CREATING AND GROWING TECHNOLOGY CLUSTERS:

Observations and Best Practices from NRC Managers engaged in the creation and development of technology based clusters.
CREATING AND GROWING TECHNOLOGY CLUSTERS:

Observations and Best Practices from NRC Managers engaged in the creation and development of technology based clusters.

By J. André Potworowski
TABLE OF CONTENTS

Introduction ....................................................................................................................................... 1
  Why look at clusters ..................................................................................................................... 2
Scope and methodology .................................................................................................................. 2
  The notion of “best practice” ...................................................................................................... 2
Limitations of the study: what this handbook does not include ................................................... 2
  Metrics, standards and baselines ............................................................................................... 3
  Theory of clusters ....................................................................................................................... 3
  Case studies and historical documentation .................................................................................. 3

PART I: LESSONS FROM THE LITERATURE......................................................................... 4
What is a technology cluster? ........................................................................................................... 5
  Definitions and description ........................................................................................................... 5
How to grow a cluster – practical guidelines.................................................................................. 5
  i. Diagnosis: analyse the local economy and community strengths ........................................ 7
  ii. Mobilization: identifying the facilitator and the champion group ...................................... 8
  iii. Action Plan: where do we go next? ...................................................................................... 8
  iv. Implementation: starting the process and achieving sustainability .................................... 8
  Institutionalizing the facilitator organization ............................................................................ 8
Mobilization through networking .................................................................................................. 9
  Develop the unifying cluster vision – where we want to be in the future ................................ 9
The art of networking ................................................................................................................... 9
  Guidelines for building regional networks .............................................................................. 9
Growing and achieving sustainability ........................................................................................... 11
  Building a more permanent facilitator organization ................................................................. 11
The start of Silicon Valley – the classic benchmark .................................................................... 12

PART II: LESSONS FROM THE NRC EXPERIENCE.................................................................... 13

PART II: LESSONS FROM THE NRC EXPERIENCE.................................................................... 14
The NRC Hexagon model for technology clusters ...................................................................... 14
  A. R&D ...................................................................................................................................... 16
  B. S&T knowledge and information ........................................................................................... 16
  C. Policy instruments and regulations ....................................................................................... 16
  D. Incubation and mentoring ..................................................................................................... 16
  E. Finance and risk capital ........................................................................................................ 16
  F. Skills and human resources ................................................................................................... 16
  Innovative firms ......................................................................................................................... 17
  Networking links – local champions and networking organizations ....................................... 17
  The location of NRC clusters .................................................................................................... 17
A. R&D: starting-up the regional research engine ....................................................................... 18
  Equipment and facilities as catalysts for research partnerships: the BRI case ...................... 19
  The Institute for Aerospace Research (IAR) equipment loan project – bringing the “lab” to the 19
  client .......................................................................................................................................... 19
B. S&T infrastructure: linking to universities, government labs and firms ............................. 20
  The IBD story – leveraging knowledge networks .................................................................. 20
D. Incubators and mentoring ........................................................................................................ 25
E. Financing innovation: involving the financial community .................................................... 25
  F. Skills and human resources: towards a learning community ............................................. 27
Acknowledgements

A number of people contributed to making this report possible:

Michael Porter, Veronica Ingham, and Neils Ketelhohn of the Harvard Business School Institute for Strategy and Competitiveness,

Dr. Arthur Carty, President of the National Research Council of Canada, and the following officers and managers from the NRC, including:

- Blaise Champagne,
- Arvind Chhatbar,
- Michel Desrochers,
- Don DiSalle,
- Kutty Kartha,
- Tom Lefeuvre,
- Ian Smith,
- Bill Wallace, and
- Andy Woodsworth.

Also Peter Leach, former head of the CITO Ontario Centre of Excellence.

Special thanks to Jack Smith, who reviewed several drafts of the document, and provided extensive comments and clarifications.

J. André Potworowski
Introduction

This report is a handbook for describing for the benefit of the NRC community some best practices in the creation and growth of technology clusters. It is primarily intended for NRC senior research officers and senior research staff involved in cluster creation. It addresses some basic questions: How do you, as an NRC officer, start building a technology cluster? What are some “best practices”? And more importantly, what are some of the "lessons learned" from NRC’s rich experience of the last two or three decades?

Why are clusters interesting and important? Clusters are more than a collection of firms. They provide a unique environment for accelerating technological innovation, nurturing new start-up firms, attracting investment and generating economic growth. A major benchmark cluster is Silicon Valley, south of San Francisco, which now has over 7,000 of the world's leading hi-tech firms. The west-end of Ottawa, in Kanata, has also achieved recognition as a viable hi-tech cluster, with some 1,400 firms, largely based in telecommunications and information technology.

Clusters are not simply a North American phenomenon. Italy, known for its art and high quality design, has a number of clusters, such as the 25,000 inhabitants of the Italian town of Montebelluna. It is the world’s sports footwear capital, produces 75% of the world’s ski boots, and is home to Nordica, Tecnica, Rollerblade, and Asolo. Italy has a number of such clusters in luxury wool textiles (Biella), sports cars (Modena), ceramic tiles (Sassuolo), food industries (Parma), and stoneworks (Carrara), which has existed since the time of Michelangelo. Not all clusters require R&D for their sustainable growth, nor is government R&D an essential ingredient in a cluster.

What makes cluster-building a challenging exercise is that a cluster is very much like a living organism, with its own cells, nervous systems, and energy source or engine drivers, with a beginning, growth, maturity, and inevitable decline. Because of the organic nature of clusters, more traditional tools such as rigorous economic analysis, government program initiatives, or regional development investment strategies become virtually useless. We need to look to other tools such as networking, community building, and partnering.

Cluster building through networks requires careful detective work. But these networks are there, and form a dynamic fabric that is the strength and vitality of the cluster. In the end, the comparative statistics and microeconomic performance parameters for that region will tell the story: clusters benefit from a more intense innovation climate, higher rate of job creation, more new companies and start-ups, more inventions, and investments and growth.

Various studies have focused on the geographical aspects of clusters:

“Geographical proximity [of a cluster] is important for a range of reasons. [...] It increases innovation through the exchange of ideas, through using a similar pool of labour, through improving collaboration, better links with suppliers, and so on. [...] Proximity to specialist business services, such as patent agents, lawyers, recruitment and property advisers, is an important benefit for companies in clusters. The critical mass effect attracts further companies, investors, services and suppliers, as well as creates a pool of skilled labour.

Clusters have been compared to a brain. The more interconnections that there are between resident companies, both vertically and horizontally, the more effective it becomes. [...] Reputation spread quickly through the cluster, helping business people to evaluate professional, legal and financial support services. [...] There is also the "general importance of being in the midst of the buzz."
Why look at clusters

NRC has been helping build clusters since 1995. In part as a result of NRC success, in its 2002 Innovation Strategy, the federal government formalized cluster creation, proposing it as a priority:

“...Governments at all levels [will] work together to stimulate the creation of more clusters of innovation at the community level. Federal, provincial/territorial and municipal governments cooperate and supplement their current efforts to unleash the full innovation potential of communities across Canada, guided by community-based assessments of local strengths, weaknesses and opportunities.

Targets:
By 2010, develop at least 10 internationally recognized technology clusters.
(…) Support the development of globally competitive industrial clusters."

As part of its recent Innovation Agenda initiative, the Government of Canada carried out a range of community-based consultations some of which were linked to cluster and community development.

Scope and methodology

This handbook is an attempt to collect existing knowledge about the practice of cluster-building. It reviews selected studies and analyses from the literature, focusing less on the "what" of technology clusters and their economic and social parameters, but more on the "how" – how did a cluster start, what elements were brought together, what did people do, in what way, using what approach, to start this amazing phenomenon.

The author then interviewed several NRC directors general (DGs) and other cluster “practitioners”, and asked them three simple questions: What did you do that worked in helping to create your cluster? What did you do that did not work? And what were the lessons learned from your viewpoint?

All of these nuggets were brought together to form a readable and useful handbook. As our collective knowledge of this particular socio-economic phenomenon grows, so too this handbook should be updated and augmented.

In the last analysis, it should be remembered that clusters are very organic in nature, so the mindset needed to understand them is more akin to ecology than to crystallography.

The notion of “best practice”

In this handbook, we refer to “best practice”. It’s worth examining what is meant by that term:

The first reference to “best practice” is found in “Principles of Scientific Management” (1911), one of the first classic management books, written by Frederick Winslow Taylor, who said that “managers must discover ‘one best method’ of working and impose it”. He was talking at the time about shifting pig iron.

As part of their ongoing work in benchmarking, the American Productivity and Quality Centre notes that although there is no single “best practice” because “best” is not best for everyone, what is meant by “best” are “those practices that have been shown to produce superior results; selected by a systematic process; and judged as exemplary, good, or successfully demonstrated. Best practices are then adapted to fit a particular organization." It goes on to report that whether practices are called exemplary, best or good, they are rarely the ultimate that can be achieved, since best practice is always contextual. Thus, it should be noted that “best” is a moving target in today’s world, and is also situation-specific.

At www.bestpractices.com, the web site for Best Practices, LLC (BP), a Chapel Hill, N.C.-based consulting firm, best practices are defined as "documented strategies and tactics employed by highly admired companies. These companies are not best-in-class in every area – such a company does not exist. But due to the nature of competition and their drive for excellence, the profiled practices have been implemented and honed to help place their practitioners as the most admired, the most profitable and the keenest competitors in the business."

Our usage in this handbook is more prosaic, and refers to a practice or principle that can be considered as a sensible, effective and imaginative approach to bringing people together into clusters, given the uniqueness of each cluster, and the difficulty of arriving at a uniform model.
**Limitations of the study: what this handbook does not include**

**Metrics, standards and baselines**

One major limitation of this project is that we did not have the resources, the time, or the mandate to refer to metrics, standards or baselines of activities. Such metrics are important in determining the success of one approach compared to another. They are essential in capturing what existed before a clustering activity began, or what were the specific objectives a manager or DG had been given, and comparing these with the end result. They could provide quantitative indication of the cost-effectiveness and risk assessment of the various measures and initiatives. We believe that developing a series of metrics for NRC-driven clusters is a valuable activity, which should be engaged in and supported by evaluation specialists. There is a performance and accountability framework currently being developed in NRC for the Atlantic Initiatives, and this may eventually lead to some valuable metrics.

**Theory of clusters**


One recent review of Canadian clusters is that of White and Gunther, for the Industrial Analysis Centre of Industry Canada. Some of their conclusions are as follows:

- **Clusters are increasingly becoming international in scope, e.g. the Canadian automotive cluster.**

- **The six stages of cluster development are:**
  - birth, potential, emerging, sustainable, mature and declining. It is important to correctly categorize clusters in terms of these six categories and to fully understand the stage of development of any cluster being evaluated.

- **Effective regional development tools for cluster-based approaches include:** innovation mentoring, community-based research and incubation practices. These tools are intended to help a community acquire the needed knowledge, practices and social capital that will lead to innovation driven growth and prosperity.

