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Regional Innovation Forum

Converging Technologies and New Product Markets: Climate Change, Health, Security

Roundtable VIII Report

April 28-29, 2003
Hilton Lac-Leamy, Gatineau/Ottawa

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Canada

Regional Innovation Forum – Ottawa

Roundtable VIII Report

CONVERGING TECHNOLOGIES AND NEW PRODUCT MARKETS: CLIMATE CHANGE, HEALTH, SECURITY

Edited by Arvind Chhatbar

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Foreword/Introduction

For the eight time, the Regional Innovation Forum has been able to deliver another Roundtable. The fact that we are able to hold these annual events without a break speaks about the importance of continuity in discussing issues related to the regions growth and success.

This year's Roundtable came at a time when many organizations and firms have been grappling with the issues related to the identification of growth opportunities. As a follow-up to last year's Roundtable, when we discussed the importance of convergence of technologies, the VIIIth Roundtable focused on identifying specific product and market opportunities in key sectors. Three key sectors that could benefit most from the convergence of technologies were identified—Health, Climate Change and Security.

As in previous Roundtables, this year's event benefited from the experiences and perspectives of leading individuals, companies and institutions that provided for an excellent discussion in the workshops. This report summarizes the various presentations as well as recommendations that emerged. I am offering this report to all who may find value in it, as the primary objective of the Roundtables and the Regional Innovation Forum is to offer new tools and ideas to companies, governments and academia, and to ease the barriers to growth and innovation.

I am grateful to the organizing committee that, in a relatively short time and in the face of severe competition from other events, made this Roundtable a success. Our sponsors also need to be thanked for their support in making this VIIIth Roundtable possible. I am especially grateful to the City of Gatineau, to Donald Picard and Véronique Gendron, who provided us with tremendous support. We look forward to many more Roundtables in Gatineau, given the extremely positive response and the excellent facilities.

Last but not least, the Roundtable would not be a success without the unwavering support of individuals who strongly believe in the value of forums such as these, and who have demonstrated their commitment through their participation. We will continue to strive to meet your expectations from year to year. We are grateful to NRC's Creative Services for helping us meet our commitment to have this report delivered at the soonest possible time after the Roundtable.

Mr. Arvind Chhatbar
Executive Director, Regional Innovation Forum – National Capital Region
President, Vitesse Re-Skilling™ Canada Inc.

Networking Reception with Guest Speakers

New Product Markets through Technology Convergence

Dr. Terry Matthews
CEO, March Networks

Dr. Matthews is Chairman and CEO of March Networks Corporation, a leading developer of interactive broadband IP applications and delivery platforms. Prior to joining the company, he served as CEO and Chairman of Newbridge Networks Corporation, a company he founded in 1986. Providing leadership and vision for 14 years, Dr. Matthews helped Newbridge become a leader in the worldwide data networking industry.

In 1972, before launching Newbridge, he co-founded Mitel Corporation. Under his leadership, Mitel grew quickly to become a world leader in the design and manufacture of enterprise voice systems and products. In 1985, British Telecom bought controlling interest in Mitel. More than 15 years later, in February 2001, Dr. Matthews purchased the company's worldwide Communications Systems division and the Mitel name. He is now owner and non-executive Chairman of the newly formed Mitel Networks Corporation, a company focused on providing next generation IP (Internet protocol) telephony solutions for broadband networks.

Summary

Broadband is here, it's never going back, and it's growing at a ferocious rate. Two years ago, when Mitel first introduced broadband IP-type PBXs, perhaps 5 to 10 percent of clients showed interest. Today, that's up to 100 percent. In 2000, Mitel increased R&D in this area intensely. At first, the company had huge losses, but is now gaining business all over the world as a result of taking that risk. Things are changing quickly, and these changes are important to society.

Key Points

- Mitel, which I founded in 1973, had a great career in the Ottawa area starting as a consulting company, then on to tone receivers, then designing the first microprocessor control.

- We caught a wave of replacement, a revolution created by microprocessors, making switching systems with capabilities that never existed before. We went from a zero market share in 1977 to 20 percent market share five years later.

- I started Newbridge, which became a supplier of core networks for private network infrastructures. We started from nothing, exported products all over the planet, and became the core network for the next generation of multimedia in many telephone companies around the world. It continues today under Alcatel.

- I started many companies, all in the telecommunications networking environment. I had a great knowledge of broadband networks, I watched that wave and participated in it.

Focus and a good team

- I've learned how to put together very good teams, create a scenario that puts them under pressure and gets them to perform better than they ever thought they could. An important part of this is ownership.

- I've learned how to focus on a few clients of a particular type, crank the handle and put a product out all over the world.

Access network growing

- The access network for broadband just came underway about three years ago. Back then, you probably couldn't get a DSL modem in your area, but today it's highly likely.

- Circuit-based voice granularity (64 kilobits) of the last 100 years covers the planet like a hairnet. But in a very short time this hairnet of connections and switches has been replaced with thick network. It has significant differences:

    - It's not narrow band—it's broadband.
    - It's not limited to 64 kilobits—it might be many megabits.
    - It's always on—you don't need to make a connection.

The next wave: connecting to the broadband network

- In the last six or seven years, the core network bandwidth has increased 100 to one.

- The next wave is connecting to that network. It's a bit like railways. Until the railway lines go in, don't try to sell tickets to passengers. First you need the rails, then the rolling stock, then stations, ticket machines, and marketing of tickets. And maybe then you can concentrate on shipping grain and cattle across the nation.

Times are tough

- In the last two years, telephone company operators have seen the number of connections go down for the first time in 100 years. There are two main reasons for this:

- Mobile phones have taken traffic away from fixed lines.
- There is competition where there used to be monopolies.

But the cost of providing service to subscribers doesn't decrease when people disconnect. So the loss from the top line goes straight to the bottom line. We've seen companies going bankrupt for the first time in the communications industry.

- The U.S. is in recession and the Canadian dollar has risen 10 per cent, reducing revenues coming back from the U.S. Many employees in the technology industry are looking for work.

Is it tough everywhere?

- No. Look below the surface—broadband continues to grow.

- The next wave for me is connections to broadband—the number of people connected to broadband grew by 50 per cent last year.

Potential services

- Here is an innovative new service: an IPSIP telephone, with a server and gateways in every major city. If you live in Deer Lake, Newfoundland, this service would allow you to have a phone number in New York. Your phone runs through the broadband network, so people who call you in New York don't have to dial long distance to reach you.

- You can cover every city in North America and appear to be local, all for less than $100/month.

- With a broadband connection of more than a megabit, you could have a video wall connecting people in New York with people in Deer Lake. You could dramatically extend your business space without paying New York real estate prices.

New technologies have potential to help society

- Potential telehealth applications—we need to stretch rules preventing a doctor from billing for patients unless they're seen face-to-face. Why not let technology take some place in the health environment? For example,

an allergy clinic that can be accessed through broadband, and allow the doctor to see the patient in detail.

- Most clients never visit the company they're doing business with—most commerce is by phone. Imagine banning commerce by phones—it's unthinkable. But we do the same thing for doing medicine by broadband.

The next giant revolution—customer premise equipment

- Voice over IP was poor a couple of years ago, but now we process the voice, and it sounds much better. Video over Internet is also much better. Why?

    - Reach of broadband network—getting into small and big locations.
    - More capacity is supplied to the links.
    - Processors are developing very quickly—from 2 gigahertz processors today, to 53 gigahertz in a few years.

- We can do things we couldn't dream of a few years ago. We're going very quickly from a network that was designed for voice to a broadband network with more than 100 times the capacity for information transfer. There is great potential for interaction between people, and between machines.

Huge markets

- The world is an open place to do business. You can do business in the U.S. or U.K. and pay no duty—barriers are down. For me, the place to do business right now is broadband applications, and I'm all over it.

John Kamler
Vice-President, Business Development, ERCO Worldwide
Carl Yank
Plant Manager for Buckingham, ERCO Worldwide

ERCO Worldwide is a division of Superior Plus, Inc. ERCO is the worldwide supplier of chlorine dioxide technology and is one of the world's largest producers of sodium chlorate, used mainly in the bleaching of wood pulp. It is also one of the two leading North American producers of sodium chlorite used to generate chlorine dioxide for water treatment, food processing and the treatment of effluents for environmental control.

ERCO of Buckingham, Quebec has demonstrated innovative techniques in recycling hydrogen for its own use.

Summary

ERCO has found new uses for its hydrogen byproducts—several ERCO plants are using hydrogen as an alternative fuel source. This excess hydrogen is an untapped resource with great potential. ERCO has received an Energy Efficiency Award and Environmental Award for its work.

Key Points

- Sodium chlorate is replacing elemental chlorine for pulp bleaching worldwide. The U.S Environmental Protection Agency has brought about regulations on effluents, and has found that sodium chlorite is very favourable for the pulp bleaching industry.

- Sodium chlorite, made from sodium chlorate, is used in the water treatment industry, and is replacing chlorine in many municipalities. Worldwide, there is tremendous growth in this area. It's useful in treating water in shrimp farms and fish farms, and is a good hospital disinfectant. Our product was used for much of the cleanup of the Hart Building during the Anthrax problem in the U.S.

