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Bruce Colbourne

St. John's ocean technology cluster: can government make it so?

***Abstract:** The St. John's (Newfoundland and Labrador) Ocean Technology Cluster arises from a natural regional interest and historical economic activities in the ocean, and a more recent series of public sector investments in research and educational facilities. The St. John's Cluster is compared to a more developed Finnish Maritime Cluster and some recent literature on clusters and economic development. The comparison indicates that government policy towards the St. John's cluster needs to shift emphasis from research per se to a stronger industrial presence, supported by research, and a background economic environment that is broadly attractive to business and individuals. An active domestic market in primary marine activities is identified as a potential base for a stronger ocean technology industries cluster. Government actions, including continued investments in education research and infrastructure, creation of an attractive tax environment and the use of government operational requirements in ocean activities to create support industry opportunities, are recommended.*

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Opinions expressed in this paper are not official policies or views of the National Research Council Canada.

Introduction

The Government of Canada, through the National Research Council, and other agencies, has embarked on an industrial development strategy based on technology clusters. In Newfoundland and Labrador the cluster is ocean technology industries and infrastructure. The provincial and St. John's municipal governments have both endorsed and become active participants in this strategy. Indeed, it could be argued that the provincial and municipal governments were pursuing the strategy well before the federal government. This paper seeks to provide ideas for government actions to accelerate development of this industrial cluster, specialized in ocean technologies. Newfoundland and Labrador has unique characteristics and history, and although some of these proposals may have relevance to other regions in Canada, the attempt here is to make appropriately specific suggestions based on analysis of the region and application.

Although we can describe clusters that exist, it is much more difficult to identify what caused them or what actions governments could take to cause a cluster to grow.

Clusters are an enduring and widely noted economic phenomena that have been extensively studied in recent years, particularly by M.E. Porter, who argues that in theory, location should no longer be a source of competitive advantage, due to changes in technology that have diminished the traditional advantages of location. But in practice, location remains central to competition. Clusters, defined as geographic concentrations of interconnected companies, suppliers, service providers, and associated institutions in a particular field, are a feature of virtually every national economy, especially in more advanced nations. The economic map of the world is characterized by clusters of linked industries and institutions that enjoy unusual competitive success. Clusters affect competition by increasing the productivity of companies based in an area, by driving the direction and pace of innovation and by stimulating the formation of new businesses within the cluster. Geographic, cultural, and institutional proximity provides companies with special access, closer relationships, better information, and other advantages that are difficult to tap from a distance. Competitive advantage lies increasingly in local knowledge, relationships, and motivation. Development and upgrading of clusters is an important agenda for governments, companies, and other institutions. Cluster development initiatives are a new direction in economic policy, building on earlier efforts in macroeconomic stabilization, privatization, market opening and reducing costs of doing business. Clusters are a relatively new way of thinking about national

and local economies, and they necessitate new roles for companies, government, and institutions in enhancing competitiveness¹.

The current Canadian interest in clusters follows this trend but although we can describe clusters that exist, it is much more difficult to identify what caused them or what actions governments could take to cause a cluster to grow. Looking at geographic regions that have technology strength, one theme is development around natural advantages or adversities, fostering capabilities based on these requirements and climbing the value chain around the resulting industry or technology. The top of a value chain is the intellectual input; design and innovation, which leads to new products, approaches or technology. This is fundamentally the underlying approach and end objective for the ocean technology cluster in Newfoundland and Labrador.

There is also a growing recognition in government that industry development activities cannot be carried out in isolation. The efforts of one department or agency may be entirely neutralized by broader policies that counter development stimulus. Thus it is not enough to set up programs designed to encourage clusters without looking at the total environment.

Background

Newfoundland and Labrador presents a challenging economic development environment. The province has (or had) abundant resources and high levels of export. Historically, these resources have been exported raw, with the benefits of processing, resale and associated technology realized elsewhere. There is an economic development history based on industrialization away from traditional marine based activities but recently there has been renewed provincial interest in economic development strategies centred on the ocean with the announcement of a Newfoundland and Labrador Marine Technology Strategy. In parallel, an unprecedented federal interest in the oceans and coasts, including the arctic has developed, embodied in an Oceans Strategy and an Ocean Action Plan.

