Marine Atlantic
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Marine Atlantic

Interim Tactical Fleet Model

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FLEETWAY

Customer Focused Solutions

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Marine Atlantic

Interim Tactical Fleet Model

Table of Contents

Introduction

The results presented are intended to explore various fleet renewal options that have one or more characteristics deemed worthy of investigation by Marine Atlantic. The cost data returned by the strategic model is general in nature and is intended to be used to assess the relative merit of various far-reaching decisions rather than to predict accurately what MAI's cash flow will be at some future date. The assessment of relative merit is made possible by using a consistent set of technically sound rules that apply identical values for inflation, fuel prices, insurance, fares, etc. for each option. In this way, the relative differences between options can be maintained at or less than ±10% while any absolute annual value may vary by ±30% or more.

Fleet modeling and simulations intend to assist Marine Atlantic in their efforts to determine the future fleet configuration that is best able to provide :

1. A service capable of meeting the Peak Traffic offering as forecasted by the Regression Data provided by MAI
2. A workable, North Sydney – Port aux Basques – Argentia, summer schedule for the vessels being considered in any option.
3. Adequate redundancy and flexibility to respond to delays caused by weather, ice or minor mechanical faults.

The Strategic Fleet Model is an analytical tool used to develop relative comparisons of various fleet configuration scenarios (options). Each option is defined within the model and the model recalculates revenue and expenses based on the relationships between the parameters entered. The calculated data is presented in a financial summary for each option, for each ship for each year for each route (NS-PAB & NS-ARG) and each season (summer/winter). To further evaluate the relative merits of each scenario, a scoring system is used to evaluate the data. This methodology has been used in the past to assess the relative merits of the 10 different fleet configurations in order to short-list the options currently being reviewed.

An Interim Tactical Model has been developed to assess the ability of any specific fleet configuration to operate on a pre-set schedule and meet the Peak Traffic (July-Aug) offering. The vehicle decks for each vessel in each option are defined within the model. The model creates loading plans for each sailing for each day. The calculated data is presented as utilization rates and % of traffic left behind for each option for the NS-PAB route over a 3 week period in the summer. Each option is further evaluated by removing one vessel from service and noting how well the fleet configuration is able to meet the total demand.

A Time Domain Discrete Event or Tactical Model is being prepared to address the enormous number of variables inherent in a robust, effective operational plan that is capable of responding to the inter-relationships and variability of traffic, weather, ice and complex mechanical systems.

Background

Marine Atlantic Inc. is a Federal Crown Corporation and as such comes under political and public scrutiny. This has been taken into consideration in the options presented in this report.

Other important factors that must be considered are the essentiality of the service, and the environment in which the fleet has to operate.

Since its introduction in 1998, experience has shown that effective load management and cost efficiency can be achieved through utilization of management discretionary sailing. Of the 33 weekly trips on the Port aux Basques service, 6 of these are management discretion. This will provide for capacity growth if the traffic offering demands it. However, to reach maximum capacity at present, all four vessels have to be in operation and meet a weekly schedule of 33 departures from Port aux Basques, 36 departures from North Sydney and 3 departures from Argentia. This maximum schedule will result in arrival/departure conflicts if any vessel does not meet its crossing and loading schedule. These conflicts emanate from (a) weather or mechanical issues exacerbated by the age of the fleet; (b) only one functional dock in Port aux Basques; (c) the stern loading Atlantic Freighter requiring more port time to load/unload; and (d) the speed of the existing assets, most notably the Atlantic Freighter (maximum speed is 17 knots).

To ensure MAI is able to maximize the schedule to provide the necessary capacity and the level of service demanded in an efficient manner, there will be a requirement to address these issues. A major factor in preparing the current operating schedule is the interaction between the passenger vessels and the Atlantic Freighter. The 3 to 4 hour load/unload time for the Freighter in each port, each day pressures the remainder of the fleet to be extremely efficient in their operating cycles to ensure the schedule is met. The commercial customers have advised MAI that their business is growing rapidly and has changed over the years from regular delivery to one of “just in time”. As a result, the capacity level must factor the considerations of its customer, the commercial industry.

With the 2005 summer schedule, the traffic demand will reach the capacity of the fleet on the Port aux Basques-North Sydney service by 2008. Previously, to provide short-term additional capacity, the Company recommended chartering a fast ferry with 500 passengers and 160 AEU capacity providing one round trip per day. This is the same capacity as the Max Mols, which provided service on the Gulf Service in 2000. However, further analysis of the present fleet and the restrictions that must be overcome demand a broader examination of the entire operation.

ASSUMPTIONS

Three fundamental assumptions have been used for the **Strategic Model** :

- The nature of the traffic demand will require vessels with high lane-metre to passenger ratios (LnM/PAX). This is due to the level of commercial traffic and the low level of passenger traffic for 50% of the year;
- Passenger (PAX) traffic increases will occur during the period mid-June through mid-September, and;
- Commercial tractor trailer (TT) and drop trailer (DT) traffic will continue to increase given the strong economic outlook for Newfoundland and Labrador.

It will be demonstrated that these fundamental assumptions have a profound effect on the type of fleet that can efficiently meet the forecasted demand using the current MAI infrastructure.

Based on the data collected during the development of the original Strategic Model; the following assumptions have been made in the development of the **Interim Tactical Model** :

1) The North Sydney terminal is the site of most of the schedule conflicts.
2) The route with the highest traffic demand is the North Sydney (NS) to Port aux Basques (PAB).
3) Meeting the traffic demand from NS to PAB indicates that the vessels returning from PAB will have sufficient capacity to meet the demand from PAB to NS.
4) Providing the same level of service (number of sailings per week) to Argentia (ARG) as is presently provided will ensure the traffic demand to/from there is met.
5) As it is difficult to predict traffic demand through the day given that demand arrives in response to the scheduled sailings, demand has been spread evenly amongst each sailing irrespective of which vessel is assigned to that sailing. (Please note that the Tactical model will simulate varying demand through the day in response to the scheduled sailings).
6) Any traffic not carried on a specific sailing is carried over to the next sailing in that day. Traffic is not carried over to the next day.
7) It is possible to unload and load each ship in the three options studied in 120min. Annex D deals with this in more detail.

The intent is to demonstrate the ability to meet peak traffic demand not to simulate the actual flow of traffic.

Model Description – Strategic Model

The Strategic Fleet Model is fundamentally an accounting system that monetizes principle parameters defining the fleet and its operation in an environment that is easy to reconfigure to test various 'what-if' scenarios. The interaction between the relevant parameters is the analytical core of the model. These parametric relationships are based on real and proven, industry accepted theoretical analytical processes.

The model is constructed on a building block approach. Each significant parameter is modeled in a single module. Each module is tested against actual ship data to ascertain that the data returned represents realistic, current, best practice values. Multiple modules define a ship and multiple ships define the fleet. Each module uses data for that particular ship and all ship models use standard data that is served to them from a central database. In total the Strategic Model can concurrently simulate eight vessels over a 17 year period (2004 to 2020) using a total of 16 modules for each ship. Changing one parameter in a fleet model sets off a recalculation of the model that involves approximately 70,000 inter-related formulas and logical branches.

Controls and Objectives

The models are controlled by setting the environment for all ships through changes in the central database (GLOBAL DATA). Each scenario or option is investigated by first defining the ships that will be used within the fleet. This is done by entering values such as LOA, displacement, DWT, speed, propulsion power, cost, crew size, etc. for each ship.

Once the fleet is defined, each ship can be put into service on a seasonal and annual basis. It is important to note that the Strategic model works on ***1 year*** as its smallest unit of measure. Seasonal variations in traffic are accounted for by defining the Summer and Winter seasons as a fractions of the year and allocating parameters accordingly.

Having specified the environment, ships and service; the final step in the analysis is to interrogate the results to determine whether the fleet configuration meets demand, how much revenue is generated and, how much it costs to operate the fleet before and after financing and depreciation.

Output

The focus of the Strategic model is the Fleet Financial Summary. This is a compilation of all the expenses and revenue calculated for each ship in that particular option. The format of the Financial Summary follows that of the "Review of BC Ferry Corporation and Alternative Uses for the Fast Ferries" prepared by Fred R. Wright for the British Columbia Ferry Corporation in 2001. The financial summary template is used for each ship in the fleet and is then summed for the Fleet Financial Summary.

The data provided is represented graphically to show :

- operating expenses by year by ship
- operating cash flow (annual and cumulative)
- net income after depreciation and financing (annual and cumulative)
- revenue source breakdown
- operating expense source breakdown

Input

The model deals with the interaction of global, far-reaching parameters that directly affect the fiscal bottom line. The data input into the model is therefore very basic as an excess of low-order data would over-burden the model without improving the accuracy or usefulness of the results. Key values such as traffic demand, fuel costs, crew salaries, fares and interest rates are entered into the GLOBAL DATA file. This ensures a valid comparison as each ship model as each option uses the same values. Known values for new and existing ships are loaded into the various ship models to particularize them. Where certain required parameters are unknown, the model provides an estimate based on trends developed specifically for MAI's model from a database of over 100 RORO and ROPAX vessels similar to the ones being proposed in the noted options.

Analytical Process

Once the environment and ship data are entered the analysis proceeds as follows :

1) Set maximum service factor by season for each ship in the fleet
2) Enter dates for acquisition, refits (if any) and retirement or sale.
3) Set service factors by route, by ship by year
4) The model allocates demand across the fleet as follows:
    a. All vehicular traffic for each route, for each season (summer and winter) is reduced to lane-metres (LnM).
    b. DT LnMs are allocated to RORO vessels until either they reach capacity or the demand is fully satisfied by the vessels in service for the route/year/season under consideration.
    c. DT overflow, TT, AEQ LnMs and PAX traffic is allocated uniformly across the ROPAX vessels for the year route/year/season under consideration.
    d. Traffic split (% DT/TT/AEQ) for ROPAX vessels is calculated for each year
    e. PAX and LnM utilization is calculated for each vessel for each year based on the total fleet capacity for that route/season/year.
5) The traffic carried by each ship is then calculated using the Utilization Factors and Traffic Split for each route/season/year.
6) Revenue is based on the number of service days per year, utilization, traffic split and tariff by route/season/year.
7) Expenses are calculated annually based on service, speed, power, vessel age, vessel size, vessel type, etc.

Data and Result Checks

All data used within the model to develop the parametric relationships have been checked against the seed data vessels. This "seed data" is a collection of over 100 current vessels that are similar to the vessels being considered by Marine Atlantic. Questionable data has been either confirmed from multiple sources or removed from the seed data set. As noted above, each module has been checked back against the seed data to ensure returned values are reasonable and representative of current RORO and ROPAX trends.

An enormous number of data fields can be accessed directly by the user. Checks are incorporated into the individual ship models to provide visual feedback if certain limits of validity have been exceeded by the user. Other than specific, fatal errors the model will process whatever data is entered in spite of any errors noted in the various modules. This feature provides the ability to test certain limiting conditions, however, a high degree of discipline is required of the user to ensure that the final output is compliant with all model limitations and all warnings have been cleared. Additionally, many parameters can be over-written by the user to customize a particular ship model to match an actual vessel. This demands a further level of discipline in that overwritten values are static and will not update as the model recalculates.

Model Description – Interim Tactical Model

The Interim Tactical Model simulates the loading of specific vessels over the peak summer period based on a daily demand and a pre-set schedule.

DEMAND : Fleetway has developed detailed demand statistics using data collected by MAI since 2000. The statistics give the number of vehicles required to be carried from each terminal, each day broken out into the following categories:

Commercial Vehicles

Tractor Trailers	(CRV-TT)
Drop Trailers	(CRV-DT)
Trucks	(CRV-ST)

Passenger Vehicles

Buses	(BUS)
Cars with large trailers	(ATH)
Motorhomes	(MH)
Cars with small trailers	(ATL)
Cars	(Auto)

VEHICLE DECK ARRANGEMENTS : Fleetway has prepared sufficient engineering for the three new vessels (175m, 180m & 200m ROPAX) to have a high level of confidence that the vehicle deck arrangements being used are representative of a vessel that could be procured by Marine Atlantic. Vehicle loading plans have bee developed using the vehicle deck plans for the new and existing vessels. These indicate the load order and location of various types of traffic for each vessel for various load types (ex: heavy Commercial traffic or heavy Auto traffic)

LOAD-OUTS : Fleetway has developed a method of rapidly simulating the actual load-out for any particular sailing. This is detailed to the point of indicating where specific vehicles are parked on the deck. (See Annex D)

SCHEDULES : Fleetway has prepared schedules for each of the various options under consideration. The schedules take into account the vessel's speed, each of the three terminals and routes. The schedule is used to confirm terminal availability, number of sailings per day and by which vessel.

Controls and Objectives

It is of paramount importance to meet the traffic demand as it is offered to Marine Atlantic (MAI). For obvious reasons this needs to be done as efficiently as possible. The check conducted demonstrates the ability of each scenario to meet the peak traffic demand within a workable schedule.

Once the fleet / schedule is defined, each ship is called into service. It is important to note that the Interim Tactical Model works on ***1 hour*** as its smallest unit of measure over a three week period. Checks are conducted in 2005, 2010, 2015 and 2020.

Output

The focus of the Interim Tactical Model is the fleet's ability to meet demand. This is demonstrated with utilization factors and a count of the number of vehicles left behind by type.

The results are represented graphically to show :

- Utilization by year (2005, 2010, 2015 & 2020) by day over the three week period
- Average utilization by day
- Terminal times (used to confirm the assumption that 120min is sufficient time)
- % of total traffic left behind

Input

The model requires a full weekly schedule for each ship in a particular option. The ships called up in the schedule must be defined by their normal crossing time (as determined by their crossing speed) and their carrying capacity (as determined by their vehicle deck arrangement).

Analytical Process

Once the schedule and ship data is entered the analysis proceeds day by day for three weeks as follows :

1) Determine the traffic demand by vehicle type for the date being studied
2) Divide the total traffic demand (for each vehicle type) by the number of sailings from North Sydney to Port aux Basques for that day to get the demand for each sailing
3) Determine which ship sails from the schedule
4) Load the ship with the specified traffic mix:
    a. 30 units of commercial traffic are loaded starting on the main deck and then the upper vehicle deck
    b. Oversized PRV traffic is loaded next starting with buses, then cars with large trailers, motorhomes, etc..
    c. Cars are loaded next prioritized to 2.50m wide lanes. Once these are full, any remaining cars are loaded into 3.0m wide lanes
    d. If there is still space, the remaining commercial traffic is loaded
    e. PAX and Terminal Times are estimated based on the number and type of vehicles actually carried.
5) Calculate utilization = 1 – (space left / total space).
6) Log the type and number of any traffic left behind.

Data and Result Checks

Individual load-outs are mapped onto the deck plans to confirm that the vehicle count and distribution can be achieved. The process is controlled by two macros ensuring that the process is consistently applied across each ship, each day for each option.

See Annex D for details
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Static vs. Dynamic

The Strategic Fleet Model is in essence static. A change in any parameter causes a chain reaction of recalculation that produces a single static set of results. The process is linear in that a change in any one parameter can be traced logically through to the final results. The advantage of this system is that it is repeatable, very robust and is capable of modeling significant changes very quickly. It is not capable of dealing with intricacies of schedule or details such as when two ships require the same shore facility at the same time or when a vessel's schedule is changed mid-week. A model capable of providing the Strategic Fleet Model with actual, ship specific service factors and utilization information needs to work in a finer time unit than a year. This type of model is described in the next section.

Time Domain, Discrete Event Models

In order to identify how the fleet actually interacts on an hour-by-hour, minute-by-minute basis the model needs to start with statistical demand data capable of providing specific information such as *"at 15:10 a car arrived at North Sydney en route to Argentia"*. This data can be synthesized from actual traffic data, traffic growth projections and randomizing factors. A different sort of model will now take this information and work logically through the discrete steps necessary to provide the vehicle and occupants with tickets, marshal the vehicle in preparation for loading, load the vessel, undock , transit to the destination and unload. Each discrete step or event will have a collection of attributes such as resources (personnel that must man the ticket booths or yarding tractors that will move the DTs) and a cycle time based on what is being done. The termination of one discrete event will potentially trigger multiple following events that may proceed in parallel or sequentially based on their relationship to one another. They will all take place in the time domain which means that the time necessary to complete a critical path of events will determine the overall time necessary to complete the model run. Decision trees will be culled from Standard Operating procedures (SOPs) or conversely will form the basis for new SOPs. The decision trees will decide which event follows which and may dynamically change the critical path as the model runs through a series of cycles or sub-cycles. The model must run through the pre-set, limiting duration (ex: 0900, 01 Jan 2004 to 0900, 31 Dec 2014) repeatedly to produce a sufficiently large statistical base.

The tactical, time domain model follows on from the strategic model in that it provides a higher level of confidence in the data being used in the strategic model. The strategic model can also use the annual data generated by the tactical model to provide a higher degree of confidence in the relative merit of specific options.

Interim Tactical Model

The question "can a particular fleet configuration meet the traffic demand on a particular day" can be answered with a relatively simple tool allowing for a few minor assumptions as previously noted in "Assumptions". This simulation technique is still deterministic as is the Strategic model, however, it has the ability to investigate a very specific set of parameters at very high detail. This makes the Interim Tactical Model an ideal check on the Strategic model and a further proof of concept prior to building the Tactical Model.

Fleet Options

In terms of a long-term strategy MAI has focused on moving ahead with plans to reconfigure the entire fleet to meet the expected traffic offering and to provide the level of service demanded by its customers.

The first stage of this reconfiguration has been initiated with the assessment and condition survey of the Caribou and Smallwood. The survey provides technical recommendations for cost effective upgrades. Should the fleet modeling conclude a mid-life refit program is the most advantageous solution for MAI, these vessels would be improved and upgraded to meet upcoming regulatory changes and improve the operation and maintainability of various systems. This would extend the life of these vessels, however, the AEU capacity would remain unchanged. Capacity can only be increased with faster crossings, with shorter turn around times, with the addition of larger vessels having more AEU capacity, or a combination of thereof.

Marine Atlantic Inc. has identified the following fleet renewal and upgrade options for study. The options have been modeled to provide a method of comparing the long-term financial implications of various fleet reconfiguration decisions.

Option A Caribou & Smallwood refits plus 2 new 180m ROPAX

Option B Three new 200m ROPAX

Option C Four new 175m ROPAX

Each option will be considered from a safety, customer service, human resource, operational and financial perspective. The report will provide a recommendation for the future configuration for MAI's fleet once all the information is available. A preliminary analysis of each option follows and in 2006 a finalized report will be available.

Option A – Caribou / Smallwood Refits and 2 New 180m ROPAX

Refitting existing tonnage is a well-used approach to address the aging of a given fleet. The intent is to minimize capital expenditures (CAPX) and operational costs (OPEX) by repairing or replacing obsolete or worn-out systems with new components and therefore make full-use of the latent value of an asset's structural and other principal systems. This is a particularly efficient approach when there is either a significant reserve of carrying capacity in the existing tonnage or demand increases very little as refitting usually has no positive impact on capacity.

Maintaining compliance with new regulations is a particularly difficult problem at times. By way of example, European ferry owners are currently faced with making vessels designed to SOLAS74 compliant with SOLAS90 and SOLAS90 +50 by adding structural blisters, "duck-tails" and/or flood control doors. Along with the inherent costs associated with implementing these changes they can also adversely affect, speed, fuel economy and/or capacity driving up operational costs.

Providing an adequate budget for an extensive refit is always a risky proposition. It is difficult to assess the condition of complex distributed systems in existing vessels that are in service. This makes accurately specifying a scope of work difficult, inevitably resulting in fairly significant "arisings" during typical mid-life refits of commercial and military vessels alike. There is no need to detail the tribulations faced by owner and builder alike during major refits such as the "Louis St. Laurent". This is not to say extensive refits have all been troubled by delays and unexpected costs. Nonetheless, the risk of some unexpected, significant problem arising is significantly higher in a major refit than it is in a smaller repair and an order of magnitude higher than in a new-build program. Ultimately the decision to refit must consider the risks associated with regulatory compliance, vessel condition unknowns and capacity limits as weighed against fiscal benefits (CAPX and OPEX) that may or may not exist through the remaining life of the vessel including all associated costs.

Given the estimated time required to conduct a full refit on two vessels, it is anticipated that a charter vessel will need to be brought in for two years to provide extra capacity. This vessel will need to be modified to suit the terminals (or vice versa) and brought into compliance with Canadian regulations. For the purposes of this study, it has been assumed that the cost of this will be covered by the $9M annual charter fee. Should a shipyard be capable of completing the refit during MAI's winter season, it may be possible to operate the Atlantic Freighter and Leif Ericson instead of bringing in a charter vessel.

Option A is provided as an option that has a low CAPX requirement spread out over a significant period of time to lessen the need to raise a large amount of funds in a short period of time. This is offset by the ever-increasing operational costs of the two existing vessels. It is a necessary comparison to Options B & C that only address replacing the entire fleet.

The fleet consists of the following assets:

Caribou [ROPAX]
Refit in 2010

Joseph & Clara Smallwood [ROPAX]
Refit in 2011

Leif Ericson [ROPAX]
Until 2014

Atlantic Freighter [RORO]
Until 2009

Charter Vessels [ROPAX]
Charter : 2010 to 2011
LOA: 180 m
PAX: 1,000
Lane Metres: 2,438 m
AEU: 457
Speed: 22 knots
Power: 24,000 kW

New Vessels [ROPAX]
Enter Service : 2009 & 2014
LOA: 180 m
PAX: 1,000
Lane Metres: 2,438 m
AEU: 457
Speed: 22 knots
Power: 24,000 kW

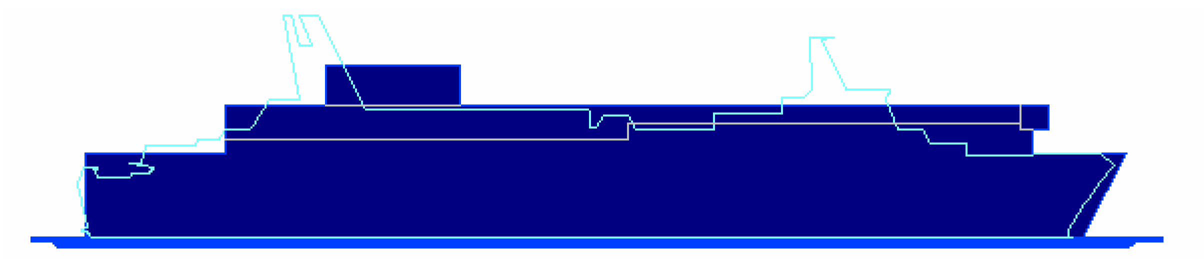


Figure 1 – 180m ROPAX

Year	AF	CAR	SML	LE	CRPX	NRPX1	NRPX2
2005	NS-PAB	NS-PAB	ARG-NS-PAB	NS-PAB			
2006	NS-PAB	NS-PAB	ARG-NS-PAB	NS-PAB			
2007	NS-PAB	NS-PAB	ARG-NS-PAB	NS-PAB			
2008	NS-PAB	NS-PAB	ARG-NS-PAB	NS-PAB			
2009		NS-PAB	ARG-NS-PAB	NS-PAB		NS-PAB	
2010		REFIT	ARG-NS-PAB	NS-PAB	NS-PAB	NS-PAB	
2011		NS-PAB	REFIT	NS-PAB	ARG-NS-PAB	NS-PAB	
2012		NS-PAB	ARG-NS-PAB	NS-PAB		NS-PAB	
2013		NS-PAB	ARG-NS-PAB	NS-PAB		NS-PAB	
2014		NS-PAB	ARG-NS-PAB			NS-PAB	NS-PAB
2015		NS-PAB	ARG-NS-PAB			NS-PAB	NS-PAB
2016		NS-PAB	ARG-NS-PAB			NS-PAB	NS-PAB
2017		NS-PAB	ARG-NS-PAB			NS-PAB	NS-PAB
2018		NS-PAB	ARG-NS-PAB			NS-PAB	NS-PAB
2019		NS-PAB	ARG-NS-PAB			NS-PAB	NS-PAB
2020		NS-PAB	ARG-NS-PAB			NS-PAB	NS-PAB

Positives to this option

- ✓ Required increase in capacity for all types of traffic until 2014 when the Leif retires;
- ✓ Existing services in place for all crewmembers;
- ✓ Faster turn around time than AF with bow & stern ramp configuration;
- ✓ Potentially less overtime for the labour force;
- ✓ Less schedule congestion as vessel speed and terminal time is better;
- ✓ There would be a return from the sale of the Atlantic Freighter and Leif Ericson; and

Negatives to this option

- ⇩ Marine Atlantic would depend on securing an appropriate charter vessel. As the vessel will almost assuredly be foreign flagged there will be an additional cost to bring the vessel in line with Canadian regulations.
- ⇩ It is unlikely that the vessel will mate exactly with MAI's shore-side infrastructure. This will require either further modifications to the vessel or to the terminal facilities.
- ⇩ It is possible that the required ROPAX would not be available for charter as few older vessels operating on the North Sea and Baltic routes are of this size.
- ⇩ Vessel modifications could prove expensive;
- ⇩ Crewing could be problematic (charter/union issues);
- ⇩ Caribou / Smallwood maintenance costs will still be high for all systems not replaced or upgraded during the refit and will escalate with time.