- We are involved with the pulp industry in engineering studies to try to close pulp mills to reduce effluent going into rivers. We also have a safety management business and a spare parts business.

- We have locations across Canada, and have 70 per cent of the generators in pulp mills around the world. We ship a lot of product from Vancouver to Japan and Asia, where many pulp mills are converting to chlorine dioxide from chlorine.

Our business starts with R&D

- We look at what our customers needs are in the pulp and paper industry. We then tailor systems to their needs and provide excellent customer

service and technical support. This is how we distinguish ourselves, since we are a commodity chemical business.

Potential markets for hydrogen byproduct

- Our processes produce a significant amount of hydrogen byproduct, which has been going into the atmosphere for years. There is a unique opportunity to tap into this potential.

- Hydrogen combustion produces no emissions, just water vapour. Hydrogen can be used in steam generation, combined with natural gas for cogeneration, use it as a building block for other products, or use it in fuel cells.

- ERCO plants, including an upcoming plant in Australia, produce 35,000 tonnes of extra hydrogen per year.

- Some of our plants use this hydrogen in several ways. At the Buckingham plant, oil usage for generating steam decreased by 94 percent from 1995 to 2001, using only half the available hydrogen.

- It took a lot of research and innovation, and more than $1 million for equipment. But savings in fuel costs are more than $2 million/year, and greenhouse gas emissions reduced by 94 percent.

Opening Remarks

Arvind Chhatbar
Executive Director, Regional Innovation Forum

This year's Regional Innovation Forum Roundtable builds on the discussions and outcomes of last year's Roundtable, but the emphasis this year is not on the technologies but on the products and markets that convergence of technologies can offer.

In setting this theme, members of the working group for the Roundtable identified three key sectors: health, climate change and security, for our discussions today. Our plenary speakers include pioneers in developing new products in new markets in different parts of the world, who will share their experiences with us today.

We are especially proud to hold the Roundtable for the first time here in Gatineau, giving credence to the regional idea of having a regional innovation forum for the National Capital Region. We appreciate the support we received from the Mayor of Gatineau. In addition, we wish to thank the following sponsors:

- Centre local de développement de Gatineau
- CFRA
- Conseil regional de développement de l'Outaouais
- Corporation de développement économique de la Ville de Gatineau
- Développement économique Canada
- Doyletech Corporation
- Federal Partners in Technology Transfer
- GAPC General Assembly Production Center
- Inmedia
- Innovatech (Montréal)
- Intersection Strategy & Creative
- L'Université du Québec en Outaouais
- Ministère des Finances, de l'Économie de la Recherche
- National Research Council Canada
- non-linear creations
- Ottawa Citizen
- The Portables
- Société de diversification économique de l'Outaouais
- TATA Consultancy Services
- Technology Partnerships Canada
- TechPoint
- Ville de Gatineau
- Vitesse Re-Skilling™ Canada Inc.

Welcoming Remarks

Dr. Arthur Carty
President, NRC & Co-Chair, Regional Innovation Forum

Dr. Carty took office as President of the National Research Council of Canada (NRC) in July 1994. Since then, he has been promoting the vision of NRC as a leader in the development of an innovative, knowledge-based economy through science and technology. He is an active researcher in the field of chemistry and a former President of the Canadian Society for Chemistry. His research interests are in the areas of synthetic chemistry, metal clusters, polynuclear activation of small molecules, and new materials. He has published over 250 papers in research journals, in addition to review articles and book chapters, and has chaired or served on many peer evaluation committees for NSERC and other organizations.

Key Points

- As Co-Chair of the Regional Innovation Forum, I would like to welcome you all here in Gatineau at the Hilton Lac Leamy. This is the first time we have had a change in venue. With NRC already active in Gatineau with our language research initiative and plans to establish an additional research presence, it was timely for us to hold an Innovation Roundtable here in this wonderful facility.

- This is our eighth Regional Innovation Forum Roundtable. Since we started this annual event, the companies, universities, governments and other organizations in the region have worked together and even harder to reduce barriers to innovation and focus on building vibrant and successful technology clusters. It's not easy to make such long-term commitments, and eight years is a long time. But our members have remained on the lookout for new and innovative ways to achieve our objectives, and they have always been ready to change direction if need be.

- Over the years, there have been changes in the membership of the Forum. It's entirely natural and appropriate that we'll see more. Indeed, it's time to include new members from the City of Gatineau so that we are truly and effectively a National Capital Region forum. The City of Gatineau's participation is a sign that we can look forward to community-minded innovation favouring members from this half of the region.

Technology clusters

- Last year, in Ottawa, I had the pleasure of publicly launching NRC's Vision to 2006 at the Roundtable. A key element of our vision is building technology clusters across the country. Part of NRC's process in initiating these clusters has involved hosting similar roundtables across Canada. In other words, the concept and model pioneered by the Regional Innovation Forum and Roundtable have been successfully exported to other parts of the country and have become an integral part of NRC's cluster development strategy. I think we can all take pride in our accomplishment.

- This region has experienced a lot of change over the past eight years from the IT pull, to the sector slowdown, to the growth of a life sciences cluster—and now the convergence of these two fields. Throughout this time, the Regional Innovation Forum has focused on relevant themes and provided a venue for discussions around capitalizing on those changes.

Strategic marketing

- I will now say a few words about outstanding business from past roundtables, notably our efforts to deliver on the recommendations concerning strategic marketing. While a draft document on this issue is ready, the uptake from companies has been slow given the current market conditions. Kirk Mandy has prompted a number of other groups to take on the challenge of developing new approaches to strategic marketing. We'll continue to work with them to achieve the goal of strengthening strategic marketing capacity in the National Capital Region. The initial goal of having strategic marketing costs qualify for tax credits continues to be one of our key objectives.

- Finally, let's take a quick look at some of the key outcomes of last year's discussions. Various groups have started work on new cluster opportunities resulting from the convergence of biotechnology and information technology. These opportunities were reflected very well in Terry Matthews' presentation last night on telehealth. Another opportunity is the current activity in biophotonics. Clearly, there is a lot more to be done. This year's theme is intended to address that.

Today's program

- The program today has been built to help us focus on two new markets: one related to climate change and another to security. In addition to the evolving health market, these new avenues will provide real growth opportunities. As in previous years, we have an excellent lineup of plenary speakers, some of whom will participate actively in the workshops this afternoon.

- These roundtables remain great idea incubators, and more importantly, they feed into a process that continues throughout the year to act on the ideas and contributions you bring to these conferences. Your being here today is testimony to the fact that the issues, recommendations and actions resulting from these annual events produce meaningful and tangible benefits, directly or indirectly to all of us.

Kirk Mandy
vice-président, Zarlink Semiconductor, et co-président, Forum d'innovation régional

Kirk Mandy has been involved in the data communications and telecommunications industries for more than 22 years. He has held senior management positions in manufacturing, product operations, and research and development. Mr. Mandy had been with Mitel Corporation for more than 15 years, and was appointed to his current role as Vice-Chairman, Zarlink Semiconductor, in 2001. Mr. Mandy is also a member of the Nominating and Audit Committee, and is Chair of the Compensation Committee.

Key Points

- Last year, the Regional Innovation Forum and Roundtable identified new and emerging clusters through the convergence of technologies as playing a crucial role in new growth. In Ottawa, the creation of the Biophotonics Consortium is an example of how convergence is already leading the way to new developments.

- Last year and the year before, I commented on the strategic marketing expertise here in the region. I'm pleased that this year we're speaking about products and markets rather than just technologies. The fact that this Roundtable emphasizes the importance of new markets is a clear demonstration that our interest lies in encouraging growth in the region by tackling issues and barriers to innovation including marketing strategies or marketing issues.

- From last evening's talk by Terry Matthews and the presentations this morning, it is clear that the end game is products that sell in markets. It is only in this way that technology will generate wealth. Technology cannot generate wealth unless it's turned into some product that has value to the client, who is prepared to pay for it. The two workshops this afternoon are especially geared to address issues that will help overcome barriers to the introduction of new products in new markets, and specific business strategies to create new product markets.

- During the presentations and discussions this morning, I encourage all of you to think of the following: What are the major challenges and barriers you face in entering new markets, such as those in the health, climate change and security sectors? What should companies do to enter and overcome those barriers? What role can governments and others play to help companies move into these sectors? What business strategies have companies used and what are the key considerations to successfully introduce those new products?

- I believe the key is to use new technologies in ways that will meet market demand. It sounds like a very simple statement, but it's remarkable how

many people don't seem to get it. Market demand is when a customer is willing to put money on a table for a product or service, and if that exchange takes place on a recurring and profitable basis, then there has been a successful marketing effort.

- We're all in this for economic growth, and the speakers that will be presenting today not only come from far and wide, but also have considerable experience. I would like to thank our Program Working Group, which once again has done an excellent job to bring this Roundtable—with this great group of speakers and panellists—together.

Raymond Brunet
Engineer and President, Ed Brunet & Associates

Mr. Brunet is Secretary General on the Board of Directors for the Corporation de développement économique de Gatineau.

Key Points:

- Innovation is a word that we usually associate with technology and high-tech without thinking of its real and original meaning, which is associated with creation. But innovation is everywhere, not only in high tech. Having been in business for more than 100 years, my construction company had to innovate all the time to survive. Without innovation, we don't have prosperity. We don't have increased productivity. We don't have increased quality of life. Without innovation, it's game over.

