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Analysis of the Economic Benefits of the Provision of Hydrographic Services in the APEC Region

Attachment 2

Economic Analysis

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APP

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1 OVERVIEW

1.1 Introduction

Most maritime stakeholders worldwide recognize the invaluable contribution of hydrographic services to the maritime sector. Furthermore, most would consider unthinkable a world without such services - the catastrophic impacts to sector safety and efficiency, and the gravity of economic, social and environmental consequences. Sustainable hydrographic services are, and have been, a cornerstone of the maritime sector throughout the ages. Not only do they facilitate safe and efficient vessel passage, they also contribute significantly to overall economic and social wellbeing through the provision of a range of other useful and varied services.

Few studies have been performed however to attempt to identify and evaluate the overall benefits of hydrographic services, and even fewer have attempted to quantify these benefits in economic terms. A primary reason for this is the fact that the benefits are difficult to quantify in real terms, and even more difficult to evaluate through rigorous economic analysis. The situation exists therefore, that although there is general agreement that hydrographic services contribute significantly to the maritime sector, little has been done to actually provide quantification of these benefits.

This report summarizes work performed in order to identify and evaluate the benefits of hydrographic services in economic terms, focusing on the APEC economies. It provides discussion of previous evaluations, identifies and describes principal benefits, and presents an economic model, which has been developed specifically to allow evaluation of certain target benefits for a selected APEC member economy, the Philippines.

1.2 Background and Rationale

National and regional hydrographic institutions produce three principal outputs: (i) *hydrographic charts and services*, which are primarily utilized for navigation; (ii) *bathymetric maps* of the ocean sub-surface, principally for resource development purposes; and (iii) *oceanographic charts*, which provide current and water temperature data to submariners, the fishing industry and other users[1]. These outputs, in the form of paper and electronic charts, are sold on to consumers often at no more than the cost of chart production itself. Direct revenues from chart sales often do not appear to cover the overall costs associated with hydrographic service provision, with supplementary costs being met from additional Government budgetary allocations.

Hydrographic services are often viewed therefore as a direct cost, where consumer cost recovery does not meet the total cost of required service provision. In this regard, hydrographic services have been justified on the basis of (i) fulfilling national and international statutory obligations; (ii) providing a “public good”; (iii) contributing to overall economic development and well-being; and (iv) being of vital strategic importance, particularly with regard to national defence.

With regard to previous studies reviewed as part of this evaluation, only one study has attempted to quantify the benefits of hydrographic services in economic terms. The study, completed for

[1] Other hydrographic publications and related services include sailing directions, small craft guides, water level publications, territorial sea and fishing zone charts, and other natural resource maps (including gravity and magnetic maps).

the Canadian Hydrographic Service[2], identified and evaluated hydrographic benefits based on the comparison of the (then) current situation (with hydrographic services) with a "counter-factual scenario" that assumed that hydrographic services had never been formally implemented throughout the nation. On this basis, and utilizing a consumer-surplus and producer-surplus analytical approach, the study determined significantly high benefit-cost ratios for the provision of hydrographic services.

This previous study assumed that the two scenarios of; (i) the "existence" of hydrographic services, compared with; (ii) the "non-existence" of hydrographic services, will directly affect demand, particularly in relation to foreign trade (through the use of producer-surplus and consumer-surplus approaches), an assumption which is often over-stated. In addition, the assumption and comparison of the "existence" and "non-existence" scenarios of hydrographic services is also considered by certain hydrographers as being too far from reality. The resulting effect therefore is that although the study reached quantitative results and conclusions, these results are subject to considerable debate and discussion, especially in relation to the assumptions made. Other studies have also provided valuable insights into the benefits of hydrographic services[3], although they do not provide quantitative analysis of economic benefits.

1.3 Benefits and Beneficiaries

Table 1 summarizes key benefits and beneficiaries of hydrographic services. As can be seen, they are substantial and wide ranging. Of primary value are the direct improvements to vessel movements in terms of efficiency and safety. Safer, faster and shorter voyages, coupled with increased flexibility and ability to sail at night and during poor visibility, yield substantial economic benefits, not only to individual APEC economies, but also to the APEC region as a whole. Benefits also accrue from the overall tendency in certain cases to support an increase in vessel size, deeper draft and optimisation of load capacity. Improved safety is also substantial, not only in direct economic terms, but also in terms of environmental and social protection.

For the fisheries sector, hydrographic services facilitate efficient sector management, and are invaluable in regulation and enforcement, and in the delineation of national and international fishing zones. They also assist commercial fleets to identify and locate fish resources, and reduce net groundings. Hydrographic services also play a key role in mineral exploration, in national defence, and provide products and services to recreational boating and fishing consumers throughout the APEC region. Hydrographic services are invaluable for emergency response, including search and rescue. And they provide the basis for the delineation and maintenance of sovereign and economic zones throughout the region.

Although difficult to quantify, hydrographic services also contribute considerably to the protection and management of the environment, not only through maritime safety improvements, but also by supporting sustainable resource management, particularly for coastal zones. As historical events indicate, environmental impacts from maritime accidents are often significant and lasting, and environmental damage sometimes irreparable. Hydrographic services therefore play a key role in reducing the number and severity of these impacts.

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2 *Benefit Cost Assessment of the Canadian Hydrographic Service*, Brinkman G, and Calverley S., 1992

3 Including (i) *An Economic Analysis of the Benefits of the RAN Hydrographic Programme*, Leech, J., and Coochey, J., 1992; (ii) *An Economic Evaluation of Hydrographic Charting With Special Emphasis on the Australian Case*, Coochey, J., 1993; (iii) *Hydrographic Charts and the Economy*, Cowan, E, 1993; and (iv) *The Case for Using Cost Benefit Analysis to Evaluate the Supply of Public Goods in the Maritime Industry*, John, M., 1996.

Table 1 - **Benefits and Beneficiaries of Improved Hydrographic Services**

Beneficiary	**Benefit**
(i) General Cargo, Passenger, Other Vessels	Faster voyages, reduced voyage duration Shorter voyages, reduced voyage duration Safer voyages, fewer accidents Improved voyage flexibility (night, restricted-visibility sailings) Reduced insurance cost Larger vessels, deeper draft, less load restrictions Less reliance on pilots
(ii) Commercial Fishing	As per (i) above Enhanced fisheries sector management, regulation and enforcement Improved economic and fishing zone delineation and maintenance Enhanced capacity to locate fish and select species Reduced net and equipment losses
(iii) Environmental Protection	Decrease in number and severity of accidents and related environmental impacts
(iv) Economic Zone Maintenance	Definition and maintenance of economic zones
(v) National Defence	As (i) above for vessels, and several benefits in (i) for submarines
(vi) Sovereign Zone Maintenance	Enhanced identification, definition and maintenance of sovereign zones
(vii) Coastal Resource Management	Improved identification, management and protection of coastal resources
(viii) Mineral Exploration	As per (i) above Improved mineral exploration and management (oil, gas, aggregates and others)
(ix) Recreational Fishing and Boating	As per (i) above Safer yachting and recreational fishing
(x) Emergency Response	As per (i) above Improved search and rescue services

2 ECONOMIC ASSESSMENT

2.1 Introduction

This section presents key aspects and results of the analysis, and draws conclusions regarding economic benefits of hydrographic services. Due to both the relative complexity of analysis and the limitations of this assessment, this economic analysis has focused on the detailed assessment of one of the predominant economic benefits accruing to an economy from the provision of hydrographic services, the benefit to the shipping sector. In addition, because of the difficulty in obtaining data, and the complexity of the work, the analysis of this benefit has been restricted to one selected APEC economy, that of the Philippines.

The benefit analysed relates to the potential cost impacts to voyage sailing times of the commercial shipping sector operating in the Philippines due to variations in hydrographic service provision and investment. It is based on the assumption that should hydrographic service provision cease, existing navigation will begin to suffer, and that the duration of vessel voyages will progressively increase over time as a result of this. This will have the effect of increasing the operating costs of vessels, and also impacting on passengers through passenger time loss, since each voyage will progressively take longer.

It is also important to emphasize that the analysed benefit forms only a portion of the overall benefits to the "General Cargo, Passenger and Other Vessels" beneficiary classification, as shown on Table 1. In addition to this, there are numerous other benefits accruing to beneficiaries from the provision of hydrographic services, and the analysed benefit only represents a small portion of the cumulative benefits.

The general methodological framework adopted has the following progression:

(i) Elaboration of foreign trade, domestic trade and passenger services, including specific demand forecasts for imports, exports, domestic trade and passengers for a 25-year planning horizon;

(ii) Evaluation of shipping services in terms of shipping patterns and projections of shipping traffic and of passenger voyages;

(iii) Assessment of benefits, in terms of vessel operating costs and passenger time savings;

(iv) Evaluation and sustainability analysis comparing costs and benefits of different scenarios; and

(v) Extrapolation of the analysis to other APEC economies.

2.2 Philippine Hydrographic Sector

Government funded Philippine national hydrographic services cover the entire archipelago of over 7,000 islands. Principally through two hydrographic service vessels, they survey up to 400,000 square km of oceanic waters per year. Each of the vessels has a crew of 48 personnel, and each perform tours of up to 20 days duration. There are no private sector survey operations performed for the Government, and practically no airborne survey work is performed.

The hydrographic surveys are carefully planned to optimise vessel use and maximize output. Generally, the major ports of the Philippines are re-surveyed every two years; secondary ports every five years and smaller ports and routes every ten years. Notable exceptions include the heavily trafficked ports of Manila and Batangas, which are subject to severe siltation. In addition to navigation-related duties, hydrographic services are provided for (i) marine resource surveys; (ii) United Nations related submarine and continental shelf mapping; (iii) regulation of the mining sector; and (iv) economic zone "fencing". In conjunction with Japanese assistance, the Philippines has recently initiated an electronic charting program, which is focusing on the mapping of major international cargo routes around Manila and the western coastline.

General observations of Philippine hydrographic specialists are that; (i) there is an overall tendency towards ever-increasing vessel size; (ii) there is a need to identify and chart new sea lanes, as many uncharted lanes are used frequently by commercial vessels; and (iii) a considerable portion of surveys are performed for non-navigation related activities. The estimated annual expenditure in Philippine hydrographic services is US$ 3.5 million.

2.3 General Methodological Framework

2.3.1 Scope

This assessment is related to the potential impact of varying the quality of hydrographic services on different user classes. In summary, the methodology includes;

(i) Forecasting future demand of potential users;

(ii) Elaborating different development scenarios for the hydrographic services;

(iii) Elaborating unit benefits and costs associated with each specific user;

(iv) Evaluating, over time, each scenario with respect to the tendency scenario;

(v) Extrapolating the analysis to other APEC economies.

Potential User Assessment

Time and resources available for this study do not allow analysing in detail the impact of hydrographic services over all users. The analysis concentrates on the commercial shipping (cargo and passengers) users. Even considering only this sub-set of users, the benefits of hydrographic services associated with these users can, largely, justify investment actions necessary to maintain and/or to improve the service.

Shipping Service Demand

Present and projected demand of commercial shipping has been analysed considering the following demand segments:

(i) Foreign Trade Shipping Services;

(ii) Domestic Trade Shipping Services;

(iii) Passenger Shipping Services;

The method used to elaborate present and future foreign trade using the maritime mode of transportation has included projections of the following;

(i) Foreign trade (e.g. imports and exports) shares over GDP in time series;
(ii) Foreign trade shares to GDP;
(iii) Maritime shares of foreign trade over total trade;
(iv) GDP;
(v) Maritime foreign trade in value;
(vi) Value to volume ratios for exports and imports;
(vii) Foreign trade volumes (tons);
(viii) Existing distribution of cargo transported by vessel type and size;
(ix) Cargo distribution by vessel type and size;
(x) Existing average cargo transported by vessel type and size;
(xi) Average cargo transported by vessel type and size;
(xii) Maritime traffic (e.g. number of ships) by vessel type and size for foreign trade.

Domestic trade forecasts are elaborated using a procedure, which has considered:

(i) Development of a relationship between domestic trade volumes and GDP;
(ii) Projections of domestic trade volumes in relation to GDP;
(iii) Calculation of existing average volumes transported by vessel type and size;
(iv) Projection of volumes transported by vessel type and size;
(v) Calculation of distribution of volumes transported by vessel type and size;
(vi) Projection of distribution of volumes transported by vessel type and size;
(vii) Projection of maritime traffic (e.g. number of ships) by vessel size and type for domestic trade.

A similar procedure is used to forecast the number of vessels used for passenger transport:

(i) Identification of a relationship between passenger traffic and GDP;
(ii) Projections of passenger traffic related to GDP;
(iii) Calculation of existing average number of passengers transported by vessel size;
(iv) Projections of average number of passengers by vessel size;
(v) Projections of passenger traffic distribution by vessel size;
(vi) Projections of maritime traffic by vessel size for passenger transportation.

Benefit Assessment

The existence of the hydrographic services provides a navigation tool, which minimizes the time spent by vessels during both open sea navigation and approaching ports. This impacts on cost,

since the extra time saved because of hydrographic services can be transformed into vessel operating cost reductions. Costs reductions, in turn, are transferred to final users (passengers, importers, exporters and traders) making goods and passenger mobilization cheaper. Benefits associated to commercial shipping considered are of two types;

(i) Vessel operating costs, which are assumed to increase or decrease according to the condition of hydrographic services and related maps. If hydrographic services improve, vessel voyage time will reduce with consequential reduction in vessel operating costs. Should hydrographic service provision reduce however, then vessel voyage time and associated vessel operating costs will increase;

(ii) Passenger time costs, which are also assumed to increase or decrease in relation to vessel voyage time increases or decreases as a result of variations in hydrographic service provision.

The method used for identifying benefit flows consists of the following procedures;

(i) Development for each vessel size an average unit operating cost related to time (e.g. US$ per hour per vessel type);

(ii) Identification of a pattern of time loss (saved) because of hydrographic services by vessel size (e.g. 10 minutes for each vessel larger than 50,000 tons, 1 minute for vessels smaller than 1,000 tons, etc.);

(iii) Development of two scenarios; (i) a tendency scenario in which hydrographic services continue to operate in accordance with the existing situation, with similar levels of expenditure; and (ii) a counter-factual scenario, whereby hydrographic services immediately and permanently cease to be provided.

(iv) Calculation of each benefit scenario the total cost savings using demand projections elaborated in the previous section.

The result of benefit assessment is a set of benefit flows associated to each scenario. This simplistic method conservatively underestimates benefit flows. Benefit underestimation is due to two main factors:

(i) Increase of unit costs due mainly to insurance premiums. If hydrographic services are not delivered, the statistical occurrence of vessel accidents increases and so the insurance premiums. The analysis performed does not consider increases on unit costs;

(ii) Relative reduction of vessel size. The general tendency of increasing the vessel size for cost reduction purposes could be offset. Shipping operators, in the absence of proper hydrographic services could choose to use reduced vessel size to reduce accident risks. This will impact on cost increases since the same transport demand will be satisfied by vessels of reduced size, which shows larger costs for ton and/or passenger transported. The analysis does not consider vessel pattern modification.

Scenario Identification and Evaluation

Two scenarios have been identified:

(i) Tendency Scenario; Hydrographic services will continue to be provided, with the same characteristics as those of the existing situation;

(ii) Counter Factual Scenario. Hydrographic services will stop being provided.

A counter-factual scenario (where hydrographic services cease activity) has been developed in order to evaluate the existing hydrographic services expenditure. The evaluation also identifies a level of sustainable development for hydrographic services, in terms of increased annual expenditure.

2.3.2 Foreign Trade

Scope

This section's main objective is to determine the projection of the number of vessels (by vessel size) transporting foreign trade cargos.
The following sub-sections are dedicated to:

(i) Estimation of the projections of total foreign trade in value;

(ii) Estimation of the projections of foreign trade transported by maritime mode in volume;

(iii) Estimation of the number of vessels by vessel type and size transporting foreign trade cargos.

Foreign trade forecasts have been performed regressing observed shares of imports and exports over GDP with respect to time. The functional relationship used is:

$$\text{Shares} = a + b \ln(\text{Years})$$

Where a and b are regression parameters and Ln (Years) is the natural logarithm of time (years). Using data at constant 1985 prices from 1980 to 2000, the results of the regression estimates are illustrated on Table 2.

Table 2 - **Regression Results (Shares = a + b Ln (Years))**

Statistics	Export Shares	Import Shares
Adjusted R square	0.828	0.796
F	97.6	79.1
a value	- 19,418	- 28,018
b value	2,561	3,694
t(a)	- 9.9	- 8.9
t(b)	9.8	8.9

Source: Consultant's estimates using data from *The National Accounts of the Philippines, National Statistical Coordination Board, Various Years*.

Using the regression results it is possible to elaborate foreign trade projections in terms of shares over GDP. Figure 1 illustrates the projections of the import and export shares with respect to GDP over time.