Option B – 3 New ROPAX

The strategy is to replace the fleet incrementally, reaping the benefits of new technologies and resulting improvements in efficiencies. These could include :

- Reduced maintenance costs.
  - Standardized, modular systems simplify maintenance and reduce required spares
  - Repair by replacement strategies where system components are easily removed and replaced facilitating repair on shore often by the vendor. This also facilitates upgrade by replacement reducing the costs of future refits.
  - Ring-main services simplifying piping repair & replacement
  - Modern equipment is invariably better designed than its predecessors using fewer parts.
- Reduced operation costs.
  - Modern analytical techniques allow engineers to design lighter structure that is as-strong and often stronger than previous. This can be translated into improved stability and/or reduced fuel usage.
  - Workflow studies, man-machine interface design and 3D simulations reduce turn-around times and resource requirements.
- Reduced acquisition costs.
  - Simplified structural and mechanical systems reduce the cost per Lane-Metre of well-designed modern ships.
  - Bulk purchasing of standardized equipment, modules and even ships has a significant impact on the overall procurement costs.

Clearly introducing new tonnage will improve the passenger and crew safety and comfort as well. Issues such as the low-quality sound insulation found on the Smallwood and ineffective heating and air conditioning found on the Caribou & Smallwood could be resolved.

Marine Atlantic raised a concern that a the Caribou / Smallwood may be the largest vessel that could be safely docked in Port aux Basques (PAB) in the sorts of winds that could be expected. Oceanic was engaged to simulate the manoeuvring characteristics of a 200m ROPAX as defined by Fleetway and to then simulate the docking of the vessel. The PAB approaches, harbour & terminal were modelled and the simulation was baselined using engine/rudder/thrusters orders from the Caribou. Three different vessel control/propulsor options were investigated : conventional rudders with CPP, Becker rudders with CPP and azimuthing podded Propulsors . Each option was fitted with bow thrusters. The CPP options were also fitted with stern thrusters. Oceanic's investigation showed that in 40 knots of wind :

1) conventional rudders and CPP would not be able to control the vessel
2) Becker rudders would provide adequate control over the vessel with a small margin
3) Podded Propulsors were very capable of controlling the vessel

Based on the potential for damaging the flaps and linkages on the Becker rudders when backing in ice, this option was deemed operationally unacceptable leaving podded Propulsors as the only control/propulsion option for such a large ferry.

Oceanic's investigation provides evidence that it is possible to dock a vessel of this size provided it is fitted with twin azimuthing, podded Propulsors and bow thrusters.

The fleet consists of the following assets:

Caribou [ROPAX]
Until 2010

Joseph & Clara Smallwood [ROPAX]
Until 2010

Leif Ericson [ROPAX]
Until 2014

Atlantic Freighter [RORO]
Until 2009

New Vessels [ROPAX]
2009, 2011 & 2014
LOA: 200 m
PAX: 1,000
Lane Metres: 3,298 m
AEU: 618
Speed: 22 knots
Power: 29,200 kW

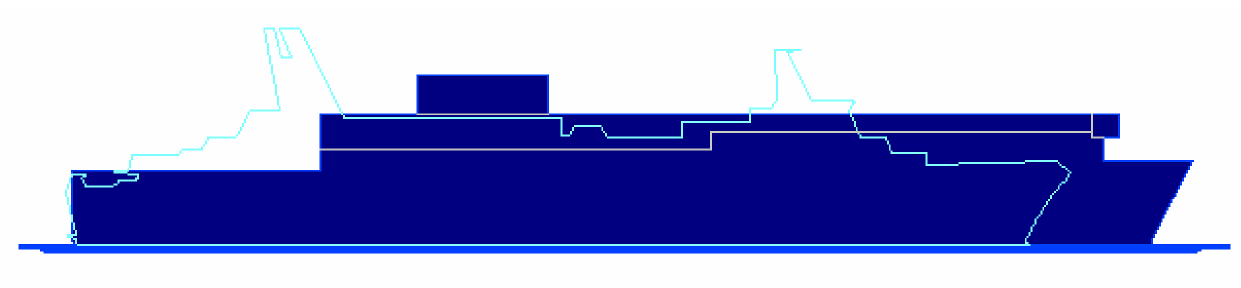


Figure 2 – 200m ROPAX

Year	AF	CAR	SML	LE	NRPX1	NRPX2	NRPX3
2005	NS-PAB	NS-PAB	ARG-NS-PAB	NS-PAB			
2006	NS-PAB	NS-PAB	ARG-NS-PAB	NS-PAB			
2007	NS-PAB	NS-PAB	ARG-NS-PAB	NS-PAB			
2008	NS-PAB	NS-PAB	ARG-NS-PAB	NS-PAB			
2009		NS-PAB	ARG-NS-PAB	NS-PAB	NS-PAB		
2010		NS-PAB	ARG-NS-PAB	NS-PAB	NS-PAB		
2011				NS-PAB	NS-PAB	ARG-NS-PAB	
2012				NS-PAB	NS-PAB	ARG-NS-PAB	
2013				NS-PAB	NS-PAB	ARG-NS-PAB	
2014					NS-PAB	ARG-NS-PAB	NS-PAB
2015					NS-PAB	ARG-NS-PAB	NS-PAB
2016					NS-PAB	ARG-NS-PAB	NS-PAB
2017					NS-PAB	ARG-NS-PAB	NS-PAB
2018					NS-PAB	ARG-NS-PAB	NS-PAB
2019					NS-PAB	ARG-NS-PAB	NS-PAB
2020					NS-PAB	ARG-NS-PAB	NS-PAB

Positives to this option

- ✓ Required increase in capacity for all types of traffic
- ✓ Faster turn around time with bow and stern door configuration;
- ✓ Potentially less overtime for the labour force;
- ✓ Less schedule congestion as all ships are identical and there are fewer ships;
- ✓ Excellent reliability and availability;
- ✓ Excellent Maintainability reduces the frequency and duration of planned work periods;
- ✓ Much simplified training with a standard ship class.
- ✓ Enormous scheduling freedom (All ships can sail all routes)
- ✓ There would be a return from the sale of the Leif, Freighter, Caribou and Smallwood;
- ✓ Existing services in place for all crewmembers, and;
- ✓ Significant reductions in operating expenses.

Negatives to this option

- ⇩ Large capital outlay;
- ⇩ Possibility of a fleet that would be incapable of meeting demand if one of the three vessels was unexpectedly laid up due to an unforeseen mechanical problem.
- ⇩ Difficulty in docking such a large vessel in PAB requires machinery systems considerably more complex (costly) than is currently fitted in the existing fleet.

Option C - 4 New ROPAX

The strategy is to replace the fleet incrementally, reaping the benefits of new technologies and resulting improvements in efficiencies. These could include :

- Reduced maintenance costs.
  - Standardized, modular systems simplify maintenance and reduce required spares
  - Repair by replacement strategies where system components are easily removed and replaced facilitating repair on shore often by the vendor. This also facilitates upgrade by replacement reducing the costs of future refits.
  - Ring-main services simplifying piping repair & replacement
  - Modern equipment is invariably better designed than its predecessors using fewer parts.
- Reduced operation costs.
  - Modern analytical techniques allow engineers to design lighter structure that is as-strong and often stronger than previous. This can be translated into improved stability and/or reduced fuel usage.
  - Workflow studies, man-machine interface design and 3D simulations reduce turn-around times and resource requirements.
- Reduced acquisition costs.
  - Simplified structural and mechanical systems reduce the cost per Lane-Metre of well-designed modern ships.
  - Bulk purchasing of standardized equipment, modules and even ships has a significant impact on the overall procurement costs.

Clearly introducing new tonnage will improve the passenger and crew safety and comfort as well. Issues such as the low-quality sound insulation found on the Smallwood and ineffective heating and air conditioning found on the Caribou & Smallwood could be resolved.

From an operational point of view, a multiplicity of identical vessels provides the greatest flexibility and the greatest capacity when faced with the loss of service of any single vessel.

- Any vessel can be assigned to any route allowing the operator the freedom to evenly utilize the vessels and to schedule maintenance on a uniform schedule.
- The total fleet capacity is affected less by the loss of any single asset (through mechanical problems for example) as the number of assets goes up.
- The sailing schedule becomes more regular and simpler to devise as every vessel has identical capacity and speed.
- Crew training is simplified, as they only need to learn how to operate and maintain one ship.

Flexibility and redundancy must be balanced against cost and the logistics of operating a large number of small assets. This suggests that there should be a fleet size that best serves the opposing demands of flexibility and complexity while minimizing cost.

The level of service (sailings per day) expected by both the private and commercial passengers negates the option of a single, very large vessel. Given the terminal congestion issues currently faced by MAI while operating 4 vessels, it is unlikely that it would be possible to operate 6 or more vessels without significant, costly upgrades to the terminals. This would then suggest the ideal fleet size would be between 2 and 5 identical vessels.

The enormous variation in traffic demand between summer and winter (winter traffic volume is approx 53% of summer traffic volume) means that the operator is either faced with a significant under-capacity in the summer or a significant redundancy in the fleet over the winter. Ideally, the variation in demand will be met by operating fewer assets in the winter than in the summer. By “cold-storing” part of the fleet over the winter season, crew, fuel, and maintenance costs can be reduced. This then suggests that the ideal capacity of the winter fleet is the minimum necessary to provide the required service through the winter months with additional numbers added in the summer to meet the increased demand.

MAI has found that two vessels are required through the winter to provide the current level of service. Currently the Caribou and Smallwood easily handle all of the traffic offered using an undemanding schedule. Should demand increase sharply due to holiday traffic or some other event, the scheduled number of sailings of the operational vessels can be increased. If an operational vessel is rendered non-functioning for some reason, the Leif can quickly be taken out of “cold-storage” and brought into service to cover. The present winter fleet would appear to be efficient and equipped with adequate redundancy to provide a robust service. Two vessels, sized to carry the predicted winter demand can then be selected as being the most advantageous configuration to match the current, expected winter service.

Given the difference in traffic volume (winter ≈ 50% of summer), logically, twice the number of these standard assets will be required in the summer than in the winter.

Following the reasoning to its ultimate conclusion, the most favourable fleet make-up would be comprised of four identical vessels. This is presented as “Option C”.

This option is similar to Option B in that the entire fleet is replaced with new tonnage, but with 4 identical ROPAX instead of 3 ROPAX. The intention is to provide the maximum fleet flexibility and redundancy. Preliminary investigations indicated a vessel larger than the Leif Ericsson yet smaller than the Caribou would meet the demand to 2020. MAI realized that this vessel may exhibit some of the undesirable seakeeping characteristic of the Leif Ericsson and suggested a larger vessel, approximately the same size as the Caribou would be a better candidate.

The basic strategy employed in this option stems from the following observations :

1) The rather low revenue to operating cost ratio exhibited by the existing fleet when compared to new tonnage

2) The need to provide redundancy with the fewest number of fleet assets to account for unforeseen mechanical problems and/or extreme weather in all seasons

3) The nature of the traffic demand i.e.: large component of commercial traffic. This requires a significantly different design than the majority of European ROPAX vessels in service.

4) The ability to design route-specific features into the new vessels that would improve their capability and availability. These could include :

a. Ships designed to reduce total through-life cost not just lowest procurement.
b. Beamier ships for improved stability capable of carrying full commercial vehicle loads on both vehicle decks.
c. Modern, efficient vehicle lashing systems to reduce turn-around times.
d. Hoistable vehicle decks for the upper and lower vehicle space that could increase the AEU capacity by 50-60% without increasing the size of the vessel.
e. More cabins
f. Route specific lounges (smaller with comfortable seating), more movie lounges, more seating with tables. Large spacing between seating. This is easily accomplished as the PAX requirements are low for the ships being considered.
g. More efficient bow shapes for reduced resistance and improved sea keeping
h. Ice capable sterns for backing into the terminals and entering North Sydney
i. Large thrusters and ice re-enforced rudders to reduce ice damage, or
j. Podded propulsors to reduce manoeuvring times.

This led Fleetway to explore the possibility of using the same fleet size that Marine Atlantic currently has but using modern, efficient vessels sized to meet demand beyond 2020. Curiously the very large ships required in option B were not required in Option C. The reasons for this are that modern vessels are volumetrically more efficient (more cargo for a given ship size) than MAI's existing assets. Earlier investigations have shown that this difference is not large enough for one new ship to compensate for 2 or 3 older ones.

Caribou :	179m LOA,	1,947 LnM
New ROPAX :	177m LOA (-1%),	2,121 LnM (+9%)

This suggested the following assets:

Joseph & Clara Smallwood [ROPAX]
Until 2008

Caribou [ROPAX]
Until 2010

Leif Ericson [ROPAX]
Until 2009

Atlantic Freighter [RORO]
Until 2008

New Vessel 1, 2, 3 & 4 [ROPAX]
2009, 2010, 2012 & 2014
LOA: 177 m
PAX: 1,000
Lane Metres: 2,121 m
AEU: 397
Speed: 22 knots
Power: 22,000 kW

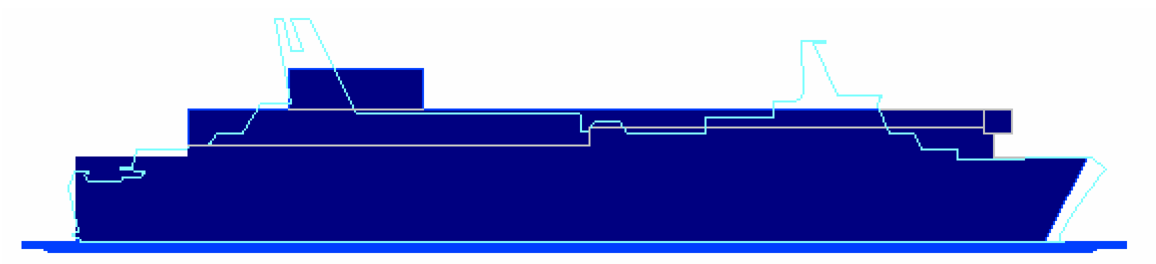


Figure 3 – 175m ROPAX

Year	AF	CAR	SML	LE	NRPX1	NRPX2	NRPX3	NRPX4
2005	NS-PAB	NS-PAB	ARG-NS-PAB	NS-PAB				
2006	NS-PAB	NS-PAB	ARG-NS-PAB	NS-PAB				
2007	NS-PAB	NS-PAB	ARG-NS-PAB	NS-PAB				
2008	NS-PAB	NS-PAB	ARG-NS-PAB	NS-PAB				
2009		NS-PAB	ARG-NS-PAB	NS-PAB	NS-PAB			
2010			*ARG-NS-PAB1*	NS-PAB	NS-PAB	ARG-NS-PAB		
2011			*ARG-NS-PAB2*	NS-PAB	NS-PAB	ARG-NS-PAB		
2012				NS-PAB	NS-PAB	ARG-NS-PAB	NS-PAB	
2013				NS-PAB	NS-PAB	ARG-NS-PAB	NS-PAB	
2014					NS-PAB	ARG-NS-PAB	NS-PAB	NS-PAB
2015					NS-PAB	ARG-NS-PAB	NS-PAB	NS-PAB
2016					NS-PAB	ARG-NS-PAB	NS-PAB	NS-PAB
2017					NS-PAB	ARG-NS-PAB	NS-PAB	NS-PAB
2018					NS-PAB	ARG-NS-PAB	NS-PAB	NS-PAB
2019					NS-PAB	ARG-NS-PAB	NS-PAB	NS-PAB
2020					NS-PAB	ARG-NS-PAB	NS-PAB	NS-PAB

Positives to this option

- ✓ Excellent reliability and availability;
- ✓ Excellent Maintainability reduces the frequency and duration of planned work periods;
- ✓ Required increase in capacity for all types of traffic;
- ✓ Faster turn around time with bow and stern door configuration;
- ✓ Potentially less overtime for the labour force;
- ✓ Much simplified training with a standard ship class.
- ✓ Enormous scheduling freedom (All ships can sail all routes)
- ✓ There would be a return from the sale of the Leif, Freighter, Caribou and Smallwood;
- ✓ Existing services in place for all crewmembers, and;
- ✓ Significant reductions in operating expenses.

Negatives to this option

- ⇩ Large capital outlay.

Option Summaries (Scorecard)

In order to simplify the evaluation of the options investigated, two separate summaries have been developed. These reflect a quantitative summary and operational cost summary. To allow a timeline comparison, values are presented for performance to 2008, 2013, and 2018. All options meet minimum capacity requirements to meet traffic demand.

Description of each category for Summaries

CUMM CapX: Reflects cumulative capital expenditures. Options assume all vessel purchase and refit costs, as well a charter fees, to be capital expenditures. Sales reflect monies from the sale of existing vessels. Net capital expenditures are the difference between purchases and sales.

Cumulative Oper Cost: Reflects cumulative operating costs up to the noted year.

Cumm Cost: Cumulative cost is the sum of net capital expenditures and cumulative operating costs.

Average Annual Total Cost: Is the cumulative cost divided by the number of years for the option, starting from 2004.

Quantitative Summary

2008	Cumm CapX Note 2					
Option	Buy or Charter	Sales	Net CAPX	Cumulative Oper Cost	Cumm Cost	Average Annual Total Cost
A	$0	$0	$0	$377	$377	$94
B	$0	$0	$0	$377	$377	$94
C	$0	$0	$0	$377	$377	$94

2013	Cumm CapX Note 2					
Option	Buy/Charter	Sales	Net CAPX	Cumulative Oper Cost	Cumm Cost	Average Annual Total Cost
A	$363	$(2)	$361	$829	$1,190	$132
B	$516	$(62)	$454	$782	$1,236	$137
C	$537	$(62)	$475	$793	$1,268	$141

2018	Cumm CapX (Note 2)					
Option	Buy/Charter	Sales	Net CAPX	Cumulative Oper Cost	Cumm Cost	Average Annual Total Cost
A	$553	$(27)	$526	$1,381	$1,908	$136
B	$774	$(87)	$687	$1,253	$1,940	$139
C	$716	$(87)	$629	$1,272	$1,901	$136

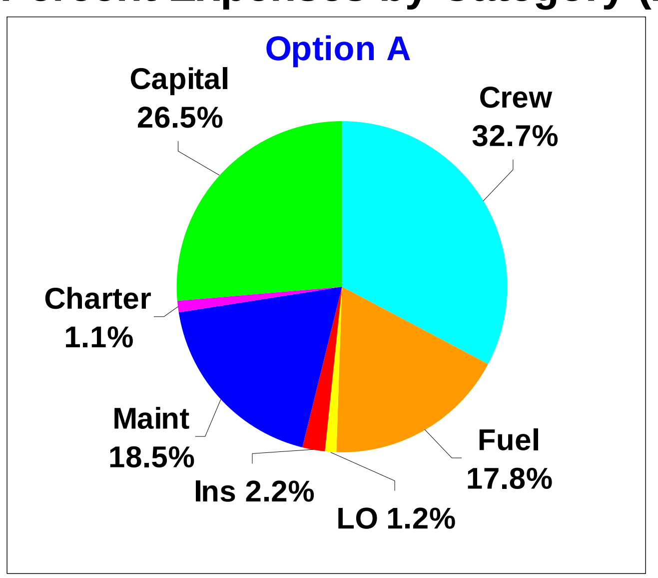
CAPX SUMMARY

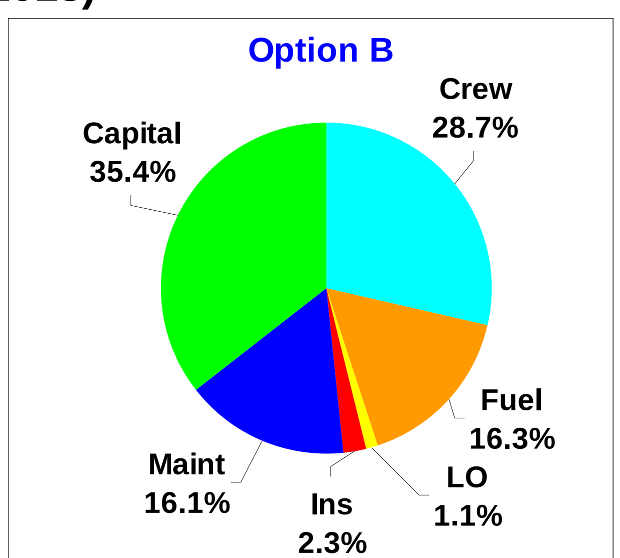
Option	Year	Description and Totals
A	2009	Sell Freighter for $2M Buy New ROPAX for $190M Total CAPX= $188M
	2010	Refit Caribou for $76.5M Charter New ROPAX for $10.1M Total CAPX= $86.6M
	2011	Refit Smallwood for $76.5M Charter New ROPAX for $10.3M Total CAPX= $86.8M
	2014	Sell Leif for $25M Buy New ROPAX for $190M Total CAPX= $165M
B	2009	Sell Freighter for $2M Buy New ROPAX for $258M Total CAPX= $256M
	2011	Sell Caribou for $30M Sell Smallwood for $30M Buy New ROPAX for $258M Total CAPX= $198M
	2014	Sell Leif for $25M Buy New ROPAX for $258M Total CAPX= $233M
C	2009	Sell Freighter for $2M Buy New ROPAX for $179M Total CAPX= $177M
	2010	Sell Caribou for $30M Buy New ROPAX for $179M Total CAPX= $149M
	2012	Sell Smallwood for $30M Buy New ROPAX for $179M Total CAPX= $149M
	2014	Buy New ROPAX for $179M Sell Leif for $25M Total CAPX= $154M

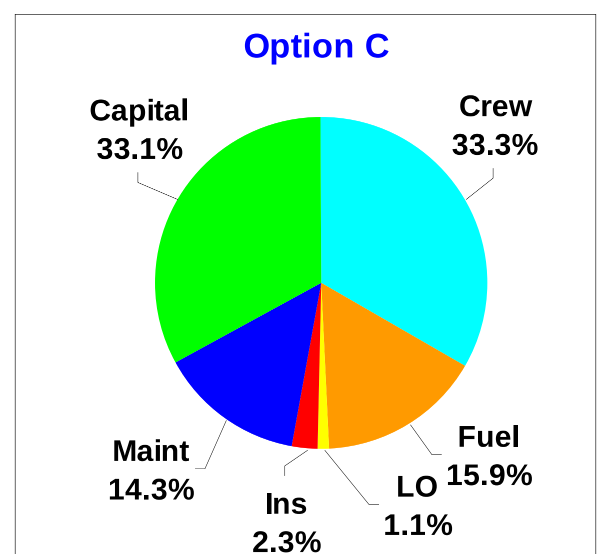
Notes: 1. Average annual total cost = Cumulative Cost / (Year-2004)
2. CAPX purchases include charter fees
3. All values in $Millions

Note: Option A also utilizes a 180M ROPAX (used) as a two year charter at $9.0M/yr. This cost is also intended to cover the cost of vessel/infrastructure modifications as well as the cost of making the vessel compliant with Canadian regulations.

