Midstream Opportunities and Challenges for Canada's West Coast Ports.

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1. Introduction

Sletmo (1999) observes that ports display a discernible life cycle consisting of early growth, development, and maturity phases. If ports fail to capture new business opportunities, decline sets in and a port ceases to be part of a modern logistics network. Outside of the transportation sector, the 2002 *Canada Marine Act Review* fostered little public debate about what role our ports could and should play in a modern logistics network. The Federal Transport Minister provided a rather narrow range of instructions to the review panel, and the government subsequently failed to act on many of the recommendations. The implied maritime policy of the federal government is that existing port foundations (i.e., dry bulk cargo, inter-modal traffic, and cruise ship travel) are sufficient to maintain Canada's trade competitiveness.

More recently (2005), the *British Columbia Ports Strategy* was released, highlighting the infrastructure needed by Canada's West Coast ports to fully capture the opportunities in containerized cargo flows generated by Chinese and Asian economic growth. This represents a significant accomplishment when considered in light of the federal government's implied policy direction. However, the B.C. strategy document is almost silent with respect to the planning and infrastructure implications that may arise from new trade opportunities generated by industrial growth in the ports' immediate hinterland.

Michael Ircha has argued persuasively that the newly commercialized Canadian Port Authorities need to be engaged in strategic planning.
Ircha's (2000) work highlights the need for port planners to focus both on the needs of existing customers, and to evaluate new business lines. The purpose of this paper is to use growth vector analysis to evaluate two particular new business lines: that arising from Alberta's oil sands production, and a potential B.C. offshore oil and gas industry. In doing so, it will explore the logistics, transportation, and infrastructure challenges that await ports wishing to participate in this specialized segment of the maritime sector.

Port executives must choose from a wide variety of strategic and competitive analysis tools. One particularly useful tool is growth vector analysis (GVA). GVA provides a disciplined approach to framing market strategies. The term growth vector refers to the strategic direction a port is taking in relation to both its cargoes ands markets. The result of the GVA analysis can be presented in a simple two row and column table that lists the market penetration, market development, cargo development or cargo diversification options available. By clearly identifying the market (expanded, or new) and cargo (improved, new) options available the vessel, cargo handling, upland terminal, and port infrastructure requirements can be readily identified

In the energy industry, the upstream sector is where oil and natural gas are found and extracted. The downstream sector is where oil is refined and processed, and where natural gas and finished petroleum products are distributed to industrial or retail markets. The midstream stream sector is the logistics system that link upstream oil and gas production with downstream refining and distribution. For example, the function of a bulk liquid crude terminal is to transfer cargo between an inland transmission pipeline or coastal transport mode, and ocean going vessels.

Canada's West Coast ports generally have sufficient water depth for ships alongside the berth and navigation channels, wharves that can handle the loads traversing them, cargo-handling equipment, storage facilities, and commercial processes to handle the dry bulk, break-bulk, and container traffic that dominate the cargo mix. Truck and rail are the dominant inland transport modes used to move cargo to and from the port. However, a liquid bulk petroleum terminal, or an offshore oil and gas port, has its own unique requirements. For example, the offshore oil and gas logistics system consists of three major components: the offshore platform, the port, and an inland transportation network. The transport option chosen to move oil or gas from the offshore (shuttle tanker or pipeline) location will result in the need for specialized port infrastructure. Offshore oil and gas ports also serve as industrial sites for large shipyards, equipment fabrication/repair, and value-added processing activities (Jayawardana and Hochstein, 2004). Ports wanting to participate in the midstream sector thus need to offer advanced handling facilities, access for large liquid bulk carriers, and sufficient upland property to support industrial activity. The provision of this infrastructure type is capital intensive and requires long lead times for planning and construction. Thus, it is important for port strategists to carefully consider all the relevant options.

2. Alberta Oil Sands

Canada is the only Group of Seven nation with the resource base to support significant growth in crude oil production. The vast majority of Canada's oil reserves are found in Alberta. Alberta has 176.1 billion barrels of oil, or about 14 percent of world reserves. The Alberta Energy and Utilities Board (EUB 2004) determines the level of established reserves based on what is recoverable under current technology and present and anticipated economic conditions as proved by drilling, testing, or production, plus a portion of contiguous recoverable reserves.

