A STUDY OF CANADA'S MERCHANT MARINE POST-SECONDARY EDUCATION AND TRAINING REGULATORY REQUIREMENTS FOR MERCHANT MARINE CREW

ANDREW RICHARD ROBERTSON

A STUDY OF CANADA'S MERCHANT MARINE POST-SECONDARY EDUCATION AND TRAINING REGULATORY REQUIREMENTS FOR MERCHANT MARINE CREW

by

Andrew Richard Robertson B. Naut. Sci. (Canadian Coast Guard College), Ch. Eng.

A thesis submitted to the School of Graduate
Studies in partial fulfillment of the
requirements for the degree of
Master of Education

Faculty of Education
Memorial University of Newfoundland and Labrador
May, 2010

St. John's, Newfoundland

Abstract

This study examined merchant marine engineering education and training in Canada, its regulatory requirements related to Transport Canada Marine Safety (TC) and Canadian merchant marine training colleges' role in satisfying the employment demands for workers in the Canadian maritime industry. Using a geographical cluster method, Canada was sectioned into four geographical sectors, Atlantic Seaboard, Great Lakes, Pacific coast and Arctic. Specific Canadian marine engineer certification requirements were utilized as a base for (n=20) surveys distributed using three mail-out questionnaires. These were supplemented by telephone and personal interviews.

TC Examiners (n=4), one in each of the four geographic sectors identified highest priority regulatory requirements for certification as a marine engineer officer. Canadian owned marine crew companies (n=8) distributed among differing maritime industry sectors identified specific desired marine engineer crew skill sets. TC trainers (n = 8) from marine engineer colleges identified mission, goals, curriculum and course design. All who participated in this study were provided with the opportunity to comment on marine engineer education and training-related issues.

There were no significant differences found among the views of TC Examiner Offices nation-wide. Differences were identified amongst the views of employers of TC engineers for the Atlantic offshore industry, Great Lakes bulk cargo and Pacific coast passenger ferry/cruise ship industries. The study also identified the nature of practical training most appropriate to the needs of sea-gong engineer officers in general. Employers across Canada provided many views regarding specific marine engineer staffing needs. Canadian marine college goals, mission statements, curriculum and course design varied according to the sector of the marine industry they served.

This study concluded with the following recommendations regarding the nature of training and recruiting of trainees:

- Increase trainer familiarity with the Canada Shipping Act 2001 and the International Convention for Training and Certification of Watch-keepers (ISTCW).
- Increase recruiting of marine engineer learners.
- Increase Canadian employer investment in comprehensive marine engineer training.
- Increase emphasis on quality practical sea training.

Increased cooperation between colleges, employers and government to meet should contribute to benefit learners and maintain and build Canada's maritime industries.

Acknowledgements

I wish to extend my sincere gratitude to my thesis advisor, Dr. George Haché for his constant support and guidance, and to the Canadian Institute of Marine Engineers for their encouragement and helpful comments.
A heartfelt thank you goes to Senior Marine Inspector Harvey G. Heaton of Atlantic Region Marine Safety, Terry McCluskey P. Eng. Registrar Canadian Coast Guard College (ret'd) Catherine Dutton Head of Marine Institute and Chief Engineer Peter Brand Head Instructor Marine Engineering Canadian Coast Guard College (ret'd) for their guidance and constructive criticism throughout my career as a Marine Engineer.
Thanks to Gerry White for his help with designing this statistical analysis.
Thanks to Janet Renou for guidance with APA format.
Thanks to teachers Frank and Marie Penny and Professional Engineer Terry McCluskey for reviewing the final draft.

Thanks to Mr. Wilco Bosma of Heerema Marine Contractors sscv Thialf, under whom I had the pleasure to recently serve. He manages the growing complexities of the world's largest heavy lift crane vessel. His crew of 750 represents a microcosm of the diverse peoples of the world. Although as many as a dozen different native tongues may he spoken, all work in harmony to complete maritime oil and gas projects on a magnificent scale. Mr. Bosma kindly took time from his busy schedule to discuss these challenges and offer insights that have been helpful to this research.

Last, but not least, thanks are due to the Canadian Institute of Marine Engineers for their understanding and support for this research as they strive to ensure the success of diverse our Canadian maritime industries.

Table of Contents

CHAPTER 1: BACKGROUND AND ORIENTATION TO THE STUDY

Introduction

This research concerned merchant marine engineer education and training in Canada. Standards were prescribed by Transport Canada Marine Safety (TC Marine Safety) (2008) as a prerequisite to examination for certification issued under the provisions of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978 (ICSTCW), as amended. Canada is a signatory member (2007) of The International Maritime Organization (IMO) and ICSTCW, and has been obliged to conform to the standards. Transport Canada (TC) and the IMO requirements have been identified for certification as a marine engineer officer. It was incumbent on TC trainers at TC-approved merchant marine engineer colleges (TC colleges) to be aware of TC regulatory requirements and develop programs designed to meet or exceed such requirements. Furthermore, TC trainers needed to meet those employer demands for TC engineer education and training in various sectors of the Canadian and even global maritime industries. This study examined merchant marine engineering education and training in Canada, its regulatory requirements related to Transport Canada Marine Safety (TC) and Canadian merchant marine training colleges' role in satisfying the employment demands for workers in the Canadian maritime industry.

Gierusz and Lisowski (1998) discussed the need for education and practical training in the context of modern vessel automated control systems. TC regulation TP 2293 requires practical training in vessel automation. This required up to four weeks of propulsion plant simulator training at a TC college as prerequisite to examination for certification. It was argued that trainers should be senior-level TC-certificated marine engineers. This view was further qualified by the statement that being a

subject matter expert did not ensure that such individuals were also effective as instructors. Others have recognized the relationship that existed between teaching and student performance for post-secondary trainers. Boyer (1991) stated, "It's not enough to be informed about one's subject, one has to understand the people in the room" (p. 7). Fleet (1998) suggested that trainers should themselves be trained to provide them with resources required to deliver their curriculum more effectively. The Government of Newfoundland and Labrador (1998) stated that, "Effective curriculum delivery is an essential component of a high quality education program"(p. 89). Walker, Gregson, and Frantz (1996) further indicated there was broad agreement in the literature regarding performance of students as being closely linked to the quality of teaching and that "the quality of teaching will not improve without dramatic improvements in teacher education" (p. 19).

Statement of the Problem

Trainers at TC colleges should prepare students to perform their various employment-related tasks as marine engineers in a safe and efficient manner while meeting all relevant TC Marine Safety regulatory requirements. Preliminary information obtained through informal interviews conducted among TC Marine Safety Examiners (TC examiners or examiners), several Canadian marine engineer trainers (TC trainers or trainers) and several major employers of marine engineer ship's crew (employers) suggested that there existed an education and training gap in the industry. Canadian subject matter experts representing TC Marine Safety, TC colleges and potential employers of TC college graduates were surveyed to identify any education needs and suggest ways to narrow any such gaps.

Background

Marine engineers are identified as professionals who require specialized training to enable them to perform their duties to required standards. The Pacific Marine Training Campus (PMTC) of the British Columbia Institute of Technology (BCIT) at Vancouver, British Columbia (2007) reported the following:

> The Canada and world maritime industries depend on the services of internationally certificated marine engineers. These professionals are trained in the operation and maintenance of the propulsion plant and other machinery systems found in all ocean-going ships. A marine engineer is responsible for the efficient operation and maintenance of the vessel's propulsion, electrical and auxiliary systems. The main activities of the marine engineer include daily watchkeeping, repairs to the machinery systems and planning and performing long-term machinery maintenance schedules. Marine engineers carry out these duties in full compliance with international standards with regards to operational safety and ocean pollution prevention (p. 1). (British Columbia Institute of Technology, 2007).

Marine engineers are professionals required to perform duties that include operation and maintenance for complex mechanical end electrical marine machinery. Responsibilities include planning for operational safety and environmental protection. Canadian and international requirements demand marine engineers be provided specialized training for TC regulatory required certification.

Canadians seeking employment as engineers onboard Canadian registered vessels require certification. Appendix A describes the *Canada Shipping Act 2001* (CSA 2001). This document authorized TC Marine Safety examiners to examine and provide TC certification for duties as a merchant marine engineer officer. Privileges provided by such certification were valid for five calendar years from date of issue and at least one full year of correctly documented days of sea service were required by date of renewal. Conditions for authorization and expediting certification were stated by Bill C-34: Transportation Appeal Tribunal of Canada Act. (Bill C-34: Transportation Appeal Tribunal of Canada Act).

Appendix A describes CSA 2001 as the principal legislation governing safety in marine transportation and recreational boating, as well as protection of the marine environment. The Minister of Transport for Canada appoints TC examiners to serve to interpret CSA 2001, within the limitations of their authority. Candidates seeking Transport Canada Certification as a marine engineer officer are required to meet those prerequisites for examination as stipulated by TC examiners.

TC Marine Safety membership in the IMO STCW 1995 Convention required implementation of a quality assurance system for certification and training of Canadian seafarers. TC examiners implemented this system to ensure Canadian seafarers were compliant to international standards typically found to prevent detentions of Canadian vessels under Port State Control (PSC) in foreign countries. TC examiners inspect foreign vessels for ICSTCW compliance. The new Canadian marine seafarer certification regime included medical standards and required a supporting quality assurance system, to meet the standards of the new ICSTCW Convention. TC colleges were compelled to conform to these requirements concerning development and implementation of their syllabus.

Appendix B lists the following TC Marine Safety-approved and monitored colleges:

- Canadian Coast Guard College,
- L'institute Maritime du Québec,
- Georgian College, Owen Sound Campus,
- Marine Institute in St. John's, NF,
- Nova Scotia Community College, 2003,
- British Columbia Institute of Technology Pacific Marine, Training Campus (BCIT PMTC),
- Holland College Marine Centre of PEI, and
- New Brunswick Community College, 2003.

These eight TC-approved colleges that were used in this research awarded a Certificate, Diploma or Baccalaureate Degree to those learners who had successfully completed their programs; in addition to or distinct from Certificates of Competency issued by TC Marine Safety. Examination for TC certification was implemented only by TC Marine Safety. Certificates recognized by IMO members qualified the holder to render service as a ship's officer at or below the rank of the holder's class of Certificate. Additional hours of classroom attendance at a specified course at the TC colleges were prerequisite to examination for successively higher levels of certification by TC Marine Safety.

Successively higher levels of training and increased minimum sea service time were prerequisite to examination for higher levels of TC certification as outlined in Appendix A. This same document also stated that that vessel horsepower determined engineering crew regulatory requirements. Most Canadian registered vessels of up to 3000 kilo Watts required at least one Second Class certificate onboard. Larger vessels required at least one First

Class and one second Class TC-certificated marine engineer. From time of first entry to attaining such rank, eight years or more may have been required. Three or more of these years may have been spent on campus in preparation for academic prerequisites to examination.

Those TC college trainers that were surveyed in this research would have normally been expected to have met or exceeded TC minimum requirements for TC examination for certification as a TC marine engineer. TC- certification should have enabled college graduates to meet requirements for employment as a TC marine engineer officer onboard all registered vessels and should have indicated competency to operate and maintain marine machinery at their level of qualification or rank. Preliminary interviews with TC examiners and employers of TC engineers identified a need for practical training in leadership strategies.

Sectors of the marine industry in this investigation included but were not limited to:

- passenger/vehicle ferries,
- bulk dry, liquid oil and chemical cargo freighting,
- offshore support vessel,
- offshore structures,
- Federal Government Department of Fisheries and Oceans and Coast Guard,
- harbour tugs, and coastal, near coastal and offshore barge tugs, and
- deep sea factory freezer trawlers.

Each of these seven sectors of the Canadian merchant marine industry required TC-certificated marine engineers with certain unique skill sets. These included welding, machining, electrical, pneumatic, hydraulic,

electronic, marine fitter and diesel mechanic abilities. Mentoring enabled TC engineers to receive and provide practical training with co-workers. Access to TC trainers and their colleges was a challenge during sea voyages. Employers expected their TC engineers to seek continual upgrading and higher levels of certification. Some rose to the rank of Chief Engineer on large vessels and offshore structures, or aspired to managerial duties as superintendent engineers ashore.

Issues Affecting the Marine Industry

During investigation for this research a number of issues became apparent. These are described in the following, and through the views of a number of reports and observations of representatives familiar with the Marine Industry. Review of the literature identified factors affecting marine engineer training. Appendix C summarized factors that affected TC college enrolments. The literature reported a global shortage in the numbers of TC and ICSTCW merchant ship certificated officers. Factors that contributed to this challenge included, but were not limited to, the following:

- Need for increased public awareness and involvement in the Canadian maritime industry,
- lack of awareness of the industry role in the Canadian economy,
- age demographics,
- vessel automation,
- global education gap,
- wage gap, and
- increased work load.

Canadians should have been more aware of their maritime industries. Retirements by an aging population created opportunities for TC engineers, provided specialized training at TC colleges. Challenges to attract and retain TC engineers included work hour and wage issues and rigorous training requirements for TC certification.

Statement of Purpose

After a review of the data and preliminary interviews, the purpose of this study became one of examining stakeholder's views concerning merchant marine engineer education and training in Canada.

The stakeholders were TC trainers, TC examiners, and employers of TC engineers. This study utilized TC examiners as a base: TC examiners were subject matter experts TC authorized to assess TC engineer knowledge. Employer needs were examined according to geographical and industrial sector: West Coast, Great Lakes, Arctic and Eastern Seaboard, identifying tug and barge, car/passenger ferry, bulk cargo and Offshore sectors. The study sought to determine which mariner competencies were in greatest demand with the context of TC Marine Safety curriculum.

Significance of the Study

This study provided stakeholder views regarding the relevance, quality, and effectiveness of merchant marine engineer training in Canada. It emphasized identification of education gaps that may be addressed by TC trainers as marine training institute faculty. The study sought to contribute to the quality and effectiveness of Canadian merchant marine education and training. Issues and trends perceived in the opinions of those who provided data for this study could assist Canadian TC engineers as trainees, and the marine industry. The study sought to provide information concerning what TC college trainers offered to

benefit their industry. The results of this study provided a basis from which industry participants could better judge their individual role in the delivery of effective marine training.

Definition of Key Terms

For the purpose of this study the following terms and their allied definitions were used:

- International Maritime Organization (IMO): the United Nations specialized agency responsible for improving maritime safety and preventing pollution from ships. IMO is also committed to technical cooperation. Motto: "safe, secure and efficient shipping on clean oceans" (2007).

- International Convention for Standards of Training, Certification and Watch keeping for Seafarers (ISTCW, ICSTCW or STCW): The United Nations-sanctioned Convention first drafted in 1978 and amended in 1995 to impact the US and other world members. International Maritime Organization (IMO) amendments to the convention now known as STCW 95 completely re-wrote enforcement related to the Convention, and more importantly created an STCW Code (similar to the USCG licensing regulations) that set stringent standards for mariners to meet.

- Canada Shipping Act (CSA) 2001: Under Canadian Federal Law CHAPTER S-9: An Act respecting shipping that may be cited as the *Canada Shipping Act*. R.S., c. S-9, s. 1, and is described in Appendix A.

- Marine Safety: (formerly: Ship Safety Canada): That branch of Transport Canada Marine mandated to ensure the safety of marine transport in Canadian waters by having the authority to inspect all floating vessels in

Canadian waters and enforce Transport Canada Marine Regulations as was proscribed under the Canada Shipping Act. Marine Safety was mandated and authorized to examine all candidates for Certification as ship's officers and crew (2008).

- Examiner: An individual appointed by Transport Canada Marine Safety to implement Transport Canada examinations conditional to certification as a Canadian merchant ship's officer.

- TC college (institute or school, all terms used synonymously): A Transport Canada Marine Safety approved college or institute that may be government supported and may or may not be a degree granting institution.

- Post-secondary education: education which follows high school, or secondary education, usually to obtain a degree, diploma, or certificate in some specialized area.

- Teacher: "One that teaches; esp.: one whose occupation is to instruct." (Merriam-Webster, 1996, p.1209)

- Trainer: For the purpose of this study is considered one that provides practical and theoretical training for TC marine engineers.

- Employer: Those who would have jurisdiction over hiring TC marine engineers (TC engineers) in both public and private institutions.

Acronyms

For the purpose of this study the following acronyms and the names from which they are derived are provided as follows:

ACIS: Transport Canada Access to Information System

ICSTCW: International Convention for Standards for Training Certification and Watchkeeping

CCGC: Canadian Coast Guard College

CMEC: Council of Ministers of Education, Canada

CMSG: Canadian Merchant Service Guild

CSA: Canada Shipping Act

ERA: Engine Room Assistant

HAS Hazardous Atmosphere Safety

ICEHR: Interdisciplinary Committee on Ethics in Human Research

IMO: International Maritime Organisation

MED: Marine Emergency Duties

MI: Marine Institute of Memorial University of Newfoundland and Labrador

MUN: Memorial University of Newfoundland and Labrador

NCES: National Center for Education Statistics

NUMAST: National Union of Marine, Aviation and Shipping Transport Officers PSE Postsecondary Education

OPI: Officer of Primary Interest

PPE: Personal Protective Equipment

PPS: Propulsion Plant Simulator

TC: Transport Canada

UN: United Nations

WHMIS: Workplace Hazardous Material Information System

Delimitations of the Study

This study was delimited to personnel (TC trainers) who worked with Canadian civilian, or merchant marine engineer colleges and specifically involved in the preparation and delivery of instruction for students who would assume duties as a watch-keeping officer at sea on board merchant vessels and offshore structures. Military training and service was excluded from consideration. This decision was made because of the differences between civilian and military training and service requirements.

Secondly, focus is placed on the criterion of TC pre-examination requirements for candidates seeking to be examined for successive certificates of competency as merchant marine engineer Officers (TC engineers). This excluded certification for merchant marine electrician, dynamic positioning and navigation officer candidates. The main focus of the study shall be to obtain the perspectives of TC examiners, employers of TC engineers and TC trainers as stakeholders helping to develop and maintain a prosperous Canadian merchant marine industry.

Three groups from which data was sought were:

> Group 1: Transport Canada Marine Safety marine engineer examiners (TC examiners) as that group of subject matter experts selected for the study and authorized by Transport Canada (TC) to assess level of candidate preparation for examination as a TC merchant marine engineer officer (TC engineer).
>
> Group 2: Canadian-based marine industry employers of Transport Canada-certificated marine engineers and trainees (employers) who were obliged by TC to ensure that these employees performed

their duties in a safe, efficient and otherwise competent manner in compliance with TC regulatory requirements.

Group 3: Trainers at TC colleges (TC trainers) for marine engineer trainees who should have provided marine engineer trainees with education and training that met Marine Safety prerequisites for TC examination for TC engineer certification.

These three groups were selected because they had responsibility for marine training and are the most likely to have knowledge of the problem and views regarding its training practices. They had first-hand knowledge of professional training requirements for merchant marine engineer officers. As well, they had first-hand knowledge of the problems and views regarding the Canadian perspective of a global maritime industry and what the industry needed, or perceived to be important in preparation of merchant marine engineer officers. Lastly, they were considered groups most likely to influence change in the delivery of pre-certification and training needs of learners seeking employment in the Canadian and global marine industries.

Limitations of the Study

Notwithstanding the previously identified issues affecting the marine industry, a number of additional limitations were noted. Due to the historical practices of TC examiners regarded how marine training was applied, not all information that could have been utilized in the research was available to the researcher. The very nature of the many groups that have an influence on merchant marine education and training placed limitations. The relatively small number of individual participants selected as representative from each group was a limitation. Also, the study risked contamination of data from preliminary interviews with TC examiners.

Contrasting and comparing the views of the four selected TC examiners reduced bias and improved validity. This researcher made an attempt to gather all relevant information, but may not have been entirely available.

Questionnaires intended for implementation to selected TC examiners, major Canadian employers of TC engineers and TC trainers respectively focused on survey items that investigated the Certification and employment requirements incumbent on TC engineers. Potential findings which may have been realistically addressed by TC trainers were viewed as a potential limitation. As well, it was unknown to the researcher whether the various groups that may have responded to the surveys had appropriately self-identified their views when filling out questionnaires. In an attempt to deal with these potential limitations an optional provision for a telephone interview was indicated as alternatively available with each mail-out survey.

Lastly, the economic climate at the time of the survey may have affected the outcome of this study. At the same time this survey data was collected, a critical, global shortage of certified marine engineer officers was identified by industry and Government authorities world-wide. This personnel shortage was forecast to intensify over the following decades of the 21st century. Industry reacted by understaffing vessels and sought "special exceptions" to further reduce crew complement to become potentially dangerous size. It was not known whether this had a positive or negative effect on the survey data that was collected, nor on decisions to be made by TC examiners, trainers or employers who may not have responded to the study surveys.

CHAPTER 2: REVIEW OF THE LITERATURE

Introduction

A significant quantity of literature was reviewed dealing with requirements for Transport Canada (TC) engineer training. Preliminary interviews with TC examiners (2006) suggested literature that concerned TC regulatory requirements for training prerequisite for certification as a TC marine engineer (TC engineer), and publications that provided recommendations of the International Convention for Standards Training for Certification for Watchkeepers (ICSTCW), 2007. Preliminary interviews with TC trainers identified the reports of Appleton, 1969; McDuff, 2000; Casey, 2003; the Canadian Marine Industry Alliance, 2005, that described employer demands for TC engineer training. The literature described those issues that challenged TC trainers to meet TC regulatory requirements and employer demands for TC engineer training. TC Access to Information System (ACIS) provided TC engineer statistics, Fleet and Hache (1999) described teacher training, and the Council of Ministers of Education, Canada (CMEC) developed indicators to measure the efficiency and effectiveness of Canadian Post Secondary Education (PSE) (1999). A limitation of the study risk of contamination of the data from preliminary interviews with, and relatively small number of TC examiners (n=4) and trainers (n=8) and employers of TC engineers (n=8) selected for survey. It was in areas of TC engineer training requirements and issues affecting TC engineer trainers that the review of the literature was focused.

A Background for Merchant Marine Education and Training in Canada

Awareness of the history of marine engineer training facilitated an understanding of present issues used to develop researcher questions.

Appendix D provides background. Appleton (1969) described a history of nautical training in Canada and offered context to modern goals, objectives and curriculum. Appleton identified challenges that faced TC trainers that suggested education and training-related needs.

International Maritime Organization

Literature concerning the IMO described Canada as one of 167 signatory member states. Canada agreed to participate in the conventions of the IMO, inclusive of those concerning the education, training and certification of merchant marine officers (training and certification). TC Marine Safety followed ICSTCW 95 guidelines that determine curriculum prerequisite to examination for certification as a marine engineer officer. TC-approved colleges followed these guidelines for engineering officer formation, provided by Appendix F: TP 8911E Transport Canada Guidelines for Canadian Marine Engineer Cadet Programs.

ICSTCW articles provided the legal framework within which mandatory technical standards contained in part A of the ICSTCW Code were applied. Part B of the Code provided guidance to assist those who were involved in educating, training or assessing the competence of seafarers or who were otherwise involved in applying the provisions of the ICSTCW. Appendix D describes the IMO that provided recommendations for standards for marine engineer training developed through international consultation and cooperation.

Offices of Transport Canada Marine Safety Examiners

IMO, ICSTCW membership committed Canada to promote and maintain the highest standards of maritime training and watch keeping onboard its merchant vessels. The Canadian Federal Government met these

obligations by deploying its responsibility for same to its Department of Marine Transportation or Transport Canada (TC) agencies. TC examiners implemented regulatory requirements developed by TC Marine Safety Ottawa for the examination and certification of seagoing merchant ships officers. The regional offices of TC Marine Safety are listed in Appendix E. Appendix A provides relevant sections of the Department of Justice *Canada Shipping Act 2001.* This empowered Transport Canada's Office of Marine Safety Examiners with the authority to promote and maintain safety in accordance with IMO conventions of the ICSTCW. TC's regulation TP2293 was replaced by TP8911E outlining marine engineer education and training (training) requirements for safety-related training. Appendix A includes the Canada Shipping Act (CSA) 2001; section TP 2293, that identified Propulsion plant simulator training pre-requisite to TC examination.

Appendix F contains an outline of the regulation Examination and Certification of Seafarers TP8911E and describes prerequisites to examination for certification as a TC engineer. Appendix A describes attendance at a TC-approved college prerequisite commencing 2007. Furthermore, all approved cadet-model programs required 36 to 45 months including studies on campus and on board ship. Trainees on practical sea training were required to complete TC-prescribed assignments identified by the colleges. Appendix F describes those requirements for TC - approved sea training record manuals. TC-approved colleges were required to develop and implement their sea training record manual for completion by their TC engineer trainees. These formed an official document prerequisite to TC examination. Sea training record manual assignments were to be scrutinized by a TC college trainer after each sea period and prior to submission to TC examiners when cadet program trainees applied for TC examination for certification as a marine engineer Fourth Class (Canada Shipping Act 2001. *TP2293*). TC identified eight

marine schools offering marine courses monitored by TC examiners and contained in Table 2.1. Appendix F contains those sections of the document TP8911E of the Canada Shipping Act 2001 that provided specific regulatory-required marine engineer training program syllabi.

Brock University Reported Need and Opportunities for TC Engineers

Dr. Lewis Soroka of Brock University published Economic Impact of the Marine Industry on the Niagara Region (republished Sunday, January 20, 2008). Appendix C provides published reports that identified industry activity levels for Niagara-based employers of TC engineers and projected, "in excess of 1,300 jobs to arise over the ten years from 2008" (p. v). The Soroka report seemed to support the practise that contributing factors were retirements of TC engineers matched by sustained demand for Great Lakes shipping fleets. This implied that TC engineers would be required to crew vessels. Soroka provided a comprehensive set of recommendations in response to issues facing Canadian maritime-based industries. He suggested various actions be taken by Government and industry stakeholders to promote Canadian competitiveness in a global economy. The following Eight marine associations represented the Canadian marine industry:

1) Association of Canadian Port Authorities
2) St. Lawrence Ship operators
3) Chamber of Maritime Commerce
4) Chamber of Shipping of British Columbia
5) Canadian Ship-owners Association
6) Shipping Federation of Canada
7) St. Lawrence Economic Development Council
8) Halifax Shipping Association

(Source: Canada's Marine Industry: A Blueprint for A Stronger Future. Final Draft, June 27, 2005)

These eight members represented themselves as the Canadian Ship-owners Association (2005), and addressed recruitment and marine training for Canadian nationals. They provided their Recommendation 46 (p. 52). Maritime-based industry stakeholders resolved, "to work with provincial authorities, the marine industry, and TC colleges to develop a long-term plan that ensured that the industry's training needs were fully met" (p. 52). This report recognized a need to support TC trainers and their colleges.

The Canadian Ship-owners Association (2005) Recommendation 47 addressed recruitment of non-TC engineers by direct entry and resolved, "to facilitate the entry of foreign nationals to fill officer positions aboard Canadian ships and allow for prompt processing by Immigration Canada of foreign crew members entering Canada" (p.53). A shortage of TC engineer and Deck officers was recognized. Recommendation 47 encouraged sourcing foreign nationals. Any such initiative appeared to diminish the need to support TC trainers and their colleges. Canadian-owned and operated shipping companies might obtain ICSTCW-certificated foreign engineers "by whatever means" (Canadian Ship-owners Association, *2005).*

The literature reported crewing issues that appeared not in keeping with the Canada Shipping Act (CSA) 2001. Canadian employers suggested hiring non- TC-engineers to crew Canadian-registered vessels in Canadian waters was acceptable. Such action would have been in violation of TC crewing regulations. Part 14, section 2, paragraph 'a' of the Canadian Department of Justice regulation CSA 2001, limited TC-certification as a marine engineer to those individuals holding Canadian citizenship or Landed Immigrant status. Those already holding non-TC-issued ICSTCW

certification prior to such status were required to apply to TC examiners to write examinations for the level of certification at the level determined by TC examiners. The literature suggested that stakeholders seeking to employ non-TC engineers as officers onboard Canadian-registered vessels needed to alter fundamental changes in the TC Marine Safety regulatory requirements of CSA 2001.

A Need to Train Personnel for Marine Bulk Cargo Transportation in the Great Lakes Region

McDuff et al (2000) reported a need to train TC engineers for employment in the Canadian Great Lakes Region. Employers demanded that existing marine schools (2000) provided accessible, effective "hands-on" training (p. 2). Surveys conducted on marine crew indicated that they shared this need and did not feel that they were able to access such career development training (p. 2). The workforce was described as aging and TC-certificated marine engineers in critically short supply (p. 4). A skilled, ready work force was critical to the success of the industry (p. 5). McDuff et al identified TC trainers as key stakeholders positioned to recruit and train persons for in-demand marine skills. Statistical data prepared for the McDuff research indicated that TC trainers should have addressed several learner groups with their own distinct education and training needs (p. 5).

A Need to Train Personnel for Marine Transportation and Offshore Petroleum Industries in Eastern Canada

Strategic Directions Inc. (2003) was engaged by the Marine Careers Secretariat of Newfoundland and Labrador and researched marine career opportunities in the marine transportation and offshore petroleum industries in eastern Canada. At the time of the study, the size of Canadian

fleets was reported to be in decline (p. 53). Tables of statistics identified contributing factors (p. 77). It is significant that lack of a "national strategy" was identified. The Canadian Government did not appear to demonstrate commitment to the present and future security of our merchant marine. This included development and implementation of programs that promoted our maritime industries. Poor public image of seafaring jobs is also cited (p. 54). Potential recruits should have been informed that seafaring jobs offered significantly higher pay and more time off than similar shore-based positions. TC engineers earned very attractive wages and benefits while living conditions onboard were reported to be good. (p. 32).

TC Engineer Training and Employment Opportunities for Males and Females

The literature reported a need to encourage females to enter non-traditional professions such as marine engineering. McDuff (2003) reported fewer than 3% of seafarers were female, and were employed primarily as stewardesses, porters and cooks. There was a small number of females employed in at-sea occupations. Census 2001 reported: 6% (305) of TC deck and engineer officers in Canada were female, and of those 30% (90) worked full-year, full time. The number of females that worked as engineering officers, or engine room crew in Canada was not available under the reporting guideline that if a population is less than 250 in any category, it was not reported by Statistics Canada (Statistics Canada respondent).

The Marine Career Secretariat (2003) reported the number of those females employed in at-sea positions (p. 40), listed on Table 2.11., Appendix C. McDuff et al stated that less than 2 to 3% of the marine workforce were female (p. 2). The Niagara Marine Secretariat (2001)

emphasized that labour unions should have provided their members with minority awareness training (p. 2). The quantity and content of literature concerning level of participation by females as marine engineers suggested questionnaire items to gather quantifiable feedback from trainers, employers and TC Marine Safety examiners.

Meeting TC Training Requirements

TC Marine Safety regulation TP 8911(formerly TP 2293) and the Canada Shipping Act (CSA) 2001 stated that only Canadian citizens or Landed Immigrants were permitted to attempt examination for TC engineer certification. Previous qualifying sea time would be taken into account for accreditation, but any and all applicable examinations would be challenged at the level of certification determined by the TC examiner. The researcher examined if these conditions challenged parity of certifications amongst IMO member states. TC-certification was required to sail as officer onboard Canadian-registered vessels. The literature suggested personal interview questionnaire items directed to the TC Marine Safety examiner group to determine TC- certification requirements for Canadian and non-Canadian trainees.

Younger individuals entering cadet-type training programs were required to meet theoretical and practical skills prerequisites for examination for the 4th class certificate of competency. This was intended to "fast-track" junior marine engineers to senior levels. This group was challenged by the need to acquire significant practical skill sets quickly and efficiently. Appendix F describes TC-mandated Cadet Training Plan and stated that cooperation between TC colleges and employers-as-mentor was required for successful TC engineer training. Older, more experienced mechanical assistants and junior-level engineer officers sought to upgrade their credentials. This group possessed significant practical skills, while being

challenged by extensive theoretical knowledge requirements for TC certification. Polarization between those two learner groups was mitigated by development and implementation mentoring systems, including satisfactory completion of the TC and STCW-required document Sea Training Record Manual TC13721E, prerequisite to examination for certification as a TC engineer 4th Class. Experienced personnel taught practical skills, while younger engineer trainees as officer candidates shared in theoretical knowledge. Interviews by the researcher with all four of four TC examiners reported the value of this system was lost on a significant portion of marine engineer officers and learners. TC examiners emphasized the importance of sea training manuals as regulatory required training instrument and included the assignment of Officers of Primary Interest (OPI's) in the dual role of mentor and mature learner.

McDuff (2000) was concerned that TC colleges were biased in favour of the "cadet route" (p.28). More mature learners felt disenfranchised and research suggested that several barriers to learning existed (p. 26):

- High cost of training courses,
- cost of travel to and accommodation at marine training Institutes,
- difficulty obtaining required time-off during navigation season,
- academic challenge of such courses, especially when it has been a long time since last in the classroom environment,
- lack of company financial support, and
- difficulty completing theoretical portions of Transport Canada exams.

McDuff (2000) suggested the following interventions:

- Improved leave system to accommodate education leave,

- internet-base courses to facilitate on-board leaning, and
- employer initiated and managed in-house training programs.

McDuff (2000) suggested questionnaire and personal interview items directed to all three stakeholder groups: employers, trainers and examiners concerning potential barriers to training (McDuff p. 37).

A Need to Replace an Aging Workforce

Marshall (2005) reported the Strategic Plan and published Immediate Objectives for 2005 to 2006. This partnership of British Columbia stakeholders sought to ensure people and businesses of British Columbia derive the maximum benefit from the development of BC's ocean industries. Those Pacific Coast marine industrial sectors identified by Ocean Industries BC required vessels crewed by TC-engineers (p. 1).

The editor, *Vancouver Sun* (Friday, October 12, 2007) reported on the British Columbia industry conference, *Coastal Connections: Building Industry Relationships*. Captain Arnold Vingsnes, secretary treasurer of the Canadian Merchant Service Guild and a member of the panel, reported an aging workforce, better wages in other industries and a slow immigration process as the causes for labour shortages in British Columbia's marine industry (p. 3). Vingsnes stated that those difficulties in crewing ships in B.C. meant that some vessels had to be tied up for days until officers and crews could be found. A shortage of TC engineers was a concern for Vingsnes. "The mean age of our officers in British Columbia is approaching 53," said Vingsnes in the interview. "It's an aging workforce." (p. 3)

Montgomery (2006) reported that, "the greying of B.C.'s maritime workforce will leave the marine industry scrambling for trained workers in

the next decade -and replacements for almost one in every two people it now employs" (p. 1). She noted that a boom in trade with China (2006), coupled with a well-heeled travelling public, will hit ferries, cruise ships and cargo and coastal vessels with a "huge and growing demand" (p. 1). Skills needed to keep Vancouver's harbour bustling would soon be in short supply.

Kahrmann, (2006) reported, "the average age of senior-level maritime workers is between 55 and 60, in mid-level ranks it's 47, and below that, the pipeline of workers is almost empty" (p. 1). It will take a concerted and flexible effort by employers, unions, training institutes and all levels of government to open the pipeline and allow new workers to gain enough relevant and required experience to fill the job gaps quickly. TC engineer employers reported concern for an aging TC engineer workforce.

Marine Engineer Wage and Tax Issues and Marine Engineer Recruiting and Retention

The Canadian Marine Industry Alliance (2005) generated their Recommendation 47 that concerned perceived risks to the Canadian maritime industry and included Canadian vessel owners that registered vessels under foreign flag (foreign-flagging). The Canadian Marine Alliance described a Canadian practise encouraged by lower waged foreign labour and excluded higher-paid TC engineers (p.42). Preliminary interviews with TC trainers volunteered their concerns that TC engineer recruiting and retention were threatened by foreign-flagging. The literature and preliminary interviews reported concerns for level of demand for TC engineer training.

Leduc (2006) reported reduced wages and benefits for TC engineers that sought employment onboard foreign-registered ships. Engineers resident

in homelands with relatively lower cost of living accepted lower wages for the same work (p. 1). In addition, Canadian Minister of Finance James M. Flaherty stated that OETC did not provide any special consideration to Canadian mariners (p. 4). There were few tax exemptions in recompense for wages earned during extended periods of time spent outside of Canada. Leduc summarized that low wages and lack of tax incentives discouraged TC engineers and trainees.

