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From the Orderly World of Frameworks to the Messy World of Data: Canada's Experience Measuring the Economic Contribution of Maritime Industries

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1. INTRODUCTION

The Canadian experience measuring the economic contribution of ocean industries[1] started in the late 90's, when the first report "Canada's ocean industries: contribution to the economy, 1988-1996" was prepared by Roger A. Stacey Consultants Ltd. (1998). This report provided the first compilation of ocean related industries in Canada and offered a first appreciation for the challenges of gathering appropriate data for estimating the economic contribution of these industries (GSGislason, 2007). The work was updated in 2003 to encompass estimates for 1988-2000.

The Roger A. Stacey Consultants Ltd. reports covered the largest maritime industries in Canada: seafood, offshore oil and gas, ocean transport, ocean tourism, marine construction, ocean manufacturing, and government. Despite the good coverage, some gaps were pointed out by GSGislason (2007), such as university and research related expenditures in the public sector, ferry revenues in ocean transport, and self-guided tourism and recreational activities in ocean tourism. In addition, it must be noted that provincial government expenditures, and support activities to offshore oil and gas and marine transportation were not included in the report.

A further limitation in the scope of this first reporting effort was that only direct impacts were estimated, which left out spill over (indirect) impacts. The study did not use Statistics Canada's Interprovincial Input-Output (IO) model, which is available since 1961 on a national basis and since 1997 at the provincial level[2]. The IO model is the most comprehensive articulation of economic activities and flows of goods and services in the Canadian economy.

Seeking to build on the work by Roger A. Stacey, and aiming to develop a national framework that captured all relevant industries and allowed for estimating the multiple layers of economic contribution of ocean industries, Fisheries and Oceans Canada first commissioned GSGislason to prepare a methodology for reporting on a marine sector national report card (2007), and subsequently retained

[1]The terms "ocean", "marine" and "maritime" industries are used interchangeably in this report.

[2] Statistics Canada Website: http://www.statcan.gc.ca/eng/nea/faq/io (visited on July 20, 2015).

Gardner Pinfold to further refine the methodology and develop the national report card (2009). The outcome was a framework that estimated the direct, indirect and induced economic contribution of a rather comprehensive set of ocean industries in Canada, with a clearly articulated methodology that addressed the most important concepts utilized as well as the limitations of the data and methods employed. This report marked the first time that Statistics Canada's IO model was used to estimate the economic contribution of maritime industries in Canada. The resulting report was peer reviewed by a number of international and Canadian experts.

Subsequent efforts have since focused on developing a time series of the economic contribution of maritime industries in Canada for use in policy development and analysis, and on assessing the feasibility of extending the coverage to ocean related activities in Canada's Arctic.

Canada has adopted a definition of ocean economy mainly focused on the natural resources of the ocean (Colgan, 2003). Ocean industries have thus been identified based on their use or exploitation of ocean resources or their linkage to industries that do so, rather than on their location along coastal areas. Exceptions to this are the marine tourism and recreation sector and the universities sector. The former includes a coastal focus in that it considers that some activities that take place along the coast are related to the enjoyment of the ocean (e.g. national parks located along the coast, visits by tourists to coastal towns). University related expenditures are included for coastal universities, which may have left out some research centers located away from the coast.

Further, the scope of Canada's ocean resources considered is geographically delimited within the country's exclusive economic zone (EEZ), and the scope of industries included encompasses businesses that operate in Canada. As a result, the use or exploitation of non-Canadian (foreign) ocean resources by domestic industries or firms is excluded (e.g. Cooke Aquaculture, a Canadian owned company, has aquaculture operations in other countries that are not included in Canada's ocean economy). Similarly, the use or exploitation of Canadian ocean resources by foreign companies not based in the country is also excluded (e.g. foreign owned cruise ships operating in Canadian waters, whose revenues do not stay in the country, except for passenger expenditures in the port of call; or foreign based submarine cable companies that use Canada's ocean floor, which may pay the government for permits but do not bring revenues to the country).

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It is important to note that Canada's efforts have so far focused exclusively on market related activities[3], as these are most easily measured (Colgan, 2003). The non-market economy has not yet been measured, although there are ongoing efforts to assess the economic value of the subsistence and barter economy in Canada's Arctic region. In addition, the government of Canada has undertaken some efforts towards measuring ecosystems goods and services, including those provided by marine ecosystems[4].

2. CURRENT FRAMEWORKS

2.1 Classification of Industries

A lot of effort has been undertaken by various researchers and countries over the past decades in defining and measuring the ocean economy. Park and Kildow (2014) conducted a comprehensive overview of the literature on the ocean economy and of the studies carried out by various countries in this regard. In their paper, they propose two very useful classifications for scoping and organizing ocean industries, as well as an international standard of ocean sectors that could be applied to the reality of just about any country for the purpose of facilitating international comparisons or aggregations.

Park and Kildow (2014) use two different perspectives for scoping and organizing ocean industries. The first classification is based on the relationship of the industry to the ocean resource or to other industries that use the ocean resource. Industries can hence be classified in three groups: "in the ocean", "from the ocean" and "to the ocean". "In the ocean" industries are those that directly use, protect, research and develop the ocean (e.g. fish harvesting, marine shipping, offshore oil and gas). "To the ocean" industries are those that supply inputs to the first ones (e.g. ship/boat building, marine manufacturing and construction, support services to marine industries), and "from the ocean" industries are those that add value to the outputs of the first ones (e.g. seafood processing, petroleum refining, marine biotechnology).

[3] Measuring economic activity, rather than economic value.

[4] http://www.statcan.gc.ca/pub/16-201-x/16-201-x2013000-eng.htm

The second classification uses the supply chain approach, focusing on the supply chain relationship among various industries that utilize an ocean resource. Industry clusters can thus be formed around ocean resources by linking the industries that directly use or harvest the resource with those that are downstream (i.e. add value to the ocean resource) or upstream (i.e. supply inputs to the "direct" industries).