2.1 Midstream Opportunities

Alberta's current crude oil production of 1.6 million barrels/day accounts for 66 percent of Canada's total oil production. Alberta's total crude oil production is forecasted to grow to 2.6 million barrels/day in the next eight years, a 60 percent increase (Alberta Energy and Utilities Board forecast period 2003 to 2013). Since 1994, marketable oil sands production has more than doubled, surpassing 1 million barrels/day in 2004. Dunbar (2004) estimated the oil price required to justify new oil sands investments, and concluded that Alberta's oil sands are a relatively high-cost source of oil compared to oil from the Middle East. Investors could expect attractive returns on projects when the price for West Texas Intermediate oil was in the range of US $25/barrel. Substantial oil sands production growth would be expected under this moderate crude price scenario (6.8 percent per year from 2002 to 2017). Under a high price scenario of US $32/barrel, oil sands production growth would be 8.7 percent per year over the 2002 to 2017 period.

In 2000, three-quarters of Canada's oil sands production was delivered to domestic refineries, all of which are operating at or close to capacity (National Energy Board, 2000 p. 66). Traditionally, the largest export markets for Alberta crude oil are the Midwest and Rocky Mountain regions of the United States. American refineries in these areas are capable of absorbing a substantial increase in crude supplies from Alberta. However, other potential market regions include the US west coast, and the Far East (Alberta Energy and Utilities Board, 2004 p.2-16). While crude oil production growth in Alberta is not without its risks, it nevertheless represents a significant to opportunity for a few West Coast ports to expand their trade.

2.2 Midstream Challenges

Crude oil exports are generally moved by pipeline to the coast, where the bulk liquid cargo is loaded into tankers at a terminal. The most basic port terminal requirements would be a tank farm for temporary oil storage and a jetty, or single buoy mooring, projecting into deep water where large tankers can load cargo. From the port, a tanker would deliver directly to a refinery, or to a crude oil terminal linked to refineries by a pipeline (Stopford 1995).

The steps in the bulk crude logistics process illustrate that pipeline economics and vessel characteristics are the two primary factors that determine whether crude oil exports are a potential business opportunity for a port. Ports that can demonstrate that their physical location represents the lowest cost expansion, or new pipeline route, will be at a competitive advantage. To understand why this is so, it is necessary to consider the logistics system used to move oil to market.

In Alberta, the various feeder pipelines that gather and move oil sands production from northern Alberta converge at two main hubs in the Edmonton region. The Edmonton hub has two main transmission pipelines. Enbridge Pipelines Inc. is the major carrier of crude oil to eastern Canadian and U.S. markets, while Teresan's Trans Mountain Pipeline System moves crude oil to the west coast. The Alberta Energy and Utilities Board (2004 p. 2-13) and the Canadian Association of Petroleum Producers (2005) both report that the expected increase in oil sands production will result in pipeline availability constraints and additional pipeline capacity would be required.

Crude oil is a globally traded commodity. Producers do not set the price, rather crude oil flows to markets that provide the highest value.

Canada's traditional oil trade pattern reveals that it flows to the domestic market first, then to the U.S. because these markets have the lowest transportation costs. Therefore, resource developers are provided with the highest net revenue. In the oil and pipeline business, this is referred to as the 'highest netback.' Increased oil sands production not only brings with it the possibility of existing pipeline capacity constraints but also increasing supply to existing markets, thereby depressing the price. Bulk liquid crude exports using a Canadian West Coast port represent an opportunity to solve the pipeline capacity problem, and simultaneously diversify the export market. However, it is important to note that as the distance to new markets increase, the pipeline shipping costs borne by oil sands producers also increases. As a result, the netback is reduced. Port planners thus need to carefully assess the economic factors driving new pipeline investment decisions.

The 1,150 km Treason Pipeline Trans Mountain pipeline transports crude oil and refined products from Edmonton to marketing terminals and refineries in Greater Vancouver and Puget Sound in Washington State. The $2.1 billion Trans Mountain Pipeline Expansion (TMX) represents a cargo and market extension for the Vancouver Port Authority because currently the Terasen Westridge Marine Terminal is the only facility on Canada's West Coast that can ship crude oil by ocean-going vessel. The company has indicated that they believe the markets for Canadian crude oil on the West Coast are Washington State and California.