- **Key success factors for cluster development are:**
  - community involvement in the process;
  - social networking and exchange of information on best practices between MNEs, SMEs and government labs; and,
  - development of an entrepreneurial spirit where the rewards of success are emphasized compared with the fear of failure. "Successful clusters are all about social cohesion and networking. The same principles should apply to the organizations trying to foster clusters."

The literature on the theory of clusters is extensive and varied, and it is beyond the scope of this handbook to review it beyond the above points.

**Case studies and historical documentation**

Perhaps more easily achievable than quantitative metrics, case studies capture the evolution and narrative of an initiative and the chronological sequence and causal effect of events that lead to a change or a new organization. This is particularly true of such organic, community-based initiatives as cluster creation. Case studies can be helpful in describing the various forces at work in developing and building clusters.

The Ontario Centres of Excellence, with close to two decades of experience, have found that individual case studies seem to best capture the very different impacts that their networking activities have had on the innovation and wealth creation. They realized that each event or contribution is so unique, that only a narrative can describe its full impact. More importantly, many of these impacts are non-additive, and do not lend themselves easily to cumulative metrics or a uniform statistic. Over the years, they developed some 150 specific case studies, published as one page impacts – e.g. placing technical programs in colleges to address a shortage of photonics technologists in a growing industry. Impacts also include creation of companies, international research partnerships, and new technologies.
Unfortunately, time and resources did not allow the development of full case studies of each of the initiatives identified in our interviews, except in the most cursory way. Again, this is a valuable activity that could lead to a valuable building up of a corporate memory bank of lessons learned and best practices. One inexpensive way of achieving this is through summer MBA students, who could be used, under careful supervision, to collect and write these case studies, as they accumulate. And this could be done in each region, with students from the nearest business school. It would also help promote the idea of clusters and innovation, and further build linkages with universities.
PART I: LESSONS FROM THE LITERATURE

This first part reviews some key lessons about starting and growing a technology cluster, based on a review of the recent literature. It reviews a number of models that practitioners have used in several countries, and summarizes these lessons into several “best practices”.

But clusters in Canada are very different from one another in terms of their:

- **Evolution and lifecycle** (i.e. birth, potential, emerging, sustainable, mature and declining),
- **Economic regions in which they are located** (e.g. Atlantic, Montreal, Toronto, Central Canada, Prairies and British Columbia), and
- **Core driving technologies** (e.g. pharmaceutical and biotech, ICT, automotive or agricultural).

Each of these parameters is reflected in the dynamics and rate of growth of the R&D/innovation core and technology transfer, in the social reality of commercialization, partnership and creation of new firms, and in the most important reality of business and the end market for the products produced by the cluster.

So any “best practice” has to be looked at very carefully before it can be applied “recipe-like” to any other situation.

What is a technology cluster?

What makes a technology cluster different from an ordinary collection of firms? Or, to put it more popularly, how would you recognize a cluster if you met one in a dark alley?

**Definitions and description**

Michael Porter defines clusters as: “a geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities.”

Another study defines cluster as “a spatial and sectoral concentration of firms; and we measure success by the ability of the cluster as a whole to grow, typically through the expansion of entrepreneurial start-ups.”

But how does this translate in reality? What would you see if you drive around the streets of a cluster?

If you were to drive around a cluster, you will probably see an industrial district, you might even see in visual proximity several companies, some with names that you would recognize, that produce similar things – e.g. electronic components, footwear, or biomedical products – or you might not see this immediately if they are separated by several city blocks, or as in the case of the Pennsylvania pharmaceutical industry cluster, by tens of miles of forest and countryside. But what will strike you most immediately is the reputation of the region: “This is great place for… e.g. agricultural innovation, or information technology or …” You will read about the cluster as you arrive at the airport, you will see it as you drive into the city on the billboards. If you probe more deeply, and talk to CEOs, they will naturally start boasting about their competitors and suppliers who happen to be in the community, and will tell you about how they know the different companies, or how they collaborate with them, and will probably point you to a central facilitating or clustering organization.

The deeper reality of clusters, the cross-flows of skilled workers, the multi-layers of networks and who knows whom are less visible to the outsider, as are the dynamic partnerships between researchers, universities and colleges, companies and government labs.

How to grow a cluster – practical guidelines

The NRC Cluster Hexagon offers an elegant way of capturing the six plus two elements of a technology-driven cluster. But the key question from a “best practice” perspective is where does one start growing a cluster? Who acts initially to structure the model, elaborate its structure, and bring the key partners together for developing the vision? What are the catalysts for this process?
Ifor Ffowcs-Williams, a cluster consultant based in New Zealand, developed an eight-step process for identifying and building clusters on a national basis, listed in the table below. A U.S. Department of Commerce study derived a similar list with seven key points, and yet another study by the U.S Economic Development Association reduces this to four steps, all of which are compared below:

For the purpose of this handbook, we have reduced these to four major steps:

i. Diagnosis and assessment
ii. Mobilization; facilitator and champions
iii. Action Plan
iv. Implementation

<table>
<thead>
<tr>
<th>Economic Development Association (EDA) October 1997</th>
<th>Ifor Ffowcs-Williams</th>
<th>U.S. Department of Commerce study</th>
</tr>
</thead>
</table>
| **Diagnosis** – Assessing the industry clusters that comprise the economy and the economic infrastructure that supports cluster performance. | i. Initial cluster stocktake.  
ii. Analyse the local economy and identify the cluster drivers. | Assess; |
| **Mobilization** – Building interests and participation among the different constituencies needed to carry out the initiative. | iii. Establish leadership group  
iv. Develop cluster vision, describing a preferred future. | Initiate;  
Visualize the future; |
| **Collaborative strategy** – Convening demand-side stakeholders (companies in each cluster) and supply-side stakeholders (public and private supporting economic institutions) in working groups, to identify priority challenges and action initiatives to address shared problems. | v. Identify stepping stones (e.g. how was the 2010 vision realized).  
vi. Immediate action agenda. | Frame opportunities and challenges;  
Develop action plans; |
| **Implementation** – Building commitment of cluster working group participants and regional stakeholders to actions, and identifying or creating an organization to sustain implementation. | vii. Institutionalizing the clustering initiative.  
viii. Upgrading the strategic agenda. | Mobilize for implementation; and  
Renew the process. |

---

3 Ifor Ffowcs-Williams, ibid.
i. Diagnosis: analyse the local economy and community strengths

Before a “greenfield” cluster-site is selected, some analysis is required. The intent is to identify the major players, the major firms, institutions and historical strengths and assets that will form the backbone of the technology cluster.

This is done by a general audit or assessment of capabilities and key gaps for building a cluster. For example, if a community has a local college but no research university, this can be considered a gap. Research universities and government labs provide a pool of young researchers with the latest knowledge and skills, which can be tapped by the community. Other elements include employment base, existing technological firms, and transportation infrastructure.

Flowcs-Williams advocates “drive-by economics”, namely driving around the region and noting all the major buildings, factories, plants, hospitals, companies, government buildings, and especially government laboratories. Given the innovation axis of NRC clusters, special attention is paid to the research-based institutions, with special emphasis on universities, and innovation-driven SMEs. Williams warns against focusing too much on analysis and not enough on action, however.

Anchor companies

Strong points as well should be given to companies that already export, and have a global perspective, i.e. “anchor companies”. Nortel, in its days, was such a company that proved critical in shaping and contributing to the Ottawa hi-tech cluster, and Bombardier in Montreal. Anchor companies play a disproportionate role in seeding cluster development.

“Anchor companies are firms (e.g., QUALCOM in San Diego, Boeing in Wichita, and IBM in Raleigh-Durham) that play a large role in budding clusters by performing several functions.

First, they act as magnets for other major companies – both rival and allied companies – that will move to a region simply to be near the anchor company. Second, anchor companies tend to organize other companies in a cluster for collective action, such as lobbying government for infrastructure improvements, or collaborating with universities to build specialized research and training facilities. Third, anchor companies, and in particular major companies with headquarters in a region, tend to be more involved in supporting community projects that improve the local quality of life. Finally, a particularly important function of anchor companies is that they produce numerous spin-out companies, which strengthen key elements of the cluster.

The anchor firm is generally the buyer of the goods and services of its spin-outs, and local demand in the cluster is improved. By producing numerous spin-outs, the anchor increases the presence of local related and supporting industries. In some cases, spin-outs directly compete with the parent anchor company, and this results in a more vibrant context for firm strategy and rivalry. Finally, due to the personal ‘alumni’ relationships among individuals in the anchor and the spin-outs, a strong web of informal networks tends to form, and cluster collaboration improves.”

A critical step is to ensure that a common understanding of the cluster, its structure and scale opportunities, is achieved among the major players in the cluster. This is key to establishing a platform for action, and begins the process of obtaining buy-in from the key players to the clustering process.

It is important to note that even in the process of evaluation and assessment, in the survey and research one undertakes, one already interacts with local players and leaders, and by necessity, already starts building the network. How the assessment is done is as important as its results, and how these results are communicated and discussed by the community.

---

ii. Mobilization: identifying the facilitator and the champion group

This step involves the key process of identifying the natural leaders of the community ie. those with vision and credibility, and motivating them to participate in and lead the cluster-building process.

A leadership group or champion group has to represent a wide sector of the cluster community, the key industry stakeholders, people with a balance of skills and who can work as a team. The “facilitator” has a key role in networking and in bringing this group together. The challenge here is to build the network and the team, and as much as possible, ensure they reflect the drive and values of the private sector firms. One of their first tasks will be developing a vision for the cluster. This cannot be done from outside or imposed externally. A key issue for NRC is whether to bring in a temporary facilitator, hire a locally recognized one, or let the community do that itself. A lot will depend on the particular cluster.

iii. Action Plan: where do we go next?

Once a vision of the “preferred future” is articulated, the leadership group needs, through engagement of the community, to identify the steps needed to achieve it. This is used to achieve broad agreement on priorities.

Ffowcs-Williams\(^6\) advocates focusing on an immediate action plan and picking the “low hanging fruit”, to gain momentum. Generally, those potential actions most easily achieved are the ones where there is some form of market failure, e.g. a lack of information, managerial myopia, under-provision of public services, or coordination failure. Another criteria for selecting the first action items is to focus on those initiatives that are prioritized by passion, and will thus garner the most support. Focus on safe, non-controversial ideas. The key is to move to action as quickly as possible, and gain momentum.

iv. Implementation: starting the process and achieving sustainability

As the cluster and the economy evolve, companies mature, and issues change, so will the needs of the cluster. There is a need to grow and nurture the cluster, beyond the initial spurt of activities, consolidating personal relationships, building cluster infrastructure such as incubation centres and technology parks, and creating the “social glue”. This involves making sure there is a continuous supply of highly trained people, investment money, a flow of innovation and start-ups, and most important, accessible markets for the cluster products.