Ocean technology in Newfoundland and Labrador has its modern roots in the establishment of the Ocean Sciences Centre at Memorial University in the mid 60s. The university expanded its interest with the Centre for Cold Ocean Resource Engineering (C-Core) in 1975. Concurrently, the provincial government established NORDCO, the Newfoundland Oceans Research and Development Corporation. Offshore oil exploration led to a community of consultants trading on

the oil companies' unfamiliarity with ice, and government interest in the offshore. Activity peaked with the 1979 Hibernia discovery. In parallel with oil exploration, provincial and federal governments invested in related infrastructure, of which the largest was the NRC Institute for Marine Dynamics, opened in 1985. The province (with federal help) built other facilities, ultimately resident at Memorial University, including; the Ocean Engineering Research Centre, The Offshore Safety and Survival Centre, the Centre for Marine Simulation and the Canadian Centre for Marine Communications.

Early public sector attempts to generate technology-based economic activity revolved around marketing the centres of excellence, the collection of public sector research facilities. This initiative emphasized securing international contracts for the facilities rather than promoting local industrial research and spin-off activities. The late 80s and early 90s yielded cutbacks in the oil industry due to declining prices and cutbacks in government due to increasing debts. Both actions led to the disappearance of many consultants and NORDCO, and a period of "survival only" in university and government. By the mid-90s, the ocean technology community had come close to collapse. The atmosphere of innovation was replaced by a scramble to get in on very competitive oil projects. However, at the same time, and almost in spite of the institutional and oil activity, a successful cohort of companies producing charting, remote sensing, data recording and communications products for ocean applications has grown up and is currently operating in St. John's. This is the true core of the present day cluster.

Through the boom, bust and recovery, a widely (but quietly) expressed sentiment, from local industry and government, has been "We did not get enough from our investment in research facilities". The centres of excellence have not yielded an economic payback with the sorts of multipliers that were expected. Although there was an implicit recognition of the cluster concept in the government investments of the 70s and 80s, there was only a vague concept of how this would transfer to economic activity. Recent studies of clusters such as Ottawa illustrate some of the links between publicly funded research and subsequent development of an industrial cluster². More importantly, they show that such investments are not guaranteed. They require other factors to act and there is a long time period between input and output.

A Benchmark

There are many industrial clusters in the world, specializing in industries from auto manufacturing, to movie production, to electronics, and based on widely different forms of natural advantage. The cluster in Newfoundland and Labrador is technology based with ocean resource/transportation roots. To benchmark that cluster we look for a similar, but more advanced, grouping for comparison. The collection of marine industries in Finland has recently been the subject of an in-depth study by the Finnish national government³. This grouping provides an appropriately larger, more advanced and well researched benchmark. Their report by Viitanen et al. defines a cluster as:

“...a unit of companies, the interaction between which can be proven to produce certain advantages... The core of the cluster is made up of companies producing key products and the key products themselves, such as ships produced by the shipbuilding industry or maritime transport services. Shipping companies, ports and shipyards form a complex and diverse network together with their contractors, subcontractors and co-operators. Some of the companies produce production technology for the other companies in the network, others produce technology contained in their end products. The cluster also includes a multitude of companies, starting from supporting and associated industries and producers of different special services such as education, research, classification and financing services”.

St. John's cannot really be said to have a “unit of companies”. There are companies operating in a broadly defined technology area. It is unclear whether there is much interaction between them and no evidence of mutual advantages. However, there have been anecdotal reports that mutually advantageous cooperation between companies is developing faster than expected. A missing element in the St. John's cluster is one or more key products. It would be reasonable to select one of the “natural” activities such as oil, or fishing and strategize on how to move to a position where there is a cluster of industrial activity organized around producing major products for that activity.