- Ottawa and Gatineau are two cities but one economic region. Whether it concerns the issue of transport, free trade, workers, promotion or international positioning, rest assured that you have here in Gatineau an ally to build a strong and innovative region.

- We are quite pleased that the National Research Council and the Ottawa partnership have extended opportunities of collaboration to the Gatineau region. Please be assured that our economic development strategies are designed to be complementary with Ottawa, while preserving our unique French language and heritage. Innovation is the key to our success, and I would like to thank NRC for its initiative in this respect.

- At a very early stage of our newly amalgamated city, we have already had many opportunities to develop closer links with Ottawa. The recent Juno Awards and the Ottawa-Gatineau Film Office are a few examples of this collaboration. Let's maintain and work hard on these collaborative efforts since together we can be stronger. There is simply no limit to what we can achieve together. Our diversity and our teamwork approach are making our region the envy of the country if not of the world.

Key Note Presentation

Climate Change: A Storm of New Products

Christopher Henderson
CEO, The Delphi Group

As CEO, Mr. Henderson has led the Delphi Group's development in Canada and internationally for the last 10 years. He has directed Delphi's strategic consulting arm to offer state-of-the-art corporate environmental strategy, international development capacity building, climate change, and health and environment services. Currently, Mr. Henderson focuses on Delphi's venture and project development in the areas of technology transfer and financing, e-business and global market development.

Summary

Mr. Henderson predicts that in the coming decades, the global climate will change in ways that people living today, in their parents' and grandparents' generations, never witnessed. Climate change will have a huge impact on the global economy, and will offer many new business opportunities. Without advanced technologies, many of the renewable energy and other "climate change technologies" available today may never be competitive or economically viable. But currently, the potential for ICTs, nanotechnology, biotechnology, e-commerce and advanced materials is largely unknown and untapped.

Key Points

Climate change forecast

- Rising consumption of fossil fuels is causing global climate change. Higher concentrations of CO2 and other greenhouse gases create the greenhouse effect, which is causing climate change.

- Climate change won't be uniform around the world. Some parts of the world may get warmer and some may get colder, and there will more variations in global patterns of heavy weather.

- By the year 2010, Canada will be releasing about 25 per cent more greenhouse gases than in 1990. Countries like China and India will be increasing their production of greenhouse gases even faster.

- By the year 2050, the average winter and summer temperatures for the northern part of Canada will be 6-10 degrees Celsius warmer than they are now—6-10 degrees. If this happened in Ottawa, our climate would resemble Georgia's climate today. Climate change of this magnitude will dramatically affect infrastructure. For the Great Lakes, climate change could lower water levels by three metres.

"Climate change solutions" market

- "Climate change solutions" are products, services or technologies that directly or indirectly prevent, reduce, mitigate or sequester greenhouse gas (GHG) emissions.

- Without advanced technologies, some of the climate change technologies currently available will never be competitive or economically viable. But the market potential for ICTs, nanotechnology, biotechnology, e-commerce and advanced materials is largely unknown and mostly untapped.

- The climate change solutions market is one great big market, but the potential valuation of companies that service this market varies significantly. The size of this market will be impacted by many convergent forces including: the Kyoto Protocol, the trend towards sustainable energy, rapid innovation, global energy market reform, demand outstripping supply, etc.

- Demand for various fuels will change significantly over the next 60 years. Indeed, consumption patterns of different fuels are already very different than they were 10 years ago. The future will see the rise of geothermal, solar, biomass and wind—possibly nuclear fuel as well. Demand for coal and oil will decline but not disappear—oil will be with us for a long time. Humans went from the Stone Age to the Industrial Age, but it didn't happen overnight.

- The future market for high tech climate solutions will resemble "a perfect storm." Perfect storms occur only once every 100 or 150 years. Like real-world storms, it will take time for the storm to emerge. From the high-tech side of climate change solutions, it will affect many key platforms. It will be diverse. There will be opportunities for strong niche technologies. And there will be convergence and integration with the high tech and enabling sectors.

- The climate change solutions market will encompass many converging technologies including: renewable energy technologies, biotechnology and bioproducts, intelligent systems, information and communications technology, nanotechnology, advanced materials, and other enabling and emerging technologies (such as advanced manufacturing, alternative power generation and eco-efficiency technology). Without high-tech solutions,

many renewable energy technologies can't work effectively (such as fuel cells and solar energy). *Prediction: high tech solutions will be the tipping point for making climate change technologies cost-effective.*

Biotechnology applications

- Potential opportunities include:

  - Biomimicry
  - Industrial biotechnology (involving biocatalysts, molecular evolution, metabolic and genetic engineering, bioproducts and bioenergy), which applies natural products toward industrial processes to speed them up and make them more effective
  - Biological sequestration (e.g., changing methane into CO_2, a greenhouse gas that traps significantly less heat than methane)

Intelligent systems

- Potential opportunities include:

  - Intelligent buildings (including integrated lighting control systems and heating ventilating and air conditioning systems)
  - Energy efficiency/energy management
  - Industrial application

ICT applications

- Potential opportunities for information and communication technologies include:

  - Microelectronics (such as light emitting diodes, electronic commerce)
  - Software and computer services
  - Teleconferencing, videoconferencing and telecommuting
  - Traffic management
  - Logistics management

- IT can help make climate change solutions work. Many microelectronics products cut energy consumption significantly. High-tech fuel cells cannot be made without microchips. In the transportation sector, one company estimates

that with an expenditure of $10-20 million, it could cut vehicular energy consumption by 7% in Toronto. Similarly, logistics management software can reduce the need for railway tracks and other expensive infrastructure.

Advanced materials

- Potential opportunities exist in transportation, resource performance and efficiency (including product manufacturing, materials with enhanced properties, conventional and renewable power generation), and construction.

- Nanotechnology will cause "dematerialization"—i.e., it will allow products to be made from fewer materials, which means less energy is required. Opportunities for nanotechnology include:

    - Nanomaterials for resource efficiency (carbon nanotubes, catalysts, nanocomposites, sensors and biodetectors, nanoparticles)
    - Energy generation (conventional and renewable)
    - Computing, information and communication technology
    - Biotechnology and genomics
    - Geoengineering

Conclusion

- Climate change heralds a new season for high-tech innovation. There is a natural interface between advanced technologies and climate change. New applications for existing products, product evolution and technology convergence are all on the horizon.

Key Note Presentation

Hydrogen Powering the Future – Bold Steps to Reality

Dr. Bragi Árnason
Science Institute, Icelandic New Energy

After completing graduate chemistry studies in Germany, Dr. Árnason joined the University of Iceland in 1962 and began studies to estimate the ratio of stable hydrogen and oxygen isotopes in Iceland's groundwater systems, especially hot groundwater systems. When combined with other research, these studies could also be used to estimate the size of Iceland's geothermal energy source. After 1976, it became clear that although only a small fraction of Iceland's domestic energy sources has been harnessed, more than 40 per cent of the energy Iceland consumes is imported fossil fuel. This initiated research on the possibility of using domestic energy sources to replace imported fossil fuel. At first, several types of synthetic fuels were considered including synthetic gasoline, methanol, ammonia and hydrogen. With time, Dr. Árnason decided to focus on pure hydrogen because it was the cheapest and easiest fuel to produce.

In 1999, these studies led to the establishment of Icelandic New Energy—a holding company owned by Daimler/Chrysler, Shell Hydrogen, Norsk Hydro and Eco-Energy that includes Icelandic partners. The purpose of the company is to set up a joint venture to investigate the potential for replacing fossil fuels with hydrogen in Iceland and creating the world's first hydrogen economy.

Summary

In Iceland, Dr. Bragi Arnason is known as "Professor Hydrogen" due to his strong belief in using hydrogen as an alternative fuel source. His dream of making Iceland the first country to be free of fossil fuel is becoming closer and closer to reality. On April 24, 2003, Iceland installed its first hydrogen station, proving that fuel cells are not simply a wonderful technology with no markets. Iceland is preparing to place its first commercial orders for fuel cell vehicles. The joint venture firm, Icelandic New Energy, is spearheading development of the world's first hydrogen economy.

Key Points

Context

- Iceland's goal is to drastically reduce its greenhouse gas emissions, to less than 50 per cent of its current emissions.

- Iceland has almost no fossil fuel energy sources, except for small amounts of peat. Relative to its population—290,000 people—the country has large amounts of hydro and geothermal energy. Iceland has only harnessed a small fraction of its domestic energy sources, yet 35 per cent of the energy consumed comes from imported fossil fuel. Of this, 70 per cent is consumed by the fishing and transport sectors.

Renewable energy reserves

- It is estimated that 50 Terawatt hours (TWh) per year of electric energy could be economically harnessed in Iceland: 30 TWh per year from hydro sources and 20 TWh per year from geothermal sources. About 8 TWh per

year are now being harnessed. In order to replace every drop of fossil fuel that Iceland currently imports, Iceland would need an additional 5 Terawatt hours per year.