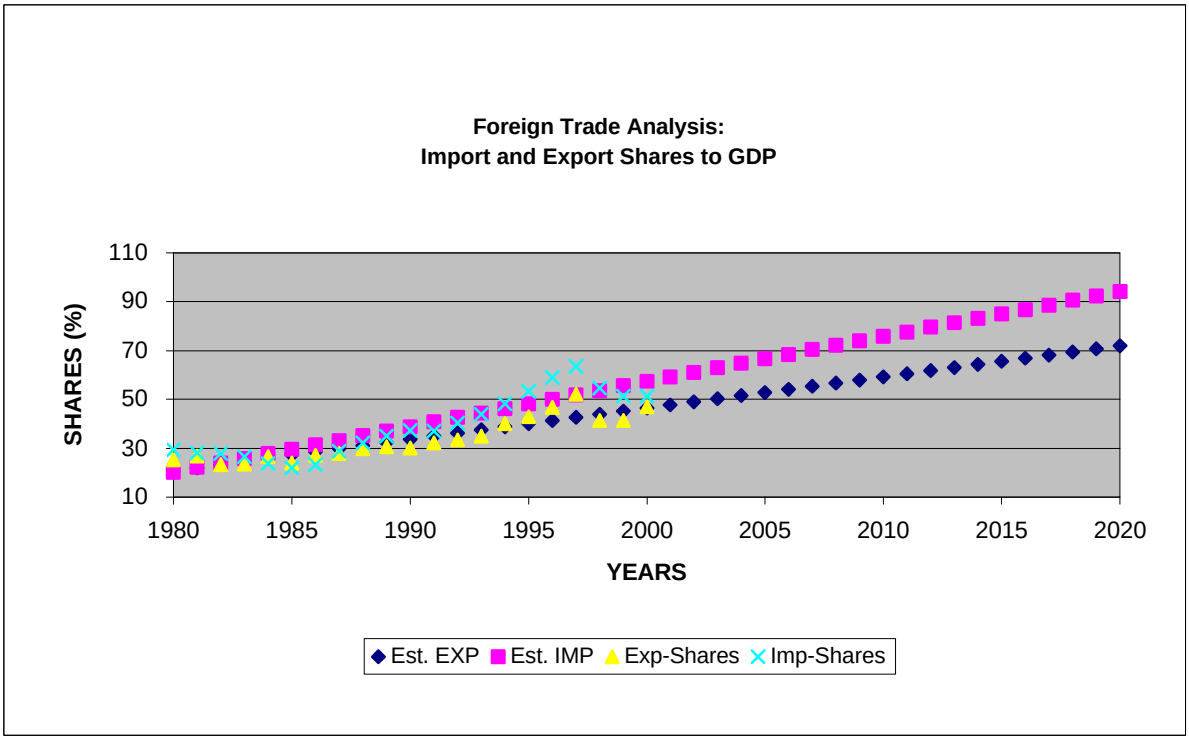

Figure 1 - **Foreign Trade Analysis: Import and Export Shares to GDP**

The projections obtained with this method imply that the Philippines is over relying on external demand. In year 2020, imports will reach 94% of GDP and exports 72%. Even if the globalisation process is going to achieve its main effects in the next 4-5 years it is reasonable to assume that, in the medium–long term, the economy will rely upon a faster increase of domestic demand.

The hypothesis that can be made is that foreign trade share will follow the trend (e.g. the regression results) until year 2005. Using this hypothesis, exports in that year will reach 53% of GDP and imports 67%.

Successively, the faster growth of internal demand will reduce the shares to GDP of both imports and exports. Setting future share value of foreign trade is, certainly, not an easy task. Tentatively it can be assumed that the shares to GDP of both imports and exports will decrease steadily to 50% by the years 2020. In that year it is also assumed a foreign trade balance. Figure 2 illustrates the assumed behaviour over time of Philippine foreign trade.

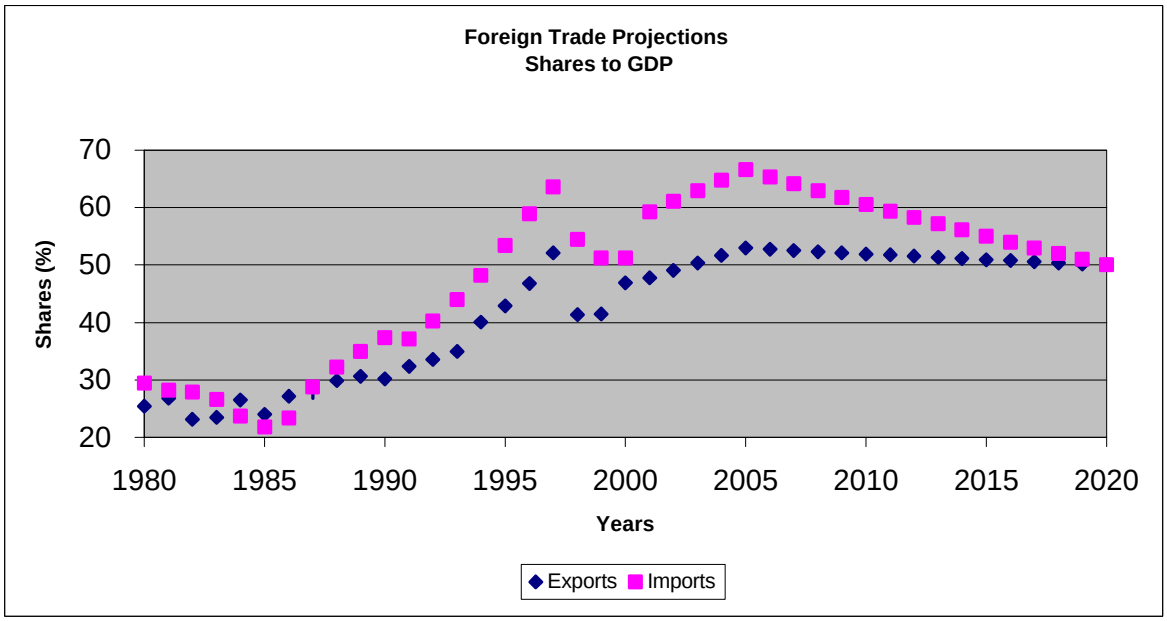

Figure 2 - **Foreign Trade Projections: Shares to GDP**

In order to project foreign trade values it is necessary to identify the projections of GDP. This allows elaborating foreign trade projections in value using the projections of the shares to GDP previously identified.

The National Economic Development Agency (NEDA) publishes yearly the projections in terms of growth rates for GDP. Published GDP expected growth rates are produced for 6 years (e.g. until 2006). The project team assumes that after 2006 and until 2012 the growth rate will be the 80% of the average expected for the 2001-2006 period, and that for the period 20013-2020 GDP yearly growth rate will be, again, the 80% of that of the previous period.

Table 3 illustrates the growth rates used in this study.

Table 3 - **GDP Yearly Growth**

Year	High	Low	Average
2001	3.30	3.80	3.55
2002	4.30	4.80	4.55
2003	5.40	6.00	5.70
2004	5.70	6.30	6.00
2005	6.10	6.70	6.40
2006	6.30	6.90	6.60
2001-2006	5.80	5.20	5.50
2007-2012	4.64	4.16	4.40
2013-2020	3.71	3.33	3.52

Source: NEDA and Consultant Estimates

Maritime International Trade

Figure 3 illustrates the shares of merchandise trade over total imports and exports for the years 1980-2000. Although the data does not show relevant trends of merchandise shares for both imports and exports, the project team considered that the shares of merchandise trade, respectively for imports and exports, will remain unchanged for the whole period (e.g. 2001-2020) and equal to the average of that observed during the period 1995-2000: 72.1% for exports and 87.3% for imports.

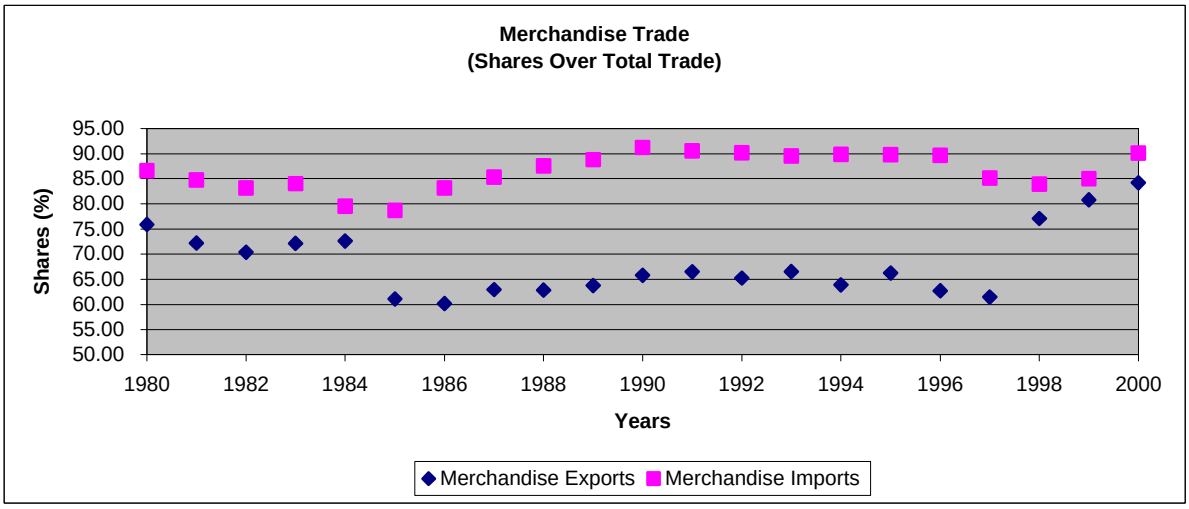

Figure 3 - **Merchandise Trade (Shares over Total Trade)**

Foreign Trade statistics report the values traded by mode of transportation (e.g. air and maritime). Figure 4 illustrates maritime shares over total merchandise trade.

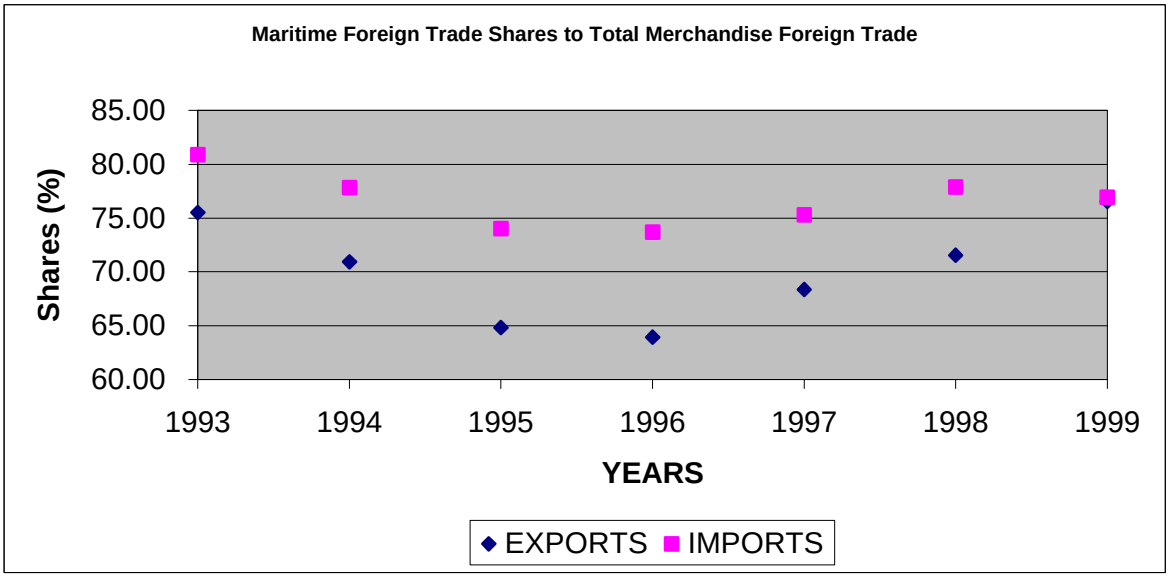

Figure 4 - **Maritime Foreign Trade Shares to Total Merchandise Foreign Trade**

Available data do not allow estimating the share projections for maritime shares of merchandise foreign trade. The project team adopted share average values between 1993 and 1999 as reference value and maintained it constant for the whole projection period. The average shares adopted are of 70.24% for exports and 76.65% for imports.

The analysis carried out allows forecasting maritime international trade in values at constant prices.

Finally, unit ratios Values to Volumes have been analysed. This ratio and its behaviour over time are necessary for transforming maritime foreign trade values into volumes (tons). The available data (1993-1999) are illustrated on Figure 5. Regression analysis was carried out for both import and export value to volume ratios. Reliable results are obtained only for exports:

Exports Value to Volume Ratios = a + b Ln(Years)

(i) Adjusted R square = 0.863

(ii) F = 31.4

(iii) a value = - 15,889,375

(iv) b value = 2,092,455

(v) t(a) = - 5.6

(vi) t(b) = 5.6

Export value to volume ratios are assumed to follow the regression results until year 2005 (in that year the ratio is of 20,399 Pesos per ton) and remaining constant thereafter. As far as import ratios are concerned, the average value between 1993 and 1999 has considered (e.g. 6,735 Pesos per ton) and maintained this for the whole projection horizon.

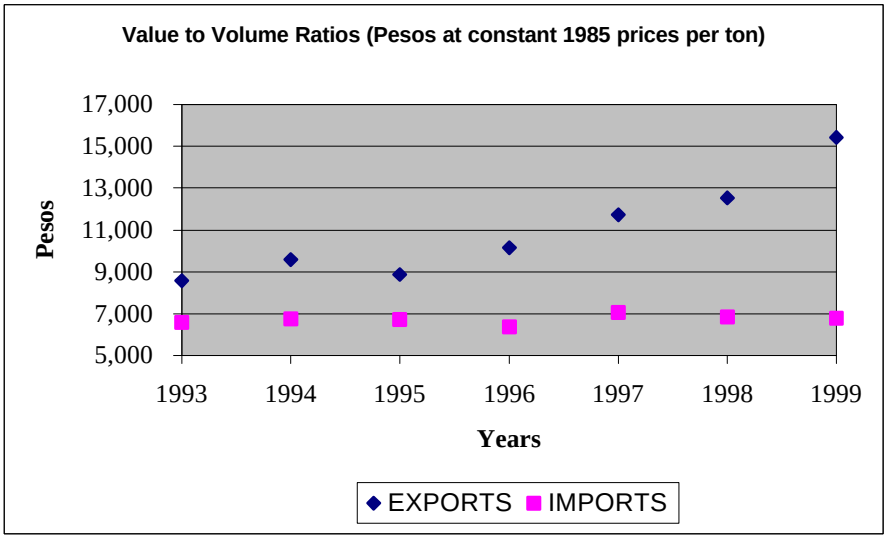

Figure 5 - **Value to Volume Ratios (Pesos at constant 1985 prices per ton)**

Projections of Foreign Trade Volumes

The analysis allows elaboration of the projections of maritime foreign trade in volume (tons). Table 9 presented later in the report illustrates the foreign trade projections.

2.3.3 Domestic Trade

Philippine Port Authority (PPA) collects, at port level, information on domestic trade volumes inbound and outbound. This information is consolidated at national level in the PPA Annual Report.

Domestic Trade Shipping Forecasts

Domestic trade forecasts have been elaborated using a relationship relating domestic trade volumes (Tons) to GDP. This relationship is used to project domestic trade volumes using GDP projections.

PPA information contains inbound and outbound trade flows volumes. These two sets of data are slightly different due to the statistical reporting system and to errors. It is reasonable to assume that inbound traffic volumes should match with outbound volumes; an average value has been used for estimation purposes.

The previous ten years of data are used for estimating the relationship:

Tons Traded = a + b Ln(GDP)

The regression results show the following statistics:

(i) Adjusted R square = 0.804

(ii) F = 42.0

(iii) a value = - 197.9

(iv) b value = 34.7

(v) t(a) = - 5.5

(vi) t(b) = 6.5

Figure 6 shows the results of the estimation.

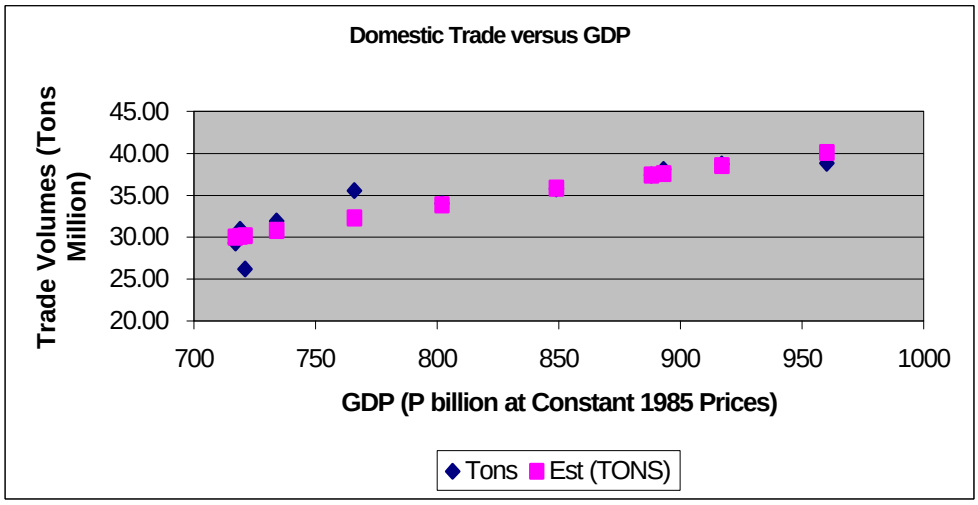

Figure 6 - **Domestic Trade versus GDP**

2.3.4 Maritime Passenger Services

The PPA produces, in its annual report, information related to passenger traffic for ports. The information is associated to each port and consolidated at national level as inbound and out bound passenger traffic.

Passenger Voyage Forecasts

Inbound and outbound data do not match and average values have been used for carrying out the analysis. Also in this case, an econometric logarithmic relationship between passenger flows and GDP has been estimated [e.g. Passengers = a + b Ln(GDP)] considering the last ten years data.
The statistics of the regression are:

(i) Adjusted R square = 0.811

(ii) F = 35.4

(iii) a value = - 217.8

(iv) b value = 38.3

(v) t(a) = - 5.0

(vi) t(b) = 5.9

Figure 7 illustrates the estimation results.