Government units, such as universities, polytechnics and research institutes are identified as supporting, but not primary, elements of a cluster, and as important foundations for competitiveness. This is encouraging for the St. John's cluster because these elements are significantly in place. However, policy towards a cluster, or center of excellence, in St. John's has concentrated on the research and educational units as the core. This interpretation has led to an inappropriate expectation of private sector performance and business generation from these

agencies, neglecting their more fundamental “in cluster” roles as foundational and supporting elements for the regional industrial sector.

The Viitanen report also offers some commentary on competitiveness and how it affects, and is affected by, an industrial cluster.

“A competitive country is one that is the best location for the companies of different industries and clusters to settle into. A three-level definition of competitiveness is given in the following:

Competitiveness of a company: A company is able to produce commodities in a more cost efficient way than its competitors or has the capability to produce such commodities or features of commodities that competitors are not able to produce and is able to sell the commodities with profit in the open market without the help of subsidies.

Competitiveness of a cluster: A cluster is competitive if it is able to generate synergetic advantages thorough innovation and the efficient use of resources across company and industry borders.

Competitiveness of a national economy: A national economy is competitive if it is able to create and sustain such production factors, basic structures and operative conditions that make up an attractive location for competitive companies and clusters.”

“Sometimes even straightforward production factor disadvantages can be the source of competitive advantage. The disadvantages have to be conquered by innovation, which may prove to be a resource of competitiveness.”

In Newfoundland and Labrador, the ocean is a source of activity that requires technology and generates wealth.

These points guide analysis of natural advantages. In Newfoundland and Labrador, the ocean is a source of activity that requires technology and generates wealth. Although in recent history the ocean has been viewed as a problem, it can equally be viewed as a natural advantage. The Finns recognize that problems, which must be dealt with as part of their natural environment, can lead to industries with export potential.

Related to natural adversity is the issue of domestic demand. To quote: "A high domestic demand may help a field of industry in one country to become a world leader." Similarly,

"Sometimes it is possible for a company to break into the international market by riding an unusually important investment wave. A good example of this could be the Finnish mining-related industry that in the 1960's and the 1970's profited from the opening of several mines that needed specialised mining technology. Another example could be strong mechanisation of the forest industry that helped Finnish producers of forest machinery gain success in the international market."

Newfoundland and Labrador has almost no track record of developing supplier industries based on traditional resource industries, nor is strategically focused domestic demand evident in the wider Canadian ocean technology sector. Government, the fishery and the oil industry dominate the consuming sector. Government is more often cited by industry as slow to buy domestically; the fishery has a history of buying foreign equipment; and the offshore oil industry is new in Canada and very international in approach.

The Viitanen report comments on government policy effects on competitiveness and reflects the current un-fashionability of direct subsidies:

"...many government measures have an impact on the competitiveness of a cluster. Sometimes politicians are not aware of this impact because they have designed the measures to influence a completely different phenomenon. "

"Industrial policy, too, is often only seen as consisting of granting subsidies to industries in distress. In the long run, direct subsidies given to the industries that are the least successful only weaken those industries' chances to succeed. Sustainable competitive advantages can only be gained by investing in education and product development, setting constructive quality, safety and environmental standards, placing challenging orders and stimulating the birth of company networks."

"If the company-level problems are not known, it is hard to apply government policies in practice."

Local industry representatives occasionally note that Government support programs in Canada are more commonly tailored to suit the requirements and fears of the government than the problems of companies.

There is a need to move towards policies that foster an industrially dominated ocean technology cluster and place the public infrastructure in a proper supporting role.