Both classifications are compatible and can be readily combined. Taking commercial fish resources as an example, fish harvesting takes place "in the ocean", while fish and seafood processing and fish distribution/wholesale/retail use the resource "from the ocean" (fish) and add commercial value to it; in turn, ship yards, fuel stations and fishing gear manufacturers amongst many others, supply inputs "to the ocean" industries that directly use the resource (fish harvesting). An industry cluster is hence built around commercial fish resources composed of many industries: ship building, fuel stations, textile product mills, fishing, seafood processing, and seafood wholesale and retail, to name a few.

These classifications offer a framework that in the case of Canada can be used in conjunction with the North American Industrial Classification System[5] (NAICS) to scope out the economic industries to be included in Canada's ocean economy. An illustration of this is offered in Figure 1 (next page), where commercial fish resources are used to illustrate the industries that contribute economic value along the supply chain (as per previous paragraph's example).

[5] http://www.statcan.gc.ca/pub/12-501-x/12-501-x2012001-eng.pdf

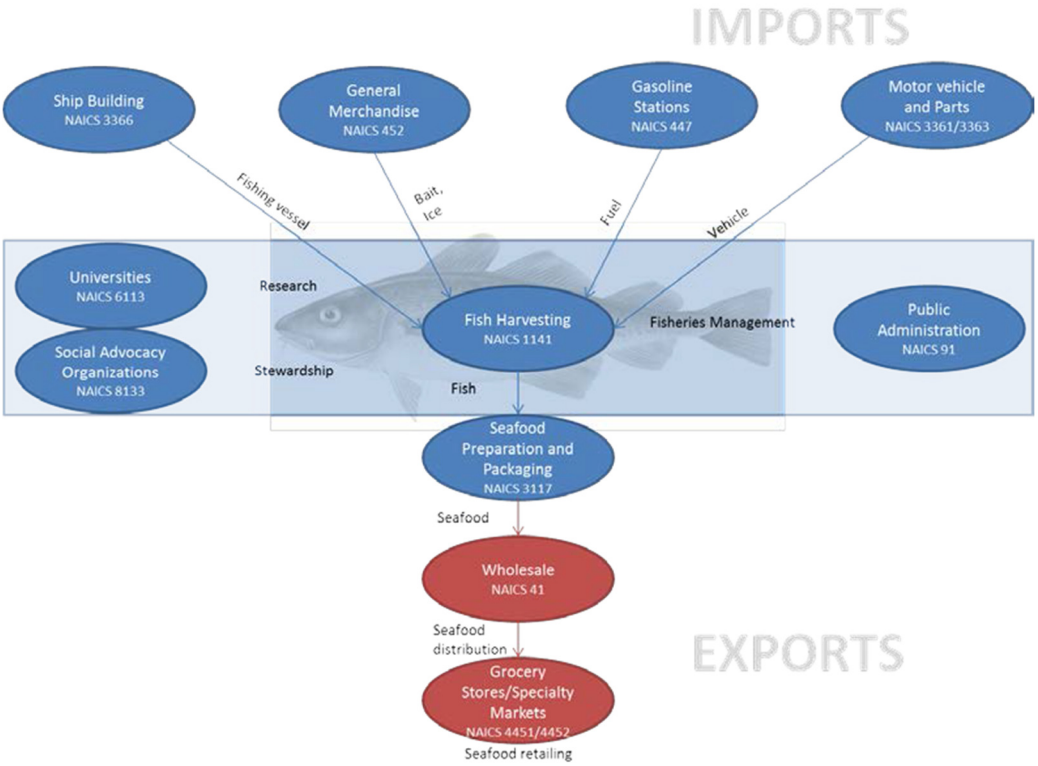

Figure 1. Combining Park and Kildow's classifications of ocean industries with the North American Industrial Classification System (NAICS): Commercial Fishing.

The NAICS provides a practical framework for implementing the conceptual definitions of maritime industries. The key advantage of this system is that it is used by Canada, the United States and Mexico as industry classification standard. Canada's national statistics agency (Statistics Canada) uses it for reporting on industry statistics and for developing the country's input-output model (see Table 1 on following page), which is the primary modeling tool used for estimating the economic contribution of maritime industries in Canada. In addition, the NAICS meet all objectives proposed by Colgan (2003).

Table 1. Input-Output Model Results by Industry (for a mall subset of industries) and province/territory (thousand CDN$) (no data for Nunavut and Yukon Territories)

NAICS	Industries	NL	PE	NS	NB	QC	ON	MB	SK	AB	BC	NT	Canada Total
BS23D000	Repair construction	239	81	366	202	228	862	112	178	445	1,189	1	3,904
BS23E000	Other activities of construction industry	8	2	13	8	25	90	8	4	81	114	1	353
BS311100	Animal food manufacturing	5,405	10	6,270	8,588	900	2,292	80	75	199	18,202	-	42,023
BS311200	Grain and oilseed milling	-	2	24	2	1,431	1,129	145	1,039	562	79	-	4,413
BS311300	Sugar and confectionery product manufacturing	0	-	1	15	26	74	0	0	22	67	0	205
BS311400	Fruit and vegetable preserving and specialty food manufacturing	0	5	5	43	97	154	10	1	10	39	-	365
BS311500	Dairy product manufacturing	23	24	584	29	166	141	9	54	76	114	-	1,219
BS311600	Meat product manufacturing	13	4	484	63	1,414	2,771	898	448	2,745	2,120	-	10,960
BS311700	Seafood product preparation and packaging	989	229	1,401	1,924	68	97	13	1	0	347	-	5,071
BS311800	Bakeries and tortilla manufacturing	7	1	28	10	47	139	6	5	33	133	-	410
BS311900	Other food manufacturing	3	6	33	25	95	165	8	2	76	166	-	581
BS312110	Soft drink and ice manufacturing	19	1	10	6	34	73	16	1	23	24	-	207

It must be noted that in addition to industries that are linked commercially, the supply chain/NAICS framework has been extended to include public and civil sector organizations (government departments, universities, social advocacy organizations). These sectors are commonly mandated with or vested in the stewardship or management of commercial fish resources[6], and are therefore concerned with how, in what manner and to what extent the commercial fish resources are harvested.