Terasen's three-phased approach to their TMX project first involves constructing a 178 km-section of 32-inch pipe looping the east end of the Trans Mountain system between Hinton and Jackman, B.C., several pump stations, and tank facilities. The second phase will bring future increases in pipeline capacity by adding new pumping stations through to the port of Vancouver.

Terasen may also offer a third expansion option. This would be a northern leg to the port of Prince Rupert or Kitimat. These ports are capable of accommodating a Very Large Crude Carrier. The first phase is planned for completion in 2008, with full expansion capacity available in 2011.

The proposed 1,200 Enbridge Inc. Gateway pipeline proposal would transport crude oil and refined products from Edmonton to a marketing terminal at either the Port of Kitimat or Prince Rupert. The $2.5 billion Gateway proposal represents both a cargo and market diversification opportunity for both ports because neither one currently has a marine terminal that can ship crude oil by ocean-going vessel. Enbridge's CEO has indicated that China, Japan, South Korea, and California would be the target markets. The project would require that a new 30-inch crude oil pipeline, bulk liquid crude storage facility and marine terminal be built. The company is aiming for an in-service date between 2009 and 2010.

Gilje, Dinwoodie, & Challacombe (2002) observe that the longer the voyage distance, the more economical efficient larger vessels will be until geographical and design constraints are encountered. High value cargoes suit smaller vessels due to increased financial penalties associated with holding large stocks, and conversely, lower value cargoes suit larger vessels. Port planners must therefore carefully consider economic the trade-offs involved in economies of large cargoes at sea against the storage, handling, and port costs incurred.

There are three main sizes of oil tankers. Popular Aframax vessels were initially 80,000 dwt (dead weight tons) but are moving to a standardized 105,00-107,000 dwt today. Very large crude carriers are over 200,000 dwt and require a water depth of about 20 meters. The larger Ultra Large Crude Carriers (ULCC) is over 300,000 dwt, with a loaded draught of 22 meters.

However, the size of the ULCC can be up to 550,00 dwt, 308 meters in length and 40 meters in breadth. While most oil tankers discharge with their own pumps, the large vessels require a complete dedicated port infrastructure, both in exporting areas and in the importing countries. Their deep draught also places restrictions on the use of key shipping lanes (Gilje, Dinwoodie, & Challacombe, 2002). The Westridge Marine Terminal in the Port of Vancouver can only accommodate the smaller Aframax tankers up to 100,000 dwt and barges for crude oil due to navigational restrictions arising from the terminals location deep inside Burrard inlet. A new bulk liquid terminal at either Kitimat or Prince Rupert ports would face no such restrictions.

3. B.C. Offshore Oil and Gas

3.1 Midstream Opportunities

According to the Geological Survey of Canada, the Queen Charlotte Basin could contain up to 734 billion cubic meters of natural gas and 1.56 billion cubic metres of crude oil. The Winona, Tofino, and Georgia basins are areas of sedimentary rocks off the B.C. coast and have a smaller resource potential, primarily natural gas. The entire Pacific Margin region is estimated to contain about 4 percent of Canada's total conventional hydrocarbon resources (Canadian Centre for Energy Information 2004 p. 13). Yet, in 1972, Canada made a policy decision not to approve any new exploration permits or programs in the West Coast offshore area and to suspend all work obligations under existing permits. This decision is known as the federal moratorium. In the midst of negotiating the Pacific Accord in the late 1980s, oil spills in Washington and Alaska led the British Columbia government to announce that it would not allow offshore exploration for at least five years. This policy decision is known as the provincial moratorium.

The area under provincial moratorium includes Johnstone Strait, Georgia Strait, Juan de Fuca Strait, Hecate Strait, and Queen Charlotte Sound.

The election of a new B.C. provincial government in June 2001 brought a renewed interest to examine the potential for offshore oil and gas development. The Liberal Government's 2003 throne speech outlined the goal of seeing exploratory drilling underway by 2010. A number of environmental issues (species and habitats at risk, sea-floor stability, currents, tides, earthquake risk) need to be considered before this goal can be achieved. Thus, the B.C. government appointed an independent panel to examine whether offshore oil and gas could be developed in a scientifically sound and environmentally responsible manner. The Scientific Review Panel (2002 p. 51) panel concluded that there was "no inherent or fundamental inadequacy of the science or technology, properly applied in an appropriate regulatory framework, to justify retention of the B.C. moratorium" on offshore oil and gas activities."

