CANADA FOUNDATION FOR INNOVATION DEC 6, 2013

Innovation – Supply Driven or Demand Driven?

By David W. Strangway

I am deeply honoured to be invited to give this talk at the CFI annual meeting.

I will give this talk in three parts. First, I will think back about the early days of CFI. Second, I will talk about innovation and the interaction between supply and demand as the driver. And I will distinguish between market driven demand and state-sponsored-demand. Finally I will say something about the fact that today there is no useful boundary between disciplines let alone geographic boundaries using ocean science as an example.

A) Some thoughts about CFI

I started here as President in 1998. I followed Keith Brimacombe for the short time he was here. I was really privileged to follow acting president Denis Gagnon. Denis Gagnon and Carmen Charette did a great deal to create the momentum of CFI. And they built an excellent team. It was my privilege to continue to work with them for the next six years, as the CFI made its mark on the Science, Technology and Innovation scene in Canada. These were heady times as universities and the affiliated teaching hospitals were given the ability to compete for state of the art facilities, as good as anywhere in the world. For the first time, universities were required to set their own research priorities, if they were applying to the CFI for major equipment. Research priority setting was new to the university community. These research planning documents when looked at collectively, read like a research plan for the country. In fact these plans when summarized, provided an insightful view of the global frontiers of research. This showed how Canada could become a major international competitive player. CFI asked the performing institutions where they planned to excel. CFI did not tell them what their agenda should be.

When a university president signed the application to CFI, he or she was acknowledging three major criteria. First, this funding, if received, would contribute to building real excellence in transformative science. Second, since CFI provided only 40% of the funds needed to acquire this capital, they were

committing to find another 60% in matching funds. This they did, largely from their provincial governments, but also from the private sector and foundations creating partnerships in the process. And thirdly they were required to demonstrate the benefits they would deliver to Canada, if they were successful in the competition. This was a foreign concept to many of the researchers. It was difficult for many to grasp the idea that excellence and relevance were not necessarily mutually exclusive. I still remember vividly a meeting with deans at one major university. They could not grasp the concept that benefit to Canada should be a criterion. The table went completely silent when in frustration, I finally said "Is it really beyond you to consider that you should be asked to demonstrate that what you are doing is important to the country, and that you are not just asking what the taxpayer should do for you?" You can imagine that the silence was profound.

The Industry Minister of the day used to get regular calls from his provincial counterparts asking why he had picked these particular projects. I am sure that it gave him great satisfaction to answer that politics had absolutely nothing to do with the projects selected. And when we at CFI responded to the query, it was always to show that we had selected the very best and most transformative of the proposals, using priorities set by their own provincial institutions. The credibility and integrity of the CFI selection process was so high, that often approval by CFI became the basis for decisions by other organizations. One senator from a small province called me once and wanted to know why in a particular competition there was no award for her province. I looked into the matter and was able to report that there had in fact been no application from that province's institutions.

When I left CFI six years later, I summarized the results in three words.

1. Empower – CFI had empowered universities to set priorities to benefit the country.
2. Decentralize – CFI had helped to build up centers of excellence in universities across the country.
3. Compete – It had strengthened the culture that universities and perhaps by extension others had to compete. There were no entitlements.

And then of course there was the creation of the Canada Research Chairs Program. The slogan was 2000 for 2000 and sure enough, the government

created the program, funded at the level of $300 m per year. This has been a highly successful program, now emulated in a number of countries around the world. These include South Africa, Finland, Australia, and others.

B) Drivers of Innovation

Innovation is in the name of the CFI. It is useful to contemplate what the main drivers of an innovation ecosystem are. There are many definitions of innovation, almost as many as there are observers. One of the ones I like best is in the title of a book called Demand. The subtitle is 'Creating What People Love Before They Know They Want It'. This simple title it seems to me captures the true essence of innovation. Many students of innovation divide the drivers of innovation into two boxes. This division is identified in the Jenkins Report released last year. The two boxes are supply driven and demand driven. Many studies suggest that Canada is doing well on the supply side, but not so well on the demand side. The private sector in Canada is not a major performer of research and development by international standards. There has been little need for business to invest in research and development or to build innovative capacity. As a recent Globe and Mail article points out "there's no demand, so there's no payoff, at least in the short term."