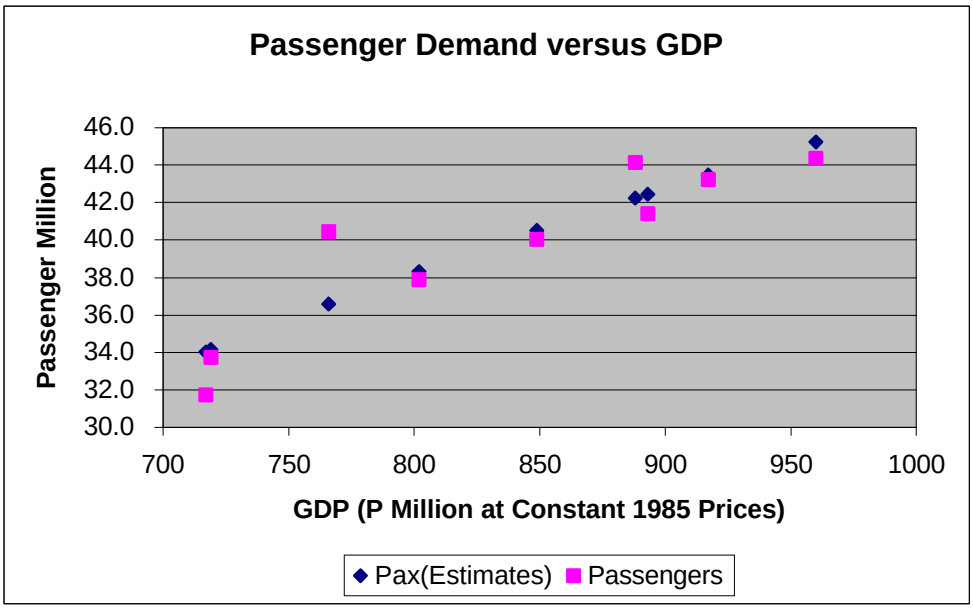

Figure 7 - **Passenger Demand versus GDP**

2.3.5 Demand Forecasts

Summarises demand projections. The following table shows the projections for:

(i) Maritime Imports (Tons);

(ii) Maritime Export (Tons);

(iii) Maritime Domestic Trade (Tons);

(iv) Number of Passenger using Shipping Services.

Table 4 - **Demand Projections**

Year	Values (P billion at Constant 1985 prices)	Maritime Foreign Trade Volumes (Tons)		Domestic Trade Volumes (Tons)	Maritime Passengers (No)
	GDP	Exports (Tons)	Imports (Tons)		
1993	734	15,037,783	35,486,553	31,933,441	37,873,205
1994	766	14,515,625	38,183,499	35,554,196	40,043,006
1995	802	16,657,559	42,418,302	34,050,327	41,414,647
1996	849	15,687,040	51,829,760	35,776,468	44,141,572
1997	893	16,670,940	51,666,207	38,075,021	43,228,478
1998	888	16,154,116	46,134,026	37,422,615	44,371,866
1999	917	15,270,683	45,307,131	38,704,193	43,463,039
2000	960	15,735,037	50,481,620	38,827,360	45,222,044
2001	994	13,198,770	50,568,107	41,326,709	46,558,062
2002	1,039	13,114,661	52,780,152	42,868,826	48,262,159
2003	1,099	13,223,279	55,694,912	44,790,083	50,385,221
2004	1,165	13,414,684	58,937,443	46,809,568	52,616,828
2005	1,239	13,700,454	62,604,106	48,959,592	54,992,685
2006	1,321	14,774,680	66,623,881	51,174,702	57,440,465
2007	1,379	15,604,307	69,438,500	52,667,058	59,089,575
2008	1,440	16,480,518	72,372,026	54,159,415	60,738,686
2009	1,503	17,405,931	75,429,483	55,651,771	62,387,796
2010	1,569	18,383,308	78,616,106	57,144,128	64,036,907
2011	1,638	19,415,566	81,937,353	58,636,485	65,686,017
2012	1,710	20,505,788	85,398,911	60,128,841	67,335,127
2013	1,771	21,474,676	88,256,459	61,327,823	68,660,048
2014	1,833	22,489,343	91,209,624	62,526,805	69,984,968
2015	1,897	23,551,954	94,261,605	63,725,787	71,309,888
2016	1,964	24,380,982	97,579,613	64,924,769	72,634,808
2017	2,033	25,239,193	101,014,416	66,123,751	73,959,729
2018	2,105	26,127,613	104,570,123	67,322,733	75,284,649
2019	2,164	26,863,366	107,514,818	68,285,214	76,348,226
2020	2,225	27,619,839	110,542,435	69,247,694	77,411,804
2021	2,286	28,376,311	113,570,052	70,184,167	78,446,642
2022	2,347	29,132,783	116,597,669	71,096,000	79,454,252
2023	2,408	29,889,256	119,625,287	71,984,457	80,436,030
2024	2,469	30,645,728	122,652,904	72,850,707	81,393,268
2025	2,530	31,402,201	125,680,521	73,695,832	82,327,164
2026	2,591	32,158,673	128,708,138	74,520,839	83,238,827
2027	2,652	32,915,145	131,735,756	75,326,662	84,129,293
2028	2,713	33,671,618	134,763,373	76,114,175	84,999,524

2.3.6 Shipping Services

The PPA provided the project with the data of ship calls to PPA ports for the year 2000. The amount of information processed has been excessive, including over 120,000 vessel movement records which is still only a representative sample of vessel movements for the nation.

Patterns of Shipping Services

Table 5 illustrates the shares of the analysed data over total Philippine shipping services as reported for year 2000 by the PPA Annual Statistical Report.

Table 5 - **Ratios Between Sampled Data and Total Shipping Services**

Ship Calls	**Total**	**Domestic**	**Foreign**
SAMPLE			
Ship Calls	122,725	116,029	6,696
Cargo Throughput	76,067,342	40,490,944	35,576,398
Passenger Traffic	20,748,758		
PPA REPORT 2000			
Ship Calls	369,767	357,745	12,022
Cargo Throughput	170,527,566	92,521,847	78,005,719
Passenger Traffic	56,615,787		
Sample/Universe Ratio (%)			
Ship Calls	33.19	32.43	55.70
Cargo Throughput	44.61	43.76	45.61
Passenger Traffic	36.65		

Source: PPA Annual Statistical Report

Considerable problems were encountered in the conduct of data processing activities. One of the most notable is the volume of the data contained in the two CD-ROMs PPA provided to the project. The data for each port was tabulated and analysed for existence of formulas or reference expressions, these expressions were then replaced with the actual values as contained in each sheet. Afterwards the data for each month was merged[4].

[4] The primary problem with the data for all the ports is that there is no primary key or common coding system for all ports that assigns a unique value to each record of ship visit. Further, the methodology initially included the use of the ship voyage or trip control number, but this proved to be difficult since this number is not in series and sometimes inconsistent in format. So, at the point of merging the data, a primary key was assigned which is a combination of some data already available, such as using the filename as the date then adding the following: port name, pier name, and other relational data. At the end of this key, a series number was assigned for each record starting from 1 to the expected end of the volume (initially estimated as around 240,000 port calls, ship records or other name).

A number of results tables were produced. These data tables are basically the result of analysing the one-year data of the Port Management Offices shown on Table 6.

Table 6 - **Processed Data by Port**

Processed PMOs	**Vessel Port Calls**
PMO Batangas	23,874
PMO Calapan	4,137
PMO Cagayan de Oro	12,535
PMO Cotabato	2,010
PMO Dumaguete	14,746
PMO Davao	11,879
PMO Iligan	10,599
PMO General Santos	4,386
PMO Limay	6,854
PMO MICT	1,849
PMO Nasipit	1,073
PMO North Harbour	6,431
PMO Ozamis	11,350
PMO South Harbour	11,002
Total	**122,725**

Records processed reported the following fields:

(v) Port Name;

(vi) Vessel Size (GRT);

(vii) Vessel Type;

(viii) Import Volumes;

(ix) Export Volumes

(x) Domestic Trade Inbound Volumes;

(xi) Domestic Trade Outbound Volumes;

(xii) Number of Inbound Passengers;

(xiii) Number of Outbound Passengers.

Following the data processing for all ports, the data tables have been produced individually by port, and the master database provided. According to the assumptions made, data have been processed with the aim of producing the pattern of shipping services by vessel type and by vessel size for each class of service.

Four shipping services have been considered:

(i) Cargo imports;

(ii) Cargo exports;

(iii) Cargo traded domestically;

(iv) Passenger Services.

Three vessel types for cargo have been also identified:

(i) Bulk Cargo;

(ii) Break bulk cargo;

(iii) Containerised cargo.

The following fourteen vessel size classes were analysed in terms of Gross Registered Tonnage (GRT):

1.	< 200	8.	10,000 - 15,000
2.	200 - 400	9.	15,000 - 20,000
3.	400 - 600	10.	20,000 - 30,000
4.	600 - 1,000	11.	30,000 - 50,000
5.	1,000 - 3,000	12.	50,000 - 75,000
6.	3,000 - 5,000	13.	75,000 - 100,000
7.	5,000 - 10,000	14.	> 100,000

Table 7 illustrates the distribution of cargo volumes (tons) among the various shipping services by vessel type.

Table 7 - **Distribution of Cargo Volumes by Vessel Types**

Vessel Type	**Distribution of Cargo Volumes By Vessel Type (Percent)**			
	Imports	**Exports**	**Domestic**	**Total**
Bulk	73.78	62.08	48.89	59.60
Break Bulk	17.11	24.12	26.61	22.72
Container	9.11	13.80	24.51	17.68
Total	*100.00*	*100.00*	*100.00*	*100.00*
Total Share (%)	*38.85*	*7.92*	*53.23*	*100.00*

Data analysed allowed elaboration of average volumes of cargo and passengers transported by each vessel class in each shipping service. Table 8 illustrates the average volumes of cargo (tons loaded and/or unloaded) and passengers (number of passengers embarked and/or disembarked) for each vessel size.

Table 8 - **Average Cargo and Passengers Transported by Vessel Size**

Vessel Size (GRT)	Average Volumes (No. of Pass. and Tons) per Vessel			
	Passengers	**Domestic Trade**	**Imports**	**Exports**
< 200	95	65	185	160
200 - 400	110	141	281	338
400 - 600	125	509	589	488
600 - 1,000	160	595	971	938
1,000 - 3,000	256	931	1,320	871
3,000 - 5,000	405	1,039	2,545	1,861
5,000 - 10,000	447	638	2,447	1,484
10,000 - 15,000	416	1,145	3,038	1,270
15,000 - 20,000	681	1,764	3,852	1,080
20,000 - 30,000	64	3,850	19,697	9,350
30,000 - 50,000	322	47,410	36,051	9,338
50,000 - 75,000	2,181	7,509	64,483	58,178
75,000 - 100,000	100	81,119	104,681	97,129
> 100,000	3,671	58,272	241,408	11,933
Total Average	*144*	*362*	*7,281*	*2,284*

Table 9 presents the maritime foreign trade forecasts, and Table 10 illustrates the sample distribution of cargo volumes for imports, exports and domestic trade for the vessel types.

Table 9 **- Maritime Foreign Trade Forecasts**

YEARS	Shares to GDP (%)		Values (P billion at Constant 1985 prices)			Merchandise Shares over Total Trade (%)		Maritime Value Shares to Total Merchandise Trade (%)		Value to Volume Ratios (P per ton)		Maritime Foreign Trade Volumes (Tons)	
	EXPORTS	IMPORTS	GDP	EXPORTS	IMPORTS	EXPORTS	IMPORTS	EXPORTS	IMPORTS	EXPORTS	IMPORTS	EXPORTS	IMPORTS
1986	27.24	23.35	591	161	138	60.2	83.2						
1987	27.88	28.85	617	172	178	62.9	85.3						
1988	29.74	32.17	659	196	212	62.8	87.5						
1989	30.62	35.05	699	214	245	63.8	88.8						
1990	30.24	37.31	721	218	269	65.8	91.2						
1991	32.36	37.10	717	232	266	66.5	90.5						
1992	33.52	40.19	719	241	289	65.3	90.2						
1993	34.88	44.01	734	256	323	66.5	89.6	75.50	80.88	8,565	6,584	15,037,783	35,486,553
1994	40.08	48.17	766	307	369	63.9	89.9	70.93	77.82	9,589	6,764	14,515,625	38,183,499
1995	42.89	53.37	802	344	428	66.3	89.8	64.83	74.03	8,876	6,715	16,657,559	42,418,302
1996	46.76	58.89	849	397	500	62.7	89.7	63.93	73.68	10,154	6,376	15,687,040	51,829,760
1997	52.07	63.61	893	465	568	61.5	85.2	68.37	75.31	11,734	7,047	16,670,940	51,666,207
1998	41.33	54.50	888	367	484	77.1	83.9	71.55	77.89	12,543	6,860	16,154,116	46,134,026
1999	41.55	51.36	917	381	471	80.8	85.0	76.57	76.93	15,428	6,795	15,270,683	45,307,131
2000	42.03	51.28	960	404	492	84.2	90.1	70.24	76.65	15,174	6,735	15,735,037	50,481,620
2001	42.52	51.19	994	423	509	72.1	87.3	70.24	76.65	16,220	6,735	13,198,770	50,568,107
2002	43.02	51.10	1,039	447	531	72.1	87.3	70.24	76.65	17,266	6,735	13,114,661	52,780,152
2003	43.52	51.02	1,099	478	561	72.1	87.3	70.24	76.65	18,311	6,735	13,223,279	55,694,912
2004	44.02	50.93	1,165	513	593	72.1	87.3	70.24	76.65	19,355	6,735	13,414,684	58,937,443
2005	44.54	50.85	1,239	552	630	72.1	87.3	70.24	76.65	20,399	6,735	13,700,454	62,604,106

Table 9 Cont.

YEARS	Shares to GDP (%)		Values (P billion at Constant 1985 prices)			Merchandise Shares over Total Trade (%)		Maritime Value Shares to Total Merchandise Trade (%)		Value to Volume Ratios (P per ton)		Maritime Foreign Trade Volumes (Tons)	
	EXPORTS	IMPORTS	GDP	EXPORTS	IMPORTS	EXPORTS	IMPORTS	EXPORTS	IMPORTS	EXPORTS	IMPORTS	EXPORTS	IMPORTS
2006	45.05	50.76	1,321	595	671	72.1	87.3	70.24	76.65	20,399	6,735	14,774,680	66,623,881
2007	45.58	50.68	1,379	629	699	72.1	87.3	70.24	76.65	20,399	6,735	15,604,307	69,438,500
2008	46.11	50.59	1,440	664	728	72.1	87.3	70.24	76.65	20,399	6,735	16,480,518	72,372,026
2009	46.65	50.51	1,503	701	759	72.1	87.3	70.24	76.65	20,399	6,735	17,405,931	75,429,483
2010	47.19	50.42	1,569	740	791	72.1	87.3	70.24	76.65	20,399	6,735	18,383,308	78,616,106
2011	47.74	50.34	1,638	782	825	72.1	87.3	70.24	76.65	20,399	6,735	19,415,566	81,937,353
2012	48.29	50.25	1,710	826	859	72.1	87.3	70.24	76.65	20,399	6,735	20,505,788	85,398,911
2013	48.86	50.17	1,771	865	888	72.1	87.3	70.24	76.65	20,399	6,735	21,474,676	88,256,459
2014	49.42	50.08	1,833	906	918	72.1	87.3	70.24	76.65	20,399	6,735	22,489,343	91,209,624
2015	50.00	50.00	1,897	949	949	72.1	87.3	70.24	76.65	20,399	6,735	23,551,954	94,261,605
2016	50.00	50.00	1,964	982	982	72.1	87.3	70.24	76.65	20,399	6,735	24,380,982	97,579,613
2017	50.00	50.00	2,033	1,017	1,017	72.1	87.3	70.24	76.65	20,399	6,735	25,239,193	101,014,416
2018	50.00	50.00	2,105	1,052	1,052	72.1	87.3	70.24	76.65	20,399	6,735	26,127,613	104,570,123
2019	50.00	50.00	2,164	1,082	1,082	72.1	87.3	70.24	76.65	20,399	6,735	26,863,366	107,514,818
2020	50.00	50.00	2,225	1,113	1,113	72.1	87.3	70.24	76.65	20,399	6,735	27,619,839	110,542,435
2021	50.00	50.00	2,286	1,143	1,143	72.1	87.3	70.24	76.65	20,399	6,735	28,376,311	113,570,052
2022	50.00	50.00	2,347	1,173	1,173	72.1	87.3	70.24	76.65	20,399	6,735	29,132,783	116,597,669
2023	50.00	50.00	2,408	1,204	1,204	72.1	87.3	70.24	76.65	20,399	6,735	29,889,256	119,625,287
2024	50.00	50.00	2,469	1,234	1,234	72.1	87.3	70.24	76.65	20,399	6,735	30,645,728	122,652,904
2025	50.00	50.00	2,530	1,265	1,265	72.1	87.3	70.24	76.65	20,399	6,735	31,402,201	125,680,521
2026	50.00	50.00	2,591	1,295	1,295	72.1	87.3	70.24	76.65	20,399	6,735	32,158,673	128,708,138
2027	50.00	50.00	2,652	1,326	1,326	72.1	87.3	70.24	76.65	20,399	6,735	32,915,145	131,735,756
2028	50.00	50.00	2,713	1,356	1,356	72.1	87.3	70.24	76.65	20,399	6,735	33,671,618	134,763,373