Methods to Analyze the Quality and Effectiveness of Canadian Post-secondary Education for TC Engineers

The National Center for Education Statistics (NCES) was recognized by the United States Federal Government to collect, analyze, and reported data related to education. Mayer et al, *Monitoring School Quality: an Indicators Report* identified several indicators addressing high priority education data needs; provide consistent, reliable, complete, and accurate indicators concerning education status and trends. They reported timely, useful, and high quality data to the U.S. Department of Education, the Congress, the [United States], other education policymakers. Review of the literature suggested methods to gather education research feedback.

The Canadian Council on Learning (2006) conducted their *Question Scan 06*, that provided literature devoted to examples of the successful implementation of accountability information that improved outcomes within post-secondary institutions. Needs identified included that a heightened attention to accountability and greater interest in alternative assessment methodologies. Their study examined the outcomes of policies and practices employed by a purposive sample of two-year postsecondary institutions. The Canadian Council on Learning developed methods to measured trainer accountability and training outcomes. The researcher

believed these methods helpful to determine the efficiency of TC college trainers meeting TC training requirements.

Mayer, Mullens and Moore (2001) examined The Colorado legislation, *Higher Education Quality Assurance Act* (1996). This was divided into six sections, one for each required accountability indicator:

1. Business Partnerships and Satisfaction;
2. Faculty and Staff Development;
3. Providing Access to Education through Flexible Scheduling, Technology and Other Means;
4. Enhancing Campus Diversity;
5. Student satisfaction with academic, administrative and Student Services, and
6. Responsiveness to Community Needs.

Mayer et al (2001) suggested that research feedback be used to focus on the positive, rather than negative aspects of institution effectiveness. These included the following:

- Development of more partnerships and utilize the collective resources of post-secondary training,
- improved communications with elected officials and policy makers,
- involvement of faculty as partners in this process, and
- address academic integrity and collective responsibility step by step.

(Mayer et al, 2001, p. 47)

Mayer, et al (2001) concluded that demand would place pressures on the post-secondary education system to respond, and suggested ways post-secondary training institutes could achieve their mission and goal

statements. These conclusions were applied to design questionnaire items to survey the eight TC colleges for research. Response to questionnaire items would generate feedback to determine the existence and nature of any partnerships between colleges and employers. The researcher suggested that trainers at Canadian colleges had a level of responsibility for learning outcomes; there were education and training leadership issues that required active partnership with industry.

> It is vitally important for department heads to continuously scan the environment and revaluate their programs in an effort to ensure that their degree programs, planning processes, and initiatives carry out the department's mission. Providing an impetus to strong leadership are recent trends in academia, including new modes of content delivery through Internet courses, weekend executive programs, and a new emphasis on creating partnerships with external constituencies, including industry and international universities. (Mayer, et al, 2001, p. 47)

The Council of Ministers of Education (CMEC, 1999) presented their report concerning *Public Expectations of Post-secondary Education.* They concluded the following:

> Governments play an important role in post-secondary education, one that respected the distinctive and often autonomous management of postsecondary institutions and academic standards, as well as the broad public interest. (p. 13)

This was extended to the role of the Office of Transport Canada Marine Safety Examiners and their responsibility to education and training for the various sectors of our marine industry. It was suggested that effective dialogue should have been maintained between TC Marine Safety and TC colleges in the best interests of the Canadian merchant marine industry.

The CMEC identified the need for governments to articulate their vision and goals for post–secondary education (PSE) policies, practices, and programs required consistency with goals. The CMEC urged government to work with [TC colleges] and others to achieve public expectations for post-secondary education. Governments had roles in the areas of policy, legislation, funding, quality, and accountability (The Council of Ministers of Education (CMEC, 1999).

Mayer et al (2001) suggested that marine engineer training was more effective when implemented by trainers who were subject matter experts. Students learn more from teachers with high academic skills and who teach subjects related to their undergraduate or graduate studies than they do from teachers with low academic skills and who teach subjects unrelated to their training. It was suggested that TC college trainers whose nautical education and certifications were reinforced by practical experience provided the better training; they were more prepared to meet TC college goals and objectives.

Trainee Recruiting and Retention Challenges Shared by TC Trainers

Media and marine industry publications reported a growing shortage in the number of new recruits. The Lloyds Ship Manager (LSM) magazine reported in its July/August 2001 issue that by 2010 the industry could face a situation where it was 20%, equivalent to 75,000, a shortage in the number of officers it will need. Larsen was managing director of Barber Ship Management and called for governments to fund basic education and training for seafarers. (Kitchen, N., Fairplay Magazine. 2001).

Anders (2007) of the Baltic and International Maritime Council (BIMCO) was the world's largest private shipping association and represented ship-owners, shipbrokers, agents and Insurers. BIMCO member states

recognized in 2000 a growing global shortage of ships officers trained to STCW standards. TC engineers were IMO-recognized competent and STCW-compliant (2007) and required maintaining TC standards of marine officer education and training. These suggested opportunity and challenge for all geographic sectors of Canada and world-wide. The opportunity was employment for TC college graduates. The challenge was to recruit and retain TC engineers in the maritime industry.

Factors Reported to Have Contributed to Shortage in Numbers of TC Engineers:

1. End of the Baby Boom: there were relatively fewer young Americans and Canadians to fill existing and future employment vacancies. This forecast (2007) included a shortage in the number of relief marine personnel, and created a potential disincentive to prospective TC engineers (Rosenburg, 2007).
2. Lack of public awareness: career opportunities went vacant in the maritime industry both Canada and world-wide. There was reduced the likelihood that learners might apply to TC colleges. The year 2000 estimate of the worldwide demand for seafarers was 420,000 officers and 599,000 ratings. Appendix I contains Table 2.9 that showed a modest theoretical shortfall of officers required to crew the world fleet of 16,000 or 4 per cent of the total workforce. (McDuff, 2001, p. 4)

Government of Canada Seafarer Statistics

TC trainers needed to be aware of who their learners were. The Canadian Department of Justice *Freedom of Information Act* provided access to TC-

engineer statistics. Appendix H provides contact information to the Access to Information System. Appendix I provides numbers of TC- engineers, compared and contrasted with earlier studies, Marine Institute (2004) and McDuff (2001) indicated increasing shortages of TC engineers. It was suggested that TC engineers were fewer, and average age had increased over time. Appendix K provides questionnaire items directed to trainers for TC engineers to measure need, if any, for increased recruiting and TC-approved marine engineer training.

Regulatory Requirements Affected Program and Course Design

The Minister of Transport Canada published the Canada Shipping Act (2001) and required TC certification for TC engineers. Canada Shipping Act (2001) requirements included those for the Marine Engineer Cadet Training Program TP 8911E (2007). The Transport Canada document TP13720 E Practical Skills Training for Marine Engineers (08/2007) provided a regulatory required syllabus for TC engineer training and stated course goals and outline (Chapter 5, p. 5). These included marine engineer basic skills (Chapter 6 p. 6-8), basic machining and minor overhauls (Chapter 7, p. 9- 11) and shipboard related maintenance (Chapter 8 p. 12). TC literature provided regulatory requirements for TC college programs.

TC examiners provided guidance during telephone interviews and personal visits to their offices, and provided the form TBC 350-57 (Rev. 2000/06/19) for statistical data that concerned TC engineers. This was described as the Transport Canada Marine Safety Access to Information System, (ACIS). Statistical information provided by ACIS concerned statistics (2007) for TC engineers and suggested questionnaire items directed to TC trainers, TC examiners and TC employers of TC engineers.

TC recognized colleges claimed to provide syllabi that met TC Marine Safety requirements. Web sites focused on marketing their facility, but provided only certain data relevant to this study, not class-size, age groups, gender, background nor career path after graduation. Visits to such facilities provided a more complete picture and provided the opportunity to interview trainers and observe the learners while on campus.

Employers surveyed in the research were Canadian employers of TC-engineers, identified in Appendix L. Preliminary research provided official employer web sites and literature. Certain other data was determined by visiting their offices and vessels. Greatest challenges concerned determining engineering department complements, total fleet engineering department size, and policies concerning training and professional development, and measurement of their effectiveness (Newfoundland Marine Careers Secretariat 2003).

A Need for Public Awareness

Bowering (2007) was Vice President of Maritime Affairs for the Canadian Navy League and reported his concerns for a need to increase the level of public awareness of the Canadian maritime industry, "All Canadians, wherever they live, are dependant on water for transportation, commerce, food, minerals, power, employment, recreation and our quality of life." (p.1) Bowering cited the Navy League paper *Canada: An Incomplete Maritime Nation* (2007) that described a reduced state of the Canadian maritime industry and inaccurate common perceptions of that concerned poor opportunity, benefits and pay for merchant mariners. Bowering reported fewer and fewer Canadians chose to earn their living on the water; formerly well-paid engineering positions were described forfeited to significantly-lower waged foreign nationals. These non-TC engineers sailed under the registry of those nations which offered lower tax rates and

leniency in crew and safety requirements described as flags of convenience (p. 1). TC trainers should have been aware that despite prosperity as a geographically vast and resource-rich nation, Canadians did not support their own maritime industries, nor any need to provide TC engineer training (Navy League of Canada, 2007).

A Concern for Supply of TC Engineers

TC trainers needed to be aware of factors that affected the numbers of and characteristics of those TC engineer trainees that attended their colleges. The literature provided information that TC engineer training issues extended to all sectors of the global maritime industries. Appendix C provides the McDuff (2000) citation of the Soroka and Hardeen report (1998) and reported a measurable marine labour supply and demand gap (p. v). TC engineers increased in median age while the younger cohort diminished. Strategic Directions (2005) reported to the Canadian Marine Consortium that fewer candidates sought higher levels of certification and identified reduced crew sizes through expedience of automation that reduced employer demand for TC engineers. Furthermore, as marine engineers retired or otherwise left the industry, it became more apparent that inadequate provisions had been made to train replacements even for fleets of vessels and required significantly reduced crew size (p. 65). TC engineer crew vacancies increased and significantly higher levels of TC certification and experience were demanded. Leduc (2007) reported that accountability had been directed to the shipping companies themselves who were reported to have failed to reinvest in their own future (p. 1). The editor of the Vancouver Sun (2007) suggested that several years or more were required to rectify the perceived shortage in the number of TC engineers p. G 4). Leduc (2007) reported Federal Government financial incentives described, "insufficient to recruit and retain TC engineers" (p. 1). Leduc (2007) suggested disinterest of Canadian political parties and

apparent, "absence of interested and influential lobby groups" (p. 1). The literature described Canadian and world economies (2007) unfavourable to meet the demands of maritime industry for both TC trainers and TC engineer trainees.

Indicators for Effectiveness of TC Engineer Training

The Council of Ministers of Education, Canada (CMEC) developed indicators to measure the efficiency and effectiveness of Canadian Post Secondary Education (PSE) (1999). These included those eight TC college trainers selected for this research. The review of the literature provided a view of methods that could be used to conduct research in this particular area. These were largely through the use of interviews and questionnaires. Questionnaire and interview items were implemented in this education research to gather feedback not directly observable. Gall, Borg, and Gall (1996) suggested feedback-collection methods that inquired about the feelings, motivations, attitudes, accomplishments, and experiences of individual stakeholders (p. 288). Review of the literature provided direction regarding the nature of the questions that could be asked of TC trainers and assisted in determining what was considered important for TC engineer training.

Trainer Training

Fleet and Hache (1999) citing Hansen (1993) stated:

> The positive effects of outstanding curriculum, excellent administration and management, and above average students may not be realized if the classroom instructor does not provide the learners with quality instruction, quality learning may not occur. (p. 1)

Walker, Gregson, and Frantz (1996) suggested that an institution of higher learning could have outstanding curriculum, excellent administration and management, and above average students, but if the syllabus matched neither the required syllabus, nor the education-related skill set needs of employers then, "level of success in examination and subsequent employment may have been significantly reduced." (p. 19).

The National Union of Marine, Aviation and Shipping Transport Officers (NUMAST) (2004) discussed marine engineer training issues and cited IMO Secretary-General Efthimios (2004) for the conference for International Shipping Federation Manning and Training. Efthimios (2004) stated the following:

> I am in no doubt that the whole future sustainability of the industry depends to a great extent on attracting and retaining high quality seafarers, and am pleased to note that many in the industry are now waking up to this fact. Most recently, a "Train-the-Trainer" programme, initially expected to consist of eighteen courses worldwide, has been developed to complement ongoing programs...Train-the-Trainer courses focus on developing the knowledge of instructors so that they are better equipped to train others. (p.1)

The Train-the-Trainer programme was developed by the International Maritime Organization to improve marine engineer training and suggested questionnaire items directed to TC trainers and employers of TC engineers.

Appendix F outlines those sections of Transport Canada regulation TP8911E 26.2 that required TC trainers provided their engineer trainees (cadets) with an Officer(s) of Primary Interest (OPI). This person or persons should have provided quality assurance to the cadet training plan by preparing and implementing a TC-approved sea training manual or (sea training book) to college trainees. OPI's were TC-required to coordinate

sea training with training vessel TC Chief Engineers. Completed sea training manuals should have been reviewed by the OPI and submitted to a TC examiner for approval as prerequisite to examination. The OPI and sea training manual were identified important by TC examiners for provision for effective TC engineer training and assessment.

Preliminary telephone interviews with TC examiners (2006) reported continual professional development a regulatory requirement to improve the safety and efficiency onboard ship. Preliminary telephone interviews with employers (2006) suggested collaboration with TC colleges, perhaps even to share a portion of the expenses incurred to ensure effective, quality training. McDuff (2000) suggested employers extended beyond sponsorship of a "chosen few" employees for regulatory-required safety training, but developed revitalized company policies directed to reinvest profits back into TC college training for all eligible employees.

A Need for On-going Dialogue

Like other providers of post secondary education (PSE), there was a responsibility amongst the TC colleges researched to provide trainees with effective quality marine engineering education and training. This required clear vision, well-defined goals and effective education leadership to ensure that programs and course offerings meet TC regulatory requirements while preparing learners for the actual education and training-related needs of potential employers. Responsibility lay with TC colleges to establish and maintain on-going dialogue between all stakeholders. TC college syllabi needed to be open to review and revision. Sjoquist (2002) was President of the Canadian Merchant Service Guild and advised that TC colleges across Canada needed to transcend autonomy

and work together to the common education goal to prepare learners for examination for certification and for employment in the ever-more global marine labour market.

Need for Compliance and Enforcement

Canadian participation in the ISTCW required enforcement by TC Marine Safety. Just as the goal of TC colleges was to prepare learners for certification and employment as ships engineer officers, the mandate of TC Marine Safety was to enforce compliance by enforcing ISTCW guidelines. TC accomplished this by determining the success or failure of candidates for examination for TC-certification as a marine engineer officer. Appendix F provides TC mandatory minimum examination requirements for engineer knowledge. Relevant sections of The Canada Shipping Act 2001 are provided by Appendix A and empowered TC examiners to revoke TC engineer certification for serious infractions. Without TC-certification, an individual could be employed neither onboard a Canadian-registered vessel nor offshore structure as a TC engineer.

Conclusions on the Review of the Literature

The literature review concerned Transport Canada engineer training. TC Marine Safety web sites outlined specific requirements for merchant marine engineer training and prerequisites for examination, based on the conventions of the International Maritime Organization. The Internet identified TC-approved marine engineer colleges, Canadian-owned and based employers of TC marine engineers, their web sites and contact information. TC college libraries provided literature that concerned education and training for Canadian maritime industries. Canadian-oriented studies conducted by McDuff and the Marine Institute of

Memorial University of Newfoundland identified issues for the research and supporting literature which included Canadian marine industry and news media publications. The research was oriented to answer if TC merchant marine engineer training needs were being met, including meeting TC and IMO training prerequisites for TC certification and employer training-related demands.

CHAPTER 3: DESIGN OF THE STUDY

Nature of the Sample

The study surveyed three groups: trainers, examiners and employers of marine engineer trainees, for their views regarding issues facing merchant marine engineer education and training as an integral part of the Canadian maritime industry. It was acknowledged that preliminary interviews with participants for study risked contaminating data collected as observations and/or notes from telephone interviews. The population used for this study was Canada-wide: eight (n =8) Transport Canada (TC) marine engineer trainers (TC trainers), eight (n =8) Canadian-based employers (employers) of TC-certificated marine engineers and four (n =4) TC Marine Safety Examiners of marine engineers (TC examiners). One trainer who was head of department was selected from each of the eight TC-approved colleges (TC colleges) for the data gathering. One human resource marine engineer manager was selected from each of the eight employers selected for data gathering. All employed TC-certificated merchant marine engineers (TC engineers). One chief examiner was selected from each of the four TC regional offices selected for the data gathering. All participants used for the research were selected by their agencies as qualified to respond to the researcher questionnaire items. Relevant issues for the research were suggested by preliminary telephone interviews with the three stakeholder groups: trainers, employers and examiners of TC merchant marine engineers.

Typically the TC trainers that were surveyed reported that their colleges had varying numbers of trainers and trainees. To obtain a clear perspective of TC engineer training, it was decided to include TC trainers from all eight TC colleges, during the teaching semester when learners were on campus, and not assigned on practical sea-training. This maximized input

concerning feedback to the researcher's questions concerning trainer needs. Employers were selected to provide a broad perspective of various sectors of the Canadian marine industry. The TC examiner population was small and all four regional offices were included in the research.

Demographic Information

The study was conducted to include all four geographical regions of the nation: Atlantic, Great Lakes, Pacific and Arctic. Table 3.1 lists those eight (n =8) TC colleges for the study, and includes their geographic region:

Table 3.1 TC Colleges Used in this Research

	College	Province	Region	Marine sector
1	Marine Institute of MUN	Newfoundland and Labrador	East Coast	Offshore, Fisheries, Ferries
2	Canadian Coast Guard College	Nova Scotia (Federal Government)	Nation-wide	Public Service
3	Owen Sound Marine Campus of Georgian College	Ontario	Great Lakes	Great Lakes, International
4	Polytechnique Maritime du Quebec	Quebec	East Coast	Offshore, Great Lakes
5	Strait Campus Nautical Institute of NSCC	Nova Scotia	East Coast	Offshore, Fisheries
6	Holland College Nautical Institute	Prince Edward Island	East Coast	Offshore
7	St. Andrew's Campus of NBCC	New Brunswick	East Coast	Fisheries
8	Pacific Marine Training Campus of BCIT	British Columbia	West Coast	Ferries, Tugs, International

Informed individuals who functioned as department heads or trainers were selected from each of the eight TC colleges. Data collected from official web sites, pamphlets, and course outline booklets were supplemented by personal visits by the researcher from 2006 to 2007. One of eight TC trainers declined to complete the written questionnaire research item, citing matters of privacy. Data collected from this TC trainer were limited to two telephone interviews, study of their official web sites, and publicly distributed brochures and booklets that described the campus and outlined course offerings. Other TC trainer-permitted data included general observations made during researcher visits on campus. None of the eight trainers' colleges published data concerning neither enrolment numbers nor learner characteristics. Questionnaire items were developed to generate feedback to determine the number and characteristics of their trainees and their geographic region for training. Table 3.2 lists those eight (n=8) employers and their geographic region as follows:

Table 3.2 Employers of TC Engineers and Trainees

	Employer name	Province	Geographic Region	Industry Sector
1	Algoma Central Marine	Ontario	Great Lakes	Bulk cargo
2	Transport Desgagnes	Quebec Arctic	Great Lakes	Bulk cargo
3	V. Ships	Quebec	Great Lakes	Bulk cargo
4	Marine Atlantic	Nova Scotia	Atlantic	Car passenger ferry
5	Atlantic Towing	New Brunswick	Atlantic	Offshore
6	Seaspan	British Columbia	Pacific Coast	Coastal Towing
7	Maersk	Newfoundland and Labrador	Atlantic	Offshore
8	Canadian Public Service	Canada-wide	All Regions	Multi- service

Appendix E identifies those four (n=4) TC examiners for Atlantic, Central, Pacific and Arctic regions.

Appendix K contains responses to the TC trainer (n=8) questionnaire that collected demographic information such as TC trainer level of education, type of training programs engaged in at the time of the study, number of years teaching, whether they possessed TC engineer certification, diploma, university degree and/or technical instructor's certificate, and the nature of teacher training that had been obtained prior to and since employment. Appendix L contains the employer (n=8) questionnaire that collected demographic information such as number of TC engineers employed, level of TC certification required for employment, and TC engineer skill sets peculiar to that maritime sector. The TC examiner survey collected demographic information such as the characteristics of those TC engineers for examination.

Sample Size

A limitation of the study was the small population size of the three groups. According to Gay (1992), a minimum acceptable sample size should have been ten percent (p. 142). McMillan and Schumacher (1997) stated, "in survey research studies there should be about one hundred subjects for each major subgroup that is analyzed and twenty to fifty subjects in minor subgroups" (p. 176). In developing the survey it was decided that all TC approved colleges, most of the major employers in Canada and all four TC regional offices should be included to constitute an acceptable sample size.

Table 3.3 shows the numbers of trainers and trainees at TC colleges surveyed and includes their geographic location by region and province as follows:

Table 3.3 Trainers and Trainees at TC Colleges Surveyed

	Name of Institute	Geographic Region	Trainers (average)	Trainees (average)
1	Marine Institute of MUN	Atlantic	5	100
2	Canadian Coast Guard College	All Regions	6	75
3	Owen Sound Marine Campus of Georgian College	Great Lakes	8	50
4	Polytechnique Maritime du Quebec	Great Lakes	6	25
5	Strait Campus Nautical Institute of NSCC	Atlantic	2	25
6	Holland College Nautical Institute	Atlantic	2	5-10
7	St. Andrew's Campus of NBCC	Atlantic	2	15-20
8	Pacific Marine Training Campus of BCIT	Pacific	5	30
		TOTAL Numbers:	36	310

The total number of all TC trainers employed at all 8 TC colleges was estimated at 36, and estimated number of trainees they trained was estimated at 310, based on trainer feedback and listed on Table 3.2.

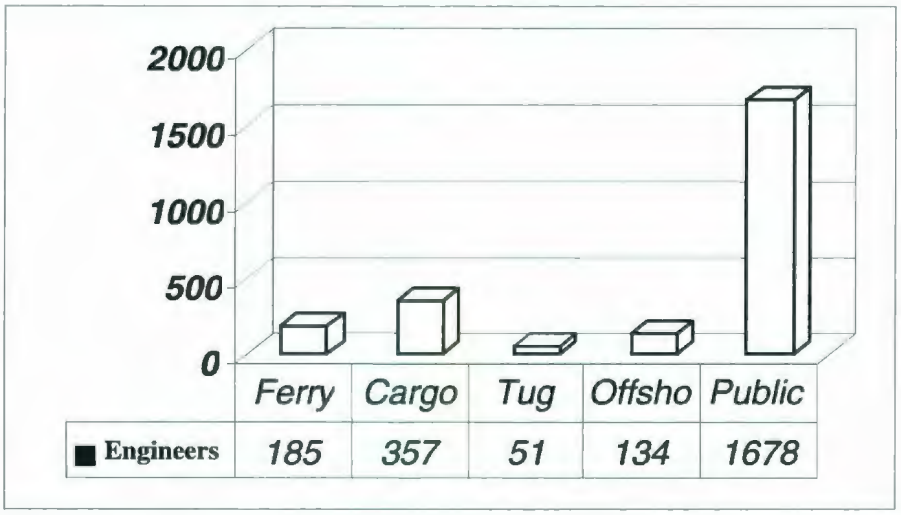
The following Table 3.4 provides the number of TC engineers and trainees employed by the eight TC employers surveyed:

Table 3.4 Number of TC Engineers Employed

Employer number	Employer name	Number of TC Engineers
1	Algoma Central Marine	164
2	Transport Desgagnes	99
3	V. Ships	94
4	Marine Atlantic Ferries	185
5	Atlantic Towing	69
6	Seaspan Towing	51
7	Maersk Offshore	65
8	Canadian Public Service Fleet	1678
	TOTAL	2405

Figure 3.1 shows the number of TC engineers employed in five sectors of the Canadian marine industry as follows:

Figure 3.1 Number of TC Engineers Employed Within Five Sectors of Canadian Marine Industry



The five sectors of Canadian marine industry identified on Figure 3.1. as follows:

- Ferries: Includes those employers for vehicle and passenger
- ferry transport,
- Cargo: Includes employers for bulk cargo transport,
- Tug: Includes employers for tug and barge towing service
- Offshore: Includes employers for offshore oil and gas support, and
- Public: Includes employers for Canadian public service at the federal level (Fisheries and Oceans and Coast Guard).

Geographical Nature of Sample Population

A geographical cluster method was used to select the sample from the above population. It commenced with the designation of four geographical sectors of Canada, from which the clusters were drawn. The four geographical sectors were those commonly used to identify the geographical areas of the nation and similar to those practices typically used when identifying any differences due to geographical location as follows:

- Atlantic Coast that included car and passenger ferries and offshore sector employers,
- Central Canada that included bulk carrier employers,
- Pacific Coast that included tug and towing and car and passenger ferries, and
- Arctic that included Canadian Department of Fisheries and Oceans and Coast Guard and provided dedicated Arctic patrol vessels.

With geographical designation the researcher raised questions concerning how any TC college training needs may have varied according to geographic location as well as sector of the Canadian merchant marine served. The following Table 3.5 lists the number of TC engineers employed in each of the four geographical regions surveyed:

Table 3.5 TC-certificated Marine Engineer Employees by Regions

Number	Canadian region	Persons as TC Engineers
1	Atlantic (East Coast)	319
2	Great Lakes (or Central Canada)	357
3	Pacific (West) Coast	51
4	Canadian Public Service (all Regions)	1678
	Total	2405

The Survey Instrument

A questionnaire was the survey instrument of choice. The trainer questionnaire contained a total of 61 items, the employer questionnaire a total of 29 items and the TC questionnaire a total of 15 items. Questionnaires differed by group. Participants within each of the three groups were provided identical questionnaire items. These consisted of closed questions provided with space for individual comments. Feedback from participants in their respective groups was combined and tabulated. Examination of feedback from participants in all groups was examined to answer the three researcher questions. Ten of the 61 trainer questionnaire items were open-ended to accommodate additional comments by the participants. Four of the 29 employer questionnaire items were open-ended to accommodate additional comments by the participants. Eight of the 16 TC examiner questionnaire items were open-ended to accommodate additional comments by the participants.

How the Survey Instrument was Conceived

Preliminary interviews with TC trainers enabled the researcher to gather information and data that described the characteristics of TC engineer trainees. Subsequently, questionnaire items were developed for the same respondents interviewed to answer the three researcher questions.

Similarly, preliminary interviews with employers enabled the researcher to gather information and data that described the characteristics of TC engineer employees and trainees. Subsequently, questionnaire items were developed to answer the three researcher questions. Letters of Consent and questionnaires were implemented to those employers for the study.

Preliminary interviews with TC examiners provided to the researcher information regarding the Transport Canada *Access to Information System* (ACIS) that provided numbers of valid TC engineer certificates issued by the Minister of Transport Canada (Appendix I). Questionnaire items were developed to answer the three researcher questions. Subsequently letters of Consent and questionnaires were developed for those TC examiners that were surveyed in the study

The questionnaire items were reviewed by an education research specialist as a means to reduce bias and improve validity. Letters of Consent developed and sent to trainer, employer and examiner groups provided authority and maintained conformity with the Memorial University research ethics guidelines for Ethics on Human Research (ICEHR). The Memorial University Ethics Review Committee provided ICEHR approval number 2006/07-096-ED.

Methods Used in Researching Attitudes and Views

Personal interviews, telephone interviews and questionnaire items provided the researcher with the direct feedback addressing trainer attitudes concerning trainee/cadet training programs. Emphasis was placed on any issues concerning trainer attitudes toward the TP8911E-acceptable sea training manual. Such trainer interviews were conducted in person at all eight participant TC colleges. This included the one TC college that declined only the written questionnaire instrument.

Validation of Survey Instrument

The questionnaires were examined for face validity. Gall, Borg & Gall (1996) stated that face validity is a "subjective inspection of the test items to judge whether they cover the content that the test purports to measure" (p. 250). Validity was improved and bias reduced by examination of each

questionnaire item by four judges. The questionnaires for this study were examined by a panel of experts consisting of two university professors and two professional instructors. The changes that were recommended were incorporated into the final questionnaires.

Questionnaire items were broken down into major sections which had been identified through the literature review:

Trainer questionnaire:

- Program funding,
- Transport Canada (TC) accreditation,
- International Convention for Training and Certification of Watch-keepers (ICSTCW) recognition,
- desired learner characteristics,
- trainer characteristics,
- recruiting,
- learner, trainer and employer statistics,
- program and course design,
- safety training,
- leadership,
- practical sea training,
- learner assessment,
- program assessment,
- learner preparation for TC examination, and
- preparation for employment environment.

Employer questionnaire:

- Marine engineer employee characteristics,
- marine engineer employee skill sets,
- employer safety training policies,

- attitudes concerning marine engineer leadership training, and
- attitudes concerning TC certification-upgrading employee training.

TC examiner questionnaire:

- Observed characteristics of candidates for examination for certification,
- observed level of preparation for examination for certification,
- sea-training issues,
- measured candidate success on examination for certification,
- TC statistics (provided through the Canadian Freedom of Information Act),
- examination-related issues identified by TC examiners (open-ended questionnaire items),
- mandatory knowledge issues,
- safety knowledge issues,
- open-ended discussion items, and
- telephone interviews.

Included at the end of the trainer, employer and examiner questionnaires was an option for a voluntary follow-up and in-depth interview. This last option was included for any needed clarification among participants and to be used in the event of a poor questionnaire return rate. The telephone interviews, however, were neither requested nor evoked by the researcher.

Format was that of the mail-out questionnaire item. All replies were kept strictly confidential and, in compliance with the Ethical Guidelines stipulated by Memorial University's School of Graduate Studies, no individual respondent or college was identified in the report of the survey, nor in the conduct of the study.

Personal Interviews (Surveys)

Personal interviews supplemented mail-out questionnaires. Using a geographical cluster method, Canada was sectioned into four geographical sectors, Atlantic Seaboard, Great Lakes, Pacific coast and Arctic. Specific Canadian marine engineer certification requirements were utilized as a base for (n=20) surveys as telephone and personal interviews. TC Examiners (n=4), one in each of the 4 geographic sectors were considered expert, and identified highest priority regulatory requirements for certification as a marine engineer officer. Canadian owned marine crew company managers (n=8), distributed among differing maritime industry sectors, were considered expert, and identified specific desired marine engineer crew skill sets. TC trainers (n = 8) were department heads for their TC colleges, and were considered expert and identified mission, goals, curriculum and course design. The procedures used for all individuals surveyed, TC examiners, trainers and employers, were identical. Personal interview format matched that for the three mail-out questionnaires, distributed to the same participants surveyed.

Appendix K contains the questionnaire, cover letter, and letter of informed consent for trainers.

Appendix L contains the questionnaire, cover letter, and letter of informed consent for employers.

Appendix M contains the questionnaire, cover letter, and letter of informed consent for TC examiners.

Survey Mail-out

The mail-out, consisting of a cover letter, letter of informed consent, questionnaire, and a self-addressed stamped envelope, were either mailed, or hand delivered to each member of the selected survey groups commencing April 20 2007. The deadline designated for the return of questionnaires was June 1, 2007. A telephone call to remind the survey participants to return the questionnaires was made two weeks after the initial mail-out.

Number of Returns on Designated Date

By June 1, 2007, the deadline stated on the questionnaire, there was a total of 4 (50%) instructor surveys 1 (12%) employer surveys and 2 (50%) of the Marine Safety Examiner surveys returned to the researcher.

Follow-Up

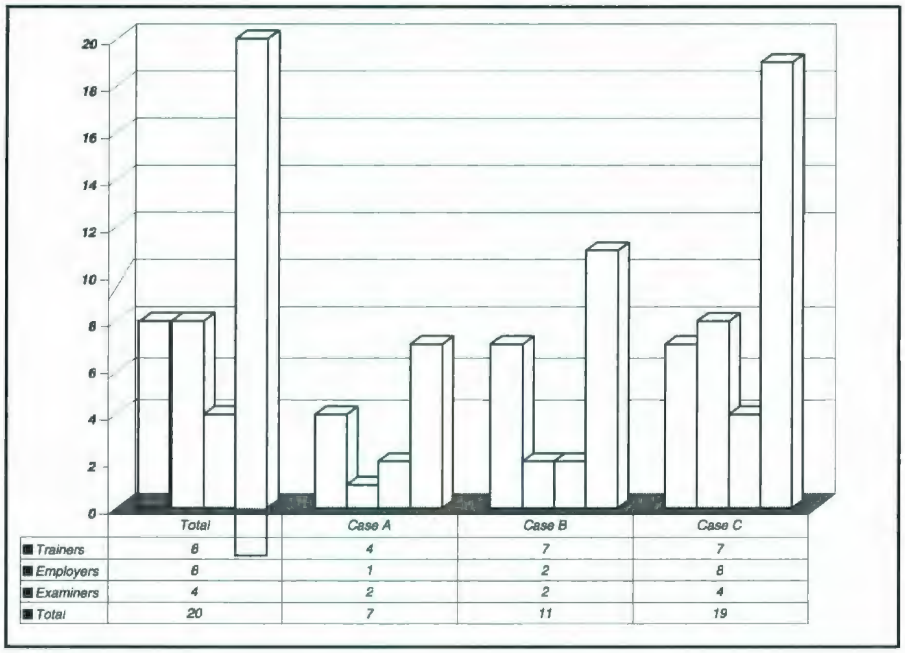
McMillan and Schumacher (1997) suggested that a "telephone call follow-up will add another 5 to 10 percent to the return rate" (p. 300). As soon as practicable after the initial deadline date stated on the questionnaire, a telephone call to each questionnaire recipient was made. This included virtually all participants for survey. They were further encouraged to complete and return the questionnaires. Seven of eight of the TC trainers eventually returned completed questionnaires. Two of four of the TC examiners returned their questionnaires. The other two TC examiners stated that they were unable to complete the questionnaires; they did not have access to the requested information. Only two of the eight employers surveyed returned completed questionnaires. One of the eight employers declined to participate in the study. Another one of the eight employers stated that they did not have access to any of the feedback requested and

declined from further participation in the study. However, these four of the eight employer group stated that they supported the study but were too busy to complete the written questionnaire. Four employers did participate in a telephone interview that consisted of questions following the same format as the original written questionnaire. A revised date of January 7, 2008 was established for follow-up returns. This resulted in a total return of 7 (87%) trainer group questionnaires, two (50%) of the TC examiner group questionnaires and two (25%) of the employer group surveys. The combined response rate for the three groups surveyed was 11 of 20 participants (55%).

Final Return Rate

The total combined return of written questionnaires and telephone interviews of similar content question items for TC trainers was seven (87%), for employer surveys was 8 (100%) and for TC examiners was four (100%). The overall return of all written questionnaires combined with telephone interviews was 85%. This return was considered adequate for three reasons: 1) the return for trainer questionnaires was equal to approximately 95 percent of the total population (n=20), of employer questionnaires: 100 percent (n=8), and for TC examiners the return of questionnaires was 4 (100%). "Babbie (1989) suggested that a response rate of 50% is adequate" (cited in Best and Kahn, 1998, p. 310); and 3) this study was of an exploratory nature. Figure 3.2 shows the following level of participant response to the questionnaire survey instruments:

Figure 3.2 Participant Response to Questionnaire Items: All Cases



	Total	Case A	Case B	Case C
Trainers	8	4	7	7
Employers	8	1	2	8
Examiners	4	2	2	4
Total	20	7	11	19

Case A: Participants completed and returned questionnaires prior to June 1, 2007.

Case B: Participants returned questionnaires January 7, 2008 with follow-up call.

Case C: participants responded to post-July 1, 2007 telephone interviews.

The three cases A, B and C indicated the date of return of printed-format questionnaires: June 1, 2008, January 7, 2008 following telephone call reminder, and July 1, 2007 for completion of questionnaire by telephone interview.

Independent Variables

The data was analyzed using three stakeholder groups as independent variables. These were trainers, employers and examiners.

Geographic location included four regions:

1. East Coast: Newfoundland, Nova Scotia, New Brunswick and Prince Edward Island;
2. Great Lakes: Quebec and Ontario;
3. Pacific Coast: British Columbia;
4. Arctic: Yukon, Northwest Territories, Nanavut.

Dependent Variable

The dependent variable for all analyses was the respondents' views regarding Canadian merchant marine engineering education and training items and issues.