Percent Expenses by Category (2018)







Operational Cost Summary

Option A

Year	Crew Cost	Fuel Cost	LO Cost	Insurance Cost	Maint Cost	Charter Fees	Capital Cost	Total Cost	Cumulative Cost
2004	$ 28.885	$ 16.086	$ 1.126	$ 1.271	$ 17.862	$ -	$ -	$ 65.231	$ 65.231
2005	$ 29.768	$ 21.805	$ 1.526	$ 1.284	$ 19.143	$ -	$ -	$ 73.526	$ 138.757
2006	$ 30.685	$ 22.323	$ 1.563	$ 1.297	$ 20.459	$ -	$ -	$ 76.328	$ 215.085
2007	$ 31.647	$ 22.897	$ 1.603	$ 1.311	$ 21.804	$ -	$ -	$ 79.262	$ 294.347
2008	$ 32.642	$ 23.502	$ 1.645	$ 1.325	$ 23.186	$ -	$ -	$ 82.300	$ 376.647
2009	$ 39.399	$ 21.729	$ 1.521	$ 2.328	$ 23.107	$ -	$ 188.000	$ 276.084	$ 652.730
2010	$ 40.291	$ 21.596	$ 1.512	$ 2.862	$ 20.753	$ 10.135	$ 76.500	$ 173.649	$ 826.380
2011	$ 41.573	$ 21.597	$ 1.512	$ 3.281	$ 20.458	$ 10.338	$ 76.500	$ 175.259	$ 1,001.639
2012	$ 43.493	$ 22.399	$ 1.568	$ 3.180	$ 21.608	$ -	$ -	$ 92.248	$ 1,093.887
2013	$ 44.903	$ 22.929	$ 1.605	$ 3.208	$ 23.451	$ -	$ -	$ 96.095	$ 1,189.982
2014	$ 48.679	$ 23.790	$ 1.665	$ 4.094	$ 22.971	$ -	$ 165.000	$ 266.200	$ 1,456.182
2015	$ 50.379	$ 24.259	$ 1.698	$ 4.130	$ 25.551	$ -	$ -	$ 106.018	$ 1,562.200
2016	$ 51.891	$ 24.849	$ 1.739	$ 4.165	$ 28.044	$ -	$ -	$ 110.689	$ 1,672.889
2017	$ 53.610	$ 25.346	$ 1.774	$ 4.201	$ 30.580	$ -	$ -	$ 115.511	$ 1,788.400
2018	$ 55.779	$ 24.370	$ 1.706	$ 4.238	$ 33.270	$ -	$ -	$ 119.362	$ 1,907.763
2019	$ 56.910	$ 26.595	$ 1.862	$ 4.275	$ 36.118	$ -	$ -	$ 125.759	$ 2,033.522
2020	$ 58.617	$ 27.123	$ 1.899	$ 4.311	$ 39.054	$ -	$ -	$ 131.003	$ 2,164.525
	$ 739.151	**$ 393.195**	**$ 27.524**	**$ 50.763**	**$ 427.419**	**$ 20.474**	**$ 506.000**	**$ 2,164.525**	

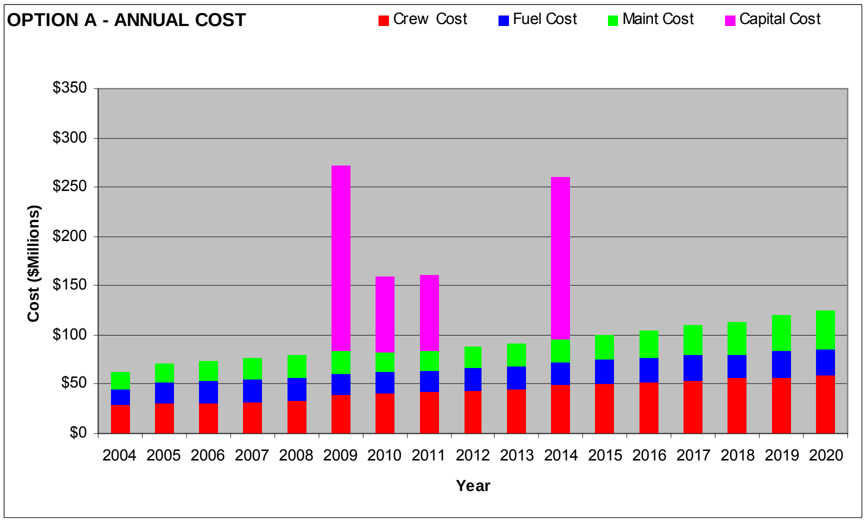
Option B

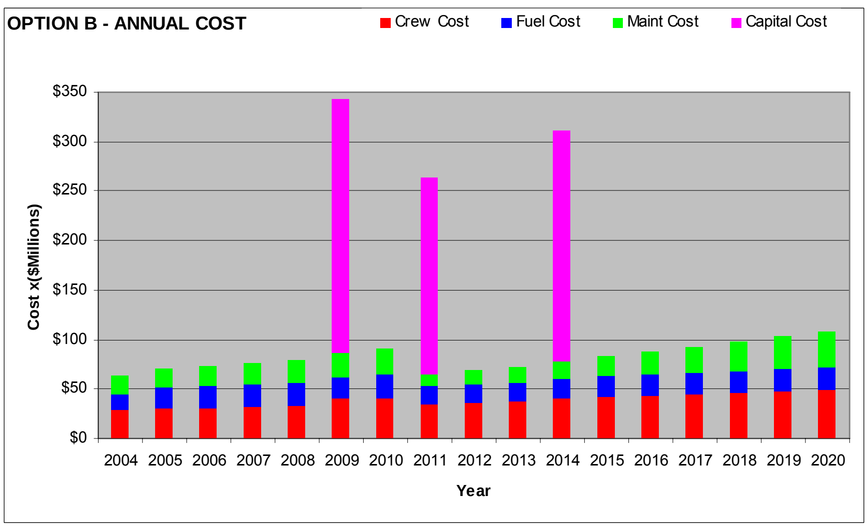
Year	Crew Cost	Fuel Cost	LO Cost	Insurance Cost	Maint Cost	Charter Fees	Capital Cost	Total Cost	Cumulative Cost
2004	$ 28.885	$ 16.084	$ 1.126	$ 1.271	$ 17.862	$ -	$ -	$ 65.229	$ 65.229
2005	$ 29.768	$ 21.803	$ 1.526	$ 1.284	$ 19.143	$ -	$ -	$ 73.524	$ 138.753
2006	$ 30.685	$ 22.321	$ 1.562	$ 1.297	$ 20.459	$ -	$ -	$ 76.325	$ 215.078
2007	$ 31.647	$ 22.894	$ 1.603	$ 1.311	$ 21.804	$ -	$ -	$ 79.259	$ 294.337
2008	$ 32.642	$ 23.500	$ 1.645	$ 1.325	$ 23.186	$ -	$ -	$ 82.297	$ 376.634
2009	$ 39.644	$ 22.590	$ 1.581	$ 2.677	$ 24.129	$ -	$ 256.000	$ 346.622	$ 723.256
2010	$ 40.978	$ 23.318	$ 1.632	$ 2.703	$ 26.332	$ -	$ -	$ 94.964	$ 818.220
2011	$ 34.449	$ 18.425	$ 1.290	$ 3.242	$ 12.054	$ -	$ 198.000	$ 267.460	$ 1,085.679
2012	$ 35.588	$ 18.869	$ 1.321	$ 3.271	$ 14.210	$ -	$ -	$ 73.259	$ 1,158.938
2013	$ 36.764	$ 19.315	$ 1.352	$ 3.301	$ 16.291	$ -	$ -	$ 77.023	$ 1,235.962
2014	$ 40.525	$ 20.350	$ 1.425	$ 4.575	$ 17.241	$ -	$ 233.000	$ 317.115	$ 1,553.077
2015	$ 41.854	$ 20.843	$ 1.459	$ 4.614	$ 20.289	$ -	$ -	$ 89.058	$ 1,642.135
2016	$ 43.150	$ 21.363	$ 1.495	$ 4.653	$ 23.391	$ -	$ -	$ 94.053	$ 1,736.188
2017	$ 44.445	$ 21.777	$ 1.524	$ 4.692	$ 26.620	$ -	$ -	$ 99.057	$ 1,835.246
2018	$ 45.778	$ 22.307	$ 1.561	$ 4.730	$ 29.940	$ -	$ -	$ 104.317	$ 1,939.563
2019	$ 47.152	$ 22.841	$ 1.599	$ 4.769	$ 33.362	$ -	$ -	$ 109.722	$ 2,049.285
2020	$ 48.566	$ 23.283	$ 1.630	$ 4.806	$ 36.894	$ -	$ -	$ 115.180	$ 2,164.465
	$ 652.519	**$ 361.883**	**$ 25.332**	**$ 54.522**	**$ 383.208**	**$ -**	**$ 687.000**	**$ 2,164.465**	

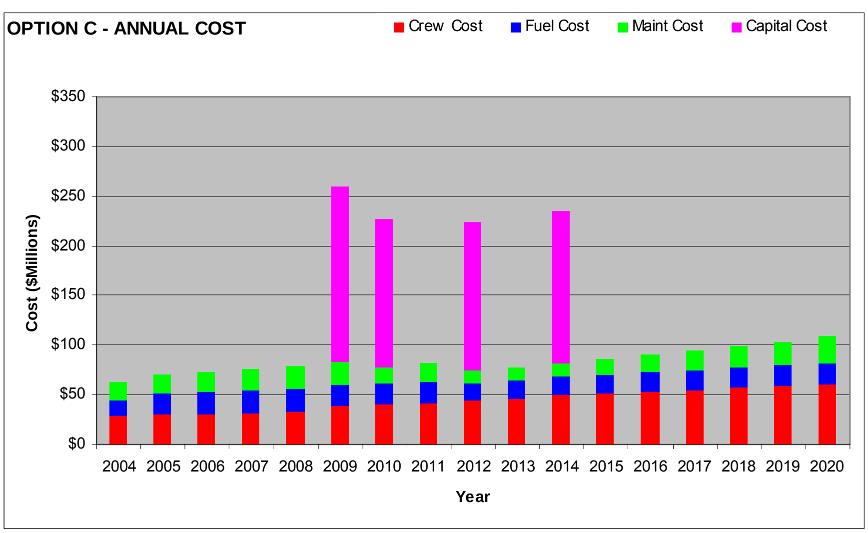
Option C

Year	Crew Cost	Fuel Cost	LO Cost	Insurance Cost	Maint Cost	Charter Fees	Capital Cost	Total Cost	Cumulative Cost
2004	$ 28.885	$ 16.085	$ 1.126	$ 1.271	$ 17.862	$ -	$ -	$ 65.230	$ 65.230
2005	$ 29.768	$ 21.804	$ 1.526	$ 1.284	$ 19.143	$ -	$ -	$ 73.526	$ 138.756
2006	$ 30.685	$ 22.322	$ 1.563	$ 1.297	$ 20.459	$ -	$ -	$ 76.327	$ 215.083
2007	$ 31.647	$ 22.896	$ 1.603	$ 1.311	$ 21.804	$ -	$ -	$ 79.261	$ 294.344
2008	$ 32.642	$ 23.502	$ 1.645	$ 1.325	$ 23.186	$ -	$ -	$ 82.299	$ 376.643
2009	$ 39.355	$ 21.245	$ 1.487	$ 2.267	$ 22.745	$ -	$ 177.000	$ 264.099	$ 640.742
2010	$ 40.706	$ 20.326	$ 1.423	$ 2.918	$ 16.487	$ -	$ 149.000	$ 230.860	$ 871.602
2011	$ 42.220	$ 20.856	$ 1.460	$ 2.945	$ 18.336	$ -	$ -	$ 85.816	$ 957.418
2012	$ 44.201	$ 17.825	$ 1.248	$ 3.484	$ 12.083	$ -	$ 149.000	$ 227.842	$ 1,185.259
2013	$ 45.844	$ 18.293	$ 1.280	$ 3.517	$ 13.874	$ -	$ -	$ 82.809	$ 1,268.068
2014	$ 49.753	$ 18.688	$ 1.308	$ 4.342	$ 12.707	$ -	$ 154.000	$ 240.798	$ 1,508.866
2015	$ 51.544	$ 19.197	$ 1.344	$ 4.381	$ 14.784	$ -	$ -	$ 91.250	$ 1,600.116
2016	$ 53.481	$ 19.563	$ 1.369	$ 4.419	$ 16.913	$ -	$ -	$ 95.745	$ 1,695.861
2017	$ 55.112	$ 20.068	$ 1.405	$ 4.458	$ 19.161	$ -	$ -	$ 100.204	$ 1,796.065
2018	$ 56.952	$ 20.450	$ 1.431	$ 4.496	$ 21.547	$ -	$ -	$ 104.876	$ 1,900.940
2019	$ 58.740	$ 20.996	$ 1.470	$ 4.534	$ 24.039	$ -	$ -	$ 109.780	$ 2,010.720
2020	$ 60.502	$ 21.372	$ 1.496	$ 4.572	$ 26.742	$ -	$ -	$ 114.685	$ 2,125.405
	$ 752.037	**$ 345.488**	**$ 24.184**	**$ 52.823**	**$ 321.874**	**$ -**	**$ 629.000**	**$ 2,125.405**	

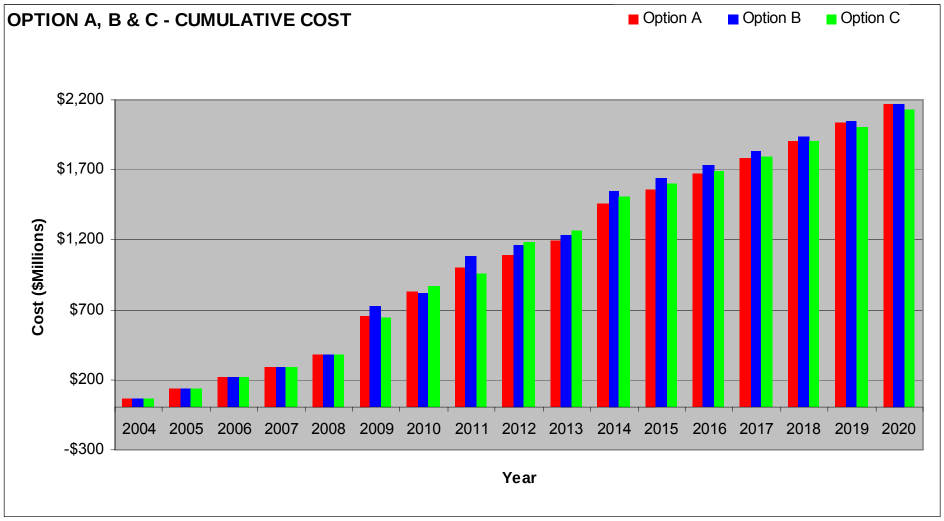
Operational Cost Summary

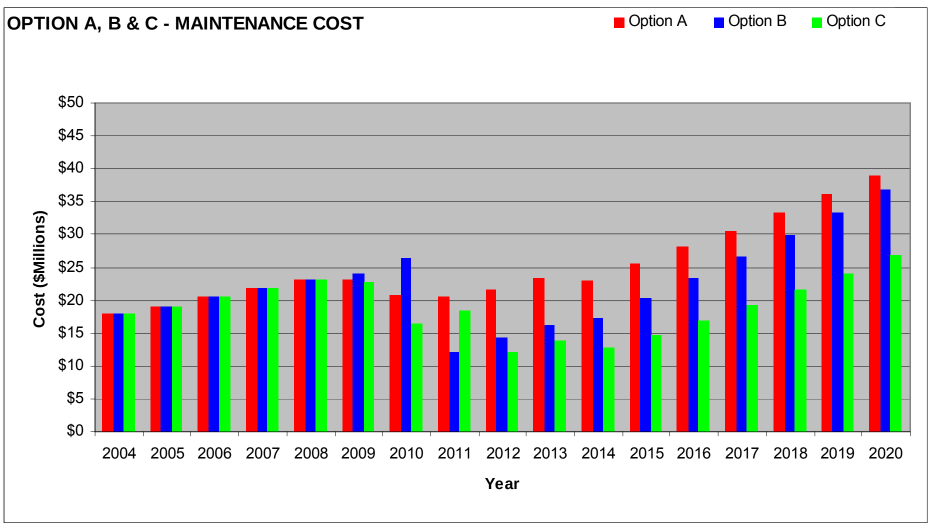


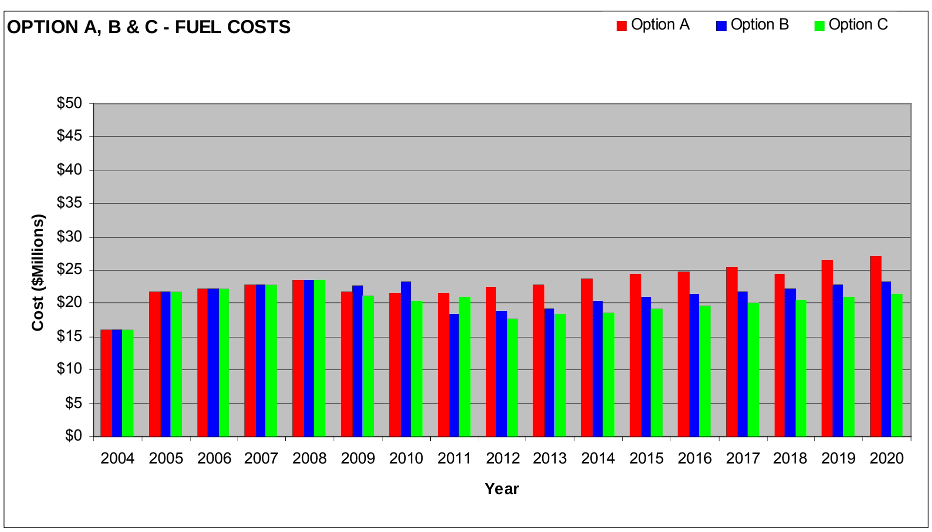




Operational Cost Summary







Conclusions

Strategic modeling and the ensuing analysis provides more than a monetized comparison of fleet renewal options. The process of building the model required Marine Atlantic to bring to light a large amount of historical data that contained the essence of the model results and ultimately these conclusions. The modeling exercise was in fact the vehicle for gathering, culling and analyzing the copious amount of data Marine Atlantic had already accumulated. The information provided by assessing the historical data provided some insight into the issues surrounding the existing fleet. Fleetway is confident that the data provided can assist Marine Atlantic in determining the future of the fleet.

The conclusion provides a general discussion on the concepts tested in each option followed by a discussion on the impact of the three underlying assumptions noted in the background and finally a discussion on the possible reasons behind the results as presented.

Concepts Tested

Operational Costs: The analysis is interesting in that revenue does not vary annually between options as long as demand is met. When this is juxtaposed with MAI's primary mandate which is to meet the demand, it is obvious that revenue is fixed and all discussion must focus on cost reduction.

Charter vs. Buy Options : Earlier studies also explored the benefits of charter over purchase for a new ROPAX. The charter option has short-term advantages to MAI in that capacity can be increased without incurring a large debt load. This would suggest that there is a potential benefit in pursuing a charter over a short term. This must be weighed carefully against the inherent risks.

Top Scorers : From this analysis it can be seen that there are significant benefits in retiring existing assets and acquiring new ones. The benefits can be summarized as : reduced operating costs, improved reliability and availability.

The message is a strong one – Marine Atlantic must acquire new tonnage to meet demand and must retire existing tonnage to reduce expenses.

The Three Fundamental Assumptions and their Impact on the Results

To re-cap, the three assumptions were :

The nature of the traffic demand will require vessels with high lane-metre to passenger ratios (LnM/PAX). This is due to the level of commercial traffic and the low level of passenger traffic for 50% of the year;
Passenger (PAX) traffic increases will occur during the period mid-June through mid-September, and;
Commercial tractor trailer (TT) and drop trailer (DT) traffic will continue to increase given the strong economic outlook for Newfoundland and Labrador.

Their impact is as follows :

Nature of Traffic – The make-up of the traffic demand requires large vessels capable of carrying significant cargo weight with relatively small passenger requirements compared to vessels in similar European services. This makes the purchase and/or charter of existing tonnage a difficult proposition as suitable vessels are in very short supply. The speed and turn-around time of the fleet is also critical due to the limited terminal capacity and the volume of vehicle traffic that needs to be processed.
PAX Traffic Seasonal Variation – The high PAX/AEU traffic demand in the summer months (with additional peaks at each weekend) makes it difficult to efficiently tune the fleet for the demand on an annual basis. A fleet with a larger number of small vessels can capitalize on putting more vessels in "cold storage" than a fleet with a small number of large vessels.
Traffic Growth Trends – The predicted growth in traffic demand coupled with MAI's primary mandate to carry the traffic that arrives at the terminals makes any Status Quo option untenable. MAI must either increase the number of vessels in their fleet or improve the overall fleet capacity. Other options fail on too many criteria to be considered viable alternatives.

Possible Reasons for the Returned Results

The fleet has evolved over time and adapted to the traffic demand. All of the existing vessels provide an important contribution to meeting this demand. The two least efficient assets are the Leif Ericson and the Atlantic Freighter. Both are less than ideal choices for the route for the following reasons :

Leif Ericson : The vessel is not well suited to meet the rigors of the environment that it needs to operate in. This can best be demonstrated through Marine Atlantic's own reluctance to operate the vessel during the winter, the very time that operating a smaller vessel would make the greatest economic sense in light of the reduced traffic demand.

Atlantic Freighter : The vessel has the capability of providing dedicated service for commercial traffic. Unfortunately due to the slow transit speed and the long terminal times brought on by the stern-only loading geometry of the vessel, the ship has not realized its full potential.

The fleet inefficiencies caused by these two vessels combined with the age of all of the assets paints a relatively easy picture to comprehend. Marine Atlantic may have focused on short-term solutions to long-term problems ultimately placing themselves in a situation where they must make significant changes to the fleet to make any appreciable difference in the current trend of ever-increasing operating costs.