In fulfilling their role, these sectors undertake activities with the goal of generating knowledge, managing the resource and providing stewardship to the exploitation of commercial fish resources. Hence, these sectors do not sell goods and services to the fishing industry; instead they contribute to the economic value through the generation of knowledge, management of the resource and provision of stewardship.

Canada's ocean industries data encompasses the majority of industries that form the commercial fisheries cluster (blue color bubbles in Figure 1). However, the economic contribution of seafood wholesale and retail are not included (red color bubbles in Figure 1). Since most of Canada's fish and seafood production is exported to international markets, with the corresponding economic value "leaking" out of the Canadian economy[7], the omission of these two industries likely results in a rather small underestimation of the economic contribution of this cluster[8].

Similar clusters can be built for other industries, with a similar supply chain flow. The offshore oil and gas cluster (Figure 2) shows upstream linkages to industries that supply engineering services, support activities and boats/vessels among others, and downstream linkages to industries such as pipelines and refining, chemicals manufacturing, natural gas distribution and wholesale/retail of fuel products. The marine transportation cluster (Figure 3) portrays an industry that

[6] This stewardship or management extends to all ocean resources. Commercial fishing resources are used here as an example, which can easily be generalized to any other ocean resource.

[7] In this context, "to leak" means that once fish and seafood are exported they cease to produce further economic value in the domestic market. Hence, the economic impacts leak out of the domestic economy.

[8] It must be emphasized that this framework is centered on the use of a country's ocean resources. Hence, the distribution and retail of imported fish and seafood (e.g. warm-water shrimp, tilapia, tuna, etc.) would not be part of Canada's ocean industry.

provides what could be considered a final service, in the sense that there are not many downstream activities or industries that could add value to marine shipping[9]. This might reflect the fact that there is no tangible good extracted from the ocean upon which further processing or value added can be applied.

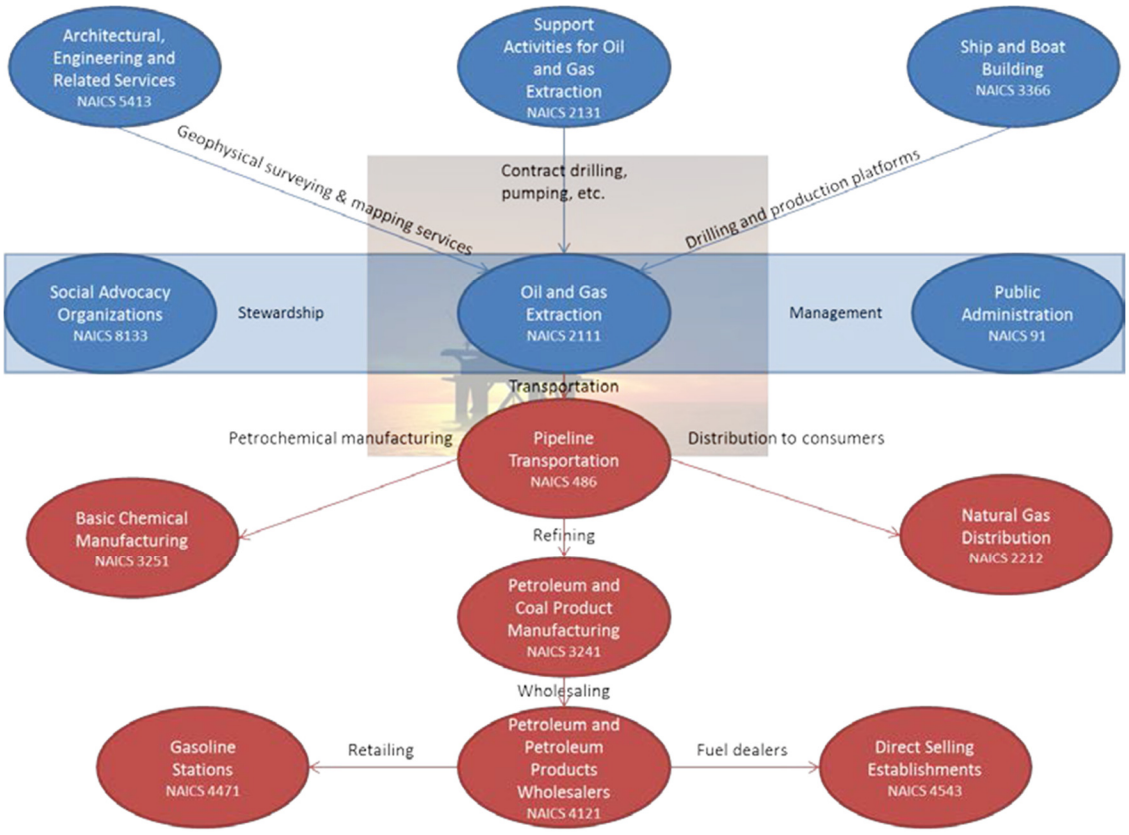

Figure 2. Combining Park and Kildow's classifications of ocean industries with the NAICS: Offshore Oil and Gas Exploration and Extraction.

[9] Note: the economic value included in the ocean economy is the value of the marine shipping service, not of the cargo carried aboard the vessel.