Rationale used to develop the questionnaire items

TC and ICSTCW regulatory requirements for TC colleges were set. Three research questions were developed to ask if despite these, and despite differing specific employment demands between various marine industry sectors, did the TC Colleges meet the following:

1. All relevant Transport Canada rules and regulations,
2. All relevant employer demands for suitably trained personnel, and
3. Individual student education and training needs for Canada-wide and even global employment?

The researcher proposed to identify the extent and nature of any such education and training gaps.

Method Used to Develop First Research Question

Review of the literature and preliminary telephone interviews helped develop questionnaire items contained in Appendix K and implemented to TC trainers. Feedback was gathered and compared with that from the employer and TC examiner questionnaire items to respond to the first research question:

1. Despite set regulatory requirements and despite differing specific employment demands between various marine industry sectors, did the selected TC trainers meet all relevant Transport Canada rules and regulations?

The Director, Marine Personnel Standards and Pilotage and the Minister of Transport authorized TC regulation TP8911E (07-2007). These marine personnel regulations are contained in Appendix F and included marine engineering cadet programs that lead towards certification as a marine engineer under the Canada Shipping Act, 2001. Graduates of approved cadet programs were entitled to certain credits and exemptions beyond the basic 4th Class engineering certificate, based on the content and duration of the specific program attended.

Appendix A contains Marine Certification Regulations SOR/97-391 Marine Certification requirements, under the Canadian Department of Justice Canada Shipping Act 2001 (CSA 2001), and outlines regulatory requirements of the TC Marine Engineer Cadet Training Program TP8911E (07-2007). Appendix F includes the document TP13720: Course Goals and Outlines for Practical Training Requirements for Marine Engineers. TC colleges were fully cognizant of these documents and modeled their programs to meet its' guidelines. The researcher addressed colleges by implementing questionnaires and personal interviews.

Feedback was reviewed for comparison with requirements itemized by the document TP8911E. This rationale suggested possible education and training-related gaps. Preliminary interviews with trainers reported concerns for perceived level of marine engineer awareness of extensive and relevant TC regulations. It was prerequisite to TC examination that TC trainers provided knowledge of TC regulations that concerned TC engineers.

Review of the literature and preliminary telephone interviews helped develop questionnaire items directed to TC trainers. Responses were gathered as feedback and compared and contrasted with that from employers and TC examiners, seeking to answer the first research question.

Method Used to Develop Second Research Question

Review of the literature and preliminary telephone interviews helped develop those questionnaire items listed in Appendix L, implemented to employers of TC engineers. Feedback was gathered and compared with that from the trainer and TC examiner questionnaire items to respond to the second research question:

2. Despite set regulatory requirements and despite differing specific employment demands between various marine industry sectors, did the TC trainers surveyed meet all relevant employer demands for suitably trained personnel?

Documented telephone interviews with eight TC engineer employers identified the following marine engineer education and training-related requirements of TC engineer employees:

- Responsible and effective vessel machinery space watch-keeping skills. Three employers discussed serious incidents that it was believed could have been less critical or prevented by vigilant watch-keeping practice,

- TC colleges should train students to wear the appropriate Personal Protective Equipment (PPE) on the job. This same required equipment is provided by employers, usually free of charge or at a discounted rate. Failure to wear PPE when required can result in immediate dismissal for safety reasons,

- TC engineer employees should have possessed an acceptable level of basic welding and basic machining skills. This was emphasized by Great Lakes bulk carrier companies, as employers. Safety and economic considerations required that specialty skill sets such as precision machining and "high pressure welding" would have continued to be subcontracted to specialty companies,

- the need for improved practical knowledge of marine electrical skills was strongly emphasized by all eight TC engineer employers researched. Reasons cited were expensive vessel delays due to relatively minor electrical faults that could otherwise be quickly and easily rectified by vessel crew,

- improved practical skills in marine electronics were recommended by all eight companies researched. This should at the minimum have enabled TC engineers and TC marine electrical officers to identify differentiate the source

of equipment faults and if not be able to rectify such faults, then call upon the correct contractor to effect repairs only if and when appropriate and necessary,

- essential computing skills should have been provided by TC colleges to enable performance of everyday practical logistics. These included literacy in word processing for data entry and inter-office communications. Spreadsheet skills should extend to enable budgeting and planning vessel mechanical maintenance, and

- TC colleges should have impressed upon learners the critical need for responsible use of vessel internet/intranet resources.

Method Used to Develop Third Research Question

Review of the literature and preliminary telephone interviews helped develop questionnaire items contained in Appendix M and implemented to TC examiners. Feedback was gathered and compared with that from the trainer and employer questionnaire items to respond to the third research question:

3. Despite set regulatory requirements and despite differing specific employment demands between various marine industry sectors, did the TC trainers surveyed meet individual student education and training needs for Canada-wide and even global employment?

Answering how student education and training needs were met concerned meeting five conditions:

1. Provided relevant, comprehensive and effective education training with direct application to the chosen profession of marine engineering;

2. achieved Canadian and world-wide recognition and accreditation for marine engineering education and training;

3. provided with recognition by Transport Canada for education and training that meets all prerequisites for examination for certification as a marine engineer 4th Class and successful preparation for achievement of higher levels of certification 3rd, 2nd and 1st Class;

4. met any employer demand(s) for TC-certificated marine engineer officers in the Canadian and world-wide employment marketplace, and

5. provided measurable overall effectiveness of the implementation of student education and training at TC colleges.

Research Feedback and Review of the Literature

The researcher proposed to identify the extent and nature of any education and training gaps. Tables comprised of descriptive statistics, frequencies and means of the instructor sample profile were included. The analysis was based on several variables: instructor, employer, examiner and geographical sector. Appendices K, L and M provide reliable analysis of

the questionnaire item feedback, and included cross-tabulation of individual items, and the results of the analysis of variance of each of the questionnaire items. Tabular representation of the results was also included. The anecdotal data that was in the form of comments made by respondents in each of the three sets of questionnaires were discussed briefly. Appendices K and L contain documented trainer and employer responses, respectively, to researcher questionnaire items.

Individual participants were selected from each TC college, and each college had a varying number of trainers. Three TC colleges provided diversified training within their marine engineering training programs. This included preparation for heavy duty mechanic and stationary engineers. Such campuses employed relatively fewer trainers. The researcher sought a clear perspective of how the post-secondary college training resources were deployed relative to the total population. It was decided to include all programs in the population from which the sample was drawn and include those instructors providing such "specialized" training in addition to marine engineering. Such persons may or may not have received pre-service trainer training. Not accessing information from such colleges would have otherwise omitted vital input for the study that had been developed to identify and address any TC engineer training needs.

Marine engineer education and training was career-long. Trainees and officers were treated as learners at their own and various levels of training and certification. Attendance at the TC colleges for study varied and consisted of cohorts of entry-level trainees and TC-officers seeking training for higher certification. The total number of TC engineers and engineer trainees employed by the eight employers are listed on Table 3.2. Appendix A contains CSA 2001 regulatory requirements for minimum permissible numbers of TC engineers employed, per vessel. These

numbers were compared and contrasted with feedback contained in Appendix L that provides the numbers of TC engineers reported by employers, per vessel.

Ethics Standards Used in the Research

All questionnaire items distributed included a letter of informed consent with the option for a voluntary follow-up in-depth interview. This last option was included to improve research validity among participants and to be used in the event of a poor questionnaire return rate. Personal interviews followed the same format as printed questionnaires. All participants from the TC trainer group were interviewed in person to supplement and improve validity of the completed printed questionnaire. The majority of members of the employer group requested telephone interviews in favour of the regular-mailed version. Only three of eight employers completed and returned the printed questionnaire. All members of the TC examiner group specifically requested interviews to clarify questionnaire items and provide additional comments relevant to this research. Two members of this group returned completed questionnaires. One sent back a letter of informed consent and an incomplete questionnaire, agreeing to participate in the research but stating he/she could not answer the questionnaire items due to lack off access to researcher-requested feedback. All telephone and personal interviews were documented in writing.

Appendix K contains the questionnaire and cover letter for trainers. Appendix L contains the questionnaire and cover letter for employers. Appendix M contains the questionnaire and cover letter for examiners. All replies were safeguarded confidential and in compliance with those guidelines stipulated by Memorial University's Interdisciplinary Committee on Ethics in Human

Research. The ICEHR Approval number was 2006/07-096-ED. No individual respondent or college was identified in the report of the survey or in the conduct of the study.

Conclusion

The study surveyed three groups: trainers, examiners and employers of marine engineer trainees, for their views regarding issues facing merchant marine engineer education and training as an integral part of the Canadian maritime industry. The population used for this study was Canada-wide. Questionnaires were developed to respond to the three research questions. Limitations of the study were the small number of participants selected for survey and contamination of data collected during preliminary interviews. Review of the literature, feedback from preliminary telephone interviews and observations made during researcher visits to all eight TC college campuses suggested use of questionnaire items. Feedback from three questionnaires implemented to the three groups of participants was cross-referenced to improve validity and reduce bias. Follow-up with supplementary mail-outs and telephone calls improved the response rate. Memorial University of Newfoundland Interdisciplinary Committee on Ethics in Human Research Guidelines for ethical research were followed and participant confidentiality safeguarded.

CHAPTER 4: FINDINGS

Introduction

The findings for this study are located in this chapter. Analysis was conducted to respond to, and report as well, on the three research questions. Preliminary review of the literature and preliminary telephone interviews provided evidence with which to develop contrasts which were in turn used to formulate the research questions. The three participant groups that responded to questionnaires were trainers, employers and examiners. Responses from these three groups were collected as data for comparison and contrast with each other and with the literature to develop findings.

Research questions that concerned Transport Canada (TC) trainers:

1. Did the TC trainers surveyed meet all relevant TC rules and regulations?
2. Did the TC trainers surveyed meet all relevant employer demands for suitably trained personnel?
3. Did the TC trainers surveyed meet individual trainee education and training needs for Canada-wide and even global employment?

Conditions for Answering the Research Questions

The research answered how TC trainee education and training needs were met on the following five conditions:

1. Provided relevant, comprehensive and effective

education training with direct application to the chosen profession of marine engineering;

2. achieved Canadian and world-wide recognition and accreditation for marine engineering education and training;

3. provided with recognition by TC that education and training provided met all prerequisites for examination certification (2007) as a TC engineer 4th Class and successful preparation needed to achieve higher levels of certification (3rd, 2nd and 1st Class);

4. met any employer demand(s) for TC-certificated marine engineer officers in the Canadian and world -wide employment marketplace, and

5. provided measurable overall effectiveness of the implementation of student education and training at TC colleges.

Responses and Findings for Research Question 1

The first research question was:

In the opinion of the respondents did the TC colleges trainers surveyed meet all relevant TC rules and regulations?

The first question related to how TC college trainers surveyed met TC regulations that concerned marine engineer training. TC requirements for college training are provided by Appendix F.

Combined TC trainer responses to the trainer questionnaire item are provided by Appendix K. Combined examiner responses to the examiner questionnaire are provided by Appendix M. Responses from these two groups were collected as data for comparison and contrast with each other and with the literature to develop findings. Furthermore, answering Question 1 focused on how the following three of the five conditions were met:

1. Provided relevant, comprehensive and effective education training with direct application to the chosen profession of marine engineering;

2. achieved Canadian and world-wide recognition and accreditation for marine engineering education and training;

3. provided Transport Canada-recognized education and training that met all prerequisites to examination needed to achieve certification (2007) as a TC engineer 4th Class and successful preparation needed to achieve higher levels of certification (3rd, 2nd and 1st Class);

Meeting Condition 1

TC trainers needed to provide TC rules and regulations for relevant training programs. They were concerned with the following:

a) Program objectives,
b) accreditation,
c) adequate learner preparation for career

progression,

d) admission prerequisites,

e) utilization of and accreditation for available training facilities,

f) trainer qualifications,

g) suitable teaching environment and facilities,

h) pass/Fail Criteria,

i) TC required theoretical knowledge, and

j) course attendance.

a) TC trainers needed to provide TC-required program objectives:

TC regulations and the International Convention for Standards of Training and Certification of Watchkeepers 1978 (ICSTCW 78) required TC college core curricula meet specific requirements. Programs were required to be full-time and provide the basic education and training for a career as a seagoing TC engineer.

Findings:

Item 30 of the trainer questionnaire indicated that 7 of 8 TC trainers researched provided full-time programs. Two colleges' trainers reported programs of four years duration (48 months), three college programs were three academic years (36 months) and two college programs were of duration one academic year (10 months). One college trainer of eight reported that it provided "courses on demand," of indeterminate duration. These were summarized in Table 4.1, as follows:

Table 4.1 Duration of College Programs

College By number	Duration of program In months
1	48
2	48
3	36
4	36
5	10
6	10
7	On demand
8	36

b) TC trainers needed to provide TC-required accreditation:

TC recognition required that colleges provide a diploma program acceptable to TC Marine Safety, the International Maritime Organization (IMO) and the shipping industry in general. TC trainers reported their colleges were obliged to match the need for practical seafarers. The college trainers surveyed for this research were believed to have been well- trained individuals, capable of starting a career as a marine engineer at the watchkeeping level.

Findings:

Item 29 of the trainer questionnaire indicated that of the eight college trainers surveyed, four reported that their college awarded a certificate, two awarded a diploma and two awarded a bachelor degree on successful program completion. One college offered accreditation neither for their marine courses nor program with the exception of their TC-accepted two-week Propulsion Plant Simulator course. One college reported no trainee assessment and awarded no TC-required accreditation. Those findings are

provided by the following Table 4.2:

Table 4.2 Accreditation Awarded by Eight TC Colleges

College by number	Non-Credit Program	1-year Certificate	3-year Diploma	4-year-Degree
1			YES	YES
2				YES
3			YES	
4		YES	YES	
5		YES		
6	YES			
7		YES		
8	YES	YES	YES	

c) TC trainers needed to provide TC-required adequate learner preparation for career progression:

TC required that TC college trainers provided training TC Marine Safety acceptable for exemption from engineer knowledge subjects towards the 2nd Class marine engineer certification level.

Findings:

Four TC college trainers participated in cadet programs in preparation for examination for the TC 4th Class Certificate of Competency as a marine engineer -usually at time of graduation. These same TC trainers surveyed reported their colleges were sanctioned by TC Marine Safety to offer graduates examination exemptions to TC marine engineer 2nd Class. Three TC trainers reported their colleges provided certain theoretical training in preparation for examination for engine room assistant (ERA) or marine engineer 4h Class.

d) TC trainers needed to provide TC-required

admission prerequisites:

Admission requirements matched prerequisite education of trainee applicants to entry-level requirements. Qualifications needed to enter programs were at the discretion of TC trainers, based on that extent to which the level of pre-program education enabled students to cope with the standard of technology inherent within the program. In general a high school diploma with a mathematics and science background was considered a minimum requirement needed to enter TC colleges.

Finding:

Response to trainer questionnaire item 5 identified the number of colleges minimum prerequisites were those high school credits provided by Table 4.3., as follows:

Table 4.3 TC College Prerequisite High School Credits

Number of colleges	College minimum high school credit prerequisite
1	No prerequisite
1	Grade 11 completion
5	High School Diploma
3	Grade 11 physics
2	Grade 12 physics
5	Grade 11 mathematics
4	Grade 12 mathematics
2	Grade 11 chemistry
2	Grade 12 chemistry
2	Minimum two years High School second language training
0	Minimum one year secondary school-level technical training
1	Minimum grade-point average

e) TC trainers needed to provide TC-required

utilization of and accreditation of available training facilities:

Those TC colleges equipped with TC-approved engine room simulators could choose to integrate the mandatory simulator training in their program; however they had to arrange for any Marine Safety examinations and provide the applicable training certificates for the engine room simulator in addition to the graduation diploma. TC colleges that chose to integrate MED and marine first aid training in their program needed to provide the training certificates for both courses in addition to the graduation diploma.

f) TC trainers needed to provide TC-required trainer qualifications:

TC regulation 8911E required all TC trainers of marine engineering specific subjects held a TC 1st Class Certificate of Competency issued under the Marine Personnel Regulations, or as a minimum, held a Canadian 2nd Class Canadian engineering certificate, approved by TC Marine Safety, Ottawa, on an annual basis.

Findings:

Response to trainer questionnaire items 35 to 43 reported trainer qualifications for those eight TC colleges surveyed. Most, but not all, trainers met minimum TC required 1st Class or 2nd Class TC engineer certification. Those trainers that did not meet TC requirements were qualified in similar shore occupations such as stationary engineer, millwright or large ("heavy") diesel mechanic. Table 4.4 summarizes

trainer questionnaire items 35 to 43 for TC college trainer qualifications as follows:

Table 4.4 TC College Trainer Qualifications

Number of College	Number of trainers TC certificated	Number of trainers Non-TC certificated	Total number Of trainers
1	5	15	20
2	6	0	6
3	8	0	8
4	6	0	6
5	1	2	3
6	1	6	7
7	0	4	4
8	No response	No response	No response

Findings:

Response Trainer questionnaire items (35-43) showed: Six of the eight TC college trainers reported their marine engineering subject matter courses were instructed by 1st or 2nd Class TC engineers, as required by TC regulations; seven of eight TC college trainers reported all their college trainers training non-specific engineering subjects were minimum required qualification as a 1st or 2nd Class TC engineers, or held provincially- recognized qualifications for the subject being taught. The Trainers for non-marine engineering-specific courses were held a provincial instructor diploma, provincial trade certificate or Bachelor degree in their field of subject matter knowledge. These included sciences, thermodynamics, electro-technology, physics mathematics, metallurgy, communications, welding and machine shop skills.

g) TC trainers needed to provide TC-required

suitable teaching environment and facilities:

TC regulation TP 8911E required at a minimum TC approved college trainers provided the following services/facilities to their students:

(i) Classrooms, lecture and study rooms suitable for the delivery of technical subjects.

Finding:

Evidence was collected that all eight TC colleges met this criterion.

(ii) Workshops with sufficient modern equipment to deliver the practical portions of the program.

Finding:

Evidence was collected that all eight TC trainers' colleges met this criterion. Practical workshop facilities varied from campus to campus.

TC regulation 8911E required provision of a learning resource centre and library with sufficient marine texts to allow independent study on marine engineering subjects.

Finding:

The researcher visited all eight TC trainers' college libraries and believed they held marine texts that met TC requirements.

TC regulation 8911E required recreational facilities at, or close by the facility that allowed students the opportunity to

relax between or after classes.

Finding:

The researcher collected evidence to indicate that all eight TC colleges showed differences between recreational facilities: Three colleges had their own complete gymnasium and pool facilities, three other colleges shared similar facilities as part of a larger multi-campus facility; two colleges had less extensive facilities, but the local community offered suitable and easily accessible recreation facilities.

TC regulation 8911E required routine access to vessels and ships sufficient to cement the practical aspects of the program and course material and facilitate regulatory required practical sea training.

Findings:

Personal interviews and visits by the researcher to all eight TC trainers colleges showed: Four colleges had their own dedicated training vessels, one college had no dedicated training vessel, but fully equipped lifeboat training and pool survival training facility; one college had no such facilities and depended on referring students to other TC colleges.

TC Marine Engineer Cadet Training Program (TP8911E 07-2007) detailed program content and required TC colleges develop and provide programs with course content that met or exceeded those minimum TC standards. These included, but were not limited to, the number of hours and the various subject areas. TC required that TC trainers implemented course content as a guide that encouraged continuous improvement and actively sought client feedback to keep the various courses up to date.

Findings:

Response to TC trainer questionnaire item 30 showed differences in duration of TC college programs, summarized in Table 4.1., Duration of college programs: Two colleges provided four academic years, two colleges provided three academic years, three colleges provided one academic year, one college provided courses "on demand." One TC college did not respond, but their published literature (2007) reported that they offered a TC approved 4-year Cadet program.

h) TC trainers needed to provide TC-required pass/fail criteria:

All courses within the programs were TC required to provide TC examiners sufficient evaluation of each student. As a minimum standard, an aggregate pass mark of 60% was required to successfully complete each course.

Finding:

Response to item 57 of the trainer questionnaire showed: Six of eight TC college trainers surveyed implemented and assessed formal written papers, quizzes and examinations. One college trainer did not assess learner performance (2007) and described their trainees “self-directed;” learner achievement was assessed on an informal basis through personal feedback on level of success attempting TC examinations assessed off campus by TC Marine Examiners. One TC college trainer declined response, but

identified their college-approved web site that stated trainees were assessed in accordance with TC requirements.

h) TC trainers needed to provide TC-required theoretical knowledge:

TC identified engineer knowledge mandatory for TC examination (mandatory knowledge). Appendix A provides Marine Certification Regulation -SOR/97-391 that identifies that practical engineer knowledge obligatory for TC engineer certification. Furthermore, Appendix J describes TC regulatory required minimum level of TC engineer knowledge needed to operate marine steam boilers. TC examinees were TC regulatory required to demonstrate the required level of subject matter knowledge (mandatory knowledge) that concerned marine steam boilers. Appendix M contains the TC examiner questionnaire and lists TC-mandatory required knowledge marine steam boiler topics as survey items.

Finding:

Four of four TC Examiners surveyed by telephone interview, reported that TC mandatory required steam engineering knowledge was weak amongst a portion of TC college candidates examined at the 4th Class level of TC-certification as a marine engineer.

TC trainers needed to provide TC-required TC required theoretical knowledge. TC examiners responded that the pass/fail mark for each TC required theoretical subject matter examination was 60%. Trainees that did not achieve a 60 % pass mark or higher in each final examination were not awarded TC certification.

Finding:

Ten courses were selected by the researcher. Eight of these courses were TC required. Computer Assisted drafting was not identified TC obligatory. The following Table 4.5 summarizes those TC college courses:

Table 4.5 TC Marine Engineer College Academic Course Offerings

Colleges Offering Course	TC required engineer knowledge by subject
7	Mathematics
5	Applied Mechanics
5	Electro-technology
4	Thermodynamics
4	Ship Stability (Naval Architecture)
5	Technical Sketching
1	Computer Assisted Drawing
4	Metallurgy
4	Strength of materials
1	Communication skills (English or French language)

Finding:

Response to the trainer questionnaire item showed: Three of the eight TC trainers reported their college provided four of six TC required courses, one college offered six of six TC required courses.

j) TC trainers needed to provide TC-required course attendance:

TC regulation 8911E required those eight TC trainers surveyed implemented a strict policy for minimum hours of trainee class attendance. Normally this policy demanded that students attend all

classes, lectures and workshops minimum 90% college program attendance. Trainees with attendance levels less than 90% were not permitted TC examination.

Finding:

> Responses to trainer questionnaire item 59 showed: Six of eight TC colleges assessed learners on (>90%) regular attendance in accordance with TC requirements.

Meeting condition 2 for quality of TC training:

Achieved Canadian and world-wide recognition and accreditation for marine engineering education and training concerned meeting the following conditions:

- Quality system,
- propulsion plant simulator training,
- other requirements of the TC marine personnel regulations, and
- proof of Canadian citizenship or permanent resident status.

Canada was a member state of the IMO (2007) and agreed to conform to the conventions of ICSTCW. TC regulations are contained in Appendix A, and conformed to the following IMO conventions:

- Quality system:

TC required those eight TC college trainers surveyed to operate under a quality system that conformed to those standards identified in Section A-I/8 of the STCW Code Part A of the International

Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as amended 1994.These were recognized by the Canada Shipping Act 2001 listed in Appendix A. Appendix J describes the Marine Engineer Cadet Training Program TP8911E (07-2007) as TC trainer guide.

Findings:

Personal interviews with TC trainers and with TC examiners identified TC trainer awareness of the need to fully comply with TC and STCW regulations.

- Propulsion plant simulator training:

The Marine Engineer Cadet Training Program TP8911E (07-2007), required that TC college trainers integrate the use of TC-approved engine room simulators in their program. TC engineer trainees in their third year were subjected to evaluation by a TC examiner. The TC examiner evaluation was at the watchkeeping level. TC examiners provided certificates that indicated successful completion of the course Propulsion Plant Simulator (PPS) level 1.

Finding:

Responses to the trainer questionnaire item 31 and researcher on-campus visits showed: Six of the eight trainers' colleges were equipped with similar Kongsberg Propulsion Plant Simulators (PPS). All such units were TC-approved for training and assessment purposes.

- Other requirements of the TC marine personnel regulations:

Appendix A contains the CSA 2001 Section 3- Chapter 33 and

required TC engineers hold Canadian citizenship.

Finding:

Personal interviews with TC trainers indicated that 100% of enrolled trainees who attended the eight TC colleges were Canadian citizens or held Resident status. CSA 2001 required TC engineers hold Canadian citizenship or Resident status. This implied that non-Canadians and non-Canadian residents could not hold or apply for examination for TC engineer examination.

CSA 2001 required TC engineers held a valid medical certificate.

Finding:

Response to the trainer questionnaire item 9 showed: valid TC mariners medicals were prerequisite to program admission for five of seven colleges. All eight of eight TC trainers reported their colleges informed applicants of the need to meet TC mariners medical requirements.

TC engineers were required first aid training and other applicable safety training courses, including marine emergency duties. and marine advanced first aid.

Finding:

Response to trainer questionnaire item 33 showed: Five of eight TC trainers provided TC required training at TC approved Marine Emergency Duty (MED) and First Aid training facilities.

g) For trainers colleges that did not have a TC examiner-approved

engine room simulator, successful completion of the watchkeeper level of Propulsion Plant Simulator Level 1 (PPS1) and any examination at that level by Marine Safety.

Finding:

Researcher campus visits and trainer surveys showed: Three of the eight TC trainers reported their colleges did not provide Propulsion Plant Simulator Level 1 (PPS1) programs. In addition, enrolment for the TC required courses: PPS1, MED and First Aid training was the responsibility of the trainee.

TC Cadet Programs greater than 36 months

Appendix F contains the TC Marine Engineer Cadet Training Program 4th Edition July 2007 (TP 8911E), outlined TC requirements incumbent on TC colleges (2007) as providers of TC Cadet programs greater than 36 months. Upon application, TC trainers' colleges that had engineering cadet programs of duration greater than the 36 months, were granted additional levels of exemption or service credits for their program.

Finding:

Response to item 30 of the Trainer questionnaire showed: Four of the eight TC colleges for survey implemented cadet training programs of 36 months duration or more. Feedback from trainers during telephone interviews were believed to confirm that same college programs conformed with TC regulations outlined in Appendix E.

Appendix F contains TC TP 8911E requirements for minimum hours of training provided by the TC college 36 month program, by subject, summarized by the following Table 4.6:

Table 4.6 Minimum TC Required Training Hours by Subject

TC-required training by subject	Minimum required Hours
Skills Training	600
Mathematics	180
Applied Mechanics	300
Refrigeration & Air Conditioning	45
Naval Architecture including stability and ship construction	165
Chemistry	70
Electro technology	250
Automation, Control and Instrumentation	120
Marine Computer Science and Networks	100
Marine Law and Ships' Business	70
Thermodynamics	180
Blue Print Interpretation and sketching, or Drawing	150
Engineering knowledge, motor, steam and general	300
Communication	100
M.E.D.(A1, B1, B2 & C) and Advanced First Aid	119
PPS Training	60
Total TC-minimum-required hours	2720

Findings:

Trainer response to items 26 to 28 of the trainer questionnaire reported three of eight TC colleges met or exceeded the required minimum 2720 instructional hours. College 4: had 2100 hrs, college 5: had 200 hrs and college 6: had 900 hrs. Two TC college trainers declined to respond. Item 38 Item 30 of the Trainer questionnaire showed that five of the eight colleges offered programs of

over 36 months duration.

Appendix F contains requirements for the TC Marine Engineer Cadet Training Program (TP8911E) that required TC colleges provide 65 hours training in materials science.

Finding:

Trainer group questionnaire Item 32 indicated: Four of the eight TC college trainers surveyed responded that their college provided training in metallurgy and materials science. The researcher visited to the eight colleges and believed there were differences in the nature and duration of metallurgical and materials training provided. Four of eight TC colleges provided metallurgical and materials training that appeared to meet TC requirements

Skills Training.

Appendix F contains TC Regulation TP8911E that required that TC trainers provided manual skills training.

Findings:

The researcher collected evidence showing differences amongst the eight TC colleges in the nature and duration of welding skills training provided: Five of eight TC colleges provided exemplary welding training that appeared to meet TC Marine Safety and TC engineer employer requirements.

Appendix F contains TC regulation TP 8911E that required TC trainers provided 200 hours machine shop and minor overhaul training. Trainer questionnaire item 31 identified those TC required manual skills outlined

by the Marine Engineer Officer Cadet Training Program TP8911E Section 8.4 of TP8911E identified those requirements for 200 hours training.

Finding:

Responses to trainer questionnaire item 31 showed differences in the nature and duration of marine machinery maintenance skills training; five of eight trainers surveyed reported they provided extensive general marine machinery training that appeared to meet TC and marine engineer employer requirements. Researcher visits to all eight TC colleges showed differences in the nature and duration of machine shop skills training provided. There were limitations in available training equipment. Five of eight colleges were amply equipped. Three of eight employed comparatively fewer machining equipment. The following Table 4.7 summarizes hours for manual workshop training provided by TC trainers:

Table 4.7 TC College Program Hours for Manual Workshop Training

College by number	Manual training hours provided
1	1048
2	720
3	600
4	225
5	600
6	No response
7	800
8	No response

Appendix F contains regulation TC TP8911E and described TC regulatory requirements for training in electrical shipboard maintenance skills. These

included assembly and disassembly of alternating current and direct current motors and their safe operation and testing. General maintenance tasks included those devices fitted to electrical distribution circuits for safe and accurate monitoring of marine electrical production.

Finding:

> Responses to the trainer questionnaire item 31 reported: Five of eight TC trainers reported their colleges provided practical training for marine electrical skills. The researcher visited all the eight TC colleges and believed there were differences between colleges in the nature and duration of that electrical skills training provided to meet TC and TC employer requirements. One college provided training for enhanced electrical trouble-shooting skills and stated their program met TC employers' demand for same skills (2007).

Appendix F contains regulation TC TP8911E, TC regulatory requirement that TC trainers provided marine steam boiler training. This included practical skills in the safe operation, maintenance and testing of marine boilers and their mountings.

Finding:

> Responses to trainer questionnaire item 31 showed four of eight trainers provided TC required training for marine steam boilers.

Meeting Condition 3 for quality of TC training:

TC required that TC trainers provided education and training that met all prerequisites for examination for certification (2007) as a TC engineer 4th

Class and successful preparation for achievement of higher levels of certification (3rd, 2nd and 1st Class).

Answering research question 1 concerned meeting the conditions that TC trainers college training provided recognition by TC for education and training; that met all prerequisites for examination for certification (2007) as a TC engineer. The TC marine engineer cadet program contained in Appendix F met ICSTCW guidelines (2007). Those TC trainers whose colleges implemented the TC cadet program met the third condition, and provided TC recognition and training for higher levels of certification.

TC regulation TP8911E required proof of six months of supervised experience in the engine room of a vessel of a sufficient power and have completed the program's TC required sea training record manual.
TC trainer questionnaire items 51 to 56 concerned TC regulatory requirement that trainees be provided TC approved practical sea training:

Finding:

Responses to trainer questionnaire item 51 showed that six of eight college trainers reported that they provided trainees with TC required practical sea training.

Finding:

Response to trainer questionnaire item 52 are summarized in the following Table 4.8 and show: Five of eight college trainers provided trainees a TC-required sea training record manual, two of eight colleges did not provide a sea training manual, and one of eight colleges did not respond.

Table 4.8 TC Trainers Colleges that Provided TC-required Sea Training Record Manuals

Number of TC colleges	Colleges that provided a TC-required sea training record manual
5	Yes
2	No
1	did not provide any response

Finding:

Response to trainer questionnaire item 54 showed: Two of eight TC trainers surveyed contacted those vessels as providers practical sea-training to ensure correct trainee completion of their TC required sea training record manual, and six of eight TC college trainers did not contact same.

Finding:

Response to trainer questionnaire item 55 showed: Five of eight TC trainers surveyed reported their colleges provided trainees with instruction concerning TC required acceptable completion of their TC required sea training record manual, and three of eight trainers reported their colleges did not provide same.

Finding:

Response to trainer questionnaire item 56 showed: Four of the eight TC trainers reported they provided any TC required sea training record manual as prerequisite to graduation, three of eight TC trainers did not provide

and did not require any TC required sea training manual, and one of eight TC trainers did not respond.

TC regulations required TC trainers provide their trainees an Officer of Primary Interest (OPI, or sea training officer). The duties of the OPI are outlined in Appendix F.

Finding:

Response to the trainer questionnaire item 53 showed: Four of eight TC trainers reported that their colleges provided trainees with a TC required OPI, three of eight TC college trainers did not provide an OPI, and one of eight TC college trainers did not respond. These are summarized in the following Table 4.9:

Table 4.9 TC College Officer of Primary Interest

Number of TC colleges	Colleges that provided trainees TC required Sea Training Officer
4	Yes
3	No
1	did not provide any response

Finding:

Response to the examiner questionnaire item 13 showed: Four of four TC examiners volunteered their belief that trainees were not consistently and effectively facilitated by any TC college OPI. Appendix M provided anecdotal feedback from four TC examiners and concerned the quality of sea training provided by eight selected TC trainers and their colleges.

Finding:

Senior examiners: Halifax, Quebec City, Sarnia (Ontario) and Vancouver Offices; all examiners volunteered emphasis on the importance of sea training record manuals. Appendix M provides anecdotal reports of their belief that TC-acceptable quality indicated integrity of the Marine Engineer Cadet Sea Training Program, TC regulation TP8911E, July 2007). Four of four TC examiners reported that oneness on was placed on TC college trainers and senior engineer officers onboard ship to ensure that trainees completed tasks itemized by the sea training record manual, in a satisfactory and timely manner.

Finding:

Response to the examiner questionnaire item 14 showed: None of 4 TC examiners reported satisfaction with consistent and effective trainee performance of TC-required training tasks listed in sea training record manuals, submitted to the office of TC Marine Safety examiners. Appendix M provides anecdotal feedback from TC examiner questionnaires and concerned quality of sea training provided by the eight TC college trainers' colleges surveyed.

Finding:

Personal interviews with TC examiners reported their intent to enforce IMO ICSTCW regulatory requirements that concerned marine engineer sea training record manuals,

Appendix F contains the TC regulatory requirement that TC trainers provided trainees sea trainings manuals and needed to

conform to the TC document "Model Training Record Manual for Candidates as Officers in Charge of an Engineering Watch or Designated Duty Engineers." Furthermore, completed sea training record manuals were documents that needed to comply with IMO, STCW.7/Circ.3, December 1, 1996. Section 25.3 Para. 1.

Finding:

Response to TC examiner questionnaire item 14 showed: Four of four TC examiners interviewed expressed concern that practical training may have been compromised (2007). Appendix F outlines TC required sea training record manuals. TC engineer trainees were provided same by their TC trainers for completion in a "correct and timely manner." One examiner described those sea training manuals submitted for assessment, a "failed process." That same examiner reported four acceptable quality manuals compared and contrasted with four that were TC examiner-assessed poor quality. TC examiners reported "disturbing inconsistencies" concerning quality of sea training manuals that they believed suggested candidates had not performed the required training tasks. One examiner of four surveyed, related several unacceptable instances that concerned maintenance tasks, sequentially endorsed by Chief Engineers as "Demonstrated, Performed under Supervision, and Performed Satisfactorily," for equipment not fitted to that same vessel. TC examiners identified a need to reminded TC trainers of the importance of sea training record manuals and their responsibility to ensure that they were completed and correct before submission to TC examiners.

Finding:

Responses to item 61 of the trainer questionnaire are summarized in the following Table 4.10, and show periods of sea training scheduled as integral to their cadet training programs:

Table 4.10: TC College Sea Training Provided to Trainees

College	Number of modules	Duration Per module (days)	Total duration (days)
1	3	60	180
2	2	120	240
3	2	120	240
4	2	90	180
5	0	0	0
6	0	0	0
7	0	0	0
8	No response	No response	No response

Four of eight TC trainers reported their colleges provided the TC minimum required 180 days (six months) sea training, three of eight colleges provided no TC required sea training, and one TC trainer did not respond to the survey item.

The researcher surveyed TC examiners if TC engineer trainee performance met TC requirements for examination. Those four examiners surveyed provided feedback that identified training deficits:

Findings:

Appendix M provides combined examiner questionnaire responses that strongly suggested trainers needed to address

the quality of trainee-completed TC sea training record manuals: Three of four TC examiners identified TC-approved sea training manuals an essential learning tool which constituted an official document that provided quality assurance for TC cadet program training standards. This was compared and contrasted with the combined response to trainer questionnaire provided by Appendix K: Five trainers surveyed reported their colleges provided TC cadet training programs. Three colleges provided shorter duration non-cadet format programs and did not provide any TC approved sea training record manuals.