Conclusions from the comparison

To summarize the analysis of Newfoundland and Labrador's clustering efforts with reference to the Finnish experience:

- Public policy, aimed at the St. John's ocean technology cluster, is too focussed on educational and research organizations. There is a need to move towards policies that foster an industrially dominated ocean technology cluster and place the public infrastructure in a proper supporting role.
- The Newfoundland and Labrador ocean technology industry is diverse. It is difficult to define the cluster in terms more detailed than ocean technologies. This description is sufficiently broad that it encompasses many activities that are not mutually supportive. Natural selection may ultimately narrow the focus but it would not be appropriate for government policy to prescribe this selection.
- There is no core industry and there is not a vertically integrated industry, either of which would substantially strengthen an industrial cluster. The province has not capitalized on the fishery to develop a supporting technology industry. It is not clear that growth in the offshore oil industry will lead to locally based technology producers. Federal and provincial governments should set an example by using their own ocean related requirements as an industrial development tool.
- The Viitanen analysis, and other references⁴, maintain that directed subsidization programs do not work in creating long-term industrial stability but that the background competitive environment is important. Newfoundland has a history of directed programs that are conflicted by a poor background economic environment. Moves to improve the background infrastructure and economic attractiveness of the region are required.

- The worldwide end-user market for ocean technology comprises four major groups: offshore oil industry; fishing industry; shipping industry; and governmental activities (science, defence, security, and so on). Canada, and Newfoundland and Labrador, have significant activities in each group, and growing industries in smaller markets such as aquaculture. Canada may be a weakly supportive ocean technology market but it is not reasonable to dismiss it as small.
- Government investments in Newfoundland and Labrador ocean technology have emphasized education and public research. These investments have been well intentioned but poorly applied. There has been a concentration on hardware and facilities with insufficient emphasis on staff and virtually no strategic research specialization. The result has been a weak, bottom-driven melange of pursuits. There has been an expectation of business success directly from research rather than the creation of a link between the research and local industrial success. There needs to be a shift in policy towards developing people and more strategic and directed public programs aimed specifically at supporting industrial growth.

It is not clear that government actions can “will” a cluster into existence, particularly in the short term. It is obvious that a long period of government and/or industry concentration in a specific area will lead to the development of expertise around that concentration. To date, the public sector effort in Newfoundland and Labrador has been scattered and weakly funded. If government efforts continue in this diffuse manner, interest will be lost, not because the idea is poor but because the implementation was carried out half-heartedly.

A way forward

To address first the weakness in core industries in the Newfoundland and Labrador ocean technology cluster, latent domestic demand is estimated, on the assumption that core technology industries would grow most naturally by working first with domestic primary ocean activities. Success in Finland’s maritime cluster is based on a strong supporting domestic market in “natural” areas. Newfoundland and Labrador has the highest provincial per-capita level of ocean related activity in Canada. Although most tend to think exclusively of the fishery, Table 1 quantifies primary ocean related economic activities.

Table 1. Ocean related primary industries in Newfoundland and Labrador (2002)

	Industry	Annual Turnover (\$m)	Installed Capital (\$m)	Sector
Primary Activities	Fishing	1,000	1,300	Fishing
	Offshore Oil Production	3,000	6,500	Oil
	Offshore Oil Exploration	200	300	Oil
	Marine Science	50	500	Government
	Coastal Security	50	300	Government
	Ferries	200	700	Government
	Shipping	100	150	Shipping
	Harbours	300	4,000	Government
	Aquaculture	15	10	Other
	Totals	\$4,915	\$13,760	

Sources: Data estimated, and taken from Economics and Statistics Branch, Department of Finance, Government of Newfoundland and Labrador, *Estimating the Value of the Marine Coastal and Ocean Resources of Newfoundland and Labrador 1997-1999*, (St. John's: Government of Newfoundland and Labrador, March 2002)

The annual turnover figure for primary activities in the oceans represents approximately 30% of provincial GDP. If we exclude government expenditures on health, education and public administration from the GDP, ocean related activities make up about 43% of the remaining (industrial / consumer) provincial GDP. The estimated installed capital base associated with this activity is \$13.5 Billion. These figures represent an appreciable market that is on the doorstep.