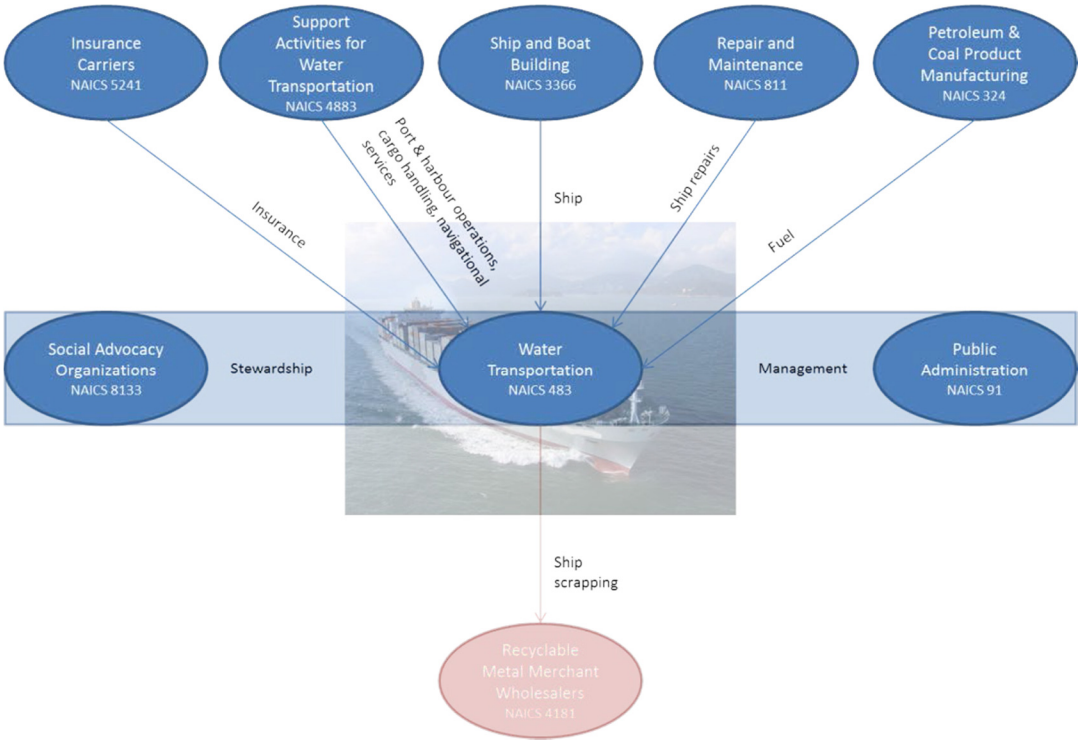

Figure 3. Combining Park and Kildow's classifications of ocean industries with the NAICS: Marine Transportation.

Based on these industry classifications and their review of country specific reports, Park and Kildow (2014) developed a proposed international standard for the ocean economy that consists of 12 sectors (Table 1). Canada's ocean industries data covers eight out of these 12 sectors, which in the case of Canada are the largest ones. The sectors or industries that are less well represented are marine mining, marine equipment manufacturing, marine business services, and other (mostly emerging) industries.

Table 2. Canada's Ocean Industries Placed in the Classification Standard Proposed by Park and Kildow (2014)

Park and Kildow, 2014		**Fisheries and Oceans Canada**	
Sector	**Definition**	**Industries included**	**Industries**
1. Fisheries	The economic activity related to the production, processing and distribution of seafood.	Commercial fishing Aquaculture Fish and Seafood Processing	Seafood wholesale and seafood retail

Park and Kildow, 2014		Fisheries and Oceans Canada	
Sector	**Definition**	**Industries included**	**Industries**
2. Marine mining	The economic activity related to the production, extraction and processing of non-living resources in the seabed or seawater. But it doesn't include offshore oil & gas.	N/A	Marine aggregates; salt; seawater dissolved minerals
3. Offshore oil & gas	The economic activity related to the exploration and production of offshore oil and gas, includes operating and maintaining equipment related to this activity. It doesn't include building offshore platforms, equipment, and OSVs.	Oil and Gas Exploration and Extraction Support Activities	
4. Shipping and Port	The economic activity related to the transportation of freight and passengers through the ocean and river, and related to operation and management of ports.	Marine Transportation (passenger and freight) Support Activities	Shipping business services (marine shipping agencies)
5. Marine leisure & tourism	The economic activity related to marine and coastal leisure and tourism, which includes eating & drinking places, hotels & lodging places, marinas, marine sporting goods retailers, zoos, aquariums, recreational vehicle parks & campgrounds.	Marine Tourism and Recreation	
6. Marine construction	The economic activity which includes construction in the ocean and related to the sea.	Ports and Harbours Construction	Seabed cable, pipeline

Park and Kildow, 2014		Fisheries and Oceans Canada	
Sector	**Definition**	**Industries included**	**Industries**
7. Marine equipment mfg.	The economic activity which includes manufacturing of marine equipment and materials, such as various machinery, valve, cable, sensor, ship materials and so on (no building, repair and/or conversion and supply services).	N/A	Machinery, valve, cable, sensor, ship components; research equipment
8. Ship building & repair	The economic activity related to the building, repair and maintenance of ships, boats, offshore platforms, and OSVs.	Ship and Boat Building Oil and Gas Facilities Construction	
9. Marine business services	The economic activity related to services to support ocean industry like finance, consulting, technical services, and so on.	N/A	Finance & Insurance, marine consulting; ocean engineering ; technical services; other
10. Marine R&D and education	The economic activity which is related to research and development, education, and training.	Universities	
11. Marine administration	The economic activity related to defense, coast guard, security, navigation and safety, coastal & marine environmental protection by government and public or private organization.	National Defence Fisheries and Oceans Other Federal Departments Provincial Governments ENGOs	

Park and Kildow, 2014		Fisheries and Oceans Canada	
Sector	**Definition**	**Industries included**	**Industries**
12. Others	The economic activity which is not classified elsewhere. It also includes economic activity related to development of the ocean resources, which are ocean renewable energy, marine living resources, seawater and spatial, but just enter into the early commercial stage.	N/A	Ocean renewable energy; marine biotech

However, some of the economic activity associated with these sectors is likely captured when estimating indirect impacts through the use of input-output models. As Colgan (2003) suggests, the economic activity associated with secondary and tertiary sectors with intermediate connections to primary industries (such as marine manufacturing and business service industries) can be best estimated using national input/output tables.

2.2 Commodities Based Activities

Despite the development of a Tourism Satellite Account and National Tourism Indicators [10], the Canadian marine tourism and recreation sector remains a collection of industries that are independently classified under the NAICS. Many of these industries (e.g. restaurants, car rental) include a large portion of non-tourism related activity, which exacerbates the already big challenge of teasing out the marine related share. Moreover, rather than an industry, marine tourism and recreation may be seen as a collection of activities undertaken by final consumers (tourists and recreationists). Hence, an alternative approach could be beneficial in portraying this activity.