Table 10 - **Volume Distribution Among Vessel Types By Vessel Size (1 of 3)**

Vessel Size	BULK CARGO			
GRT	IMPORTS	EXPORTS	DOMESTIC	TOTAL
< 200	0.08	0.02	1.46	0.68
200 - 400	0.01	0.24	11.04	4.85
400 - 600	0.01	-	25.79	11.26
600 - 1,000	0.05	0.29	15.56	6.84
1,000 - 3,000	0.86	1.56	26.19	11.98
3,000 - 5,000	4.77	9.64	11.56	8.14
5,000 - 10,000	3.93	12.39	0.5	3.13
10,000 - 15,000	2.37	2.8	1.23	1.91
15,000 - 20,000	1.87	5.39	0.52	1.57
20,000 - 30,000	17.36	40.77	0.01	11.71
30,000 - 50,000	11.66	3.93	1.25	6.48
50,000 - 75,000	5.1	1.56		2.58
75,000 - 100,000	4.32	20.78	4.1	5.58
> 100,000	47.61	0.64	0.8	23.3
TOTAL	**100**	**100**	**100**	**100**

Table 10 - **Volume Distribution Among Vessel Types By Vessel Size (2 of 3)**

Vessel Size	BREAK BULK CARGO			
GRT	IMPORTS	EXPORTS	DOMESTIC	TOTAL
< 200	0.04	-	15.21	9.49
200 - 400	0.4	0.15	25.96	16.31
400 - 600	1.14	0.43	23.85	15.24
600 - 1,000	0.97	0.03	10.85	7.05
1,000 - 3,000	4.44	0.41	9.46	7.23
3,000 - 5,000	16.37	23.47	5.38	10.12
5,000 - 10,000	30.08	67.39	3.52	16.66
10,000 - 15,000	12.65	6.34	3.57	6.46
15,000 - 20,000	12.62	0.52	0.42	4
20,000 - 30,000	15.88	1.07	0.13	4.82
30,000 - 50,000	5.31	0.18	1.22	2.33
50,000 - 75,000	0.1	-	0.28	0.2
75,000 - 100,000	-	-	-	-
> 100,000	-	-	0.16	0.1
TOTAL	**100**	**100**	**100**	**100**

Table 10 - **Volume Distribution Among Vessel Types By Vessel Size (3 of 3)**

Vessel Size	CONTAINERISED CARGO			
GRT	IMPORTS	EXPORTS	DOMESTIC	TOTAL
< 200	-	-	1.27	0.94
200 - 400	-	0.01	0.74	0.55
400 - 600	0.00	0.31	1.44	1.08
600 - 1,000	-	-	2.46	1.81
1,000 - 3,000	0.14	0.95	12.41	9.25
3,000 - 5,000	0.98	0.71	22.58	16.90
5,000 - 10,000	29.91	34.12	37.46	35.74
10,000 - 15,000	29.01	41.30	17.07	20.96
15,000 - 20,000	36.98	21.09	4.58	12.09
20,000 - 30,000	2.96	1.51	-	0.69
30,000 - 50,000	-	-	-	-
50,000 - 75,000	0.00	-	-	0.00
75,000 - 100,000	-	-	-	-
> 100,000	-	-	-	-
TOTAL	**100.00**	**100.00**	**100.00**	**100.00**

Projection of Shipping Traffic

Shipping traffic projections have been carried out according to two main assumptions that can be relaxed after conducting a more detailed study of the sector, which is a task that goes beyond the scope of this study. The two assumption made are:

(i) Shipping traffic distribution among different vessel types remain unchanged for the whole projection time horizon considered (e.g. until 2020);

(ii) Distribution of cargo among different vessel sizes within the same vessel type remains unchanged for the whole projection time horizon.

Assuming the patterns shown, future volumes of cargo and passengers have been transformed in ship calls. Shipping traffic projections are reported, by vessel size, on:

(i) Table 11 : Bulk Vessel Traffic;

(ii) Table 12 : Break Bulk Vessel Traffic;

(iii) Table 13 : Container Vessel Traffic;

(iv) Table 14 : Passenger Vessel Traffic;

(v) Table 15 : Total Vessel Traffic.

Table 11 - **Bulk Cargo Vessel Projections: Ship Calls Per Vessel Size (1 of 4)**

GRT	2000	2001	2002	2003	2004	2005	2006
< 200	8,376	8,903	9,236	9,651	10,088	10,554	11,036
200 - 400	28,853	30,693	31,836	33,261	34,759	36,354	38,002
400 - 600	18,632	19,831	20,571	21,493	22,462	23,494	24,557
600 - 1,000	9,663	10,277	10,660	11,137	11,638	12,173	12,725
1,000 - 3,000	10,762	11,400	11,820	12,347	12,903	13,497	14,118
3,000 - 5,000	5,300	5,483	5,673	5,920	6,184	6,471	6,794
5,000 - 10,000	1,705	1,593	1,627	1,681	1,745	1,819	1,939
10,000 - 15,000	901	892	919	957	999	1,046	1,106
15,000 - 20,000	777	706	716	735	758	786	840
20,000 - 30,000	755	687	699	721	747	779	834
30,000 - 50,000	171	166	171	179	187	197	210
50,000 - 75,000	32	32	33	35	37	39	41
75,000 - 100,000	55	53	54	56	58	61	64
> 100,000	84	83	87	91	96	102	108
TOTAL	**86,065**	**90,798**	**94,101**	**98,264**	**102,662**	**107,372**	**112,376**

Table 11 - **Bulk Cargo Vessel Projections: Ship Calls Per Vessel Size (2 of 4)**

GRT	2007	2008	2009	2010	2011	2012	2013
< 200	11,361	11,686	12,012	12,338	12,664	12,992	13,255
200 - 400	39,112	40,222	41,333	42,444	43,556	44,667	45,561
400 - 600	25,273	25,990	26,706	27,422	28,138	28,855	29,430
600 - 1,000	13,097	13,469	13,842	14,215	14,587	14,960	15,260
1,000 - 3,000	14,538	14,960	15,382	15,806	16,231	16,657	17,001
3,000 - 5,000	7,017	7,243	7,473	7,706	7,942	8,183	8,380
5,000 - 10,000	2,027	2,118	2,213	2,313	2,417	2,526	2,619
10,000 - 15,000	1,149	1,193	1,239	1,285	1,334	1,384	1,426
15,000 - 20,000	880	922	966	1,011	1,060	1,110	1,154
20,000 - 30,000	875	918	963	1,010	1,060	1,112	1,156
30,000 - 50,000	220	229	239	250	261	272	282
50,000 - 75,000	43	45	47	49	51	53	55
75,000 - 100,000	67	70	73	76	79	82	85
> 100,000	113	118	123	128	133	139	143
TOTAL	**115,772**	**119,183**	**122,610**	**126,053**	**129,513**	**132,992**	**135,807**

Table 11 - **Bulk Cargo Vessel Projections: Ship Calls Per Vessel Size (3 of 4)**

GRT	2014	2015	2016	2017	2018	2019	2020
< 200	13,518	13,782	14,046	14,311	14,576	14,790	15,003
200 - 400	46,455	47,349	48,242	49,135	50,029	50,746	51,464
400 - 600	30,005	30,581	31,156	31,732	32,307	32,769	33,231
600 - 1,000	15,560	15,860	16,160	16,460	16,760	17,001	17,242
1,000 - 3,000	17,346	17,692	18,037	18,382	18,729	19,007	19,287
3,000 - 5,000	8,580	8,782	8,981	9,183	9,387	9,553	9,721
5,000 - 10,000	2,715	2,816	2,907	3,001	3,098	3,179	3,261
10,000 - 15,000	1,469	1,513	1,556	1,599	1,644	1,681	1,719
15,000 - 20,000	1,199	1,246	1,287	1,329	1,373	1,409	1,446
20,000 - 30,000	1,203	1,252	1,296	1,341	1,389	1,428	1,468
30,000 - 50,000	292	302	313	324	335	344	353
50,000 - 75,000	57	59	61	63	65	67	69
75,000 - 100,000	88	90	93	96	99	101	104
> 100,000	148	153	158	164	170	174	179
TOTAL	**138,636**	**141,478**	**144,294**	**147,121**	**149,961**	**152,249**	**154,546**

Table 11 - **Bulk Cargo Vessel Projections: Ship Calls Per Vessel Size (4 of 4)**

GRT	2021	2022	2023	2024	2025	2026	2027	2028
< 200	15,278	15,524	15,770	16,016	16,261	16,507	16,753	16,999
200 - 400	52,392	53,220	54,048	54,876	55,704	56,532	57,360	58,188
400 - 600	33,830	34,363	34,896	35,430	35,963	36,496	37,030	37,563
600 - 1,000	17,554	17,832	18,110	18,388	18,666	18,944	19,222	19,500
1,000 - 3,000	19,645	19,966	20,287	20,608	20,929	21,250	21,571	21,892
3,000 - 5,000	9,929	10,118	10,307	10,496	10,684	10,873	11,062	11,251
5,000 - 10,000	3,357	3,447	3,537	3,626	3,716	3,806	3,895	3,985
10,000 - 15,000	1,764	1,805	1,846	1,888	1,929	1,971	2,012	2,053
15,000 - 20,000	1,489	1,529	1,570	1,610	1,650	1,690	1,731	1,771
20,000 - 30,000	1,515	1,558	1,602	1,645	1,689	1,732	1,776	1,819
30,000 - 50,000	364	375	385	395	405	416	426	436
50,000 - 75,000	71	73	75	77	79	81	84	86
75,000 - 100,000	106	109	112	114	117	119	122	125
> 100,000	185	190	195	200	205	210	216	221
TOTAL	**157,479**	**160,109**	**162,739**	**165,369**	**167,998**	**170,628**	**173,258**	**175,888**

Table 12 - **Break Bulk Cargo Vessel Projections: Ship Calls Per Vessel Size (1 of 4)**

GRT	2000	2001	2002	2003	2004	2005	2006
< 200	24,056	25,601	26,557	27,747	28,998	30,330	31,703
200 - 400	19,161	20,377	21,137	22,084	23,080	24,142	25,238
400 - 600	5,094	5,391	5,590	5,840	6,103	6,385	6,680
600 - 1,000	2,008	2,123	2,202	2,300	2,404	2,515	2,632
1,000 - 3,000	1,533	1,569	1,623	1,693	1,768	1,851	1,947
3,000 - 5,000	1,424	1,406	1,450	1,511	1,578	1,654	1,752
5,000 - 10,000	2,401	2,315	2,380	2,475	2,582	2,705	2,874
10,000 - 15,000	1,060	1,020	1,047	1,086	1,130	1,181	1,254
15,000 - 20,000	752	682	693	714	739	769	823
20,000 - 30,000	138	127	130	135	140	147	157
30,000 - 50,000	37	34	34	35	36	38	41
50,000 - 75,000	4	4	4	5	5	5	5
75,000 - 100,000	-	-	-	-	-	-	-
> 100,000	0	0	0	0	0	0	0
TOTAL	**57,667**	**60,651**	**62,847**	**65,624**	**68,565**	**71,722**	**75,107**

Table 12 - **Break Bulk Cargo Vessel Projections: Ship Calls Per Vessel Size (2 of 4)**

GRT	2007	2008	2009	2010	2011	2012	2013
< 200	32,628	33,553	34,478	35,404	36,329	37,254	37,998
200 - 400	25,977	26,717	27,457	28,198	28,939	29,680	30,277
400 - 600	6,880	7,081	7,282	7,484	7,687	7,890	8,055
600 - 1,000	2,711	2,791	2,871	2,951	3,032	3,113	3,178
1,000 - 3,000	2,014	2,082	2,151	2,222	2,294	2,367	2,428
3,000 - 5,000	1,821	1,892	1,966	2,042	2,122	2,203	2,272
5,000 - 10,000	2,996	3,122	3,254	3,391	3,533	3,681	3,806
10,000 - 15,000	1,306	1,361	1,417	1,476	1,536	1,600	1,653
15,000 - 20,000	863	905	949	996	1,045	1,096	1,140
20,000 - 30,000	164	172	180	189	198	207	215
30,000 - 50,000	43	45	47	49	51	54	56
50,000 - 75,000	5	6	6	6	6	6	6
75,000 - 100,000	-	-	-	-	-	-	-
> 100,000	0	0	0	0	0	0	0
TOTAL	**77,410**	**79,727**	**82,059**	**84,407**	**86,771**	**89,152**	**91,084**

Table 12 - **Break Bulk Cargo Vessel Projections: Ship Calls Per Vessel Size (3 of 4)**

GRT	2014	2015	2016	2017	2018	2019	2020
< 200	38,742	39,486	40,229	40,973	41,717	42,314	42,911
200 - 400	30,873	31,470	32,067	32,664	33,262	33,742	34,222
400 - 600	8,220	8,385	8,550	8,716	8,882	9,016	9,150
600 - 1,000	3,244	3,310	3,376	3,442	3,508	3,562	3,616
1,000 - 3,000	2,490	2,553	2,615	2,677	2,741	2,793	2,846
3,000 - 5,000	2,342	2,415	2,486	2,558	2,633	2,694	2,757
5,000 - 10,000	3,935	4,069	4,197	4,329	4,464	4,576	4,691
10,000 - 15,000	1,709	1,766	1,819	1,874	1,931	1,978	2,025
15,000 - 20,000	1,186	1,234	1,276	1,321	1,366	1,404	1,443
20,000 - 30,000	223	232	240	249	257	264	272
30,000 - 50,000	58	60	63	65	67	69	71
50,000 - 75,000	7	7	7	7	7	7	7
75,000 - 100,000	-	-	-	-	-	-	-
> 100,000	0	0	0	0	0	0	0
TOTAL	**93,029**	**94,987**	**96,925**	**98,875**	**100,836**	**102,420**	**104,011**

Table 12 - **Break Bulk Cargo Vessel Projections: Ship Calls Per Vessel Size (4 of 4)**

GRT	2021	2022	2023	2024	2025	2026	2027	2028
< 200	43,684	44,374	45,063	45,752	46,442	47,131	47,821	48,510
200 - 400	34,843	35,397	35,951	36,505	37,059	37,612	38,166	38,720
400 - 600	9,322	9,476	9,630	9,784	9,938	10,092	10,246	10,399
600 - 1,000	3,684	3,746	3,807	3,869	3,930	3,992	4,053	4,115
1,000 - 3,000	2,910	2,969	3,028	3,087	3,146	3,205	3,264	3,323
3,000 - 5,000	2,831	2,900	2,969	3,037	3,106	3,175	3,244	3,312
5,000 - 10,000	4,826	4,952	5,077	5,202	5,328	5,453	5,578	5,704
10,000 - 15,000	2,082	2,134	2,186	2,239	2,291	2,343	2,395	2,448
15,000 - 20,000	1,488	1,531	1,573	1,615	1,657	1,699	1,742	1,784
20,000 - 30,000	280	288	296	304	312	320	328	336
30,000 - 50,000	73	75	77	79	81	83	85	87
50,000 - 75,000	7	7	8	8	8	8	8	8
75,000 - 100,000	-	-	-	-	-	-	-	-
> 100,000	1	1	1	1	1	1	1	1
TOTAL	**106,033**	**107,849**	**109,665**	**111,481**	**113,298**	**115,114**	**116,930**	**118,747**

Table 13 - **Container Cargo Vessel Projections: Ship Calls Per Vessel Size (1 of 4)**

GRT	2000	2001	2002	2003	2004	2005	2006
< 200	22,129	23,554	24,433	25,528	26,679	27,904	29,167
200 - 400	17,495	18,621	19,316	20,181	21,091	22,060	23,058
400 - 600	4,469	4,754	4,931	5,152	5,383	5,630	5,886
600 - 1,000	1,734	1,846	1,915	2,000	2,091	2,187	2,285
1,000 - 3,000	995	1,053	1,092	1,140	1,191	1,245	1,302
3,000 - 5,000	519	549	569	595	622	651	681
5,000 - 10,000	1,586	1,541	1,584	1,645	1,715	1,794	1,903
10,000 - 15,000	1,442	1,348	1,375	1,420	1,472	1,534	1,634
15,000 - 20,000	889	822	840	870	905	946	1,011
20,000 - 30,000	14	13	14	14	15	16	17
30,000 - 50,000	2	3	3	3	3	3	3
50,000 - 75,000	4	4	4	4	4	4	5
75,000 - 100,000	-	-	-	-	-	-	-
> 100,000	0	0	0	0	0	0	0
TOTAL	**51,278**	**54,108**	**56,075**	**58,553**	**61,171**	**63,973**	**66,951**

Table 13 - **Container Cargo Vessel Projections: Ship Calls Per Vessel Size (2 of 4)**

GRT	2007	2008	2009	2010	2011	2012	2013
< 200	30,017	30,868	31,718	32,569	33,419	34,270	34,953
200 - 400	23,730	24,403	25,075	25,748	26,420	27,092	27,633
400 - 600	6,058	6,230	6,402	6,574	6,746	6,918	7,057
600 - 1,000	2,352	2,419	2,485	2,552	2,619	2,685	2,739
1,000 - 3,000	1,341	1,379	1,418	1,457	1,496	1,535	1,567
3,000 - 5,000	701	721	742	763	783	804	821
5,000 - 10,000	1,981	2,061	2,145	2,231	2,321	2,415	2,493
10,000 - 15,000	1,707	1,783	1,863	1,946	2,032	2,123	2,200
15,000 - 20,000	1,059	1,109	1,162	1,217	1,275	1,335	1,387
20,000 - 30,000	17	18	19	19	20	21	22
30,000 - 50,000	3	3	4	4	4	4	4
50,000 - 75,000	5	5	5	5	5	5	6
75,000 - 100,000	-	-	-	-	-	-	-
> 100,000	0	0	0	0	0	0	0
TOTAL	**68,971**	**71,000**	**73,038**	**75,085**	**77,142**	**79,209**	**80,882**