Finding:

Appendix M provides responses to the TC examiner questionnaire and provided feedback from selected TC examiners. Four of four examiners responded that those sea training record manuals submitted were of poor quality and did not believe those trainees competent to perform duties as a TC engineer. Furthermore, TC examiners reported those trainees seeking TC certification showed gaps in required TC mandatory required sea training knowledge. Poor quality of sea training record manuals showed lack of TC required practical sea experience. Those four TC examiners surveyed reported their concerns that quality and TC engineer competency was compromised by lack of sea training. These findings suggested that TC engineers as graduates of TC colleges (2007) were disadvantaged to those engineers of other nationalities who met or exceeded STCW minimum standards.

Finding:

> Four of four TC examiners reported that trainees lacked knowledge of marine steam boiler safety. Two senior examiners reported the decline of steam ships had been accompanied by failure of examinees to demonstrate adequate knowledge of TC and STCW required marine steam boiler skills.

TC required trainees be provided training obligatory for safety (mandatory knowledge). Appendix J identifies specific engineering safety knowledge a mandatory prerequisite for TC certification. Feedback from TC examiners identified this same knowledge a requirement for the safe performance of TC engineer duties.

Finding:

> Response to TC examiner questionnaire item 11 strongly suggested that candidates for examination for certification did not meet TC Marine Safety Examiner-required level of "mandatory" engineering knowledge (2007). Three of four TC examiners reported that candidates for certification demonstrated minimum, and below minimum TC-acceptable levels of knowledge and appreciation for those safety topics. Three of the four examiners surveyed, assessed such examinees as unable to competently manage potentially hazardous work-place situations. Examinations concerned TC requirements for maintenance and operation of steam boilers, main engine malfunction, flooding and fire fighting procedures, systems and appliances. Those TC examiners surveyed reported candidates failed to demonstrate neither awareness, appreciation, nor appropriate knowledge of critical engine room machinery,

nor appropriately situated machinery operation conditions. TC examiners cited TC regulation TP8911E (07-2007), that corresponded to the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, (ICSTCW) 78, Section 4.7. Section A-I/8 of the STCW Code Part A Section 23.6 required TC trainers to provide instruction for watchkeeping duties that included tests and precautions outlined by Appendix F.

Findings:

Responses to the TC examiner questionnaire and documented telephone interviews provided anecdotal feedback: Four of four TC senior examiners described a "disturbing tendency." Trainees for TC examination failed to follow those instructions provided by TC examiners listed below:

1. The examinee was directed to write their name on each of the examination booklets, and in that space provided,
2. respond to those questions for examination actually being asked,
3. provide legible handwriting, in blue or black pen, make drawings in pencil, and fill the entire page provided,
   "We don't see this" (respondent examiner),
4. attempt response to all those selected examination questions, within the allotted examination time. Use clear, legible handwriting in grammatically correct English or French, and
5. TC examiners volunteered that they observed TC

> trainees for examination make poor quality engineer drawings and failed to demonstrate acceptable level of preparation for TC examination.

Answer to Research Question 1

1. The first research question was: Did the TC trainers surveyed meet all relevant TC rules and regulations?

Answering research question 1 concerned meeting the following three conditions:

> Meeting condition 1 required that TC trainers provided relevant, comprehensive and effective education and training with direct application to the chosen profession of marine engineering. Those seven TC trainers that reported their colleges implemented full-time training programs provided relevant, comprehensive and effective education training with direct application to the chosen profession of marine engineering. There were differences between colleges. The researcher believed that the college that did not provide a full-time TC approved training program, did not meet this condition.
>
> Meeting condition 2 required that TC trainers colleges achieved Canadian and world-wide recognition and accreditation for marine engineering education and training. Those four of eight trainers colleges that implemented the TC-required marine engineer cadet

training program, provided Canadian and world-wide recognition and accreditation for marine engineering education and training. There were differences between trainers' colleges. Those colleges that appointed OPI's and provided TC required sea training best met this condition. Those three of eight colleges that did not appoint OPI's and did not provide TC required sea training were not believed by the researcher to have met this condition for providing Canadian and world-wide recognition.

Meeting condition 3 required that TC trainers' colleges were provided recognition by Transport Canada. TC trainers were TC required to provide education and training that met all prerequisites for examination for certification (2007) as a TC engineer 4th Class and successful preparation needed to achieve higher levels of certification (3rd, 2nd and 1st Class). Those four of eight TC trainers that reported their colleges implemented the TC-required marine engineer cadet training program, provided education and training that met all prerequisites for examination for certification (2007) as a TC engineer 4th Class and successful preparation for achievement of higher levels of certification (3rd, 2nd and 1st Class). There were differences between trainers. Those trainers that appointed OPI's and provided TC required sea training best met this condition. Those three of eight trainers that did not appoint OPI's and did not provide TC required sea training were not believed by the researcher to have met this condition.

Responses and Findings for Research Question 2

The second research question was:

Did the TC trainers surveyed meet all relevant employer demands for suitably trained personnel (TC engineers)?

The second research question concerned meeting the first three conditions, and the fourth condition, that employer demand(s) in the Canadian and world-wide employment marketplace were also met. Combined TC trainer responses to the trainer questionnaire item are provided by Appendix K. Appendix G contains the list of employers selected for survey by questionnaire. Combined employer responses to the employer questionnaire provided by Appendix L. Responses from these two groups were collected as data for comparison and contrast with each other and with the literature to develop findings. Furthermore, answering Question 2 focused on how three of the five conditions were met:

Research Question 2 concerned meeting the first three conditions; and the fourth condition, that employer demand(s) for TC engineers in the Canadian and world-wide employment marketplace were also met. Combined trainer responses to the trainer questionnaire are provided by Appendix K. Combined employer responses to the employer questionnaire are provided by Appendix L, and supplemented by anecdotal feedback from documented telephone interviews. Responses from the trainer and employer surveys were collected as data for comparison and contrast with each other and with the literature to develop findings.

Response to employer questionnaire item 1 identified those maritime sector services provided by the eight employers surveyed and identified on the following Table 4.11:

Table 4.11 Employer Maritime Industry Sectors

Number of Employers	Maritime industry sector
3	Public Service which provided marine safety (Search and Rescue, Ice breaking and navigational aids)
1	Car/passenger ferry service on domestic routes.
0	Car/passenger ferry service on international routes.
3	Offshore vessel support service.
1	Bulk cargo carriage within domestic trade routes.
3	Bulk cargo carriage on international trade routes.
2	Bulk oil tanker on domestic trade routes.
1	Bulk oil tanker on international trade routes
3	Towing (Bulk goods by barge or log boom)
3	Cable or pipe-laying

Eight of eight employers for survey agreed to participate in documented telephone interviews and supplemented feedback from the mail-out employer questionnaire item. Eight of eight employers reported that their web sites (2007) provided reliable descriptions of their TC engineer crewing requirements. TC engineer skills were considered minimum and additional skill sets were described by employers.

Findings:

Response to the employer questionnaire items 2 and 3 showed: Eight of eight employers were owners and operators of Canadian-flagged vessels. In addition, four of the eight employers owned and operated foreign-registered (foreign-flagged) vessels that did not require TC

certificated marine engineers. These same four employers engaged mixed nationalities.

Findings:

Employer responses to employer questionnaire items 4 to 7 are summarized in the following Table 4.12.:

Table 4.12 Eight Canadian-owned and Operated Shipping Fleets

Employer	Canadian Registry vessels	non-Canadian Registry Vessels	Crew Size per vessel	TC Engineers per vessel	Non-Cert. Eng. Crew per vessel	Total Eng staff company	ERA per company
1	19	26	22				80
2	11	0	18 to 22	4	2-4	60	35
3	14	0	22	3	3	42	42
4	3	1	60	10	11	76	83
5	44	0	3 – 11	2	0-1	64	0
6	44	0	5	1-2	0	50	0
7	5	0	11	2	0-1	25	40
8	124	0	15	4	3-4	443	1035
Total persons	264	27	141-153	26-27	19-24	760	1315

Eight Canadian-owned and operated employers of TC engineers, provided the following information:

1. Number of vessels in each employer fleet ("Canadian registry vessels" and "non-Canadian registry vessels"),
2. corresponding average crew size per vessel in each employer fleet,
3. average number of marine engineers per vessel in each employer fleet ("Engineer (Officers per vessel"),

4. average number of certificated Marine Engineer crew employed per vessel, and
5. number of non-certificated Engine Room Department staff employed per vessel, including mechanics, electricians and trainees. ("Non-Cert Eng crew per vessel").

Findings:

Responses to employer questionnaire, items 8 to 11, are summarized in the following Table 4.13:

Table 4.13 Eight Canadian-owned and Operated Shipping Fleets Surveyed

Employer number	TC engineers fleet-wide	ERA's Fleet-wide	Shore-based TC engineers (total)	Shore engineers (total)
1	76	80	4	4
2	60	35	4	0
3	42	42	6	4
4	76	83	2	24
5	64	0	5	0
6	50	0	1	0
7	25	40	0	40
8	443	1035 (est.'s)	200 (est.'s)	1000 (est.'s)
Total	836	1315 (est.'s)	222 (est.'s)	1072 (est.'s)

Table 4.13. identifies TC engineer categories, by column and as follows:

1. Employers number 1 to 8,
2. total number TC engineers, fleet-wide, per employer,
3. total number engine room assistant(s) (ERA), fleet-wide, as non-TC engineers, per employer,
4. total number of certificated shore based TC engineers on staff ("Shore-based TC engineers total"), and
5. total number of shore-based non-TC engineers, per employer

("Shore-based engineers total").

Findings:

Response to the questionnaire items 8 to 11, showed: Employers required TC-certificated marine engineer officers. Relatively fewer positions required non-certificated marine mechanical positions (termed "Engineering Assistant" or ERA's) onboard non- Canadian Government vessels. Fewer ERA's appeared to imply reduced opportunity for those persons who sought TC certification by the "non-cadet" TC training option.

Finding:

Response to employer questionnaire item 12 showed: Six of the eight employers were limited to Transport Canada (TC) -certificated marine engineer officers, two of eight employers required engineers acceptable from any IMO member state. IMO member states included Canada, UK, Continental Europe, former Eastern Bloc, Middle and the Far East.

Finding:

Response to employer questionnaire item 13 reported percentages of TC engineers as TC college graduates: Eight of the eight employers surveyed hired one or more graduates from TC colleges.

Percentages by company are provided by the following Table 4.14:

Table 4.14. Percentage of TC Engineer Employees as Graduates of TC Colleges

Employer 1	25%
Employer 2	15%
Employer 3	15%
Employer 4	10%
Employer 5	60%
Employer 6	05%
Employer 7	75%
Employer 8	95%

Finding:

Table 4.14 shows that three of eight employers surveyed employed the highest percentage of TC college graduates. Employer descriptions provided by Appendix J correlated to Table 4.14 indicated most TC engineers were employed by Canadian Government and the Offshore Petroleum sectors.

Finding:

Response to employer questionnaire item 14 indicated: Seven of eight employers engaged trainees from the TC colleges and one of eight employers did not engage trainees or cadets.

The researcher identified that a limitation of the finding was that scheduling of college calendars, and varied

employer crewing requirements affected minimum and maximum numbers of trainees engaged during normal vessel operations. Those employers that engaged trainees reported the numbers of trainees, data are listed in the following Table 4.15:

Table 4.15 Number of TC Trainees Engaged by Employers

Employer by number	Trainees
1	10 -20
2	5-10
3	10-15
4	1-3
5	2-5
6	0
7	1-5
8	20-55
Total	47-108

Finding:

Response to the employer questionnaire item 14 showed: Seven of eight employers surveyed engaged trainees. Those seven employers surveyed who engaged trainees, provided total minimum 47 and maximum 108 trainee positions.

Finding:

Response to item 15 of the employer questionnaire showed: Seven of eight employers engaged in active dialogue with one or more TC colleges, one company did not engage marine engineer trainees. Employers volunteered that TC college trainers did not describe TC sea training requirements. Furthermore, employers did not state those employment-related skills required of their marine engineer employees. Employers responded that the nature of this

dialogue was limited and concerned availability of training berths, determination of travel arrangements and meeting consensus on health care and financial recompense to trainees.

Finding:

Response to item 16 of the employer questionnaire showed: Six of eight employers surveyed assigned marine engineer officers and company technical staff to conduct "in-house" staff technical training.

Finding:

Response to employer questionnaire item 17 showed: Seven of eight employers reported they provided employees training at the workplace, and implemented employee familiarization booklets and instructional videos. Four employers provided their employees visiting trainers who implemented instruction at the workplace. One employer facilitated visits by TC college trainers.

Finding:

Response to employer questionnaire item 18 showed: Six of eight employers financially compensated TC engineer trainees for duties performed onboard ship.

One of eight employers did not financially compensate their TC engineer trainees. This same employer volunteered the response, "Exemplary performance of unpaid trainees would be taken into consideration when filling any future employment vacancies." One employer reported that they did not engage TC engineer trainees.

Finding:

Response to item 19 of the employer questionnaire showed: Seven of eight employers reported they required minimum TC 4th Class marine engineer certificate for new-hire TC engineers, one of eight employers did not provide any minimum training or certification prerequisite to employment.

Finding:

Response to item 20 of the employer questionnaire identified those employer requirements for specialized safety training:

- Eight of eight employers surveyed required TC engineers hold a valid mariners first aid or advanced first aid certificate, and Marine Emergency Duties (MED) Level A and B certificate.
- Two of eight employers required completion of the Basic Survival Training (BST). Two of eight employers required successful completion of Marine Emergency Duties Senior Officer Level (M.E.D.) C and D.
- Two of eight employers required completion of the Marine Offshore petroleum industry-required, Approved Helicopter Underwater Escape Training (HUET).
- Two of eight employers required new employees be trained in workplace safety handling hazardous cargos.

- Six of eight employers required training in Workplace Hazardous Materials Information Systems (WHMIS).

Finding:

Response to employer questionnaire item 21 identified those TC required courses listed by item 20, that were employer-sponsored and showed: Five of the eight employers surveyed responded that they fully sponsored WHMIS, Confined Spaces Awareness, and Hazardous Atmosphere Safety (HAS) courses.

Finding:

Response to employer questionnaire item 22 showed: Seven of eight employers surveyed provided incentives for employees to obtain the TC Certificate of Competency as a Marine Engineering Assistant (TC ERA); one company responded that these were required and sponsorship and completion the responsibility of the TC engineers themselves.

Finding:

Response to employer questionnaire item 23 showed: Six of eight employers provided partial or full recompense for cost of tuitions, eight of eight employers allowed unpaid educational leave, six of eight employers awarded paid educational leave, and five of eight employers provided on-board facilities for self-directed training. These included world wide web (Internet) courses completed during off-duty hours.

Employer requirements for TC engineers with specialized technical skills:

Finding:

Response to employer questionnaire item 24 indicated those employer-required skills not provided by TC engineer employees, listed on the following table 4.16:

Table 4.16 Specialized Skills Required by TC Engineer Employers

Number of Employers	Specialist skill
4	Marine Diesel fitter
5	Pipe fitter
7	Hydraulics fitter
5	Electrical fault finding (applications below 500 Volts)
8	Electronics technician (for vessel propulsion automation)
3	Welding repairs
6	Machinist repairs and fabrication
5	Pneumatics fault finding and installations

Finding:

Response to employer questionnaire item 25 suggested reasons for out-sourcing those marine specialist skills identified by item 24: Eight of eight employers reported reductions in size of TC engineer department; four of eight employers reported limited time in port, six of eight employers reported a need for consistently high quality of workmanship for specialized technical tasks (such as high-pressure welding), and eight of eight employers reported they believed there were TC engineer skills deficits due to lack of personnel training. Two marine offshore petroleum

sector, one car/passenger ferry, and two bulk cargo employers volunteered that they required:

- Electrical fault finding
- Significantly improved electrical and electronics skills.
- Good welding skills.
- A high level of computer literacy.

TC, ICSTCW and employer required safety training

TC and IMO, ICSTCW employers responded to marine disasters (2007) that caused injury and death. The literature reported that TC engineer training was enhanced to improve safety.

Finding:

Response to employer questionnaire item 20 is data contained in the following Table 4.17, and shows the number of employers that required TC approved engineer safety training:

Table 4.17 Safety Training Required by Employers

Course	Number of employers	Required course
1	8	Standard First Aid
2	7	Advanced First Aid
3	2	Basic Survival Training (B.S.T.)
4	8	Marine Emergency Duties (M.E.D.) Level A and B
5	2	Marine Emergency Duties Senior Officer Level (M.E.D.) C and D
6	2	Helicopter Escape (H.U.E.T.)
7	2	Hazardous Cargo
8	6	Workplace Hazardous Materials Information System W.H.M.I.S.)

Finding:

All eight employers required their TC engineers be provided First Aid and M.E.D. training, six required W.H.M.I.S. training, and two required B.S.T., H.U.E.T. and/or Hazardous Cargo Training.

The TC Marine Engineer Cadet Training Program (TP8911E), (Appendix E) identified those confined space entry training a TC requirements for Sea Training (Appendix F). These were required in accordance with Canada Labor Code safe working practices and concerned tank cleaning, inspection and testing.

Response to the Employer questionnaire item 20 was compared with that for trainer questionnaire item 50: TC college trainers identified five safety courses their colleges provided for TC engineer trainees, Table 4.18:

Table 4.18 Specialized Safety Training Required by Employers

Number of Colleges	Confined space work safety training courses provided by the colleges.
4	Personal Protective Equipment (PPE) familiarization.
4	Workplace Hazardous Material Information System (WHMIS) familiarization.
4	Confined Spaces Entry (procedures and management).
3	Hazardous Atmospheres training (H2S, SO2, O2 depletion).
1	No employer-required safety training provided by college.

Finding:

Response to TC trainer questionnaire item 50 showed differences in the nature and duration of that workplace safety training provided by those eight TC colleges surveyed. Telephone interviews with four TC examiners and eight TC employers indicated strong emphasis on the need for training that provided confined space work safety.

Table 4.15, Specialized safety training required by employers, identified five employer required confined space work safety training courses, and the number of TC colleges that provided the training. Review of the literature: TP 8911E (07-2007), and response to the TC examiner questionnaire showed that TC colleges met most, but not all, TC and STCW requirements.

Leadership training addressed crisis management skills

Employers required TC engineers to demonstrate effective crisis management skills (leadership). Media reports of marine disasters (2007) obliged Canadian shipping companies to mitigate injury and loss of life attributed to lack of engineer training. Employer questionnaire items 26 to 28 surveyed that leadership training provided to TC engineers:

Finding:

Response to the employer questionnaire item 26 showed: Four of the eight employers surveyed reported a demand for marine engineer-related leadership skills prerequisite to employment. Eight of eight employers identified self-motivation and team player skills as a valued personal asset.

Findings:

Response to the employer questionnaire items 27 and 28 identified the number of eight employers who provided for "in-house" workplace leadership training, those topics listed in the following Table 4.19:

Table 4.19 Workplace Leadership Development Training

Number of Employers	Leadership oriented training
3	Career development
7	Occupational health and safety
2	Manager as trainer (or, "Train the Trainer")
1	Conflict resolution (or, "Dealing with Difficult People")
1	Public speaking

Finding:

Response to the employer questionnaire item 28 showed: Four of the eight employers identified TC engineer career development in one or more of the topics listed in item 27. Two employers provided "Crisis Management" (critical incident) training for ferry and cruise ship operations to protect passengers in event of emergency. The literature and employer responses described a world-wide trend (2007) that reduced vessel crew size and increased TC engineer responsibilities to include participation in passenger relations.

Finding:

Response to the employer questionnaire item 29 showed: Five of eight employers demanded leadership training at TC colleges; included organized team sports, human resource management, crisis management and technical administration. Three of eight employers stated that marine engineer training should be limited to technical knowledge and skills.

TC engineer trainees represented by gender

Findings:

Items 10 to 16 of the trainer questionnaire showed that one of eight TC trainers colleges recruited, retained and graduated more than 50 percent enrolment (2006) female trainees, two colleges graduated one female trainee, and five colleges, no female trainees.

Finding:

Response to item 6 of the examiner questionnaire showed: the percentage of females seeking examination for certification as a marine engineer officer; the Vancouver TC Examiner Office: 6%, and Sarnia, Ontario TC examiner office: 1% of all candidates were female. The telephone interview item with the Dartmouth, Nova Scotia TC examiner office indicated a similar percentage. This same examiner recommended the Sydney, Nova Scotia Marine Safety Examiner Office for further information. The researcher contacted the Sydney Examiners office by telephone and was informed that every year a high but un-quantified number of "young" females attempt and pass the 4th Class certificate. This figure (2007) correlated to Item 11 of the Trainer group questionnaire which identified a similar percentage of female applicants who applied to training institutes (5%). The exception was the Canadian Coast Guard College which accepted (2000 to 2006) from 50 to 100% female program intake. Rate of graduation by female marine engineer trainees was reported (2007) by all participant schools to have been comparable to or exceeded that of males.

Finding:

Response to trainer questionnaire item 17 showed an employment rate of 100% for both male and female marine engineer graduates.

Answer to Research Question 2

Response to survey items provided feedback from selected trainers, employers and TC examiners. Feedback was compared and contrasted to answer the second research question:

In the opinion of the respondents, do the TC trainers surveyed meet all relevant employer demands for suitably trained personnel?

Answering how TC trainee education and training needs were met concerned meeting the following three conditions:

1. Provided relevant, comprehensive and effective education training with direct application to the chosen profession of marine engineering:

   Responses to the trainer and employer questionnaires provided feedback; the researcher believed six of the eight TC trainers surveyed met this condition. One of eight TC trainers did not provide the required level of TC engineer training, one of eight TC trainers provided minimum TC engineer training.

2. Achieved Canadian and world-wide recognition and accreditation for marine engineering education and training:

Responses to the trainer and employer questionnaires provided feedback that strongly suggested to the researcher, those colleges that did not meet TC requirements, did not meet IMO, ICSTCW requirements. Those trainers whose colleges met only minimum TC and ICSTCW requirements did not provide trainees with adequate training to meet the competitive Canadian and world-wide maritime industries.

3. Provided with recognition by TC for education and training that met all prerequisites for examination for certification (2007) as a TC engineer ^{4th} Class and successful preparation for achievement of higher levels of certification (3rd, 2^{nd} and 1^{st} Class):

   Responses to trainer and TC examiner questionnaires provided feedback that the researcher believed that there were differences between those TC trainers colleges that provided the three and four year cadet programs. Three of eight trainers adequately prepared trainees for TC examination at all levels of TC certification, five of eight TC trainers did not adequately prepare trainees for examination for the 4^{th} Class level of TC certification. Three TC trainers did not provide practical sea training. Seven of 8 TC trainers did not adequately prepare trainees for TC examination regulatory required (mandatory) engineer safety knowledge.

Responses and Findings for Research Question 3

The third research question was:

In the opinion of the respondents, do the TC trainers' colleges for study meet individual training needs for Canada-wide and even global employment?

Answering how TC trainee education and training needs were met concerned meeting all the five conditions; the first four addressed research questions 1 and 2, and also concerned answering research question 3. The fifth condition required that in the opinion of the respondents, TC trainers provided measurably effective training. Combined trainer responses to the trainer questionnaire are provided by Appendix K. Combined employer responses to the employer questionnaire provided by Appendix L. Combined examiner responses are contained in Appendix M. Responses from these three groups were collected as data for comparison and contrast with each other and with the literature to develop findings.

Appendix A lists TC requirements for TC engineer training. Appendix F contains TC requirements for cadet program sea training. Those TC colleges that provided the TC cadet program adequately prepared trainees for TC engineer certification. In addition, the TC cadet program was IMO endorsed ICSTCW compliant; provided training with direct application, and required certification for employment on IMO member state vessels. Researcher findings supported the belief that those colleges that did not provide the TC cadet program did not meet the first four conditions. Meeting the fifth condition required that TC colleges

followed up on graduate career paths to gather feedback for on-going program development.

Finding:

Response from trainer questionnaire items 44 to 49 provided feedback to answer research question 3. TC college trainers and employers reported only moderate level of cooperation for TC engineer training. These included poor quality of sea training and little or no career follow-up of TC college graduates.

Finding:

Response to trainer questionnaire item 44 showed: Four of eight TC college trainers telephoned employers; six of eight college trainers E-mailed employers, and one of eight TC college trainers surveyed employers, to determine if employer education and training requirement were met. In addition, two TC college trainers volunteered they attended bi-annual marine industry participant Advisory Committee meetings. One of those eight TC college trainers surveyed reported they undertook in-house annual program revisions.

Finding:

Response to trainer questionnaire item 45 showed the number of TC college trainers that reported active employer participation with their college for effective partnership for TC engineer training: Two of eight trainers reported their college employed a full-time on-board OPI , two of eight trainers appointed a part-time OPI that visited trainees onboard training vessels, two of eight trainers reported their college established and maintained regular

communication with training vessel employers, and one trainer reported they did not appoint an OPI and did not contact training vessels. Consideration of TC engineer education and training needs was limited to made periodic review of TC required sea training manuals.

Finding:

Response to trainer questionnaire item 46 reported those methods by which learner progress was monitored and assessed during sea-training: Two of eight TC college trainers reported their college required regular reports by the assigned OPI, four trainers reported a college requirement for regular reports from employer engineers as mentor, one TC college trainer reported they assessed on-campus performance and content of those sea training manuals completed and submitted by trainees. Two TC college trainers provided no response.

Finding:

Response to trainer questionnaire item 47, concerned sea training progress reports and showed: Six of eight TC college trainers surveyed requested employers provide trainee progress reports: Two of those six trainers requested and were provided verbal progress reports, four of six trainers requested and were provided written progress reports in the TC marine training record manual. Three of eight trainers volunteered that TC-required sea training record manuals were not their responsibility. No TC required OPI was trainer reported assigned by these three same colleges.

Finding:

Response to trainer questionnaire item 48 showed: Four of eight TC college trainers surveyed explored new training opportunities for TC engineers.

Finding:

Response to trainer questionnaire item 49 indicated methods used by TC college trainers to research opportunities for TC engineer training; provided by the following Table 4.20:

Table 4.20 Method of Research for TC Training Opportunities

Number of Colleges	Method of research and contact
2	Search for relevant Internet web sites
3	Promotions via public media (radio, television, etc.)
4	Contact management by telephone
1	Distribution of invitations by E-mail
1	Distribution of program promotions by Canada Post
2	Conduct visits by campus representatives
1	feedback from Industry and schools-participant Marine Advisory Committee.

Finding:

Response to trainer questionnaire item 17 showed: for seven of eight TC college trainers, 95 to 100% of their TC college graduates found related employment within one year of graduation.

Finding:

Response to trainer questionnaire item 49 seemed to contrast to contrast data collected from seven of eight TC college trainers surveyed; four of the eight trainers

volunteered that they did not provide any measure for the success of graduates for TC examination and at the workplace (2007). TC college trainers identified considerations they believed contributed to lack of follow-up of TC trainees:

- cost in person hours to research graduate career paths.
- practical difficulties attendant to any such program
- issues of personal privacy.

Finding:

Employer response to employer questionnaire item 13 indicated that all eight employers engaged one or more graduates from those TC colleges surveyed. The percentages of TC college graduates varied from 10% to 95% of total marine engineer officers employed, shown by the following Table 4.21:

Table 4.21 Percentage of TC Engineers as Graduates of TC

Employer By number	TC college graduates
1	25%
2	15%
3	15%
4	10%
5	60%
6	05%
7	75%
8	95%

Answer to Research Question 3

Response to survey items provided feedback from selected trainers, employers and TC examiners to answer the third research question:

In the opinion of the respondents do the TC trainers surveyed meet individual trainee education and training needs for Canada-wide and even global employment?

Answering how TC trainee education and training needs were met on the following five conditions:

1. Provided relevant, comprehensive and effective education training with direct application to the chosen profession of marine engineering:

   Responses to the trainer, employer and TC examiner questionnaires provided feedback; the researcher believed 6 of the eight TC trainers surveyed met this condition. One of eight TC trainers reported providing neither the required levels of TC nor of ICSTCW training, required for Canada-wide and even global employment.

2. Achieved Canadian and world-wide recognition and accreditation for marine engineering education and training:

   Responses to the trainer, employer and TC examiner questionnaires provided feedback; the

researcher believed those trainers whose colleges met only minimum TC and ICSTCW requirements did not provide trainees with adequate training to meet the demands of competitive Canadian and world-wide maritime industries.

3. Provided with recognition by TC that education and training provided met all prerequisites for examination certification (2007) as a TC engineer 4th Class and successful preparation needed to achieve higher levels of certification (3rd, 2nd and 1st Class):

   Responses to the trainer, employer and TC examiner questionnaires provided feedback; the researcher believed that there were differences between those TC trainers colleges that provided the three and four year cadet programs. Three of eight trainers adequately prepared trainees for TC examination at all levels of TC and ICSTCW certification, three TC trainers reported they did not provide practical sea training, seven of eight TC trainers did not adequately prepare trainees for TC examination regulatory required (mandatory) engineer safety knowledge.

4. Met any employer demand(s) for TC-certificated marine engineer officers in the Canadian and world -wide employment marketplace:

   Responses to the trainer, employer and TC examiner questionnaires provided feedback; the

researcher believed that four of eight TC college trainers telephoned employers; six of eight TC college trainers E-mailed employers, and one of eight TC college trainers surveyed employers, to determine if employer education and training requirement were met. In addition, two TC college trainers volunteered they attended bi-annual marine industry participant Advisory Committee meetings. One of those eight TC college trainers surveyed reported they undertook in-house annual program revisions.

5. Provided measurable overall effectiveness of the implementation of student education and training at TC colleges:

   Responses to the trainer, employer and TC examiner questionnaires provided feedback; the researcher believed four of the eight TC trainers surveyed met this condition by measurement of the success of graduates for TC examination and at the workplace (2007).

   Those trainers surveyed that provided the TC cadet program reported they adequately prepared trainees for TC engineer certification. In addition, the TC cadet program was reported IMO endorsed ICSTCW compliant; provided training with direct application, and required certification for employment on IMO member state vessels. Researcher findings supported the belief that those

TC colleges that did not provide the TC cadet program did not meet the first four conditions. Those trainers surveyed that reported their TC colleges neither provided neither OPI nor TC approved sea training manual did not provide Measurable overall effectiveness of the implementation of their programs.

Conclusions

Transport Canada (TC) and the International Maritime Organization (IMO) identified requirements for certification as a marine engineer officer. It was incumbent on the TC trainers to be aware of TC regulatory requirements and capable of generating programs designed to meet or exceed such requirements.

A questionnaire survey instrument was chosen to collect feedback to answer the three research questions. Seven of eight trainers agreed to respond. All (eight) TC trainers consented to researcher campus visits and participated in personal interviews that matched the format of the questionnaire. Of those (eight) employers who agreed to participate in the questionnaire, the initial rate of response was low (two of eight) but improved by telephone interviews (eight) with format matching the questionnaire. All (four) TC examiners agreed to the research. Two returned completed questionnaires. Telephone interviews improved rate of response to all (four) TC examiners and provided anecdotal feedback as voluntary comments. Feedback was compared and contrasted and tables provided. The researcher answered all three research questions based on measuring if five conditions were met. These answers were used to provide a summary, conclusions and recommendations in this study.

CHAPTER 5: SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

The stated purpose of this study was to examine trainer views regarding the present state of Transport Canada (TC) merchant marine engineer college training in Canada and identify any education gaps within their ability to address. This study examined the needs of employers according to geographical and industrial sector: West Coast, Great Lakes, Arctic and Eastern Seaboard, identifying tug and barge, car/passenger ferry, bulk cargo and "Offshore" sectors. The study sought to determine competencies in greatest demand while limiting their scope to regulatory requirements of the TC Marine Safety curriculum. Three groups identified for this study were as follows:

Group 1: TC Marine Safety Marine Engineer Examiners.
Group 2: Canadian-based marine industry employers of TC-certificated marine engineers and trainees.
Group 3: Trainers at TC-approved colleges for TC engineer learners.

Methods Used in this Study

The population of this study was 20 participants representing three major stakeholder groups: eight trainers of marine engineer learners, eight Canadian-owned and operated employers of TC engineers as learner and graduate of same trainers and four TC Marine Safety examiners (examiners) who assessed learners as candidates for certification as a marine engineer ship's officer. These participants were located Canada-wide and represented the following geographical sectors: East Coast,

Great Lakes, Pacific Coast and Canadian Arctic. The eight employer group participants selected for research represented the following sectors of the Canadian marine industry: ferries, tugs, bulk cargo, offshore and Fisheries and Oceans and Coast Guard who perform a variety of functions in direct support of the industrial sectors for study. The trainers were either employed by Provincially or Federally- funded marine training institutes whose programs were and are TC-approved. A geographical cluster method was used to select the sample surveyed from the above population. It commenced with the designation of four geographical sectors of Canada. Various sectors of the marine industry operated to greater or lesser extent in each geographic area. All the employers are required by TC to employ TC certificated marine engineers. These same marine engineers graduated from the various TC colleges should have all met or exceeded the same minimum standard of criterion to determine their competency. In addition, those employer participants selected for research represented sectors of the marine industry with their own unique and distinct employment requirements to be met by learners both as graduates of the TC colleges and as meeting the criterion for TC Marine Safety marine engineer officer certification.

Representatives from all eight TC colleges were surveyed by the researcher. As well, all eight colleges were provided with identical questionnaire items to complete on a clearly voluntary basis. The seven of 36 trainers who agreed to participate in the research represented 19% of the marine engineer trainer population. All eight colleges agreed to provide personal interviews with the marine engineer training department Heads. All eight later agreed to provide telephone interviews whose formats followed that of the written questionnaire items.

All eight employer group participants were sent identical employer group questionnaire items to be completed on a clearly voluntary basis. All eight employer group participants agreed to telephone interviews whose format followed that of the written questionnaire items.

Two of the four selected TC examiners were visited by the researcher. All four of same were sent identical TC examiner questionnaires with items for completion on a clearly voluntary basis.

The trainer questionnaire consisted of 61 items.
The employer questionnaire consisted of 29 items.
The Examiner questionnaire consisted of 15 items.

All questionnaires were composed of items requiring a combination of numerical and written format, with allowances for "best estimates" in cases where precise information was not available. Space was provided for participants to elaborate on their responses. This improved the quality and quantity and accuracy of feed-back returned to the researcher. It was intended to improve overall validity.

The 61 items of the questionnaire directed to trainers were broken down into 14 major sections, or areas of marine engineer training, which had been identified through the literature review. The 14 sections were as follows:

1. Recruiting methods,
2. Learner entry prerequisites,
3. Number of student applications received and the characteristics of the successful leaner applicants,
4. Program funding, duration, class size, characteristics of those learners accepted,

5. Program design, syllabus, subjects instructed, duration of component courses,
6. Methods of learner evaluation, for early diagnosis and trainer education -related intervention,
7. Balance of practical and theoretical aspects of programs,
8. Availability of education and training resources (including libraries, laboratories, workshops, training vessel(s),
9. Trainer skills and techniques, level of trainer education, relevant experience, TC-certification, if any,
10. Level of emphasis on workplace safety skills,
11. Level of emphasis on leadership skills,
12. Accommodation of practical sea training requirements, and
13. Credentials awarded in recognition of achievement.

The 29 items of the questionnaire directed to employers were broken down into 10 major sections, or areas of marine engineer, which had been identified through the literature review. The 10 sections were as follows:

1. Characteristics and size of the company, industry sector served, number and type of vessels,
2. characteristics of the marine engineer employees, total number, credentials,
3. TC certifications required of marine engineer employees;
4. characteristics of in-house training, level of sponsorship for outside training,
5. characteristics of dialogue with marine training institutes;
6. duties required of employees/crew as trainees,
7. special provisions for employees as trainees, assignment of Sea training Officers of Primary Interest (OPI's),
8. dialogue with Marine Safety Examiners concerning any crew training issues,

9. specialized training required of employees, and
10. employer-identified education and training-related deficits or special needs.