Tourism and recreation activities are commonly measured through the amount tourists or recreationists spend on a variety of commodities (e.g. accommodation, food services, car rental, travel fares). Figure 4 shows a graphic definition of marine tourism and recreation through the use of Statistics Canada's Input-Output

[10] http://www.statcan.gc.ca/eng/nea/list/tourism

Commodity Codes classification (IOCC)[11]. The bubbles in this diagram represent the commodities purchased by tourists and recreationists in pursuit of tourism and recreation activities, rather than the industries that provide these commodities[12]. Gardner Pinfold (2009) collected expenditure data by commodity type according to the IOCC and used the commodities table of Statistics Canada's IO model to estimate the associated economic impacts (Table 2). IO models connect commodities to industries, so impacts can be traced to industries involved in the ocean economy.

Table 3. Recreational Fishing Expenditure Weighting and Concordance for Statistics Canada 2005 IO model (Gardner Pinfold 2009)

Weight	StatCan No.	StatCan Code	Description
Packages			
0.097	567	5321	Travel agents, tour wholesaler and operator
Food and Lodging			
0.097	567	5321	Travel agents, tour wholesaler and operator
0.023	647	56901	Hotel and motel accommodation services
0.003	648	56902	Other accommodation services
0.023	649	57001	Meals (outside home)
0	138	1162	Distilled alcohol beverages, consumed on license
0	140	1192	Beer including coolers, consumed on license
0	142	1202	Wine including coolers, consumed on license
0.098	600	5531	Retailing margins
0.001	137	1161	Distilled alcohol beverages, bought in stores
0.002	139	1191	Beer including coolers, bought in stores
0.002	141	1201	Wine including coolers, bought in stores
Transport			
0.033	446	3950	Motor gasoline
0.084	560	5301	Air transportation, passenger
0.049	448	3962	Diesel oil
0.002	451	3970	Lubricating oils and greases
Fishing services			
0.035	567	5321	Travel agents, tour wholesaler and operator
Supplies			
0.034	39	300	Hunting and trapping products

[11] ttp://www.statcan.gc.ca/eng/nea/classification/io_com/cat

[12] The diagram does not show downstream or upstream industries, since it is based on a classification of commodities rather than industries.

Weight	StatCan No.	StatCan Code	Description
Other			
0.019	600	5531	Retailing margins
Fishing equipment			
0.04	600	5531	Retailing margins
Boat equipment			
0.121	396	3520	Pleasure boats and sporting craft
0.035	394	3500	Ship repairs
0.017	379	3391	Non-commercial trailers
Camp equipment			
0.064	600	5531	Retailing margins
Vehicles			
0.108	373	3350	Trucks, road tractors and chassis
0.012	597	55101	Automotive repair and maintenance service
Land/Buildings			
0.097	554	5240	Non-residential building construction

Note: The industry classification presented in this table corresponds to the 2005 version of Statistics Canada's IO model. Subsequent updates are based on more recent versions of Statistics Canada's IO model

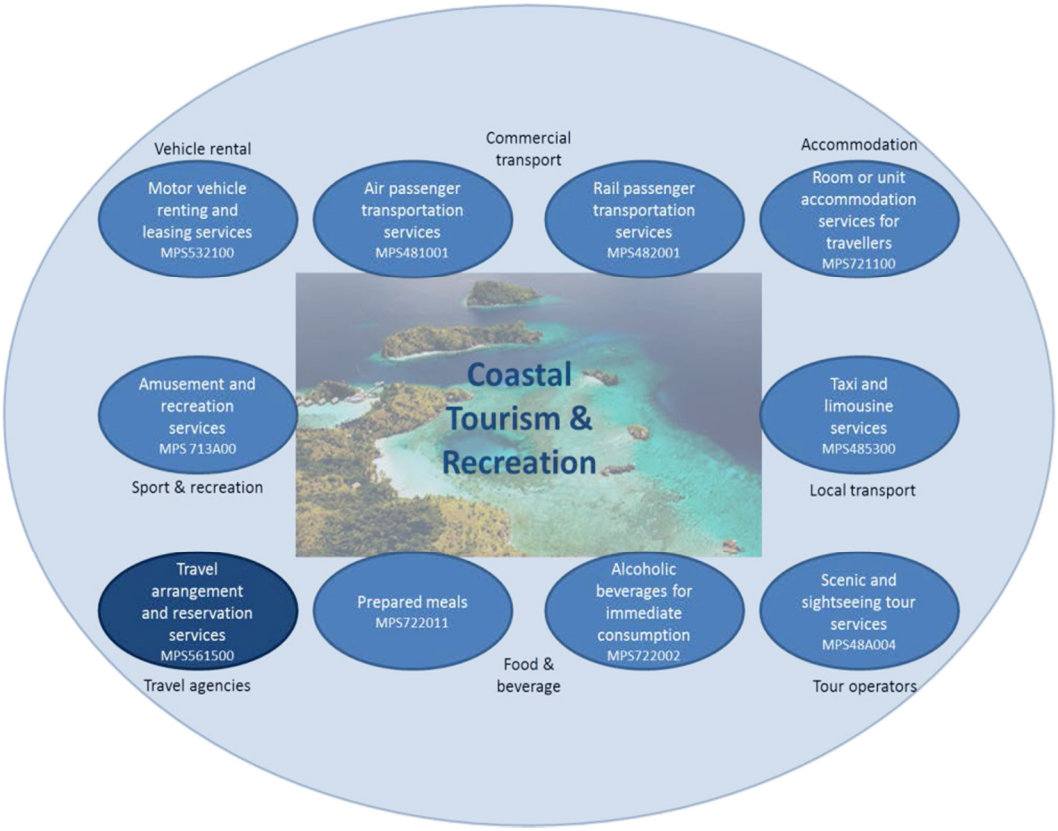

Figure 4. Combining Park and Kildow's classifications of ocean industries with the NAICS: Marine Tourism and Recreation.