General Observations

The existing fleet is aging resulting in a gradual decline in dependability, increased maintenance costs, downward trend of machinery efficiency and of course, a general lack of new technology that could reduce operational costs.

The service Marine Atlantic is engaged in is unique in the world. The combination of route environment and traffic mix do not match any other service. The closest match is clearly the North Sea and longer Baltic routes. As a result of this, the most efficient vessels in the fleet are vessels that were designed specifically for the route (i.e.: Caribou & Smallwood). The purchased vessels do not perform as well in terms of Revenue as a percent of Operating Expenses (Rev/OP Exp) as the custom vessels. The purchased vessels also suffer from operational restrictions due to either capacity or capability to function in the given environment.

Vessel	Utilization	Rev/Op Exp
Caribou[1]	80%	106%
Smallwood[1]	80%	113%
Leif Ericson[2]	80%	90%
Option C New ROPAX[3]	80%	165%

1 : Old North American design
2 : Current European design
3 : Proposed North American design

Recommendations

Marine Atlantic will need to develop corporate strategies similar to successful European operators such as DFDS in Denmark whose target fleet age is between 10 and 20 years depending on the service (http://www.dfdsseaways.co.uk/DFDSGROUP/EN/Presentation/BusinessStrategy/). The financial rational for such a strategy can be seen by studying the Marine Atlantic's Strategic Model results, the proof of its validity is in the success of companies like DFDS.

Fleet renewal needs to be approached from a corporate point of view rather than at a vessel level. This means that instead of looking at the cost/benefits of replacing one vessel with another; Marine Atlantic should focus on what their long-term fleet objectives are and then concentrate on achieving those goals through an aggressive schedule and budget based on facts won through study and analysis not speculation. This will open the possibility of adopting fleet-wide renewal options and new opportunities for scheduling that may not have been previously considered due to the limitations of the existing assets.

Ultimately, Marine Atlantic will need to replace every vessel in their fleet.
This is an indisputable fact.

The only real questions are when and with what.

Glossary

AEU	**A**utomotive **E**quivalent **U**nit. This is a method of relating the carrying capacity of cargo deck space to standardized vehicles. Typically 5.34m long by 2.5m wide. It is important to recognize that the AEU is a theoretical unit based loosely on a Volkswagen Golf. The AEU accounts for the fact that passenger vehicles (PRV's) can be stowed closer together than commercial vehicles (CRV's) as they are narrower. Deck markings and Standard Operating Procedures (SOP's) need to reflect this in order to truly capitalize on the higher stowage rate as commercial vehicles require a minimum 3.0m of lane width.
AF	M.V. **A**tlantic **F**reighter
ARG	**Arg**entia, Newfoundland
CAR	M.V. **Car**ibou
CRV	Commercial Vehicle
DT	**D**rop **T**railer. The trailer portion is dropped off at the departure terminal. The carrier (Marine Atlantic) moves the DT onto the vessel using Yarding Tractors; small very manoeuvrable trucks fitted with hydraulic fifth wheels. Upon arrival other Yarding Tractors unload the vessel to the marshalling yard where they await pick-up. Typically 15.24 m. long.
DWT	**D**eadweigh**t**. Displacement - Lightship = Deadweight The portion of the vessels total weight (Displacement) that is made up of everything not part of the vessel itself (Lightship). This includes all the liquid in the tanks, vehicles, passengers, crew, provisions, spares, etc.
FMEA	**F**ailure **M**odes and **E**ffects **A**nalysis. An analytical process used extensively in other transportation industries, the offshore industry and the military. The process involves tracking the effects of a point failure through a particular system to determine any critical failure points.
kW	Kilowatt. One thousand watts. Metric unit of measure for power. BHP x 0.746 = kW
Link-Span	The shore ramps that link the vehicle decks with the terminal. The ramps are adjustable to account for changes in tide and vessel draft.
LnM	**L**a**n**e **M**etres. Unit of measure for vehicle decks. Lane-metres are always measured on standard 2.50 m. lane widths.
LE	M.V. **L**eif **E**ricson
LOA	**L**ength **O**ver **A**ll. Refers to the maximum length of a vessel in its normal operating

configuration.

MAI — **M**arine **A**tlantic **I**ncorporated

NS — **N**orth **S**ydney, Nova Scotia

PAB — **P**ort **A**ux **B**asques, Newfoundland

PAX — Passenger(s). Used across travel industry, origin unknown.

PRV — Passenger Vehicle

PWP — **Pl**anned **W**ork **P**eriod. Vessels are removed from service during periods of reduced demand to facilitate maintenance and repair. This differs from refits in terms of the scope of the work carried out and the time frame of the work.

RAM — **R**eliability, **A**vailability**,** **M**aintainability. The basic concepts used to describe the ability of a system or vessel to meet its design objectives through its service life.

ROPAX — **R**oll **O**n **PAX**. This acronym is used for commercial vessels that load cargo over stern and/or bow ramps. They carry a large number of passengers, usually based on the number of AEU's the vessel can carry plus an allowance for walk-on traffic. The vessels range from day ferries with no dining facilities or overnight accommodations to cruise ferries that have a full complement of services.

RORO — **R**oll **O**n **R**oll **O**ff. This acronym is used for commercial vessels that load cargo over stern ramps. Traffic is backed on and driven off. They are limited to a maximum of 12 passengers by Transport Canada. Higher loading/discharge efficiency can be achieved by using bow and stern ramps which allows the traffic to drive on and drive off. Occasionally referred to as a PCTC : Pure Car Truck Carrier or PCC : Pure Car Carrier if the load type is specialized.

SML — M.V. Joseph & Clara Smallwood

SOP — **S**tandard **O**perating **P**rocedure. The rules that govern the operational aspects of everything from ticketing to emergency procedures. The SOP's contain the decision matrix for efficiently and safely operating the fleet in a consistent manner.

TT — **T**ractor **T**railers. Highway semi-trailer units. They can be up to 24.4m long and require 3.00 m. of lane width. Typically 21.24m. long.

ANNEX A

A Review of Asset Features

Vessel features found to directly and/or indirectly affect the fiscal performance of the fleet have been noted below for information :

- Capacity to load/unload off of the high and low level link-span (shore ramp) simultaneously
- Internal ramp(s) to facilitate loading the upper vehicle deck in Argentia
- Drive-on Drive-off capability to reduce loading time (i.e.: no backing on ROPAX)
- Sufficient displacement and stability to carry an all commercial vehicle load on both vehicle decks (Caribou & Smallwood are both DWT and Stability limited now)

- Ice strengthening of hull and all appendages
- Good seakeeping qualities (passenger comfort criteria)
- Ability to back into an ice infested terminal without damaging appendages
- Ability to occasionally negotiate heavy 100% ice cover when entering the harbour
- Adequately sized bow/stern thrusters to manoeuvre in Port aux Basques

- Simple, robust, easily maintained systems
- Redundancy in service critical systems (ex: propulsion, thrusters, water, heating, etc)

- Adequate seating for the entire PAX capacity.
- Unadorned dining and snack facilities
- Comfortable and robust seating with additional space for carry-on bags
- Unadorned, yet comfortable passenger cabins
- Video (movie) lounges
- “Rent-a-bunk” facilities
- In service information systems (ex: PA & info screens) that include special needs passengers.

Full regulatory compliance has been assumed as a prerequisite and has not been further addressed in this list.

ANNEX B

Maintenance, Crewing, and Fuel Costs Approach and Assumptions

Maintenance – Approach to Costs

Maintenance costs used in the financial analysis of options have been developed based on extensive analysis of MAI in-service maintenance costs for existing vessels. This analysis evaluated different approaches to predicting future maintenance costs for existing, and newbuild vessels.

Areas addressed included the analysis of cost data against different vessel parameters to determine the best correlation between these functions. Correlations evaluated included those between costs and

- Gross Register Tonnage (GRT)
- Lane-Metres (LnM)
- Power (kW)
- Vessel Age
- Number of Passengers (PAX)

Since age is of primary importance to the cost of maintenance, each category was plotted against age to determine the best correlation. Of the combinations reviewed, the relationship between $/GRT/LnM versus Age provided the best correlation with existing vessels, other than the Leif Ericson. This vessel proved to be unique in its maintenance costs and did not correlate well with the other vessels in the fleet, and was therefore excluded from trend lines for maintenance predictions. This likely reflects the recent purchase of the vessel, additional maintenance required upon vessel purchase to bring it into the fleet, and limited historical data.

Figure B.1 provides a graphical representation of operations maintenance costs for the four existing vessels in MAI's fleet. Figure B.2 indicates an improved correlation when maintenance costs are plotted as a function of vessel age.

Figures B.4 and B.5 represent the algorithms used to predict maintenance costs for the model. When compared with actual values over the period between 1995 and 2004 for the existing fleet, overall predicted values compare favourably with actual values, with predicted values within 2½% of actual when excluding the Leif Ericson in the analysis, and within 5½% when including the Leif Ericson. These differences are considered well within the accuracy of this analysis and fairly represent expected maintenance costs for the options evaluated.

Though it is recognized that maintenance costs fluctuate significantly year-to-year for specific vessels, the data provided by MAI cannot be reconciled to specific trends reflecting the usual 5-year / 2-3 year docking periods. To this end, given the intent to predict long-term financial implications of options in lieu of costs in a specific year, the approach used is deemed best suited to the analysis.

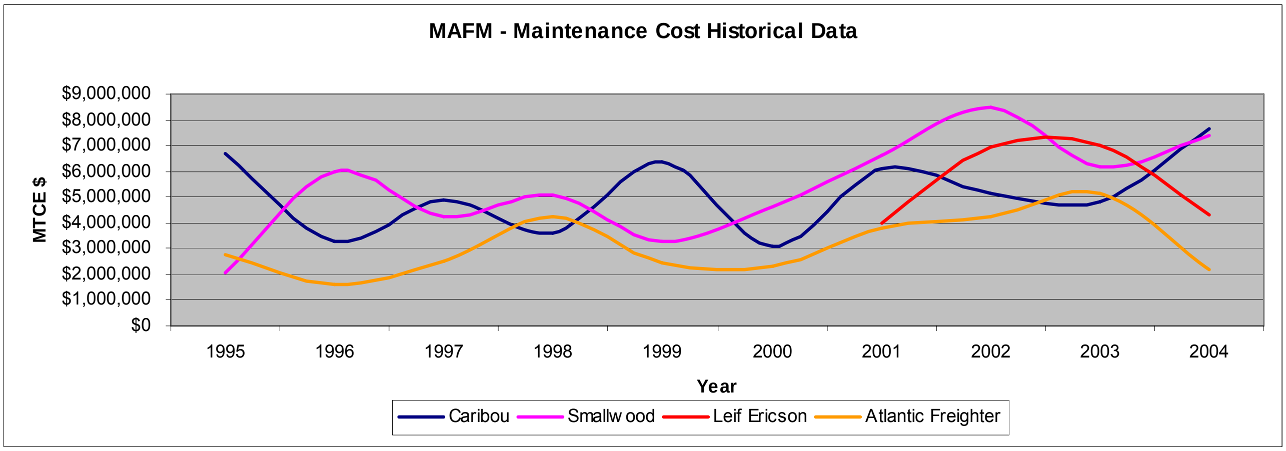


Figure B.1 - Vessel Maintenance Costs versus Year

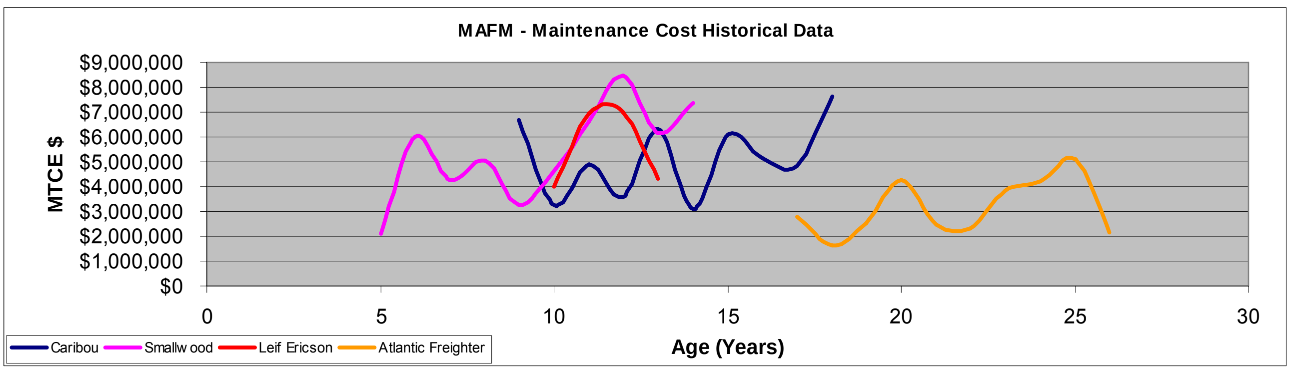


Figure B.2 - Vessel Maintenance Costs versus Vessel Age

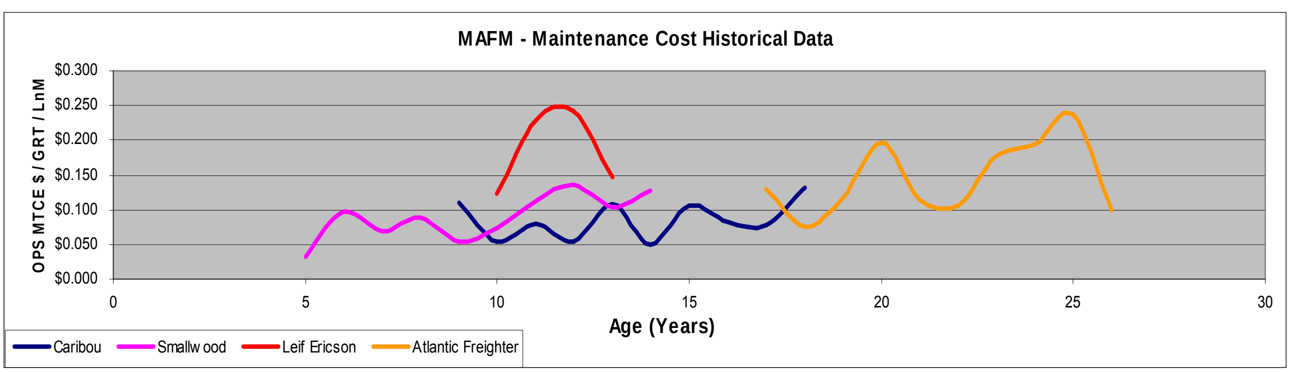


Figure B.3 - Vessel Maintenance Costs ($/GRT/LnM) versus Vessel Age

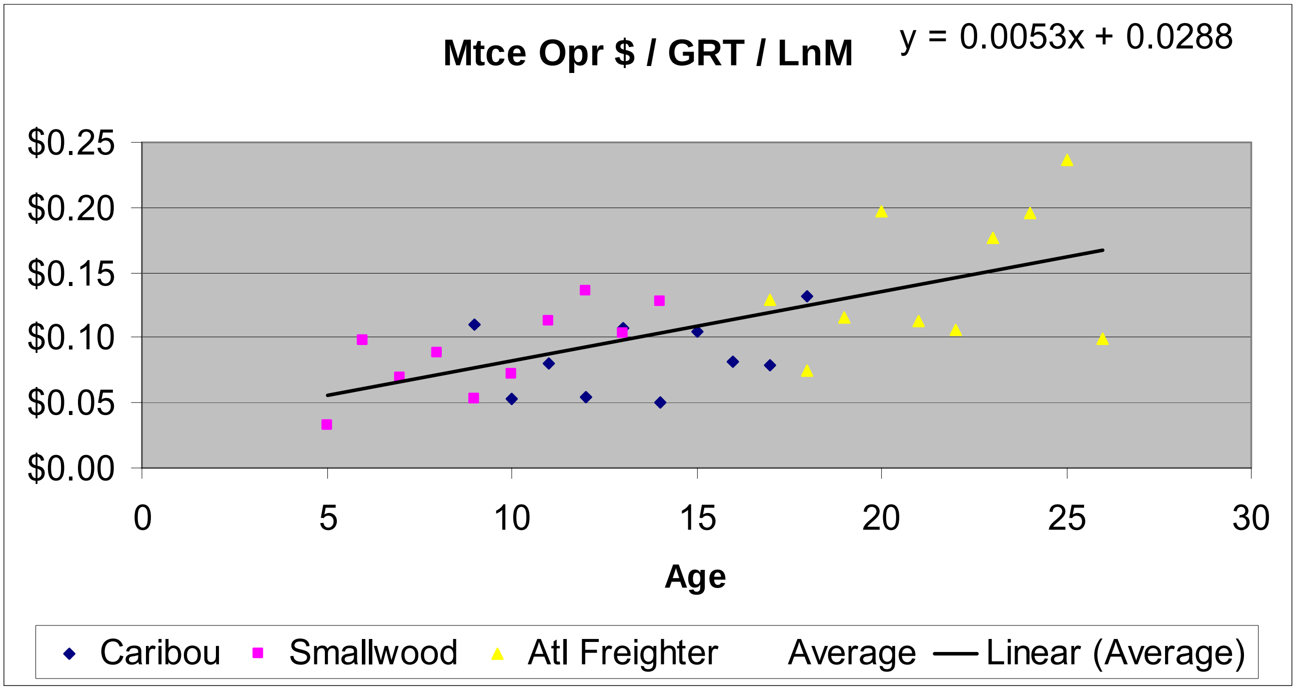


Figure B.4 – Predicted Vessel Maintenance Costs – Operations (\$/GRT/LnM) versus Age

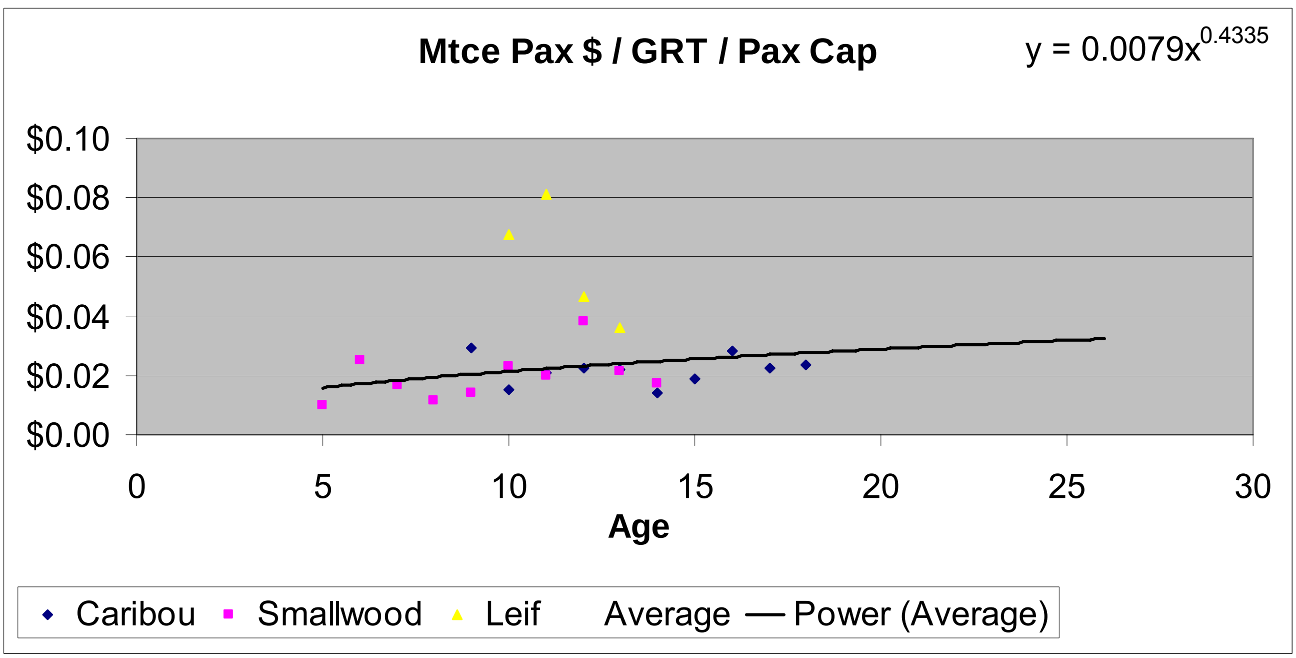


Figure B.5 – Predicted Vessel Maintenance Costs – PAX (\$/GRT/Pax Cap) versus Age

Maintenance – Costs

Figures B.6 through B.8 below summarize maintenance costs for each of the three options investigated. S1 through S8 represent ships 1 through 8 used in the option analysis. Other designators reflect the following for each option below:

AFO	: Atlantic Freighter
CARBU	: Caribou
SMALL	: Joseph and Clara Smallwood
LEIF	: Leif Ericson
N0RPX	: New ROPAX No.0
N1RPX	: New ROPAX No.1
N2RPX	: New ROPAX No.2
N3RPX	: New ROPAX No.3
C1RPX	: Charter ROPAX No.1

All costs shown are in Millions of Dollars and exclude crew labour, which is accounted for separately in crew costs.