Institutionalizing the facilitator organization

This refers to creating a permanent home for the “facilitator organization” or network builder to maintain and nurture the cluster, very much like the Ottawa Centre for Research and Innovation (OCRI) does in the west of Ottawa for the hi-tech sector. This is a not a quick fix, but requires careful planning on the part of the facilitator, and can take one or two years to establish. This is a very organic process, which has to fit the community and reflect the strategy of the cluster. It is important to avoid clutter and duplication of organizations.

The network facilitator is often the catalyst as well as the glue that ensures dynamism at the community level is generated and maintained. Ideally, this facilitator should specialize in energizing, organizing and promoting the cluster in as entrepreneurial a manner as possible.

Organizations that fully depend upon and begin to act like public authorities rather than public-private collaborations may lose the agility they require to constantly inject new viewpoints and broaden the cluster’s membership.

\(^6\) Ifor Ffowcs-Williams, ibid.
Mobilization through networking

Once the decision has been made to locate a cluster-generating institute in a specific region, based on assessments and diagnostic studies, the challenge is to mobilize local resources. In some cases, even the early exercise of assessment and diagnostic can serve as a vehicle for mobilizing the local community, over and above collecting basic economic development data and arriving at a preliminary decision.

Develop the unifying cluster vision – where we want to be in the future

A powerful way of bringing key players into the clustering process is by developing a unifying vision for the cluster. One way of looking at vision is answering the question, what will we be doing at some point in the future? This discussion is generally led by the leadership or champion group, with key industrial stakeholders. A major input is the findings of the assessment study or economic survey, as well as the ambitions and drive of the community. Ffowcs-Williams, as a way of starting the vision discussion, suggests asking: “It is 2010, what are we doing? Who are our customers? How do we conduct our business, deliver our products? What are our competitive advantages? What is making our success?”

The art of networking

At the end of the day, paraphrasing the real estate broker’s mantra of “location, location, location,” cluster-building can be summarized in three words: “network, network, network”.

“In the traditional economy, ideas were held tightly within institutions; in the new economy, ideas flow more freely within networks. The unit of innovation has become the network, not simply the firm. To stay abreast of change and speed up the commercialization process, the walls that once separated public and private institutions, education and business, large and small firms must come down. Separation and hierarchy do not work when speed is of the essence. [...] Increasingly, the process of innovation is not conducted simply within an individual company but through knowledge-creating networks of individuals with ideas in companies, universities, and other institutions. The key is [...] trust, willingness to share, and mutually beneficial exchange over time.”

Guidelines for building regional networks

The Collaborative Economics group in Palo Alto California prepared a study “based on the experience of leaders working in regions across the United States and a review of the evolving literature on new growth theory, innovation, and networks.” They produced the following guidelines or best practices to regional innovation, or in our words “clustering”, and their term “regional leaders” can be easily substituted for our term “cluster facilitator”:

“Best Practice: While each cluster is very different from one another, the basic steps of creating a cluster can be summarized or regrouped in the following four phases:

i. Diagnosis and assessment
ii. Mobilization: facilitator and champions
iii. Action Plan
iv. Implementation

It is important to identify an organization or facilitator – a network builder for a cluster that is focused on stimulating interchange in an entrepreneurial, proactive manner.

These are only guidelines, as each case will more than likely present significant variations on these themes.

1. **Innovation is a Team Sport**
Innovation is not simply the job of scientists and technologists, nor is it the product of a lone inventor working in a garage. Regional leaders are the key in building diverse teams from business, education, government, and the community that will work together to promote an innovative region.

2. **Good Information Puts Innovation on the Regional Agenda**
Regional leaders can use well-designed indicators to raise the visibility of innovation as a key to regional success, spotlight key issues and opportunities, and provide a catalyst for action. Without good information on sources of innovation in a region, it is unlikely the region will embrace innovation as a priority.

3. **Inform, Connect, and Promote (Over and Over Again)**
Good information is not enough. Regional leaders must share information widely and often as a tool to connect leaders from diverse perspectives and help them embrace a regional vision for innovation. Regional leaders can work to inform, connect and promote innovation through formal visioning processes and repeated reminders through the media, speeches, and face-to-face encounters.

4. **Think Regionally, Act Regionally**
Many believe that innovation is either something that ‘just happens’ or is largely the product of strong assets (e.g., universities) dependent on funding from outside the region. They see little if any regional role. Encouraging new thinking about the cornerstones of regional innovation can lead to action on a regional basis – action to use both national and regional assets to promote a regional vision for innovation.

5. **Tear Down the Walls Between People**
The greatest barrier to innovation has been the traditional ‘walls’ that separate universities, industries, and entrepreneurs. Regional leaders can immediately create new forums and mechanisms to permeate these boundaries. Forget worrying about institutions and programs per se, and focus on connecting people.

6. **Hot Ideas Come From Cool Places**
Innovation is about sharing knowledge or ‘know-how’. Creating environments where innovative ideas can be shared face-to-face is important in innovative regions. These can be personal networks of people with hot ideas who want to gather in creative places. Regional leaders can create spaces and amenities that are attractive for innovative people.

7. **Learn from Others, But Create your Own**
Benchmarking against best practice is an important learning tool, but each region’s assets, networks, culture, and community are so different that borrowing instead of creating is a mistake. Regional leaders should take time to understand their unique challenges, consider the experience of others, and customize strategies to fit their situation. Trying to duplicate the Silicon Valley experience is not going to work.

8. **Unleash the Power of Networks**
Remember that encouraging the growth of networks has a very high leverage impact. Metcalf’s Law shows that the number of nodes on a network grows exponentially – i.e., each new node adds its own set of network connections. Networks connect to networks. Regional leaders can encourage the “networking of networks”, and address obstacles discouraging the growth of networks.

9. **The Job is Never Done**
Innovation is a continuous process. Once an innovation culture is created, an environment of continuous improvement must take over. Regional leaders can create the expectation that continuous innovation is the norm. They must remain vigilant and prepare the next generation of leaders to understand and further build the cornerstones of regional innovation.

10. **Anyone Could Create the “Next Big Thing”**
In the old economy, hierarchy ruled and R&D departments were responsible for generating a predictable flow of new improvements. In today’s innovation economy, anyone with a good idea can potentially become innovation leaders. This new reality creates a positive-sum opportunity, where everyone can benefit
from participating in innovation networks. However, it also means that the regional culture of innovation must be inclusive and welcoming, accepting of new ideas from untraditional sources. Regional leaders can nurture and celebrate the diversity of innovators and in the process help expand the scope and benefits of regional innovation.

**Best Practice:** To mobilize a community requires an iterative process of bringing people together through networking, mobilizing leaders and champions, and with the help of a cluster facilitator, articulating a vision for the future of the cluster.

---

**Growing and achieving sustainability**

Once there is a facilitator, a champion, a thriving network of companies, what does it take to achieve sustainable growth?

Some clusters, such as the wine and food clusters of France and Italy, have existed and thrived for centuries without the benefit of enlightened regional development policies. They have evolved over time into complex social and business networks dedicated to quality products. Other clusters, such as the Calgary Wireless Cluster, according to Cooper Langford, arose out of a failed government-initiated consortium, Novatel. NRC cluster-building is a more focused and proactive approach.

There are no simple recipes, but in the words of one study, there are some “deep regularities” that can be found. R&D-driven innovation has to flower, start-up companies need support to thrive, nurtured by available financial capital and highly trained people and managers, and most importantly, products produced by the cluster companies, new and mature, have to be sold to accessible and hungry markets. One essential element for sustainability is to move towards a more permanent facilitator organization.

**Building a more permanent facilitator organization**

Developing a full-blown cluster may take decades. But this process can be accelerated provided firms and organizations in the cluster are aware of, and can contribute to, the cluster. Not only must firms be aware of the presence of a local cluster, they must also get together and coordinate activities to improve the cluster’s business environment. Nurturing and acceptance of new companies is important if the cluster is to grow quickly and reach a critical mass.

Institutions for collaboration can significantly increase the success rate of start-up companies:

> “Cluster development depends in large part on generating new companies from within a region. Successful regions almost always have a hospitable environment for start-ups.”

These organizations, both formal and informal, play a critical role in making conscious efforts to raise cluster competitiveness and innovative capacity. They generally facilitate the exchange of information and technology, and foster various kinds of coordination and collaboration that can improve the business environment in the cluster or in the overall economy. Some of their tasks include:

- Promote cluster awareness.
- Engage in ongoing diagnosis of cluster’s competitive position.
  - Compare position relative to other regional clusters.
  - Identify constraints, obstacles, and advantages.
- Develop training and management programs.
  - Provide programs through institutions for collaboration.
  - Coordinate with local institutions to provide programs.

---


11 Clusters of innovations, Porter, ibid. p. 64.
12 Clusters of Innovations, Porter, ibid. p.xvi.
• Actively participate with government in recruitment efforts.
  - Communicate with firms in clusters to identify gaps in the cluster and recruit accordingly.

• Widen institutional membership to include all cluster constituents.\textsuperscript{13}

Some will also focus specifically on providing collaboration to provide start-up support, in a specific cluster. Examples include Joint Venture Silicon Valley in San Jose\textsuperscript{14}, Digital Greenhouse\textsuperscript{15} (sponsored by the Commonwealth of Pennsylvania) in Pittsburgh, and UCSD CONNECT\textsuperscript{16} based out of the University of California in San Diego. Closer to home, we have OCRI and OLSC in Ottawa, for the hi-tech and life sciences clusters.

The quality of these “facilitators”, i.e. the ability to build the social fabric of the cluster, can have a significant influence on the trajectory and eventual sustainability of cluster development.

Despite these best practices, sometimes the dynamics of a community, or the different factions, or the set culture might not allow for a natural leader to emerge, or to identify a champion to lead the charge.

\textbf{The start of Silicon Valley – the classic benchmark}

“What was important in determining the success of the early Silicon Valley back in the 1960s?\textsuperscript{17} Moore and Davis (2001)\textsuperscript{18} bring forward several elements.

First, there was a rich technological opportunity in the semiconductor business. Second, there were immediately available markets such as consumer electronics and defense. The creation of general-purpose semiconductors led quickly to sales in those markets, where the value of a miniaturized component was clear. There was also the prospect of whole new uses of semiconductors in information technology industries, a real prospect for long run growth. Both the technological and the market opportunity were separate from the existing high-tech (tube-based) electronic industry, and provided an advantage to producers located far from existing sellers.

How was this technological and market opportunity exploited? The Moore-Davis story is as far as can be imagined from one in which young entrepreneurs instantly succeed in a supportive environment of external effects. None of the modern institutions of Silicon Valley existed, so none of the incoming benefits of external effects were there. No mentoring from experienced entrepreneurs now working as venture capitalists, no easy access to the required skills or to wise and experienced thoughts about business models, no networks of connections to supply partners and marketing partners; none are part of the early period story.

Instead, the story is one of investment in human capital, firm building, and market building processes that took a long time and quite serious effort and risk. Allowing for changed circumstances, this same element is present in many of our regions. Building a new capability at the firm level which will lead to local increasing returns and positive feedback does not involve anticipating or exploiting those high-payoff features, it involves investing in the key assets which will permit later collective payoffs.