3. FRAMEWORK OBJECTIVES

The US National Ocean Economics Program has developed a set of four objectives to inform the development of a framework to measure the economic contribution of ocean industries (Colgan, 2003):

1. Comparability (consistency) across industries and space
2. Comparability (consistency) across time
3. Theoretical and accounting consistency (i.e. no double counting)
4. Replicability

These objectives are very similar, if not the same as the ones used by Gardner Pinfold (2009) in their analysis of the economic contribution of ocean industries in Canada. As noted by Gardner Pinfold, comparability across industries, geographies and time are greatly enhanced by classifying industries according to the NAICS

and by obtaining statistical information for all industries from a unique source (Statistics Canada). However, despite any efforts in this regard, data availability and industry definitions often conspire to introduce imperfections in comparability and consistency. In the case of Canada, the following industries have presented issues with obtaining comparable data across industries and sometimes across geography (provinces):

a) Offshore oil and gas: value of output data has been suppressed by Statistics Canada due to confidentiality concerns; the alternative used has been production data published by provincial petroleum boards together with average market prices quoted by the United States Energy Information Administration and exchange rates published by the Bank of Canada.

b) Marine transportation (shipping): data is also suppressed by Statistics Canada due to confidentiality concerns; the alternative used is custom statistics on industry revenues prepared by the Canada Revenue Agency.

c) Ocean related tourism and recreation: this industry is not defined in the NAICS; Statistics Canada has developed a national Tourism Satellite Account and National Tourism Indicators, although this does not explicitly differentiate ocean tourism; the value added for this industry is obtained by looking at the expenditures of tourists and recreationists, rather than the value of output of any particular industry; a number of sources are used for various sub-sectors: (a) DFO's survey of recreational fishing (Figure 5 displays how recreational fishing is classified by Colgan and Kildown, on one hand, and by the NAICS, on the other); (b) recreational boating survey (2006) adjusted by the Tourism Satellite Account to account for changes in participation over time for recreational boating; (c) Tourism Satellite Account for cruise ships; and (d) Statistics Canada's travelers surveys for recreational travel.

d) Shipbuilding and boat building (includes offshore oil and gas drilling and production platforms): data is suppressed for confidentiality reasons for some provinces; Statistics Canada's Business Register

data on employment and establishment counts is used to prorate national estimates.

e) Marine Construction: port and harbor related construction is included in a broader NAICS code (237990: Other heavy and civil engineering construction); capital expenditures on construction by type of asset published by Statistics Canada have been used as an alternative.

f) Government/Public administration: government departments, whether federal or provincial, oftentimes have mandates that overlap marine and land related roles; government public accounts have been used in conjunction with expert judgment and special requests to some government departments to discern the marine component.

g) Social advocacy organizations: income and gross domestic product (GDP) by primary area of activity for non-profit institutions and volunteering was terminated in 2008; expenditures for a representative sample of marine-related environmental non-government organizations (ENGOs) have been used instead.

h) Universities: universities undertake research in a broad range of disciplines, only a subset of which is related to ocean resources; data and information on ocean related grants to coastal universities have been used in conjunction with average salaries for professors in ocean-related institutes associated with coastal universities.

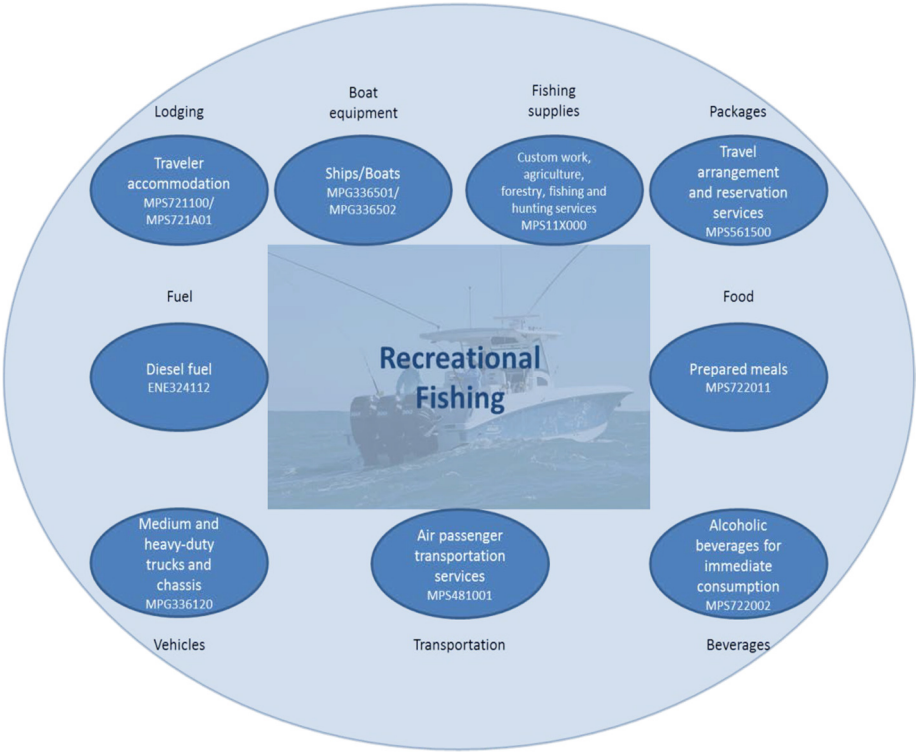

Figure 5. Combining Park and Kildow's classifications of ocean industries with the NAICS: Recreational Fishing.

Meeting the objective of comparability over time has also presented challenges. The discontinuation of data sources, whether of data published by Statistics Canada or reports prepared by/for industry associations, is an ongoing difficulty, particularly with diminishing budgets in the public administration. Examples are the recreational fishing survey regularly undertaken by DFO, which is currently delayed, and the recreational boating survey, which has been discontinued. Data confidentiality can also pose a problem in this regard, as data may be confidential in some years but not in others, particularly at the provincial level.