OPTION A	S1	S2	S3	S4	S5	S6	S7	S8	
Maintenance Costs	**AF0**		**CARBU**	**SMALL**	**LEIF**	**C1RPX**	**N2RPX**	**N3RPX**	
2004	$ 2.820		$ 6.815	$ 5.672	$ 2.555	$ -	$ -	$ -	**$ 17.862**
2005	$ 2.979		$ 7.289	$ 6.130	$ 2.745	$ -	$ -	$ -	**$ 19.143**
2006	$ 3.132		$ 7.778	$ 6.603	$ 2.947	$ -	$ -	$ -	**$ 20.459**
2007	$ 3.291		$ 8.282	$ 7.091	$ 3.140	$ -	$ -	$ -	**$ 21.804**
2008	$ 3.455		$ 8.802	$ 7.594	$ 3.334	$ -	$ -	$ -	**$ 23.186**
2009	$ -		$ 9.339	$ 8.114	$ 3.571	$ -	$ 2.082	$ -	**$ 23.107**
2010	$ -		$ -	$ 8.651	$ 3.781	$ 5.577	$ 2.744	$ -	**$ 20.753**
2011	$ -		$ 6.923	$ -	$ 4.023	$ 6.244	$ 3.268	$ -	**$ 20.458**
2012	$ -		$ 7.448	$ 6.091	$ 4.250	$ -	$ 3.819	$ -	**$ 21.608**
2013	$ -		$ 7.989	$ 6.614	$ 4.486	$ -	$ 4.361	$ -	**$ 23.451**
2014	$ -		$ 8.548	$ 7.155	$ -	$ -	$ 4.984	$ 2.284	**$ 22.971**
2015	$ -		$ 9.126	$ 7.713	$ -	$ -	$ 5.691	$ 3.022	**$ 25.551**
2016	$ -		$ 9.721	$ 8.289	$ -	$ -	$ 6.420	$ 3.615	**$ 28.044**
2017	$ -		$ 10.336	$ 8.884	$ -	$ -	$ 7.170	$ 4.190	**$ 30.580**
2018	$ -		$ 10.970	$ 9.498	$ -	$ -	$ 7.945	$ 4.857	**$ 33.270**
2019	$ -		$ 11.625	$ 10.132	$ -	$ -	$ 8.744	$ 5.617	**$ 36.118**
2020	$ -		$ 12.301	$ 10.786	$ -	$ -	$ 9.569	$ 6.398	**$ 39.054**
	$ 15.678	**$ -**	**$ 143.294**	**$ 125.016**	**$ 34.833**	**$ 11.821**	**$ 66.796**	**$ 29.982**	**$ 427.419**
									$ 25.142

Figure B.6 - Maintenance Costs - Option A

OPTION B	S1	S2	S3	S4	S5	S6	S7	S8	
Maintenance Costs	AF0		CARBU	SMALL	LEIF	N1RPX	N2RPX	N3RPX	
2004	$ 2.820		$ 6.815	$ 5.672	$ 2.555	$ -	$ -	$ -	**$ 17.862**
2005	$ 2.979		$ 7.289	$ 6.130	$ 2.745	$ -	$ -	$ -	**$ 19.143**
2006	$ 3.132		$ 7.778	$ 6.603	$ 2.947	$ -	$ -	$ -	**$ 20.459**
2007	$ 3.291		$ 8.282	$ 7.091	$ 3.140	$ -	$ -	$ -	**$ 21.804**
2008	$ 3.455		$ 8.802	$ 7.594	$ 3.334	$ -	$ -	$ -	**$ 23.186**
2009	$ -		$ 9.339	$ 8.114	$ 3.571	$ 3.104	$ -	$ -	**$ 24.129**
2010	$ -		$ 9.894	$ 8.651	$ 3.781	$ 4.007	$ -	$ -	**$ 26.332**
2011	$ -		$ -	$ -	$ 4.023	$ 4.817	$ 3.214	$ -	**$ 12.054**
2012	$ -		$ -	$ -	$ 4.250	$ 5.773	$ 4.187	$ -	**$ 14.210**
2013	$ -		$ -	$ -	$ 4.486	$ 6.749	$ 5.056	$ -	**$ 16.291**
2014	$ -		$ -	$ -	$ -	$ 7.752	$ 6.051	$ 3.439	**$ 17.241**
2015	$ -		$ -	$ -	$ -	$ 8.784	$ 7.066	$ 4.438	**$ 20.289**
2016	$ -		$ -	$ -	$ -	$ 9.849	$ 8.110	$ 5.432	**$ 23.391**
2017	$ -		$ -	$ -	$ -	$ 10.948	$ 9.184	$ 6.488	**$ 26.620**
2018	$ -		$ -	$ -	$ -	$ 12.083	$ 10.291	$ 7.566	**$ 29.940**
2019	$ -		$ -	$ -	$ -	$ 13.255	$ 11.434	$ 8.673	**$ 33.362**
2020	$ -		$ -	$ -	$ -	$ 14.466	$ 12.615	$ 9.813	**$ 36.894**
	$ 15.678	**$ -**	**$ 58.199**	**$ 49.855**	**$ 34.833**	**$ 101.587**	**$ 77.208**	**$ 45.849**	**$ 383.208**
									$ 22.542

Figure B.7 - Maintenance Costs - Option B

OPTION C	S1	S2	S3	S4	S5	S6	S7	S8	
Maintenance Costs	AF0	N0RPX	CARBU	SMALL	LEIF	N1RPX	N2RPX	N3RPX	
2004	$ 2.820	$ -	$ 6.815	$ 5.672	$ 2.555	$ -	$ -	$ -	**$ 17.862**
2005	$ 2.979	$ -	$ 7.289	$ 6.130	$ 2.745	$ -	$ -	$ -	**$ 19.143**
2006	$ 3.132	$ -	$ 7.778	$ 6.603	$ 2.947	$ -	$ -	$ -	**$ 20.459**
2007	$ 3.291	$ -	$ 8.282	$ 7.091	$ 3.140	$ -	$ -	$ -	**$ 21.804**
2008	$ 3.455	$ -	$ 8.802	$ 7.594	$ 3.334	$ -	$ -	$ -	**$ 23.186**
2009	$ -	$ -	$ 9.339	$ 8.114	$ 3.571	$ -	$ -	$ 1.720	**$ 22.745**
2010	$ -	$ -	$ -	$ 8.651	$ 3.781	$ 1.753	$ -	$ 2.303	**$ 16.487**
2011	$ -	$ -	$ -	$ 9.205	$ 4.023	$ 2.350	$ -	$ 2.758	**$ 18.336**
2012	$ -	$ -	$ -	$ -	$ 4.250	$ 2.826	$ 1.810	$ 3.197	**$ 12.083**
2013	$ -	$ -	$ -	$ -	$ 4.486	$ 3.267	$ 2.443	$ 3.679	**$ 13.874**
2014	$ -	$ 1.902	$ -	$ -	$ -	$ 3.745	$ 2.912	$ 4.149	**$ 12.707**
2015	$ -	$ 2.534	$ -	$ -	$ -	$ 4.206	$ 3.421	$ 4.623	**$ 14.784**
2016	$ -	$ 3.048	$ -	$ -	$ -	$ 4.738	$ 3.892	$ 5.235	**$ 16.913**
2017	$ -	$ 3.536	$ -	$ -	$ -	$ 5.362	$ 4.397	$ 5.866	**$ 19.161**
2018	$ -	$ 4.052	$ -	$ -	$ -	$ 6.005	$ 4.973	$ 6.516	**$ 21.547**
2019	$ -	$ 4.561	$ -	$ -	$ -	$ 6.668	$ 5.623	$ 7.187	**$ 24.039**
2020	$ -	$ 5.219	$ -	$ -	$ -	$ 7.352	$ 6.292	$ 7.879	**$ 26.742**
	$ 15.678	**$ 24.852**	**$ 48.305**	**$ 59.060**	**$ 34.833**	**$ 48.272**	**$ 35.762**	**$ 55.112**	**$ 321.874**
									$ 18.934

Figure B.8 - Maintenance Costs - Option C

Crewing – Approach & Costs

Crewing costs are based on manning requirements from MAI, using dayrates by crew category. Costs are developed based on the dayrates, and the number of days spent each year for specific operations, including normal operating, 24-36 hour standby, 36-48 hour standby, refit, planned work period, and layup. The number of days for each of these activities for each option is provided in Appendix C.

Figures B.9 through B.11 summarize crewing costs for each of the three options presented.

Option A	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**
Number of PAX (Capacity)	**12**		**1000**	**1000**	**500**	**1000**	**1000**	**1000**
Number of Crew (Summer)	**AF0**		**CARBU**	**SMALL**	**LEIF**	**C1RPX**	**N2RPX**	**N3RPX**
Senior Deck	3		4	4	4	4	4	4
Junior Deck	9		15	15	13	15	15	15
Senior ER	3		4	4	3	4	4	4
Junior ER	10		17	17	12	17	17	17
Commissary	4		55	55	38	65	65	65
	29		**95**	**95**	**70**	**105**	**105**	**105**

Option A	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**
Number of Crew (Winter)	**AF0**		**CARBU**	**SMALL**	**LEIF**	**C1RPX**	**N2RPX**	**N3RPX**
Senior Deck	3		4	4	4	4	4	4
Junior Deck	9		15	15	13	15	15	15
Senior ER	3		4	4	3	4	4	4
Junior ER	10		17	17	12	17	17	17
Commissary	2		30	30	21	35	35	35
	27		**70**	**70**	**53**	**75**	**75**	**75**

Option A	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	
Crew Costs	**AF0**		**CARBU**	**SMALL**	**LEIF**	**C1RPX**	**N2RPX**	**N3RPX**	
2004	$ 2.429		$ 10.652	$ 10.652	$ 5.153	$ -	$ -	$ -	**$ 28.885**
2005	$ 2.501		$ 10.971	$ 10.971	$ 5.324	$ -	$ -	$ -	**$ 29.768**
2006	$ 2.585		$ 11.300	$ 11.300	$ 5.500	$ -	$ -	$ -	**$ 30.685**
2007	$ 2.674		$ 11.639	$ 11.639	$ 5.694	$ -	$ -	$ -	**$ 31.647**
2008	$ 2.762		$ 11.989	$ 11.989	$ 5.903	$ -	$ -	$ -	**$ 32.642**
2009	$ -		$ 8.144	$ 12.348	$ 6.079	$ -	$ 12.828	$ -	**$ 39.399**
2010	$ -		$ 2.987	$ 12.719	$ 6.301	$ 4.842	$ 13.442	$ -	**$ 40.291**
2011	$ -		$ 13.100	$ 3.077	$ 6.503	$ 4.987	$ 13.905	$ -	**$ 41.573**
2012	$ -		$ 8.899	$ 13.493	$ 6.741	$ -	$ 14.361	$ -	**$ 43.493**
2013	$ -		$ 9.166	$ 13.898	$ 6.981	$ -	$ 14.858	$ -	**$ 44.903**
2014	$ -		$ 14.315	$ 9.441	$ -	$ -	$ 15.338	$ 9.585	**$ 48.679**
2015	$ -		$ 14.744	$ 9.724	$ -	$ -	$ 10.296	$ 15.614	**$ 50.379**
2016	$ -		$ 10.016	$ 15.187	$ -	$ -	$ 16.273	$ 10.416	**$ 51.891**
2017	$ -		$ 10.316	$ 15.642	$ -	$ -	$ 10.923	$ 16.728	**$ 53.610**
2018	$ -		$ 10.626	$ 10.626	$ -	$ -	$ 17.264	$ 17.264	**$ 55.779**
2019	$ -		$ 16.595	$ 10.945	$ -	$ -	$ 17.781	$ 11.589	**$ 56.910**
2020	$ -		$ 17.093	$ 11.273	$ -	$ -	$ 11.936	$ 18.315	**$ 58.617**
	$ 12.951	**$ -**	**$192.552**	**$194.923**	**$ 60.177**	**$ 9.829**	**$169.207**	**$ 99.511**	**$739.151**
									$ 43.479

Figure B.9 - Manning & Crewing Costs - Option A

Option B	S1	S2	S3	S4	S5	S6	S7	S8
Number of PAX (Capacity)	**12**		**1000**	**1000**	**500**	**1000**	**1000**	**1000**
Number of Crew (Summer)	**AF0**		**CARBU**	**SMALL**	**LEIF**	**N1RPX**	**N2RPX**	**N3RPX**
Senior Deck	3		4	4	4	4	4	4
Junior Deck	9		15	15	13	15	15	15
Senior ER	3		4	4	3	4	4	4
Junior ER	10		17	17	12	17	17	17
Commissary	4		55	55	38	65	65	65
	29		**95**	**95**	**70**	**105**	**105**	**105**

Option B	S1	S2	S3	S4	S5	S6	S7	S8
Number of Crew (Winter)	**AF0**		**CARBU**	**SMALL**	**LEIF**	**N1RPX**	**N2RPX**	**N3RPX**
Senior Deck	3		4	4	4	4	4	4
Junior Deck	9		15	15	13	15	15	15
Senior ER	3		4	4	3	4	4	4
Junior ER	10		17	17	12	17	17	17
Commissary	2		30	30	21	35	35	35
	27		**70**	**70**	**53**	**75**	**75**	**75**

Option B		S1	S2	S3	S4	S5	S6	S7	S8	
Crew Costs		**AF0**		**CARBU**	**SMALL**	**LEIF**	**N1RPX**	**N2RPX**	**N3RPX**	
	2004	$ 2.429		$ 10.652	$ 10.652	$ 5.153	$ -	$ -	$ -	**$ 28.885**
	2005	$ 2.501		$ 10.971	$ 10.971	$ 5.324	$ -	$ -	$ -	**$ 29.768**
	2006	$ 2.585		$ 11.300	$ 11.300	$ 5.500	$ -	$ -	$ -	**$ 30.685**
	2007	$ 2.674		$ 11.639	$ 11.639	$ 5.694	$ -	$ -	$ -	**$ 31.647**
	2008	$ 2.762		$ 11.989	$ 11.989	$ 5.903	$ -	$ -	$ -	**$ 32.642**
	2009	$ -		$ 8.144	$ 12.348	$ 6.079	$ 13.073	$ -	$ -	**$ 39.644**
	2010	$ -		$ 12.719	$ 8.388	$ 6.301	$ 13.571	$ -	$ -	**$ 40.978**
	2011	$ -		$ -	$ -	$ 6.503	$ 14.037	$ 13.909	$ -	**$ 34.449**
	2012	$ -		$ -	$ -	$ 6.741	$ 14.458	$ 14.389	$ -	**$ 35.588**
	2013	$ -		$ -	$ -	$ 6.981	$ 14.892	$ 14.892	$ -	**$ 36.764**
	2014	$ -		$ -	$ -	$ -	$ 9.996	$ 15.338	$ 15.190	**$ 40.525**
	2015	$ -		$ -	$ -	$ -	$ 15.799	$ 10.296	$ 15.759	**$ 41.854**
	2016	$ -		$ -	$ -	$ -	$ 16.273	$ 16.273	$ 10.605	**$ 43.150**
	2017	$ -		$ -	$ -	$ -	$ 10.923	$ 16.761	$ 16.761	**$ 44.445**
	2018	$ -		$ -	$ -	$ -	$ 17.264	$ 11.251	$ 17.264	**$ 45.778**
	2019	$ -		$ -	$ -	$ -	$ 17.781	$ 17.781	$ 11.589	**$ 47.152**
	2020	$ -		$ -	$ -	$ -	$ 11.936	$ 18.315	$ 18.315	**$ 48.566**
		$ 12.951	**$ -**	**$ 77.414**	**$ 77.287**	**$ 60.177**	**$170.003**	**$ 149.205**	**$ 105.482**	**$ 652.519**
										$ 38.383

Figure B.10 - Manning & Crewing Costs - Option B

Option C	S1	S2	S3	S4	S5	S6	S7	S8
Number of PAX (Capacity)	**12**	**1000**	**1000**	**1000**	**500**	**1000**	**1000**	**1000**
Number of Crew (Summer)	**AF0**	**N0RPX**	**CARBU**	**SMALL**	**LEIF**	**N1RPX**	**N2RPX**	**N3RPX**
Senior Deck	3	4	4	4	4	4	4	4
Junior Deck	9	15	15	15	13	15	15	15
Senior ER	3	4	4	4	3	4	4	4
Junior ER	10	17	17	17	12	17	17	17
Commissary	4	65	55	55	38	65	65	65
	29	**105**	**95**	**95**	**70**	**105**	**105**	**105**

Option C	S1	S2	S3	S4	S5	S6	S7	S8
Number of Crew (Winter)	**AF0**	**N0RPX**	**CARBU**	**SMALL**	**LEIF**	**N1RPX**	**N2RPX**	**N3RPX**
Senior Deck	3	4	4	4	4	4	4	4
Junior Deck	9	15	15	15	13	15	15	15
Senior ER	3	4	4	4	3	4	4	4
Junior ER	10	17	17	17	12	17	17	17
Commissary	2	35	30	30	21	35	35	35
	27	**75**	**70**	**70**	**53**	**75**	**75**	**75**

Option C	S1	S2	S3	S4	S5	S6	S7	S8	
Crew Costs	**AF0**	**N0RPX**	**CARBU**	**SMALL**	**LEIF**	**N1RPX**	**N2RPX**	**N3RPX**	
2004	$ 2.429	$ -	$ 10.652	$ 10.652	$ 5.153	$ -	$ -	$ -	**$ 28.885**
2005	$ 2.501	$ -	$ 10.971	$ 10.971	$ 5.324	$ -	$ -	$ -	**$ 29.768**
2006	$ 2.585	$ -	$ 11.300	$ 11.300	$ 5.500	$ -	$ -	$ -	**$ 30.685**
2007	$ 2.674	$ -	$ 11.639	$ 11.639	$ 5.694	$ -	$ -	$ -	**$ 31.647**
2008	$ 2.762	$ -	$ 11.989	$ 11.989	$ 5.903	$ -	$ -	$ -	**$ 32.642**
2009	$ -	$ -	$ 12.348	$ 8.144	$ 6.079	$ -	$ -	$ 12.784	**$ 39.355**
2010	$ -	$ -	$ -	$ 12.719	$ 6.301	$ 13.170	$ -	$ 8.516	**$ 40.706**
2011	$ -	$ -	$ -	$ 13.100	$ 6.503	$ 8.774	$ -	$ 13.842	**$ 42.220**
2012	$ -	$ -	$ -	$ -	$ 6.741	$ 14.257	$ 14.000	$ 9.203	**$ 44.201**
2013	$ -	$ -	$ -	$ -	$ 6.981	$ 14.752	$ 9.331	$ 14.781	**$ 45.844**
2014	$ -	$ 14.853	$ -	$ -	$ -	$ 9.841	$ 15.164	$ 9.895	**$ 49.753**
2015	$ -	$ 9.923	$ -	$ -	$ -	$ 15.768	$ 10.055	$ 15.799	**$ 51.544**
2016	$ -	$ 16.083	$ -	$ -	$ -	$ 10.605	$ 16.188	$ 10.605	**$ 53.481**
2017	$ -	$ 10.725	$ -	$ -	$ -	$ 16.761	$ 10.866	$ 16.761	**$ 55.112**
2018	$ -	$ 17.186	$ -	$ -	$ -	$ 11.251	$ 17.264	$ 11.251	**$ 56.952**
2019	$ -	$ 11.589	$ -	$ -	$ -	$ 17.781	$ 11.589	$ 17.781	**$ 58.740**
2020	$ -	$ 18.315	$ -	$ -	$ -	$ 11.936	$ 18.315	$ 11.936	**$ 60.502**
	$ 12.951	**$ 98.674**	**$ 68.899**	**$ 90.514**	**$ 60.177**	**$144.896**	**$122.771**	**$153.154**	**$752.037**
									$ 44.237

Figure B.11 - Manning & Crewing Costs - Option C

Fuel – Approach & Costs

Fuel costs are calculated based on fuel usage, and fuel costs per tonne, with inflation added. Overall costs are based on each vessel's operating profile and power and are based on tonnes of fuel per cycle.

Figures B.12 through B.17 summarize fuel costs for Options A, B & C, and provide the number of days spent each year for the different operations.

Option A	S1	S2	S3	S4	S5	S6	S7	S8
Tonnes of Fuel per Cycle	**AF0**		**CARBU**	**SMALL**	**LEIF**	**C1RPX**	**N2RPX**	**N3RPX**
NS-PAB-NS	22.94		41.02	41.02	25.61	38.37	38.37	38.37
NS-ARG-NS	72.10		118.54	118.54	75.99	118.23	118.23	118.23
	95.04		**159.56**	**159.56**	**101.60**	**156.60**	**156.60**	**156.60**

Option A	S1	S2	S3	S4	S5	S6	S7	S8	
Fuel Costs	**AF0**		**CARBU**	**SMALL**	**LEIF**	**C1RPX**	**N2RPX**	**N3RPX**	
2004	$ 1.854		$ 6.245	$ 6.564	$ 1.423	$ -	$ -	$ -	**$ 16.086**
2005	$ 2.704		$ 8.410	$ 8.777	$ 1.915	$ -	$ -	$ -	**$ 21.805**
2006	$ 2.790		$ 8.606	$ 8.970	$ 1.957	$ -	$ -	$ -	**$ 22.323**
2007	$ 2.879		$ 8.830	$ 9.185	$ 2.002	$ -	$ -	$ -	**$ 22.897**
2008	$ 2.981		$ 9.071	$ 9.404	$ 2.046	$ -	$ -	$ -	**$ 23.502**
2009	$ -		$ 3.472	$ 9.628	$ 2.095	$ -	$ 6.533	$ -	**$ 21.729**
2010	$ -		$ 1.634	$ 9.853	$ 2.145	$ 1.267	$ 6.697	$ -	**$ 21.596**
2011	$ -		$ 8.994	$ 1.925	$ 2.196	$ 1.623	$ 6.858	$ -	**$ 21.597**
2012	$ -		$ 3.431	$ 9.703	$ 2.248	$ -	$ 7.017	$ -	**$ 22.399**
2013	$ -		$ 3.511	$ 9.937	$ 2.306	$ -	$ 7.175	$ -	**$ 22.929**
2014	$ -		$ 9.635	$ 4.136	$ -	$ -	$ 7.332	$ 2.687	**$ 23.790**
2015	$ -		$ 9.847	$ 4.229	$ -	$ -	$ 2.790	$ 7.394	**$ 24.259**
2016	$ -		$ 3.747	$ 10.624	$ -	$ -	$ 7.657	$ 2.821	**$ 24.849**
2017	$ -		$ 3.831	$ 10.851	$ -	$ -	$ 2.917	$ 7.747	**$ 25.346**
2018	$ -		$ 3.918	$ 4.513	$ -	$ -	$ 8.017	$ 7.921	**$ 24.370**
2019	$ -		$ 10.767	$ 4.616	$ -	$ -	$ 8.196	$ 3.016	**$ 26.595**
2020	$ -		$ 11.007	$ 4.726	$ -	$ -	$ 3.122	$ 8.268	**$ 27.123**
	$ 13.209	**$ -**	**$ 114.956**	**$ 127.641**	**$ 20.334**	**$ 2.890**	**$ 74.311**	**$ 39.854**	**$ 393.195**
									$ 23.129

Option A	S1	S2	S3	S4	S5	S6	S7	S8	
Operating Days (Summer)	**AF0**		**CARBU**	**SMALL**	**LEIF**	**C1RPX**	**N2RPX**	**N3RPX**	
2004	116		116	116	116	0	0	0	**462**
2005	116		116	116	116	0	0	0	**462**
2006	116		116	116	116	0	0	0	**462**
2007	116		116	116	116	0	0	0	**462**
2008	116		116	116	116	0	0	0	**462**
2009	0		116	116	116	0	116	0	**462**
2010	0		58	116	116	58	116	0	**462**
2011	0		116	58	116	58	116	0	**462**
2012	0		116	116	116	0	116	0	**462**
2013	0		116	116	116	0	116	0	**462**
2014	0		116	116	0	0	116	116	**462**
2015	0		116	116	0	0	116	116	**462**
2016	0		116	116	0	0	116	116	**462**
2017	0		116	116	0	0	116	116	**462**
2018	0		116	116	0	0	116	116	**462**
2019	0		116	116	0	0	116	116	**462**
2020	0		116	116	0	0	116	116	**462**
	578	**0**	**1907**	**1907**	**1156**	**116**	**1387**	**809**	**7860**
									462

Option A	S1	S2	S3	S4	S5	S6	S7	S8	
Operating Days (Winter)	**AF0**		**CARBU**	**SMALL**	**LEIF**	**C1RPX**	**N2RPX**	**N3RPX**	
2004	0		195	195	0	0	0	0	**389**
2005	0		195	195	0	0	0	0	**389**
2006	0		195	195	0	0	0	0	**389**
2007	0		195	195	0	0	0	0	**389**
2008	0		195	195	0	0	0	0	**389**
2009	0		0	195	0	0	195	0	**389**
2010	0		0	195	0	0	195	0	**389**
2011	0		195	0	0	0	195	0	**389**
2012	0		0	195	0	0	195	0	**389**
2013	0		0	195	0	0	195	0	**389**
2014	0		195	0	0	0	195	0	**389**
2015	0		195	0	0	0	0	195	**389**
2016	0		0	195	0	0	195	0	**389**
2017	0		0	195	0	0	0	195	**389**
2018	0		0	0	0	0	195	195	**389**
2019	0		195	0	0	0	195	0	**389**
2020	0		195	0	0	0	0	195	**389**
	0	**0**	**1947**	**2141**	**0**	**0**	**1752**	**779**	**6619**
									389