\textsuperscript{13} Clusters of Innovation, Porter, ibid. p.xix.
\textsuperscript{14} www.jointventure.org
\textsuperscript{15} www.digitalgreenhouse.com
\textsuperscript{16} www.connect.org
\textsuperscript{17} “Old Economy’ Inputs For ‘New Economy’ Outcomes: Cluster Formation In the New Silicon Valleys,” ibid. p.11-12.
Our research suggests that these include the importance of being linked to a sizable and growing demand as well as the availability of a proper supply of key factors like, in the case of ICT, skilled labor. Other critical factors are firm- and market-building capabilities. These require significant and systematic efforts by the “pioneers” of the cluster to promote organizational and technological capabilities of various sorts, create new firms and institutions, etc. Finally, another factor is plain “luck”. Founders such as Moore recognize that there was considerable uncertainty at the beginning about the potential size of rents and the appropriate firm and industry structure to pursue them.”

**Best Practice:** Once the right ingredients are together, starting the dynamic growth of a cluster towards sustainability requires the following: R&D-driven innovation has to flower; start-up companies need support to thrive, nurtured by available financial capital and highly trained people and managers; and most importantly, products produced by the cluster companies, new and mature, have to be made to accessible to emerging markets.
PART II: LESSONS FROM THE NRC EXPERIENCE

This section examines several lessons with respect to cluster-building, drawn directly from the experience of the NRC. Some observers have pointed out that there are only two or three full-fledged clusters associated directly with NRC, and that the jury remains out regarding some cluster initiatives, especially in Atlantic Canada. These may not eventually result in full-fledged, sustainable technology clusters if the full range of ingredients cannot be fully assembled.

In the last five years, we have become particularly aware of clusters. It is not surprising that we should pay particular attention to those early steps in cluster catalysis and formation. With time, we will have accumulated sufficient experience and data to become more proficient at focusing on those efforts most likely to be fruitful.

The NRC Hexagon model for technology clusters

What simplifies the scope of this handbook is its focus on clusters relevant to the NRC, i.e. technology-driven clusters that grow around or out of an NRC institute or its satellite.

In the case of an NRC technology cluster, there are some givens, namely that technology and research will be a major driver of that cluster, and innovation will be the primary engine. NRC has a distinct role. It initially provides the research and technology base. Because of its experience and resources – e.g. access to networks such as CISTI, IRAP and CTN – it plays a much broader catalytic role in bringing the cluster together.

What is a technology cluster as seen from the NRC perspective?19

- It is an approach to industrial development through technological innovation that stresses competitive advantages in communities, in an era where communities are competing against one another on a global basis.

- It is characterized by growth of a significant concentration of innovative companies around a nucleus of R&D facilities.

- Clusters are built, survive and prosper through linkages and networks of local firms, institutions, laboratories and universities, and NRC can be a catalyst for these networks.

- Informal and formal information networks that enable sharing of new and emerging S&T knowledge are essential components.

The elements of an NRC technology cluster are listed below, in the hexagon diagram that is well known to the NRC community. The challenge is how to make this happen in real time, in a pre-defined location, for a given technology.

Arthur Carty20 on clusters:

“NRC is a fairly diverse organization, and we contribute in many ways to innovation systems. We want to be relevant to industry and the Canadian context, and build links to the university community. Almost all of our new institutes and facilities are located on university campuses.

Six years ago, we focused on entrepreneurship, spinoffs, and cultural change within NRC. We can also point to a number of significant community-based developments:

In Ottawa, we had an action plan for innovation and clustering in 1995-96. Because of the community context, we were able to work with a lot of people, and built linkages that are critical. This turned out to be a natural evolution.

There was also a “blueprint” for innovation and clustering in Saskatoon in 1996-97, and PBI is one case where we had a significant impact. The city of Saskatoon decided 20 years ago that agricultural-biotechnology would be its economic driver. This was a community decision, not just government. NRC has been a

---


key player in Saskatoon through its institute and labs since the '50s, and played a key role in the Saskatoon decision in picking its cluster focus. PBI was a source of resources and expertise, and worked with ag-biotech and the university community. It turned out to be a key resource for this development, but 10 years ago we were not fully aware of this dynamic effect. We did not go out of our way to grow clusters. Today, we are much more conscious of the impact of our institutes on local technology clusters. At PBI, we have a new building, and are focusing actively on partnership activity and spinoffs. And as we get more and more involved with the community and regional dimension of Saskatoon, this effort is becoming more intense.

Another case is Montreal. In the mid-80s there was no biotech industry, and today, BRI can now be considered integral to developing the Montreal bio cluster. The biotech cluster was a provincial initiative, but BRI succeeded in attracting companies like Astra Pharma, helping them to set up in Montreal, and helping other firms to co-locate as well. BRI made itself part of the biotech/bioprocesses activities in the region. They built strong linkages with the community and extensive research collaborations. With the help of the federal government biotech strategy, they are now strengthening their links with universities, and now have a major facility for the incubation of smaller companies.

So this conscious effort of working with regions and communities is in most cases relatively new. We’ve moved from a stage where NRC was rather inward looking and not very well linked to the community, to a cultural change in which people are encouraged to do external activities. We need to become more aware of clusters, their dynamic and how we can influence them. This is captured in the NRC “hexagon” below, which is an assembly of innovative firms, institutions and laboratories that interact with one another and the community to provide services and growth. We need greater awareness of these elements."
The six nodes of the Cluster Hexagon are as follows:

A. R&D
How can NRC create a world class R&D capacity in key technologies, focused on the needs of local firms. The research base is seen as the most important contribution NRC makes to clusters.

B. S&T knowledge and information
How might NRC encourage an entrepreneurial S&T infrastructure, with universities, government labs and innovative firms, linked to a national and global knowledge infrastructure? Beyond actual R&D are many related functions, facilities and programs such as IRAP to assist firms to develop and commercialize technology.

C. Policy instruments and regulations
How can NRC influence and align sustainable development strategies, policies and regulations by local, regional and national governments? Government remains a significant player by virtue of its many roles, which impact on the business environment.

D. Incubation and mentoring
How can NRC provide partnership facilities for incubating start-up firms, and providing them with mentoring support?

E. Finance and risk capital
How might NRC facilitate firms’ access to knowledgeable, local sources of innovation capital, and to significant venture capital in specialized markets?

F. Skills and human resources
How might NRC help firms locate and cultivate sources of motivated learners, and develop pools of highly qualified personnel?
Key to the infrastructure of the Cluster Hexagon are two central elements:

**Innovative firms**
1. At the **centre** of the Hexagon are **innovative firms**, old and new, which are clearly the focus and attention of the cluster growth, since these are the connected firms that will produce and sell the products that will generate the wealth of the cluster.

**Networking links – local champions and networking organizations**
2. Most importantly, there are all the **criss-crossing lines**, which represent the vital **networking links** that keep the cluster together. Building and maintaining these links is what cluster-building is all about. Two kinds of players help build these networks, **local champions** and **networking organizations**. Most successful clusters appear to have developed an entrepreneurial and self-sustaining networking organization dedicated to fostering the links among the various players. Generally, these networking organizations are separate from government, and initially led by a **local champion** of the cluster.

**The location of NRC clusters**

Over the years, the structure of NRC has become increasingly decentralized, with institutes and satellite laboratories distributed across the country. Clusters are by definition geographically focused. Any cluster activity by NRC accordingly has to be linked to the location of major institutes or satellite laboratories. In other words, NRC, by the very nature of its R&D activities, can stimulate cluster development only in those geographical areas where it has a physical presence. The selected locations are the result either of intentional policy decisions, which lead to "greenfield" clusters, e.g. the "e-business" cluster of New Brunswick, or of a natural convergence of economical and technical factors, which may or may not be re-enforced with specific program initiatives. Examples of the latter would include the PBI biotechnology cluster, the evolution of the biotech and BRI in Montreal, or oceans sciences and technology in Atlantic Canada. Either way, there is a strong location dimension. In fact, to Michael Porter, the guru of clusters, the geographic dimension is a critical element: "A cluster is a *geographically proximate group* of interconnected companies ..."  

For the e-business cluster in New Brunswick, there was an active and conscious process for determining which of the three cities – Moncton, Saint John, or Fredericton – would be the principal site of the new IIT laboratory, as described by Andy Woodsworth:

“In trying to select a city for our lab, our initial questions were what would we do in terms of research initiative, and who would our partners be? The issue was to identify the potential research agendas of the universities, what NRC could do jointly with SMEs and what would the cities offer. We developed criteria for a site selection. We had three cities to choose from initially, and each one came to us with very persuasive presentations.

There was an internal committee with the two NRC VPs and Industry Canada, who came up with the final scoring. There was some pressure from individual MPs and MLAs, but absolutely no official pressure from either governments as to which city we should choose.

The site selection eventually fell on Fredericton, and we decided to build our building on the Campus of UNB. But, given all the rich activities and potential we discovered as part of our research, we also decided to have a small research presence in rented facilities in the other two cities, Moncton and Saint John. Those three sites and Miramichi will be linked by a high speed broadband communications network."

Another satellite laboratory is the Aluminum Technology Centre (ATC) in Saguenay-Lac St.Jean. A key factor of this initiative was the presence of a major aluminium smelting and production capacity in the region, and the desirability of adding value to this bulk aluminium capacity by adding advanced manufacturing technologies for the transformation of aluminium.

---


22 Interview with Andy Woodsworth, DG IIT, June 20, 2002.
The choice of location was further justified by a decision of Alcan to invest $10 million in R&D activities planned for the NRC centre. The intent was to help create SME manufacturing companies specializing in aluminium in that region.23

The creation of the ATC was also the result of a technology roadmap on aluminum. A technology roadmap is useful for mapping common themes as well as forecasting, and for networking – identifying who’s who.

In general, NRC experience seems to support at least two distinct strategies. One is to create a new institute – i.e. a “greenfield” research centre – where everything is new and has no historical baggage or established traditions and attitudes, and build a cluster around it. In this instance, the motivation of staff and researchers may be higher and more focused on cluster linkages than in more established institutes and research centres, where clustering can sometimes be seen as a late addition to the organization’s mandate. The second strategy, more the norm, is to build on existing programs, institutional and local business strengths in order to elevate a community’s potential for global competition.

Another factor is that locating clusters in cities is easier than in rural regions, because of the greater concentration and availability of a diversified economy and supporting resources.

But a key principle remains true – Canada is a very diverse country, with very different economic regions and different technological capacities, and indeed technologies. As recent research by the Innovation Systems Research Network indicates, clusters across the country are very different and behave and evolve in differing ways,24 e.g. the Calgary wireless cluster, the new media cluster in Vancouver, or the Ottawa telecom cluster.