The 15 items of the questionnaire directed to TC examiners were broken down into six major sections, or areas of marine engineer assessment, which had been identified through the literature review. The six sections were as follows:

1. Prerequisites to examination for TC-certification as a marine engineer officer,
2. characteristics of the candidates (including gender),
3. certifications sought, level of preparation,
4. identification of problem areas for candidates during examination for certification, mandatory knowledge, general level of candidate preparation,
5. candidate success rate,
6. sea training issues, and
7. additional comments relevant to this research.

Limitations of Methods used in this Study

In developing the survey, it was appreciated by the researcher that there was a limited number of TC-approved merchant marine education and training institutes, believed to be eight in total. The researcher believed that this sample size represented 100% of all such colleges. There were numerous Canadian-owned and operated employers of TC Marine Safety certificated marine engineers. Eight such employers were selected on the basis of being of significant size and as representative as possible of the spectrum of sectors of the Canadian marine industry. The selection of eight major employers was considered adequate to achieve this range. 23

TC Marine Safety examiner offices were located in 5 regions. Only the five TC Marine Safety regional main offices were considered because preliminary investigation by the researcher suggested that data and feedback from those other, smaller Marine Safety examiner offices was limited.

It was a limitation of the study that personal interviews may have biased responses to written questionnaire items. It was a limitation of the study that none of the eight employer group participants were visited by the researcher. However, all eight employer group participants were sent identical employer group questionnaire items to be completed on a clearly voluntary basis. It was a limitation of the study that two of the four selected TC examiners were visited by the researcher. However, four of the four TC examiners agreed to telephone interviews and four of four same TC examiners agreed to participate in telephone interviews whose format followed that of the written questionnaire items. It was a limitation of the study that one of the four TC examiners declined to participate in any portion of the research and suggested contacting the Ottawa-based Senior Superintendent Marine Engineer Examiner for all-Canada, who agreed to participate as TC examiner in a telephone interview following the format of the questionnaire directed to Marine Examiners.

Questionnaires intended for implementation to selected TC examiners, major Canadian employers of TC engineers and TC trainers respectively focused on survey items that investigated the Certification and employment requirements incumbent on TC engineers. Potential findings which may have been realistically addressed by TC trainers were viewed as a potential limitation. As well, it was unknown to the researcher whether the various groups that may have responded to the surveys had appropriately self-identified their views when filling out questionnaires. In an attempt to deal with these potential limitations an optional provision for

a telephone interview was indicated as alternatively available with each mail-out survey. Lastly, the economic climate at the time of the survey may have affected the outcome of this study. At the same time this survey data was collected, a critical, global shortage of certified marine engineer officers was identified by industry and Government authorities world-wide. This personnel shortage was forecast to intensify over the following decades of the 21st century. Industry reacted by understaffing vessels and sought "special exceptions" to further reduce crew complement to become potentially dangerous size. It was not known whether this had a positive or negative effect on the survey data that was collected, nor on decisions to be made by TC examiners, trainers or employers who may not have responded to the study surveys.

Findings and their Implications

There were three research questions for this study:

Despite set regulatory requirements and despite differing specific employment demands between various marine industry sectors, do the selected Canadian marine engineering trainers surveyed:

1) Meet all relevant Transport Canada rules and regulations?
2) Meet all relevant employer demands for suitably trained personnel?
3) Meet individual student education and training needs for Canada-wide and even global employment?

The researcher proposed to identify the extent and nature of any such education and training gaps.

Research Question 1:

Despite set regulatory requirements and despite differing specific employment demands between various marine industry sectors, did the selected trainers surveyed meet all relevant Transport Canada rules and regulations?

Answer to Research Question 1:

The document TP8911E provided the instrument to measure if the selected trainers met all relevant Transport Canada rules and regulations.

There were significant differences among all eight TC colleges on the following criterion: on-campus facilities, program design, duration, implementation and level and nature of support provided learners.

Seven of eight TC colleges provided TC examiner-approved Engine-room Propulsion Simulator facilities. TC examiners volunteered that these facilities conformed fully to TC Marine Safety requirements in accordance with the IMO STCW. Marine engine-room propulsion simulator courses provided at these same seven TC colleges conformed fully with TC examiner regulatory requirements. This finding was confirmed by all four TC Senior Examiners interviewed.

Five TC trainers' colleges offered cadet training programs. Three TC trainers' colleges did not offer cadet training programs.

Three trainers surveyed reported their TC colleges did not offer cadet training programs on the model of TP8911E. They instead provided programs of duration of one academic year or less. None of the trainers at two such TC colleges were TC-certificated marine engineers at any level of certification and were unfamiliar with the requirements of TP8911E. One other such trainer reported their college employed one TC-certificated marine engineer trainer and one STCW-certificated marine engineer trainer. Both these TC trainers were familiar with TP8911E. One TC

trainer reported their college appeared to offer only certain undisclosed courses "on-demand," described on their World Wide Web home page as "to be announced." Two TC trainers surveyed reported their "TC-recognized" colleges did not provide a dedicated marine engineering program, but did provide non-marine diesel mechanic programs of training. Their learners were provided a brief but comprehensive introduction to diesel engine mechanics. A marine component was added to one college's program to provide some basic knowledge of marine diesel engineering. Trainers expressed the desire to design and implement longer and more intensive programs, but reported limitations concerning campus policies and budget, and Provincial Government Department of Education legislation.

Five of those trainers selected for survey reported their colleges offered Cadet training programs of three or four years' duration. Four colleges' programs differed significantly from the requirements of TP8911E. The identified representative from one of the colleges declined to participate in the written questionnaire instrument, but permitted the researcher to visit the campus on thee separate occasions and conduct telephone and personal interviews. Reasons for variance from TP8911E were reported to be matters of institute policy and practical limitations based on available provincial government funding. The majority of trainers at these colleges held 2nd or 1st Class TC marine engineer certificates and a marine engineer college diploma or degree. Only a small minority of trainers reported holding a Provincial Instructor Diploma or equivalent training.

Feedback from written questionnaires, telephone interviews and personal interviews at all five of these colleges provided good agreement and suggested that measured level of conformity varied concerning the guidelines of TP8911E. Such items concerned absence of certain TP8911E-required theory courses, limited practical workshop hours of

training and absence of training in certain required workshop projects. Four of theses trainers reported their colleges met or exceeded most requirements of TP8911E. Two trainers reported their colleges lacked workshop training facilities for required practical workshop training tasks to be undertaken and completed.

One or more (intentionally unidentified) trainers for research were providers of Cadet training schemes (2007). TC examiners suggested they should review their TP8911E-required programs of Practical Sea Training. Dedicated Officers of Primary Interest (OPI's) should be appointed. TP8911E-required Practical Sea Training Manuals should be carefully reviewed with students to improve quality prior to submission to Marine Safety.

TC Marine Safety has identified the need for trainers to fully apprise their learners of prerequisites for examination for certification as a marine engineer officer. This included but was not limited to the following:

- Comprehensive instruction in so-called "Mandatory marine engineering knowledge." This is an essential safety topic on which examinees shall be strictly assessed for competency,

- steam engineering knowledge should be better emphasized as an essential safety topic, and

- learners should have been provided instruction in how to write a Marine Safety-implemented examination to determine competency as a marine engineer. This included the demonstrated ability to read and follow instructions.

Research Question 2:

Despite set regulatory requirements and despite differing specific employment demands between various marine industry sectors, did the TC trainers surveyed meet all relevant employer demands for suitably trained personnel?

Answer to Research Question 2:

Responses from the eight employer group participants and review of the literature identified the following marine engineering education and training-related needs:

1. TC trainers should have provided the essentials of responsible and effective vessel machinery space watch-keeping skills. Vessel crew sizes were insufficient that trainees could have been provided more than minimal supervision. Computerized Engine-room simulators are helpful, but those schools were also provided with dedicated training vessels are considered the most effective.

2. Employers for research reported a shortage of TC-certificated marine engineers, especially at higher levels of TC-certification. Trends to reduce engine-room department staff size had until that time (2007) "hidden the problem." Employers indicated that the burden of responsibility for training to meet any TC-certificated employee shortage lay outside themselves. The literature identified Canadian corporate schemes to petition government to amend Marine Safety Canada regulations to permit and encourage foreign national marine engineers to be employed as officers onboard

Canadian-registered vessels. The literature supported that even were this to occur, world-wide shortage of marine engineers still needed to be addressed.

3. TC colleges should have trained students to wear the appropriate Personal Protective Equipment (PPE) on the job. This same required equipment was provided by employers, usually free of charge or at a discounted rate. Failure to wear PPE when required could have resulted in immediate dismissal for safety reasons.

4. TC Colleges should have provided trainees with an acceptable level of basic welding and basic machining and practical workshop skills.

5. All employers researched required that trainees be provided with improved practical knowledge and marine electrical skills. Those TC colleges providing dedicated electrical trouble-shooting skills were highly regarded by employers.

6. Improved practical skills in marine electronics were recommended by all eight employers researched. This should have enabled TC engineers and TC electrical officers to identify the source of equipment faults.

7. Essential computing skills should have been provided by TC trainers to enable performance of "everyday" practical logistics: literacy in word processing for data entry and inter-office communications. Spreadsheet skills should have been extended to enable budgeting and planning vessel mechanical maintenance.

8. TC colleges should have impressed upon learners the critical need for responsible use of vessel internet/intranet resources.

9. Table 4.21. (page 119) was created from feedback from questionnaire items directed to employers of TC engineers. While the majority of Federal Government ships officers were TC college graduates, it was suggested that there was a significant number of non-college graduates TC-certificated marine engineer officers. Those TC trainers surveyed should have investigated opportunities to provide for the training needs of such individuals. This might have included up -grading of TC certificates, programs to complete various relevant certificate, diploma and/or degree programs or shorter-duration courses directed to meet specific employment needs.

Research Question 3:

Despite set regulatory requirements and despite differing specific employment demands between various marine industry sectors, did the selected TC trainers surveyed meet all relevant individual student education and training needs for Canada-wide and even global employment?

Answer to Research Question 3:

All participant TC Marine Safety Senior Marine Engineer Examiners emphasized that TC trainer conformity to TP8911E should have ensured learners received training to meet Transport Canada and IMO STCW marine engineer education and training requirements.
The research suggested that level of trainer conformity to the TP8911E (Canada Shipping Act 2001) varied as outlined by Answer 1. Not all trainers were aware of TP8911E. Of those who were aware of it, a

significant number did not all appear to fully appreciate its significance to the success of their trainees.

Conclusions

The research showed that all stakeholders agreed that there existed a significant educational need for effective high quality marine engineering training in Canada. Review of the literature, responses to written questionnaire items, telephone interviews with participants from all three stakeholder groups, and personal visits to all eight TC colleges for research provided answers to the three research questions.
Current Transport Canada statistics indicated that the number of Canadian marine engineers steadily declined even as the global demand for marine engineers increased. The literature reported that these trends were accurately forecast by Canadian and international studies published 15 and 20 years ago. Root causes investigated a growing gap between labour supply and demand. No "quick cures" were determined. The problem was long in the making and may be challenging to rectify. No less than seven years are required to train a new recruit to the level of TC-certificated Marine Chief Engineer 1st Class.

Responses to questionnaires and telephone interviews indicated that outside of the Federal government fleets, there were many TC-certificated marine engineers who were not TC college graduates. These persons could have benefited from the TC colleges for research.

The conclusion that can be drawn from this study is that there is a need in Canada for increased learner recruiting and effective high quality marine engineering training. Increased cooperation between colleges, employers and government to meet should contribute to benefit learners and maintain and build Canada's maritime industries.

Recommendations

Recommendation #1

It is suggested that TC colleges offer many services that could benefit Canadian marine engineer learners and their employers. Such products could include the following:

i. Upgrading of current TC certifications;
ii. short and medium duration courses designed to meet specific employment needs. This includes safety training, personnel management skills, mechanical, electrical, electronic and computing skills;
iii. completion of relevant program certificates, diplomas and degrees.

Recommendation #2

Employers and trainer responses identified challenges to campus-based training programs. Education and training may be brought to the learners while at sea or at home on leave. Tools include the internet and travelling instructors visiting vessels.

Recommendation #3

Certain stakeholders identified in the review of the literature suggested that the shortage of TC-certificated marine engineers may be met by hiring non-Canadians holding valid ICSTCW certifications. Trainers should become more familiar with The Canada Shipping Act 2001 (CSA 2001) and the ICSTCW. It was suggested that CSA 2001 is not harmonious with the spirit of ICSTCW. Only those individuals holding Canadian citizenship or Landed Immigrant status are permitted to hold TC-certification as a marine engineer. Engineers employed on Canadian-registered vessels must hold valid TC-certification at or above the required level of competency. Those already holding non-TC-issued

ICSTCW certification prior to such status would be required to obtain Canadian citizenship or landed Immigrant status prerequisite to TC Marine Safety examination for the level of certification at that level determined by the Office of TC Marine Safety Examiners. The language of such examination would be either French or English, only. This implies that stakeholders seeking to employ non-Canadian marine engineers as officers onboard Canadian-registered vessels would need to accomplish fundamental changes in the TC Marine Safety regulatory requirements of CSA 2001. Even were such changes accomplished, there would remain the issue of the global shortage of marine engineer officers at all levels of STCW certification.

Recommendation #4

TC colleges' feedback strongly suggested that student capacity was not being filled. Contributing factors to this condition may have included but were not limited to: changing Canada-wide age demographics, changing Canadian government policies, changing world economics. Initiatives were required to lobby Government to improve public awareness of opportunities in the Canadian maritime industries, such as through secondary school programming and nation-wide multi-media advertising.

The following recommendations address maximizing the quality and effectiveness of merchant marine engineer education and training in Canada:

Recommendation #5

TC colleges and employers should cooperate under the authority and guidance of the TC Marine Safety Examiners Offices to increase recruiting. Researcher visits to Canadian East and West Coast High Schools (Spring 2007) suggested low level of student and teacher awareness of Canadian maritime industries. Many and varied

misconceptions seemed apparent amongst students and teachers. There is a need for widespread public education concerning careers in the Canadian maritime industry.

Recommendation #6

TC engineer trainers should make themselves aware of the contents of the Canada Shipping Act 2001 and TP3811E as authoritative guidelines for developing TC Marine Safety and ICSTCW-acceptable cadet training programs.

Recommendation #7

TC engineer trainers should appreciate and emphasize the importance of comprehensive Sea Training. TC trainers should acquaint themselves with the contents of TP8911E requirements. This includes the need to appoint competent TC-certificated Officers of Primary Interest, correct and timely completion by learners of high quality sea training record manuals and comprehensive theoretical and practical training. Active participation and cooperation with the offices of TC Marine Safety Examiners is encouraged.

Recommendation #8

TC engineer trainers should emphasize essential requirements for success in examination for TC-certification as a marine engineer officer. This includes familiarity with examination syllabus, so-called "mandatory knowledge" subject matter, the demonstrated ability to follow instructions, write legibly and draw clearly.

Recommendation #9

TC engineer trainers should appreciate that their learners could be dismissed from employment for failing to appreciate the importance of

wearing personal protective equipment (PPE). Inculcation of required workplace behaviours may be developed by requiring same of learners during practical workshop training.

Recommendation #10

TC colleges should follow the career paths of graduates. Valuable feedback could be generated to determine how programs could be optimized to meet education and training needs of various sectors of the Canadian marine industry.

Recommendation #11

There were relatively few female marine engineers (2007). Again, the research did not suggest any "quick fixes." It is hoped that improved public awareness of career opportunities in the Canadian maritime industry may increase the numbers of female marine engineers. The Canadian Department of Fisheries and Oceans and Coast Guard provide the broadest spectrum of experience in this respect.

Recommendation #12

The best course of action is improved awareness by Canadians of the vital importance of our maritime industry. The public should be informed by the media and our public education system of the excellent career opportunities that exist. Wages are excellent within Canada, despite reports of lowering wages on the international job market. Above all, Canada's sovereignty and security depend on safeguarding our own merchant marine.

Extensive crewing-related studies have been conducted concerning various specific sectors of the Canadian maritime industry. These are identified in the Reference section:

- *Marine Careers: A Resource Guide* (2004)

- *The White Paper* (2003)
- *Marine Careers Strategy Report* (2003)
- *Niagara Marine Secretariat* (2001)
- *Making Waves -A profile of Career Opportunities in Niagara's Marine Sector* (2000)

Those seeking further information concerning the Canadian marine industry may refer to these resources which make many further valid recommendations relevant to this research.

References

American Psychological Association. (2002). *Publication Manual.* Fifth Edition. Washington D.C.: American Psychological Association.

Appleton, T. (1969). *Usque Ad Mare –A History of the Canadian Coast Guard and Marine Services (Why Canada not a Seafaring Nation).* Retrieved January 4, 2008, from http://www.ccg-gcc.gc.ca/eng/CCG/USQUE_Nautical_Education

Babbie, E. (1989). The *Practice of Social Research, 5th edition.* San Francisco. Woodsworth.

Access to Information Act. (2005). Department of Justice Canada. August 31, 2004. (http://laws.justice.gc.ca/en/A-1/8.html)

Anders, P. (2006). *BIMCO Request for Data for 2005: BIMCO/ISF Manpower Update 2005.* Denmark. Baltic and International Maritime Council (BI MCO). Retrieved November 30, 2006, from http://www.marinetalk.com/aboutCompany.asp?userid=BIM003

Berman, B.(2003). *General Counsel, On the Need to Enforce IMO Regulations. LISCR Vol. 25 No. 03 (2003, June 4).* (Liberian International Ship and Corporate Registry). retrieved January 15, 2008, from http://www.iisd.ca/linkages/oceans/icp4/*Linkages.*

Berman, B. (2002). *Does the UNCTAD Convention on the Registration of Ships need amending?* Retrieved January 12, 2008 from, http://www.itfglobal.org/seafarers/icons-site/images/120_BERMAN.PDF

Best, J., & Kahn, J. (1998). *Research in Education* (8th ed.). Boston. Allyn and Bacon.

Bowering, K. (2007). Oceans of Opportunity. Ottawa. Navy League Maritime Affairs. Retrieved January 4, 2007, from http://www.navyleague.ca/eng/ma/

Boyer, E. (1991). Preparing tomorrow's professoriate. In J.D. Nyquist, R.D. Abbott, D.H. Wulff, & J. Sprague (Eds.), Preparing the professoriate of tomorrow to teach. (pp. 3-11). Dubuque, IA: Kendall/Hunt.

British Columbia Institute of Technology. (2008). *Pacific Marine Training Campus. Programs.* Retrieved January 2, 2008, from http://www.bcit.ca/study/programs/2845dipts

Canadian Council on Learning (CCL). (2007). *Canadian Council on Learning Question Scan: How is the Efficiency of Post-Secondary*

Institutions Determined? Retrieved January 7, 2008, from http://www.aved.gov.bc.ca/ccl_question_scans/documents/13-%20Indices_of_Efficiency.pdf

Canadian Council on Learning. (2006). *Question Scan 06. Summary Report.* Retrieved January 15, 2008, from http://www.aved.gov.bc.ca/ccl_question_scans/documents/24-Tax_Credit_Models.pdf

Canadian Marine Industry Alliance. (2005). *Canada's Marine Industry: A Blueprint for A Stronger Future.* Montreal. St. Lawrence Economic Development Council Publishers. Retrieved January 2, 20007, from http://www.tmq.ca/anglais/publication/canevas_eng.pdf .

Canadian Ministry of Education (CMEC). (1999). *A Report on Public Expectations of Postsecondary Education in Canada.* Council of Ministers of Education, Canada (CMEC). Retrieved January 7, 2008, from http://www.cmec.ca/postsec/expectations.en.pdf .

Casey, D. (2003). *Marine Career Opportunities in the Marine Transportation and Offshore Petroleum Industries in Eastern Canada. Marine Careers Secretariat.* St. John's, Newfoundland. Strategic Directions Inc. Publishing. Government of Newfoundland and Labrador.

Collard, E. A. (1991). *A Passage to the Sea.* Doubleday Canada Ltd., Toronto. The CSL Group, Inc.

Communications Canada. (2008). *Education in Canada Foreign Affairs and International Trade Canada.* Communications Canada, Public Works & Government Services Canada. Retrieved February 19, 2008, from http://www.dfait-maeci.gc.ca/ics-cki/stu_ces-en.asp .

Council of Ministers of Education. (1999). A Report on Public Expectations of Postsecondary Education in Canada. Toronto. Retrieved November 2007, from http://www.cmec.ca/postsec/expectations.en.pdf .

Director, Canada Marine Personnel Standards and Pilotage. (July, 2007). Marine Engineer Cadet Training Program 4th Edition. Transport Canada TP8911E.

Editorial. (2007, October 12). Marine Industry lacks workers: Experts. *Vancouver Sun.* Canwest Publishing Inc.. Vancouver, Canada. Retrieved January 20, 2008, from http://www.ocninc.com/ .

Efthimios, M. (2004). Keynote Speech for International Shipping Federation Manning and Training Conference. London. International Maritime organization Publications. Retrieved February 3, 2007, from http://www.imo.org/About/mainframe.asp?topic_id=847&doc_id=4360 .

Fleet, B. (1998). *A Survey of Newfoundland and Labrador's Post-Secondary instructors and their Employers regarding their views of the importance of pre-service teacher training for post-secondary instructors. A Thesis submitted to the School of Graduate Studies in partial fulfillment of the requirements for the degree of Master of Education. Memorial University of Newfoundland.*

Fleet, B., Hache, G. (1999). *Views of Post-Secondary Instructors and their Employers on the Importance of Pre-Service Teacher Training.* St. John's, Newfoundland. Memorial University. Retrieved Jan 10, 2008, from http://www.mun.ca/educ/faculty/mwatch/win99/fleethache.htm .

Fisheries and Marine Institute of Memorial University of Newfoundland. (1999, June). *Here the Tides Flow – Career Opportunities in the Marine Transportation Industry.* Marine Institute of Memorial University of Newfoundland.

Gall, M., Borg, W., & Gall, J. (1996). *Educational Research: An Introduction.* U.S.A. Longman Publishers.

Gay, L., (1992). *Educational research: Competencies for analysis and application.* New York: Macmillan.

Gierusz, W., & Lisowski, J. (1998). *The Education of Marine Engineers in Control Engineering in Accordance with the IMO Requirements. Contained in the STCW'95 Convention.* Gdynia, Poland. Gdynia Maritime Academy. Retrieved January 14, 2008, from http://www.eng.monash.edu.au/uicee/gjee/vol2no2/gierusz.pdf .

Government of Newfoundland and Labrador. (1998). *Post-secondary indicators '98.* Department of Education, Division of Corporate and Business Planning.

Hansen, W.L. (1993). Bringing total quality improvement into the college classroom. *Higher Education, 25,* 259-279.

Harrison, R. (2004). Leaders of The Canadian Navy League emphasize the need for increased public awareness of the Canadian maritime industry. *Strategic Issues* (2006, September 28). Department of National Defence Canada. Retrieved January 12, 2008, from http://www.navy.forces.gc.ca/cms_strat/strat-issues_e.asp?category=24&id=294 .

International Maritime Organization. (2008). Model Training Record Book for Candidates as Officers in Charge of an Engineering Watch or Designated Duty Engineers. *International Maritime Organization STCW.7/Circ.3, December 1, 1996.* Retrieved February 5, 2008, from www.imo.org/includes/blast_bindoc.asp?doc_id=1194&format=WORD .

International Maritime Organization. (1996). *Model Training Record Book for Candidates as Officers in Charge of an Engineering Watch or Designated Duty Engineers STCW.7/Circ.3*, December 1, 1996. London, UK. IMO Publishing. Retrieved February 5, 2008, from www.imo.org/includes/blast_bindoc.asp?doc_id=1194&format=WORD .

International Maritime Organization. *International Convention on Standards of Training, Certification and Watch-keeping for Fishing Vessel Personnel (STCW-F), (1995, July).* Retrieved January15, 2007, from http://www.imo.org/Conventions/mainframe.asp?topic_id=257&doc_id=677 .

International Maritime Organization. (1978). *Section A-I/8 of the STCW Code Part A of the International Convention on Standards of Training, Certification and Watch-keeping for Seafarers, 1978, as amended.* London, UK. IMO Publishing. Retrieved January, 2007 from http://www.uscg.mil/stcw/stcw-code-ach1.htm#top .

Johansen, D. –preparer. (2001). *Bill C-34: Transportation Appeal Tribunal of Canada Act.* Canadian Law and Government Division. Retrieved January 3, 2008, from http://dsp-psd.pwgsc.gc.ca/Collection-R/LoPBdP/LS/371/c34-e.htm .

Kahrmann, G. (2006). Skills needed to keep Vancouver's harbour bustling will soon be in short supply. *The Province.* Vancouver, British Columbia. Canwest Publishing Inc..

Keefe, M. (2003*). Marine Careers Opportunities in the Marine Transportation and Offshore Petroleum Industries in Eastern Canada.* Strategic Directions Inc. *(SDI).* Retrieved July 15, 2007, from http://www.lmiworks.nl.ca/locindinti/mcs_report.pdf .

Kitchen, N. (2002). Skill Shortages drive Bosses to Desperate Measures. Fairplay International Shipping Weekly. Retrieved January 15, 2007, from http://www.lloydsshipmanager.com/ll/news/articleSearch.htm .

Luduc, M. (2007). Martin's Marine Engineering Page. *The Seafarer and the Taxman.* Retrieved January 4, 2008, from http://www.dieselduck.net/taxes/index.htm .

Marshall, P. (2005). Ocean Industries British Columbia. Retrieved January 4, 2008, from http://www.oceanindustriesbc.ca/index.php .

Mc Duff, D. (2001). *Marine Careers: A Resource Guide prepared by the Niagara Marine Secretariat in partnership with the Canadian Federal Government.* Retrieved January 10, 2007, from www.marinecareers.ca .

Mc Duff, D., Garrett, C. (2000). *Making Waves. A Profile of Career Opportunities in the Niagara's Marine Sector.* , Niagara, Ontario. Researched for Human Resources Development Canada by Workplace Learning, Ventures Division, Niagara College, Glendale Campus. Retrieved January, 2007, from http://www.niagaracollege.ca/business/pdf/research_mr.pdf .

McDuff, D. (2000). *BIMCO/ISF 2000 Manpower Update Summary Report.* Niagara College Department of Economic Development Retrieved November 30, 2006, from http://www.marisec.org/resources/2000Manpowerupdate.htm

McInnis, R. (2007). Marine *Careers – A Resource Guide. Niagara Marine Secretariat: A partnership of industry, labour, education and government.* Niagara, Ontario. Retrieved January 18, 2008, from www.marinecareers.ca .

McMillan, J. H., & Schumacher, S. S. (1997). *Research in Education: A Conceptual Introduction.* New York: Longman. Retrieved March 10, 2007, from http://www.upei.ca/~xliu/ed611/day5.htm .

Marine Careers Secretariat. Retrieved January 4, 2007, from http://www.exec.gov.nl.ca/exec/wpo/publications/mcs_report.pdf .

Marine Institute of Memorial University of Newfoundland. (2004). *White Paper Report on Post-Secondary Education. Marine Institute Submission the Commissioner:* 2004, October 7). St. John's. Memorial University of Newfoundland Publishing.

Marine Safety Directorate of Transport Canada. (2007). *What is the Canada Shipping Act, 2001? -A public information brochure.* Retrieved January 3, 2008, from http://www.tc.gc.ca/MarineSafety/tp/tp13813/brochure/about.htm#whatis .

Mayer, D., Mullens, J., Moore, J. (2001). *Mary School Policy: An Indicators Report.* Washington, D.C. T. Mathematical Policy Research, Inc. National Center for Education Statistics U.S. Department of Education. Retrieved January 07, 2008, from

http://nces.ed.gov/pubs2001/2001030.pdf .

Merriam-Webster. (2000). *Webster's Dictionary*. Springfield, Massachusetts. Merriam-Webster Inc.

Minister, Department of Justice for Canada. (2008). *BILL C-34: Transportation Appeal Tribunal of Canada Act Bill-34 Revised Canada Shipping Act 2001.* Retrieved January 10, 2008, from http://dsp-psd.pwgsc.gc.ca/Collection-R/LoPBdP/LS/371/c34-e.htm .

Minister, Transport Canada (2007). TBC 350-57 (Rev. 2000/06/19) Marine Safety Automated Seafarer Examination Question System, (ACES).

Minister, Transport Canada. (2007). *Transport Canada Certificate of Competency Filing System: Summary Production Report -Certificates Issued Canada-wide for the period of December 31, 2003 to January I, 2007.* Ottawa. Transport Canada Access to Information Act (ACES) Publishers.

Minister, Transport Canada. (2007). *TP 8911E Transport Canada guidelines for Canadian marine engineer cadet programs.* Ottawa. Transport Canada Marine Safety Publications. Retrieved February 15, 2008, from http://www.tc.gc.ca/MarineSafety/training-examination-certification/publications.htm .

Minister, Transport Canada. *(2007).* Transport Canada Marine Safety Marine Engineer Cadet Training Program Record Manual. Requirements for Applicants to the Fourth-Class Engineer Certificate. 2nd Edition. 2007 TP 13721 (July 2007).
Retrieved January 10, 2008, from www.tc.gc.ca/publications/EN/TP13721/PDF/HR/TP13721E.pdf .

Minister, Transport Canada. (2007). *TP2293E and TP 2293F: The Examination and Certification of Seafarers Revision 5 July, 2007.* Ottawa. Transport Canada Marine Safety Publications. Retrieved January 10, 2008, from ww.tc.gc.ca/MarineSafety/TP/TP8911/TP8911E.PDF .

Minister, Transport Canada. (2007). Transport Canada. Practical Skills Training for Marine Engineers. 2nd Edition, (July 2007). TC-1001891. TP 13720E. Ottawa. Transport Canada Marine Safety Publications. Retrieved January 10, 2008, from www.tc.gc.ca/marinesafety/Tp/Tp13720/TP13720E.pdf .

Minister, Transport Canada. (2007). *Marine Training, Examination and Certification.* Retrieved January 10, 2008, from

http://www.tc.gc.ca/marinesafety/training-examination-certification/menu.htm .

Minister, Transport Canada. (2007). *Central Registry for Canadian Seafarers*. Retrieved January 05, 2007, from http://www.tc.gc.ca/MarineSafety/training-examination-certification/central-registry.htm .
Minister, Transport Canada. (2007). *Marine Schools Monitored by Transport Canada Marine Safety*. Ottawa. Transport Canada Marine Safety Publications. Retrieved January 15, 2008, from http://www.tc.gc.ca/marinesafety/training-examination-certification/schools.htm .

Minister, Transport Canada. (2006). *Canadian Coast Guard College Course of Studies. Syllabus -Marine Engineering Four Year Degree Program*. Westmount, Nova Scotia, Canada.

Montgomery, C. (2006). Waterfront workforce shortage looms. *The Province*. Vancouver, British Columbia. Canwest Publishing Inc.

Murray, L. (2005). Deputy Minister of Fisheries and Oceans Canada's Oceans: Maximizing Opportunities for Canadians from a Sovereignty and Security Perspective. What Canadian Military and Security Forces in the Future World? A Maritime Perspective. Ottawa. Canadian Armed Forces Center for Foreign Policies Studies.
Retrieved December 20, 2007, from http://naval.review.cfps.dal.ca/pdf/canadasoceansmurray.pdf .

Navy League of Canada. (2003). *Canada, an Incomplete Maritime Nation* –Precis. Rideau St., Ottawa, Ont. Retrieved March 15, 2008, from http://www.navyleague.ca/eng/ma/papers/2003%20Navy%20League%20Policy%20Paper%20-%20Precis.pdf .

Petroleum Industry Human Resources Committee. (2003). *Presentation and Discussion of the Study "Labour Market Assessment of the Offshore Oil and Gas Industry Supply and Service Sector in Newfoundland and Labrador"*. St. John's, NL: Petroleum Industry Human Resources Committee.

Praxis Research and Consulting Inc. for HRP/HRDC. (2003). *A Long Way Back – A Situational Analysis of Human Resource Issues in the Shipbuilding and Industrial Marine Industry in Canada*. Ottawa: Human Resources Development Canada. Retrieved January 15, 2007 , from www.nrc-cnrc.gc.ca/clusters/ocean/shipbuilding_e.html .

Rosenberg, M. (2006). *Baby Boom Explained: The Population Baby Boom of 1946-1964 in the United States.* Retrieved January 4, 2008, from

http://geography.about.com/od/populationgeography/a/babyboom.htm

Savoie, L. (2008). Transport Canada Certificate of Competency Issuing System. Certificates Issued. Transport Canada Access to Information and Privacy Division. Place de Ville, Tower C, Ottawa, Ontario.

Secretary General of the International Maritime Organization. (1978). International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978 Seafarers Training, Certification and Watchkeeping (STCW). *Code Part A. Chapters 6 and 7: On the requirements to complete relevant education and training requirements and* meet the standard of competence. International Maritime Organization. *International Convention for the Safety of Life at Sea 1974.* London. Retrieved, December 20, 2007, from http://www.imo.org/Conventions/contents.asp?topic_id=257&doc_id=647

Sectoral Committee of the Quebec Marine Industry. (2002). *Executive Summary of Sectoral Profile – "Let's Not Miss the Boat"*. Retrieved January 16, 2008, from http://www.tmq.ca/anglais/publication/canevas_eng.pdf .

Sjoquist, M. -National President. (2002). *A Message from the President.* Canadian Merchant service Guild News. -Vol. 24, No. 3 -December. Ottawa, Ontario, Canadian Merchant Service Guild.

Soroka, L., Hardeen, I. (1998). *Economic Impact Study of the Marine Industry on the Niagara Region.* Brock Centre for Social and Economic Research on Niagara Retrieved January 20, 2008, from http://www.niagaracollege.ca/business/pdf/research_mr.pdf .

Strategic Directions, Inc. (2003). *Marine Careers Opportunities in the Marine Transportation and Offshore Petroleum Industries in Eastern Canada.* St. John's, Newfoundland. Government of Newfoundland and Labrador

United Nations International Labour and Maritime Organization. (2008). International Labour Organization (ILO): Shipping; ports; fisheries; inland waterways. London, U.K.. International Maritime Organization Publications. Retrieved January 10, 2008, from http://www.ilo.org/public/english/dialogue/sector/ sectors/mariti/security.htm .

Walker, T., Gregson, J., & Frantz, N. (1996). Standards of quality for programs that prepare and certify trade and industrial education teachers: The need and key issues. *Journal of Industrial Teacher Education, 34(1), 19-30.*

World Maritime University Academic Handbook -Postgraduate Degree in Maritime Affairs (2007). World Maritime University, Malmo, Sweden. World Maritime University at Malmo, Sweden. Retrieved February 1, 2007, from http://www.wmu.se .

Appendix A: Canada Shipping Act CSA 2001 and TP8911E (07-2007)

The researcher used as guide the Canadian Department of Justice Canada Shipping Act (CSA) 2001, that passed final Parliamentary legislation in July 2007 and included the Marine Engineer Cadet Training Program: TP8911 (07-2007). CSA 2001, TP8911 provided programming guidelines for those Transport Canada (TC) approved colleges for research; as providers of training for merchant marine engineer cadets (trainees). These were identified by Canadian Marine Certification Regulations SOR/97-391 Marine Certification requirements, CSA 2001. Reference was made to Marine Personnel Regulations *CSA 2001 – Regulatory Reform Project – Phase 1 – Consultations – Fall 2004* (Pages 1-12).

CSA 2001 included the Marine Personnel Regulations (2001) that required Canadian ship owners employed sufficient crew for the safe operation of vessels. Crews that included TC engineers were trained and certified to perform relevant duties; able to manage and operate vessels. Marine personnel regulations indicated TC commitment to the International Convention for Standards for Training and Certification for Watchkeepers (ICSTCW).

Prerequisites for TC certification

CSA 2001 addressed application and eligibility for candidates for examination for certification as TC engineers. The recipient of a certificate or endorsement was required at least 18 years of age; have reached at least 16 years of age before starting to acquire the applicable service requirements, or 15 years of age in the case of a family enterprise or in the case the certificate sought is a fishing certificate. Applicants enlisted in an Approved Cadet Program were not required to be Canadian citizens or permanent residents. However, it was a TC requirement for holders of TC engineer certificates be a Canadian citizen or permanent resident.

Applicants were required to pay the applicable exam fees and meet any examination pre-requisites, as set out in TP-2293, before being eligible to take the examinations (CSA 2001 Schedule 5. p. 119.1). Applicants were required to provide the examiner with a valid medical certificate, attesting to the fitness of the applicant, and any certificates of completion for courses required for the certificate sought.