Another big challenge related to creating time series data is the cost of gathering all value of output and expenditure data required for estimating economic impacts through an input-output model. Canada's experience suggests that benchmarking studies may be conducted approximately every five years, with ongoing annual updates based on readily available proxies. Benchmarking studies are often contracted out to consulting economists, who bring a wealth of expertise and knowledge as well as industry contacts, particularly concerning industries that are

outside the mandate of DFO. Cost and expertise considerations make it difficult to replicate benchmarking studies with internal DFO resources.

The use of the NAICS and of Statistics Canada's interprovincial IO model provides a reasonable guarantee of theoretical and accounting consistency. However, the challenge of double counting has not been entirely eliminated from Canada's estimates. The risk of double counting is highest when ocean industries purchase inputs from other ocean industries (Pugh, 2008 and Oxford Economics, 2013). In these cases, the value added of a sector included as a separate industry can be double counted as part of the indirect value added of other maritime sectors it supplies goods or services to. Examples are commercial fishing and seafood processing, shipbuilding and marine transportation, and support activities to marine transportation or to offshore oil and gas and their respective direct industries. In these instances, the "in the ocean" activity (commercial fishing) is double counted to some extent in the indirect impacts corresponding to the "from the ocean" activity (fish and seafood processing), or the "to the ocean" activity (shipbuilding, support activities) is double counted to some extent in the indirect impacts corresponding to the "in the ocean" activity (marine transportation, offshore oil and gas).

Canada's ocean industries estimates include these industries separately, without proper adjustment to indirect impacts to eliminate (or minimize) double counting.

It is difficult to estimate with exactitude the magnitude of double counting in Canada's estimates. However, the following may provide a general appreciation of the problem[13]:

a) Support activities for offshore oil and gas are estimated to contribute CDN$208 million[14] (2012) in total economic impacts. A portion of this would be double counted in the indirect impacts of offshore oil and gas industry.

b) Support activities for marine transportation are estimated to contribute CDN$4.6 billion (2012) in total economic impacts. A portion of this

[13] For context, the total value of Canada's marine industries was estimated at CDN$36.1 billion (2012): http://www.dfo-mpo.gc.ca/stats/maritime/tab/mar-tab1-eng.htm.

[14] All dollar figures presented in this paper are expressed in Canadian dollars (CDN$).

would be double counted in the indirect impacts of marine transportation.

c) Ship and boat building are estimated to contribute CDN$984 million (2012) in total economic impacts. A portion of this would be double counted in the indirect impacts of marine transportation, commercial fishing, aquaculture, and marine tourism and recreation.

Gardner Pinfold (2009) made some adjustments to commercial fishing and seafood processing to avoid double counting. This correction was done by setting purchases from the fishing industry to zero when estimating the processing industry impacts. DFO is planning on addressing double counting problems more broadly in the next benchmarking study.

The replicability of estimates is affected by some of the challenges already noted, such as the discontinuation of data sources and the suppression of data due to confidentiality concerns. Hiring external consultants does tend to add to the complexity of the quantification effort itself. Private consultants often specialize or find niches, either through their accumulated knowledge and expertise or through their networks of contacts. This can make it difficult for other consultants to fully replicate their methodology. In addition, extra efforts have been required on occasion to get precision on data sources utilized or to obtain copies of materials used (e.g. spreadsheets with calculations or results).

Seeking to make estimates replicable, DFO has developed a spreadsheet based methodology for updating estimates on an annual basis. Due to unavailability of some data sources (i.e. discontinued: marine construction, or infrequent: recreational fishing) and difficulties replicating the methodology for particular sectors[15] (marine transportation), the model uses a combination of the methodology developed by the latest benchmarking study (commercial fishing, aquaculture, seafood processing, offshore oil and gas) together with proxy indicators to generate growth rates that are applied to benchmarking study results (remaining sectors). This has allowed for reasonably accurate estimates that can be used in high-level policy analysis.

[15] Refer to previous paragraph for a discussion on challenges replicating estimates.

4. ALLOCATING INDIRECT AND INDUCED ECONOMIC IMPACT ESTIMATES

The use of input-output type models facilitates in great fashion the estimation of economic impacts at the industry and regional (provincial) level, and allows for the capturing of the value added generated by upstream industries and by labor demand (i.e. indirect and induced impacts). The results of the input- output model show the entire flow of economic activity throughout industries and provinces (regions), which can be readily used to portray the economic contribution of the ocean sectors. The linkages to land-locked regions and to land-based industries can be then directly observed. As shown in Figures 7 and 8, impacts spread beyond Canada's marine coastal provinces and beyond ocean industries.

However, there may be merit in presenting the results in such a way that all economic activity that is triggered by an ocean industry is combined to show the aggregated economic impact of the ocean industry, including impacts that arise in non-ocean sectors [16]. Likewise, economic activity may be aggregated at the provincial level to show the cumulative economic impact of any one province's ocean economy, regardless of the province where the impacts occur.

The allocation of direct economic impacts is straightforward, since they reflect the value added by the industry involved in the direct activity and take place in the province where the industry operates. Hence, direct impacts will always accrue to ocean industries and coastal, marine provinces.

Allocating indirect and induced impacts presents challenges. These straddle both coastal and in-land provinces. For example, the latest benchmarking study undertaken by DFO indicates that approximately 10% of GDP and 11% of employment generated by Canada's maritime industries occur in non-coastal (in-land) provinces (Figure 8). This is an average for all industries included in the study. For some industries the percentage of economic impacts occurring in non-coastal regions is likely bigger.

[16] IO models simulate successive rounds of purchases of goods and services that, like the branches of a tree, spread or reach farther and farther from the main trunk of ocean industries.

Table 4. Total Economic Contribution of Maritime Industries in Canada (GDP and Employment), by Province, 2008

Province	GDP	% of Canada Total	Employment	% of Canada Total
Coastal Provinces				
Newfoundland and	$14,844,453	38%	36,394	11%
Prince Edward Island	$632,271	2%	9,940	3%
Nova Scotia	$5,228,902	13%	56,389	17%
New Brunswick	$1,404,653	4%	21,194	6%
Quebec	$4,627,365	12%	62,329	19%
British Columbia	$8,455,801	22%	105,794	32%
Non-Coastal Provinces				
Central Provinces	$3,833,562	10%	37,134	11%
Total Canada	**$39,027,007**	**100%**	**329,174**	**100%**

Notes:

(1) Central provinces include Ontario, Manitoba, Saskatchewan and Alberta.