Best Practice: NRC clusters benefit from the Hexagon model, consisting of six components: A. R&D, B. S&T knowledge and information, C. Policy instruments and regulations, D. Incubation and mentoring, E. Finance and risk capital, and F. Skills and human resources. Key to the infrastructure of the Cluster Hexagon are two central elements: innovative firms, which are at the centre of the cluster, and the vital networking links that keep the cluster together driven by local champions. These describe the essential ingredients for a cluster, and provide a helpful checklist in elaborating any clustering strategy. No one component is sufficient on its own, and what should be strived for is an appropriate balance among all components.

A. R&D: starting-up the regional research engine

The first key ingredient in the NRC Cluster Hexagon model is R&D – the core business of the Council. Yet in recent years, the traditional model of carrying out R&D has evolved significantly from the traditional ivory tower laboratory. Research partnerships have been the norm at NRC for some years, and it is in the same spirit of collaboration and innovation that clusters are built. It is interesting to note that Andy Woodsworth’s first thoughts when starting the New Brunswick e-business initiative were: “What would we do in terms of research initiative, and who would our partners be?” At the end of the day, research and innovation are the core businesses of the NRC, and this is what drives the creation of their technology clusters. This relatively new way of looking at innovation represents a continuous evolution of NRC’s role over the last several decades where industrially relevant research, technology transfer and commercialization, revenue generating contract research, licensing, spinoffs, start-ups, and incubators, all the way to regional innovation systems and now technology clusters, are all seen as necessary tools to achieve results and wealth for Canada.

This section examines several best practices for further bringing researchers and industry partners together.

---

23 Interview with Blaise Champagne, DG IMI, June 4, 2002.
24 Annual General meeting of Innovation System Research Network, Quebec City, May 8-10, 2002.
Equipment and facilities as catalysts for research partnerships: the BRI case

One of the powerful attractions for companies to be associated with BRI is that BRI had top quality laboratory facilities and a state-of-the-art pilot plant facility:

“As part of their efforts to promote biotechnology, the Quebec government brought in a number of new fiscal measures, tax rebates and tax incentives to attract foreign scientists. By the 1990s, there were 150 new biotech firms in Quebec. Biochem Pharma became the flagship of these companies, and played a major role. So did the VC community.

At the time BRI began taking on guests. Merck became the first tenant, and spent three years at BRI before moving to their new facilities in Kirkland. Similarly, Astra spent three years at BRI, and Biochem Pharma stayed almost four years at BRI. These are some of the successes. Now, BRI has a new wing, referred to as the "condominium", of 35,000 square feet, which opened in September 2002. Some tenants include Caprion, Intellivax, Methylgene, Phénogene.

Part of the attraction was the extensive bioprocessing facility, offering unique pilot-plant scale-up facilities for biopharmaceutical manufacturing. This facility alone has generated $18 million of contracts with Merck US.”

The Institute for Aerospace Research (IAR) equipment loan project – bringing the “lab” to the client

One model is to build a top quality R&D facility, another is to take the R&D equipment to the client firm. IAR’s Bill Wallace has a vision to create a virtual laboratory, where there is no building, but equipment and research teams are distributed throughout the different clients. This became possible when IAR received the go-ahead from Treasury Board for their new laboratory.

They faced the traditional five-year cash flow of a minimal stream of expenses for the first two years, with costs peaking in the later third to fifth years, but TB gave them a guideline to try to even out the cash flow. IAR made the strategic decision to buy highly specialized state-of-the-art manufacturing equipment right from the start, and build research programs around these. When the equipment arrived – and these were large pieces of equipment, as large as a room – instead of placing these in storage, they placed them on loan with the clients in their factories, on company sites.

The first equipment was a large aluminium welding machine used to melt and fuse aluminium joints for fuselage structure. The machine uses a YAG (Yttrium-Aluminium-Garnett) 4kW laser, with a fibre-optic cable attached to a highly flexible robot arm. This is a significant advantage over the traditional technology for building and fastening aircraft fuselage, based on rivets, which often crack, corrode, and can fail in a “zipper-like” mode. The machine, which costs approximately $1.5 million (with the chillers, tracking control) was placed in AWS, a Mississauga-based SME. AWS manufactured lasers for the car manufacturing industry. Unfortunately, AWS went bankrupt, and the equipment had to be relocated with Orenda, which had a stronger focus on the aircraft industry, and is part of the Magellan conglomerate.

A second piece of equipment was a large CO₂ laser CNC tool system, which was placed with Standard Aero in Winnipeg, worth approximately $1 million. The company provides repair and overhaul services for gas turbine engines.

Another equipment consists of a large 42kW electron beam welding system, to join together thick sections parts. It can be used for cutting and vaporizing/deposition as well. Located at Aerospace Welding in Blainville, Quebec, its approximate cost was $2 million.

They also bought a used large autoclave for compositing processes from FRE Composites. This was used for manufacturing the arm booms for the CanadaArm. The autoclave has a high temperature range necessary for thermoplastics.

---

25 Michel Desrochers interview, June 4, 2002.
In an R&D environment, equipment is used maybe 10-20% of the time. The rest of the time it is used for experiment design and set up, and once the experiment is complete, for data processing and interpretation. By placing the equipment on company clients’ premises, the researchers still have the opportunity to use the equipment for tests and research 10-20% of the time. But the added bonus is that the company can also use it the rest of the time (80%) for test production runs that help establish process economic viability, and for staff training.

Through this equipment loan process, people in the company are able to determine the economic attractiveness of the new equipment to their company and explore more fully how it will help improve the quality or attractiveness of their end-product.

This kind of partnership requires quite a lot of legwork. Terms of reference included the following:

- That the equipment eventually be repatriated by NRC.
- That it be used primarily to do R&D.
- That it could be used for small production runs, provided the company pays NRC at cost.
- That there be NRC people on the premises.
- That it be accessible for other researchers and other companies.
- That NRC will not pay for space rental.
- That companies cover insurance.

The “loan” formula allows the equipment to be used for research while waiting for the lab to be built for industrial R&D. IAR’s only problem was with the with YAG, where the placement was interrupted because of AWS bankruptcy.26

**Best Practice:** NRC has always stood for excellence in research. New requirements for industrial partnerships and engagement of industrial clients in the research process requires imaginative new approaches for structuring research infrastructures, from shared facilities to locating facilities outright on client premises.

B. S&T infrastructure: linking to universities, government labs and firms

A key ingredient in the NRC Cluster Hexagon recipe is to create a sound and entrepreneurial S&T infrastructure. This goes beyond the NRC’s own laboratory facilities. What is meant are links with universities, other government labs and innovative firms, and to global knowledge and technology networks. As mentioned earlier, anchor firms – i.e. large, globally connected research-based firms – can play a key role in this S&T infrastructure by bringing global market intelligence into the community. A good practical way of appreciating what is involved in building this S&T infrastructure and making these S&T linkages and partnerships is to examine the case study of the Winnipeg-based Institute for Biodiagnostics (IBD).

**The IBD story – leveraging knowledge networks**

The Institute for Biodiagnostics started in Winnipeg, branched out to Calgary, and most recently, expanded to Halifax. In the words of Ian Smith, “Every city needs a separate plan, because each one is a special case.”27

In 1991, Smith was named DG of IBD in Winnipeg. His mandate was to establish a biomedical R&D presence to align with the strong medical research infrastructure in Winnipeg, and to create a base that could spur innovation to help diversify the regional economy.

---

26 Bill Wallace interview, June 14, 2002.

27 Based on interview with Ian Smith.
“The objective was not to create a fortress with the new Institute, but to help other companies, and to start new companies. Winnipeg had traditionally been a commodity and textiles-based economy, and the challenge was to diversify it.”

Only the building, originally constructed as a manufacturing research facility, was there to start with. This provided him with a major advantage of not inheriting past jobs and employees with a set attitude. The people he was able to hire shared the vision that this was not a traditional university or a government paper-generation research lab, but that they were to undertake research dedicated to economic and regional development – i.e. pursuing innovation that also would support the “social side of the equation.”

His institute had a clearly dual economic-social motivation. The initial idea came from the kernel of collaboration that existed with some of the Winnipeg hospitals and Ottawa scientists, which led to moving this seed of activity to Winnipeg, and building a new institute around it.

The first task was to generate a mission statement, which captured this new ideal. IBD also received $7 million from the Western Economic Diversification Fund, with the condition that they had to generate $3 million in revenues over the next two years.

They looked for partners – in Manitoba, the rest of Canada, and the world. They now have research collaborators in Eastern Europe: Romania, Hungary, Poland and Slovakia. In the ‘80s, these represented pools of “giant frustrated excellence”: they had a lot of creativity, but no resources. Smith initially brought the researchers over for short periods as post-docs and associates, and when they returned to their countries, they became research collaborators, shared expenses, or benefited from some outsourced research contracts. In one instance, a Polish laboratory has a $1 million research instrument, financed by IBD. He enabled their creativity and encouraged the flow of research papers, as well as benefited from their research.

This kind of international collaboration also exists with Australia and Germany. In Australia, they happen to be very good in one area of medicine, and IBD happens to be expert in a specific area of computing. This formed the basis of collaboration and partnership for that project.

Smith focused on integration with the community – not just the university but also hospitals, companies, and financial companies. He started building links with financial companies as early as 1992. He now sits on three venture capital (VC) boards.

This was a win-win proposition for both sides. The VC companies did not have the technical expertise – so IBD offered them its scientific expertise to assess deals. In return, IBD learned a great deal from VCs, especially when it comes to commercialization of new technologies.

Over ten years, IBD has spun off six companies, now worth a total of $75 million. For example, Novadaq raised $16 million and soon became profitable. IMRIS, which raised $25 million, soon followed.

IBD also has links with the regulatory community, and the medical devices group in Health Canada. Again, this is a linkage that provided IBD with valuable insights and essentially free advice in the approval process required for medical devices, as well as into what works and doesn’t work. It also allowed IBD to become better known.

Many companies and organizations have subsequently offered to put their offices in the IBD building, which is located downtown in the middle of the hospital and financial districts. IBD gets between 50 and 60 visitors a day. At any time, there are 225 people on the premises, of which 150 are NRC employees.

IBD has a new incubator building, called the Winnipeg Centre for Hi-Tech Innovation. There are already six companies in the current building – in computers, software, and medical devices (respiratory technology).

The fourth floor has 50,000 square feet of commercial space, including IRAP, prototyping, and the Prairie Centre for Competitive Intelligence. This attracts a steady stream of final year commerce students and MBAs looking for opportunities to do their research papers.

Smith’s philosophy and approach is to “walk the streets, knock on doors, introduce yourself.” In the early days, he would give up to two lectures a week to any group, including the Curmudgeon Society. He spoke at least 100 times in the first couple of years.
“The idea is to get out there, and meet people – and eventually people come to you, students come to you, doctors, business people – people with ideas to commercialize, or some element/resource that can help commercialization, or create a partnership.”

By year two, IBD had already generated $3 million – mostly through research contracts, as opposed to licensing or spin-offs. It was the first NRC institute to hold equity. IBD did this through a non-profit holding corporation, which managed the NRC equity in the different spinoffs.