Examination for certification as a TC engineer

CSA 2-001 standardized rules of conduct for examinations and these were listed in TP-2293, *The Examination and Certification of Marine Personnel.* Local examination centers established those additional rules of conduct to serve their clients and were required to conduct examinations properly, fairly and objectively. Passing grades were set out in TP-2293. Passing grades for all nautical examinations and the General engineering knowledge, Motor knowledge and Steam knowledge of the engineering examinations were limited valid for five years. Passing grades in any other examinations were valid for life. A passing grade in an examination that required for more than one certificate remained valid for life for the superior certificate if the lesser certificate had been obtained.

Approved courses and programs

The Minister of Transport approved programs or courses, given by recognized TC colleges and taught by qualified trainers, as substitutes for the examinations required to obtain a certificate. These programs and courses, and the qualified trainers were listed in TP-10655, *Transport Canada Marine Safety Directorate Approved Training Courses.* A Transport Canada examiner was required to audit all such programs and courses before they received approval by Marine Safety. Retention of

approval of the program or course required TC audit on a regular schedule.

Computation of qualifying service

Candidates for examination for certification as a TC engineer were TC required to prove sufficient prerequisite sea service. The work or watch keeping routine consisted of at least eight hours in a 24- hour period, the day equaled one day of qualifying service. Service for watches other than 8 hours per day were prorated to a maximum of twelve hours per day based on an eight-hour day equaling one day of qualifying service, except for applicants registered in an approved cadet training program. It was incumbent on TC approved colleges to provide their trainees with opportunity to acquire sufficient good quality sea service. (CSA 2001 Schedule 5 p.115 para.1-.3)

Validation of certificates and endorsements

TC trainers should have been aware that all certificates and endorsements were valid for 5 years, after which they were required endorsed or renewed to remain valid, except for engine room ratings, whome did not require revalidation. Certificates for Restricted Engineer, Motor Ship were valid for five years from the date of issue. These certificates were not eligible for revalidation. Candidates were required to re-apply for those certificates. All other certificates must be accompanied by a corresponding continued proficiency endorsement (CPE). Applicants were required to provide the TC examiner with proof of successful completion at a recognized marine engineer college of the required courses in marine emergency duties (MED).

TC engineer training for passenger safety a regulatory requirement

TC required TC colleges provided TC engineers those skills for passenger safety. Division 2 of CSA 2001 concerned training and familiarization on Canadian merchant ships. All persons employed in any capacity on a ship were required provided onboard familiarization training before being assigned shipboard duties. This training was defined in TP-4957, *Marine Emergency Duties Training Program.* Passenger and crew safety included TC engineer training for the preparation or launching of a survival craft. This required a certificate of successful completion of training (TC MED Certificate), at a recognized TC college, in marine emergency duties with respect to survival craft.

The CSA 2001 Part 2, Division 2, section 36, amended the TC engineer certificate structure to require training and certification for passenger safety management. TC college training should have included the following:

a) Assisting passengers in emergency situations,
b) providing direct service to passengers in passenger space, and
c) embarking and disembarking passengers.

Appendix B: Contact Data for Transport Canada Colleges Surveyed

Transport Canada (TC) Marine Safety provided the following web site that identified TC colleges for marine engineer training:

http://www.tc.gc.ca/marinesafety/training-examination-certification/schools.htm

Those eight TC colleges for study are provided the following web sites:

1) British Columbia Institute of technology (BCIT) Pacific Marine Training Campus:
   http://www.bcit.ca/about/marine.shtml

2) Canadian Coast Guard College:
   http://www.cgc.gc.ca

3) Georgian College Owen Sound Campus.
   http://www.georgianc.on.ca/owen-sound/

4) Holland College of Prince Edward Island, Canada.
   http://www.hollandcollege.com

5) Institute Maritime du Quebec:
   http://www.imq.qc.ca

6) Marine Institute of Memorial University of Newfoundland:
   http://www.mi.mun.ca

7) New Brunswick Community College (NBCC) –St. Andrew's Campus Marine Diesel Mechanics Program:
   http://www.nbcc.ca/content.asp?id=72&mid=5

8) Nova Scotia Community College:
   http://www.nscc.ca/Learning_Programs/Schools/trades.asp#Transportation

In addition, those eight TC colleges for study provided the following web

Canada Post addresses and telephone numbers:

1) British Columbia Institute of Technology (BCIT) Pacific Marine Training Campus. 265 West Esplanade, North Vancouver, British Columbia, V7M 1A5, Canada
   Telephone: 604-453-4111

2) Canadian Coast Guard College.
1190 Westmount Road P.O. Box 4500, Sydney, Nova Scotia, Canada B1P 6L1
Telephone: (902) 564-3660

3) Georgian College Owen Sound Campus.
(Great Lakes International Marine Training Center).
MTCY Marine Engineering Technology. 1450 8th Street East Owen Sound, Ontario N4K 5R4
Telephone: 519-376-0840 ext.2030

4) Holland College Marine Training Centre.
100 Water Street, Summerside, P.E.I. Canada, C1N 1A9
Telephone: 1-800-446-5265

5) Institut maritime du Québec –Rimouski.
Service de l'information scolaire et professionnelle. 53, rue Saint-Germain Ouest. Rimouski, Québec G5L 4B4
Telephone: 418-724-2833, extension 2029

6) Marine Institute of Memorial University of Newfoundland.
Fisheries and Marine Institute of Memorial University of Newfoundland and Labrador. P.O. Box 4920, St. John's, NF Canada A1C 5R3
Telephone: 1-800-563-5799, extension 522

7) New Brunswick Community College (NBCC) –St. Andrew's Campus Marine Diesel Mechanics Program
99 Augustus Street, St. Andrews, NB E5B 2E9
Telephone: (506) 529-5000

8) Nova Scotia Community College –Strait Area Campus.
Nautical Institute. 226 Reeves Street, Port Hawkesbury, Nova Scotia Canada B9A 2A2
Telephone: (902) 625-4228

Appendix C: A Reported and Growing Shortage in the Numbers of TC Marine Engineers

Review of the literature suggested a shortage of TC engineers and described various complex contributing factors as follows:

- Need for Increased Public Awareness and Involvement in the Canadian Maritime Industry

  Despite having one of the longest natural coastlines in the world, Canadians did not perceive their nation as seafaring (Appleton, 1969). Dr. Lewis Soroko of Brock University reported that the marine industry is almost "hidden" from the attention of the general public but its contribution to our lifestyle is widely felt. The local economic impact was over $137 million[1] (2000) to the Niagara Region [of Ontario].

- Lack of Awareness of the Industry Role in the Canadian Economy

  The Canadian Navy League (2004) reported that TC trainers and employers of TC engineers should have been aware that Canadian maritime industries directly employed nearly 145,000 Canadians and generated $19 billion of economic output. Even so, the Navy League and the Naval Officers Association of Canada identified, "the irony that despite the apparent indifference of Canadians to the maritime dimension of their country, they are widely dependent on it. (Canadian Navy Strategic Issues, 2003) (Harrison, Ronald, 2004). They surmised that one of the unfortunate consequences of this indifference was that

Canada, "has not managed its oceans and the related industries as well as it could." (p. 3)

- Age Demographics

North America and Western Europe experienced a surge in birth rate following the Second World War (1944-1965). Many of these individuals were at, or near retirement age in the most recent decade. The research suggested a shortage of replacements in most sectors of industry, including TC-certificated marine engineer officers (Rosenberg, 2006).

- Vessel Automation

PhD-level researchers Gierusz, Witold and Lisowski Josef were also sea-going marine engineers. Their research entitled *The Education of Marine Engineers in Control Engineering in Accordance with the IMO Requirements* (1998) outlined how modern vessel propulsion systems were controlled by complex electronics and auxiliary machinery. Even very large vessels could be operated by relatively few, highly skilled persons. Fewer, more highly certificated marine engineer officers were hired while entry-level engine room positions were dramatically reduced. Canadian marine training institutes were challenged to address ever-more sophisticated education and training needs.

- Global Education Gap

The Gierusz et al report (1998) highlighted the need for all 167 IMO member states to meet ISCTW requirements with effective maritime education and training that addressed modern technology. They reported that the gap is being closed by founding world-recognized maritime training institutes including the World Maritime University (WMU) of Malmo, Sweden, Dalian School (DSU) in China, and Korean Maritime University. Their web sites and published literature improved public awareness. Canada also needed to ensure that our own marine engineer education and training institutes met or exceed ISCTW minimum requirements. This literature suggested questionnaire items directed to trainers of marine engineers.

- Wage Gap

Marine engineer and web master Leduc provided the web site *Martin's Marine Engineering Page* as a forum for Canadian marine engineers. He reported a wide variance of cost of labour amongst member states (2007). In principle, Certificates of Competency should have been on par amongst member states. Cost of living and corresponding wages varied considerably amongst these same member states. Canadian marine engineers who sought employment onboard foreign-registered ships completed with those resident in homelands whose relatively lower cost of living allowed them to accept a lower wage for the same work. Leduc provided a web-based forum that focused on careers for the Canadian marine engineer and suggested questionnaire items directed to the employer group and

what may be done to provide financial incentive to recruit new marine engineer learners.

- Increased Work Load

  Literature published by the International Labour Organization (ILO) documented recent world-wide employment trends whereby shipping companies changed from an eight-hour to twelve-hour work day. The ILO and TC Marine Safety were mandated to protect the basic human rights of seafarers. Reports of overworked seafarers challenged TC Marine Safety Examiners, whose duties included routine ship inspection and enforcement of TC-Marine regulations. There were frequent reports of longer duty hours onboard, higher level of responsibility and long periods of time away from home at sea which contributed to increased workplace stress. This report suggested questionnaire and personal interview items directed to Marine Safety examiners and addressed such potential disincentives to those investigating careers as a TC-certificated marine engineer.

Soroka (2005) of Brock University projected in excess of 1,300 jobs to arise over those following ten years. Of these, 73% would arise through the need to replace retiring TC engineer personnel. Over 98% of the projected jobs were for full-time work.

The following industry activity levels were reported (2001) for Niagara-based marine sector companies:

- In excess of 1,300 jobs were projected to arise (2005-2015).
- Approximately 760 of these jobs were to occur before the year 2005.
- Of these, 73% of jobs were to arise through the need to replace retiring personnel.
- Over 98% of the projected jobs (2005-2015) were to be for full-time work, with the majority tied to the shipping season.

For the top 9 occupations that would become vacant (2005-2015), salary/wage rates would range from $30,000 to $96,000 per year with and average of $50,509 per year. Soroka reported a need for TC engineers and described with predicted labour shortages Canada-wide and globally. The numbers of STCW and TC qualified seafarers (2005) were as follows:

The worldwide supply of seafarers was estimated (2005) as follows:

466,000 officers
721,000 ratings
Worldwide demand was estimated at:
476,000 officers
586,000 ratings
(BIMCO/ISF 2000 Manpower Update Summary Report
for16 February 2005)

Colleges that met TC Marine Safety approval were required to provide education and training that prepared trainees for TC examination for certification. TC college graduates were expected to find employment that would help meet the demand for TC engineers.

Appendix D: A Historical Context of Merchant Marine Education and Training in Canada

Thomas Appleton (1969) described the development of Canadian merchant marine colleges from the mid-nineteenth century. Challenges included prevailing attitudes and compounded by lack of public education. Early Canadian nautical schools struggled to exist. "Not surprisingly, there was little public interest in most of these schools, for they were uninspired; while admitting to this state of affairs, the general superintendent reported, in 1906, that he was at a loss to understand the reason." (p.1). Today, excluding highway routes to the United States, 97% of Canadian exports and 70% of our imports are moved across ocean trade routes. Despite these facts, Canadians appear to be indifferent to the maritime dimension we are so dependent on to maintain our standard of living (Canadian Navy League, 2003).

The first official Canadian merchant marine school was founded in Quebec City in 1851 under the British maritime authority Trinity House and was intended to, "educate the sons of naval veterans and seafaring persons" in a shore-based school, rather than solely by training ship (p.1). This concept of training on a dedicated shore-based campus was a departure from that exclusively onboard ship. Textbooks and instruction were provided equally in English and French The college trainer was required to accompany his 50 students for periods of practical sea-training. Curriculum was a balance of academic and technical curriculum. "Character training" was analogous to modern leadership training. The Quebec nautical school was an advanced concept, bilingual and the precursor to the modern Canadian and world-wide campus-based systems which recognize the maritime education and training need to develop and harmonize theory, practical skills and leadership.

Trainers were experienced mariners with academic training. The Quebec school challenged accepted attitudes of the day and was contrary to the contemporary philosophy for training ships. The school closed in 1869 and there were no others to replace it, despite introduction of British and of Canadian systems of certificates of competency for merchant mariners (p. 1).

Appleton reported that criterion for Canadian Federal Government certification as a merchant marine officer were based on those practical skills learned at sea. Practical experience was available, but level of education amongst mariners was low. It was challenging to prepare for examination for certification at any level was challenging as a merchant marine officer. Though modest by modern standards, examinations were difficult for most seamen. They had little early schooling, and great determination was required to succeed (p. 1).

No formal system of merchant marine engineer training existed until 1902, when colleges were founded in Montreal, Halifax, Saint John, Yarmouth and Victoria. Appleton (p.1) described inadequate funding and low wages for the Canadian merchant marine colleges. Curriculum was rudimentary and consisted of elementary questions and answers in practical seamanship. Training aids were minimal. Attendance was poor. Colleges were opened at Lunenburg, North Sydney, Quebec, Kingston, Toronto and Collingwood, and Vancouver. Formal merchant marine engineer training was virtually non-existent except by apprenticeship. "If a man could do a job, most likely he could have it." (p.1)

Appleton reported there was demand for required certificates of competency for Canadian merchant marine engineers. The standards of the early 1900's were kept at the simplest level commensurate with the demands of safety and existing legislation that existed at that time.

Professional education was popularly considered a luxury and had little to do with earning a living at sea. (p.1) Post-World War II, privately owned engineering colleges closed. The Canadian Department of Transport first entered marine engineer training in 1954. Marine engineer instructors were attached for the first time to existing schools of navigation at Toronto, Montreal, Halifax and St. John's, Nfld. and to the Quebec Government school at Rimouski, l'Institut de la Marine Marchande (p. 2). The Canadian Coast Guard College was founded in 1965 by the Department of Transportation. Its aim was to provide full professional training in navigation and engineering to meet the needs of an expanding fleet of sophisticated ships and the demands of the new age in mercantile shipping (p. 3). All schools prepared students for statutory examination for certification as a Canadian merchant marine engineer officer.

The modern marine industry became highly complex and demanded extensive education and training. Merchant marine schools were transferred to provincial authorities in 1961 under a federal provincial agreement on vocational training as a whole. By 2007, courses of study for certificates of competency were designed to meet the demanding requirements of the Canada Shipping Act 2001 in accordance with the international Conventions for Standards of Training Certification and Watch-keeping (ICSTCW). Certificates of competency were parchments until 1951. After 2006 they were produced in booklet style similar to a Canadian passport and can be cancelled or suspended, in cases of proven neglect or incompetence, after due process of legal enquiry. In some cases the defaulter may revert to a junior grade of certificate, in others he could not hold certificated employment but could go back to sea.

The International Maritime Organization

The International Maritime Organization (IMO) was headquartered in

London, England and promoted cooperation among governments and the shipping industry to improve maritime safety and to prevent marine pollution:

The IMO was founded in 1948 under the United Nations (UN) and consisted of 168 member states. It was governed and administered by an elected assembly of members. The work of IMO was conducted through five committees and these were supported by technical sub-committees. Canada was obligated by IMO membership to conform to consistent maritime safety and environmental protection standards. These included those international conventions for safety of Life at Sea (SOLAS). Safety requirements were proscribed by the International Convention for Standards of Training, Certification and Watchkeeping (ICSTCW). The Canadian Federal Government legislated Transport Canada (TC) Marine Safety to implement and enforce ICSTCW requirements for training and certification of marine engineers. These were included in the Canadian Department of Justice Canada Shipping Act 2001 as regulatory requirements.

Canada Shipping Act -2001

The Canada Shipping Act 2001 outlined those regulatory requirements for the training and certification of TC marine engineers. Those TC engineer colleges selected for the study were regulatory required to comply with TC Marine Safety standards for marine engineer training. Canada Marine Safety-recognized colleges should have been familiar with the requirements of Marine Safety and the ICSTCW.

Awareness of the ICSTCW rand TC requirements facilitated education leaders and trainers to prepare their learners to meet Marine Safety requirements for examination for TC-certification as a marine engineer

officer. TC Marine Safety certification was recognized by other UN IMO members. Certified TC engineers were permitted to serve onboard those ships engaged in domestic and global trade. It was incumbent upon trainers to prepare their learners to satisfy such examination for Certification and thereby indicate their ability to safely and efficiently perform their duties. (TP 8911E Transport Canada guidelines for Canadian marine engineer cadet programs)

The *SCTCW 1978 Convention - Chapter III: Engine department* outlined basic principles to be observed in keeping an engineering watch; mandatory minimum requirements for certification of chief engineer officers and second engineer officers; mandatory minimum requirements for certification of engineer officers in charge of a watch in a traditionally manned engine room or designated duty officers in a periodically unmanned engine room; requirements to ensure the continued proficiency and updating of knowledge for engineer officers; mandatory minimum requirements for ratings forming part of an engine room watch (TP 8911E Transport Canada guidelines for TC engineer cadet training.

Appendix E: Transport Canada Marine Safety Examiners Offices Surveyed

Four offices of Transport Canada Marine Safety Examiners were selected for survey:

Transport Canada Marine Safety
Atlantic Region
Harvey G. Heaton
Senior Marine Engineer Inspector
45 Alderney Drive, P.O. box 1013
Dartmouth, NS
B2Y 4K2
Tel.: 902-426-9323
Fax: 902-426-6657
Cel: 902-476-4508
Email: heatonh@tc.gc.ca

Transport Canada Marine Safety
Quebec Region
Andre Des Rochers
Paul Mannion
Operations Technical Services Division –NME
Marine Engineer Examiners Office
901, Cap Diamant, 4th floor
Quebec, Quebec
G1K 4K1

Ravi Shankar
Acting Manager / Gestionnaire Int.
Marine Safety | Sécurité maritime
Transport Canada | Place de Ville, Ottawa, Ontario K1A ON5
Transports Canada | Place de Ville, Ottawa (Ontario) K1A 0N5
Government of Canada | Gouvernement du Canada
Facsimile / Télécopieur (613) 990-1538
Tel.: (613) 998-0658

Marine Safety -Central Region
Obaid Barlas
Chief Marine Engineer Examiner
100 Front St. South
Sarnia, Ontario
N7T 2M4

Transport Canada, Marine Safety
Pacific Region
Dave A. Hall
Senior Marine Engineer Examiner
620-800 Burrard Street,
Vancouver, BC
V6Z 2J8

Appendix F: Marine College Training -A Regulatory Requirement Prerequisite to TC Certification

Introduction

TC required candidates attend TC college prerequisite to examination for certification as a TC engineer. The Marine Safety Directorate (MSD) of Transport Canada (TC), Ottawa agreed to the International Maritime Organization (IMO) International Convention on the Standards of Training, Certification and Watchkeeping for Seafarers (STCW) 1978, as amended and implemented in 1995. TC regulation TP13720 provided course goals and outlines for TC on practical training requirements for marine engineers.

Regulation III/1 (2.3) and section A III /1 (1) of STCW 95 outlined those requirements for training relevant to the duties of an officer in charge of an engineering watch. *Marine Certification Regulations*, section 34(2) (b), (SOR/97-391) mandated these requirements since 1997. An equivalent clause of the regulations was used to allow candidates outside of the approved cadet programs to qualify for the 4th Class Engineering examination; alternatively, all candidates for their first engineering certificate, were required to provide TC Marine Safety evidence of passing an approved "Practical Skills for Marine Engineers Course;" required minimum 500 hours duration, before being allowed to sit for examination. (Source: TP13720: Course Goals and Outlines for Transport Canada on Practical Training Requirements for Marine Engineers)

Purpose

There were two purposes for the TC marine engineer cadet training program:

1. To successfully complete an approved course in "Practical Skills for Marine Engineers" as a part of the mandatory training,

before being examined for an officer in charge of an engineering watch certificate of competency, and

2. to provide information to TC colleges outlining the requirements of the course, before Marine Safety would grant approval.

(Source: TP13720: Course Goals and Outlines for Transport Canada on Practical Training Requirements for Marine Engineers)

Goal

The goal of the TC marine engineer cadet training program was to equip TC marine engineers with those skills required to perform their duties onboard ship in a safe and efficient manner. These included safe and acceptable use of common tools to perform routine maintenance and repair of marine machinery. TC engineers were also required trained to maintain seaworthiness of their ship. (Source: TP13720: Course Goals and Outlines for Transport Canada on Practical Training Requirements for Marine Engineers).

Successful course completion enabled TC college graduates (2007) to carry out engineering maintenance and watchkeeping duties that were integral to the duties of an officer in charge of an engineering watch. The program course instructional hours are provided by the following Table 2.2:

Table 2.2 Marine Engineer Program – Instructional Hours

SUBJECT	HOURS
Marine Engineering Basic Skills	90
Basic Machining and minor Overhauls	120
Shipboard related maintenance	120
Legislative Requirements	20
Seaworthiness	40
Total number of hours	390

(Source: TP13720: Course Goals and Outlines for Transport Canada on Practical Training Requirements for Marine Engineers)

Those course outlines from the Marine Engineer Cadet Training Programme
(TP 8911E), and from the STCW Code Table A-III/1; Sections 6, 7 and 8, required the following skills:

1. Safe and efficient use of equipment,
2. safe working practices,
3. inspection and care of equipment, and
4. selection of equipment.

TC approved marine engineer programs were required to provide trainees the fundamentals of work planning, preparation of work area, commissioning, the clean up of work area and record keeping.

TC (2007) based their marine engineer cadet training program on Chapter III of Code A of the ICSTCW 1978, as amended in 1995. This applied to

applicants for 4th Class, 3rd Class and 2nd Class certificates of competency as a marine engineer as applicable, effective January 1, 2004. Authority was identified by Section 34 of the *Marine Certification Regulations*, SOR/97-391 and SOR/2002-150 made pursuant to the *Canada Shipping Act (R.S.C. 1985, c.s-9)* as amended.

Requirements

TC college trainees for TC examination for certification were TC regulatory required to meet the following prerequisites:

1.After the effective date, all candidates for their first engineering certificate were required to show a certificate of successful completion of an approved course in "Practical Skills for Marine Engineers".

2.The first engineering certificate generally referred to the 4th Class Engineer Motor Ship or 4th Class Engineer Steam Ship. However, candidates who proceeded directly to the 3rd or 2nd Class certificate were also be required to successfully complete an approved "Practical Skills for Marine Engineers Course".

Alternative path to Practical Skills Training for Marine Engineers

TC (2007) required practical skills training for those trainees for the Fourth-class Engineer certificate. The same provision was made by the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) endorsement. There were two routes for seafarers to acquire their first certificate of competency with STCW endorsement as Fourth-class Engineer (2007). (Source: Marine Engineer Cadet Training Program TP 8911E 07/2007)

Regulatory Requirements for Two Options for Required Practical Sea Training

Transport Canada (TC) Sections of TP 13720 E are provided by Appendix A for TC college training as regulatory requirement prerequisite to TC certification. TC recognized two options for seafarers to acquire the first certificate of competency with STCW endorsement as Fourth-class Engineer:

Option One: Trainees were required TC college trained in the TC marine engineer cadet training program. TC Marine Safety credited those graduates required training time, plus six months qualifying time. The TC required sea training record manual provided those required practical skills outlined by TC regulation TP 13721E, Practical Sea Training Manual for Marine Engineer Cadets.

Option Two: Trainees attended a TC-recognized college for a minimum of 500 hours approved training in accordance with TP 13720E, Practical Skills for Marine Engineers, Training Course and completed no less than three years of qualifying time in lieu of any sea training record manual.

TC Required Officers of Primary Interest

Option One TC required TC colleges appoint one or more Officers of Primary Interest OPI's, assigned to develop and implement a TC-acceptable sea training record manual. Furthermore, the OPI was required to coordinate vessel sea training with their college, with the cooperation and assistance of training vessel Chief Engineer. Trainees were required to undertake and successfully complete, under supervision of the Chief Engineer, those TC required training tasks listed in the sea training record manual. The OPI was TC required to ensure the quality of the sea training

process by regular communication with the sea training vessel Chief Engineer. Training needs were discussed and trainee performance assessed. Trainees were required to submit in a timely manner the completed sea training record manual for assessment by the OPI. Those manuals determined OPI acceptable were submitted to TC examiners for final review as regulatory required document prerequisite to examination. Trainer group questionnaire item 54 concerned those TC and SCTW regulatory requirements that a TC college OPI be appointed and assigned to meet same requirements.
(Source: TP 8911E 07-2007: Training Record Manual Requirements for Applicants to the Fourth-Class Engineer)

The TC document TP 13721 –Training Record Manual Requirements for Applicants to the Fourth Class Engineer Certificate was developed to facilitate efficient, effective TC engineer training.

A TC example sea training record manual provided by TC examiners included directions to facilitate effective, efficient TC engineer training included but was not limited to the following requirements:

- Description of TC approved on-board training program,
- guidance for the Chief Engineer officer or supervising engineer officer,
- instructions to trainers concerning conduct of effective training,
- guidance for trainees completing a sea training record manual,
- Chief Engineer or Master's review/sign off of training manual,
- TC required trainee personal information,
- vessel information,
- vessel safety familiarization, and
- basic safety familiarization provided to trainees.

- safety and environmental protection,
- engineering watchkeeping,
- ship operational responsibilities,

- marine laws and regulations,
- Canadian maritime regulatory requirements, and
- international maritime pollution regulatory requirements.

(Source: TP 8911E 07-2007: Training Record Manual Requirements for Applicants to the Fourth-Class Engineer)

The purposes of the TC document TP 13721 were the following:

1. To inform the ship owners, ship operators, masters, officers and crew members of the requirement to successfully complete a Marine Safety approved training record manual as a part of the mandatory minimum 6 months of sea service before being examined for the fourth-class certificate of competence bearing the STCW endorsement,

2. to provide details of the on-board training during the required seagoing service,

3. to provide an approved model Training Record Book, that may be used by applicants to the fourth-class certificate of competency, and

4. to provide an alternative to the training courses on marine laws and regulations, and Ship Construction and Stability.

Harmonization of TC regulatory requirements with STCW

TC document TP 13721was required to be applied to applicants to the certificate of competency as fourth-class engineer bearing the STCW endorsement, in compliance with Chapter III of the Seafarers' Training, Certification and Watchkeeping Code A (STCW Code) of the Convention on Standards of Training, Certification and Watchkeeping for Seafarers

(STCW Convention), as amended to which Canada is a party. The Marine Personnel Regulations, section 147, (SOR/2007-115) were made pursuant to the Canada Shipping Act, 2001 (2001, c.26).

Regulatory requirements for Sea Training Record Manual Manuals for Applicants to the Fourth-Class Engineer Certificate TP 13721E

After July1st, 2007, all applicants to the STCW-endorsed fourth-class engineer certificate were required to show, in addition to the testimonials and the training certificates required by the Marine Personnel Regulations, a successfully completed Marine Safety approved training record manual. TC regulatory requirements were as follows:

1. Applicants who for the STCW-endorsed fourth-class certificate were required to complete a TC Marine Safety approved training record manual as a part of the mandatory six months of sea service. Applicants who did not complete this record manual were be issued a fourth-class certificate restricted to Near Coastal Waters 11 voyages or to a specific ship engaged on voyages in Canadian waters,

2. approval for various TC college sea training record manuals was required verified by the local Marine Safety office and employer. Section 3.4 of TP 8911E listed those TC colleges that provided TC Approved manuals (2008),

3. lack of any Approved TC sea training manual was addressed by Annex A of TP 8911E which provided the model sea training record manual based on the IMO 1987 model training record manual for candidates for certification as officers in charge of an engineering watch or designated duty engineers. This was TC modified to more closely fit Canadian maritime industry

requirements,

4. TC required the sea training manual was signed off by either the Chief Engineer, Master or company training officer, and

5. TC Marine Safety examiners sighted the completed Approved training manual as proof of the duties and competencies acquired during the mandatory service period aboard ship.

(Source: TP 8911E, 2007 p. 102)

Furthermore, TC regulation TP 13721E required applicants to the Fourth-Class Engineer Certificate submitted two original sea training record manuals for Approval by the TC Marine Safety Engineering section. Formal Approval or recommended changes were communicated to the TC college concerned, with those requirements or recommendations of the Manager, Engineering Certification. (Source: TP 8911E-2007.)

Section 3.4 of TC regulation TP 13721 identified sea training manuals Approved by the Manager, Engineering Certification. These manuals met the requirements of the STCW Code and the Marine Personnel Regulations relating to the fourth-class engineer Training Record Manual. These manuals were as follows:

1. Model training record manual for applicants to the Fourth -Class Engineer Certificate, TP 13721, Annex A;

2. Canadian Coast Guard Ships' Crew OJT Manual (DFO/5559), First Edition, September 1998. (Applicants must have successfully completed chapters 3, 4; British Columbia Ferry Corporation Watchkeeping Engineer Training Record Book, First Edition, 2001;

3. Training manual from the International Shipping Federation. (Source: Transport Canada Marine Safety examiner)

Conclusion

The goal of the TC marine engineer cadet training program equipped TC marine engineers with those skills required to perform their duties onboard ship in a safe and efficient manner. These provided for safe and acceptable performance of watchkeeping duties and routine maintenance and repair of marine machinery. TC provided two routes for training for certification as a TC engineer. Both options required TC college training. Those TC college trainers that followed TC regulation TP 8911E met Transport Canada and International Convention for Standards for Training for Certification and Watchkeeping.

Appendix G: Organizations and Employers of TC Engineers

Canadian Marine Engineer Professional Institutions

Canadian Institute of Marine Engineering - CIMarE
8090A Rte Trans Canadienne
St. Laurent, Quebec H4S 1M5
Tel.: (514) 856-0904 fax.; (514) 636-4107
World Wide Web Site: http://www.cimare.org/

Ontario Marine Transportation Forum
Issue 1 May June 2007 Inaugural Address OMTF President Wayne Smith
Retrieved January 10, 2008 from:
World Wide Web Sitehttp://www.omtf.org/newsletter/1/index.html

Other Marine Engineer Professional Organizations

Canadian Marine Engineer Officers were invited to join:
Society of Naval Architects and Marine Engineers (SNAME)
The Society of Naval Architects and Marine Engineers
601 Pavonia Avenue
Jersey City, New Jersey 07306
Toll Free (800)798-2188
Telephone (201)798-4800
Fax (201)798-4975
Membership Information attention of Linda Davis E-mail: ldavis@sna

Canadian Marine Engineer Labour Organizations

Canadian Merchant Service Guild
National Office: 1150 Morrison Drive, Suite 150, Ottawa, Ontario K2H 8S9
Tel.:(613) 829-9531
Fax: (613) 596-6079
E-mail: cmsgott@on.aibn.com
Canadian Marine Officer Union

CMOU Headquarters: 9670 Note-Dane Street E., Montreal, Quebec H1L 3P8
Tel: (514) 354-8321
Fax: (514) 354-8368
E-mail: cmou@videotron.ca

CMOU Thorold Branch Office: 17 Front Street N., Thorold, Ontario L2V 1X3
Tel: (905) 227-6226
Fax: (905) 227-9164
World Wide Web Site : http://www.cmsg-gmmc.ca/about/index-e.html
E-mail: cmou@cogeco.net

Canadian employers of TC Engineers that participated in the study:

Employer 1: Algoma Central Marine Shipping (Ontario-based);
Employer 2: Transport Desgagnes Shipping (Quebec City-based);
Employer 3: V.Ships vessel crewing and management (Montreal – based);
Employer 4: Marine Atlantic (Sydney, NS and Port-Aux-Basque-based);
Employer 5: Atlantic Towing Limited –an Irving Division (St. John-based);
Employer 6: Seaspan Towing –privately owned by Mark Washington of USA.: Vancouver-based;
Employer 7: Maersk Offshore –Danish –owned (St. John's-based division);
Employer 8: Canadian Coast Guard and Department of Fisheries and Oceans (Ottawa-based).

Table 2.1 Canadian Owned and Operated Employers of TC Engineers

Employer name	Province	Geographic Region	Company Web Site
Algoma Central Marine	Ontario	Great Lakes	http://www.algonet.com/
Transport Desgagnes	Quebec Arctic	Great Lakes	http://www.groupedesgagnes.com/en/home/26.cfm
V. Ships	Quebec	Great Lakes	http://www.vmanpower.com/
Marine Atlantic	Nova Scotia	East Coast	http://www.marine-atlantic.ca/
Atlantic Towing	New Brunswick	East Coast	http://www.atlantictowing.com/
Seaspan	British Columbia	Pacific Coast	http://www.seaspancorp.com/contact.cfm
Maersk	Newfoundland and Labrador	East Coast	http://www.seabase-maersk.com/seabase/seabase.htm
Canadian Coast Guard	Canada-wide	All Regions	http://www.ccg-gcc.gc.ca/

Appendix H: Government of Canada Access to Information System (ACIS)

Statistical Data concerning Number of holders of TC-issued certificates of competency as a marine engineer officer:

Transport Canada Certificate of Competency Filing System: Summary Production Report -Certificates Issued Canada-wide for the period of December 31, 2003 to January 1, 2007

Reported to Researcher Andrew Robertson on February 20, 2008. File: A-2007=01085/dsp

A document of 7 pages concerning:

Transport Canada ACIS System Report on Number of holders of Certificates of Competency as a Marine Engineer.

Received by Canada Post from Linda Savoie Coordinator and Dave St-Pierre Senior ATP Advisor Transport Canada Access to Information and Privacy Division. Place de Ville, Ower C 26th Floor, XMSP Ottawa, Ontario K1A 0N5

Fax.: (613) 991-6594

Tel.: (613) 991-6595

Appendix I: TC Statistics that Concerned TC-Certificated Marine Engineers

Preliminary interviews provided participant responses that suggested interest in current (2007) TC engineer statistics, requested through the Transport Canada Access to Information Act. Focus was on the Ship Safety Automated Seafarer Examination Question System [Automated Certification & Examination System (ACES)]. This system was in response to International Maritime Organization (IMO) requirements convention on counterfeit and fraudulent use of certificates of Marine Safety Canada. Table 2.3, identifies the number and classification of those marine engineer certificates issued by TC valid to December 31, 2007. One individual may hold one or more TC marine engineer certificates.

TC marine engineer statistics (2007) included both deck and engineering officers at all levels of certification at all age groups and for Canadian residents and non-residents. Data was limited by the following:

1) Gender of the certificate holder was not indicated.
2) Only the total numbers of TC-issued certificates were indicated. A single individual could hold one or more certificates of competency.
3) Statistical data did not differentiate newly-issued certificates from those being renewed at the regulatory-required five-yearly intervals.
4) Individuals certificate-holders may have been for any reason no longer employed as ships officers.
5) Individual certificate-holders may have failed to hold a valid Seafarers Medical.
6) The number of active sea-going engine-room staff was significantly less than the number of certificates reported by TC.