Figure B.12 - Fuel Costs & Operational Days - Option A

Option B	S1	S2	S3	S4	S5	S6	S7	S8
Tonnes of Fuel per Cycle	AF0		CARBU	SMALL	LEIF	N1RPX	N2RPX	N3RPX
NS-PAB-NS	22.94		41.02	41.02	25.61	43.29	43.29	43.29
NS-ARG-NS	72.10		118.46	118.46	75.92	136.27	136.27	136.27
	95.04		**159.47**	**159.47**	**101.53**	**179.56**	**179.56**	**179.56**

Option B	S1	S2	S3	S4	S5	S6	S7	S8	
Fuel Costs	AF0		CARBU	SMALL	LEIF	N1RPX	N2RPX	N3RPX	
2004	$ 1.854		$ 6.245	$ 6.562	$ 1.423	$ -	$ -	$ -	**$ 16.084**
2005	$ 2.704		$ 8.410	$ 8.775	$ 1.915	$ -	$ -	$ -	**$ 21.803**
2006	$ 2.790		$ 8.606	$ 8.967	$ 1.957	$ -	$ -	$ -	**$ 22.321**
2007	$ 2.879		$ 8.830	$ 9.183	$ 2.002	$ -	$ -	$ -	**$ 22.894**
2008	$ 2.981		$ 9.071	$ 9.401	$ 2.046	$ -	$ -	$ -	**$ 23.500**
2009	$ -		$ 3.472	$ 9.626	$ 2.095	$ 7.397	$ -	$ -	**$ 22.590**
2010	$ -		$ 9.585	$ 4.006	$ 2.145	$ 7.583	$ -	$ -	**$ 23.318**
2011	$ -		$ -	$ -	$ 2.196	$ 7.765	$ 8.463	$ -	**$ 18.425**
2012	$ -		$ -	$ -	$ 2.248	$ 7.945	$ 8.676	$ -	**$ 18.869**
2013	$ -		$ -	$ -	$ 2.306	$ 8.123	$ 8.885	$ -	**$ 19.315**
2014	$ -		$ -	$ -	$ -	$ 3.093	$ 9.091	$ 8.167	**$ 20.350**
2015	$ -		$ -	$ -	$ -	$ 8.479	$ 3.992	$ 8.372	**$ 20.843**
2016	$ -		$ -	$ -	$ -	$ 8.670	$ 9.499	$ 3.194	**$ 21.363**
2017	$ -		$ -	$ -	$ -	$ 3.303	$ 9.702	$ 8.772	**$ 21.777**
2018	$ -		$ -	$ -	$ -	$ 9.078	$ 4.261	$ 8.969	**$ 22.307**
2019	$ -		$ -	$ -	$ -	$ 9.280	$ 10.146	$ 3.415	**$ 22.841**
2020	$ -		$ -	$ -	$ -	$ 3.535	$ 10.387	$ 9.362	**$ 23.283**
	$ 13.209	**$ -**	**$ 54.219**	**$ 56.519**	**$ 20.334**	**$ 84.251**	**$ 83.102**	**$ 50.250**	**$ 361.883**
									$ 21.287

Option B	S1	S2	S3	S4	S5	S6	S7	S8	
Operating Days (Summer)	AF0		CARBU	SMALL	LEIF	N1RPX	N2RPX	N3RPX	
2004	116		116	116	116	0	0	0	**462**
2005	116		116	116	116	0	0	0	**462**
2006	116		116	116	116	0	0	0	**462**
2007	116		116	116	116	0	0	0	**462**
2008	116		116	116	116	0	0	0	**462**
2009	0		116	116	116	116	0	0	**462**
2010	0		116	116	116	116	0	0	**462**
2011	0		0	0	116	116	116	0	**347**
2012	0		0	0	116	116	116	0	**347**
2013	0		0	0	116	116	116	0	**347**
2014	0		0	0	0	116	116	116	**347**
2015	0		0	0	0	116	116	116	**347**
2016	0		0	0	0	116	116	116	**347**
2017	0		0	0	0	116	116	116	**347**
2018	0		0	0	0	116	116	116	**347**
2019	0		0	0	0	116	116	116	**347**
2020	0		0	0	0	116	116	116	**347**
	578	**0**	**809**	**809**	**1156**	**1387**	**1156**	**809**	**6704**
									394

Option B	S1	S2	S3	S4	S5	S6	S7	S8	
Operating Days (Winter)	AF0		CARBU	SMALL	LEIF	N1RPX	N2RPX	N3RPX	
2004	0		195	195	0	0	0	0	**389**
2005	0		195	195	0	0	0	0	**389**
2006	0		195	195	0	0	0	0	**389**
2007	0		195	195	0	0	0	0	**389**
2008	0		195	195	0	0	0	0	**389**
2009	0		0	195	0	195	0	0	**389**
2010	0		195	0	0	195	0	0	**389**
2011	0		0	0	0	195	195	0	**389**
2012	0		0	0	0	195	195	0	**389**
2013	0		0	0	0	195	195	0	**389**
2014	0		0	0	0	0	195	195	**389**
2015	0		0	0	0	195	0	195	**389**
2016	0		0	0	0	195	195	0	**389**
2017	0		0	0	0	0	195	195	**389**
2018	0		0	0	0	195	0	195	**389**
2019	0		0	0	0	195	195	0	**389**
2020	0		0	0	0	0	195	195	**389**
	0	**0**	**1168**	**1168**	**0**	**1752**	**1557**	**973**	**6619**
									389

Figure B.13 - Fuel Costs & Operational Days - Option B

Option C	S1	S2	S3	S4	S5	S6	S7	S8
Tonnes of Fuel per Cycle	**AF0**	**N0RPX**	**CARBU**	**SMALL**	**LEIF**	**N1RPX**	**N2RPX**	**N3RPX**
NS-PAB-NS	22.94	34.69	41.02	41.02	25.61	34.69	34.69	34.69
NS-ARG-NS	72.10	107.50	118.51	118.51	75.98	107.50	107.50	107.50
	95.04	**142.19**	**159.53**	**159.53**	**101.59**	**142.19**	**142.19**	**142.19**

Option C	S1	S2	S3	S4	S5	S6	S7	S8	
Fuel Costs	**AF0**	**N0RPX**	**CARBU**	**SMALL**	**LEIF**	**N1RPX**	**N2RPX**	**N3RPX**	
2004	$ 1.854	$ -	$ 6.245	$ 6.564	$ 1.423	$ -	$ -	$ -	**$ 16.085**
2005	$ 2.704	$ -	$ 8.410	$ 8.776	$ 1.915	$ -	$ -	$ -	**$ 21.804**
2006	$ 2.790	$ -	$ 8.606	$ 8.969	$ 1.957	$ -	$ -	$ -	**$ 22.322**
2007	$ 2.879	$ -	$ 8.830	$ 9.185	$ 2.002	$ -	$ -	$ -	**$ 22.896**
2008	$ 2.981	$ -	$ 9.071	$ 9.403	$ 2.046	$ -	$ -	$ -	**$ 23.502**
2009	$ -	$ -	$ 9.321	$ 3.916	$ 2.095	$ -	$ -	$ 5.912	**$ 21.245**
2010	$ -	$ -	$ -	$ 9.315	$ 2.145	$ 6.608	$ -	$ 2.258	**$ 20.326**
2011	$ -	$ -	$ -	$ 9.558	$ 2.196	$ 2.895	$ -	$ 6.207	**$ 20.856**
2012	$ -	$ -	$ -	$ -	$ 2.248	$ 6.937	$ 6.274	$ 2.366	**$ 17.825**
2013	$ -	$ -	$ -	$ -	$ 2.306	$ 7.097	$ 2.396	$ 6.493	**$ 18.293**
2014	$ -	$ 6.528	$ -	$ -	$ -	$ 3.101	$ 6.587	$ 2.472	**$ 18.688**
2015	$ -	$ 2.493	$ -	$ -	$ -	$ 7.416	$ 2.511	$ 6.778	**$ 19.197**
2016	$ -	$ 6.853	$ -	$ -	$ -	$ 3.237	$ 6.891	$ 2.582	**$ 19.563**
2017	$ -	$ 2.612	$ -	$ -	$ -	$ 7.745	$ 2.624	$ 7.087	**$ 20.068**
2018	$ -	$ 7.169	$ -	$ -	$ -	$ 3.385	$ 7.192	$ 2.703	**$ 20.450**
2019	$ -	$ 2.730	$ -	$ -	$ -	$ 8.109	$ 2.740	$ 7.418	**$ 20.996**
2020	$ -	$ 7.483	$ -	$ -	$ -	$ 3.543	$ 7.521	$ 2.825	**$ 21.372**
	$ 13.209	**$ 35.868**	**$ 50.482**	**$ 65.685**	**$ 20.334**	**$ 60.072**	**$ 44.736**	**$ 55.102**	**$ 345.488**
									$ 20.323

Option C	S1	S2	S3	S4	S5	S6	S7	S8	
Operating Days (Summer)	**AF0**	**N0RPX**	**CARBU**	**SMALL**	**LEIF**	**N1RPX**	**N2RPX**	**N3RPX**	
2004	116	0	116	116	116	0	0	0	**462**
2005	116	0	116	116	116	0	0	0	**462**
2006	116	0	116	116	116	0	0	0	**462**
2007	116	0	116	116	116	0	0	0	**462**
2008	116	0	116	116	116	0	0	0	**462**
2009	0	0	116	116	116	0	0	116	**462**
2010	0	0	0	116	116	116	0	116	**462**
2011	0	0	0	116	116	116	0	116	**462**
2012	0	0	0	0	116	116	116	116	**462**
2013	0	0	0	0	116	116	116	116	**462**
2014	0	116	0	0	0	116	116	116	**462**
2015	0	116	0	0	0	116	116	116	**462**
2016	0	116	0	0	0	116	116	116	**462**
2017	0	116	0	0	0	116	116	116	**462**
2018	0	116	0	0	0	116	116	116	**462**
2019	0	116	0	0	0	116	116	116	**462**
2020	0	116	0	0	0	116	116	116	**462**
	578	**809**	**694**	**925**	**1156**	**1271**	**1040**	**1387**	**7860**
									462

Option C	S1	S2	S3	S4	S5	S6	S7	S8	
Operating Days (Winter)	**AF0**	**N0RPX**	**CARBU**	**SMALL**	**LEIF**	**N1RPX**	**N2RPX**	**N3RPX**	
2004	0	0	195	195	0	0	0	0	**389**
2005	0	0	195	195	0	0	0	0	**389**
2006	0	0	195	195	0	0	0	0	**389**
2007	0	0	195	195	0	0	0	0	**389**
2008	0	0	195	195	0	0	0	0	**389**
2009	0	0	195	0	0	0	0	195	**389**
2010	0	0	0	195	0	195	0	0	**389**
2011	0	0	0	195	0	0	0	195	**389**
2012	0	0	0	0	0	195	195	0	**389**
2013	0	0	0	0	0	195	0	195	**389**
2014	0	195	0	0	0	0	195	0	**389**
2015	0	0	0	0	0	195	0	195	**389**
2016	0	195	0	0	0	0	195	0	**389**
2017	0	0	0	0	0	195	0	195	**389**
2018	0	195	0	0	0	0	195	0	**389**
2019	0	0	0	0	0	195	0	195	**389**
2020	0	195	0	0	0	0	195	0	**389**
	0	**779**	**1168**	**1363**	**0**	**1168**	**973**	**1168**	**6619**
									389

Figure B.14 - Fuel Costs & Operational Days - Option C

Option A	S1	S2	S3	S4	S5	S6	S7	S8	
Layup Days	AF0		CARBU	SMALL	LEIF	C1RPX	N2RPX	N3RPX	
2004	176		0	0	176	0	0	0	352
2005	175		0	0	175	0	0	0	350
2006	173		0	0	173	0	0	0	346
2007	172		0	0	172	0	0	0	344
2008	171		0	0	169	0	0	0	340
2009	0		156	0	168	0	25	0	349
2010	0		0	0	165	203	0	0	368
2011	0		0	0	164	203	0	0	367
2012	0		156	0	161	0	0	0	317
2013	0		156	0	159	0	0	0	315
2014	0		0	156	0	0	0	178	334
2015	0		0	156	0	0	156	0	312
2016	0		156	0	0	0	0	165	321
2017	0		156	0	0	0	156	0	312
2018	0		156	156	0	0	0	0	312
2019	0		0	156	0	0	0	156	312
2020	0		0	156	0	0	156	0	312
	867	0	936	780	1682	406	493	499	5663
									333

Option A	S1	S2	S3	S4	S5	S6	S7	S8	
Operating Standby Days	AF0		CARBU	SMALL	LEIF	C1RPX	N2RPX	N3RPX	
2004	43		1	1	44	0	0	0	89
2005	43		1	1	43	0	0	0	88
2006	43		1	1	43	0	0	0	88
2007	43		1	1	42	0	0	0	87
2008	42		1	1	42	0	0	0	86
2009	0		39	1	41	0	6	0	87
2010	0		30	1	41	50	23	0	146
2011	0		1	30	40	50	16	0	138
2012	0		39	1	40	0	10	0	90
2013	0		39	1	39	0	4	0	83
2014	0		1	39	0	0	1	44	85
2015	0		1	39	0	0	39	19	98
2016	0		39	1	0	0	1	41	82
2017	0		39	1	0	0	39	5	84
2018	0		39	39	0	0	1	1	80
2019	0		1	39	0	0	1	39	80
2020	0		1	39	0	0	39	1	80
	216	0	274	236	419	100	179	150	1575
									93

Option A	S1	S2	S3	S4	S5	S6	S7	S8	
Refit / Maintenance Days	AF0		CARBU	SMALL	LEIF	C1RPX	N2RPX	N3RPX	
2004	30		54	54	29	0	0	0	167
2005	31		54	54	31	0	0	0	170
2006	33		54	54	33	0	0	0	174
2007	34		54	54	35	0	0	0	177
2008	36		54	54	38	0	0	0	182
2009	0		54	54	40	0	24	0	172
2010	0		277	54	43	54	32	0	460
2011	0		54	277	45	54	39	0	469
2012	0		54	54	48	0	45	0	201
2013	0		54	54	51	0	51	0	210
2014	0		54	54	0	0	54	27	189
2015	0		54	54	0	0	54	36	198
2016	0		54	54	0	0	54	43	205
2017	0		54	54	0	0	54	50	212
2018	0		54	54	0	0	54	54	216
2019	0		54	54	0	0	54	54	216
2020	0		54	54	0	0	54	54	216
	164	0	1141	1141	393	108	569	318	3834
									226

Figure B.15 - Layup, Standby & Maintenance Days - Option A

Option B	S1	S2	S3	S4	S5	S6	S7	S8	
Layup Days	AF0		CARBU	SMALL	LEIF	N1RPX	N2RPX	N3RPX	
2004	176		0	0	176	0	0	0	352
2005	175		0	0	175	0	0	0	350
2006	173		0	0	173	0	0	0	346
2007	172		0	0	172	0	0	0	344
2008	171		0	0	169	0	0	0	340
2009	0		156	0	168	0	0	0	324
2010	0		0	156	165	0	0	0	321
2011	0		0	0	164	0	0	0	164
2012	0		0	0	161	0	0	0	161
2013	0		0	0	159	0	0	0	159
2014	0		0	0	0	156	0	0	156
2015	0		0	0	0	0	156	0	156
2016	0		0	0	0	0	0	156	156
2017	0		0	0	0	156	0	0	156
2018	0		0	0	0	0	156	0	156
2019	0		0	0	0	0	0	156	156
2020	0		0	0	0	156	0	0	156
	867	**0**	**156**	**156**	**1682**	**468**	**312**	**312**	**3953**
									233

Option B	S1	S2	S3	S4	S5	S6	S7	S8	
Operating Standby Days	AF0		CARBU	SMALL	LEIF	N1RPX	N2RPX	N3RPX	
2004	43		1	1	44	0	0	0	89
2005	43		1	1	43	0	0	0	88
2006	43		1	1	43	0	0	0	88
2007	43		1	1	42	0	0	0	87
2008	42		1	1	42	0	0	0	86
2009	0		39	1	41	18	0	0	99
2010	0		1	39	41	8	0	0	89
2011	0		0	0	40	1	17	0	58
2012	0		0	0	40	1	6	0	47
2013	0		0	0	39	1	1	0	41
2014	0		0	0	0	39	1	15	55
2015	0		0	0	0	1	39	3	43
2016	0		0	0	0	1	1	39	41
2017	0		0	0	0	39	1	1	41
2018	0		0	0	0	1	39	1	41
2019	0		0	0	0	1	1	39	41
2020	0		0	0	0	39	1	1	41
	216	**0**	**44**	**44**	**419**	**149**	**106**	**99**	**1077**
									63

Option B	S1	S2	S3	S4	S5	S6	S7	S8	
Refit / Maintenance Days	AF0		CARBU	SMALL	LEIF	N1RPX	N2RPX	N3RPX	
2004	30		54	54	29	0	0	0	167
2005	31		54	54	31	0	0	0	170
2006	33		54	54	33	0	0	0	174
2007	34		54	54	35	0	0	0	177
2008	36		54	54	38	0	0	0	182
2009	0		54	54	40	37	0	0	185
2010	0		54	54	43	47	0	0	198
2011	0		0	0	45	54	38	0	137
2012	0		0	0	48	54	49	0	151
2013	0		0	0	51	54	54	0	159
2014	0		0	0	0	54	54	40	148
2015	0		0	0	0	54	54	52	160
2016	0		0	0	0	54	54	54	162
2017	0		0	0	0	54	54	54	162
2018	0		0	0	0	54	54	54	162
2019	0		0	0	0	54	54	54	162
2020	0		0	0	0	54	54	54	162
	164	**0**	**378**	**378**	**393**	**624**	**519**	**362**	**2818**
									166

Figure B.16 - Layup, Standby & Maintenance Days - Option B

Option C	S1	S2	S3	S4	S5	S6	S7	S8	
Layup Days	**AF0**	**N0RPX**	**CARBU**	**SMALL**	**LEIF**	**N1RPX**	**N2RPX**	**N3RPX**	
2004	176	0	0	0	176	0	0	0	**352**
2005	175	0	0	0	175	0	0	0	**350**
2006	173	0	0	0	173	0	0	0	**346**
2007	172	0	0	0	172	0	0	0	**344**
2008	171	0	0	0	169	0	0	0	**340**
2009	0	0	0	156	168	0	0	28	**352**
2010	0	0	0	0	165	27	0	178	**370**
2011	0	0	0	0	164	177	0	0	**341**
2012	0	0	0	0	161	0	26	169	**356**
2013	0	0	0	0	159	0	176	0	**335**
2014	0	26	0	0	0	164	0	160	**350**
2015	0	176	0	0	0	0	168	0	**344**
2016	0	0	0	0	0	156	0	156	**312**
2017	0	166	0	0	0	0	158	0	**324**
2018	0	0	0	0	0	156	0	156	**312**
2019	0	156	0	0	0	0	156	0	**312**
2020	0	0	0	0	0	156	0	156	**312**
	867	**524**	**0**	**156**	**1682**	**836**	**684**	**1003**	**5752**
									338

Option C	S1	S2	S3	S4	S5	S6	S7	S8	
Operating Standby Days	**AF0**	**N0RPX**	**CARBU**	**SMALL**	**LEIF**	**N1RPX**	**N2RPX**	**N3RPX**	
2004	43	0	1	1	44	0	0	0	**89**
2005	43	0	1	1	43	0	0	0	**88**
2006	43	0	1	1	43	0	0	0	**88**
2007	43	0	1	1	42	0	0	0	**87**
2008	42	0	1	1	42	0	0	0	**86**
2009	0	0	1	39	41	0	0	7	**88**
2010	0	0	0	1	41	7	0	44	**93**
2011	0	0	0	1	40	44	0	22	**107**
2012	0	0	0	0	40	22	7	42	**111**
2013	0	0	0	0	39	16	44	12	**111**
2014	0	7	0	0	0	41	20	40	**108**
2015	0	43	0	0	0	5	41	1	**90**
2016	0	19	0	0	0	39	9	39	**106**
2017	0	41	0	0	0	1	39	1	**82**
2018	0	7	0	0	0	39	1	39	**86**
2019	0	39	0	0	0	1	39	1	**80**
2020	0	1	0	0	0	39	1	39	**80**
	216	**157**	**5**	**45**	**419**	**255**	**201**	**288**	**1586**
									93

Option C	S1	S2	S3	S4	S5	S6	S7	S8	
Refit / Maintenance Days	**AF0**	**N0RPX**	**CARBU**	**SMALL**	**LEIF**	**N1RPX**	**N2RPX**	**N3RPX**	
2004	30	0	54	54	29	0	0	0	**167**
2005	31	0	54	54	31	0	0	0	**170**
2006	33	0	54	54	33	0	0	0	**174**
2007	34	0	54	54	35	0	0	0	**177**
2008	36	0	54	54	38	0	0	0	**182**
2009	0	0	54	54	40	0	0	20	**168**
2010	0	0	0	54	43	21	0	27	**145**
2011	0	0	0	54	45	28	0	33	**160**
2012	0	0	0	0	48	33	22	38	**141**
2013	0	0	0	0	51	39	29	43	**162**
2014	0	22	0	0	0	44	35	49	**150**
2015	0	30	0	0	0	50	40	54	**174**
2016	0	36	0	0	0	54	46	54	**190**
2017	0	42	0	0	0	54	52	54	**202**
2018	0	48	0	0	0	54	54	54	**210**
2019	0	54	0	0	0	54	54	54	**216**
2020	0	54	0	0	0	54	54	54	**216**
	164	**286**	**324**	**432**	**393**	**485**	**386**	**534**	**3004**
									177

Figure B.17 - Layup, Standby & Maintenance Days - Option C

ANNEX C

General Assumptions

Assumptions by Module

Time Module:

- Shore facilities are fixed meaning the number of ramps and the numbers of lanes per ramp are fixed at 2.
- Load rates are based on empirical data provided by MAI.
- All Times are based on Normal operating conditions and do not take into account extreme weather or any other mishaps.
- Transit times are broken down into legs (Harbour, Leg1/Leg3 in/out of Harbour, Leg 2 Transit).
- The Transit time is simply the ships speed multiplied by the distance between PAB and NS. The claimed maximum crossing speed has been reduced by 15% to account for days that the speed would be reduced by weather and/or ice conditions.
- Leg 1 and Leg 3 are from the point the vessel makes its approach into the Harbour to where it starts manoeuvring with thrusters. The speed and distance estimated for this Leg is half the ships speed with a distance of 1.5 Nm. The time it takes to complete the leg when calculated this way corresponds well to the values provided by Marine Atlantic.
- The Harbour portion of the time cycle is not base on speed and distance it is given directly as time based on a time factor. This time Factor is derived from the ship's Manoeuvrability and the harbour in which it has to manoeuvre.
- The Manoeuvring time factor is calculated using a decision matrix, a qualitative value of fast, average or slow is all that is required as input to determine the time factor.
- The Manoeuvring time estimated by the model matches the times provide by Marine Atlantic.
- Ultimately having this manoeuvring scale allows for slight changes in the vessels capability which will have a direct impact on cost of the vessel and it ability to generate revenue.

Crew Module:

- The number of Deck and Engineering crew do not change from winter to summer
- The module assumes a crew complement based on passengers at full capacity.
- Values for crew requirements are derived form historical data.

Fuel/Power Module:

- The fuel module assumes three basic consumers main engine, Gensets and Boilers.
- Values for the *sfc* (Specific Fuel Consumption) are based on empirical data.
- Age and Efficiency of the main engine is estimated and based on good engineering practice.