Best Practice: A sound and entrepreneurial S&T infrastructure is the result of dynamic linkages with research partners, universities, firms and institutions throughout the world. These linkages serve to leverage and dramatically magnify the impact of the NRC portion of the R&D investment, and have to be pursued aggressively and creatively.

Ian Smith interview, July 4, 2002.
C. Policy instruments: aligning visions and development strategies

Given the dispersed nature of the different players and leaders in the clustering process, it is imperative that all the different levels of government work in the same direction and have their strategies aligned. Otherwise, there will be an incredible waste of effort and energy as the different authorities battle against each other, instead of promoting a given region’s growth.

Internally, the same can be said of NRC’s internal workings, where optimal efficiency is achieved if all levels of authority, from the President, VPs, DGs, directors and managers all the way to the researchers share the same vision of networking, partnering and collaboration, albeit at different levels of competency and responsibility.

Michael Porter has outlined quite clearly what such an alignment of policies and programs might look like, ideally, in the U.S. context of division of power:

FEDERAL GOVERNMENT

- Invest in the foundations of science and technology.
  - Increase federal funding of research at universities and other research centers.
  - Establish federal overhead recovery rules, and other policies, to encourage investment in universities’ science and technology infrastructure.
  - Provide federal support for specialized training programs in science and engineering.

- Improve the innovation policy context.
  - Fortify intellectual property protection.
  - Strengthen and enforce anti-trust laws with a greater weight on innovation.
  - Reinforce federal tax incentives that encourage business investment in R&D and industry-university collaboration.

- Allocate federal resources to reinforce cluster development.
  - Distribute federal research funding through a system of peer-reviewed competitive grants in a way that fosters cluster development.
  - Encourage locally-based federal agencies to communicate and coordinate with local business, institutions for collaboration, and educational and research centers based around clusters.

- Provide better data for measuring regional economic composition and performance.
  - Collect more up-to-date data down to the county level.
  - Collect measures of both economic performance and innovation.

- Encourage the development of regional economic development strategies that stress innovation.

- Provide federal matching funds for innovation-focused state and regional economic development strategies.

STATE GOVERNMENT

- Invest in the foundations of science and technology.
  - Recognize the state government’s important role in supporting R&D funding at state universities.
  - Establish and maintain high levels of state support for community colleges and specialized training centers.
  - Create a strong university or college presence in all major regions of the state.

- Sponsor state programs that encourage cluster development.
  - Build cluster thinking into research parks and incubators.
  - Organize state systems of higher education around local clusters.

- Focus business recruitment around strong clusters.
  - Coordinate activities with firms, universities, and training centers to recruit anchor companies to their region.
• Create regional dimension to state economic development strategy.
  - Encourage and assist regions to develop economic strategies.
  - Cultivate attitudes toward collaboration and sharing of information among firms, universities, training centers, labor, institutions for collaboration, and government.
  - Improve information systems to regularly collect data and measure progress.

REGIONAL AND LOCAL GOVERNMENT
• Strongly support K-12 education, and create strong standards and accountability.

• Upgrade core business infrastructure.
  - Transportation infrastructure.
  - Communications infrastructure.
  - Ensure specialized training programs are a high priority in any economic development strategy.

• Develop a regional strategy that involves all stakeholders.
  - Support regional benchmarking initiatives.
  - Encourage a common vision and collaboration among firms, universities, and training centers.
  - Work with firms, universities, institutions for collaboration, and state government to create an organizational structure to help implement a regional strategy.

• Encourage cluster development.
  - Establish research and industrial parks that encourage innovation-based competition.
  - Implement cluster-focused and innovation-focused recruitment efforts.

CLUSTER-SPECIFIC INSTITUTIONS FOR COLLABORATION
• Promote cluster awareness.

• Engage in ongoing diagnosis of cluster’s competitive position.
  - Compare position relative to other regional clusters.
  - Identify constraints, obstacles, and advantages.

• Develop training and management programs.
  - Provide programs through institutions for collaboration.
  - Coordinate with local institutions to provide programs.

• Actively participate with government in recruitment efforts.
  - Communicate with firms in clusters to identify gaps in the cluster and recruit accordingly.

• Widen institutional membership to include all cluster constituents.

FIRMS
• Recognize the importance of location to competitive advantage.

• Take an active role in improving competitive environment.
  - Consistently communicate your needs and desires (e.g., for talent, ideas, patents) to local universities, research institutes, and training centers.

• See their cluster as a competitive asset.

• Contribute actively to cluster development activities.
  - Actively participate in cluster activities to identify issues of common concern and opportunities for mutual gain (e.g., regulatory matters, new buyer needs, innovative supplier capabilities).
  - Support recruitment activities of local chambers and other regional economic development officials to bring in companies that will fill missing niches in the cluster (e.g., suppliers, services providers, competitors).
  - Contribute to programs that support new ventures (e.g., improving access to risk capital, mentoring programs, and specialized services) in order to build-out cluster.  

The roles that Porter assigns to universities and research institutes are particularly pertinent to NRC cluster builders, and are highlighted here, and could be considered a “best practice”:

---

**Best Practice:**
**Universities and Research Institutes**
- Recognize the important role of universities in regional economic development.
  - Take the lead on, and participate in, regional and cluster development efforts.
  - Create and support technology transfer offices.
  - Work with firms and venture capital to streamline the technology transfer process.
  - Benchmark the commercialization of university-created intellectual property using measures that promote efficient dissemination of knowledge.
- Actively participate in cluster development efforts.
- Align university curricula and research to meet the needs of local clusters.
  - Create cluster-specific institutions to support collaboration between academia and industry clusters.
  - Work with local industry to create areas of excellence within universities that differentiate the university and complement local industry strengths.
  - Integrate research and training efforts with the needs of local industry.
  - Participate in the recruitment of companies.
- Support company start-up efforts by professors and students through mentorship, entrepreneurial education, and financing.\(^3\)

---

**D. Incubators and mentoring**

Yet another ingredient from the NRC Cluster Hexagon is the need to provide partnership facilities for incubating start-up firms, and providing them with mentoring support.

One major evolution in this direction is that there has been a radical change within NRC as to how laboratory space is used. The new direction is to make these as open and accessible to outside researchers as possible:

In Montreal, BRI started expanding in 1994, and now has a new wing, referred to as the “condominium”, of 35,000 square feet, for a total of 100,000 square feet. Some tenants have included Caprion, Intellivax, Methylgene, and Phénogene.\(^3\)

In Saskatoon, PBI has opened a new building of 75,000 square feet, to provide space for its core program, as well as incubator space for SMEs.\(^3\)

In Longueuil, of approximately 300 people on the IMI site, only 200 are NRC employees: others are graduate students, companies, etc. They are finishing a new wing exclusively for outside companies wishing to test new processes. IMI receives 10,000 visitors a year.\(^3\)

At IBD in Winnipeg, the fourth floor has 50,000 square feet of commercial space, including IRAP, prototyping, and the Prairie Centre for Competitive Intelligence. This attracts a steady stream of final year commerce students and MBAs looking for opportunities to do their research papers.\(^3\)

As experience accumulates with these entrepreneurial tenants, more best practices will emerge as to how best to provide them with mentoring services.

---

\(^3\) Michel Desrochers, ibid.
\(^3\) Kutty Kartha interview, July 16, 2002.
\(^3\) Blaise Champagne, ibid. June 4, 2002.
E. Financing innovation: involving the financial community

A key ingredient in the clustering brew is to have access to knowledgeable, local sources of innovation and risk capital – i.e. to have an adequate capital flow to support the creation of start-up companies and ensure their growth. The challenge is to generate local awareness and involvement of the financial community, not unduly influenced by national standards and priorities.

There is no magic formula for attracting the financial community to the table, other than simply inviting them. Ian Smith used the opportunity of talking to VCs to learn about business plans and investments in exchange for exposing them to new opportunities. Blaise Champagne brought them together as part of the key players in the community interested in nanotechnologies. The experience of SiGe Microelectronics (see below) brought together some of the national organizations like the Business Development Bank. At the end of the day, the financial community is simply one of the six nodes on the NRC cluster hexagon, and has to be brought into the picture, like all the other elements.

“The presence of VCs and angels is crucial to new company growth – but this is difficult to find in some areas of the country, e.g. Atlantic Canada. We will need to put incentives in place. Silicon Valley has grown from the $ investments from angels and VCs. We will need to get financing if we want to be successful.”

BRI’s Michel Desrochers has worked actively with Canadian embassies and consulates abroad, to encourage them to bring visitors to BRI. Last year, they had 25,000 visitors. This has helped tremendously in attracting major investments into their region.

BRI also works closely with the regional investment community. The effectiveness of these “best practices” was demonstrated clearly in the Biointermediaire success story, in 1994-95. Brigitte Leger, a Canadian trade commissioner, brought a visitor to BRI, Mr. René M. Ridder van Rappard, who wanted to see the pilot plant. Indeed, it turned out that he was interested in finding a new site to build a plant. Desrochers put him in touch with a number of venture capital firms in Montreal, including Bernard Coupal of Innovatech. Within weeks of this first meeting, Coupal and Desrochers went to Amsterdam to make a presentation to the company’s board. The result was a combined investment of $50 million, to set up Biointermediaire’s new facilities right next to the BRI campus.

When Biointermediaire was subsequently bought out by DSM, there was a new financial package put together by the City of Montreal, the Government of Quebec, the Société Générale de Financement, and Industry Canada. This agreement resulted in a new investment of $350 million for DSM in the Montreal region.

Both of these developments show the importance of being closely linked with the VC community. A strong business development office (BDO) is helpful. One of Desrochers’s first actions when he was named DG was to set up a revitalized business development office where all employees have an industrial background, with masters or MBAs, who could talk using the same vocabulary as industry. Today, one of the key officers in the BDO comes herself from the VC community.

Ultimately, a big test of a sustainable, dynamic and globally competitive cluster is its ability to generate capital and sponsor new company formation from within the community – via publicly traded firms. In this way, a vehicle exists for investors to use the benefits realized from one company to help start and develop subsequent generations of firms, thus enabling the cluster’s growth and dynamism.

Best Practice: One key result of a mature cluster is to generate publicly traded and financed companies locally. Engaging the financial community at an early stage is critical, both to familiarize them with the new cluster technologies, and to learn from them, at an early stage, their risk profile and investment criteria.

---

34 Ian Smith, ibid.
36 Michel Desrochers interview, June 4, 2002.
F. Skills and human resources: towards a learning community

Another key ingredient of the Cluster Hexagon in achieving sustainable growth of clusters is the continued supply of highly skilled people. The challenge is to cultivate sources of motivated learners, and develop pools of highly qualified personnel to support the growth of the cluster firms.

Clusters need a number of ingredients to grow and become sustainable, as any organic structure. Infusion of new talent, and cross-fertilization of skilled workers who move from firm to firm, are some of these elements, and are especially critical in instances of rapid growth clusters. This requires a tight coupling with local and technical training institutions.