However, Newfoundland and Labrador secondary industries provide relatively little in technology manufacturing and services to the primary activities. The level of activity in support industries is a small percentage of GDP (1%) and a small percentage of the activity and installed capital base of the primary industries (Table 2). The secondary technology industry offers significant growth potential. If provincial companies could capture 50% of the technology supply associated with operations and 30% of the technology supply associated with capital maintenance/replacement, and assuming 10% of each budget to technology annually, the secondary industries would have an annual turnover of \$648 Million. This implies employment of 8300 and a technology cluster at 4% of GDP based on provincial domestic demand alone.

The world ocean activity market (including the rest of Canada) is obviously much larger and a strong domestic market base can provide the springboard to export success. However the provincial and national domestic markets in ocean related activities do not presently act to develop domestic technology capability and experience indicates that many policymakers do not even see a domestic market.

Table 2. Ocean related support industries in Newfoundland and Labrador (2002)

	Industry	Annual (M\$)	Employment (Persons)
Secondary Industries	Ship building/Repair	75	750
	Offshore Fabrication	25	300
	Marine/Ocean Technology	60	1000
	Totals	\$160	2050

Source: Department of Industry Trade and Rural Renewal, Government of Newfoundland and Labrador *A Marine Technology Sector Development Strategy for Newfoundland and Labrador* (St. John's: Government of Newfoundland and Labrador, Feb 2003).

Government actions

Based in the preceding, there is potential for a stronger technology cluster in Newfoundland and Labrador, in an area that is natural – ocean technology. There is a latent domestic requirement for technology based on primary industries. Government has made investments in research and education facilities. The cluster of supporting technology industries is developing, but all levels of government seek to accelerate the pace through constructive action.

It is becoming accepted that government actions should not try to directly influence industry actions. Governments influence the business environment. Furthermore it is insufficient for a single government department or agency (or even a group of agencies) to set a development policy objective. Effort must be across all agencies, and departmental actions need to be evaluated in terms of their contribution (or non-contribution) to overall objectives.

In addition to policy, governments conduct certain operations, usually because such actions are deemed a common good. Many of these government operations are conducted in the oceans. Both policy actions and operational actions can be used to influence cluster development. Policy sets an environment that is industrially and socially attractive – or not. Directed procurement to support operations – and develop industry – can also help, but is complicated by a diversity of agendas.

Policy Actions

A positive policy environment for a technology cluster can be set by concentrating government actions in the areas of education and research, infrastructure, and taxes. Societal infrastructure, although lacking in glamour, is a major underpinning of a competitive economy, and an important aspect of the technology business “environment”. High quality transportation, environmental and health care infrastructure improves living standards and reduces industry costs. Infrastructure

attracts people and ultimately, people decide where to work and locate businesses. Poor infrastructure is not attractive to people or business. Newfoundland and Labrador has been playing a difficult game of catch-up and the tendency has been to focus efforts on direct business supports. Infrastructure provides an important and impartial application of government effort.

Much like infrastructure, taxes can attract or repel. Newfoundland and Labrador has high levels of direct government inputs to regional development and yet has one of the higher rates of personal taxation in Canada. Perhaps the negative effects of taxation outweigh the arguably positive impacts of the other programs – a case of one set of government actions negating another.

Education and research

Ideas around the benefits of research, particularly how to extract these benefits, are more mixed. Education and research create intellectual capacity, which is a necessary prerequisite for climbing a value chain. In a third world economy, which Newfoundland was in the 1950s, research is less prominent because education is a first priority to underpin a functioning society. Newfoundland met that challenge with a strong secondary education system and benefits of that system are now infiltrating society as a broadly better-educated generation moves into position.

Many research endeavours go nowhere, but at the same time produce researchers, professors, graduate students and technologists.

As society matures, research becomes the foundation of a first world economy and particularly of clusters⁶. It is fair to say that much research in any field is non-productive in terms of commercial output. Research has the characteristics of oil exploration - many dry holes, some reasonable producers, and the occasional gusher. Furthermore, there is little evidence that innovation can be planned or organized, and a lot of evidence that true innovations arise from previously unconsidered approaches or combinations – so called network innovations⁷. Accepting these characteristics, more research activity leads to an increased probability of beneficial outcomes.