(2) Economic impacts include direct, indirect and induced.

A similar challenge arises because there are many non-maritime industries involved in supplying maritime industries, hence creating economic value that is indirectly related to the ocean economy. The same Canadian benchmarking study suggests that in 2008 approximately 32% of GDP and 45%[17] of employment were generated by industries that have little or no ocean related component (Figure 9).

Table 5. Total Economic Contribution of Maritime Industries in Canada (GDP and Employment), by NAICS, 2008

NAICS	Industries	GDP (thousand CDN$)	As % of Total Ocean GDP	Employment (FTE)	As % of Total Ocean Employment
Industries with a Marine Component					
11A	Crop and Animal Production	$411,163		6,129	
114	Fishing, Hunting and Trapping	$1,357,916		16,832	
211	Oil and Gas Extraction	$13,721,618		2,974	

[17] These two percentages must be used with caution, as they are based on high level aggregation of industries. Actual percentages are likely somewhat different.

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NAICS	Industries	GDP (thousand CDN$)	As % of Total Ocean GDP	Employment (FTE)	As % of Total Ocean Employment
213	Support Activities for Mining and Oil and Gas Extraction	$482,944		5,011	
230	Construction	$500,117		6,964	
311	Food Manufacturing	$1,339,987		24,849	
336	Transportation Equipment Manufacturing	$627,476		9,507	
48A	Other Transportation	$3,358,064		38,534	
710	Arts, Entertainment and Recreation	$738,530		16,256	
720	Accommodation and Food Services	$636,423		17,003	
813	Grant-Making, Civic, and Professional and Similar Organizations	$163,820		3,169	
F20	Travel, Entertainment, Advertising and Promotion	$0		-	
GS2	Universities and Government Education Services	$188,732		2,262	
GS5	Other Provincial and Territorial Government Services	$161,594		1,827	
GS6	Other Federal Government	$2,704,126		29,867	
	Sub-total	$26,392,510	68%	$181,184	55%
	Industries with Little or no Marine Component				
	Other Industries	$12,634,497	32%	147,990	45%
	Total	**$39,027,007**	**100%**	**329,174**	**100%**

Thus far, DFO's approach has been to re-allocate all indirect and induced impacts to the coastal provinces where the direct activity that generated the indirect or induced impacts took place. A similar approach has been used for industries, whereby indirect and induced economic impacts are re-allocated to the maritime industries that originated or triggered the indirect economic activity. This is done through the use of multipliers, which are available at the industry level (i.e. NAICS) and at the provincial level. Alternatively, IO model results may be calculated separately for each industry and for each province, although this has a rather high monetary cost.

5. CONCLUSION

The contribution of this paper consists in placing the experience of quantifying the economic contribution of ocean sectors in Canada within the context of current methodological frameworks, and in reflecting on some of the challenges encountered in pursuing the objectives proposed in the literature for implementing these frameworks.

Canada's experience thus far shows that despite the inherent challenges of the task, it is possible to integrate disparate data sources into a coherent framework that provides robust estimates of the economic contribution of maritime sectors in Canada. Currently, economic impact estimates (direct, indirect and induced) are available for gross domestic product (GDP), employment and labor income by industry and by province, for the years 2006, 2008-2012[18]. All major ocean industries are included in the estimates. Benchmarking studies are conducted approximately every five years and annual updates are prepared in between.

This overview of frameworks and of Canada's experience show that Canada's maritime industries data does not include some ocean related sectors, most notably marine pipelines and refineries, marine equipment manufacturing, marine business services and emerging industries (renewable energy, undersea cables), although the economic impacts associated with these industries are likely accounted for at least in part within the indirect impacts associated with the ocean industries they supply.

[18] http://www.dfo-mpo.gc.ca/stats/maritime-eng.htm

Double counting seems to be the main problem affecting Canada's data. As a result, the economic contribution of some sectors may show an upward bias. The magnitude of this bias has not yet been quantified, although it is an area for future work. The main industries affected are: shipbuilding-marine transportation, support services-marine transportation, and support services-offshore oil and gas.

A potential solution for dealing with double counting would be to estimate the economic impacts at the level of ocean industry clusters (i.e. supply chain). This may require calculating the IO model results for the "in the ocean" (marine transportation) or "from the ocean" (seafood processing, retail gas stations) industries, as these are closer to the final demand and would therefore capture all upstream industries through indirect impacts (IO model). However, this presents its own problems, which could be the subject of another paper. In particular, industry classifications (NAICS) are typically broader than their ocean component. For example, retail sale of gasoline includes supplies from land-base as well as marine-based oil rigs. In addition, imports and exports are more difficult to trace or track. Continuing with the same example, the gasoline purchased at the pump could originate from marine-based oil rigs located in Canada or abroad. Therefore, careful consideration must be given before embarking in this approach.

Other challenges arise, which are common to most if not all studies reviewed, concerning suppressed data due to confidentiality issues, discontinuation of data sources, or plain unavailability of output or expenditure data for some industries. This remains a lesser challenge, and one that cannot be fully eradicated. As Pugh (2008) suggests, aggregate estimates of the economic contribution of maritime industries represent a ballpark. Canada's ocean industries data series does at a minimum meet this qualifier.

The next steps in quantifying Canada's ocean economy include the conducting of a benchmarking study for 2013 (time lag due to data availability). This study will place particular focus on expanding the geographical scope of Canada's ocean sectors data to include Canada's Arctic and on avoiding double counting. Future goals would be revisiting the definition of industries included in Canada's ocean economy in light of the clusters framework to ensure complete coverage, and seeking to enlarge the scope of the data set to include some of the new and emerging industries (renewable energy, sea bed cables).

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