- Assuming a 100 Megawatt plant and an electricity price of US$0.02 per kilowatt hour, the cost of producing hydrogen in Iceland would be two to three times more expensive than imported gasoline (at $35 per barrel), based on its energy content. But hydrogen used to power PEM fuel cells is two to three times more energy efficient than fossil fuel used in a conventional internal combustion (IC) engine, because fuel cells convert chemical energy directly into electricity. Therefore, when both the production costs and energy efficiency are considered, hydrogen gas made from hydro or geothermal energy would approach the competitiveness of the current fuel economy.

Hydrogen-powered bus

- Recent developments are paving the way for Icelandic buses, cars and fishing vessels to run on fuel cells powered by electrolytically produced hydrogen. Iceland will introduce a hydrogen-powered city bus in September, 2003. In the fuel cell bus, hydrogen will be stored on board as pressurized gas in sufficient amounts to travel about 250 kilometres on one filling—the average distance that Reykjavik city buses run each day. It takes about six minutes per fill up. A city bus fleet needs only one filling station, so a complicated distribution infrastructure is not required.

- The case is more complicated for hydrogen-powered cars. For example, a passenger vehicle carrying hydrogen stored on board as pressurized gas may have a maximum range of about 100 kilometres between fillings. Other solutions are also being explored. In Japan, the big auto makers—Honda, Mazda, Toyota, Nissan—have all said that they will mass produce private cars by the end of this decade, perhaps using a number of different hydrogen storage methods.

Converting the fishing fleet

- Fishing vessels consume about one-third of Iceland's imported fossil fuels. In principle, there are no obstacles to developing hydrogen-powered fishing vessels if fuel cells in the megawatt range become commercially available—and experts say this will not be a problem. However, space limitations for long journeys at sea may make it difficult to store fuel on board as pure

hydrogen. Hydrogen can be stored in liquid form, but this is very expensive. A longer-term possibility is to store hydrogen in methyl hydrate. But in order to power fishing vessels with hydrogen in this decade or the next, there is currently no other solution than to store the hydrogen in methanol.

- How can Iceland produce the methanol it requires? To produce methanol, you need both hydrogen and carbon. Carbon is available in the form of carbon oxides released by the metals industry. Aluminum smelting and ferrosilicon production emit vast amounts of carbon oxide-containing gases. If the ferrosilicon plant furnaces and aluminum smelter electrolytic cells can be enclosed, their carbon oxides could be combined with hydrogen to produce methanol. In this way, enough methanol could be produced to replace 95 per cent of the fossil fuels now used by Iceland's transport and fishing sectors. If this route is pursued, greenhouse gas emissions would drop to less than 50 per cent of current levels and the metals industry would become a "green industry."

Toward a "hydrogen economy"

- The transformation of Iceland into a "hydrogen economy" may be completed between 2030 and 2040. The transformation will involve five phases:

    - Phase I: PEM fuel cell bus demonstration project. Up to three hydrogen-powered city buses will be introduced in Reykjavik's public transportation. This phase has already started.
    - Phase II: gradual replacement of Reykjavik and other bus fleets by PEM fuel cell buses.
    - Phase III: introduction of hydrogen-powered fuel cell cars for private transportation.
    - Phase IV: fuel cell vessel demonstration project, with hydrogen stored on board as methanol.
    - Phase V: gradual replacement of current fishing fleet by fuel cell-powered vessels.

- The above scenario led to the creation of Icelandic New Energy Ltd., a university spin-off created "to investigate the potential for eventually replacing the use of fossil fuels in Iceland with hydrogen and create the world's first hydrogen economy." Icelandic New Energy is owned by Vistorka hf., DaimlerChrysler AG, Norsk Hydro ASA and Shell Hydrogen.

The majority partner Vistorka (EcoEnergy Ltd.) is a holding company owned by public and private enterprises and institutions, which play a vital role in research, development and financing of new industrial projects in Iceland.

- During negotiations that led to the creation of Icelandic New Energy, Iceland's politicians provided significant support. The Prime Minister, Ministry of Industry, and Ministry of Environment signed an Intention of the Government of Iceland to move toward a hydrogen economy.

ECTOS project

- Phase I is called the ECTOS project. Funded by the European Commission, foreign partners and domestic companies, ECTOS is a 7 million euro initiative. The project involves building a hydrogen refilling station in Iceland, with on-site electrolytic production of hydrogen using renewable energy, and the operation of three PEM fuel cell buses. The hydrogen refilling station opened on April 24, 2003. The first three PEM fuel cell buses will arrive in September 2003.

Hydrogen-related R&D

- Hydrogen-related research and development at University of Iceland involves:

    - Thermoelectricity
    - Thermal management of metal hydride storage
    - Nanotechnology
    - NorFA summer school: "Infrastructure of the modern hydrogen society", June 2003
    - HYPEC: a new proposed European project involving hydrogen storage, storage management and technological foresight (HYPEC: Hydrogen and Proton Energetics Consortium)

The University of Iceland's research program has developed a thermoelectricity device based on solid-state methods. It uses low temperature geothermal water to generate electricity for hydrogen production and to assist metal hydride storage management.

Key Note Presentation

Breaking the 'Chicken and Egg' Conundrum in Getting the Infrastructure in Place

Jon Slangerup
President and CEO, Stuart Energy Inc.

Jon Slangerup has served as President and CEO of Stuart Energy Inc. since August 2001. Prior to joining Stuart Energy, Mr. Slangerup was Chairman and CEO of Electron Economy Inc., a market leader in supply chain management software. From 1993 to April 2000, he was President of FedEx Canada. During his tenure as President, Mr. Slangerup maintained double digit revenue growth, doubled its international market share, and generated strong profit growth and margins. Prior to his appointment as President, he held several managerial positions with FedEx Canada.

Summary

There is no longer a "chicken and egg" problem with respect to fuel cells and hydrogen. The egg was hatched a long time ago, and a lot of chickens are now running around. On the infrastructure side, the industry has more than enough capacity to meet the demand of any automobile applications. The market opportunities for hydrogen fuels are vast in China and Hong Kong, which both have strong incentives for reducing fossil fuel consumption.

Key Points

About Stuart Energy

- Stuart Energy provides hydrogen systems that generate hydrogen from water and electricity. The company is the global leader in this market. The founder of Stuart Energy designed and built the first electrolysis systems at the University of Toronto. The company was formed in 1948. Few Canadians are aware of the company, but Stuart Energy is well known in California, northern Europe and Asia.

- Stuart Energy exports virtually 100 per cent of its product. In 2003, the company acquired its largest competitor, Vandenborre Hydrogen Systems, which has perfected a different type of technology. Stuart Energy has offices in Canada, Belgium, the United States, Germany, France, Hong Kong, China and India. It has 1,100 industrial hydrogen systems installed in 100 countries around the world, so it is well prepared for the time that fuel cells enter the marketplace.

- Historically, Stuart Energy has provided industrial gas as an alternative to merchant gas for manufacturing applications. The company supplied areas where it was too expensive for merchant gas companies to set up large centralized plants and distribution systems. (Stuart Energy's systems produce hydrogen onsite from water and electricity, so they will work anywhere.) In recent years, the company's technology has become so inexpensive

relative to the merchant model that merchant gas partners now use electrolysis for many applications within concentrated industrial markets.

- With the growing interest in fuel cells, Stuart Energy hopes to provide a fuel source for fuel cells. By making its equipment smaller, more compact and appliance-based, the company can provide on-site fuelling stations, as required around the world. In the meantime, Stuart Energy has discovered that internal combustion engines can run on hydrogen. In partnership with Ford Motor Company, it has pioneered an energy station concept using internal combustion technology, in which hydrogen would power buildings and industrial settings. So far, Stuart Energy has installed a dozen of these systems in North America and is currently constructing and installing systems in northern Europe and China. The company believes its systems are the forerunner of what will someday be widely distributed hydrogen systems for personal and heavy industrial use.

- Stuart Energy's largest partner—with a 10 per cent stake in its company—is Cheung Kong, a $100 billion firm based in Hong Kong. Stuart Energy is working with Cheung Kong to replace diesel-powered generators, which are used as backup systems for all of Hong Kong's industrial buildings. Other partners include Ford Motor Company (automotive and power generation systems), UTC Hamilton Sundstrand (development of PEM technology), and Toyota Motor Company (fuelling applications). Stuart Energy's customers and partners also include some major merchant gas companies such as Air Liquide, BOC and Air Products.

Market drivers

- The leading market drivers are global warming and energy security. While the war in Iraq had political causes, it underscored the issue of dependence on Middle East oil. Many countries around the world are concerned about the political sensitivity and volatility of that dependence. Finally, in Europe, Asia and North America, hydrogen is seen as the "end game" in an energy-based economy.

- In China, climate change is considered a major issue. Carbon dioxide emissions are the driving force behind climate change—they represent about 82 per cent of the problem. China is unique for being able to rapidly advance because of the way it approaches problem solving, not only with

central planning but also its focus on large urban initiatives. In Beijing, there are currently 12,000 city buses—by the beginning of 2008, there will be 18,000. China's goal is to have 16,000 buses running on a mixture of natural gas and hydrogen, which means they need to build a hydrogen infrastructure. China is the world's second largest consumer of energy, yet its per capita energy consumption is only 5 per cent of North America's. Given that the Chinese economy is growing at 6 to 7 per cent on a sustained basis, what happens when per capital energy consumption rises to 10, 15, 30 or 50 per cent of North America's energy consumption? Clearly, they need an aggressive push to reduce CO2 emissions and other pollutants. Because China is hosting the 2008 Olympic Games, followed by the World Expo in 2010, the government is very focused politically on addressing the issue now.