Another feature is that research is not very efficient. However, the inefficiencies are taken up as a kind of hyper-education. Many research endeavours go nowhere, but at the same time produce researchers, professors, graduate students and technologists, who form a pool of potential technology entrepreneurs (or employees of, or consultants to, technology entrepreneurs). As a result of their work – successful or unsuccessful – they have learned. These people are the basic

matter of technology clusters. Driven by stereotypes of the impractical scientist, inclinations to force direct commercialization and strong desires to eliminate seemingly non-productive pursuits, there appears to be substantial unwillingness to let this natural process proceed. This has led to a tendency in government funding in which the method is more important than the subject or the outcome. It has also yielded increasing overhead in administration, planning, and evaluation. Emphasis on market-driven, pre-conceived outcomes probably comes at the expense of an ability to generate real innovation – a longer and less direct activity.

A promise to ignore competition and buy at home can easily lead to a sense of supplier entitlement... but it is difficult to talk local preference if you are not walking local preference.

The importance of a strong research base, underpinned by a strong educational system is identified in most of the references cited in this paper. Research is the seed of technology industries and government support is a major element of research. Generally higher levels of publicly funded research increase the propensity of technology industries to develop, which leads to more industrial research and eventually to clusters. Programs should be oriented to concentrate research activity and to provide incentive for researchers to disseminate their knowledge to industry. This is not as direct as subsidies but it is more likely to have a lasting effect.

Directed procurement

Government operational requirements offer thorny potential as a tool for technology cluster development. Domestic suppliers of ocean technologies commonly identify the government market as the hardest sell. Development branches of government commonly lament the poor industrial development attitudes of operating branches. Free trade conflicts directly with domestic preference. A promise to ignore competition and buy at home can easily lead to a sense of supplier entitlement. In the face of all this, governments pressure new primary industries – the oil industry in particular - to use local suppliers, but it is difficult to talk local preference if you are not walking local preference.

Canadian governments have not used their requirements as constructive industry development tools, particularly in the ocean and marine industries. Canada has a long coastline, many islands and a large continental shelf. This leads to requirements to move people, manage resources, protect sovereignty and regulate commercial activities, all of which leads to a ferry fleet, a navy,

fishery patrol, a coast guard and a fleet of research ships, all consumers of technology and all operated by government. This is a part of the domestic market and on this basis alone Canada should be good at marine industries, yet these industries struggle.

Despite the hazards and complications, public operating agencies have to move towards constructive acquisition of domestic technology. Only if government sets an example and tests policies on itself first, will it have any credibility in persuading primary industry to support an ocean technology (or any other) cluster. How this is to be achieved is not clear but the objective is important.

Conclusion

The ocean technology cluster in St. John's is not a new idea, but the industrial activity has not yet developed to a, generally agreed, satisfactory level. Governments have taken some constructive actions. However, as understanding of clusters has developed, we see that research and education facilities are not sufficient, nor are they likely, by themselves, to be the sole attractors of industry. Other factors are necessary. Development of a cluster requires a broad and consistent long-term push from industry, government and institutions.

Genuinely supportive government policies can foster the growth of technology industries in a region that is naturally suited to both produce and use the products.

Governments are in international competition to create attractive locations for people and businesses. Government responsibility for business growth should ideally concentrate on setting the economic and social environment. The fundamentals of that environment for growth in technology industries are education, research, infrastructure and taxes. Canadian governments should also direct their operational spending to foster development of domestic capability in ocean technology. Canada is a maritime nation. There is a domestic market. The domestic market should be the springboard to the international market – not the last international adopter of domestic technology.

Ocean technology is a broadly international activity and if Newfoundland and Labrador is to have an enduring cluster then it will be in the face of stiff competition. Ocean technology is a rational selection and some key cluster components are in place. There have been setbacks and some

mis-application of initiatives but there is a growing worldwide interest in the oceans that will lead to requirements for new technologies. Genuinely supportive government policies can foster the growth of technology industries in a region that is naturally suited to both produce and use the products.

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