Insurance Cost Module:

- Charter vessel insurance for Hull & Machinery (H&M), Increased Value (IV), Replacement Tonnage (RT), and War Risks are assumed to be carried by the vessel's owner, and included in the charter costs. Only Protection & Indemnity (P&I) insurance is included in insurance costs for charters. This is calculated based on vessel GRT
- Insurance costs are calculated for 2004 based on current Marine Atlantic Rates, and based on age for insured value, and GRT for RT and P&I, and are adjusted for follow-on years based on inflation, annually reduced insured value, and annually increased RT rates
- Where a vessel undergoes a refit, the cost of the refit is added to the insured value and the rate used is based on the current age of the vessel, less the years of "rejuvenation" obtained from the refit (IO input). This affects H&M insurance, as well as IV. RT is based on GRT and is only affected by annual rate changes

Crew Cost Module:

- Deck and engine crew rates are based on individual dayrates averaged by group for senior and junior personnel. Commissary personnel are averaged for all individual categories. Users may change individual rates in the Global Controls Module and averages will be recalculated
- Dayrates for crew costs for each vessel are based on manning obtained from the crew module (see above) for normal operations. Dayrates for other periods, such as refits, standby, PWP, etc. are based on weighted average percentages of normal operating determined from Marine Atlantic manning data for each type of vessel. Different costs are used in summer and winter, with winter assuming a 50% reduction in commissary crew costs over that for the summer. Deck and engine crew are assumed to remain the same all year.
- Crew costs are calculated based on the number of days for each operation, and the daily crew cost for that operation
- The number of normal operating days is obtained from the IO module for each season. Maintenance days are obtained from the Maintenance Cost Model. Where the number of days remaining after operations and maintenance is less than 30, the vessel is assumed to remain on standby. If greater or equal to 30 days, the vessel is assumed to be laid-up while not operating or in maintenance

Depreciation & Finance Module:

- Depreciation is calculated as 5% per year straight-line starting in the year the ship is acquired using the purchase price
- Financing costs are based on annual payments only, and ignore interest savings from monthly payments. Interest rates are assumed fixed for the amortization period of the loan
- Acquisition or refit cost amounts not financed are assumed as capital expenditures in the year they occur
- Vessel sales are considered negative capital costs in the year of sale, and have not been applied to reduce debt (loan balance when capital expenditures are financed), but are accounted for in the net capital expenditures used in the scorecard

- Shoreside costs have not been considered. Only direct vessel costs.
- Revenues for ancillary services are assumed to be a percentage of the services they support, as noted in the Global Data Module. Similarly, expenses associated with this revenue is considered to be a percentage of the revenue, as calculated from average annual historical costs obtained from Marine Atlantic.

Demand Allocator (DA) Module:

- The summer service factor is not to be greater than 95% in summer and 90% in winter (per Marine Atlantic Instruction)
- Demand must be met for the model to return comparative cost/revenue data.
- The passenger capacity in the winter is assumed to be 50% of that in summer (see also crew cost module)
- The utilization factor is calculated based on demand, and fleet capacity, and assumes that TLTs (Tractorless Trailers) are carried by any ROROs with loads equally distributed on all ROROs in the fleet. If TLT demand exceeds RORO capacity, overflow is evenly distributed over remaining ROPAX vessels
- Though ROROs can carry a limited number of TTs (Tractor Trailers) or AEQs (Automobile Equivalent Units – Passenger Vehicles) due to a limit of 12 passengers on the vessels, the DA Module assumes that only DT traffic will be loaded on a RORO, and that all live traffic will be loaded on a ROPAX. This simplifies the model and will have negligible impact on overall results.
- TT, AEQ, and PAX (Passenger) traffic is equally distributed over all ROPAX vessels operating
- The split of PRVs (Passenger Related Vehicles), TTs and TLTs as used to calculate revenue is based on the demand data given in the Global Data Module
- Atlantic Freighter LnM capacity is based on using only the main and upper decks, reducing capacity from 1,650 to 1,350 LnM based on Marine Atlantic Operations
- Lane Meter and Passenger Capacity are considered to be exceeded when Demand is within 15% of max Capacity.

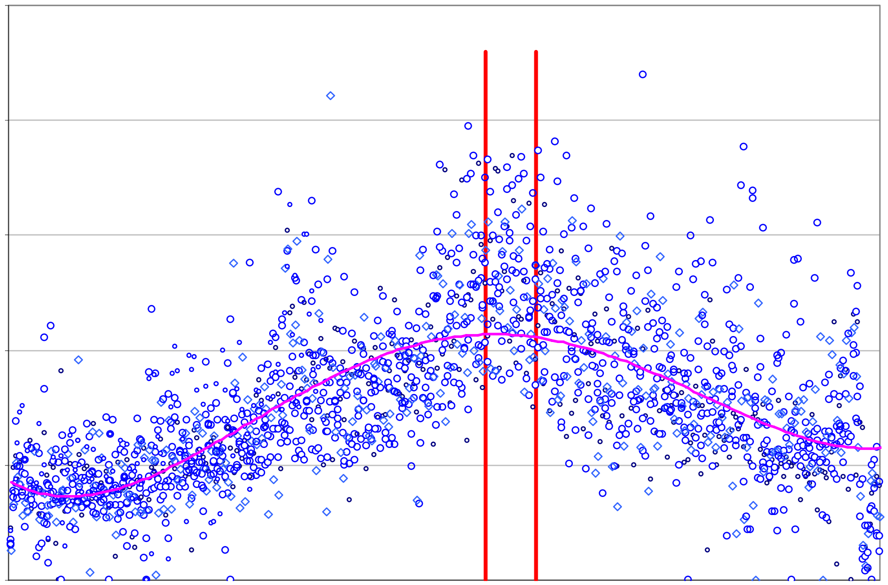
Maintenance Cost Model:

- Annual maintenance cost has been developed based on historical data, and incorporates inflation. Inflation has therefore not been applied to these costs
- Annual maintenance costs are directly proportional to vessel age and GRT
- Number of days spent on maintenance in a year is proportional to the amount of dollars spent in the same year, and is estimated based on historical data
- The number of days spent in PWP, refit, or 24-48 hour maintenance layup is based on average historical data, and applied to the number of total days in maintenance estimated per year
- The number of days in maintenance annually cannot exceed time available after operational days are considered

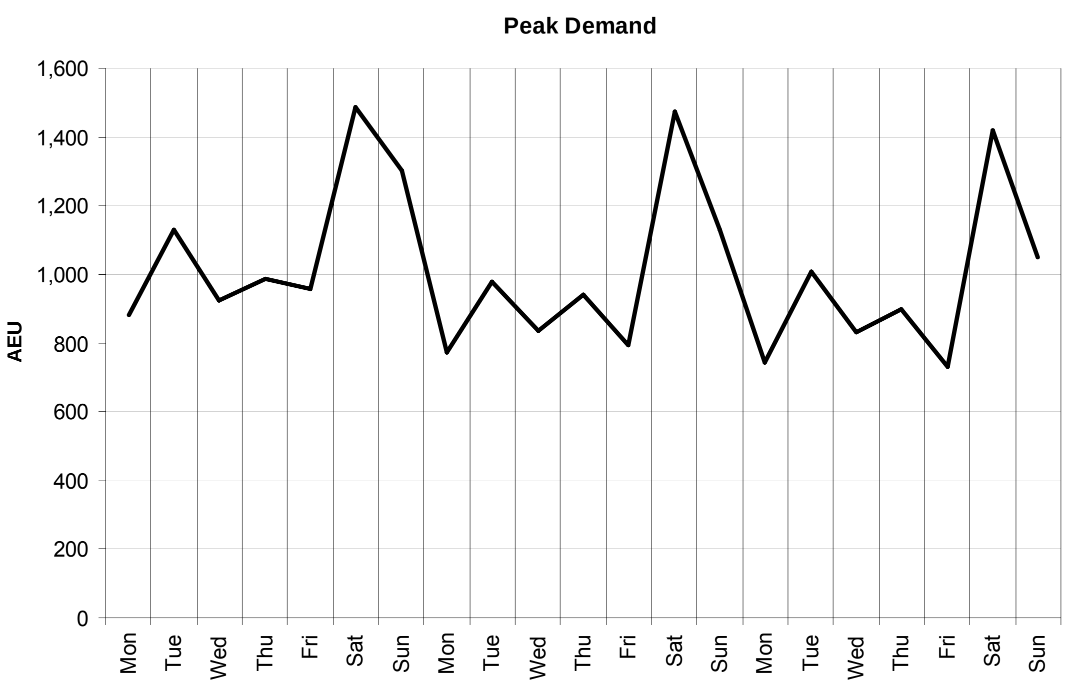
ANNEX D
Peak Capacity Check

Demand

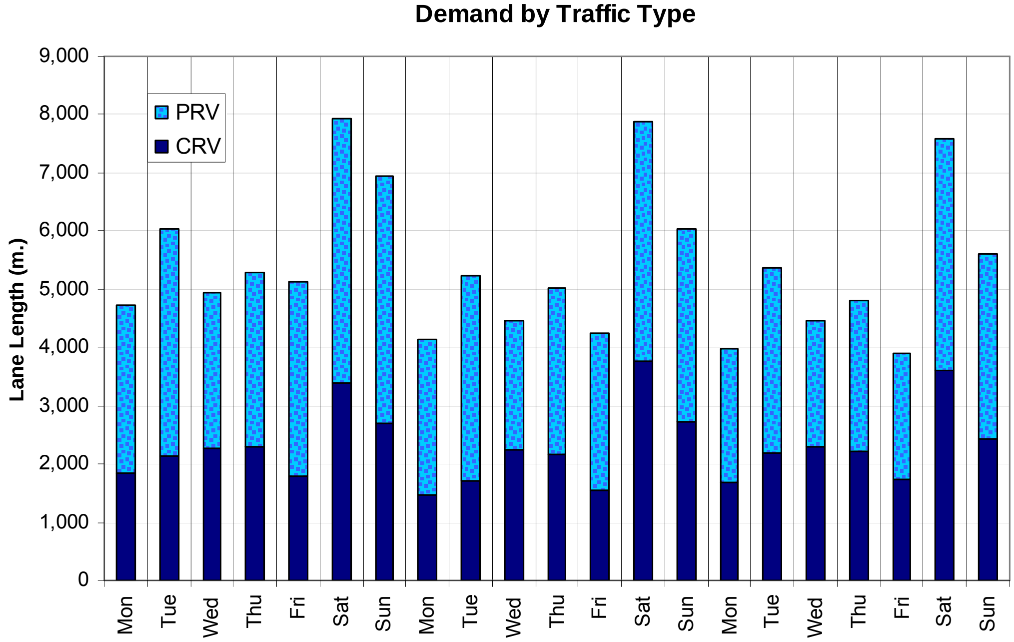
Fleetway's review of MAI demand history from 2000 on has shown that peak demand occurs over a three week period at the end of July / beginning of August.



Using pro-rated average values on a day-by-day basis (to capture weekend traffic peaks), the following three week 2004 traffic demand was generated.

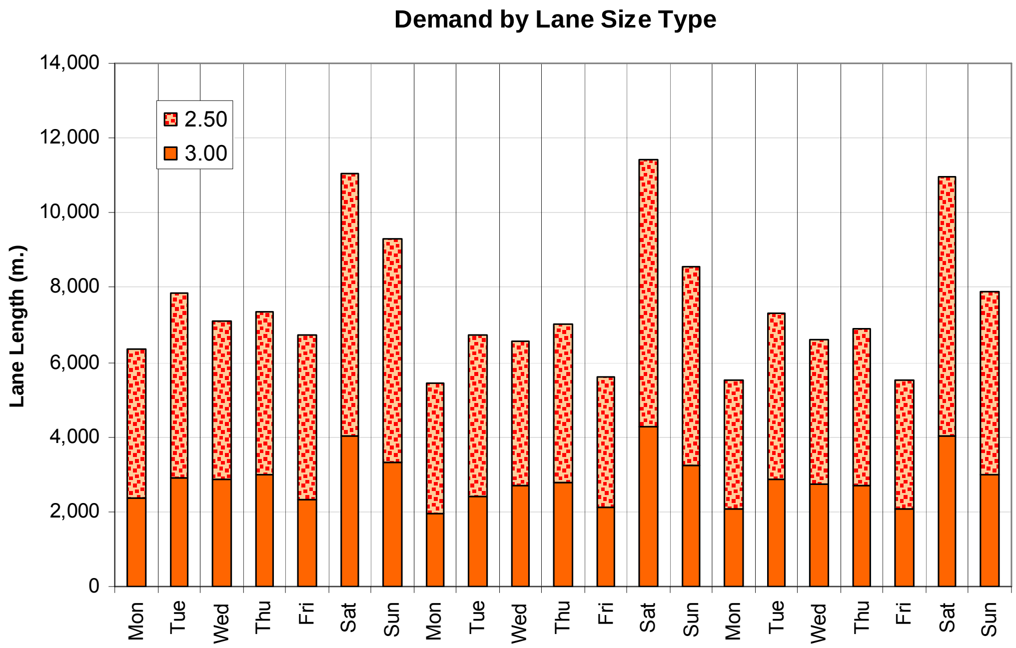


The traffic is most commonly described as being either Commercial (CRV) or Passenger (PRV). The following graph shows this split



For the purposes of loading the vessel, it is far more useful to describe the traffic by the lane size it requires. These are shown in the following table.

	CRV-DT	CRV-TT	CRV-ST	BUS	ATH	MH	ATL	Auto
Lane Width (m.)	3.00	3.00	3.00	3.00	3.00	3.00	2.50	2.50



Demand – Growth

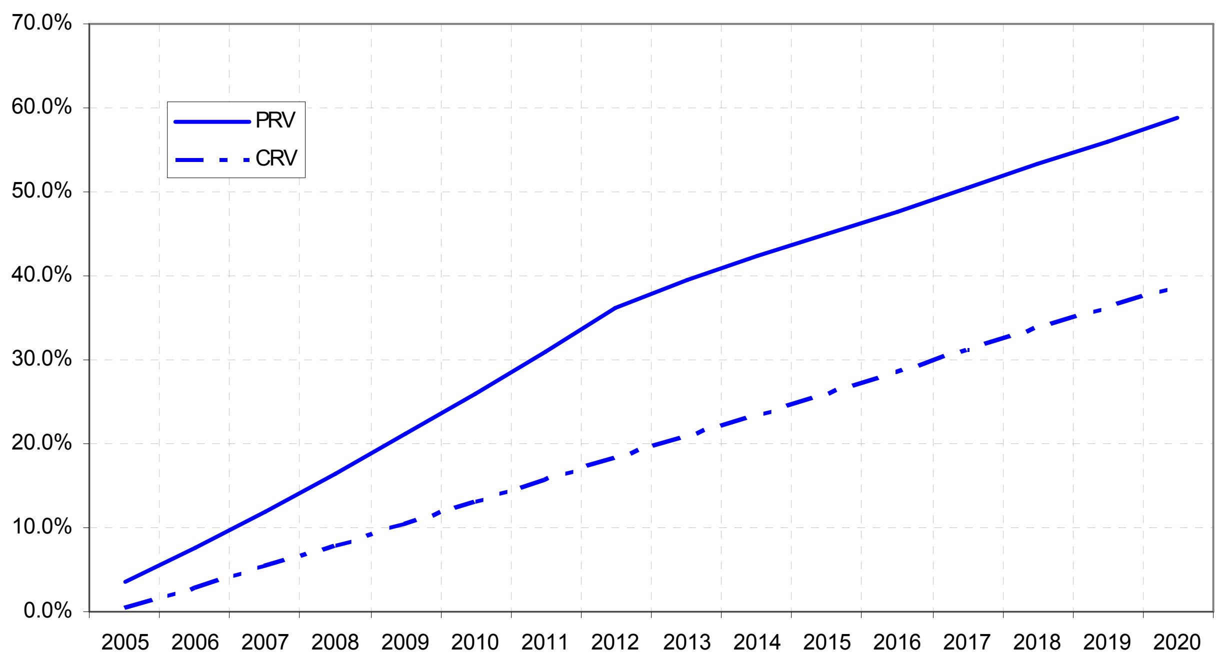
Marine Atlantic provided Fleetway with projected growth values based on trending and regression analysis conducted in-house. These were used to project the 2004 data to 2005, 2010, 2015 and 2020 as follows :

MAI 2005 Regression

YEAR	PAX	AEQ	TT	TLT
2005	3.50%	3.50%	0.50%	0.50%
2006	4.00%	4.00%	2.30%	2.30%
2007	4.00%	4.00%	2.50%	2.50%
2008	4.00%	4.00%	2.40%	2.40%
2009	4.00%	4.00%	2.40%	2.40%
2010	3.00%	4.00%	2.30%	2.30%
2011	1.30%	4.00%	2.30%	2.30%
2012	1.30%	4.00%	2.30%	2.30%
2013	1.20%	2.50%	2.20%	2.20%
2014	1.20%	2.00%	2.10%	2.10%
2015	1.20%	1.90%	2.10%	2.10%
2016	1.20%	1.80%	2.00%	2.00%
2017	1.20%	1.90%	2.00%	2.00%
2018	1.10%	1.80%	2.00%	2.00%
2019	1.20%	1.80%	1.90%	1.90%
2020	1.10%	1.80%	1.90%	1.90%

Cummulative

	PAX	AEQ	TT	TLT
2005	3.5%	3.5%	0.5%	0.5%
2006	7.6%	7.6%	2.8%	2.8%
2007	11.9%	11.9%	5.4%	5.4%
2008	16.4%	16.4%	7.9%	7.9%
2009	21.1%	21.1%	10.5%	10.5%
2010	24.7%	25.9%	13.0%	13.0%
2011	26.3%	31.0%	15.6%	15.6%
2012	28.0%	36.2%	18.3%	18.3%
2013	29.5%	39.6%	20.9%	20.9%
2014	31.1%	42.4%	23.4%	23.4%
2015	32.6%	45.1%	26.0%	26.0%
2016	34.2%	47.7%	28.6%	28.6%
2017	35.8%	50.5%	31.1%	31.1%
2018	37.3%	53.2%	33.8%	33.8%
2019	39.0%	56.0%	36.3%	36.3%
2020	40.5%	58.8%	38.9%	38.9%



Vessel Load-Out – Schedules & Sailings

Schedules have been prepared for each option. Each schedule is laid out in 1 hour blocks using the following assumptions:
Any vessel can be loaded in 120min (this assumption has been checked as part of the peak demand check – it was found that the terminal time for the 200m vessel needed to be increased to 180min on Mon, Tues & Wed when one ferry is always servicing ARG)

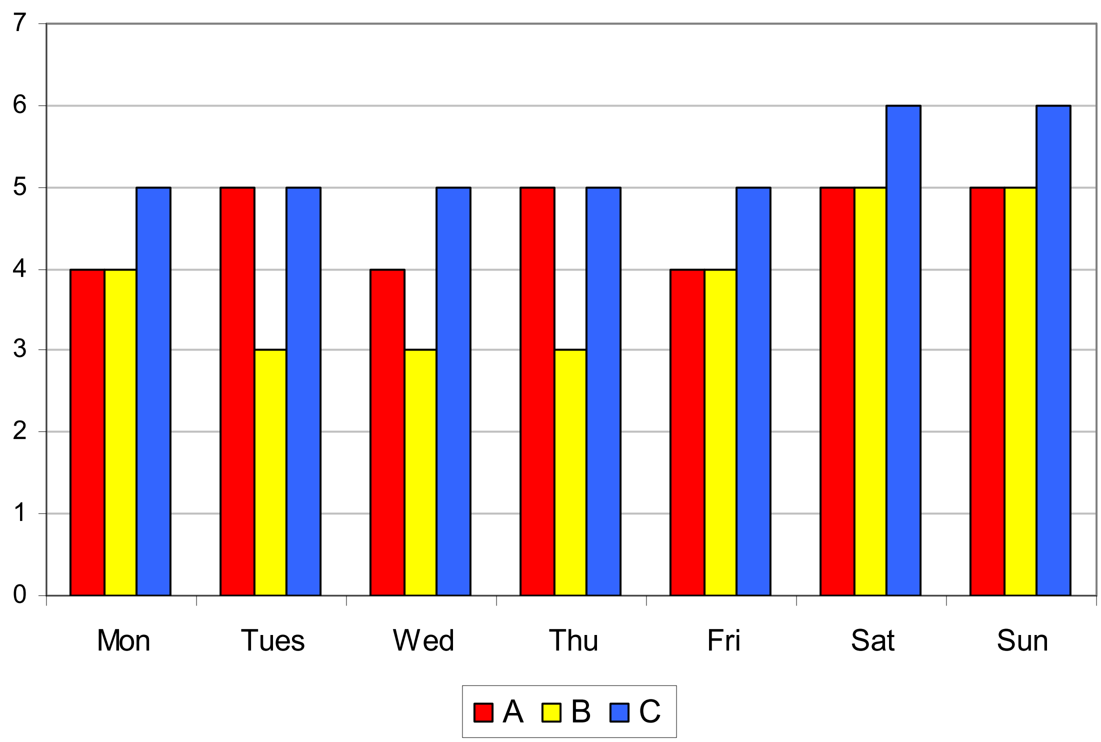
Vessel crossing times are based on vessel speed and are rounded up to the nearest hour block to provide some “float” as contingency

Taking on potable water can be accomplished nightly during a normal unload / load evolution without increasing the turn-around time.

Taking on fuel and oil will take place after 6 sailings (NS-PAB) and will require an additional 2 hours to complete.

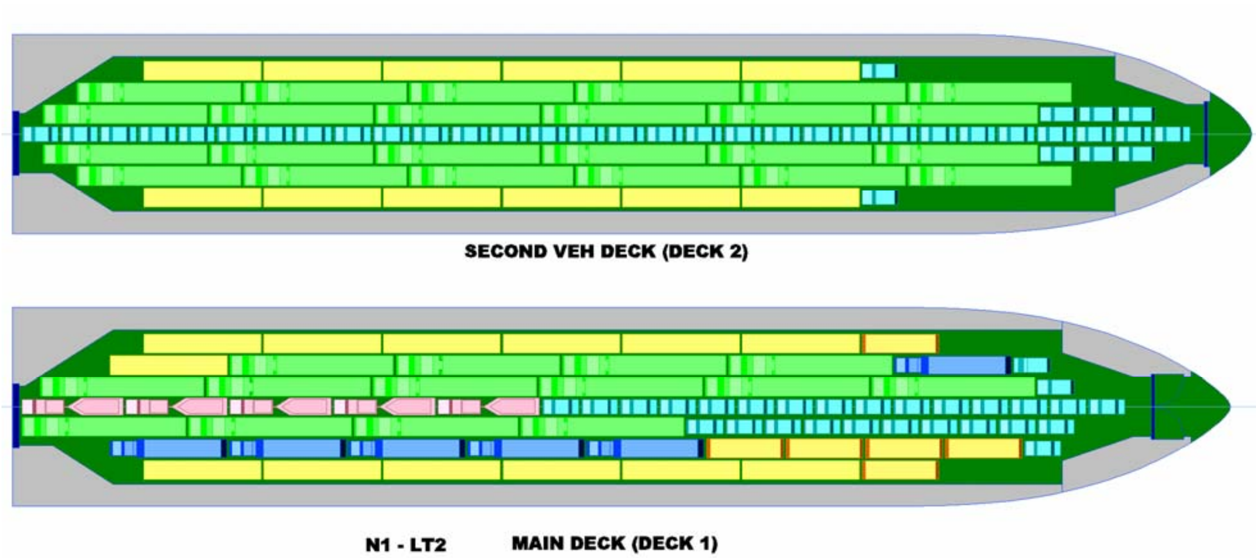
Two operational vessels cannot be in any terminal (NS, PAB, ARG) at the same time. If a vessel has been unloaded and shifted to the alternate berth while an active ship cycles through, it can then return to the main berth, load and depart.