During the last four years, the Government of Canada has also been reconsidering its offshore oil and gas policy options. For example, it appointed an independent panel to facilitate and coordinate a public and First Nations review process. The review panel noted that many participants in the public and First Nations process believed that significant socio-economic information gaps existed with respect to the potential impact offshore oil and gas development. The Report of the Public Review Panel on the Government of Canada Moratorium on Offshore Oil and Gas Activities in the Queen Charlotte Region of British Columbia (2004 p. p. 106) surprising concluded that the firmly held and polarized views they received did not provide a basis for reaching a policy compromise regarding keeping or lifting the moratorium. The final report was rendered after the 2004 federal election that resulted in a minority federal Liberal government.

The report's authors were no doubt aware that a minority government would probably prefer not to deal with the complex policy issues associated with offshore oil and gas development in a region where they hoped to garner future electoral success.

The application of the growth vector technique to Canada's west-coast ports reveals that the offshore oil and gas sector represents both market development and service diversification opportunities since there are no ports currently participating in this market segment. Jayawardana and Hochstein's (2004) research reveals that ports can become a centre of the midstream sector if they effectively connect the onshore logistics network with the offshore segment. The network requires liquid bulk cargo handling terminals, industrial sites for large shipyards, equipment fabrication and repair, and value-added processing activities. Given the nature of these activities, any port seeking to participate in a future B.C. offshore oil and gas industry would be well advised to assess how they could accommodate the offshore oil and gas industry's logistics requirements. Unless these logistics requirements are correctly identified at the outset, they will not be able to be considered in the preparation of any long-range strategic plans, land-use plans or infrastructure-upgrading decisions. However, port officials with this type of planning information will be in an ideal position to contribute to the public policy debate regarding the economic impacts associated with offshore oil and gas development.

3.2 Midstream Challenges

The five sequential phases in typical offshore oil and gas development are seismic and geophysical surveys; exploration; development; production, and decommissioning. An effective logistic system to support each of these phases consists of the offshore platforms, port infrastructure, and inland transportation networks.

Offshore oil and gas exploration and development may be made cost prohibitive if there are deficiencies in any of these three areas. This paper will now briefly examine typical logistics issues that may need to be incorporated into certain west coast ports' strategic plans.

The Scientific Review Panel (2002 p. 33) report stated that significant advances in drilling technology have enabled the industry to conduct offshore exploration and production in much deeper waters than when the federal moratorium was first introduced. Given the relatively deep waters off the B.C. coast, the Panel's observation that it was now technically feasible to contemplate the extension of offshore operations beyond the narrow continental shelf raised public awareness of the potential scope for exploration and development activity. This in turn increased the information needs of coastal communities and First Nations residents as they sought to make informed policy opinions.

In the event that an economic offshore oil deposit is identified, there are a limited number of offshore drilling and production platforms to consider. The type of offshore platform used depends on water depth, as well as the economic characteristics and production life of the resource. For example, drill rigs on piles can be used in water three meters in depth, submersible rigs in waters up to 20 meters, jackups in 100 meter water, anchored semi-submersible platforms in waters up to 200 meters, and dynamically positioned drill ships in water over 2,000 meters or more (Canadian Centre for Energy Information 2004).

The Scientific Review Panel (2002 p. 34) concluded that offshore oil and gas production options in B.C. include a moored semi-submersible, a tension leg platform, a floating production storage and offloading unit, or possibly a gravity-base structure. Floating facilities are less costly and are suited to a smaller resource with a shorter production life.

The Panel also concluded that it should be possible to require that the lines from the production platforms be tied into pipelines as opposed to offloading the oil into shuttle tankers by way of buoys. In contrast, the Terra Nova oil field uses shuttle tankers to carry the crude oil from Terra Nova directly to market or to the same transhipment terminal used by the Hibernia project.

If the offshore resource being developed is natural gas, there are a few basic logistics options to transport natural gas production to market. For example: (a) using an undersea gas pipeline; (b) cooling the natural gas until it liquefies (LNG), and then transporting it by ship; (c) compressing the natural gas (CNG), and then transporting it by ship.