- In Hong Kong, if you stand on a street for more than a few hours, your chest will burn. The ground-level ozone pollution is so bad you can literally feel it. One problem is the lack of natural gas distribution; the city relies on diesel and other sources. Hong Kong is very focused now on hydrogen as the way to advance rapidly toward a clean fuel environment. The stakes are high. In Hong Kong, there are 8,000 buildings that are 20 storeys or higher, all of them backed up by diesel power. The diesel engines could be replaced with internal combustion engines powered by hydrogen, or fuel cells. If you extrapolate over all of Asia, there is an $18 billion market just to replace diesel generators. Stuart Energy is very focused on providing infrastructure for that huge opportunity.

A new energy paradigm

- How is this energy paradigm shaping up? First, from a production, distribution and consumption perspective, Stuart Energy is trying to shift how people think about these things. Its hydrogen infrastructure solutions are transforming how energy is used. You can take low value energy in the form of electricity and actually store it for later deployment for a variety of purposes—a paradigm shift that has never before been achieved on that scale. Consider a windmill—when the wind stops blowing, the electricity stops flowing. But with hydrogen, you can take some of the peak energy produced by the windmill, generate hydrogen and store the surplus energy as hydrogen. When the wind stops blowing, you can put the excess energy back on the electrical grid. A windmill is much more effective this way.

- Some of Stuart Energy's customers have 100 per cent "off-grid" applications in an urban setting. If you transplant such a system into rural settings around the world, where 100 to 200 million people have no power, the opportunity to inexpensively generate and store electricity from renewable energy sources could really change lives. That could dramatically change national economies and stimulate Third World development.

Hydrogen Energy Station

- Our Hydrogen Energy Station has a number of core attributes. First, you can use the capital invested in these systems for multiple applications. By itself, a hydrogen-generating system that provides backup power to a building is not very cost effective. A diesel system is cheaper. But if you install a hydrogen generator as an electricity storage system, and the generator attached to the storage system runs on hydrogen, you can use the generator to sell electricity back to the grid and save power. So you buy electricity for 3 cents, store it, and during peak periods you regenerate the electricity back to the grid. So with the capital you used for a specific purpose—to provide backup emergency power—you can recoup some of your investment.

- Stuart Energy is developing a miniature version of its Hydrogen Energy Station for personal appliance use. The personal hydrogen system may be commonplace later this decade. In your home, you will have a small device that powers up to two cars a week and also provides power through a small internal combustion engine. Stuart Energy will have about one dozen of these installed by the end of 2003. This will be a really big paradigm shift because for the first time, you won't have to worry about going to the corner gas station for your fuel needs.

The future

- We need cars and we need applications. Stuart Energy's joint venture firm will introduce hydrogen-powered IC-engine cars later this year. The company hopes its approach of using hydrogen and ICE technology in cars will help accelerate the move toward clean fuel cars.

Key Note Presentation

Bioinformatics: A Convergent Technology with Opportunities

Rod Bryden
President and CEO, World Heart Corporation

Mr. Bryden has been President and Chief Executive Officer for World Heart since January 2000. He founded the company in April 1996 with the Ottawa Heart Institute, Dr. Tofy Mussivand and Dr. Michael Cowpland. Mr. Bryden has founded or co-founded many companies over the years, including Systemhouse Ltd., Paperboard Industries Corporation (PIC), and SC Stormont Corporation—an Ottawa-based company specializing in the management of complex corporate transactions. Mr. Bryden is the Chairman of SC Stormont Corporation.

In January 1992, Mr. Bryden became CEO of Terrace Corporation, the principal owner of the Ottawa Senators Hockey Club, and Vice Chairman and Alternate Governor of the Ottawa Senators Hockey Club. On September 1, 1993, Mr. Bryden became Chairman and Governor of the Club. Mr. Bryden is the owner and Chairman of the Corporation.

Summary

Mr. Bryden spoke about capital markets and their support for the technology sector of the medical industry. New opportunities are arising from the convergence of sciences and technologies, and Canada has an excellent S&T base. The question is whether capital markets are ready to support these new technologies at a sufficient pace for Canada to be among the leaders in this sector.

Key Points

Status of the medical device industry

- The good news is that the percentage of venture capital going to medical devices has increased from 2.4 per cent in 2000 to 8.5 per cent in 2002. The bad news is that the actual amount of funding has declined. So our participation has tripled, but we have half as much money.

- The result is that much new technology has to be funded from the earnings and capital base of established companies and, on a smaller scale, from venture funding of new or independent companies.

- This occurs in each capital market cycle as the venture market anticipates a return to response to new investment in the capital markets. The venture funding typically comes three to four years earlier with the expectation of realizing on the next round of valuations.

- When the valuations get high, the venture funds find that the price of investing in young companies is too high. That investment falls off and the capital comes from mature companies operating from their cash flows.

Where are we in the venture capital cycle?

- A venture company invests for one of two reasons: to see the company become a public company, or to have it acquired.

- Proceeds from IPOs have dropped: $606 million in 2001; $372 million in the first half of 2002; zero in the second half of 2002.

- The exit in the near term for a venture investor in IPOs doesn't exist at the moment. That's not to say it won't exist again as the markets stabilize and expectations adjust to the new base.

- One of the factors is how investors view the economy's future. There has been a lot of uncertainty recently.

    - Micro level: at what rate can the community adapt these new technologies?
    - Macro level: where is the U.S. economy going? Will there be a prolonged period of stagnation?

Canada's situation

- We're in a good position. Concerns over Quebec's possible separation have lessened. Canada's economy has performed the best of the OECD countries for most of the last decade. We have the macro base to be a very attractive place for the next round of venture investment and early stage investment.

- Nevertheless, only the best will get funded in the short term, and the investment in medical devices is likely to be relatively slow.

- The National Institutes of Health (NIH) in the U.S. invests 13 times more per capita in early stage and mid-stage R&D than the Canadian Institutes for Health Research (CIHR). NIH is focused on ensuring that U.S. companies are in the forefront of developing and delivering new health care treatment. By contrast, in Canada we spent most of our CIHR money on pure research and very little on commercialization.

- The current mood in the capital market has also affected mergers and acquisitions (M&As), which declined to almost nothing in Q3 and Q4 of 2002. There is evidence that M&As will start to turn around later this year.

But right now most investment will come from funds or private investors aiming at early stage investment, with a view to two, three or five years before they see an exit.

Issues for healthcare companies

- Healthcare companies can be more complex than other types of companies, largely due to the regulatory approval process. In order to attract successful investment, you need the following:

  - Large patient population with unmet clinical need

    The patient population determines the size of the market opportunity. World Heart deals with patients in the late stages of heart failure. In Canada this year about 40,000 people will die from heart failure, about half of whom could live a normal life if their heart were restored. We also have significant markets in the U.S., Western Europe and Japan.

  - Unique technology underpinning working devices

    Your device must be unique enough to capture meaningful market share and establish a competitive niche. Also, while venture capitalists expect approval and market penetration risks, there must be relatively little technical risk.

    Our device has been implanted more than 1500 times, and is a successful solution to the most common cause of heart failure: failure of the left ventricle.

  - Efficient path to regulatory approval

    This is an arduous process. Our current device is approved in 14 countries. We hope to import that process and the history of the device into our next generation, so we will be able to have a more predictable approval process.

  - Clear cut reimbursement

    Someone must be able to pay for your product when it's introduced.

For most countries, the market is public or private insurance. In the U.S., the deciding agency is CMS, which sets the standard for approval in the private insurance market.

Only last year, CMS decided that a device like ours should be reimbursed. Our product has moved through an arduous series of steps, so we hope the timeframe between investment and recovery of return will be relatively limited.

Key Note Presentation

Bioinformatics – A Convergent Technology with Opportunities

Dr. M. Vidyasagar
Executive Vice-President (Advanced Technology),
Tata Consultancy Services

Dr. M. Vidyasagar immigrated to the United States with his parents in 1960. He received all of his degrees in electrical engineering at the University of Wisconsin. In 1989, he returned to India to become Director of the newly established Centre for Artificial Intelligence and Robotics. Under his directorship, CAIR grew into one of the premier R&D laboratories in the government sector, consisting of more than 40 scientists, and working in such diverse areas as expert systems, neural networks, robotics, flight mechanics and control, image processing, virtual reality, and network security.

In 2000, he left CAIR to join Tata Consultancy Services (TCS), India's largest information technology firm. In his capacity of Executive Vice-President in charge of Advanced Technology, Dr. Vidyasagar oversees cutting edge R&D work and its commercialization. The Advanced Technology Centre (ATC) of TCS, established and headed by Dr. Vidyasagar, includes about 60 people working in E-Security and Bioinformatics. The Bioinformatics Division consists of about 40 people who undertake the development of end-to-end software products as well as basic research in protein structure prediction. Soon, the ATC will initiate work on facilitating the use of the Internet in Indian languages other than English.