Supply side in this simple model is driven largely by so research. This is largely funded competitively by the federal government. This funding is based on the premise that research is a public good and will lead to benefits to Canadians. It is typically assumed that the demand side is the responsibility of the private sector. In this model, innovation responds to consumer and market demand. But this simple division is not how successful innovation ecosystems work.

I had the privilege to be on the faculty at MIT and later was invited to be the chief of Geophysics and Physics for NASA's Apollo missions to the moon. Many forget that Apollo was not about doing science. It was about the political objective of demonstrating American superiority. Apollo was designed to meet a public policy challenge. How fortunate that scientists were given the opportunity to do science as part of the missions. For the first time we had a chance to study a nearby planetary object. From the time of the first returned lunar samples, the early history of the terrestrial planets was rewritten. Apollo is still widely recognized as a driver of innovation. State-sponsored-demand in this case led to both innovation in industry and to breakthroughs in science. Not only that, even in

carrying out the scientific work on the moon and on the retuned lunar samples, the best investigators from around the country, and indeed the world, were selected on a competitive basis. The technology was contracted out to industry to most effectively develop solutions to the demand. Public demand to land a man on the moon was explicitly used to build innovative capacity both in the private sector and in the university sector.

Edward Jung, former chief architect at Microsoft and now Chief Technology Officer at Intellectual Ventures has written an interesting article 'Silicon Valley or Demand Mountain'. He divides demand into two categories. First is consumer or market driven demand. Second is state-sponsored-demand. "Silicon Valley itself was built on demand. The US Department of Defense put up tens of billions of dollars in contracts for microelectronics, a commitment that both paid down innovators' risk and created an infrastructure that would support the growth of startups." In Canada we bemoan the failure of the private sector to carry out more research and development to meet implicit market demand. Edward Jung points out that the success of Silicon Valley is based on state-sponsored-demand. "The economic planners and policymakers who are chasing Silicon Valley's taillights are learning that they cannot always replicate the entrepreneurial culture and finance mechanisms that exist there now. But they have forgotten how it all started; guaranteed demand, which stimulates the most ambitious kind of innovation". Innovation in the United States is not largely driven by consumer or market demand. Jung states that consumer demand alone is a weak mechanism for innovation. By far the most important demand driver is state-sponsored-demand.

We know from recent reports on innovation success in Israel, for example, that the same principle is at work. 'Regardless of your economic beliefs, in this world, government plays a key role'. In the Israeli case, as in the CFI, the best decisions are made outside the political process and the results are dramatic. Edler et al of the University of Manchester state bluntly "Across the OECD world, public procurement of innovation is becoming a cornerstone of innovation policy. " In the United States there is a well=known funded program of direct awards referred to as the Small Business Innovation Research program (SBIR). This program has had dramatic effects on the innovation ecosystem of the US.

In Canada, the lack of a dynamic private sector innovation ecosystem is due to the failure of government to realize that it needs to be an important demand driver. Government could make this choice. State-sponsored-demand-driven innovation should be about much more than the creation of short term jobs. It should explicitly focus on creating private sector and university innovation capacity, that will build the long term knowledge economy and the consequent jobs.

The European Union is getting ready to adopt its next framework plan. Horizon 2020 includes a significant commitment to innovation. They have observed that the US contracts out twenty times as much state-sponsored-demand in Science, Technology and Innovation as is done in all the EU countries combined. They are creating real incentives, where two or more states intend to contract out their STI needs.The Canadian government holds the key to the state-sponsored, demand side of the innovation ecosystem. There have been some successes in the past, such as spinning out satellite work, Radarsat, Canadarm and others. But the record is limited, when you consider the scale of Canada's purchasing power. It is time for Canada to adopt a Smart Procurement innovation test for all of its procurements, if it wants an innovative country.