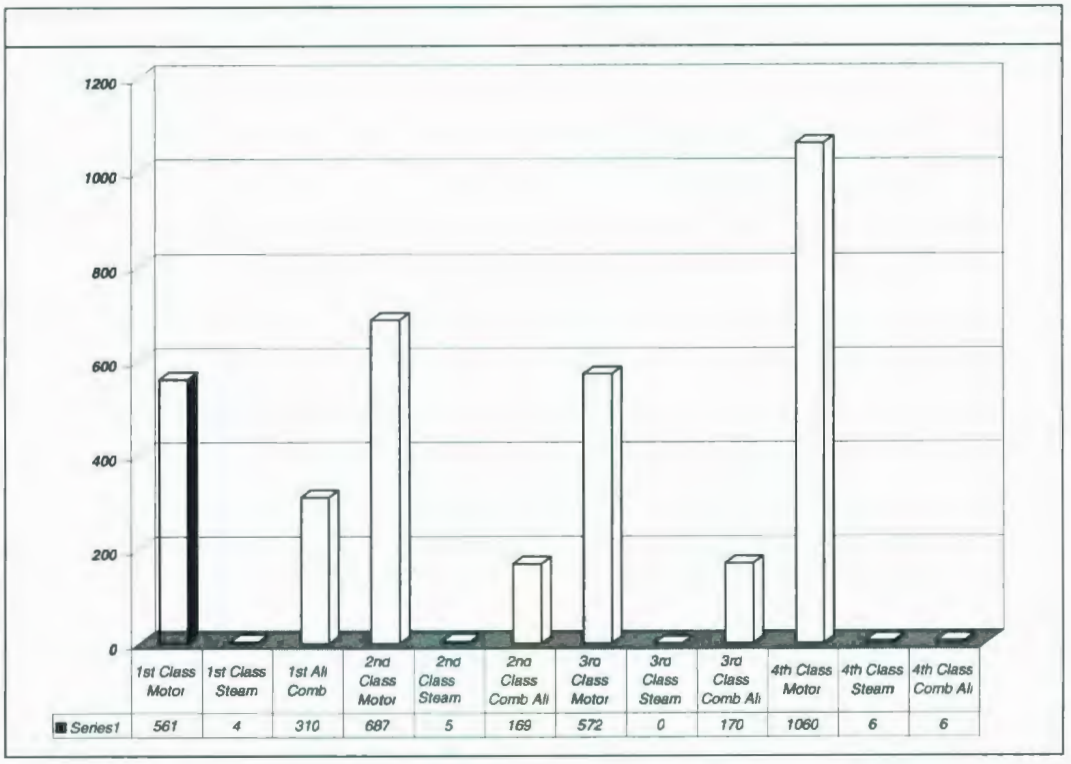
A Senior advisor for Transport Canada provided the researcher with data that concerned the number of TC engine-room certificates current to December 31, 2007. (Table 2.3), Transport Canada Engine-room Certificates (2003/01/01 to 2007/12/31) for all-Canada:

Table 2.3 Transport Canada Engine-room Certificates (2003/01/01 to 2007/12/31) for all-Canada

Certificate Name	Total Issued
First Class Engineer, Motor Ship	561
First Class Engineer, Steam Ship	4
First Class Engineer, Motor Ship + Steam	82
First Class Engineer, Motor Ship + 2nd, 3rd or 4th Steam	220
First Class Engineer , Steam Ship + 2nd, 3rd or 4th Motor	8
Second Class Engineer, Motor Ship	687
Second Class Engineer, Steam Ship	5
Second Class Engineer, Motor and Steam Ship	28
Second Class Engineer, Motor Ship + , 3rd, or 4th Class Steam	138
Second Class Engineer, Steam Ship + 3rd, or 4th Motor	3
Third Class Engineer, Motor Ship	572
Third Class Engineer, Motor Ship + Steam	17
Third Class Engineer, Steam and 4th Motor	104
Third Class Engineer, Motor Ship + 4th Steam	49
Fourth Class Engineer, Motor Ship	1060
Fourth Class Engineer, Steam Ship	6
Fourth Class Engineer, Steam and Motor Ship	6
Engine-room Rating (non-officer)	346
TOTAL ENGINE-ROOM CERTIFICATES	4344

(Source: Transport Canada ACIS: valid to December 31, 2007.)

Figure 2.1 TC-certificated Marine Engineers by Level of Certification



(Source: Transport Canada ACIS: valid to December 31, 2007.)

Note 1: "Comb All" = all combined levels of certification for motor-driven ship and steam-driven ship

Note 2: Number of certificates issued by TC does NOT correlate to number of certificate-holders. Example, a 1st Class Certificate holder may also hold one or more additional, successively lower certificates to all TC Engine-room certificates issued (Table 2.3) listed on the following Table 2.6 :

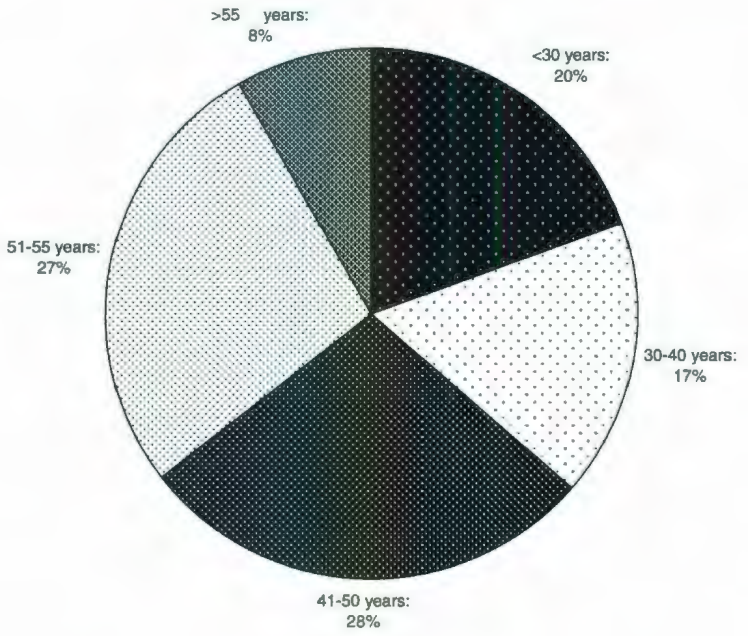
Table 2.4 TC-certificated Marine Engineers Reaching Age 65 by 2013

Survey Results	2003	Age 65 by 2013	% of those Employed In 2003 Reaching Age 65 by 2013
First Class Marine Engineer	163	35	21%
Second Class Marine Engineer	170	27	16%
Third Class Marine Engineer	127	32	25%
Fourth Class Marine Engineer	199	36	18%
Other	32	5	16%
Total	691	135	20%

(Source: Marine Careers Secretariat, 2003. p. 32)

The majority of marine engineer certificates are held by individuals aged 41 years or above. Nearly half are held by individuals 51 years or above. Compared with 1997 statistics and earlier, an aging workforce is indicated in the following Figure 2.2:

Figure 2.2 Graphical Representation of Table 2.4:
TC-certificated Marine Engineers Reaching Age 65 by 2013



(Source: Transport Canada ACIS: valid to December 31, 2007.)

According to the total the number of new TC certificates for nautical and engineering officers issued in Ontario by Transport Canada in 1998 and 1999, it was estimated that Ontario residents make up between 25-30% of the Great Lakes mariners. The small number of new tickets issued over that two year period raised "serious supply concerns." It was anticipated that a significant number of then-current mariners needed to renew their certifications over the following several years. This put increased pressure on the training institutes to meet the demand for simulator training. A senior TC examiner advised the researcher on February 29, 2008 that this situation was unchanged, nation-wide. TC engineer statistics updated to December 31, 2007 are provided on the following Table 2.4.:

Table 2.5 Number of Certificates by Age Group of Holders

Number of TC Engine-room Certificates	Age of certificate-holder
<30 years:	885
30-40 years:	759
41-50 years:	1275
51-55 years:	1244
>55 years:	372
TOTAL	4535

(Source: Transport Canada ACES: valid to December 31, 2007)

McDuff and Garrett (2000) provided contrast and reported those TC engineers employed for the years 1998 to 1999 for Great Lakes (Central Canada)-based Shipping employers on Table 2.7., TC Certificates Classification 1998 1999.

Table 2.6 TC Certificates Classification 1998 1999

TC Marine Certification	Number of certificates
1st Class Engineer	713
2nd Class Engineer	59
3rd Class Engineer	1113
4th Class Engineer	1631
Institutional Training	36

(Source: McDuff and Garrett report, 2000).

The McDuff and Garrett report (2000) emphasised that the majority of marine engineers employed on the Great Lakes were residents of Eastern Canadian Provinces.

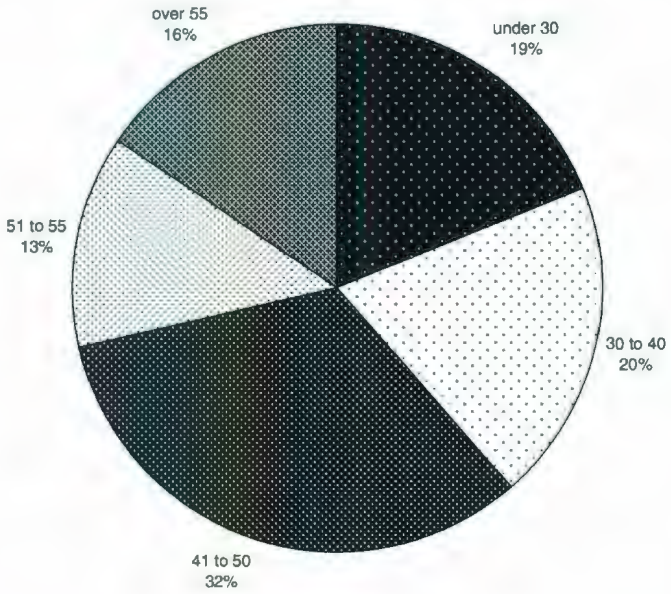
For further comparison, the Marine Career Secretariat East Coast Careers Report of 2003 classified by age group the numbers of TC-certificated marine engineers then employed Canada-wide:

Fourth Class marine engineer

Of the 885 Fourth Class marine engineer reported in Eastern Canada by Transport Canada,

19% (167) were under 30 years of age, 20% (175) were 30 to 40 years of age, 33% (290) were 41 to 50 years of age, 13% (115) were 51 to 55 years of age, and 16% (138) were more than 55 years of age.

Figure 2.3 Percentage of TC-certificated 4th Class Marine Engineers, by Age Group

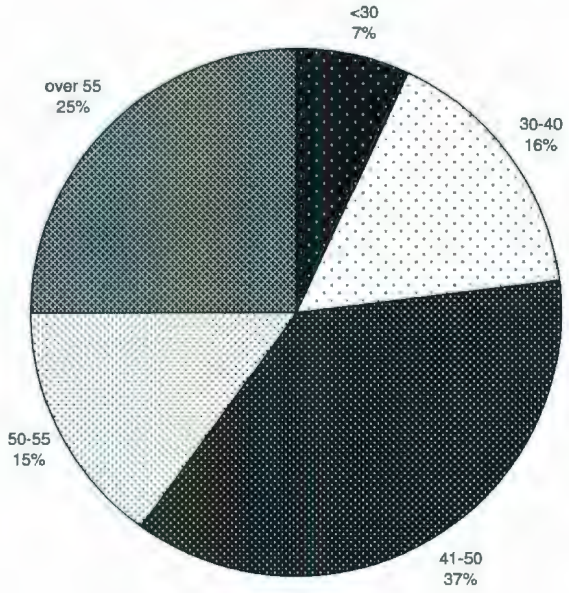


(Source: Transport Canada ACIS: valid to December 31, 2007)

Third Class marine engineer

Of 718 Third Class marine engineer certificate holders reported in Eastern Canada by Transport Canada, 7% (47) were under 30 years of age, 16% (116) were 30 to 40 years of age, 37% (266) were 41 to 50 years of age, 15% (107) were 50 to 55 years of age, and 25% (182) were more than 55 years of age.

Figure 2.4 Percentage of TC-certificated 3rd Class Marine Engineers, by Age Group

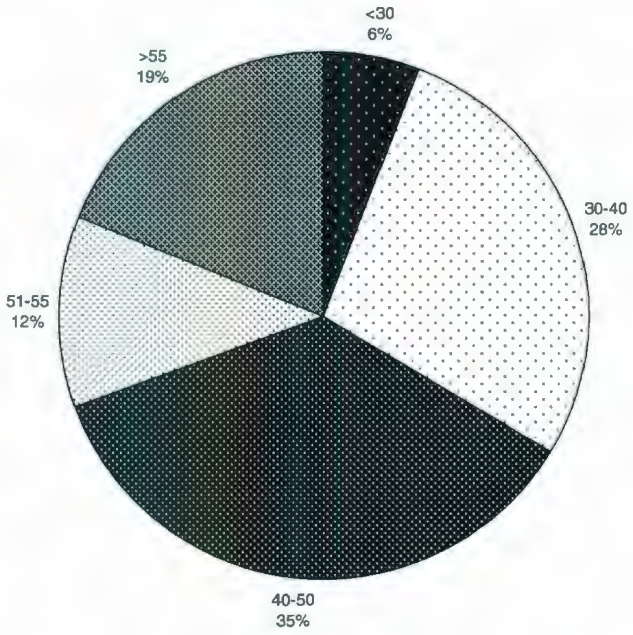


(Source: Transport Canada ACIS: valid to December 31, 2007)

Second Class marine engineer

Of the 521 Second Class marine engineer certificate holders reported in Eastern Canada by Transport Canada, 6% (30) were under 30 years of age, 28% (144) were 30 to 40 years of age, 36% (186) were 41 to 50 years of age, 12% (63) were 51 to 55 years of age, and 19% (98) were more than 55 years of age.

Figure 2.5 Percentage of TC-certificated 2nd Class Marine Engineers, by Age Group

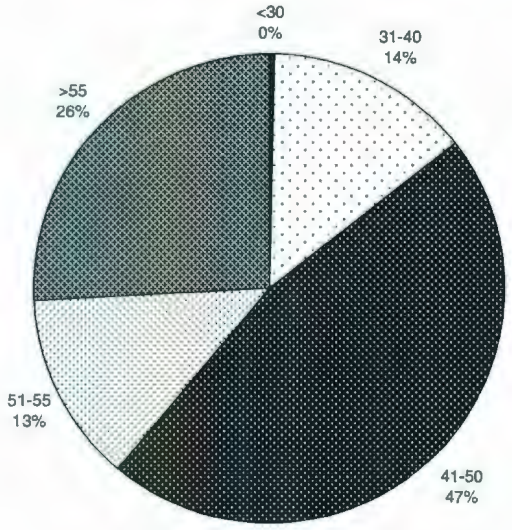


(Source: Transport Canada ACIS: valid to December 31, 2007)

First Class marine engineer.

Of the 481 First Class marine engineer certificate holders reported in Eastern Canada by Transport Canada, 0.4% (2) were under 30 years of age, 14% (65) were 30 to 40 years of age, 47% (226) were 41 to 50 years of age, 13% (63) were 51 to 55 years of age and 26% (125) were more than 55 years of age.

Figure 2.6 Percentage of TC-certificated 1st Class Marine Engineers, by Age Group



(Source: Transport Canada ACIS: valid to December 31, 2007)

Employment Profile: Twenty-three participating employers reported 933 engineering officer positions. These positions are forecast to increase by 19.7% to 1,117 by 2008, and by 10.7% to 1,237 by 2013. The number of

positions reported (current and forecast) for each engineering group for Engineering Officers for 2003, 2008 and 2013. These numbers are listed collated in Table 2.7:

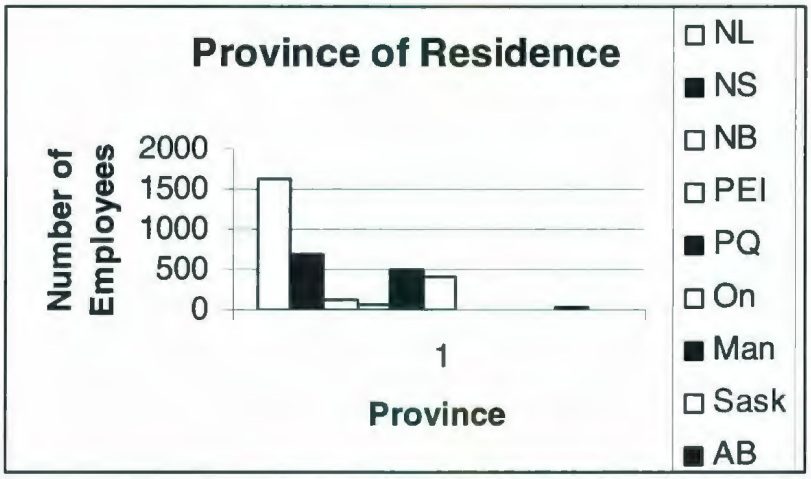
Table 2.7 Employment Profile for Twenty-three Employer Participants of the Marine Secretariat Study of 2003

Position	2003	2008	2013
First Class Marine Engineer	220	266	301
Second Class Marine Engineer	213	268	306
Third Class Marine Engineer	177	197	219
Fourth Class Marine Engineer	231	284	303
Subtotal	841	1,015	1,129
Other	60	60	60
Marine Engineer Officer Back-up Positions	32	42	48
Subtotal	933	1117	1237
Marine Engineer Officer Cadet	104	124	142
Total	1,037	1,241	1,379

(Source: Marine Careers Secretariat, 2003. p. 32)

The following, Figure 2.7., shows the distribution by province of residence for TC engineers and deck officers, reported by the Marine Career Secretariat (2003). The majority were residents of Newfoundland and the Maritime Provinces. TC engineers were employed in all four Canadian geographic and all marine industrial sectors for study.

Figure 2.7 Province of Residence for Canadian Merchant Marine Officers



(Source: Marine Careers Secretariat. p. 42)

Data provided by the following Table 2.7, shows numbers and percentages of the total of all those female TC engineers employed in at-sea positions:

Table 2.8 Females Employed in At-Sea Positions

Position	Number of females employed	% of total females employed
Catering – Cooks, Stewards, Assistant Stewards and Caterers	96	65%
Deck Officers	11	8%
Engineering Officers	4	3%
Deckhands	23	16%
Engine Room Assistant	3	2%
Onboard Administration (Ships Clerk)	4	3%
Specialist Positions (Ballast Control Operator, Dynamic Position Operator),	2	1%
Missing Data	3	2%

(Source: Marine Careers Secretariat. p. 43)

Data providing the global supply and demand for the numbers of seafarers in 2007 is contained in the following Table 2.9:

Table 2.9 Global Supply and Demand for Seafarers (in 1000's).

	Supply	Demand	Balance
Officers	404	420	-16
Ratings	823	599	+224

(Source: Marine Careers Secretariat. p. 43)

Appendix J: Mandatory Engineering Knowledge

TC marine engineers were required to operate complex and expensive marine machinery. Lack of knowledge and poor judgment could have resulted in destruction of property, damage to the environment, injury and loss of life. TC and the IMO recognized these hazards and developed items for examination, designed to determine if the examinee demonstrated adequate level of engineering competency. The literature and responses from four of four TC Marine Safety examiners for survey identified the Canada Shipping Act -2001) (CSA 2001) Marine Certification Regulations SOR/97-391. Transport Canada (TC) CSA 2001 Chapter 6 emphasized those regulatory requirements for TC engineer safety knowledge; an applicant was considered to have failed an engineering knowledge examination (so-called "failing question") if questions that included the following were answered incorrectly:

1. Confirming the water-level in a boiler by using the water gauge and column test method;
2. the precautions to be taken when blowing down a boiler;
3. the danger involved in relighting the fire in an oil-fired furnace where unburned gases may have accumulated;
4. the precautions to be taken to prevent the contents of a boiler from backing up into another boiler through blow-down or scum valves;
5. the precautions to be taken when connecting one boiler to another; and
6. the definition, causes, prevention and effects of water hammer.

Where an applicant was required to pass both an oral and a written examination in a subject, the applicant was required to pass the written examination first. An oral examination was required completed within 12 months after the day of passing the corresponding written examination.

Where these requirements were not met, the applicant was considered to have failed the written examination. In addition, an applicant who failed an examination was not permitted to retake the examination before a period of six months has passed beginning on the date of the examination or after such shorter period as the examiner determined based on the failure mark received by the applicant.

(Source: Canada Shipping Act CSA 2001 -TP8911E. 2007)

Appendix K: Letter of Informed Consent and Questionnaire for Trainers for TC Engineers

Andrew Robertson
Student of the Department of Education
Memorial University of Newfoundland
Home address: P.O. Box 302 Port Williams,
Nova Scotia B0P 1T0 Canada
E-mail: medboe@ns.sympatico.ca
Tel.: 902-542-1597
Cel.: 902-698-0911

April 20, 2007

(Name of TC college selected for survey)
(Address of TC college selected for survey)
(Attn: Name of TC trainer selected for survey)

Dear (name of TC trainer selected for survey)

You are invited to participate in a research project on education and training issues for Canadians seeking Transport Canada (TC) certification as a merchant Marine Engineer. This project will be conducted by Andrew Robertson under the supervision of Dr. George Hache at Memorial University of Newfoundland at Saint John's, Newfoundland.

In this project, Mr. Robertson interview and questionnaire stakeholders representative of the Canadian merchant marine affected by issues concerning merchant marine engineer education and training. Interviews shall be conducted in person or by telephone and are anticipated to require approximately half an hour. Such interviews, which will be audio taped with your permission. You will be asked to respond to questions concerning marine engineer learners attending your institution. These will specifically relate to issues concerning:

1) Preparation of students to meet Transport Canada prerequisites for examination for Certification as a marine engineer officer.

2) Preparation of students to enter the employment as a sea-going merchant marine engineer.

You will be asked to discuss your experiences in teaching marine engineering-related subject matter. The audiotapes and all other information obtained during this research project will be kept secure. The audiotapes will be kept in a locked file cabinet and will be accessible only

to project personnel. The audiotapes will be transcribed and coded to remove individuals' names and will be erased after the project is completed.

This interview will be followed by a questionnaire to be distributed by regular Canada Post. Such a questionnaire will require about half an hour to complete and concern matters directly related to instructing marine engineer learners attending your institution.

We do not anticipate any risk to this study greater than normal life and we anticipate that the results will increase our understanding of effective teaching techniques to improve marine engineering knowledge and skills. The results of this study may be used for a dissertation, a scholarly report, a journal article and conference presentation. In any publication or public presentation pseudonyms will be substituted for any identifying information.

Your participation in this project is completely voluntary, and you are free to withdraw at any time and for any reason without penalty. Your choice to participate or not will not impact your job or status at school. You are also free to refuse to answer any questions you do not wish to answer. You will receive a copy of the research results after this project is completed.

I would appreciate if you would please return these sheets to me by June 1, 2007.

If you have any questions about this research project, please contact Mrs. Robertson by telephone at 902-542-1597 or by e-mail at medboens.sympatico.ca or Dr. G. Hache at 709-737-7630, E-mail: ghache@mun.ca.

Sincerely,

Andrew Robertson

Consent Form (Marine Engineer Trainers):

I have read and understand the above information and voluntarily agree to participate in the research project described above. I have the right to revoke my permission at any time. I have been given a copy of this consent form.

_____

Signature Date

I do agree to have the interview audio taped for the purposes of transcription.

_____

_____

Signature Date

_____

Signature of Witness-Optional

_____

Date

_____

Printed name of Witness

If you have any questions about your rights as a research participant please contact Eleanor Butler, Coordinator of the Interdisciplinary Committee on Ethics Involving Human Research ICEHR at 709-737-8368, E-mail: ebutler@mun.ca

INTRODUCTION

The following questionnaire was designed to learn more about eight selected Transport Canada-approved marine engineering training colleges.

Selected Transport Canada-recognized marine training institutes for survey:

1) Canadian Coast Guard College
http://www.cgc.gc.ca/CGC.php?l=e

2) Institute Maritime du Quebec
http://www.imq.qc.ca

3) Georgian College Owen Sound Campus
http://www.georgianc.on.ca/owen-sound

4) Marine Institute of Memorial University of Newfoundland
http://www.mi.mun.ca

5) Nova Scotia Community College: Strait Campus.
http://www.nscc.ca/Learning_Programs/Schools/trades.asp#Transportation

6) BCIT Pacific Marine Training Campus
http://www.bcit.ca/about/marine.shtml

7) Holland College of Prince Edward Island, Canada
http://www.hollandcollege.com/FactSheets/FullTimePrograms.htm

8) New Brunswick Community College, St. Andrew's Campus
http://www.nbcc.ca/viewProgram.asp?id=1767&year=2007&mid=1

Seven TC approved colleges agreed to participate in the written and telephone interview questionnaire portions of this study.

One TC college declined to participate in the written and telephone interview questionnaire portions of this study. This same institute did not object to their public domain website being accessed and cited by the researcher.

This portion of the study focused on the eight TC approved colleges for study.

Researcher-confidential participant identity key:

MI: Marine Institute of Memorial University Newfoundland campus
CGC: Canadian Coast Guard College campus
OS: Owen Sound Campus
Rim: Rimouski PQ campus
PH: Port Hawkesbury, NS Strait Area Community College campus
HC: Holland College, PEI campus
St.A.: St. Andrew's Community College NB campus

Certain general data were available on the Internet. Numerical data relevant to this study was determined by questionnaires directed by mail to the TC colleges themselves. Data relevant to this study concerned current (2007) numbers of trainers on staff, student enrolments and successful graduates. It was also sought to determine if there was effective dialog between the training providers, Transport Canada as regulatory and examining body, and potential employers of marine engineering graduates. Data collected was studied to identify any education and training-related gaps.

TO THE MARINE ENGINEERING TRAINER:

The following questionnaire is intended to learn more about your marine engineer training program(s). It seeks to benefit your learners and the quality of such education and training in Canada.

Complete or partial response to the following survey items is voluntary. This questionnaire when completed and returned shall be confidential.

NOTE:

Numbers entered indicated those selected TC colleges that responded in kind to a given questionnaire item. No one college was unambiguously identified:

Researcher instructions to Trainer group participants:

To respond to questionnaire items please mark "X" on the line beside your selection. Where numerical or other written data are requested, please enter same on the lines provided.

RECRUITING:

1) Please identify media utilized by your college to recruit potential new learners:

7 Internet
5 Television
____ Academic journals. (Please specify in the space provided below):
_____
_____
_____

Marine trade publications and/or journals. (Please specify in the space provided below):

1: Seaway Review
1: Canadian Sailings
1: Professional Mariner
1: Maritime News

Major newspapers. (Please specify in the space provided below):

1: Toronto Globe and Mail
1: Toronto Star
1: Le Soleil
1: The Telegram
5: regional and local newspapers

4 "word of mouth" (such as by satisfied employers of graduates and by alumni)

2) Please identify your best resources for potential providers of learners:

7 high schools Province-wide only
3 high schools region-wide only (Pacific, Atlantic, Great Lakes)
2 high schools nation-wide
3 Employment Insurance (EI) Offices
0 marine crewing companies
1 employers of marine engineers
0 marine engineer labour unions

3) Please identify media used by your campus to contact these same potential providers:

2 E-mail
7 Web site
6 Telephone
5 Personal visits by your campus representatives.
5 Mail-out of information packages.

4) Campus and/or departmental policy includes follow-up of these same Potential providers of learners:

5 Yes.
2 No.

5) Minimum entry requirements for applicants:

1 Not specified
1 Grade 11 completion
5 High School Diploma
3 Grade 11 physics
2 Grade 12 physics
5 Grade 11 mathematics
4 Grade 12 mathematics
2 Grade 11 Chemistry
2 Grade 12 chemistry
2 Two or more years High School second language training
0 One or more year's secondary school-level technical training
1 Minimum Grade Point Average (GPA) (please specify if applicable)

(1 college identified criterion for selection based, in part, on high academic standing)

1 Letter(s) of recommendation (such as by High School Guidance Counsellor,
past/present employers, Employment Insurance Representative, etc.)

STUDENT APPLICATIONS AND COURSE INTAKE

Please enter the following numerical data in the space provided. If no data is available, please indicate by marking "N/A." If data is confidential please mark "CONF"

5) Student seats offered per academic year:
MI:48, CGC: 20-50, O.S.: 32, Rim: 66, P.H.: 16, H.C.: N/A, St. A.: 24.

6) Application enquiries received per academic year:
MI: 60, CGC: 300+, O.S.: 60+, Rim: 160, P.H.: 20, H.C.: N/A, St. A.: 55 .

7) Completed applications received per academic year:
MI: 50, CGC: 300+, O.S.: 50+, Rim: 160, P.H.: N/A, H.C.: N/A, St. A.: 30.

8) Valid Transport Canada Mariners Medical prerequisite to

successful application:
Yes: 5 "No: 2

9) Male applicants meeting minimum criterion:
MI: 40=100%, CGC: 15%, O.S.: CONFID. , Rim: 25%, P.H.: 75%, H.C.: CONFID, St. A.: CONFID.

10) Female applicants meeting minimum criterion:
MI: all (5) accepted, CGC: 100%, O.S.: CONFID, Rim: all the 20% accepted, P.H.: 1, H.C.: N/A, St. A.: CONFID.

11) Applicants accepted per academic year:
MI: no limit, CGC: 20-48, O.S.: CONFID (established 20), Rim: 138 (all programs), P.H.: 12, H.C.: N/A, St. A.: 24.

12) Male applicants accepted per academic year:
MI: 40, CGC: 20-48, O.S.: CONFID, Rim: 20% of applicants accepted), P.H.: 11, H.C.: N/A, St. A.:CONFID.

13) Female applicants accepted per academic year:
MI: 5, CGC: 20-48, O.S.: CONFID, Rim: 1 or 2/annum, P.H.: 1, H.C.: N/A, St. A.:0.

14) Male applicants successfully completing program:
MI: 95% of grads =50% of intake, CGC: 50% of intake (approx 15 to 20 per annum), O.S.: CONFID, Rim: 50% , P.H.: 0, H.C.: 0, St. A.:0.

15) Female applicants successfully completing program:
MI: =5% of yearly grads, CGC: 50% of intake (approx 15 to 20 per annum), O.S.: CONFID, Rim: 0-50% per annum (i.e. 1 or 2 per annum), P.H.: 1, H.C.: 0, St. A.: 0.

17) Applicants finding related employment within one year of graduation
MI: 100%, CGC: 100%, O.S.: 100%, Rim: 100%, P.H.: 100%, H.C.: N/A, St. A.:95%.

MATURE LEARNERS

Mature students contribute a wealth of experience and life skills that deserve recognition. Please enter the following numerical data as applicable.

18) Number of learners by age group:
18 or under:
MI: 0, CGC: 0, O.S.: 0, Rim: 0, P.H.: 0, H.C.: N/A, St. A.: 4.
19 to 24:
MI: 80%, CGC: 20-48=75%, O.S.: 70%, Rim: "majority", P.H.: 8=60%, H.C.: N/A, St. A.:5.

25 to 44:
MI: 20%, CGC: 25%, O.S.: 30%, Rim: "a minority", P.H.: 3=25%, H.C.: N/A, St. A.:5= 30%.
44 and above:
MI: 0, CGC: 0, O.S.: 0, Rim: 0, P.H.: 1, H.C.: N/A, St. A.:2.

19) Learners upgrading existing Transport Canada Certifications:
1 college
20) One or more years experience in a relevant trade (e.g.: automotive or heavy equipment, electrical, etc...):
"5% of learners" identified at 3 colleges
21) One or more year's formal training at a community college:
15% of learners identified at 4 colleges
22) Diploma or Certificate in a related skill (e.g.: welding, machinist, diesel mechanics, electronics, etc...)
10% of learners identified at 4 colleges
23) Bachelor, or Master Degree in any field of study:
5% of learners identified at 2 colleges

PROGRAM FUNDING

24) deleted item
25) Please indicate program funding resources:
6 Student Tuition fees $100 per semester or above
6 Provincial Department of Education funding.
1 Federal Government funding.
1 Special Programs or Grants (please specify in the space provided below):

_____

_____

_____
0 Employer funding.
____ Other (please specify):

_____

YOUR MERCHANT MARINE ENGINEERING TRAINING PROGRAM

Duration of training:

26) TOTAL Number of program "class + shop" hours:
MI:3233, CGC:5064, OS:2800, Rim:2100, PH900,HC:?, StA:1200
27) Hours of practical shop training (entire program):
MI1048, CGC:720, OS:600, Rim:225, PH600,HC:?, StA:800
28) Hours of classroom theory (entire program):
MI:2185, CGC:4344, OS:2200, Rim:1875, PH300,HC:?, StA:400

29) Programs offered by your institution (number of colleges awarding):
4 Certificate
2 Diploma
0 Associate Degree
2 Bachelor Degree
0 Master's Degree
2 Other (please specify in the space provided) letter acknowledging course completion, no award of academic credits.

30) Duration of your program(s) (number of colleges):
0 Less than six months
3 One academic year
0 Two academic years
2 Three academic years
1 Four academic years
X Other (please specify): 2 colleges schedule programs only "on-demand"only.

PRACTICAL SKILLS TRAINING

31) Indicate practical workshop skills training provided by your program(s):
7 Diesel mechanics
7 Pipe fitting
6 Electric arc welding
6 Gas welding
7 Hand tools skills
4 Machine lathe skills
1 Milling machine skills
4 Hydraulics
3 Pneumatics
3 Programmable logic control
3 Electrical trouble-shooting skills
2 Electronic trouble-shooting skills
3 Operating diesel engine of 500 kW or more
5 Transport Canada-required Diesel Simulator
4 Campus-operated training vessel of 200 kW or more
__Other (please specify in the space provided):
_____
_____

THEORETICAL TRAINING

32) Indicate theoretical training provided by your program(s) (number of colleges):

7 Mathematics
5 Applied Mechanics
5 Electro-technology
4 Thermodynamics
4 Ship Stability
5 Technical sketching
1 AutoCAD (Computer Assisted Drawing)
4 Metallurgy
4 Strength of Materials
X Other (please identify in the space provided): Special training in workplace communication skills emphasized by curriculum of 1 college.

LEADERSHIP

Sea-going marine engineer officers require leadership skills if they are to perform their duties effectively.

Trainers must themselves display leadership skills if they are to successfully engender
such qualities in their learners.

33) Please identify leadership training techniques implemented by your program (number of colleges):

1 Implementation of para-military-type marine engineer officer leadership training.
3 Implementation of leadership theory classes.
5 Encourage learners to function as team-players such as by assigning groups of learners to specific tasks such as workshop projects.
3 Creation of real-life training scenarios such as onboard a school training vessel that requires learners to function as a crew in order to accomplish a defined objective.
4 Formation of organized extra-curricular competitive sports teams.
4 Actively encourage sea-training vessel crew to mentor the learners in leadership.
____ Other techniques of leadership training (please outline in the space provided):
5 colleges identified Transport Canada-required 2-week Marine Safety Engine room Simulator Course as leadership training. 5 schools identified Marine Emergency Duty Training Course as leadership training.
2 colleges' trainers responded that leadership training was not a focus of their training program

FACTORS ADVERSELY AFFECTING LEARNER ACHIEVEMENT

Learner achievement can be facilitated by identifying factors that challenge them to complete their course of studies. Strategies can be developed to achieve success.

34) Please identify issues that have prevented your learners from achieving program course completion:
- 5 Financial pressures,
- 3 Left due to pressures of marine–related employment (such as insufficient leave time),
- 1 Left for other (non-marine related) employment,
- 2 Personal issues (such as domestic obligations),
- 2 Illness,
- 7 Academic issues attributable to poor study habits.
- 3 Absentee-ism,
- 1 Issues of personal conduct, and
- X Other reasons: 1 college identifies many students "homesick and seasick."

YOUR TRAINING STAFF

Responses to the following questions help the researcher to learn more about who are marine engineering trainers.

35) Total number of trainers and support staff (administrative, technical support, etc. on campus:
MI: 330, CGC: 50, O.S.: 55 , Rim: 2, P.H.:13 , H.C.: 10, St. A.: 50.

36) Total number of trainers in marine engineering training department:
MI: 20, CGC: 6, O.S.: 8, Rim: 6, P.H.: 3, H.C.: 2, St. A.: 4.

37) Total number of Transport Canada-certificated instructors as trainers:
MI: 5, CGC: 6, O.S.: 8, Rim: 6, P.H.: 0, H.C.: 6, St. A:0.

38) Number of TC 1st Class certificated trainers:
MI: 3, CGC: 5, O.S.: 2, Rim:2, P.H.:2 , H.C.: 1, St. A: 0 .

39) Number of TC 2nd Class certificated trainers:
MI: 1, CGC: 1, O.S.:1 , Rim: 4, P.H.: 0, H.C.: 0, St. A.:0.

40) Number of TC 3rd Class certificated trainers:

MI: 1, CGC: 0, O.S.: 0, Rim: 0, P.H.: 0, H.C.: 0, St. A.:0.

41) Number of TC 4th Class certificated trainers:
MI: 0, CGC: 0, O.S.: 0, Rim: 0, P.H.: 0, H.C.: 0, St. A.: 0.

42) Number of marine engineer trainers holding a marine engineering diploma:
MI: 3, CGC: 6, O.S.: 1, Rim: 6, P.H.: 0, H.C.: 0, St. A.: 0.

43) Number of marine engineer trainers holding a marine engineering degree:
MI: 0, CGC: 0, O.S.: 2, Rim: 0, P.H.: 1, H.C.: 0, St. A.: 0.

PARTNERSHIP WITH EMPLOYERS

Trainers and Employers can work together to mutual benefit of and enhance the quality and effectiveness of marine engineer education and training.