Table 13 - **Container Cargo Vessel Projections: Ship Calls Per Vessel Size (3 of 4)**

GRT	2014	2015	2016	2017	2018	2019	2020
< 200	35,637	36,320	37,003	37,687	38,370	38,919	39,467
200 - 400	28,173	28,713	29,253	29,794	30,334	30,768	31,201
400 - 600	7,195	7,334	7,472	7,610	7,749	7,860	7,971
600 - 1,000	2,792	2,846	2,900	2,953	3,007	3,050	3,093
1,000 - 3,000	1,599	1,630	1,662	1,693	1,725	1,750	1,775
3,000 - 5,000	837	854	871	888	905	919	932
5,000 - 10,000	2,575	2,659	2,738	2,820	2,904	2,973	3,044
10,000 - 15,000	2,281	2,364	2,439	2,517	2,597	2,663	2,730
15,000 - 20,000	1,441	1,497	1,549	1,603	1,659	1,705	1,752
20,000 - 30,000	23	23	24	25	26	26	27
30,000 - 50,000	4	4	4	4	4	4	4
50,000 - 75,000	6	6	6	6	6	6	6
75,000 - 100,000	-	-	-	-	-	-	-
> 100,000	0	0	0	0	0	0	0
TOTAL	**82,562**	**84,251**	**85,922**	**87,600**	**89,285**	**90,642**	**92,004**

Table 13 - **Container Cargo Vessel Projections: Ship Calls Per Vessel Size (4 of 4)**

GRT	2021	2022	2023	2024	2025	2026	2027	2028
< 200	40,178	40,811	41,444	42,077	42,711	43,344	43,977	44,611
200 - 400	31,763	32,264	32,764	33,265	33,766	34,266	34,767	35,268
400 - 600	8,115	8,243	8,371	8,500	8,628	8,756	8,884	9,012
600 - 1,000	3,148	3,198	3,248	3,297	3,347	3,396	3,446	3,496
1,000 - 3,000	1,808	1,837	1,866	1,896	1,925	1,954	1,983	2,013
3,000 - 5,000	950	965	981	997	1,013	1,028	1,044	1,060
5,000 - 10,000	3,128	3,205	3,283	3,360	3,438	3,515	3,593	3,670
10,000 - 15,000	2,810	2,884	2,957	3,031	3,105	3,179	3,253	3,326
15,000 - 20,000	1,807	1,859	1,910	1,962	2,013	2,065	2,116	2,167
20,000 - 30,000	28	28	29	30	31	31	32	33
30,000 - 50,000	4	5	5	5	5	5	5	5
50,000 - 75,000	6	7	7	7	7	7	7	7
75,000 - 100,000	-	-	-	-	-	-	-	-
> 100,000	0	0	0	0	0	1	1	1
TOTAL	**93,745**	**95,306**	**96,866**	**98,427**	**99,987**	**101,547**	**103,108**	**104,668**

Table 14 - **Projections Of Passenger Vessels By Size (1 of 4)**

GRT	2000	2001	2002	2003	2004	2005	2006
< 200	94,689	97,486	101,055	105,500	110,173	115,147	120,273
200 - 400	42,525	43,782	45,384	47,381	49,479	51,713	54,015
400 - 600	16,610	17,100	17,726	18,506	19,326	20,198	21,097
600 - 1,000	5,511	5,674	5,882	6,141	6,413	6,702	7,001
1,000 - 3,000	5,125	5,277	5,470	5,710	5,963	6,232	6,510
3,000 - 5,000	2,774	2,856	2,960	3,090	3,227	3,373	3,523
5,000 - 10,000	5,479	5,641	5,848	6,105	6,375	6,663	6,960
10,000 - 15,000	1,743	1,794	1,860	1,941	2,027	2,119	2,213
15,000 - 20,000	289	297	308	322	336	351	367
20,000 - 30,000	17	18	19	19	20	21	22
30,000 - 50,000	16	17	17	18	19	20	21
50,000 - 75,000	40	42	43	45	47	49	51
75,000 - 100,000	13	13	14	15	15	16	17
> 100,000	22	22	23	24	25	27	28
TOTAL	**174,854**	**180,020**	**186,609**	**194,818**	**203,447**	**212,633**	**222,097**

Table 14 - **Projections Of Passenger Vessels By Size (2 of 4)**

GRT	2007	2008	2009	2010	2011	2012	2013
< 200	123,726	127,179	130,632	134,085	137,538	140,991	143,765
200 - 400	55,566	57,117	58,668	60,218	61,769	63,320	64,566
400 - 600	21,703	22,309	22,915	23,520	24,126	24,732	25,218
600 - 1,000	7,202	7,403	7,604	7,805	8,006	8,207	8,368
1,000 - 3,000	6,697	6,884	7,071	7,257	7,444	7,631	7,781
3,000 - 5,000	3,624	3,725	3,827	3,928	4,029	4,130	4,211
5,000 - 10,000	7,160	7,360	7,559	7,759	7,959	8,159	8,319
10,000 - 15,000	2,277	2,340	2,404	2,467	2,531	2,595	2,646
15,000 - 20,000	377	388	398	409	419	430	438
20,000 - 30,000	23	23	24	25	25	26	26
30,000 - 50,000	21	22	23	23	24	24	25
50,000 - 75,000	53	54	56	57	59	60	61
75,000 - 100,000	17	18	18	19	19	19	20
> 100,000	28	29	30	31	32	32	33
TOTAL	**228,474**	**234,850**	**241,227**	**247,603**	**253,979**	**260,356**	**265,479**

Table 14 - **Projections Of Passenger Vessels By Size (3 of 4)**

GRT	2014	2015	2016	2017	2018	2019	2020
< 200	146,539	149,314	152,088	154,862	157,636	159,863	162,090
200 - 400	65,812	67,058	68,304	69,549	70,795	71,796	72,796
400 - 600	25,705	26,192	26,678	27,165	27,651	28,042	28,433
600 - 1,000	8,529	8,691	8,852	9,014	9,175	9,305	9,435
1,000 - 3,000	7,932	8,082	8,232	8,382	8,532	8,653	8,773
3,000 - 5,000	4,292	4,374	4,455	4,536	4,618	4,683	4,748
5,000 - 10,000	8,480	8,640	8,801	8,962	9,122	9,251	9,380
10,000 - 15,000	2,697	2,748	2,799	2,850	2,901	2,942	2,983
15,000 - 20,000	447	455	464	472	481	488	494
20,000 - 30,000	27	27	28	29	29	29	30
30,000 - 50,000	25	26	26	27	27	28	28
50,000 - 75,000	62	64	65	66	67	68	69
75,000 - 100,000	20	21	21	21	22	22	22
> 100,000	34	34	35	36	36	37	37
TOTAL	**270,602**	**275,725**	**280,847**	**285,970**	**291,093**	**295,206**	**299,318**

Table 14 - **Projections Of Passenger Vessels By Size (4 of 4)**

GRT	2021	2022	2023	2024	2025	2026	2027	2028
< 200	164,974	167,545	170,116	172,687	175,258	177,829	180,400	182,970
200 - 400	74,091	75,245	76,400	77,555	78,709	79,864	81,019	82,173
400 - 600	28,939	29,390	29,841	30,291	30,742	31,193	31,644	32,095
600 - 1,000	9,602	9,752	9,902	10,051	10,201	10,351	10,500	10,650
1,000 - 3,000	8,929	9,068	9,208	9,347	9,486	9,625	9,764	9,903
3,000 - 5,000	4,832	4,908	4,983	5,058	5,134	5,209	5,284	5,360
5,000 - 10,000	9,547	9,695	9,844	9,993	10,142	10,291	10,439	10,588
10,000 - 15,000	3,036	3,083	3,131	3,178	3,225	3,272	3,320	3,367
15,000 - 20,000	503	511	519	527	535	542	550	558
20,000 - 30,000	30	31	31	32	32	33	33	34
30,000 - 50,000	28	29	29	30	30	31	31	32
50,000 - 75,000	70	71	72	74	75	76	77	78
75,000 - 100,000	23	23	23	24	24	25	25	25
> 100,000	38	39	39	40	40	41	42	42
TOTAL	**304,643**	**309,391**	**314,138**	**318,886**	**323,633**	**328,381**	**333,128**	**337,876**

Table 15 - **Projections Of Total Shipping Traffic By Vessel Size (1 of 4)**

GRT	2000	2001	2002	2003	2004	2005	2006
< 200	149,251	155,544	161,280	168,425	175,937	183,936	192,178
200 - 400	108,034	113,473	117,672	122,907	128,410	134,269	140,313
400 - 600	44,805	47,077	48,819	50,991	53,275	55,708	58,220
600 - 1,000	18,917	19,920	20,658	21,578	22,546	23,577	24,643
1,000 - 3,000	18,414	19,299	20,004	20,890	21,825	22,825	23,877
3,000 - 5,000	10,016	10,294	10,653	11,116	11,611	12,148	12,750
5,000 - 10,000	11,172	11,091	11,438	11,907	12,417	12,981	13,676
10,000 - 15,000	5,145	5,054	5,201	5,405	5,629	5,880	6,207
15,000 - 20,000	2,706	2,508	2,558	2,640	2,738	2,852	3,041
20,000 - 30,000	923	846	862	890	923	963	1,030
30,000 - 50,000	227	219	225	235	246	258	275
50,000 - 75,000	80	81	84	88	93	97	102
75,000 - 100,000	68	66	68	71	73	77	81
> 100,000	106	106	111	116	122	129	137
TOTAL	**369,865**	**385,577**	**399,632**	**417,258**	**435,845**	**455,699**	**476,531**

Table 15 - **Projections Of Total Shipping Traffic By Vessel Size (2 of 4)**

GRT	2007	2008	2009	2010	2011	2012	2013
< 200	197,732	203,286	208,840	214,395	219,951	225,507	229,971
200 - 400	144,386	148,459	152,533	156,608	160,684	164,760	168,036
400 - 600	59,914	61,609	63,304	65,000	66,697	68,395	69,760
600 - 1,000	25,362	26,082	26,802	27,522	28,243	28,965	29,545
1,000 - 3,000	24,590	25,305	26,022	26,742	27,465	28,191	28,778
3,000 - 5,000	13,163	13,583	14,007	14,438	14,876	15,320	15,683
5,000 - 10,000	14,163	14,661	15,171	15,694	16,230	16,780	17,238
10,000 - 15,000	6,439	6,677	6,922	7,174	7,434	7,701	7,925
15,000 - 20,000	3,179	3,324	3,475	3,633	3,798	3,971	4,119
20,000 - 30,000	1,079	1,131	1,186	1,243	1,303	1,366	1,420
30,000 - 50,000	287	299	312	326	340	354	367
50,000 - 75,000	106	110	113	117	121	125	128
75,000 - 100,000	84	87	91	94	98	102	105
> 100,000	142	148	154	160	166	172	177
TOTAL	**490,627**	**504,760**	**518,933**	**533,148**	**547,405**	**561,708**	**573,251**

Table 15 - **Projections Of Total Shipping Traffic By Vessel Size (3 of 4)**

GRT	2014	2015	2016	2017	2018	2019	2020
< 200	234,436	238,901	243,367	247,833	252,300	255,886	259,472
200 - 400	171,313	174,590	177,866	181,143	184,420	187,052	189,683
400 - 600	71,125	72,491	73,857	75,223	76,590	77,687	78,785
600 - 1,000	30,126	30,707	31,288	31,869	32,450	32,917	33,385
1,000 - 3,000	29,366	29,957	30,545	31,135	31,727	32,203	32,681
3,000 - 5,000	16,052	16,425	16,793	17,165	17,542	17,848	18,157
5,000 - 10,000	17,705	18,184	18,643	19,111	19,589	19,979	20,376
10,000 - 15,000	8,155	8,391	8,613	8,840	9,073	9,263	9,457
15,000 - 20,000	4,272	4,432	4,576	4,725	4,879	5,006	5,136
20,000 - 30,000	1,476	1,535	1,588	1,643	1,700	1,748	1,796
30,000 - 50,000	379	393	406	419	433	444	456
50,000 - 75,000	132	135	138	142	146	149	152
75,000 - 100,000	108	111	114	117	121	123	126
> 100,000	183	188	194	200	207	212	217
TOTAL	**584,828**	**596,440**	**607,989**	**619,567**	**631,175**	**640,517**	**649,880**

Table 15 - **Projections Of Total Shipping Traffic By Vessel Size (4 of 4)**

GRT	2021	2022	2023	2024	2025	2026	2027	2028
< 200	264,114	268,253	272,393	276,533	280,671	284,811	288,950	293,090
200 - 400	193,089	196,126	199,163	202,200	205,237	208,275	211,312	214,349
400 - 600	80,205	81,471	82,738	84,005	85,271	86,537	87,804	89,070
600 - 1,000	33,989	34,528	35,066	35,605	36,144	36,683	37,222	37,760
1,000 - 3,000	33,293	33,841	34,390	34,938	35,486	36,034	36,583	37,131
3,000 - 5,000	18,542	18,891	19,240	19,589	19,936	20,285	20,634	20,983
5,000 - 10,000	20,858	21,299	21,741	22,182	22,623	23,065	23,506	23,947
10,000 - 15,000	9,692	9,906	10,120	10,336	10,550	10,765	10,980	11,194
15,000 - 20,000	5,288	5,429	5,572	5,713	5,855	5,996	6,139	6,280
20,000 - 30,000	1,853	1,905	1,959	2,011	2,064	2,116	2,169	2,222
30,000 - 50,000	470	483	496	508	521	534	547	559
50,000 - 75,000	155	158	162	165	168	172	176	179
75,000 - 100,000	129	132	135	138	141	144	147	150
> 100,000	224	230	235	241	246	252	259	264
TOTAL	**661,900**	**672,654**	**683,409**	**694,163**	**704,915**	**715,669**	**726,426**	**737,179**

2.4 Benefit Assessment

Two benefits have been assessed; (i) vessel operating cost savings, calculated by vessel type and size; and (ii) passenger time savings.

2.4.1 Vessel Operating Costs

Average vessel operating costs have been estimated for vessel size classifications for the four vessel groups for Philippine commercial shipping, using proprietary models[5]. These are summarized as follows;

Table 16 - **Hourly Operating Costs per Vessel Type and Size**

Vessel Size	Estimated Hourly Operating Costs (US$)			
GRT	Bulk Cargo	Break Bulk	Container	Passengers
< 200	38	40	40	62
200 - 400	54	57	57	86
400 - 600	68	73	73	130
600 - 1,000	84	87	139	211
1,000 - 3,000	138	152	193	419
3,000 - 5,000	198	190	251	547
5,000 - 10,000	261	284	327	720
10,000 - 15,000	327	320	451	936
15,000 - 20,000	432	423	585	1,260
20,000 - 30,000	541	528	758	1,598
30,000 - 50,000	643	643	985	1,826
50,000 - 75,000	774	774	1,482	2,041
75,000 - 100,000	1,004	1,004	1,505	2,390
> 100,000	1,308	1,308	1,961	3,631

Source: Meyrick and Associates, Maritime Economics Consultancy

The data and costing models utilized to derive these estimates have been applied in a wide range of studies for international organizations, port authorities, national governments and shipper interests. They were adapted for the present project through specific modifications to reflect:

(i) Fuel costs in the Philippines;

(ii) Labor costs in the Philippines;

(iii) The type and age of vessels currently used in the Philippines

[5] Information provided by Meyrick and Associates, a specialist maritime economics consultancy

The unit costs presented are intended as a guide to the typical long run costs of vessel provision and operation. Costs for individual vessels vary widely depending on time and place of construction, financing arrangements, manning agreements, maintenance practices, vessel operating speed, location of operation and a host of other factors.

Passenger vessel costs in particular can vary dramatically, depending on the quality of the accommodation and quality of passenger service provided. The costs in the accompanying estimates are intended to reflect the type of passenger vessel most commonly used in the Philippines: a ro-ro vessel designed to carry a mix of passengers and freight.

Ship costs are estimated using a synthetic approach, building up the total daily cost from estimates for each individual component. The approach taken to each of the major cost components is outlined below;

Capital Costs

Capital costs are estimated using the following procedure:

(i) typical replacement costs for each vessel type and size are estimated using information from in-house databases[6];

(ii) an average age, economic life and residual value for each vessel type and size is assumed;

(iii) depreciation costs are estimated on a straight-line basis over the life of the vessel

(iv) estimated written down replacement costs are estimate for 'typical' vessels in each category;

(v) a cost of capital of 10% per annum is applied to this value to estimate the required return on capital; and

(vi) capital costs are estimated as the sum of depreciation and required return.

An alternative approach would have been to simply amortize the new building costs over the life of the vessel as a constant annuity. However, this approach does not adequately reflect the reduction in capital costs that result from the use of older vessels in the Philippines and most other developing countries.

Fuel Costs

The relationship between fuel consumption and size for each type of vessels was estimated using in-house databases. These relationships were used to estimate typical fuel consumption for each vessel class used in the analysis. Fuel prices obtained from suppliers of bunkers in the Philippines were applied to these consumption rates to estimate fuel costs.

[6] Shipbuilding markets are notoriously volatile. The replacement costs used in the analysis are the estimated long run equilibrium costs — that is, we have attempted to smooth out the short run cyclical effects that arise from imbalances in demand for and supply of shipbuilding capacity.