Education and training is an intrinsic part of the NRC way of doing things. For example, as part of one of the first Ottawa Innovation Roundtables, one of the issues identified was the critical need for more trained skilled IT people. This led to the creation of O-Vitesse, a program to re-skill chemists and biologists into IT specialists. In the Okanagan, one result of a similar roundtable was the creation of a new training program by the Okanagan University College to train technicians in aircraft maintenance. Almost all of the new NRC institutes or satellite institutes have been built on university campuses to facilitate the smooth connection between talent and technology: Alberta (NINT), Ecole Polytechnique (IAR), e-Business (UNB), etc. In terms of best practices, we need to look at ways to enhance these connections and intensify the linkages with new firms needing talent.

The literature does recognize that there is more than one way of ensuring an adequate flow of skilled people:

“In reference to ICT clusters, there can be different sources of skills in different regions, and – given that it is the availability of the skills that matters – regions can look for the most appropriate way (or mix thereof) for acquiring skilled labor, from universities to larger firms and other local as well as distant institutions. The policy implication is also straightforward – forming or attracting skilled labor, rather than a particular means for doing it, is the crucial aim.”37

Also, as Arthur Carty says, there will be a need for new skills at the managerial level of NRC:

“We need people who will commit themselves to interacting with the community, and help create a centre of economic development, and provide their time and expertise to make this happen.

This needs lots of different skills: the ability to manage reasonable risk, to be entrepreneurial, to balance risk and rewards, and to be sensitive to conflict of interest, and policy imperatives.

We’ve moved from a stage where outside activities were the exception and not really encouraged, to where people now have as a principal part of their job networking, liaison, and community involvement.”38

Best Practice: Access to sources of motivated learners and pools of highly qualified personnel are essential to achieve sustainable clusters. Creation of key linkages with training and educational institutions, as well as firms that expect rapid or specialized skill-based development, should be made at an early stage, especially in the case of dynamic and high growth clusters, to ensure a proper balance between supply and demand.

38 Arthur Carty, ibid.
Innovative firms: spin-offs and new ventures

At the centre of the NRC Cluster Hexagon are innovative firms, old and new, which are clearly the focus and attention of the cluster growth, since these are the connected firms that will produce and sell the products that will generate the wealth of the cluster.

At the end of the day, a key metric in the success of a cluster is economic growth and wealth generation, and this is best exemplified by the number of new start-up companies, as well as by the growth of the more established firms. NRC has already established an enviable record of developing spin-off companies. In a cluster context, however, the intent is to ensure that the community has the mentoring, financial and other resources required to thrive, and grow in a sustainable way. It is useful to review some of the innovative thinking that went into the creation of one of the first cluster-oriented spinoffs of NRC, SiGe Microelectronics:

“The first “spin-out experiment” in linking NRC to local businesses was the creation of SiGe Microsystems. This allowed us also to bring in financial players like the VCs, the Business Development Bank, and the Canadian Science and Technology Growth Fund (CSTGF), which invested significantly in the new facility. The intent was to have a technical facility, a state-of-the-art lab for silicon germanium and clean rooms, with great commercial value, which would attract businesses. Our unique technology was the Ultra-High Volume Chemical Vapor Deposition technique. This was only one of two facilities in the world. The purpose was to provide SiGe wafers to those who wanted to use it. We also had Nortel as a partner, which provided at the time a credible entity.

SiGe was a for-profit corporation, and generated revenues. Its leaders included Derek Houghton, John Roberts, and David Edwards of the Strategic Microelectronics Consortium. It took 18 months to make it happen, and was a precursor of the photonics cluster.

In retrospect, this experiment shattered some widely held traditions within NRC, and brought home some new values or principles:

• NRC employees can get involved in industry or business.
• VCs will participate in NRC projects.
• NRC can and should be regional in its focus.”

And Michel Desrochers, whose new strategic plan explicitly states that BRI wants to “be recognized as a catalyst for biotechnology in the pharmaceutical and environmental industry clusters," summarizes his three best practices to attract investment and new firms to the biotech cluster as follows:

• “A focused R&D program, directly relevant to the industry’s interests (e.g. we dropped forestry).
• Strong links with the financial community (which allowed him to close the Biointermediair and DSM deals).
• And close links with Canadian consulates abroad, to make BRI a point of destination for the many technology delegations visiting Canada.

39 Arvind Chhatbar interview, July 9, 2002.
The overall philosophy is to aim for technology transfer, with protected intellectual property to achieve maximum economic impact. There is a need to become far more client oriented, and to become deeply aware of the local innovation system, become part of it with NRC’s infrastructure and lab space. In all of these, the DG has a critical role (clé de voute). “41

The local champion: the initial spark plug

An essential element in starting a cluster is the local champion, who brings together all the players, helps develop the vision and gradually attracts more resources, partners and enterprises, until a critical mass is reached. In many instances of technology clusters initiated by NRC, an NRC employee is frequently engaged in this champion role, or more precisely, in the role of “convenor” or cluster-builder, which is eventually surrendered to a local individual.

The NRC “cluster builder” as convenor

The NRC “cluster-builder” is in a powerful position: he or she has no formal power compared to the local mayor or head of economical development agency, but brings a lot of informal authority and credibility as part of NRC. The NRC “cluster builder” has at his/her disposal and can use the ultimate tool of clustering – that of “convening”, bringing people together around the idea of innovation, calling workshops, and building networks across the community. There is no rule in the country that says that an NRC manager cannot talk to people about innovation and research partnering. In fact, that is the behavioural norm and is even expected of an NRC official. This can be turned into a very powerful and influential role within a community or region, albeit an informal one.

When asked how he dealt with universities, government departments, provincial and federal economic development groups, Ian Smith replied:

“Be in their face, and tell them that you will help change their dream into reality.”

Smith is charismatic, focused and dynamic. His very strong and successful scientific background gives him the credibility to engage in conversations that will lead to research partnerships, but he also has the business skills and the ability to nurture relationships.42

Arthur Carty recognizes that this will require a new breed of research managers:

“We need people who rather than be isolated in their immediate NRC environment, will commit themselves to interacting with the community, and help create a centre of economic development, and provide their time and expertise to make this happen. Building relationships is crucial to make this happen – you want this to become a source of pleasure.”43

And indeed, networking and face-to-face contact does generate a sense of pleasure and creative energy, which stimulates innovation, exchange of ideas, and value that Storper and Venables call “buzz”.44

Best Practice: Focusing on the growth of innovative firms, old and new (start-up), is central to any cluster. At the end of the day, it is the products and services produced by these firms and sold to growing markets that will generate the economic wealth expected of a cluster. In the last analysis, all initiatives, networking efforts, and policy support must focus on this objective.

41 Michel Desrochers, ibid.
42 As recounted by Don Di Salle, April 26, 2002.
43 Arthur Carty, ibid.
Making the first steps: the New Brunswick e-Business Cluster

The New Brunswick e-cluster initiative is a good example of how NRC entered a region, used initially an NRC officer to play the role of cluster champion or convenor, and then devolved this role to a local champion, who was hired subsequently.

The following are based on interviews with Andy Woodsworth, the DG responsible for the initiative, and Don Di Salle, who was acting director for the project, ran the secretariat, and played the role of the NRC cluster champion.

The Fredericton cluster initially focused on e-commerce. This was part of the Atlantic Innovation Partnership, which provided $110 million over five years, of which $25.5 million was earmarked for NRC/New Brunswick. It subsequently evolved to e-business, which was seen to be broader as it also included e-learning, e-government, etc. The initiative started with the report “Catching Tomorrow’s Wave”, where NRC identified that it had no physical presence in New Brunswick. The NB Premier (Lord) wrote a number of letters to senior officials and politicians – e.g. to the NRC President, Industry Minister Manley, and the Prime Minister regarding an e-commerce initiative.

Don Di Salle was appointed to head the secretariat for NRC. This involved preparing the Memorandum to Cabinet, as well as coordinating the different roundtables in Atlantic Canada. “All this was done in addition to our regular jobs,” said Andy Woodsworth.

Don’s role in Fredericton started in February 2001, as Acting Director. In effect, he was the “local champion”. Two weeks later he had an office at UNB. He worked closely with universities and faculties. His role was to shape NRC’s research program around community needs, and work with partners on such topics as voice recognition. In all of these discussions, he found a high degree of recognition of NRC’s contributions.

His three objectives for the New Brunswick initiative were to:

- Design an incubator.
- Develop a cluster, find a champion through the economic development corporation, and educate the private sector about the concept through a roundtable. He eventually found the champion, who chaired the workshop – the former president of Alliant, NB power/telecom company.

Few companies came to see him once they realized he had no money to give out. When companies did come to see him, his message was that he was not into product development, but in technology development that cut across several companies.

Andy Woodsworth’s first major task was to select the site where the NRC would be located. New Brunswick is a small but very agile community. The province was attractive because of the efforts of NB Tel and the former premier Frank McKenna to attract call centres and e-learning expertise. It is the second strongest e-commerce centre in Canada after BC, with companies like CGI and Xerox. An 80 people lab in Ottawa would barely make the news, but it was front page in NB. Moreover, all other cities are 1.5 to 2 hours apart by car – Moncton, Fredericton, Saint John and later Miramichi.

The key questions, given the technology and innovation-driven nature of NRC, were “what would we do in terms of research initiative, and who would our partners be?” The issue was to identify the potential research agendas of universities, what NRC could do jointly with SMEs, and what would the cities offer. They developed criteria for a site selection, and a formal decision process, and the site selection eventually fell on Fredericton.

The NRC team had to work with a number of players, including federal granting agencies, NRC-IRAP, and ACOA. There were some sensitivities with ACOA, which felt that NRC was doing economic development, when in reality it was recognized that ACOA did not have the technical capacity to assess potential technology sites or projects. In fact, ACOA asked NRC later on to review some of the 50 proposals under the Atlantic Innovation Fund.
Each city also had its own economic development agency. It was the local economic development agency that built the NRC building in Fredericton, and was in effect a contractor building it to NRC’s specifications.

The umbrella clustering organization was KILN, the Knowledge Industry Leadership Network, which among other things, sponsored awards dinners initially held in Fredericton, then in other centres.

There were also the industry partnerships, which co-shared the costs of meeting rooms and community events.

Don Di Salle summarizes his “best practices” in the following way:

- “Develop the research agenda with key stakeholders/leaders – e.g. municipal governments – the most visible leaders, and ensure that they are all on the same page.

- Build a collaborative model of R&D – challenge the universities to leverage their capacity, on their own campuses.

- Build a “facilitator organization”, like Bill Collins and OCRI, which cuts across all players. In Halifax, we created a separate entity, a Life Sciences Development Organization, with multiple sources of funding. They had a methodology and an action plan. Most communities do not have a longer-term vision of where they want to go.

- Develop a decision-making model, a collaborative model, where you consult before you invest.”