The schedules act as objective evidence that the number of sailings from NS to PAB can actually be achieved. The number of sailings by day of the week for each option is shown below.



Vessel Load-Out – Deck Plans & Loading

The Interim Tactical Model loads each vessel as required by the schedule with the traffic designated to be loaded on that day. An example of a typical load-out is shown below.

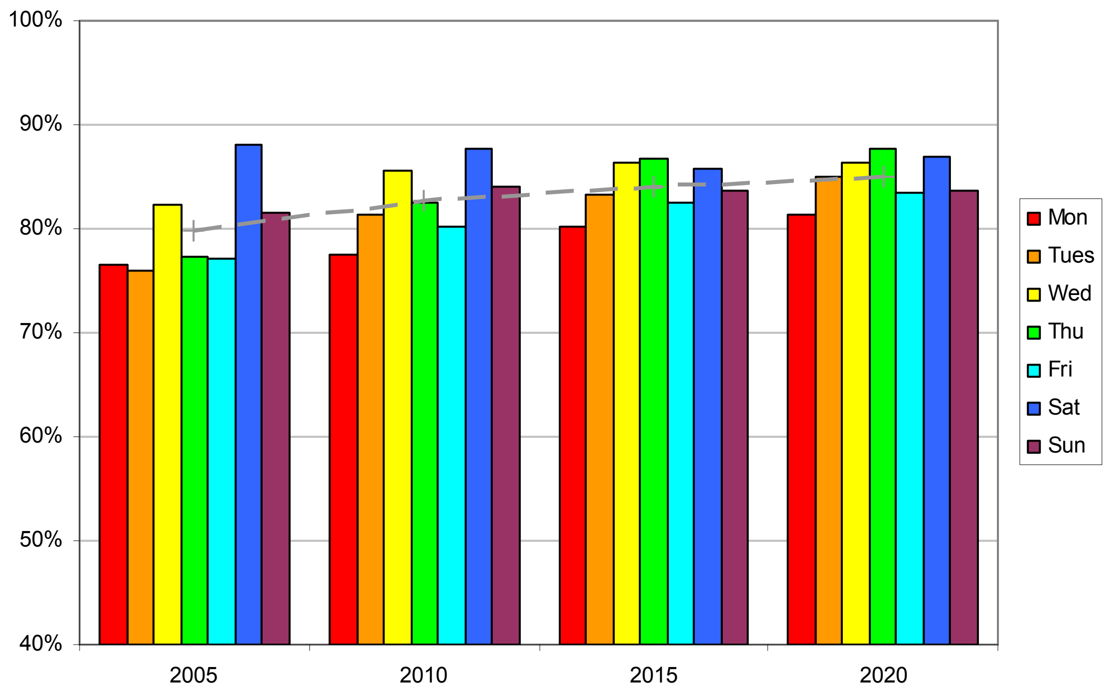


The process is automated as there are 5 different classes of ships each with two different load configurations (high 3.00m demand and high 2.50m demand) that need to be loaded. In total, a full run loads 570 ships while collecting statistics for each load.

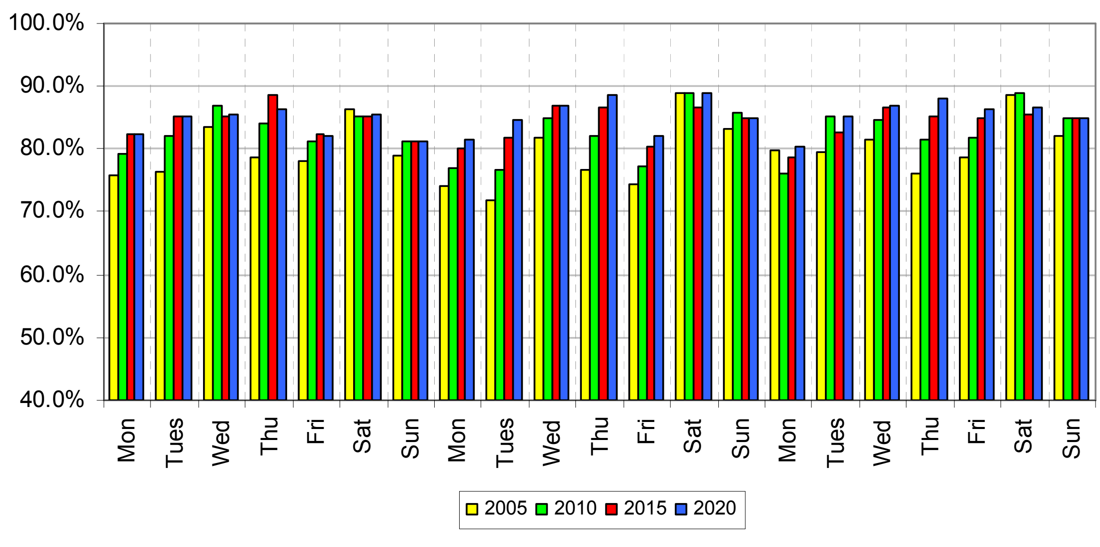
Capacity Check – Option A (Caribou, Smallwood & 2 x180m ROPAX)

The Caribou and Smallwood routinely leave traffic behind from 2005 on, however, the larger 180m ROPAX in the following sailing is usually able to accommodate this leftover traffic. In 2020 there is a possibility that demand will sporadically exceed capacity by 6%-7% on PRV's.

Average Utilization by Day of Week.



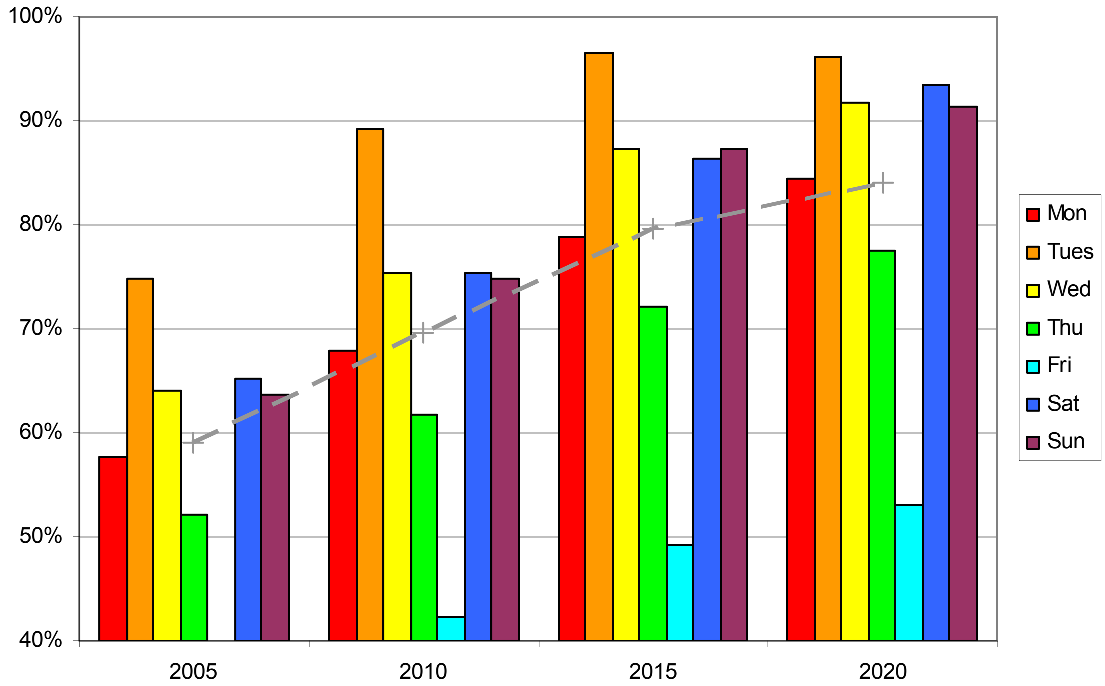
Utilization by Day of Week by Year.



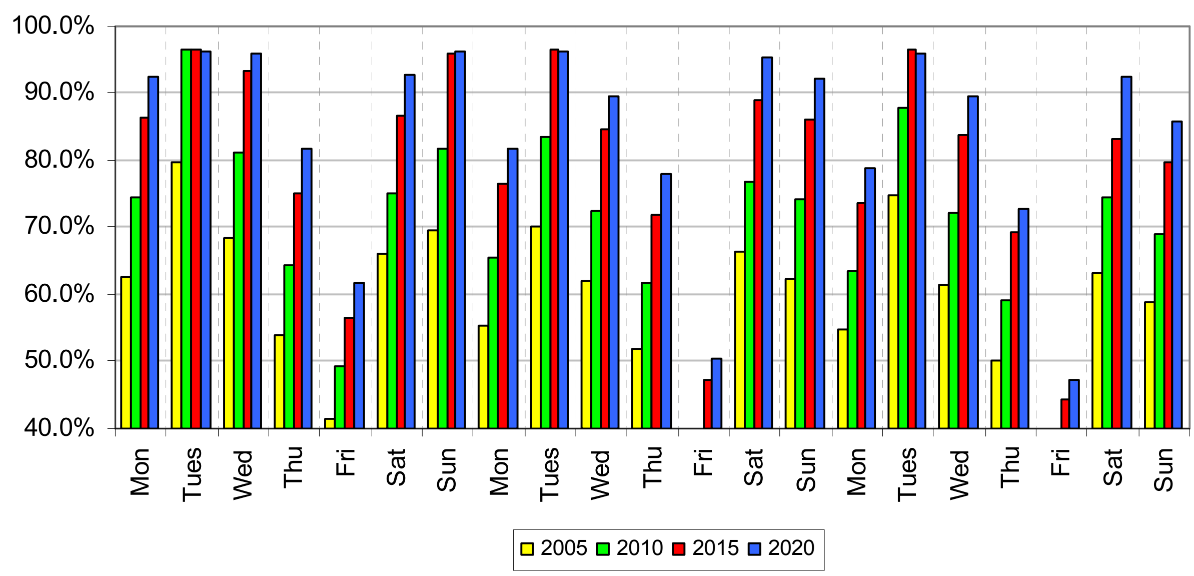
Capacity Check – Option B (3 x 200m ROPAX)

In 2020 there is a possibility that demand will sporadically exceed capacity by 6% on CRV's.

Average Utilization by Day of Week.



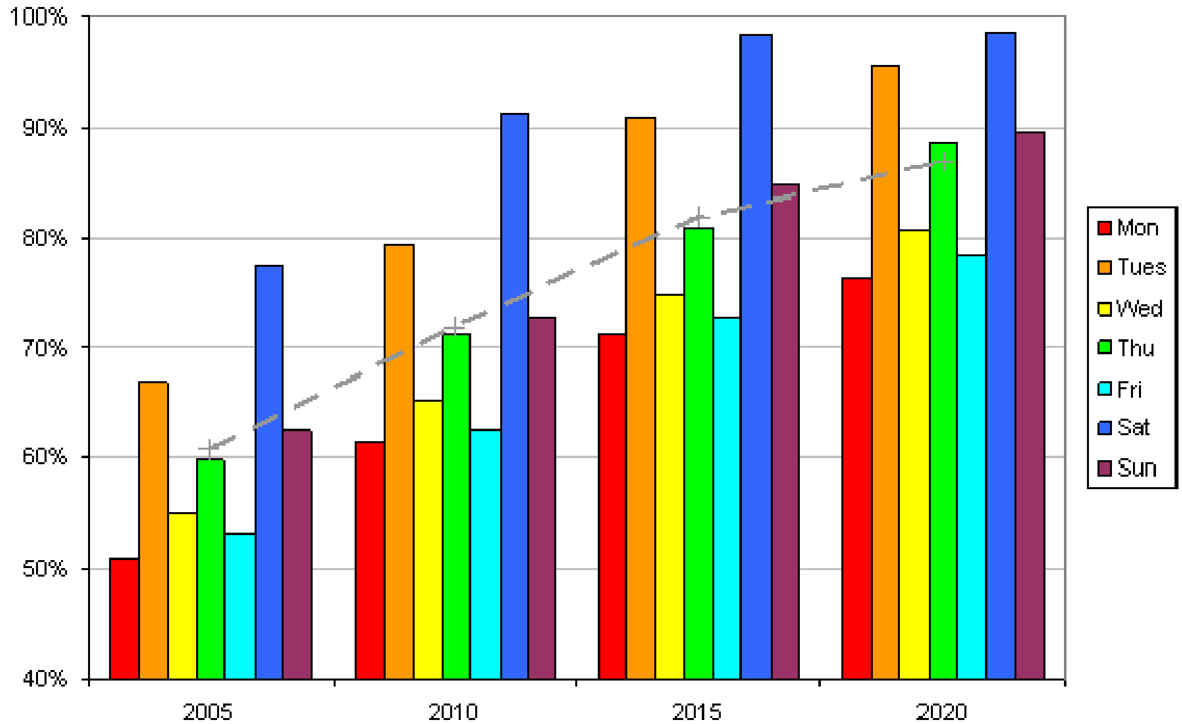
Utilization by Day of Week by Year.



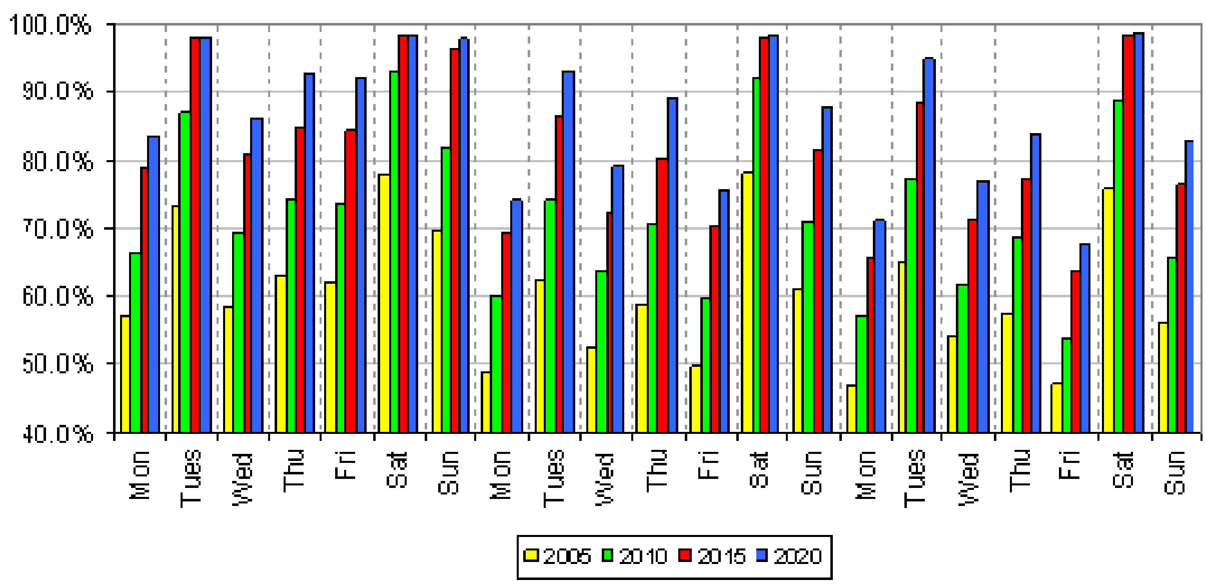
Capacity Check – Option C (4 x175m ROPAX)

This option has adequate capacity to carry all of the traffic as described by the demand profile.

Average Utilization by Day of Week.



Utilization by Day of Week by Year.

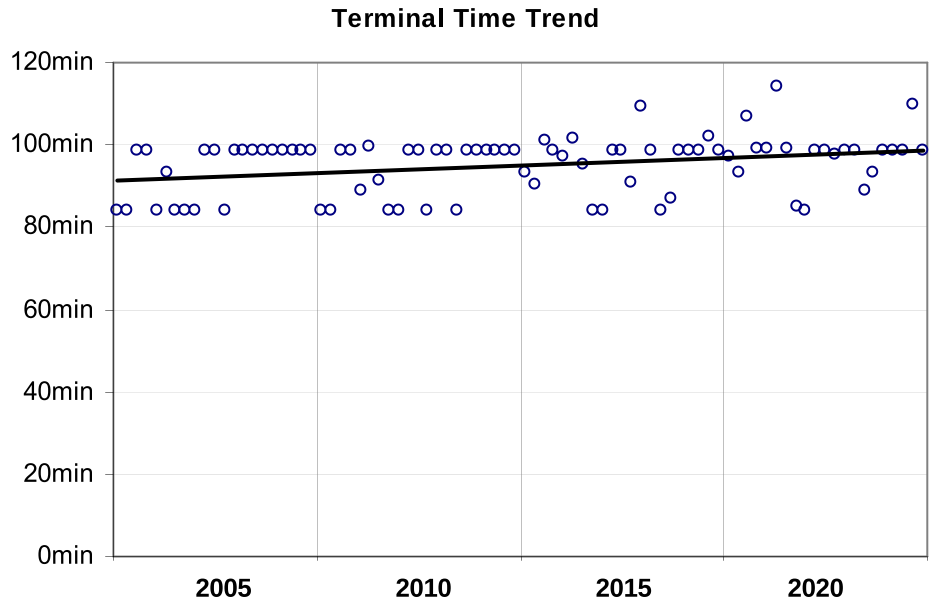


Terminal Time

A check to ensure terminal times do not exceed 120min was conducted to assess the validity of the assumption that each of the 3 options could deploy ramps/doors, unload, load and close ramps/doors in 12o min or less.

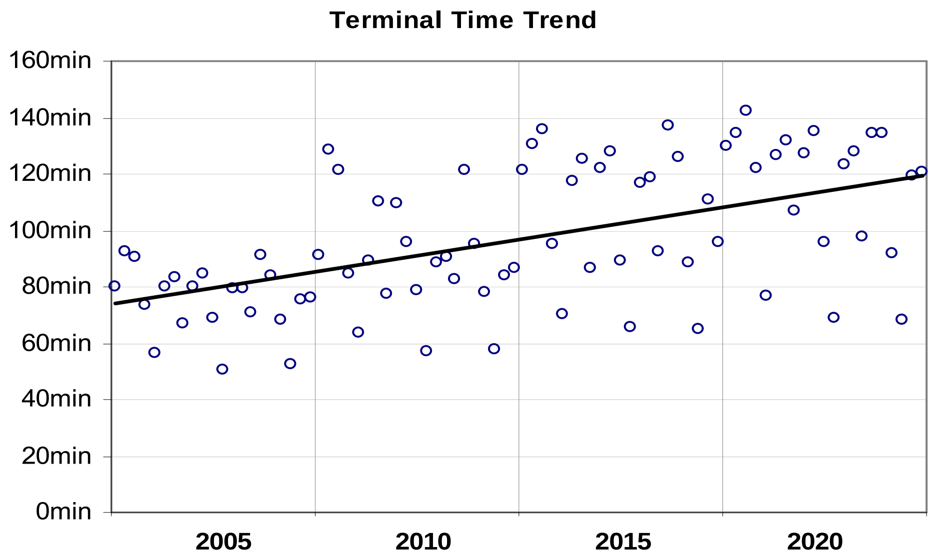
Option A

It is not anticipated that the terminal times will exceed 120min in this option. The maximum terminal times are almost always dictated by either the Caribou or Smallwood as they run at near capacity (87% - 93%) from 2010 on.

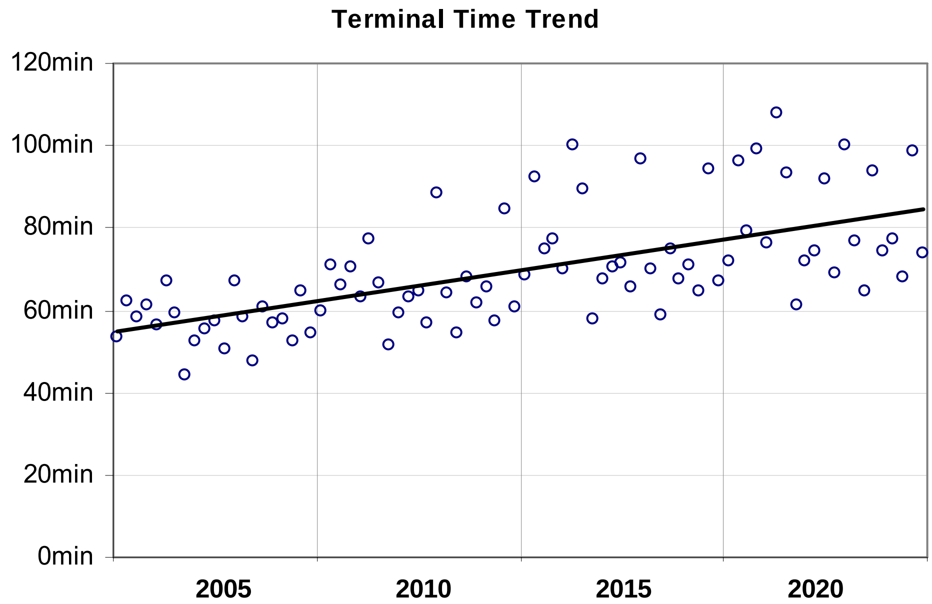


Option B

It is highly likely that the terminal times for this option will exceed 120min during the peak summer months from 2010 on. The schedule has been modified to account for the high utilizations on Tuesdays and Wednesdays.



Option C
It is not anticipated that the terminal times will exceed 120min in this option.



ANNEX E

Redundancy

General

To get a sense of how the fleet would be able to cope with demand when one asset is disabled, each option was re-run assuming one vessel was not in service. The concession against this was that one sailing to Argentia was removed from the schedule.

Option A

The simulation was re-run assuming the Smallwood was not available through the entire three week period. It is anticipated that the terminal times for the remaining vessels will exceed 120min occasionally, however, assuming that the fleet is operating in a "Drop & Go" mode at this time; there is sufficient time reserve to accommodate the occasional overruns.

The following table indicates the amount of average excess traffic by year:

	2010	2015	2020
CRV's	12.5%	14.5%	22.6%
PRV's	11.6%	21.9%	22.2%

Option B

The simulation was re-run assuming the one of the three vessels was not available through the entire three week period.

The following table indicates the amount of average excess traffic by year:

	2010	2015	2020
CRV's	25.5%	35.3%	42.4%
PRV's	6.5%	19.3%	19.6%

Option C

The simulation was re-run assuming one of the four vessels was not available through the entire three week period. It is anticipated that the terminal times for the remaining vessels will exceed 120min occasionally, however, assuming that the fleet is operating in a "Drop & Go" mode at this time; there is sufficient time reserve to accommodate the occasional overruns.

The following table indicates the amount of average excess traffic by year:

	2010	2015	2020
CRV's	3.8%	9.0%	16.5%
PRV's	6.8%	14.0%	14.6%

Conclusion

From the presented data it is clear that Options A and C are better able to cope with the loss of one vessel than Option B. This is completely expected as one vessel constitutes a significantly higher portion of the total fleet capacity in Option B than the others. The data indicates that Option B leaves almost twice as much traffic as A or more than 3 times as C.

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