Crew Costs

Typical crew complements were based on information obtained on regulatory requirements on crew size and composition promulgated by Marina. Rates of pay were estimated at approximately 70% of the minimum ITF standards for vessels trading internationally.

Insurance

Insurance costs were estimated as a percentage of the vessel value. In line with commercial practice, the percentage applied was higher for older than for newer vessels.

Maintenance Costs

Maintenance costs were estimated as a percentage of the replacement cost of the vessel. The percentage applied was increased with each year by which the age of the vessel exceeds a specified threshold value.

Stores and Lubes

This cost component was also estimated as a percentage of vessel replacement cost.

Administration

Vessel administration costs were estimated as a margin on direct vessel costs.

2.4.2 Passenger Time Savings

Passenger time savings have been established using the following procedure;

(i) Calculating the yearly GDP per employed person for the year 2001, which is US$ 2,642;

(ii) Calculating the hourly GDP per employed person, by dividing the yearly GDP per employed by an assumed average yearly number of hours (8,760), equating to US$ 1.25 per hour;

(iii) By assuming this average, the time value has been expressed as a percentage of the hourly GDP per employed person. This percentage is in general terms set at 25 percent, therefore the unit hourly value of time is of the order of US$ 0.3127[7].

2.4.3 Voyage Duration Assessment

Unit benefits have also been applied to the different vessels (and to their projections) under the following assumptions;

(i) The larger the vessel size, the larger the time saved or lost due to the presence or absence of hydrographic maps and services;

[7] This assumption is in general terms made in a large number of transport studies, and considered an accepted practice to estimate time value.

(ii) As a consequence of curtailment of hydrographic services, the hydrographic charts will become increasingly obsolete over time;

(iii) The rate of obsolescence of charts will vary between ports according to certain characteristics, including geographical features and processes and the rate of infrastructure development, but average estimates may be assumed;;

(iv) Cartographic obsolescence occurs sooner and with greater impact for larger vessels.

Table 17 summarizes the assumptions regarding time gains and losses per vessel size over time, assuming that the hydrographic services cease completely, and compared with the current level of investment;

Table 17 - **Time Losses/Savings Over Time Per Vessel Size (Minutes)**

Vessel Size (GRT)	Year 5	Year 10	Year 15	Year 20	Year 25
< 1,000 Tons	1	2	3	4	5
1,000 to 5,000 Tons	3	6	9	12	15
5,000 to 20,000 Tons	5	10	15	20	25
20,000 to 100,000 Tons	8	16	24	32	40
> 100,000 Tons	10	20	30	40	50

2.5 Results

The evaluation process has been implemented on the assumption that hydrographic services cease completely at the commencement of the evaluation period, resulting in the progressive degradation in hydrographic charts and services, in turn resulting in the lengthening of vessel voyage duration, as elaborated in Table 17. The impact in terms of vessel operating cost-increases, and passenger time-losses for the various size classifications of the four vessel types are presented on the following tables;

Table 18 - **Vessel Operating Cost Losses If Hydrographic Services Suspend Activity: Bulk Vessels (US$) – (1 of 4)**

GRT	2003	2004	2005	2006	2007	2008
< 200	1,528	3,195	5,013	6,989	8,265	9,766
200 - 400	7,484	15,642	24,539	34,201	40,435	47,766
400 - 600	6,090	12,729	19,970	27,831	32,902	38,866
600 - 1,000	3,898	8,147	12,781	17,815	21,062	24,882
1,000 - 3,000	21,222	44,354	69,592	97,061	114,813	135,709
3,000 - 5,000	14,652	30,610	48,044	67,263	79,801	94,622
5,000 - 10,000	9,142	18,974	29,674	42,174	50,633	60,784
10,000 - 15,000	6,521	13,612	21,376	30,146	35,966	42,899
15,000 - 20,000	6,613	13,645	21,223	30,238	36,387	43,786
20,000 - 30,000	13,003	26,954	42,143	60,176	72,504	87,362
30,000 - 50,000	3,830	8,034	12,696	18,039	21,633	25,943
50,000 - 75,000	894	1,887	3,000	4,260	5,104	6,116
75,000 - 100,000	1,872	3,892	6,092	8,619	10,311	12,334
> 100,000	4,970	10,490	16,668	23,639	28,296	33,870
TOTAL	**101,717**	**212,163**	**332,810**	**468,452**	**558,114**	**664,703**

Table 18 - **Vessel Operating Cost Losses If Hydrographic Services Suspend Activity: Bulk Vessels (US$) – (2 of 4)**

GRT	2009	2010	2011	2012	2013	2014	2015
< 200	11,531	13,605	16,042	17,846	19,745	21,839	24,146
200 - 400	56,385	66,510	78,400	87,193	96,450	106,649	117,884
400 - 600	45,876	54,111	63,780	70,928	78,454	86,745	95,876
600 - 1,000	29,373	34,648	40,845	45,427	50,252	55,568	61,425
1,000 - 3,000	160,292	189,200	223,177	248,387	274,930	304,203	336,478
3,000 - 5,000	112,134	132,823	157,256	175,700	195,132	216,664	240,520
5,000 - 10,000	72,968	87,590	105,141	119,152	133,979	150,655	169,412
10,000 - 15,000	51,154	60,986	72,693	81,790	91,385	102,098	114,062
15,000 - 20,000	52,687	63,398	76,286	86,662	97,676	110,095	124,097
20,000 - 30,000	105,268	126,850	152,863	173,919	196,217	221,384	249,789
30,000 - 50,000	31,111	37,309	44,743	50,657	56,882	63,874	71,726
50,000 - 75,000	7,328	8,780	10,520	11,901	13,350	14,975	16,798
75,000 - 100,000	14,751	17,639	21,091	23,806	26,677	29,893	33,497
> 100,000	40,542	48,526	58,081	65,630	73,550	82,425	92,371
TOTAL	**791,398**	**941,974**	**1,120,919**	**1,259,001**	**1,404,680**	**1,567,066**	**1,748,081**

Table 18 - **Vessel Operating Cost Losses If Hydrographic Services Suspend Activity: Bulk Vessels (US$) – (3 of 4)**

GRT	2016	2017	2018	2019	2020	2021	2022
< 200	26,688	28,801	31,073	33,394	35,883	38,705	41,122
200 - 400	130,254	140,523	151,552	162,829	174,911	188,612	200,337
400 - 600	105,932	114,278	123,241	132,407	142,226	153,361	162,888
600 - 1,000	67,872	73,226	78,977	84,856	91,156	98,300	104,414
1,000 - 3,000	372,008	401,587	433,387	465,886	500,731	540,250	574,134
3,000 - 5,000	266,747	288,885	312,798	337,177	363,415	393,186	418,951
5,000 - 10,000	189,679	207,422	226,821	246,477	267,835	292,095	313,582
10,000 - 15,000	127,183	138,500	150,813	163,321	176,859	192,230	205,721
15,000 - 20,000	139,001	152,067	166,359	180,838	196,576	214,452	230,299
20,000 - 30,000	280,419	307,477	337,145	367,163	399,854	436,995	470,069
30,000 - 50,000	80,456	88,147	96,572	105,101	114,382	124,926	134,301
50,000 - 75,000	18,858	20,678	22,674	24,693	26,892	29,390	31,615
75,000 - 100,000	37,404	40,793	44,487	48,235	52,298	56,912	60,975
> 100,000	103,611	113,513	124,361	135,341	147,291	160,867	172,936
TOTAL	**1,946,113**	**2,115,897**	**2,300,258**	**2,487,719**	**2,690,309**	**2,920,280**	**3,121,346**

Table 18 - **Vessel Operating Cost Losses If Hydrographic Services Suspend Activity: Bulk Vessels (US$) – (4 of 4)**

GRT	2023	2024	2025	2026	2027	2028
< 200	43,680	46,385	49,246	52,272	55,472	58,854
200 - 400	212,740	225,857	239,728	254,395	269,902	286,294
400 - 600	172,966	183,624	194,895	206,812	219,411	232,730
600 - 1,000	110,882	117,722	124,956	132,605	140,692	149,241
1,000 - 3,000	609,986	647,914	688,034	730,466	775,338	822,785
3,000 - 5,000	446,249	475,166	505,793	538,226	572,566	608,919
5,000 - 10,000	336,423	360,695	386,482	413,872	442,957	473,834
10,000 - 15,000	220,042	235,243	251,372	268,483	286,633	305,881
15,000 - 20,000	247,147	265,052	284,077	304,287	325,749	348,537
20,000 - 30,000	505,253	542,669	582,447	624,727	669,652	717,377
30,000 - 50,000	144,272	154,872	166,140	178,114	190,835	204,345
50,000 - 75,000	33,981	36,498	39,174	42,018	45,040	48,250
75,000 - 100,000	65,291	69,873	74,737	79,900	85,379	91,191
> 100,000	185,772	199,420	213,926	229,341	245,718	263,112
TOTAL	**3,334,683**	**3,560,990**	**3,801,009**	**4,055,519**	**4,325,344**	**4,611,350**

Table 19 - **Vessel Operating Cost Losses If Hydrographic Services Suspend Activity: Breakbulk Vessels (US$) – (1 of 4)**

GRT	2003	2004	2005	2006	2007	2008
< 200	4,624	9,666	15,165	21,135	24,986	29,516
200 - 400	5,245	10,963	17,201	23,976	28,348	33,491
400 - 600	1,776	3,713	5,826	8,128	9,616	11,367
600 - 1,000	834	1,743	2,735	3,817	4,516	5,340
1,000 - 3,000	3,216	6,719	10,550	14,798	17,581	20,876
3,000 - 5,000	3,588	7,496	11,786	16,641	19,870	23,720
5,000 - 10,000	14,644	30,556	48,011	68,027	81,450	97,510
10,000 - 15,000	7,240	15,072	23,624	33,440	40,017	47,879
15,000 - 20,000	6,291	13,021	20,324	29,011	34,950	42,106
20,000 - 30,000	2,375	4,941	7,750	11,047	13,289	15,987
30,000 - 50,000	756	1,564	2,439	3,479	4,188	5,042
50,000 - 75,000	119	249	391	545	645	763
75,000 - 100,000	-	-	-	-	-	-
> 100,000	18	37	58	80	95	112
TOTAL	**50,725**	**105,739**	**165,861**	**234,126**	**279,552**	**333,710**

Table 19 - **Vessel Operating Cost Losses If Hydrographic Services Suspends Activity: Breakbulk Vessels (US$) – (2 of 4)**

GRT	2009	2010	2011	2012	2013	2014	2015
< 200	34,839	41,094	48,439	53,868	59,585	65,883	72,820
200 - 400	39,537	46,640	54,984	61,156	67,655	74,815	2,704
400 - 600	13,429	15,854	18,705	20,822	23,051	25,510	28,222
600 - 1,000	6,309	7,450	8,792	9,789	10,839	11,998	13,276
1,000 - 3,000	24,779	29,398	34,866	39,024	43,407	48,272	53,675
3,000 - 5,000	28,311	33,784	40,309	45,399	50,765	56,763	63,467
5,000 - 10,000	116,725	139,714	167,221	188,943	211,865	237,568	266,391
10,000 - 15,000	57,277	68,513	81,945	92,524	103,700	116,226	130,264
15,000 - 20,000	50,729	61,119	73,640	83,768	94,502	106,615	120,287
20,000 - 30,000	19,233	23,139	27,838	31,621	35,619	40,125	45,203
30,000 - 50,000	6,071	7,309	8,799	10,002	11,277	12,715	14,337
50,000 - 75,000	901	1,063	1,255	1,397	1,546	1,711	1,893
75,000 - 100,000	-	-	-	-	-	-	-
> 100,000	133	156	184	205	227	251	277
TOTAL	**398,272**	**475,234**	**566,976**	**638,519**	**714,038**	**798,452**	**892,815**

Table 19 - **Vessel Operating Cost Losses If Hydrographic Services Suspend Activity: Breakbulk Vessels (US$) – (3 of 4)**

GRT	2016	2017	2018	2019	2020	2021	2022
< 200	80,459	86,799	93,609	100,572	108,032	116,492	123,731
200 - 400	91,391	98,607	106,358	114,283	122,774	132,404	140,648
400 - 600	31,208	33,697	36,373	39,108	42,040	45,367	48,220
600 - 1,000	14,684	15,859	17,122	18,413	19,798	21,368	22,716
1,000 - 3,000	59,614	64,659	70,120	75,681	81,676	88,479	94,391
3,000 - 5,000	70,841	77,225	84,181	91,242	98,893	107,580	115,222
5,000 - 10,000	297,975	325,533	355,630	386,144	419,271	456,895	490,152
10,000 - 15,000	145,547	158,830	173,318	188,016	203,957	222,060	238,023
15,000 - 20,000	134,969	147,917	162,106	176,467	192,100	209,860	225,660
20,000 - 30,000	50,728	55,602	60,945	66,351	72,238	78,925	84,876
30,000 - 50,000	16,077	17,608	19,285	20,983	22,830	24,929	26,793
50,000 - 75,000	2,093	2,260	2,439	2,622	2,819	3,042	3,233
75,000 - 100,000	-	-	-	-	-	-	-
> 100,000	306	330	356	383	411	443	471
TOTAL	**995,892**	**1,084,926**	**1,181,842**	**1,280,265**	**1,386,839**	**1,507,842**	**1,614,136**

Table 19 - **Vessel Operating Cost Losses If Hydrographic Service Suspends Activity: Breakbulk Vessels (US$) – (4 of 4)**

GRT	2023	2024	2025	2026	2027	2028
< 200	131,388	139,486	148,049	157,104	166,677	176,796
200 - 400	149,368	158,591	168,345	178,659	189,564	201,092
400 - 600	51,240	54,435	57,815	61,390	65,171	69,170
600 - 1,000	24,143	25,653	27,250	28,940	30,727	32,617
1,000 - 3,000	100,658	107,301	114,340	121,798	129,699	138,068
3,000 - 5,000	123,339	131,956	141,102	150,809	161,108	172,033
5,000 - 10,000	525,493	563,039	602,918	645,264	690,220	737,935
10,000 - 15,000	254,980	272,990	292,112	312,412	333,956	356,815
15,000 - 20,000	242,465	260,334	279,329	299,516	320,964	343,745
20,000 - 30,000	91,206	97,937	105,092	112,697	120,776	129,359
30,000 - 50,000	28,776	30,884	33,125	35,505	38,034	40,720
50,000 - 75,000	3,435	3,650	3,876	4,116	4,369	4,637
75,000 - 100,000	-	-	-	-	-	-
> 100,000	500	531	563	598	634	673
TOTAL	**1,726,992**	**1,846,786**	**1,973,919**	**2,108,809**	**2,251,899**	**2,403,659**

Table 20 - **Vessel Operating Cost Losses If Hydrographic Services Suspend Activity: Container Vessels (US$) – (1 of 4)**

GRT	2003	2004	2005	2006	2007	2008
< 200	4,255	8,893	13,952	19,444	22,987	27,154
200 - 400	4,793	10,018	15,718	21,905	25,896	30,590
400 - 600	1,567	3,275	5,138	7,161	8,466	10,001
600 - 1,000	1,159	2,422	3,799	5,295	6,259	7,394
1,000 - 3,000	2,750	5,745	9,010	12,564	14,861	17,564
3,000 - 5,000	1,867	3,902	6,123	8,542	10,106	11,947
5,000 - 10,000	11,209	23,365	36,662	51,847	61,994	74,112
10,000 - 15,000	13,344	27,670	43,229	61,401	73,688	88,427
15,000 - 20,000	10,603	22,053	34,580	49,296	59,307	71,352
20,000 - 30,000	359	750	1,181	1,673	2,002	2,395
30,000 - 50,000	93	194	304	424	501	592
50,000 - 75,000	201	421	661	21	1,088	1,286
75,000 - 100,000	-	-	-	-	-	-
> 100,000	24	51	80	111	131	155
TOTAL	**52,224**	**108,759**	**170,437**	**240,585**	**287,288**	**342,969**

Table 20 - **Vessel Operating Cost Losses If Hydrographic Services Suspend Activity: Container Vessels (US$) – (2 of 4)**

GRT	2009	2010	2011	2012	2013	2014
< 200	32,051	37,804	44,559	49,553	54,811	60,603
200 - 400	36,107	42,588	50,198	55,824	61,747	68,272
400 - 600	11,806	13,926	16,415	18,256	20,195	22,330
600 - 1,000	8,727	10,294	12,133	13,493	14,925	16,502
1,000 - 3,000	20,744	24,483	28,876	32,134	35,565	39,349
3,000 - 5,000	14,113	16,662	19,658	21,883	24,225	26,809
5,000 - 10,000	88,586	105,871	126,515	142,717	159,823	178,975
10,000 - 15,000	106,106	127,315	152,757	173,034	194,502	218,638
15,000 - 20,000	85,846	103,288	124,278	141,178	159,046	179,182
20,000 - 30,000	2,866	3,428	4,101	4,631	5,190	5,816
30,000 - 50,000	699	825	972	1,081	1,196	1,322
50,000 - 75,000	1,518	1,790	2,110	2,346	2,595	2,870
75,000 - 100,000	-	-	-	-	-	-
> 100,000	183	216	255	283	313	346
TOTAL	**409,351**	**488,488**	**582,828**	**656,415**	**734,131**	**821,013**

Table 20 - **Vessel Operating Cost Losses If Hydrographic Services Suspend Activity: Container Vessels (US$) – (3 of 4)**