44) Which of the following methods are employed to determine the education and training needs of marine engineering employers?

4 Telephone conversations
6 E-mail enquiries
1 Questionnaire(s) distributed by E-mail or regular post
2 Other (please explain in the space provided: 2 colleges report attending bi-annual Marine Industry participant Advisory Committee meetings. 1 college reported undertaking in-house annual program revisions

45) Number of colleges reporting active employer participation engaged for effective partnership in marine engineer training by:
On-board assignment of an on-board campus-employed Officer of Primary Interest (OPI):
2 Regular on-board visits by a campus-employed OPI
2 Regular communication with training vessel officers by OPI
X Other (please explain in the space provided): 1 college reported periodic review of TC Marine Safety-required Sea Training Record Books accomplishes this function.

46) Methods by which learner progress is monitored and assessed during sea-training:
2 Regular reports by the assigned OPI
4 Regular reports by senior vessel crew as mentors
X Other (please explain in the space provided): No response to above by two colleges. 1 college reported that assessment of 3 successive

colleges and TC-required Sea Training Record Manuals should have sufficed to accomplish this function.

47) Employers are formally requested to provide feedback and recommendations concerning marine engineer learner progress:
6 Yes.
1 No.
If "Yes," please identify format:
2 Verbal
4 Written i.e.: written comments in Transport Canada-required marine training record manual.
X Other (please explain in the space provided): 3 colleges report that the TC-required Sea Training Record Manuals were solely the responsibility of those students so-inclined to pursue TC certification a marine engineer.

48) Departmental initiatives are in place to research new education and training-related opportunities in the marine industry:
4 Yes.
3 No.

49) If "Yes," please indicate method(s) employed to research and contact any such Potential partners in marine engineer training:

2 Search for relevant Internet web sites
3 Promotions via public media (radio, television, etc.)
2 Contact management by telephone
1 Distribution of invitations by E-mail
1 Distribution of program promotions by Canada Post
2 Conduct visits by campus representatives
X Other. Please explain in the space provided: 1 college reported seeking feedback from industry and schools-participant Marine Advisory Committee.

PROMOTING LEARNER SAFETY AWARENESS

Safety awareness is urged by all marine crew employers. Marine Emergency Duty Training (MED) and Basic Survival Training (BST) are the minimum regulatory requirements prior to being permitted onboard as crew

50) The following training courses contribute to developing safety-oriented work habits onboard ship. Please indicate those implemented at your marine training campus:

4 Personal Protective Equipment (PPE) familiarization.

4 Workplace Hazardous Material Information System (WHMIS) familiarization.
4 Confined Spaces Entry (procedures and management).
3 Hazardous Atmospheres training (H2S, SO2, O2 depletion, etc.)
X Other (please specify in the space provided): 1 school reports that All the above topics are presumed to be instructed at TC Marine Safety-approved Marine Emergency Duty (MED) training facilities

PRACTICAL SEA TRAINING

Transport Canada Marine Regulation TP 2274 requires that candidates for the Fourth Class level of Certification as a marine engineer receive a minimum of six months practical sea training and that learner activities be performed ands documented in accordance with same regulatory requirements.

51) Your institute accommodates learner sea training learner requirements:
6 Yes.
1 No.
If "Yes," please explain in the space provided: 1 college reported merely advising trainees to seek employment on ships. 1 TC Marine Safety-approved college did not focus on marine training except as a career option.

Transport Canada Marine Regulation TP 13595 requires that candidates for the Fourth Class Certificate of Competency as a marine engineer officer complete a marine training record manual whose format and contents are determined by the Canadian Minister of Transport.

52) Your program provides enrolled students with a Transport Canada "marine training record manual:"
5 Yes.
2 No.
If "Yes," please identify same in the space provided: Extent of school-initiated participation varies re.: TC-required Marine Training Record Manual. 4 colleges placed significant emphasis. 2 colleges merely made trainees aware of requirement. 2 colleges neither emphasized nor officially informed trainees of this regulatory requirement for TC marine engineer certification.

53) A responsible Officer of Primary Interest (OPI) appointed at your institution to ensure that this marine training record manual was implemented as per Transport Canada regulations?
3 Yes.
4 No.

If "Yes" then please briefly describe OPI duties in the space provided:
Colleges that reported "Yes" varied significantly in quality and extent of learner facilitation.

54) Vessels agreeing to provide practical sea-training are contacted by the campus OPI to ensure correct completion of the marine training record manual?
2 Yes.
4 No.
1 N/A.

55) Prior to leaving campus for commencement of required practical sea training, are students formally instructed concerning correct completion of the marine training record book?
5 Yes.
1 No.
1 N/A.
NOTE: Certain specific participant responses of "Yes" to this item seemed to contradict their responses to preliminary, related items.

56) Does successful Graduation from your institution require Transport Canada-acceptable completion of the marine training record manual?
4 Yes.
3 No.
__ N/A.
NOTE: Certain specific participant responses of "Yes" to this item seemed to contradict their responses to preliminary, related items.

TRAINEE ASSESSMENT

57) Successful program completion by students conditional on meeting one or more of the following institution-determined criterion:
6 Formal assessment of practical minor class workshop projects
6 Formal assessment of major class workshop projects
6 Quizzes
6 Formal minor written tests
6 Formal examination
6 Formal minor written report(s)
4 Formal major written report(s)
0 Thesis-style written report(s)
___ Other (please specify)

_____

1 Not Applicable

58) Students instructed in one or more of the following:

____ Basic marine industry-accepted safe work rules and regulations
____ Basic marine industry-accepted workshop safety procedures
____ Other (please specify):_____

_____

59) Student achievement assessed on one or more of the following:
6 Regular class attendance.
6 Compliance to industry-accepted accepted safety rules and regulations.
4 Wearing of Personal Protective Equipment while in practical workshop class
6 Ability to work harmoniously and effectively with classmates.
6 Ability to complete tasks in a workman-like and timely manner.
X Other criterion specified by your marine college.
(please specify): 1 school did not respond to any of the previous 6 workplace performance-related items.

60) If your program offers one or more modules of on-the-job-training as practical sea training, then please respond to the following:

61) Number and duration of sea training modules:
1 TC collegel implements 3 sea training modules of 60 days= 180 days total,
1 TC college implements 1 x 4 month and 1x 5 month sea training module= 270 days total,
1 TC college implements 2 x 4 months sea training modules=240 days total,
1 TC college implements 1 x 3 months and 1 x 6 months sea training modules= 270 days total,
2 TC colleges implement marine-specific program, but no specified sea training module, and
1 TC college implements non-marine-specific program and no specified sea training program.

Appendix L: Letter of Informed Consent and Questionnaire for Employers of TC Engineers

Letter of Consent and Consent form (Employer)

Andrew Robertson
Student of the Department of Education
Memorial University of Newfoundland
Home address: P.O. Box 302 Port Williams,
Nova Scotia B0P 1T0 Canada
E-mail: medboe@ns.sympatico.ca
Tel.: 902-542-1597
Cel.: 902-698-0911

April 20, 2007

(Name of employer selected for survey)
(Address of employer selected for survey)

Attn.: (Employer)

Dear _____,

(Employer Name) is recognized as an important employer of Transport Canada-certificated marine engineers.

You are invited to participate in a research project addressing issues affecting the education and training of those seeking Transport Canada (TC) certification(s) as a marine engineer. This project will be conducted by Andrew Robertson under the supervision of Dr. George Hache at Memorial University of Newfoundland at Saint John's, Newfoundland.

In this project, Mr. Robertson shall interview and questionnaire stakeholders representative of the Canadian merchant marine affected by issues concerning the aforementioned. Interviews shall be conducted in person or by telephone and are anticipated to require approximately half an hour. Such interviews, which will be audio taped with your permission. You will be asked to respond to questions concerning marine engineers employed by your company. These shall specifically relate to issues concerning:

3)Identification of employment-related skill sets required of (Employer Name) engineers -Fourth Class and higher. (This might

address various practical skills, supervisory ability [leadership], computer literacy, etc.)

4)Your comments concerning level of demonstrated employment-related ability by those employees as students/recent graduates of Canadian marine engineering colleges.

5)Company policies, if applicable, concerning marine engineer education and training.

You will be asked to discuss the aforementioned with respect to merchant marine engineer education and training in Canada. The researcher seeks to determine how the Transport Canada-certificated marine engineer employment needs of your company should be best served. The audiotapes and all other information obtained during this research project will be kept secure. The audiotapes will be kept in a locked file cabinet and will be accessible only to project personnel. The audiotapes will be transcribed and coded to remove individuals' names and will be erased after the project is completed.

This interview will be followed by a questionnaire to be distributed by regular Canada Post. Such a questionnaire will require about half an hour to complete and concern matters directly related to examination marine engineer candidates at your office.

We do not anticipate any risk to this study greater than normal life and we anticipate that the results will increase our understanding of effective teaching techniques to improve marine engineering knowledge and skills. The results of this study may be used for a dissertation, a scholarly report, a journal article and conference presentation. In any publication or public presentation pseudonyms will be substituted for any identifying information.

Your participation in this project is completely voluntary, and you are free to withdraw at any time and for any reason. You are also free to refuse to answer any questions you do not wish to answer. You will receive a copy of the research results after this project is completed.

If you have any questions about this research project, please contact Mr. Robertson by telephone at 902-542-1597 or by e-mail at medboens.sympatico.ca or Dr. G. Hache at 709-737-7630, E-mail: ghache@mun.ca.

Sincerely,
Andrew Robertson
Consent Form (Employer):

I have read and understand the above information and voluntarily agree to participate in the research project described above. I have the right to revoke my permission at any time. I have been given a copy of this consent form.

_____

Signature Date

I do agree to have the interview audio taped for the purposes of transcription.

_____

Signature Date

_____

Signature of Witness-Optional Date

_____

Printed name of Witness

If you have any questions about your rights as a research participant please contact Eleanor Butler, Coordinator of the Interdisciplinary Committee on Ethics Involving Human Research ICEHR at 709-737-8368, E-mail: ebutler@mun.ca

Combined Feedback: Questionnaires Directed to Eight Canadian Employers of Transport Canada Certificated Marine Engineers

Eight companies were selected for this research. Two declined to participate in the study and were replaced by two other similar employers.

Questionnaire responses were supplemented by feedback from employer group participants collected and documented during personal interviews. Marine engineer education and training-related issues frequently raised by employers were supported by citations resourced from marine industry and news publications.

Confidential key to company identity codes:

Alg.: Algoma Central Marine Shipping (Ontario-based)
Trans. Deg.: Transport Desgagnes Shipping (Quebec City-based)
V. Ships: V.Ships vessel crewing and management (Montreal –based)
Mar. At.: Marine Atlantic Towing (Sydney, NS and Port-Aux-Basque-based)
At. Tow: Atlantic Towing Limited –an Irving Division (St. John-based)
Seaspan: Seaspan Towing –privately owned by Mark Washington of USA.;
Vancouver-based
Maersk Off. Maersk Offshore –Danish –owned (St. John's-based division)
CCG: Canadian Coast Guard and Department of Fisheries and Oceans (Ottawa-based)

Instructions: mark "X" in the space beside selected response.

ABOUT YOUR COMPANY

1) Which of the following best describes the nature of your shipping company?

1 Public Service providing marine safety (search and rescue, ice breaking and navigational aids)
1 Car/passenger ferry service on domestic routes.
0 Car/passenger ferry service on international routes.
3 Offshore vessel support service.
3 Bulk cargo carriage within domestic trade routes.
3 Bulk cargo carriage on international trade routes.
2 Bulk oil tanker on domestic trade routes.
1 Bulk oil tanker on international trade routes
3 Towing (Bulk goods by barge or log boom)
3 Cable or pipe-laying
__Other (please identify in the space provided):
_____

2) Is your company vessel registry:

8 Canadian
4 Foreign
X Other (please explain in the space provided): 4 Canadian-based employers owned and managed both Canadian and foreign-registered vessels.

3) Nationality of your vessel crews:
8 Canadian Citizens/Landed Immigrants
4 International (mixed nationalities)

4) Number of vessels in your company fleet:
Alg.: 19 dom + 26 ff, Trans. Deg..11: , V. Ships: 14,. Mar. At.: 4, At. Tow: 44, Seaspan: 44 , Maersk Off.: 5, CCG: 124.

5) Average crew size per vessel:
Alg.: 22, Trans. Deg.: 18-22 , V. Ships: 22. Mar. At.: 4, At. Tow: 1,3, Seaspan: 5, Maersk Off. 11; CCG: 15.

6) Average number of certificated marine engineers employed per vessel:
Alg.: 4, Trans. Deg.: 4, V. Ships: 3, Mar. At.: 10, At. Tow: 2, Seaspan: 1, Maersk Off.: 2 CCG: 4.

7) Number of non-certificated engine room department staff employed per vessel (includes mechanics, electricians, trainees, etc.):
Alg.: 3-5, Trans. Deg.: 2-4, V. Ships: 3,. Mar. At.: 11, At. Tow: 0,1, Seaspan: 0, Maersk Off. 1GP, CCG: 3-4.

8) Total number of certificated shipboard marine engineers on staff:
Alg.: 76 (est.), Trans. Deg.: 60 (est.) , V. Ships: 42 ,. Mar. At.: 76, At. Tow: 64, Seaspan: 50, Maersk Off.: 25, CCG: 443(est.).
Total number of non-certificated engine room department staff fleet-wide:
Alg.: 80 (est.), Trans. Deg.: 35, V. Ships: 42, Mar. At.: 83, At. Tow: 0, Seaspan: 0, Maersk Off.: 40, CCG: 1035(est.).

9) Total number of certificated shore based marine engineers on staff:
Alg.: 4, Trans. Deg.: 4, V. Ships: 6. Mar. At.: 2, At. Tow: 5, Seaspan: 1, Maersk Off.: 0 CCG: 200 (est.).

10) Total number of non-certificated marine mechanical personnel on staff:
Alg.: 4, Trans. Deg.: 0 , V. Ships: 4,. Mar. At.: 24, At. Tow: 0, Seaspan: 0, Maersk Off.: est'd 40 GP's, CCG: (unable to est.).

11) Does your company require ship's Marine Engineer Officers to hold:
8 Transport Canada Certification (only) as a marine engineer officer
2 Marine Engineer Officer Certification from any International Marine Organization member State (includes UK, continental Europe, former Eastern Bloc, Middle and Far East, etc. as well as

Canada)
____ Other (please explain in the space provided):
_____
_____
_____

12) Your company employs one or more graduates from Canadian marine engineering colleges:
8 Yes
0 No
If "Yes," please state the approximate number of such graduates (as percentage of shipboard marine and marine electrical engineers):
Alg.: 25%, Trans. Deg..: 15%, V. Ships: 15%, Mar. At.: 10%, At. Tow: 60%, Seaspan: <5%, Maersk Off.: 75% CCG: 95%.

13) You employ or otherwise engage trainees from Canadian marine engineering colleges:
7 Yes
1 No
If "Yes," please state the approximate number of such trainees (factors include time of academic year and vessel operational requirements:
Alg.: est.10-20 , Trans. Deg.: est. 5-10 , V. Ships: est. 10-15,. Mar. At.: est 1-3, At. Tow: est 2-5, Seaspan: 0, Maersk Off.: est. 1-5, CCG: 20-55.

14) Your company engages in active dialogue with one or more marine engineer colleges:
7 Yes
1 No

15) Marine engineer officers/technical staff in your company conduct staff technical training:
6 Yes
2 No
____ Not Applicable

16) Please identify resources your company allocates to marine engineer training on-board:
7 employee familiarization booklets
____ other company training aids (please specify in space provided below):
_____
_____
7 Instructional videos
4 Visits by company trainers
1 Visits by marine college staff as trainers

17) Marine engineer officer trainees engaged by your company are financially compensated for active sea-duty:
6 Yes
2 No
X Other compensation (if other than accommodations and rations; please explain in the space provided):
1 company takes no trainee marine engineers. 1company provides food and board only ("berth") only to trainees. Trainee financial and other compensations vary significantly from company to company.

18) Minimum level of TC-certification required for new-hire marine engineering positions in your Company:
1 Unspecified
__Certified Engine room Assistant (ERA)
7 Fourth Class Certificate
__Third Class Certificate
__Second Class Certificate
__First Class Certificate
NOTE: New employees may be selected at any higher level, as well.

19) Your company requires marine engineer officers to complete one or more of the following courses as "Endorsements" to Certification:
8 Standard First Aid
7 Advanced First Aid
2 Basic Survival Training (B.S.T.)
8 Marine Emergency Duties (M.E.D.) Level A and B
2 Marine Emergency Duties Senior Officer Level (M.E.D.) C and D
2 Helicopter Escape (H.U.E.T.)
2 Hazardous Cargo
6 Workplace Hazardous Materials Information System (W.H.I.M.I.S.)
__Other (please specify in the space provided:
_____

20) Means by which such courses sponsored?
8 Self-sponsored
7 Partially company-sponsored
5 Fully company-sponsored

21) Your company implements incentives for employees to obtain Transport Canada Marine Certificates of Competency as a marine engineering assistant and/or engineer:
7 Yes
1 No

22) If "yes" to Item 21, do these include any of the following:
6 Scholarship for cost of tuitions

8 Unpaid educational leave
6 Paid educational leave
__Other learning expense compensation (please explain in the space provided): facilities provided onboard for self-directed Internet courses during off-duty hours.

23) Please indicate marine engineering-related skills that employers find "need to contract-out" despite availability of TC-certificated marine engineers onboard:

4 Marine Diesel fitter
5 Pipe fitter
7 Hydraulics fitter
5 Electrical "trouble-shooting" (applications below 500 Volts)
8 Electronics technician (for vessel propulsion automation)
3 "Minor" Welding repairs
6 "Minor" Machinist repairs and fabrication
5 Pneumatics "trouble-shooting" and installations

24) Please identify possible reasons for such "contracting-out"
8 Limited engineering department crew size
4 Constraints on time in port
6 Need for consistently high quality of workmanship (such as high-pressure welding)
8 Identifiable skills deficit(s) such as due to lack of personnel training
_Other reasons (please outline in the space provided): All employer group participants identified need for:
-Significantly improved electrical and electronics skills.
-Good welding skills are expected of marine engineer employees.
-High level of computer literacy is required and expected of all marine engineer employees.

LEADERSHIP

"Good leaders are made; not born. If you have the desire and willpower, you can become an effective leader. Good leaders develop through a never ending process of self-study, education, training, and experience." -RHR International on Leadership

This study considers "leadership" as an education and training issue inclusive of, but not limited to the following marine engineer employee attributes:

- self-motivation
- motivation of co-workers
- team-player skills

- knowledge and demonstration of pro-safety attitude and behaviours in the work place
- demonstration of life-long learning behaviours
- proactive mentor to co-workers
- intelligent application of company policies

25) Your organizational policies state in writing the need for one or more of the leadership attributes previously listed as a pre-requisite for employment of new marine engineer employees?
4 Yes
4 No

26) Your organizational policies provide for "in-house" training in one or more of the following:
3 Career development
7 Occupational health and safety
2 Manager as trainer (or, "Train the Trainer")
1 Conflict resolution (or, "Dealing with Difficult People")
1 Public speaking

27) Your organization policies include of marine engineer employees as candidates for career development in one or more of the previously listed topics.
4 Yes
4 No

28) Your company actively endorses leadership development initiatives for marine engineers while on campus. This may include organized team sports, human resource management, crisis management, technical administration, etc..
5 Yes
3 No
NOTE: Those companies responding "No" emphasized technical knowledge training.

(End of Questionnaire)

Appendix M: Letter of Informed Consent and Questionnaire for TC Marine Safety Examiners for TC Engineers

Andrew Robertson
Student of the Department of Education
Memorial University of Newfoundland
Home address: P.O. Box 302 Port Williams,
Nova Scotia B0P 1T0 Canada
E-mail: medboe@ns.sympatico.ca
Tel.: 902-542-1597
Cel.: 902-698-0911

April 20, 2007

Transport Canada Marine Safety
(Name of TC examiner regional office selected for survey)
(Address of TC examiner regional office selected for survey)
(Attention: name of TC examiner selected for survey)

Dear (name of TC examiner selected for survey),

You are invited to participate in a research project on education and training issues for Canadians seeking Transport Canada (TC) certification as a merchant marine engineer. This project will be conducted by Andrew Robertson under the supervision of Dr. George Hache at Memorial University of Newfoundland at Saint John's, Newfoundland.

In this project, Mr. Robertson shall interview and questionnaire stakeholders representative of the Canadian merchant marine affected by issues concerning merchant marine engineer education and training. Interviews shall be conducted in person or by telephone and are anticipated to require approximately half an hour. Such interviews, which will be audio taped with your permission. You will be asked to respond to questions concerning marine engineer learners attending your institution. These will specifically relate to issues concerning:

6) Transport Canada prerequisites for examination for Certification as a marine engineer officer, Fourth Class and higher.

7) Your comments concerning level of preparation by students attempting examination for examination for Certification as a Transport Canada certificated merchant marine engineer.

You will be asked in general terms to discuss your experiences conducting the examination of candidates seeking Transport Canada marine engineer

certification, specifically Fourth Class. The audiotapes and all other information obtained during this research project will be kept secure. The audiotapes will be kept in a locked file cabinet and will be accessible only to project personnel. The audiotapes will be transcribed and coded to remove individuals' names and will be erased after the project is completed.

This interview will be followed by a questionnaire to be distributed by regular Canada Post. Such a questionnaire will require about half an hour to complete and concern matters directly related to examination marine engineer candidates at your office.

We do not anticipate any risk to this study greater than normal life and we anticipate that the results will increase our understanding of effective teaching techniques to improve marine engineering knowledge and skills. The results of this study may be used for a dissertation, a scholarly report, a journal article and conference presentation. In any publication or public presentation pseudonyms will be substituted for any identifying information.

Your participation in this project is completely voluntary, and you are free to withdraw at any time and for any reason. You are also free to refuse to answer any questions you do not wish to answer. You will receive a copy of the research results after this project is completed.

If you have any questions about this research project, please contact Mrs. Robertson by telephone at 902-542-1597 or by e-mail at medboens.sympatico.ca or Dr. G. Hache at 709-737-7630, E-mail: ghache@mun.ca.

Sincerely,

Andrew Robertson

Consent Form (Marine Examiners):

I have read and understand the above information and voluntarily agree to participate in the research project described above. I have the right to revoke my permission at any time. I have been given a copy of this consent form.

_____

Signature Date

I do agree to have the interview audio taped for the purposes of transcription.

_____

Signature Date

_____

Signature of Witness-Optional Date

_____

Printed name of Witness

If you have any questions about your rights as a research participant please contact Eleanor Butler, Coordinator of the Interdisciplinary Committee on Ethics Involving Human Research ICEHR at 709-737-8368, E-mail: ebutler@mun.ca

INTRODUCTION:

The following questionnaire was designed to learn from Transport Canada (TC) Marine Safety examiners concerning candidates attempting examinations for certification as a TC-certificated marine engineer officer. The Internet provided data outlining certain specific requirements for such certification. TC-approved marine engineer education and training institutes should have followed such guidelines.

Other data relevant to this research was collected by generating written questionnaires implemented to TC examiners. TC safeguards the confidentiality of individual candidate examination assessment. Non-confidential feedback was gathered concerning Canadian marine engineering education and training issues. Such feedback identified learner education and training-related needs that may have been addressed by Canadian merchant marine engineering education and training providers.

It was sought to determine if there was effective dialog between the training providers, Transport Canada as regulatory and examining body, and potential employers of marine engineering graduates. Data collected was studied to identify education and training-related gaps.

The following Transport Canada Marine Safety Examiners offices were contacted to request their participation in this study:

1) Saint John's: TC – Marine Safety – Newfoundland and Labrador 10, Barter's Hill
P.O. Box 1300 John Cabot Building, St. John's, Newfoundland A1C 6H8
Tel: (709) 772-2122
-Declined to participate in written questionnaire, stating high work-load. Agreed to participate in telephone interview.

2) Dartmouth: Transport Canada, Atlantic Region, Marine Safety Office: 45,
Alderney Drive P.O. Box 1013 Dartmouth, Nova Scotia B2Y 4K2
Tel: (902) 426-3598 Fax: (902) 426-6657
-Declined to participate in written questionnaire, stating high work-load; agreed to participate in telephone interview.

3) Quebec City: Transport Canada, Laurentian Region, Gare Maritime Champlain
901, Cap Diamant, 4th Floor, Quebec, PQ G1K 4K1

-Declined to participate in written questionnaire, stating high work-load; agreed to participate in telephone interview.
4) Sarnia, Ontario: Ontario Region Obaid Barlas, Chief Examiner, 100 Front St. South
Sarnia, Ontario N7T 2M4
-Agreed to complete written questionnaire. Participated in telephone interview.

4) Vancouver: Transport Canada's Marine Safety office: Room 810 - 800 Burrard Street
Vancouver, BC V6Z 2J8 Tel: (604) 666-0834 Fax: (604) 666-9177
-Agreed to complete written questionnaire. Participated in telephone interview.

TO THE EXAMINER:

The following questionnaire is intended to learn about candidates attempting examination for Transport Canada (TC) certification as a marine engineer officer, emphasizing Fourth Class (certification).

The researcher seeks to develop recommendations for Canadian merchant marine engineer training institutes. These are intended to improve the quality of same education and training in Canada and benefit their learners as candidates seeking TC certification.

INSTRUCTIONS:

Complete or partial response to the following survey items is voluntary. This questionnaire when completed and returned shall be confidential.

To respond to questionnaire items, please mark: Y= "yes", N= "no", or C= "confidential" on the line beside your selection. Where numerical or other written data are requested, please enter same in the space provided.

Candidate Statistics:

1) Number of candidates per annum attempting examination for marine engineer officer (motor ship) TC certification:

Fourth Class
Vancouver, BC: 28
Sarnia, Ontario: 2-3

Third Class
Vancouver, BC: 03
Sarnia, Ontario: 7-10

Second Class
Vancouver, BC: 11
Sarnia, Ontario: 5-6

First Class
Vancouver, BC: 17
Sarnia, Ontario: 10-1

2) Number of successful candidates per annum achieving marine engineer officer (motor ship) TC certification:

Fourth Class
Vancouver, BC: 11
Sarnia, Ontario: ALL

Third Class
Vancouver, BC: 02
Sarnia, Ontario: ALL

Second Class
Vancouver, BC: 01
Sarnia, Ontario: ALL

First Class
Vancouver, BC: 03
Sarnia, Ontario: ALL

3) Number of candidates per annum attempting examination for marine engineer officer (steam ship) TC certification:

Fourth Class
Vancouver, BC: 1
Sarnia, Ontario:6-7 renewals only

Third Class
Vancouver, BC: NONE
Sarnia, Ontario: 1-2 renewals only

Second Class
Vancouver, BC: NONE
Sarnia, Ontario: NONE

First Class
Vancouver, BC: NONE. (The last Combined Steam-Motor certificate was passed in 2003.)
Sarnia, Ontario: NONE

1) Number of successful candidates per annum achieving marine engineer officer (steam ship) TC certification:

Fourth Class
Vancouver, BC: NONE ("Perhaps 1 TC engineer certificate renewal, only.")
Sarnia, Ontario: NONE ("Perhaps 1 TC engineer certificate renewal, only.")

Third Class
Vancouver, BC: NONE ("Perhaps 1 TC engineer certificate renewal, only.")

Sarnia, Ontario: NONE ("Perhaps 1 TC engineer certificate renewal, only.")

Second Class
Vancouver, BC: NONE ("Perhaps 1 TC engineer certificate renewal, only.")
Sarnia, Ontario: NONE ("Perhaps 1 TC engineer certificate renewal, only.")

First Class
Vancouver, BC: NONE ("Perhaps 1 TC engineer certificate renewal, only.")
Sarnia, Ontario: NONE ("Perhaps 1 TC engineer certificate renewal, only.")

2) Estimated average age of candidates that attempted examination for TC engineer certification:

Fourth Class
Sarnia: 24
Vancouver: 20-40

Third Class
Sarnia: 30
Vancouver: 25-55

Second Class
Sarnia: 35
Vancouver: 25-50

First Class
Sarnia: 40
Vancouver: >40 candidates

6) Approximate percentage male and female candidates:
99% Male in Sarnia:
94% Male in Vancouver:

1% Female in Sarnia:
6% Female in Vancouver:

100 % =Total

7) Approximate percentages of candidates providing documentation for the following durations of classroom and practical training:

% Meet Minimum requirements ONLY of 390 hours as per TP1370E
Sarnia: N/A
Vancouver: 40%

% Successful completion of a one year community college marine diesel mechanic course, or equivalent
Sarnia: N/A
Vancouver: 30%

% Successful completion of a TC-approved, three year marine engineering diploma program
Sarnia: 70%
Vancouver: 20%

% Successful completion of a TC-approved four year marine engineering degree program
Sarnia: 30%
Vancouver: 0%

100 % =Total

Candidate Examination Performance:

8) The majority of candidates appear to be informed concerning the Essential requirements for TC engineer certification (Fourth Class motor and/or steam):

TC examiner-volunteered personal responses:

Sarnia: "Mostly TC college trainees as candidates for TC examination had all the information beforehand; only a few needed advise and confirmation concerning requirements for examination." (examiner –TC Marine Safety office, 2006)

Vancouver: TC Marine Safety examiners identified steam engineering knowledge to be a mandatory requirement for TC engineer certification. In spite of this regulatory requirement, many candidates failed to demonstrate TC-acceptable level of knowledge, neither of steam boiler safety fittings, nor their correct use and maintenance. In Vancouver, the Examiners were concerned that even those marine engineers certificated as competent motor engineers nevertheless failed to demonstrate acceptable level of steam engineer knowledge prerequisite to ANY level of certification as a TC marine steam engineer officer.

Halifax-Dartmouth, St.John's Examiners Offices: Level of preparation amongst candidates varied (2006). Some of those candidates that arrived "off the street," to "challenge" TC examinations for certification at TC 4th Class level engineer were assessed as "unsuccessful" when required to describe what knowledge was required of them. This was most evident for those employed in the fisheries industry, and the majority of candidates had received little or no formal engineer training.

9) Approximate percentages of candidate demonstrating the following levels of marine engineer motor and general engineering knowledge commensurate to the Fourth Class level of Certification:

____ % Acceptable
Sarnia: 60%
Vancouver: 80%
Halifax-Dartmouth: 75%

____% Marginally acceptable
Sarnia: 00%
Vancouver: 15%
Halifax-Dartmouth: 15%

____% Do not meet TC requirements
Sarnia: 40% (fail first attempt)
Vancouver: 05% (fail first attempt)
Halifax-Dartmouth: 10% (fail first attempt)
100 %

10) Candidates generally appear to demonstrate TC-acceptable level of knowledge concerning the following safety issues:
(NOTE: considers four Marine Safety offices: Vancouver, Sarnia, Quebec City, Halifax-Dartmouth)

4 Signal for fire stations,
3 Location of fire muster stations,
3 Fire safety equipment fitted onboard ship,
3 Correct use of fire safety equipment fitted onboard ship,
4 Signal for boat stations,
4 Location of boat muster stations,
2 Signal for man overboard,
2 Location of man overboard station,
1 Man overboard duties,
3 Signal for General Alarm,
2 Location of General Alarm muster stations, and
2 General Alarm duties.

COMMENTS: The four Marine Safety Offices for questionnaire and interview provided the same general comments: That although candidates for examination for certification at the 4th Class level had recently completed the mandatory two week Marine Emergency Duties Courses "A" and "B;" it was suggested that 'many' candidates had not taken the initiative to become acquainted with specific emergency procedures onboard their own vessel. Identified were:
1) Man-overboard alarm signal, muster and duties.
2) General Alarm signal, muster and duties.

11) Candidates generally appear to demonstrate TC-acceptable level of knowledge of concerning the following:

NOTE: Documented telephone survey feedback was provided by five TC Marine Safety offices: Vancouver, Sarnia, Quebec City, Halifax-Dartmouth) and included the following:

1 Proving a boiler gauge glass,
1 Blowing-down a steam boiler,
0 Marrying two boilers,
1 Crankcase explosion,
0 Uptake fire,
0 Air receiver safety fittings, and
0 Bilge ejection (or, injection) valve.

COMMENTS: Four of four TC Marine Safety Examiners for questionnaire and telephone survey volunteered that 'an alarming number" of candidates for Engine Room Rating and 4th Class Engineer demonstrated weakness in specified "mandatory knowledge" subject matter. Those items marked "0" indicated below-acceptable TC-required level of knowledge. Those items marked "1" indicated that only one TC examiners office reported consistent and acceptable level of knowledge demonstrated by majority of candidates.

12) TC examiners volunteered that the following factors contributed to unacceptable level of engineer knowledge:

- Lack of awareness of need to become thoroughly familiar with TC Marine Safety syllabi for examination,

- loss of emphasis on need for marine steam boiler knowledge, perhaps due in part to reduced numbers of steamships in modern fleets world-wide,

- candidate misconceptions concerned purpose and emphasis of examination and certification process, and

- modern automation in vessel machinery spaces and reduced engine room department staffing reduces opportunity for candidates to receive one-on-one onboard training nor benefit from practical work experience.

13) Marine Safety Offices Vancouver and Dartmouth report that a significant number of candidates for TC engineer 4th, 3rd and 2nd Class level had sailed on a very limited number of relatively small, low powered vessels; this was indicated by candidate's regulatory required documents:

i) "Mariners Record of Discharge Book"

ii) "Testimonial of Sea Service" documents.

These two documents and assessment by examination strongly suggested that practical work experience and corresponding knowledge of safety features and procedures were correspondingly limited.

14) Candidates demonstrate TC-acceptable level of awareness concerning the following environmental issues:
4 Discharge overboard of oily water,
2 Jettisoning of rubbish at sea, and
1 Excessive emission of air pollutants.

COMMENTS: All five Marine Safety Examiners surveyed reported that TC college trainees as candidates for examination were generally aware of laws and regulations concerning accidental or intentional discharge overboard of oily water from machinery spaces. Relatively few TC college trainees as recent-graduates were aware of laws concerning regulations against jettisoning of rubbish at sea; few were aware of regulations that addressed main propulsion and auxiliary machinery exhaust gas emissions.

Marine training record manual requirements:

NOTE: considered five Marine Safety offices: Vancouver, Sarnia, Quebec City, Halifax-Dartmouth and Saint John's)

Transport Canada Marine Regulation TP 13595 (2007) required that candidates for the Fourth Class Certificate of Competency as a marine engineer officer completed a marine training record manual (book).

15) Officers of Primary Interest (OPI) are consistent and effective in facilitation of satisfactory completion of their officer cadet's learner(s)' performance of TC-required training tasks:_0_ .

COMMENTS: All Marine Safety Examiners Offices reported that only those candidates who had attended three of the eight marine colleges addressed by this study provided OPI's. In such cases, Sea training Manuals were completed and submitted to the Marine Safety Examiners Office.

16) Candidate marine training record books are consistently complete and in all respects TC-acceptable:_0_ .

COMMENTS: As per Item 13. Quality of submitted sea training record manuals was often poor; all Examiners interviewed expressed serious concern. The Dartmouth Marine Safety Examiner identified their criticism for consistent poor quality for those same trainee-completed documents, submitted to them for assessment. Four of four TC examiners surveyed stated that those candidates enrolled in the Cadet route for Certification needed to provide complete, consistent, high quality work; otherwise the objectives of this document are defeated and prerequisites for certification were not met.

17) Candidate demonstrated performance during examination seems to confirm satisfactory achievement of the learning objectives of their marine training record manual:_0_.

COMMENTS: As per items 15, 16 and 17. TC Marine Safety examiners

reported that a completed and TC-submitted sea training record manual constituted an official TC document. False entry was grounds for refusal for acceptance by the TC examiner. A recent trend towards failure to submit acceptable quality sea training record manuals was cause for general concern by TC Marine Safety examiners; they emphasized that it was incumbent upon TC-recognized colleges that TC trainers apprised engineer trainees of the need to complete this document to TC and STCW standards. Trainers were required to provide support to learners and monitor progress onboard training vessels. There were documented instances of senior-level engineering officers "signing-off" as completed, required training tasks concerning equipment that was not fitted onboard their vessels. In other instances, questioning of candidates during examination would seem to have suggested that one or more of the required training tasks were never at any time performed. TC examiners stated that it was for the Officer of Primary Interest as sea training officer to intervene and

prevent such occurrences. One examiner described this as "a failed process" of significant concern to TC Marine Safety examiners.

(End of questionnaire.)