.pdf#search=%22arctic%20ice%20free%20summers%20john%20falkingham%22. [Accessed 3 October 2006].
- FOSTER, J. J. (2001) *Data analysis using SPSS for Windows versions 8 to 10*. London, Sage Publications.
- HUPP, E. & BROWN, D. (2006) *NASA Sees Rapid Changes in Arctic Sea Ice* [online]. Available From: http://www.nasa.gov/home/hqnews/2006/sep/HQ_06315_sea_ice.html. [Accessed 10 October 2006].
- INDIAN-AND-NORTHERN-AFFAIRS-CANADA (2006) *Northern oil and gas annual report 2005* [online]. Available From: http://www.ainc-inac.gc.ca/oil/Pdf/report05_e.PDF. [Accessed 3 October 2006].
- JAFFRAY, J.-Y. & JELEVA, M. (2007) *Information processing under imprecise risk with the Hurwicz criterion* [online]. Available From: <http://www.sipta.org/isipta07/proceedings/>. [Accessed 4 May 2009].
- JOHNSON, R. A. & WICHERN, D. W. (2007) *Applied multivariate statistical analysis*. 6th. Upper Saddle River, Pearson.
- KAISER, H. F. (1974) An index of factorial simplicity [online]. *Psychometrika* 39, (1) 31-36.
http://www.springerlink.com/content/112911/?sortorder=asc&p_o=121. [Accessed 24 April 2009].
- KIM, J.-O. & MUELLER, C. W. (1978) *Introduction to factor analysis: what is and how it works*. Beverly Hills, Sage Publications.
- KLINE, P. (1994) *An easy guide to factor analysis*. London, Routledge.
- LEAHY, S. (2008) *Climate change: "Things happen much faster in the Arctic"* [online]. Available From: <http://ipsnews.net/print.asp?idnews=45102>. [Accessed 30 April 2009].
- LEE, R. M. (1993) *Doing research on sensitive topics*. London, Sage Publications.
- MILES, M. B. & HUBERMAN, A. M. (1994) *Qualitative data analysis: an expanded sourcebook*. 2nd. Thousand Oaks, Sage Publications.
- NATIONAL-RESEARCH-COUNCIL (2005) *Polar icebreaker roles and U.S. future needs: a preliminary assessment*. Washington, The National Academies Press.

- NEUMAN, W. L. (2007) *Basics of social research: qualitative and quantitative approaches*. 2nd. Boston, Pearson.
- PATTON, M. Q. (1990) *Qualitative evaluation and research methods*. 2nd. London, Sage Publications.
- PHARAND, D. (1984) *The Northwest Passage: Arctic straits*. Dordrecht, Martinus Nijhoff
- PRESSER, S. (1984) The use of survey data in basic research in the social sciences. IN TURNER, C. F. & MARTIN, E. (Eds.) *Surveying subjective phenomena*. New York, Russell Sage Foundation.
- SAUNDERS, M., LEWIS, P. & THORNHILL, A. (2007) *Research methods for business students*. Harlow, Prentice Hall.
- STEPHAN, F. F. & MCCARTHY, P. J. (1965) *Sampling opinions: an analysis of survey procedure*. New York, John Wiley & Sons, Inc.
- STEVENS, J. P. (2009) *Applied multivariate statistics for the social sciences*. 5th. New York, Routledge.
- TABACHNICK, B. G. & FIDELL, L. S. (2001) *Using multivariate statistics*. 4th. Boston, Allyn and Bacon.
- VAUS, D. D. (2004) *Analyzing social science data: 50 key problems in data analysis*. London, Sage Publications.
- WARNER, R. M. (2008) *Applies statistics: from bivariate through multivariate techniques*. Los Angeles, Sage Publications.
- YATES, A. (1987) *Multivariate exploratory data analysis: a perspective on exploratory factor analysis*. Albany, State University of New Your Press.