There were some sensitivities with respect to the political level, both at the provincial and federal levels, who wanted to be involved more deeply in the process to the point of risking to slow it down. On one occasion, the Minister failed to appear for a major event and cancelled at the last minute. But in the end, in the words of Arthur Carty, the process had been more than successful:

“When we started, people were keen, but each of the communities wanted the NRC presence for themselves. In two short years, we now have an almost completed institute in Fredericton, we’ve hired 35 staff in e-learning, e-business and e-commerce. The communities now accept our idea of a dispersed network, which is built around a federal institute. The buy-in is just phenomenal. People are now open, friendly and welcoming, seeking advice and trying to make it work. We’ve delivered in two years.”

Eventually, a local champion was identified and hired.

“We now have a person responsible for the cluster, Christian Couturier, who is connected with the local university of Moncton. He’s the director of the research program. There are local sensitivities, but his attitude is to help them, not to have power or control.”

Best Practice: Once a site with sufficient potential is selected, a key step is for NRC to stimulate local interest among key stakeholders. An NRC champion is usually assigned to the given region, who acts as convenor or cluster-builder, and bring together key players. The NRC champion should eventually be replaced by a local community leader, who can evolve this into a more sustainable function.

Arthur Carty, ibid.
Organized networking: engaging the community

Over the years, NRC has developed a number of powerful networking tools for engaging a region or community in discussions around innovations and action plans. The normal evolution would be to gradually move these tools to a more permanent networking organization that manages such events on a sustainable basis. This section explores a number of networking events of different types in the NRC toolbox.

The NRC technology cluster leader generally challenges the community by asking the following questions: “In what new technology platforms do we want to be recognized as world-leaders? What new companies will we be creating? What new businesses and markets will we be building?”

Tools for achieving this can include innovation roundtables or technology road maps, or some other form of technology/community meeting and dialogue (see below). Other tools can involve scenario planning and technology foresight. BRI, with its Crossroads conference aimed at the large pharmaceutical industry, is one of the earlier models.

BRI’s Crossroads

As part of his early strategy to focus on industrial interests, BRI’s Michel Desrochers focused his publicity and information programs on specific companies, with targeted workshops.

His best known program for reaching out to major industrial players is “Crossroads”, an annual conference with large pharmaceutical companies, focusing primarily on business, strategic and finance issues, not scientific. This annual conference has taken on a high visibility profile, and attracted as many as 1,200 CEOs and VPs from across the world. It reviews broad issues such as where is industry going, the good and bad of alliances. The name comes from the statement that Montreal is at the crossroads of Europe and the U.S.\textsuperscript{46}

The Regional Innovation Roundtable

The Regional Innovation Roundtable was one of the first initiatives of the new NRC Innovation Centre in Ottawa, created in 1995.\textsuperscript{47} At that time, the ongoing question for outside clients was how to reach into and interact with the NRC, how to connect with the right people. The concept of the first roundtable proved successful enough that they have become an annual event in Ottawa since that time. The concept was also “copied” successfully in other areas of the country.

As Arvind Chhatbar describes it, “the original intent was to provide one-on-one contacts between NRC senior executives and scientists on the one hand, with local CEOs and business entrepreneurs on the other. The role of the Innovation Centre was not to be a funnel but a catalyst to encourage NRC to be in touch with the real world, and promote one-on-one interactions. The funnel concept is foreign to clustering.”

Industry researchers had the perception that the research carried out at NRC was too basic and fundamental. But by sitting together at the same table, both parties realized they were much closer than they thought. It was all about building relations. The roundtable started initially with a limited number of workshops, this increased in subsequent years to six to eight workshops, and went down to only two breakout sessions for 2002. The roundtable format has now been replicated in Halifax, New Brunswick, Saskatoon, Victoria and Vancouver.

The selection of themes is very important, and these need to strike a chord with all the players. Themes have to address a burning issue, be practical versus esoteric, and be specific to a region. The whole idea is to bring forward issues that have not been previously tackled at the regional level.

\textsuperscript{46} Michel Desrochers, ibid.  
\textsuperscript{47} Arvind Chhatbar interview, July 9, 2002.
Some examples from the Ottawa roundtables:

- “Barriers to innovation” at a time of major government layoffs.
- “Telecom – what does the sector need.” This was in 1996 when there was a shortage of IT employees. The workshop identified training as a priority, which led to the creation of O-Vitesse.
- “Life sciences and convergence.”
- “Service sector and its contribution to the economy.”
- “Marketing ability for local companies.”
- “Bio-informatics and convergence.”

Some themes did not work out as planned – e.g. the “marketing theme” that was used one year did not attract the technology people as expected, but instead attracted the PR and marketing community.

The concept of roundtables has evolved significantly, and is now used in some regions as a means of developing or forging a “cluster vision” for the future.

The Kelowna Roundtable experience

In Kelowna BC, there was a local champion, and the objective was to create meetings that would encourage contacts and networking. The champions helped identify local players. The Okanagan University College in Kelowna was the initial contact, with the college president, and a consultant, Adam Bielecki. Like a chain reaction, these first contacts led to other key players in economic development and major private sector leaders, who then pointed to little-known but significant regional activities. A key local asset was the aerospace maintenance training school, the Flight School Repair Centre, which led eventually to a significant community initiative. In a short time, they identified a significant list of other community visionaries. The common theme was “Technology and innovation in the Okanagan.”

The first roundtable aimed at 100 participants. In fact, 275 people attended! It was held in February 2001. They broke out into small groups and identified a number of initiatives. Among them was a new program “Kelowna Aircraft Repair”, created by the Okanagan University College to train qualified technicians.

While there was a VC network in Ottawa, no one put together such a network of angels in the Okanagan. This led to a seminar to create such a network, OSTEC – Okanagan Science Technology & Entrepreneurship Council.48

The New Brunswick Roundtable experience

“In New Brunswick, we wanted to leverage all the local resources and contacts: university, firms, local associations. The roundtables were facilitated by local facilitators, known to the community and sensitive to the local culture. This was obvious when the banter turned collegial and friendly between the facilitator and the meeting participants. One of the challenges was how to deal with the various NRC bodies (IRAP, CISTI, the Secretariat), as well as ACOA and other agencies.”49

In brief, the idea behind the roundtables is to start with a general idea, but to identify specific individuals with an interest in a particular issue. A key to a successful roundtable is to bring to the table the “icons” of the community. Also, it is important to avoid duplicating all the roundtable formulas in every region. There is a need to be innovative. What the roundtable provides is a very rich, fertile environment, where innovation seeds grow very rapidly.

Other forms of workshops: IMI’s “Nanotechnologies in Emergence”

IMI’s Blaise Champagne, in describing this initiative, pointed to the speed with which his workshop was pulled together. The “Nanotechnologies in Emergence” workshop (June 4, 2002 in Longueuil) was two months in planning, but responded to a strong local interest from the various communities. It would not have been possible to do this without strong existing links to the community and local

48 Arvind Chhatbar, ibid.
49 Andy Woodsworth interview, June 20, 2002.
companies. The meeting was intended to bring together all possible parties – companies, investors and researchers – interested in nanotechnologies, together with some distinguished international speakers. In a sense, it was the first public event to bring together the seeds of a potential cluster. The idea was to bring together key performers, and let them talk to each other.

Champagne has no qualms that “NRC/IMI is in a good position to bring together such a diverse group of stakeholders, because it is not only an R&D performer but has access to a local, national and international network. In the past, IMI had worked with 350 companies.”

For the new nanotechnology initiative, they have already identified the major players: the city of Longueuil and Montreal, Nano Québec, Société de développement régional, Industry Canada, NRC. His view is that VCs should be brought in as quickly as possible, because this is in the spirit of bringing together the whole community.

Blaise interprets his mandate to bring the community together aggressively. In nanotechnologies, there are two to three nodes in Canada, NINT being the latest. The challenge is not only to create regional clusters but to link them.  

Practical advice on networking events
Peter Leach directed information and computer technology centres of excellence (TRIO and CITO) for the Province of Ontario for 13 years. Over the years, the Ontario Centres of Excellence have specialized in building research networks between industry and universities. Together with OCRI, the Ottawa-based clustering facilitator organization, Peter has accumulated a wealth of experience in organizing networking events for innovation. The following are his “best practices”:

“To build a network, you need to get people to meet people. You need to create lateral linkages, and bring together similar people in the same place at the same time. For this you have to create an event. You want to ensure that valuable connections are made at the meetings. And the value accrues to the participants because they were there.”

The first step is to identify the topics people are interested in hearing, so they will make this event a priority to attend. OCRI has been spectacularly successful in organizing regional events to attract specific communities: hi-tech leaders, marketing, financial community – they invented the Technology Executive Breakfast (TEB). The events are tailored to a specific community, and are organized by people from that community.

A successful meeting is built around hot technologies that are on the forefront of people’s minds, which even people in the field don’t understand well. The presentations should be a combination of simplified technical detail with talks from people that have some understanding of the early strategic marketing of the technology, how it could be used in the future. If you get down too much into the details of the technology, you only attract a very narrow group of “techies”.

For a successful technical event, target the number of participants between 60 and 100, and cut registration off at 120. Once it gets bigger, there is a natural tendency for people to talk only to friends. The networking value, the intensity of interactions, starts to go down.

On a more practical side, roundtables are better than rows, provided there is space to move around. You want longer coffee breaks, but less time for lunch unless it is a buffet (otherwise you get locked in). Lunch is less valuable time, if you sit at a table of eight, people may inhibit free discussion.

From a networking perspective, dinners are a disaster, but the pre-dinner reception can be useful. People will pay, so you can make a profit. The networking value of a dinner, especially during presentations and speeches, is not as high.

Don’t put people in too large a space. You want to avoid isolation, but you still want to be in the earshot of other people, so you can hear comments of others.

50 Blaise Champagne interview, June 4, 2002.
The metrics of a successful networking event:

- How many projects or new ideas did the event generate?
- Will they come again at the next event?
- Do they come forward with ideas for other events, e.g. can you do one for me?
- Does it generate lots of work for the community network?\(^{51}\)

**Best Practice:** In the course of engaging various technology communities, NRC and others have accumulated considerable experience in organizing successful networking events, including workshops, international conferences and roundtables. These events are eventually managed by a more permanent and sustainable networking organization, which supports the cluster, and through these events promotes cluster growth and sustainability.

**References**


“Strategic Planning in the Technology-Driven World: A Guidebook for Innovation-Led Development,” prepared by Collaborative Economics for the Economic Development Administration, U.S. Department of Commerce, 2001. (Based on "best practices" from across the United States, this guidebook is designed to help economic development practitioners adopt a realistic, principles-based approach to strategic planning, one that is applicable to areas with widely different technology assets.)

“Clusters of Innovations: Regional Foundations of U.S. Competitiveness,” Michael E. Porter, Harvard Business School and Monitor Group, Council on Competitiveness, October 2001. (This is a detailed review of some of the major clusters in the U.S., and a comparative analysis of some of the factors that led to their growth and evolution.)

\(^{51}\) Peter Leach interview, July 18, 2002.