Summary

As biology evolves into an "information-driven" science, bioinformatics has emerged as one of the central tools for turning raw molecular data into information. Bioinformatics requires the collaboration of many specialists including computer scientists, engineers, life scientists, and people to communicate across these disciplines. In 2002, the world market for bioinformatics was estimated at $1.3 billion and was growing at 20 to 25 per cent per year. By 2006, it should be worth at least $2.5 to 3 billion, and will likely be higher, as pharmaceutical companies increasingly turn to bioinformatics to lower the costs of drug discovery and development.

Key Points

What is bioinformatics?

- "Bio" = life. Informatics means the use of computational methods. So any activity that combines computation with life science problems should qualify as bioinformatics. In the pharmaceutical industry, bioinformatics is useful not just at the beginning of the drug discovery process but also at the end. At every stage, there is room for the use of computational methods.

- Over the last half-decade, the life sciences have changed dramatically at the experimental level. The art of experimentation has gone down while the speed of experimentation has gone up. An organism such as a mosquito can now be sequenced in just six to eight months; the SARS virus was sequenced in hours. But then what do you have? Lots of raw data, which tells you the sequence of a disease-causing gene but doesn't tell you how to cure it. Bioinformatics is one of the central tools for turning this raw data into information. Biology is becoming more of an "information-driven" science.

Why the excitement about bioinformatics?

- In the last 50 years, the technology that most transformed our lives has been the computer. The last half of the 20th century belonged to solid-state physics, engineering and computer science. Many people believe the 21st century will belong to the life sciences.

- Popular imagination is often captured by seminal events. People generally sit up and pay attention only when something dramatic happens. When the draft human genome map was announced in February 2001, the product was supposed to take about 10 years but only took two years. This feat sparked some wild dreams. For example, there were expectations that since we roughly knew what the genome looked like, we would soon know how genetic variations determine phenotypes (e.g., why is one person tall and another person short?) Or more seriously, why are some people more prone to obesity, diabetes or cardiac disease? There was also expectation that you could fine tune drugs to optimize their performance in an individual. People were speculating that these achievements were just around the corner. But they're not. Realistically, at least 10 to 15 years must pass before people can visit a lab, get their DNA extracted, determine their genetic sequence on the spot, and receive a customized treatment. It's not impossible, but many problems have to be solved at the research and the industrial level before this could happen.

A "convergent" technology

- Bioinformatics requires the joint work of many specialists. You need computer scientists to create algorithms and databases, computer engineers to provide the software and special-purpose hardware, and life scientists (biologists and chemists) to provide the raw data. You need people who can communicate across these disciplines. One group working by itself cannot be very productive.

Market estimates

- In 2002, the total world market for bioinformatics was estimated at $1.3 billion, growing at about 20 to 25 per cent per year, so it should be $2.5 to 3 billion by 2006. Bioinformatics is a subset of biotech R&D, which was worth $13 billion in 2002 and estimated to reach $30 billion in 2006. The entire biotech market (as distinct from the biotech R&D market) was about $50 billion in 2002. Therefore, about 25 per cent of the total

biotech market is spent on R&D. The pharmaceutical R&D market was about $50 billion in 2002, out of about $600 billion in total global sales. Therefore, the fraction of the biotech market spent on R&D is much higher than the fraction of all pharma spent on R&D.

- On the surface, these are not impressive numbers. Tata Consultancy Services (TCS) will earn about $2 billion this year. Why should we enter a field where the entire world market will be only $3 billion in 2006? Because these figures are extremely conservative—the guaranteed minimum. The reality could be much higher.

Drug discovery process

- Today, pharma companies are getting bigger by mergers and acquisitions. They do not necessarily have more new drugs entering the pipeline. The cost of discovering a drug is now close to $1 billion, partly because candidate drugs fail at various stages of the drug discovery process. In the computer chip business 10 to 15 years ago, the manufacturing process was so unreliable that the yield of good chips was about 5 per cent. Chip manufacturers did not know if they had a bad chip until near the end of the manufacturing process. Today, yields are much higher because we can tell earlier if something has gone wrong. We have to do something similar with drugs. If a candidate drug is going to fail, and we can discover that early, then the costs of drug discovery may be lowered by about 30 per cent. We have to make it easier to predict when a drug candidate is likely to fail, as early as possible.

- The future probably belongs to bioinformatics, and no other alternative is in sight. Bioinformatics may turn out not to be the wave of the future, but right now there is nothing else on the horizon.

About TCS

- TCS is an IT company, not a biotech company. But if bioinformatics becomes big, we're poised to be major players. The key is to have a multidisciplinary team. If you're too small and can't form a multidisciplinary team, you should partner with other individuals. It may also help to have a specific focus like cancer or diabetes, to give sharpness to your R&D efforts.

- The Tata Group of Companies is the largest corporation in India. The Group has about 85 companies including TCS, which has 22,000 employees.

Our revenues were more than $1 billion in 2002. TCS alone accounts for 10 per cent of India's software exports. TCS has more than 150 offices in 31 countries including three offices in Canada.

- Many people believe IT companies will eventually have a presence in every aspect of the pharmaceutical business except for manufacturing and distribution. Conventional activities include IT support for clinical trials and statistical analysis of raw data. The next generation activity is bioinformatics, which involves using computational methods to turn "raw data" into "information." Bioinformatics is therefore a natural activity for a mainstream IT company.

TCS approach to bioinformatics

- TCS has created a separate team of domain specialists. TCS is a consulting company, but we believe our main source of revenue will come from creating intellectual property and assets such as new computational algorithms, software tools and products. Biotech and companies often don't make a distinction between experimental and analysis work, therefore TCS enters into alliances with small biotech companies and pharma companies, offering "end to end" services.

- TCS launched its bioinformatics activity in 2002. Within five years, we want to be global leaders in biotech/pharma software and IT-related services. Our mission is to advance the frontiers of knowledge in the life sciences through the development of new computational techniques and algorithms, special-purpose computing tools and platforms, and drug targets and candidates (together with our partners).

- The TCS bioinformatics activity is part of its Advanced Technology Centre. About 60 people work in the Centre. TCS has alliances with organizations inside and outside India. TCS has academic collaborations with the Centre for DNA Fingerprinting and Diagnostics, Indian Statistical Institute, University of Buffalo, UC Riverside and Carnegie-Mellon University.

- TCS is developing a product called Bio-suite, a comprehensive, portable scalable software suite. We plan to have our first version out by October 2003. Our next product will be a database management tool that includes: substantial amount of pre-processing, customizable query mechanisms so the users can redesign the database to suit their own applications, both hardware and software.

Key Note Presentation

Intelligent Transportation Systems: An Open Marketplace

Pierre Bolduc
Vice-President, Transportation Systems, Delcan Corporation

Mr. Bolduc graduated in 1982 from McGill University in civil engineering and has been involved in the transportation sector for the last 22 years. As a consulting engineer, Mr. Bolduc started his career in the field of traffic planning and management. Over time, he has focussed his professional activities towards the planning, the design and delivery of transportation projects that require the application and integration of communications and computer technologies.

Summary

Intelligent Transportation Systems (ITS) are a range of diverse technologies applied in an integrated fashion to transportation facilities in order to save lives, time and money. ITS improves the movement of people and goods over roadways, and through interfaces and terminals to highway systems, ports, airports and border crossings. ITS is being implemented in many ways by the public sector, provincial g overnments and transit authorities. It's estimated that the annual global market will rise from $25 billion in 2001 to $90 billion in 2011.

Key Points

Benefits of ITS

- ITS can help to address key transportation problems, such as urban congestion, increased trucking traffic, processing of goods and people through border crossings, and the need to encourage the use of public transportation.

- Improve safety—this includes measures such as improving traffic signals, rerouting traffic, communicating with cars whose airbag had deployed and sending help if needed.

- Increase operational efficiencies—this includes traffic flow on highways, storage at terminals.

- Reduce energy use—this is a direct benefit of more efficient transportation.

- Enhance productivity and competitiveness—for example, accommodating "just in time" manufacturing strategies.

- Data collection—for example, when is the time to widen a road?

Technologies used in ITS systems

- Computer hardware and software technologies—traffic management systems that measure traffic in real time, assess congestion, notify operators and prepare response plans.

- Sensors and monitors—cameras view traffic and are monitored remotely, so operators can send assistance in the case of accidents or breakdowns. Sensors can also automatically regulate stoplights based on traffic flow.

- Telecommunications—used for real-time pictures, or be used for toll roads to read electronic tags on cars and communicate billing information.

- Display devices—electronic signs on highways, airports, and soon at bus stops, that provide travelers with information.

- Data warehousing—all these devices store data that can be made available for other purposes.

Sample subsystems in the trucking sector

- Automatic vehicle identification and classification—at toll facilities, an electronic system can identify the vehicle and classify it so it's charged properly. Sensors embedded in the roadway can determine whether a vehicle is a car, car with a trailer, five-axle truck or a full semi trailer—this can be done by measuring its size or weight.

- Automatic product identification—this is already used in the container business to track the movement and contents of containers, which helps speed border crossings.

How is ITS being implemented?

- ITS is already being implemented by the public sector, provincial governments and transit authorities. These groups must work together so the information collected by one can be used by the others.