Offshore platforms used to extract an oil and gas resource require a fleet of dedicated vessels to service their needs. For example, anchor handling tugs, cable laying vessels, supply vessels, construction vessels, dredgers, floating storage vessels, shuttle tankers, mobile drilling units, mobile production systems, remotely operated vessels, standby and rescue vessels, survey vessels, and tugs.

There are also significant differences at each stage of the onshore logistics process for an offshore port compared to a typical cargo-handling terminal at a conventional port. While conventional ports attempt to maximize throughput productivity, the functions at an offshore port mean that reliable and uninterrupted supplies of inventory to the offshore platforms are a major focus of activity. This requires a significant landside area for staging product, fabrication, and consolidation supplies. For example, warehousing infrastructure may be related to the need for safety inventories and thus may be in storage for longer periods. Transporting goods (personnel and cargo) offshore by either air or water is also an important element of the logistical system.

Common cargo include food and provisions, water for drinking and industrial use, drilling mud, lubricants and fluids, waste disposal, and turbines and other instrumentation (Jayawardana and Hochstein, 2004). The exact nature of the activities in an upland port area will depend on offshore requirements in exploration, development, and production. However, it is not hard to imagine the volume of rail and truck traffic required to support such activities. Port engineers and planners will no doubt note that the vessel berthing areas, repair and maintenance services, and landside services at the offshore oil and gas port are generally inconsistent with what would be found at a dry bulk, break-bulk, or container terminal. They would be difficult to incorporate in ports pressured by urban encroachment such as Vancouver Port Authority of the Fraser River Port Authority where there are significant traffic volumes and congestion outside the port's property limits. Ports on Vancouver Island would potentially incur more expensive inland transportation costs given their location, unless barge service could be established for transporting heavy equipment or supplies.

4. Matching West Coast Port Capacity With Oil and Gas Production: Some Conclusions

Increased production in the Alberta oil sands over the coming years offers the potential for a cargo and market extension for the Port of Vancouver, or a cargo and market diversification opportunity for Kitimat or Prince Rupert port, if the appropriate logistics networks are put in place at the right time.

Port strategists have a number of items to consider when evaluating the Terasen and Enbridge proposals. Terasen's focus on the California market suggests an Aframax-sized vessel might be deployed for the ocean going portion of the trip to market where the shipping advantage of using ULCC may not be advantageous.
This is important since the location of Terasen's Vancouver terminal prohibits a VLCC or ULCC from berthing because they

require a deep draught anchorage, wide approach channels, and turning basins. It appears that the Terasen's short-term strategy is based on physical and operational constraints at their terminal, as those influencing pipeline economics.

There are more factors to consider before deciding whether increasing oil sands production represents a cargo and market diversification opportunity for either Kitimat or Prince Rupert port. A key item is the capital cost of a new pipeline corridor. Given B.C.'s coastal geography and the fact that Kitimat is closer to the Edmonton hub, a crude oil terminal at Kitimat may result in significant pipeline cost savings compared to Prince Rupert. A northern port option represents an advantage compared to a Vancouver terminal location because of the economies of scale in ocean shipping. Locating a liquid bulk crude terminal at either port would make it accessible to the largest ocean going vessel. This would extend the potential market reach of Alberta oil sands producers. Given the fact that both crude pipeline proposals feature a northern port option, the long-run choice may not be a southern or northern port location. Rather, it may between the two northern competitors.

It is difficult to anticipate if any of B.C.'s offshore oil and gas resources will be developed. Nevertheless, port engineers and planners can readily appreciate the fact that deep-water oil and gas exploration and production generates a greater need for more extensive, and capital-intensive port infrastructure. The geographical location of B.C.'s offshore oil gas resources and water depths may indicate that developing one main offshore oil port would probably be the most economical option. Based on the logistic needs identified in this paper, the Vancouver Port Authority

and Fraser River Port Authority do not appear to be ideally positioned to assume this role. The logistics requirements seem to favour either Kitimat or Prince Rupert. Kitimat may be able to leverage its competitive advantage for a bulk liquid crude terminal for Alberta's oil sands exports to become the location for a future B.C. offshore oil and gas port.

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