Now let us consider another dimension of the innovation ecosystem. Is there a clear division between supply side and demand side? In the world of innovation there is no clear boundary between supply side and demand side. As we have seen, meeting state-sponsored-demand to meet public policy needs, often leads to fundamental breakthroughs in science. Galileo invented the technology of the telescope. And he used this new technology to discover the four Galilean satellites of Jupiter. But we also know that fundamental discoveries in basic science can have an enormous impact on demand. Who knew that the incredible advances in Physics in the 1920s would lead to the digital revolution of recent years? It is estimated today that almost half of the US GDP can be traced to this revolution. Or who would have guessed that the discovery of the double helix would have led to the biological revolution now under way. Who knows where the quantum revolution will take us in the next few years? Korea has just announced significant increases in basic science spending, as they see a global need to increase the supply side. It is clear that there is no real boundary between supply side and demand side driven innovation. Both are necessary conditions for a performing innovation ecosystem. On the demand side there must be a new

focus on state-sponsored-demand. There is so much Canada can do. Supply side impacts demand and demand side opens horizons for supply.

C) Science and Technology Know No Boundary – Geographic or Discipline
I have been privileged to chair the recent panel review on Ocean Science carried out by the Council of Canadian Academies on behalf of a consortium of Canadian universities involved in ocean science. Ocean science is a good example of a field that is fast changing and of immense importance, not only to Canada but to other countries. Canada has the world's longest coast line. Canadians have a major impact on the ocean, but the ocean also has a major impact on the lives of Canadians. We must protect it, to be sure that it can deliver its benefits to Canadians. Our coastline is just one small part of the global coastlines. We need to contribute our information to the global information base, so that we can have access to the world wide information on oceans. There are many new technologies developed or being developed that provide a great deal more information on the size scale and time scale of ocean processes. We must know more about the ocean itself, about the subsurface and the energy potential and about the ecosystem of living creatures, including the source of a great deal of food. Monitoring the ocean is absolutely crucial. CFI has played a significant role in supporting important tools for ocean science. These include refitting the Amundsen icebreaker to be a platform for science observations. And supporting the Neptune project on the west coast as the world's first under ocean observatory.

It is interesting to think about ocean science from the point of view of academic disciplines. Ocean science draws on many disciplines. The ocean does not belong to any one field of science or social science or the humanities. If Canada is to live up to our report subtitle 'Meeting the Challenges, Seizing the Opportunity' networks of people must work together. Canadian investigators must have access to the incredibly effective new technologies for gathering data. The techniques to monitor and understand the ocean are developing fast and will dramatically help our understanding of the ocean.

I find it interesting to paraphrase a famous commentator as we think about the way ahead.

1. There are things that we know we know. And of course the question here is to determine how we can use these better to meet the demand.
2. There are things that we know we can know as we look ahead. The question here is to be sure that we are constantly looking to the horizon to be sure that we are adopting the most effective of these to meet the demand
3. There are things that we know, we don't know. And here is where we must continue to support research on many fronts. We know from past experience that there will be discoveries over the horizon that will surprise us and that will help us even better to meet the demand and even create the demand.

There will be many innovations developed as a result of our need to understand the ocean. We must understand the impact we have on the ocean and we must understand the impact the ocean has on Canadians.

This will take partnership between universities, governments and the private sector. It will take innovation driven by supply, innovation driven by state-sponsored- demand and innovation driven by market demand. There is no simple linear relationship among these three pillars, as all three interact with each other. Perhaps most significantly, experience has shown that for a successful innovation ecosystem, governments must be on both sides of the supply/demand boundary. It is not enough to blame the private sector for not responding to market demand. As the recent Globe and Mail article said "If there is any area where government could do more to fill a crucial gap in investing in the long term health of the economy, you're looking at it." It is time for Ottawa to work with partners to create a Demand Mountain instead of just a few Demand Hills.

As I conclude let me add that yesterday the world lost Nelson Mandela. I grew up in Africa and feel this loss with so many others. It is little known that Nelson Mandela was a strong supporter of science and technology. He saw this as essential to Africa's economic development and a tool to help pull it out of poverty. I am working with a group of universities in Tanzania, Nigeria, Burkina Faso and Mali that were established as graduate and research institutions under the name of Nelson Mandela. These are designed to achieve high levels of excellence. The idea is for Canada to create a program of Canada-Nelson Mandela Institution research chairs modeled on the Canadian program. The intent is to

give them a boost as they work to fulfill Mandela's vision of a strong STI capacity in Africa.

References

Silicon Valley of Demand Mountain, Edward Jung, Business Day, Oct 23, 2013
Procurement and Innovation: Underpinning the Debate, Jakob Elder, Luke Georghiou, Elvira Uyarra and Jillian Yeow, Manchester Institute of Innovation Research, Oct 2011