- Canada and the U.S. have created an ITS architecture, which has built a common vocabulary, defined user services, and started investigating how these systems will eventually communicate with each other.

Travel and transportation management

- En-route driver information
- Route guidance
- Traveller services information
- Traffic control
- Incident management
- Emissions testing and mitigation

Travel demand management

- Pre-trip travel information—this involves warning people to avoid facilities that are already busy
- Ride sharing
- Demand management and operations

Public transportation operations

- Public transportation management—e.g. managing the state of repair of bus fleets
- En-route transit information—electronic signs or real-time information through cell phones
- Personalized public transit—notification of problems or delays
- Electronic payment systems

Commercial vehicle operations

- Electronic clearance
- Automated roadside safety inspection

- On-board safety monitoring—e.g. monitoring the temperature of food cargo
- Automated paperwork processing
- Hazardous material incident response
- Commercial fleet management

Emergency management

- Emergency notification and personal security, including satellite-based systems that notify authorities if help is needed
- Emergency vehicle management

Growth of the ITS market

- Initial investments have come from the public sector. The market will grow once it produces consumer products—for example, when travellers are equipped with smart vehicles and start buying services, such as traffic notification or navigation systems.
- Canada is currently about 5 per cent of the ITS market. We can grab a larger part of that market—there are many ITS systems that can be deployed in Canada.
- ITS is a multi-billion dollar industry. The annual global market in 2001 was CAN$25 billion—estimates are $60 billion in 2006 and $90 billion in 2011. Our share of the pie depends on our vision, policy and strategy.

Key Note Presentation

Canadian Security Industry – New Markets and Evolving Technologies

Michael Lum
Security Industry Team Leader, Industry Canada

After September 11, 2001, Michael Lum was tasked to form and lead the Canadian security industry team at Industry Canada. This team fosters new security technologies and solutions to help companies capture new business opportunities.

Summary

Since September 11, 2001, there has been a huge increase in demand for national and homeland security products. In Canada, the number of security companies has doubled in the last few years. Some firms command from 50 to 75 per cent of the global security markets in their own areas. Key ingredients of success include: a world-class technology, especially a system solution; winning security contracts from the federal government; a firm commitment to export products, and continuous efforts to innovate.

Key Points

Growth of the security industry

- What is a security product? It is a device that safeguards the citizens, assets, intellectual properties and communication channels of a country from being attacked by hostile entities. Here, we're not talking about lower-end security and safety equipment, household security systems, or commercial security systems. Our focus is on national and homeland security.

- In the years from 1993-2000, the number of companies in the security sector was fairly stable, with an average of 240 companies. But in the last few years, it has grown beyond 500 companies in the sector. So there is a quantum jump in the number of companies. There is also a quantum jump in the products, solutions and technologies offered by this sector. We all know why this is the case. This sector has two peculiar features: it consists mainly of small to medium-sized companies, of which a high percentage are Canadian-owned. Also, there are very few Canadian security companies that can offer a total systems solution to a security problem.

North American security market

- In Canada, $7.4 billion will be assigned at the federal level over the next three years to procure and improve Canadian national security. In the United States, US$48 billion has been announced. To upgrade security systems at the provincial, state or city level, the market is estimated at $5 billion in Canada and $30 billion in the United States. For high industrial security in the private sector, the Canadian market is estimated at $2 billion in the next

three years and $20 billion in the U.S. So there is a huge increase in demand and a huge window of opportunity for security companies to capture this market and grow, and continue to innovate and make healthy profits.

- In Canada, the security industry offers many world-class technologies in a wide variety of security products, which can provide innovative solutions for better security. Some of the leading companies command from 50 to 75 per cent of the world security markets in their areas. In the last few years, these companies have increased their revenues from 100 to 200 per cent. Other Canadian companies have been refining traditional technologies to improve security. These companies are also doing very well. However, there are many companies that offer "me too" technologies for dealing with security problems. If these companies don't continue to innovate and be committed to exports, they will not generate long-term revenue growth and healthy profits.

- Industrial sectors, where a lot of innovation and activities occur, are: electronic and electrical sector, biochemical sector, advanced materials sector, and optical sector.

Electronic and electrical sector

- Traditional technologies include:

  - Information and telecommunications security (encryption and firewalls)
  - Explosives and weapons detection (gas and particulate analysis)
  - Electromagnetic perimeter devices and smart cards for access control

- Evolving technologies include:

  - Biometrics using multi-algorithms to analyse and secure unique biological characteristics such as facial features, fingerprints, DNA, hand geometry, voice and iris patterns to identify and authenticate a person.
  - Software to secure wireless communication in close proximity or over long distances.
  - Personal, cargo or asset tracking around the world using compact L-band data terminals via GPS or satellite technology.

Biochemical sector

- Traditional technologies include products to detect and protect against nuclear, biological, chemical and radiological attacks. These include conventional gas, x-ray, particulates, and bacterial and viral detectors; protective clothing; air filters, and de-contamination agents.

- Evolving technologies include:

    - The use of DNA techniques to identify bioterror agents quickly and inexpensively.
    - The development of vaccines and pharmaceutical agents for anti-bioterrorism
    - Portable neutron analyses to detect nuclear irradiation.

Materials sector

- Conventional materials include:

    - Kevlar used to produce soft armour to protect a person involved in bomb or landmine disposal.
    - Hardened metal, ceramics and polycarbonates used to build rigid armour, to protect important persons and assets in vehicles or buildings.

- Evolving technologies include the development of nanotechnology combined with bio-alloys to detect biological and chemical agents. This technology will revolutionize the world of bio-terrorism detection. It's cheap, accurate, and very quick. This development is occurring here in Ottawa.

Optical sector

- Traditional technologies include CCTVs and cameras used for surveillance, and motion detection systems.

- Evolving technologies include detection and alarm systems using invisible and multiple laser beams, or thermal imaging technology.

- Canadian products and technologies are being applied in Canada, the United States, and all over the world. Canadian companies are particularly strong in the transportation security (airports, rail and ocean terminals, border crossings). We're good at developing technology to identify problems,

and at developing security systems that move people and goods quickly across the border. Canada also has very strong security companies involved in law enforcement, defence, and cyberspace.

Case for continuous innovation

- Security companies must continue to innovate because there are new technologies being developed by other disciplines that can help to reduce the cost, and increase the accuracy and speed of detecting security problems. Second, there is competition in every discipline and every area. To stay ahead of the competition, it is necessary to innovate. Third, the bad guys are not stupid. Within three years, they will figure out how to overcome even the best security solution today. To retain your market share and keep ahead of the bad guys, you must continuously innovate.

Industry Canada initiatives

- The Canadian Security Industrial Team has launched three initiatives:

    - Seminars enabling federal security buyers to meet Canadian security sellers. So far, seminars have been held in Ottawa, Toronto and Montreal. In the next few months, similar events will be held in central and western Canada, and in the United States.
    - Programs to help accelerate the commercialization of innovative security solutions.
    - Export facilitation programs.

Conclusion

- Many Canadian security companies are very successful. Some key ingredients of success include: a world-class technology, especially a system solution; winning security contracts from the federal government, a firm commitment to export products; and continuous efforts to innovate.

Luncheon with Guest Speaker

Convergence of Technologies: Lessons from the Silicon Valley Experience

Doug Henton
President, Collaborative Economics, California

Mr. Henton has more than 20 years of experience in economic development at the national, regional, state, and local levels. He is nationally recognized for his work in bringing industry, government, education, research, and community leaders together around specific collaborative projects to improve regional competitiveness.

Mr. Henton founded Collaborative Economics in July 1993 after a decade as assistant director of SRI International's Center for Economic Competitiveness. At SRI, he directed major projects on the economic future of Hong Kong, the technopolis strategy in Japan, and regional development in China. Mr. Henton holds a bachelor's degree in political science and economics from Yale University and a master of public policy degree from the University of California, Berkeley

Summary

Innovation is really about change and adapting to change—there is no smooth ride. In Silicon Valley, several lessons have been learned over the last 10 years. First, innovation comes in waves. Second, true innovation occurs in times of adversity—when we're challenged, we create our most innovative solutions. And third, convergence is a driver of innovation. This isn't the first time convergence has happened—technologies always migrate into new market space at times when these major shifts occur.

Key Points

Innovation comes in waves

- It's not about the technology; it's about the innovation, and innovation comes in waves. For example, in the '50s and '60s, Silicon Valley was driven by defence industries, and then the space race. But when the U.S. cut back on defence spending, it caused a major recession in Silicon Valley. People thought the region was finished.

- Then Shockley Semiconductor invented the integrated circuit, which was the application of a transistor on a silicon chip. It was first developed for the defence department, but when they could no longer provide funding, the integrated circuit was commercialized in devices like pocket calculators.

- A group left Shockley to form Fairchild Semiconductor. This started a pattern of people leaving major companies to go out on their own. From that company came almost the entire semiconductor industry—Intel, National Semiconductor, AMD, etc. The circuit took off, and that's where the name silicon valley came from.

Innovations become commodities

- Once the Japanese learned to make semiconductors cheaper and more

efficiently, Intel almost went out of business. Then Intel switched to microprocessors, which laid the foundation for the personal computer.