GRT	2015	2016	2017	2018	2019	2020	2021
< 200	66,982	74,007	79,838	86,099	92,502	99,362	107,140
200 - 400	75,459	83,372	89,941	96,995	104,208	111,936	120,699
400 - 600	24,683	27,273	29,423	31,732	34,094	36,623	39,492
600 - 1,000	18,239	20,152	21,740	23,445	25,188	27,056	29,174
1,000 - 3,000	43,520	48,105	51,919	56,018	60,208	64,699	69,792
3,000 - 5,000	29,659	32,797	35,413	38,225	41,099	44,182	47,678
5,000 - 10,000	200,420	223,846	244,178	266,344	288,837	313,222	340,914
10,000 - 15,000	245,778	275,022	300,573	328,490	356,787	387,518	422,422
15,000 - 20,000	201,876	226,545	248,310	272,164	296,305	322,588	352,446
20,000 - 30,000	6,517	7,291	7,966	8,704	9,452	10,264	11,187
30,000 - 50,000	1,461	1,614	1,741	1,878	2,018	2,167	2,337
50,000 - 75,000	3,172	3,505	3,781	4,077	4,381	4,705	5,074
75,000 - 100,000	-	-	-	-	-	-	-
> 100,000	383	423	456	492	529	568	612
TOTAL	**918,148**	**1,023,953**	**1,115,278**	**1,214,665**	**1,315,608**	**1,424,890**	**1,548,967**

Table 20 - **Vessel Operating Cost Losses If Hydrographic Services Suspend Activity: Container Vessels (US$) – (4 of 4)**

GRT	2022	2023	2024	2025	2026	2027	2028
< 200	113,796	120,836	128,282	136,155	144,480	153,281	162,585
200 - 400	128,197	136,128	144,516	153,386	162,765	172,680	183,161
400 - 600	41,947	44,544	47,290	50,195	53,266	56,512	59,945
600 - 1,000	30,986	32,903	34,931	37,075	39,342	41,738	44,272
1,000 - 3,000	74,156	78,773	83,657	88,823	94,286	100,063	106,170
3,000 - 5,000	50,677	53,851	57,209	60,762	64,519	68,493	72,696
5,000 - 10,000	365,311	391,225	418,743	447,958	478,968	511,875	546,789
10,000 - 15,000	453,300	486,117	520,985	558,023	597,357	639,118	683,448
15,000 - 20,000	379,017	407,278	437,330	469,276	503,228	539,301	577,618
20,000 - 30,000	12,002	12,869	13,790	14,768	15,807	16,910	18,080
30,000 - 50,000	2,482	2,636	2,798	2,970	3,151	3,343	3,546
50,000 - 75,000	5,389	5,723	6,075	6,448	6,843	7,260	7,700
75,000 - 100,000	-	-	-	-	-	-	-
> 100,000	650	691	733	778	826	876	929
TOTAL	**1,657,911**	**1,773,573**	**1,896,339**	**2,026,617**	**2,164,836**	**2,311,451**	**2,466,939**

Table 21 - **Vessel Operating Cost Losses If Hydrographic Services Suspend Activity: Passenger Vessels (US$) – (1 of 4)**

GRT	2003	2004	2005	2006	2007	2008
< 200	27,254	56,923	89,239	124,282	146,861	173,407
200 - 400	16,978	35,460	55,592	77,422	91,488	108,025
400 - 600	10,024	20,936	32,822	45,711	54,016	63,779
600 - 1,000	5,399	11,276	17,677	24,619	29,091	34,350
1,000 - 3,000	29,907	62,464	97,927	136,381	161,159	190,289
3,000 - 5,000	21,130	44,132	69,187	96,356	113,862	134,443
5,000 - 10,000	91,576	191,265	299,851	417,597	493,465	582,663
10,000 - 15,000	37,859	79,071	123,962	172,639	204,004	240,879
15,000 - 20,000	8,446	17,640	27,655	38,515	45,512	53,739
20,000 - 30,000	1,035	2,161	3,388	4,719	5,576	6,584
30,000 - 50,000	1,109	2,315	3,630	5,055	5,973	7,053
50,000 - 75,000	3,057	6,386	10,011	13,942	16,475	19,453
75,000 - 100,000	1,161	2,424	3,801	5,293	6,255	7,385
> 100,000	3,674	7,673	12,029	16,752	19,795	23,374
TOTAL	**258,609**	**540,126**	**846,772**	**1,179,283**	**1,393,532**	**1,645,423**

Table 21 - **Vessel Operating Cost Losses If Hydrographic Services Suspend Activity: Passenger Vessels (US$) – (2 of 4)**

GRT	2009	2010	2011	2012	2013	2014
< 200	204,601	241,237	284,245	315,995	349,430	386,260
200 - 400	127,457	150,280	177,071	196,850	217,679	240,622
400 - 600	75,253	88,727	104,546	116,223	128,521	142,067
600 - 1,000	40,529	47,786	56,305	62,595	69,218	76,513
1,000 - 3,000	224,520	264,723	311,918	346,758	383,449	423,864
3,000 - 5,000	158,628	187,032	220,376	244,991	270,914	299,468
5,000 - 10,000	687,476	810,577	955,087	1,061,768	1,174,115	1,297,865
10,000 - 15,000	284,210	335,101	394,842	438,946	485,391	536,550
15,000 - 20,000	63,406	74,760	88,088	97,927	108,289	119,702
20,000 - 30,000	7,768	9,159	10,792	11,998	13,267	14,666
30,000 - 50,000	8,322	9,812	11,561	12,853	14,213	15,711
50,000 - 75,000	22,952	27,062	31,886	35,448	39,199	43,330
75,000 - 100,000	8,714	10,274	12,106	13,458	14,882	16,451
> 100,000	27,578	32,516	38,313	42,593	47,100	52,064
TOTAL	**1,941,412**	**2,289,046**	**2,697,137**	**2,998,404**	**3,315,666**	**3,665,132**

Table 21 - **Vessel Operating Cost Losses If Hydrographic Services Suspend Activity:**

Passenger Vessels (US$) – (3 of 4)

GRT	2015	2016	2017	2018	2019	2020	2021
< 200	426,818	471,472	508,504	548,268	588,943	632,513	681,892
200 - 400	265,888	293,705	316,774	341,546	366,884	394,026	424,787
400 - 600	156,984	173,408	187,028	201,654	216,614	232,639	250,801
600 - 1,000	84,547	93,393	100,728	108,605	116,662	125,293	135,074
1,000 - 3,000	468,371	517,372	558,009	601,645	646,279	694,091	748,277
3,000 - 5,000	330,913	365,533	394,244	425,074	456,609	490,389	528,672
5,000 - 10,000	1,434,144	1,584,185	1,708,615	1,842,227	1,978,898	2,125,295	2,291,213
10,000 - 15,000	592,889	654,918	706,359	761,595	818,096	878,619	947,211
15,000 - 20,000	132,271	146,110	157,586	169,909	182,514	196,016	211,319
20,000 - 30,000	16,206	17,901	19,307	20,817	22,361	24,016	25,890
30,000 - 50,000	17,360	19,177	20,683	22,300	23,955	25,727	27,735
50,000 - 75,000	47,880	52,889	57,043	61,504	66,067	70,955	76,494
75,000 - 100,000	18,178	20,080	21,657	23,351	25,083	26,939	29,042
> 100,000	57,531	63,550	68,541	73,901	79,384	85,256	91,912
TOTAL	**4,049,980**	**4,473,693**	**4,825,079**	**5,202,395**	**5,588,350**	**6,001,773**	**6,470,319**

Table 21 - **Vessel Operating Cost Losses If Hydrographic Services Suspend Activity:**

Passenger Vessels (US$) – (4 of 4)

GRT	2022	2023	2024	2025	2026	2027	2028
< 200	724,124	768,792	816,028	865,975	918,781	974,603	1,033,607
200 - 400	451,096	478,922	508,348	539,462	572,358	607,133	643,889
400 - 600	266,334	282,763	300,136	318,507	337,929	358,460	380,162
600 - 1,000	143,440	152,288	161,645	171,539	181,999	193,057	204,745
1,000 - 3,000	794,621	843,638	895,473	950,282	1,008,229	1,069,486	1,134,234
3,000 - 5,000	561,415	596,046	632,669	671,392	712,333	755,612	801,358
5,000 - 10,000	2,433,119	2,583,205	2,741,923	2,909,748	3,087,181	3,274,748	3,473,006
10,000 - 15,000	1,005,876	1,067,923	1,133,539	1,202,919	1,276,272	1,353,814	1,435,776
15,000 - 20,000	224,407	238,250	252,888	268,367	284,731	302,031	320,316
20,000 - 30,000	27,494	29,190	30,983	32,880	34,885	37,004	39,245
30,000 - 50,000	29,453	31,270	33,191	35,223	37,371	39,641	42,041
50,000 - 75,000	81,232	86,242	91,541	97,144	103,068	109,330	115,949
75,000 - 100,000	30,840	32,743	34,755	36,882	39,131	41,508	44,021
> 100,000	97,605	103,626	109,993	116,725	123,843	131,367	139,320
TOTAL	**6,871,057**	**7,294,897**	**7,743,112**	**8,217,045**	**8,718,109**	**9,247,794**	**9,807,669**

Table 22 - **Value Of Passenger Time Losses If Hydrographic Services Suspend Activity (US$) – (1 of 4)**

GRT	2003	2004	2005	2006	2007	2008
< 200	15,132	33,500	55,880	82,959	102,344	126,161
200 - 400	8,106	17,945	29,934	44,440	54,824	67,582
400 - 600	3,550	7,859	13,109	19,461	24,009	29,596
600 - 1,000	1,698	3,759	6,270	9,308	11,483	14,156
1,000 - 3,000	7,570	16,760	27,957	41,505	51,203	63,119
3,000 - 5,000	6,488	14,365	23,961	35,573	43,885	54,097
5,000 - 10,000	23,579	52,201	87,075	129,272	159,479	196,591
10,000 - 15,000	6,972	15,434	25,746	38,222	47,153	58,126
15,000 - 20,000	1,892	4,189	6,987	10,373	12,797	15,775
20,000 - 30,000	17	38	64	95	117	144
30,000 - 50,000	81	179	299	444	548	676
50,000 - 75,000	1,355	3,000	5,004	7,429	9,164	11,297
75,000 - 100,000	20	44	74	110	136	167
> 100,000	1,540	3,410	5,689	8,446	10,419	12,844
TOTAL	**78,000**	**172,684**	**288,048**	**427,636**	**527,562**	**650,331**

Table 22 - **Value Of Passenger Time Losses If Hydrographic Services Suspend Activity (US$) – (2 of 4)**

GRT	2009	2010	2011	2012	2013	2014
< 200	155,405	191,295	235,316	273,111	312,640	357,756
200 - 400	83,248	102,473	126,054	146,300	167,475	191,643
400 - 600	36,456	44,875	55,202	64,069	73,342	83,926
600 - 1,000	17,437	21,464	26,403	30,644	35,079	40,142
1,000 - 3,000	77,750	95,706	117,730	136,639	156,416	178,988
3,000 - 5,000	66,637	82,027	100,903	117,109	134,059	153,405
5,000 - 10,000	242,161	298,086	366,683	425,577	487,173	557,476
10,000 - 15,000	71,600	88,135	108,417	125,831	144,043	164,829
15,000 - 20,000	19,432	23,919	29,424	34,150	39,092	44,734
20,000 - 30,000	178	219	269	312	357	409
30,000 - 50,000	832	1,024	1,260	1,463	1,674	1,916
50,000 - 75,000	13,916	17,129	21,071	24,456	27,995	32,035
75,000 - 100,000	206	254	312	362	415	475
> 100,000	15,821	19,475	23,956	27,804	31,828	36,421
TOTAL	**801,079**	**986,081**	**1,213,002**	**1,407,826**	**1,611,588**	**1,844,154**

Table 22 - **Value Of Passenger Time Losses If Hydrographic Services Suspend Activity (US$) – (3 of 4)**

GRT	2015	2016	2017	2018	2019	2020	2021
< 200	409,237	467,964	522,486	583,174	644,079	711,206	788,320
200 - 400	219,220	250,679	279,886	312,395	345,021	380,980	422,288
400 - 600	96,002	109,779	122,569	136,806	151,093	166,841	184,931
600 - 1,000	45,918	52,507	58,625	65,435	72,268	79,800	88,453
1,000 - 3,000	204,744	234,125	261,403	291,765	322,237	355,821	394,401
3,000 - 5,000	175,480	200,662	224,041	250,064	276,179	304,964	338,030
5,000 - 10,000	637,696	729,207	814,167	908,734	1,003,639	1,108,241	1,228,404
10,000 - 15,000	188,548	215,605	240,725	268,686	296,747	327,674	363,203
15,000 - 20,000	51,171	58,514	65,332	72,920	80,536	88,929	98,571
20,000 - 30,000	468	535	597	666	736	813	901
30,000 - 50,000	2,192	2,506	2,798	3,123	3,449	3,809	4,222
50,000 - 75,000	36,645	41,903	46,786	52,220	57,674	63,684	70,590
75,000 - 100,000	543	621	693	774	854	944	1,046
> 100,000	41,662	47,641	53,191	59,369	65,570	72,404	80,254
TOTAL	**2,109,525**	**2,412,249**	**2,693,300**	**3,006,130**	**3,320,082**	**3,666,110**	**4,063,612**

Table 22 - **Value Of Passenger Time Losses If Hydrographic Services Suspend Activity (US$) – (4 of 4)**

GRT	2022	2023	2024	2025	2026	2027	2028
< 200	860,718	939,544	1,025,355	1,118,756	1,220,401	1,331,003	1,451,334
200 - 400	461,070	503,296	549,263	599,296	653,746	712,993	777,452
400 - 600	201,915	220,406	240,537	262,447	286,292	312,238	340,466
600 - 1,000	96,576	105,421	115,049	125,529	136,934	149,344	162,846
1,000 - 3,000	430,623	470,060	512,992	559,720	610,574	665,909	726,112
3,000 - 5,000	369,074	402,874	439,670	479,720	523,305	570,731	622,329
5,000 - 10,000	1,341,219	1,464,050	1,597,766	1,743,307	1,901,697	2,074,043	2,261,550
10,000 - 15,000	396,559	432,877	472,412	515,445	562,276	613,234	668,674
15,000 - 20,000	107,624	117,481	128,210	139,889	152,599	166,429	181,475
20,000 - 30,000	983	1,073	1,172	1,278	1,394	1,521	1,658
30,000 - 50,000	4,610	5,032	5,491	5,992	6,536	7,128	7,773
50,000 - 75,000	77,072	84,131	91,815	100,178	109,280	119,184	129,959
75,000 - 100,000	1,142	1,246	1,360	1,484	1,619	1,766	1,925
> 100,000	87,625	95,649	104,385	113,894	124,242	135,501	147,752
TOTAL	**4,436,810**	**4,843,141**	**5,285,478**	**5,766,935**	**6,290,895**	**6,861,025**	**7,481,304**

Table 23 presents the total cumulative impact of hydrographic services cessation over the period of evaluation.

Table 23 - **Value Of Impact If Hydrographic Services Suspend Activity (US$)**

Years	Vessel Operating Costs					Passenger Time Savings	**Total**
	Bulk	General Cargo	Container	Passengers	Total		
2003	101,717	50,725	52,224	258,609	463,275	78,000	541,275
2004	212,163	105,739	108,759	540,126	966,786	172,684	1,139,470
2005	332,810	165,861	170,437	846,772	1,515,879	288,048	1,803,928
2006	468,452	234,126	240,585	1,179,283	2,122,446	427,636	2,550,082
2007	558,114	279,552	287,288	1,393,532	2,518,487	527,562	3,046,048
2008	664,703	333,710	342,969	1,645,423	2,986,805	650,331	3,637,136
2009	791,398	398,272	409,351	1,941,412	3,540,433	801,079	4,341,512
2010	941,974	475,234	488,488	2,289,046	4,194,742	986,081	5,180,823
2011	1,120,919	566,976	582,828	2,697,137	4,967,860	1,213,002	6,180,862
2012	1,259,001	638,519	656,415	2,998,404	5,552,338	1,407,826	6,960,164
2013	1,404,680	714,038	734,131	3,315,666	6,168,515	1,611,588	7,780,103
2014	1,567,066	798,452	821,013	3,665,132	6,851,664	1,844,154	8,695,817
2015	1,748,081	892,815	918,148	4,049,980	7,609,024	2,109,525	9,718,549
2016	1,946,113	995,892	1,023,953	4,473,693	8,439,651	2,412,249	10,851,900
2017	2,115,897	1,084,926	1,115,278	4,825,079	9,141,181	2,693,300	11,834,481
2018	2,300,258	1,181,842	1,214,665	5,202,395	9,899,160	3,006,130	12,905,290
2019	2,487,719	1,280,265	1,315,608	5,588,350	10,671,942	3,320,082	13,992,024
2020	2,690,309	1,386,839	1,424,890	6,001,773	11,503,811	3,666,110	15,169,921
2021	2,920,280	1,507,842	1,548,967	6,470,319	12,447,408	4,063,612	16,511,021
2022	3,121,346	1,614,136	1,657,911	6,871,057	13,264,451	4,436,810	17,701,261
2023	3,334,683	1,726,992	1,773,573	7,294,897	14,130,144	4,843,141	18,973,286
2024	3,560,990	1,846,786	1,896,339	7,743,112	15,047,228	5,285,478	20,332,706
2025	3,801,009	1,973,919	2,026,617	8,217,045	16,018,590	5,766,935	21,785,525
2026	4,055,519	2,108,809	2,164,836	8,718,109	17,047,273	6,290,895	23,338,168
2027	4,325,344	2,251,899	2,311,451	9,247,794	18,136,488	6,861,025	24,997,513
2028	4,611,350	2,403,659	2,466,939	9,807,669	19,289,617	7,481,304	26,770,921

The Philippines currently spends approximately US$ 3.5 million annually in hydrographic service provision. It follows that if the hydrographic activity is suspended, the economy will “save” the current hydrographic investment (US$ 3.5 million per year). But for such a scenario, the economy will also progressively suffer additional costs in terms of increased vessel operating costs and passenger time costs. These costs are estimated on Table 23 above, for example US$ 541,275 for the year 2003, rising to US$ 26,770,921 for the year 2028.

Conversely, if the current hydrographic investment (of US$ 3.5 million annually) is maintained, the cost to the economy will be US$ 3.5 million annually when compared to the above scenario. However, the economy will also benefit because it will not incur vessel operating costs and

passenger time costs as shown on the table, for example, US$ 541,275 for the year 2003, rising to US$ 26,770,921 for the year 2028.

According to this scenario, it is also possible to evaluate the sustainability of hydrographic service annual expenditure for the Philippines. Utilizing these results, the annual expenditure flow of US$ 3.5 million represents a Net Present Value (NPV) at a 12 percent discount rate of US$ 19.2 million, and an Internal Rate of Return (IRR) of 23.6 percent. This means that the investment (of US$ 3.5 million annually) in hydrographic services represents a sound expenditure indeed, with a considerable economic return in terms of vessel operating and passenger time savings.

The assessment has also been utilized to estimate the level of expenditure in hydrographic services that can be sustained to achieve an IRR of 12 percent for the benefit analysed. An IRR of 12 percent is considered by the international community to represent an acceptable return on this type of investment. The results of the study indicate that hydrographic services expenditure can be increased to approximately US$ 5.9 million, and still maintain an internationally acceptable IRR (12 percent) for the investment made. This represents an increase of nearly 70 percent over and above the current expenditure level. This means that the benefits to commercial shipping from existing hydrographic services in the Philippines are significant enough to allow expenditure to be increased to nearly US$ 6 million, and still return an acceptable IRR.

It is also important to note that the analysis is considered to be conservative, and only assumes relatively small incremental impacts in vessel operating and passenger time costs and savings of a matter of minutes over voyages often of many hours. The scope of the study has been restricted by the limited data available. There appears to be the potential for much greater savings in specific cases. For example, international shipping entering the Sulu Sea from the Macassar Strait and traveling north towards Luzon is unable to sail directly north by the shortest route partly because of inadequate hydrographic surveys, but instead must sail west to enter the China Sea south of the Palawan Islands, and then north east to Luzon. This extends the voyage by some 150 miles, or up to 10 hours, probably for thousands of ships each year. Data does not currently exist to assist an analysis of this potentially dramatic improvement to maritime traffic. This is an aspect of regional hydrographic services that is worthy of further study by APEC, with the intention to identify routes that may deliver economic benefits resulting from regional co-operation in surveying and charting.

In addition, not all of the benefits from improved efficiency of inter-port voyages will flow to the Philippine economy. Many of the ships will be ships in transit, and the benefits will flow to the economies of the ports of departure and destination within the region. It is suggested that APEC might research ways to collate data on transit voyages on a regional basis so that these potential benefits can be defined. It is also important to emphasize that vessel navigation-related benefits only represent a fraction of the cumulative benefits to a given APEC economy from hydrographic services. Other significant benefits relate to the commercial fishing sector, environmental protection, sovereign and economic zone maintenance, national defence, coastal resource management, mineral exploration, emergency response, and recreational fishing and boating.

In summary, the analysis indicates the tremendous economic benefits to the Philippine economy from the current expenditure in hydrographic services. It also indicates that by considering only the sole navigation-related benefit, representing a fraction of the total benefits, additional hydrographic services expenditure can be justified to further improve the hydrographic services.

3 EXTRAPOLATION TO OTHER APEC ECONOMIES

3.1 Introduction

The previous section presented the economic impacts from vessel-operating and passenger-time voyage savings as a result of varying investment levels in hydrographic services for the selected APEC economy (the Philippines). It reveals that the impacts are considerable; increased or decreased hydrographic services expenditure greatly affects vessel voyage efficiency and corresponding costs. The analysis of this single benefit alone reinforces the considerable economic viability and importance of hydrographic services to the Philippine economy, and highlights the potential for significant, additional benefits through increased expenditure. The economic benefits of hydrographic services and economic justification to increase investment for the Philippines have been demonstrated from this one benefit alone.

The objective of Section 3 of this report is to relate the results of the Philippine case study to other APEC economies that responded to the hydrographic questionnaire, in order to assess their relative economic sensitivity to the impact of hydrographic services on their economy. The analysis produced the possibility to classify (cluster) APEC economies responding to the questionnaire into three broad classifications;

(i) Substantial Impact (High sensitivity to increased investment in hydrographic services);

(ii) Moderate Impact (Moderate sensitivity to increased investment in hydrographic services);

(iii) Low Impact (Low sensitivity to increased investment in hydrographic services)

As shown in the previous section, the methodology utilized to develop the economic assessment for the Philippine case is both extensive and complex. It requires significant input data, including;

(i) detailed voyage data for a range of vessel categories and size classifications;

(ii) vessel operating cost data, which varies for each economy; and

(iii) variable economic growth rates.

To complete an analysis in similar detail for other APEC economies therefore, would involve individual assessment of each economy, as each possesses markedly variable and unique base parameters. This is beyond the scope of this project, but is a clear recommendation of the assessment. Furthermore, once assessment of individual economies has been completed, then the assessment could consider regional effects.

However, a preliminary assessment has been performed in order to identify a relative measure of the impact between the different APEC economies that responded to the questionnaire. This has been accomplished by identifying two sets of key indicators, which are used to estimate the relative economic sensitivity of the impacts benefit-wise for each of the APEC economies. These two parameter sets are; (i) navigational parameters which relate to physical and infrastructure characteristics for each economy; and (ii) economic parameters, which consider the relative impacts to the national economies.

These are further described as follows;

3.2 Navigation Indicators

As outlined above, the assessment considers the economic impact of reducing or extending the time taken for each voyage due to the quality of hydrographic services. From a navigational sense, this would depend on a number of key factors, but all of which relate to the length of voyage during which hydrographic services influence. For example, for a vessel sailing through open ocean, the impact of hydrographic services would be relatively minimal, whereas for a vessel sailing around the coast, the impact would be greater. Also affecting the voyage and the reliance on hydrographic services is the relative complexity of the seabed, on which the dependency of hydrographic services would increase. From this, therefore, there are a number of key indicators that provide an indication of the length of voyage influenced by hydrographic services, the "navigational complexity", and therefore the reliance on the hydrographic services. These are summarized as follows;

(i) Length of coastline – coastal waters are generally shallow in nature, and contain hazards to navigation which must be surveyed and published in charts. The longer the coastline, then the greater the task facing the hydrographic services;

(ii) Continental shelf – which is shallow and potentially dangerous to navigation. The greater the width of the continental shelf, the greater the task facing hydrographic services;

(iii) Archi-pelagic Waters – which are waters within island groups, which represent a special case of wide shallow seas and complex coastlines, which increase the task facing hydrographic services and for which good charts are essential; and

(iv) Ports – the production of charts for ports requires a higher degree of accuracy, and therefore an increasing number of ports increases the relative complexity of navigation. The restricted navigation of ports and high volume of traffic requires that surveys and charts be developed to much higher specifications and revised at more frequent intervals, which increases the task of the hydrographic services.

The hydrographic audit provides data about the differing geographic circumstances of the APEC economies. The Philippines has a long coastline, extensive areas of shallow water, an archi-pelagic geography and many ports. By contrast, Singapore has a relatively short coastline, a narrow continental shelf, one major port and practically no archi-pelagic waters. The impact on navigation therefore of increasing hydrographic services investment would be greater from a navigational sense in the Philippines than in Singapore.

3.3 Economic Indicators

The economic benefits in this study flow from improved efficiency of shipping, measured in voyage time savings, the number of vessel voyages, vessel cargo values, and passenger movements, represented by the following primary indicators;

(i) Volume of maritime foreign trade – from which is derived an indication of the number of vessel voyages. When these are aggregated, it provides an indication of the total time saved;

(ii) Maritime foreign trade as share of GPD – indicating the relative economic importance of international shipping;

(iii) Per capita GDP – indicating the value of passenger time savings; and

(iv) Volume of maritime domestic trade – indicating the relative economic importance of domestic shipping.

The economic impact can be again illustrated using the example of Singapore and the Philippines. Singapore has a relatively high dependence on foreign trade and high per capita GDP. In comparison, the Philippines has a lower dependence on foreign trade and lower GDP.

3.4 Scoring System

In order to infer the relative importance of each indicator to the various economies responding to the questionnaire, each economy has been assessed in terms of each of the navigational and economic indicators. A simplified "scoring system" has been utilized, whereby each economy has been assessed for each elementary indicator according to the following three relative levels;

(i) A score of 3 points is given where there is considered to be a high impact;

(ii) A score of 2 points is given where there is considered to be a medium impact;

(iii) A score of 1 point is given where there is considered to be a low impact.

The process of comparison is completed by summing up the value of all the indicators for each economy to provide an overall "impact score". The results of this are shown on Table 24. Where data was lacking, professional judgment was applied.

Table 24 - **Elementary Indicators Score Structure**

Economy	Economic Factors					Navigational Factors					Overall Impact Indicator
	Foreign Trade	Foreign Trade/GDP	Domestic Trade/GDP	Per Capita GDP	Total	Ports	Coastline	Continental Shelf	Archi-Pelagic Waters	Total	
AUS	M	S	S	L	7	M	L	L	S	9	**16**
CAN	L	M	S	L	9	M	L	L	S	9	**18**
CHL	S	S	S	M	5	M	L	M	S	8	**13**
HKG	L	L	S	L	10	S	S	S	S	4	**14**
IND	M	S	L	S	7	M	L	L	L	11	**18**
JAP	L	S	M	L	9	M	M	M	M	8	**17**
KOR	L	M	S	M	8	M	M	S	S	6	**14**
MEX	M	M	M	M	8	M	M	M	S	7	**15**
NZE	S	S	M	L	7	S	M	M	S	6	**13**
PER	S	S	S	S	4	S	S	S	S	4	**8**
PHI	S	M	L	S	7	L	L	L	L	12	**19**
SIN	L	L	S	L	10	S	S	S	S	4	**14**
USA	L	S	S	L	8	M	L	L	S	9	**17**

Legend: L (Large Impact) = 3 points, M (Medium Impact) = 2 points, S (Small Impact) = 1 point.

3.5 Weighting

The overall impact indicators have then been weighted according to the status of hydrographic surveying and charting in each economy, as reported in the hydrographic questionnaire. This weighting represents the size of the outstanding hydrographic task. Thus economies whose surveying and charting is well advanced received a low weighting, and those that have large outstanding areas for surveying and charting receive a high rating. This represents the relative effect of improving hydrographic services, in that economies which still have lots to do, will benefit more than those whose task is well advanced. The weighting utilized is as follows;

(i) Where little hydrographic services improvement is considered necessary: 1 point;

(ii) Where medium hydrographic service improvement is necessary: 2 points;

(iii) Where large improvements are considered necessary: 3 points.

Table 25 illustrates the results of the weighting system developed, and the total weighted score for each economy.

Table 25 - **Relative Impact Of Hydrographic Services Among APEC Economies**

Economy	Factor Scores			Weighting System	Final Rating
	Economic	Navigational	Total		
PHI	7	12	19	3	57
IND	7	11	18	3	54
MEX	8	7	15	3	45
CAN	9	9	18	2	36
USA	8	9	17	2	34
AUS	7	9	16	2	32
NZE	7	6	13	2	26
CHL	5	8	13	2	26
JAP	9	8	17	1	17
PER	4	4	8	2	16
HKG	10	4	14	1	14
KOR	8	6	14	1	14
SIN	10	4	14	1	14

3.6 Other Considerations

Two other matters have been considered in coming to a view about the impact of increased investment in hydrographic services in different economies.
These are summarized as follows;

(i) The identification of critical issues and problems in the responses to the questionnaire is to some extent subjective, reflecting the financial realities and service expectations of individual economies. Some well-developed economies

have the goal of total hydrographic coverage of the EEZ to the most comprehensive IHO standards, with highly developed navigation services.

Other less well-developed economies have more restricted goals, reflecting the current state of economic development and priorities. This means that a certain status of surveying and charting might be regarded as acceptable in a developing economy, but not acceptable in a developed economy;

(ii) We have also observed that some economies with relatively large hydrographic budgets regard the size of the budget as a critical issue, whereas other economies with relatively small hydrographic budgets have not reported the value of the budget as an issue.

These issues have been taken into consideration during the evaluation.

3.7 Evaluation

As shown on Table 25, the results of the analysis have revealed that the APEC economies that responded to the questionnaire can be broadly classified into the following three groups;

(i) Substantial Impact – This group shows the economies where the benefits associated with increased hydrographic services expenditure are considered to be substantial. Economies: Philippines, Indonesia, and Mexico;

(ii) Medium Impact – Where the impact of increased hydrographic service expenditure is considered to be medium. Economies: Canada, Australia, USA, New Zealand, Chile, Japan and Peru;

(iii) Low Impact – Representing economies in which increased expenditure on hydrographic services would seem to offer relatively less benefit. Economies: Hong Kong, Korea and Singapore.

It must be remembered that the extrapolation process has not taken into account the actual investment that economies presently make in hydrography. Therefore the grouping in itself does not suggest that all members of Group 1 and 2 for example should necessarily increase their present investment in hydrographic services. It rather takes account of the responses (where they were received) of the economies' hydrographic authorities as to whether in their opinion the present rates of funding are sufficient.

Importantly, when interpreting the implications of these responses, it needs to be remembered that such an opinion is highly dependent on the aspirations and social norms of the economy in question. Consequently the response in investment terms will mean very different things between for example the extremes of a developing economy and a developed economy.

Rather these groupings indicate the importance of hydrography for an economy. In other words they indicate the relative potential within an economy for generating economic gain by investing in hydrography. Countries in Group 1 should see hydrographic services as potentially providing major value to their economies. For those in Group 2 the potential benefit of increased investment is smaller. While those in Group 3 should see hydrographic services as important but possibly not as critical an issue for economic development, because their present level of investment seems appropriate to their needs.

Also the analysis of the Philippines case conducted within this report provides a valuable benchmark for economies to gauge their investment requirement. In the case of the Philippines it is clear from the economic analysis that a minimum investment of the order of US$ 5.9 million per annum is justified based purely on the benefits to shipping efficiency. While additional investment on and above US$ 6 million per year is clearly justifiable when benefits to ships in transit and other non-transport sector benefits of hydrographic services are taken into account.

Other economies of the Group 1 category can use this benchmark to provide an indicative gauge of their needs by considering the length and difficulty of their coastline and economic status of their economy in relation to that of the Philippines. Because of the evident limitations in this extrapolation of the Philippine results, we repeat our recommendation that a full hydrographic audit and economic assessment should be a priority for economies in the top tier grouping, and an important management tool for other economies.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

Conclusions of the economic assessment are summarized as follows;

(i) The economic assessment demonstrates that the provision of hydrographic services has a significant and positive economic impact to the efficient and safe performance of the maritime transport sector in the selected APEC case study economy of the Philippines;

(ii) Based on the economic assessment, the entire national expenditure for hydrographic service provision can be justified from the benefits accruing from only one solitary benefit[8] of hydrographic services. The economic benefits from this single benefit alone when compared with the annual hydrographic services expenditure of US$ 3.5 million, are sufficient to achieve a Net Present Value (NPV) at a 12 percent discount rate of US$ 19.2 million and an Internal Rate of Return (IRR) of 23.6 percent;

(iii) The assessment of this one benefit also indicates that hydrographic service investment can be increased by nearly 70 percent from the current investment level to US$ 5.9 million and still achieve an internationally acceptable Internal Rate of Return (IRR) of 12 percent;

(iv) The cumulative benefits of hydrographic services to the Philippine economy are considerably higher than even this estimate, since the numerous other benefits accruing from hydrographic service provision have not been included in the assessment. These include benefits relating to fisheries, mineral exploration, national defence, delineation and maintenance of sovereign- and economic-zones, search and rescue, environmental protection, sustainable resource management and maritime recreational uses;

(v) There is sound economic justification that the Philippine economy can benefit significantly from progressive and carefully planned additional investments in hydrographic services;

(vi) An initial qualitative assessment performed in order to infer relative economic sensitivity to varying hydrographic service investment levels in economies responding to the questionnaire has resulted in a broad classification of three major groupings. These include APEC economies where the benefits from increased investment are considered to be of; (i) substantial value (Philippines, Indonesia and Mexico); (ii) medium value (Canada, Australia, USA, New Zealand, Chile, Japan and Peru, and; (iii) of lower value (Hong Kong, Korea and Singapore).

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[8] Vessel-operating and passenger-time savings / costs accruing from voyage time savings / losses associated with vessel movements.

4.2 Recommendations

The following actions are recommended to supplement this initial assessment;

(i) A similar economic assessment, incorporating the model developed herein, should be performed for each of the other APEC economies in order to assess both current expenditure levels and benefits, and where appropriate, to define future expenditure level. This should be a priority for economies in the top tier grouping;

(ii) Where necessary, additional and more detailed hydrographic and economic assessment should be performed for APEC economies in order to further refine optimum investment levels and strategies for sector development;

(iii) Consideration should also be made to initiate further studies in order to evaluate the cumulative economic benefits of improving hydrographic services of regional sea lanes, with the objectives of developing improvement strategies, identifying appropriate levels of investment, and defining options for future co-operative hydrographic activity.

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