- When personal computers also became a commodity and were no longer made in Silicon Valley, we had a recession. Then a defence technology called Arpanet was commercialized as the Internet, and we took off on the next ride.

- The Internet also became a commodity. Now we're on the edge of the next round of innovation. It's not a smooth ride—innovations quickly become commodities, and we have to move upward.

Creative destruction

- Joseph Shumpeter's theory of economic development states that economies are driven by dynamic waves of innovation. Entrepreneurs move into those opportunity areas. When many people see profit opportunities and swarm around those clusters, profits decline. The industry becomes mature and we have to move on. This doesn't mean innovation has stopped.

- The same thing happened with venture capital investment in Internet companies, which increased to $20 million in 2000 and then went back down. Those investors believed that electronic commerce would change the way we live, and it has. But at the time, too many companies were trying to take advantage of a market opportunity.

- We live in a world that doesn't go in a straight line—surges are followed by slowing down. It takes a while for technologies to be adapted, for innovation to catch up, and for society to catch up.

Sources of productivity

- Productivity is not the same as jobs. It comes from two things:

    - Producing products and services that are more highly valued by the market (for their uniqueness or quality)

    - Producing products and services more efficiently (improving processes)

- Social innovation hasn't kept up with technology innovation. California's state revenue base went way up during the Silicon Valley boom, then went

down again. Now we have a revenue deficit that we're struggling to deal with. The social and government infrastructures need to match the innovation infrastructure.

Clusters

- In addition to clusters themselves, it's important to recognize the importance of business support industries. Clusters represent about 40 per cent of the employment base—the rest comes from business services, financing, machinery, etc.

Why innovation is key

- Innovation is actually about continuous innovation to achieve productivity gains in government and society.

- Productivity is the basis for prosperity.

- Innovation is the basis for productivity.

- We think innovation is about the next new thing, but it's about entrepreneurs and innovation across firms, industries and regions. Every industry must have innovation—it's about applying technology, not just inventing it.

Innovation is a social process

- The economist Paul Romer says that economic growth comes from recipes, which are new ideas that combine ingredients (resources) in new ways to yield more value and more economic results.

- What regions must do is create the right ingredients, which are intellectual capital, human capital and financial capital, put those recipes together to form new ideas and create productivity, prosperity and, eventually, cluster vitality.

Innovation is place-based

- Location matters because people matter. Your entrepreneurs must be connected to your assets in new ways. The four basic lessons are:

    - Continue to build your fundamental assets (people, education, universities, research)

- Connect entrepreneurs to those assets in ongoing ways
- Promote an ongoing culture of innovation
- Quality of life matters to attract and keep the best talent.

It's about talent, technology, capital, and a supportive infrastructure that holds on to all those things.

Geography matters

- You can't have a successful economy without a successful community. People want a distinctive quality of life. The most creative work still takes place face to face. You need to create quality environments, like Ottawa, where people want to live and interact.

- A region can make this happen, but it takes leadership from business, the academic community, and government. Forums like this one are critical.

The next wave

- We are on the edge of a new convergence. In the 1990s it was the Internet revolution, which was a great platform to build on. The next step is most likely the convergence of information and bio, and nanotechnology.

- In Silicon Valley, small and medium-sized companies are applying new tools in the bioinformatics, genomics, proteomics, and other new areas. Our advantage is using the information platform to advance the bio platform. For example, Applied Biosystems created the computer algorithms that speeded up the mapping of the human genome. Massive amounts of data—that's the future.

Preparing for the next wave

- Do leaders understand the opportunity?

- How can we ensure it happens here?

- What are the requirements?

- How can local people and communities benefit?

- Can we some of the pitfalls of past waves?

Workshop 1: Overcoming Barriers in Developing New Product Markets

Chair: Gilles Patry, Rector, University of Ottawa

Through the convergence of technologies, many products are possible, but not all are suitable to existing markets or capable of opening new markets. The purpose of this workshop was to identify external market-related challenges faced in developing new products, and then identify new product markets themselves. Issues for discussion included the influence of technology awareness, the nature of the markets, attitudes, cost, regulations and policies. Panellists were asked to address the following questions:

1. What are the major challenges in developing new product markets?
2. What can companies or industry do to overcome these barriers?
3. What is the role of government?
4. How can we facilitate acceptance for new products?

Panellist 1: Glen St. John, Director, BioDentity Systems Corporation

Founded in 1999, BioDentity has developed a suite of technologies that allow controlled capture and recognition of facial images in border clearance and airport settings. BioDentity's facial recognition technology and unique application products provide timely solutions for border security concerns.

Product acceptance

- Networking is important for new product development. You can't develop in a vacuum, but must understand the environment. Since September 11th, development of biometrics has increased rapidly. The environment is favourable for this technology right now.

Government's role and barriers to entry

- Canada offers many innovative programs, including SR&ED tax credits, IRAP, TPC, marketing assistance from DFAIT, and Team Canada missions.

- But while the Canadian government aggressively pursues new markets for Canadian products abroad, it fails to do so domestically. We offered to provide our technology for free at Canada's border crossings, but have received no response.

- We need an organized way to introduce our products to government, which would be helpful for them and create validation for us when marketing overseas.

- There is no better marketing tool for Canadian technology abroad than to say, "Yes, the Canadian government uses this technology at home."

Panellist 2: David Stanley, Vice-President, Research & Development, PCI Geomatics

PCI Geomatics is a world leading developer of Geomatics software (geographic modeling, measurement, analysis, and output) and solutions based on its remote sensing, digital photogrammetry, spatial analysis, and cartographic editing programs. The company is a privately held Canadian Corporation headquartered in the Toronto area with another large facility in the National Capital Region.

Market opportunities

- Geomatics has unprecedented opportunities in the next decade or so. This is driven by convergence of data availability from satellite, broadband Internet, widespread acceptance of GPS, wireless access through cell phones and increasing computational and storage capacity.

- New global concerns require geomatics solutions: homeland security, public health, sustainable development and environmental monitoring. The environment seems ready for this technology.

Barriers to entry

- Data accessibility remains a major barrier. Data is fragmented across many levels of government or businesses, in different departments with different access policies and formats, and is rarely publicly online. For data that is online, issues of consistency between data sets must be addressed.

- The many sources of data present issues of intellectual property, data ownership and billing processes. These can be insurmountable obstacles to creating new products.

- Some of the most innovative products use information about individuals. These products face challenges of public acceptance and legal issues. For example, homeland security or health care for disease tracking raise issues of individual privacy and security.

Panellist 3: Sonny Lundahl, Vice-President, Research & Development, AMITA Corporation

Mr. Lundahl is a founder of AMITA Corporation and its subsidiary WorldReach Software. AMITA's expertise is in implementing network-based information systems to allow customers to collect and share valuable data around the world. Mr. Lundahl has more than 25 years of experience in building network-based database systems and leads the R&D efforts of both AMITA and WorldReach.

Challenges

- Understanding the needs of the customer—what problems keep that customer awake at night? We try to be part of the customer's world—we join their groups, ask questions and learn their business.

- We use outside consultants—Peter Fillmore, Reid Eddison, etc.—who bring their experience to bear on what we're doing. That advice is inexpensive for the benefits we receive.

Role of government

- Foreign affairs has been a helpful partner for the WorldReach software, introducing us to customers, demonstrating the system, providing names and references, etc. Our software has benefited them as well, saving them one year's salary in overtime.

- Other partners in our products include NRC and the Canadian Bioinformatics Resource in Halifax.

Facilitating product acceptance

- WorldReach is used by consular services. We are immersed in their environment year after year—they know us. We must also give them a business case to justify our system.

Workshop 1 Recommendations

1. What are the major challenges in developing new product markets?

Government procurement

- The regulatory process is not receptive.
- Government doesn't value domestic products. There is no organized way to introduce products that have potential for use by the Canadian government. When the government does not adopt Canadian products, this reduces our credibility when marketing overseas.
- Government culture (e.g. telemedicine challenged by requirement that doctors can only bill face-to-face patients). Must be aware of similar challenges in other countries.
- Purchasing is highly decentralized.
- Since 911, the government has been swarmed by new technologies, but most are not complete solutions. Time is needed to adequately assess which is the best, so they tend to stick with known companies.
- There is no standard Canadian agency to evaluate security products or processes.

Marketing

- Local markets don't recognize value of domestic products.
- Ability/resources to market the technology: Canadian companies may lack the resources (human or financial) to raise their visibility. Companies need to invest more time and money in marketing. For example, U.S. companies react to downturns by increasing marketing spending, while Canadian companies do the opposite.
- Cost of overseas marketing is prohibitive.
- RFP process in Canada (particularly with government) appears onerous versus U.S.

- Government support for private sector R&D has the potential to create dependency. Small companies must continue R&D in order to qualify for tax credits and other government benefits. These benefits may be the main source of their profit margins. This can make it difficult to transfer more money to marketing.

2. What can companies or industry do to overcome these barriers?

- Spend more on marketing: for every dollar spent on R&D, spend a dollar or more on marketing.

- Markets are global: Canada is just one market. Companies must choose whether they want to be visible in domestic markets or global markets– go where your marketing dollar has greatest result.

- Take full advantage of IRAP support for market studies, which provide a good starting point.

- Question reliance on government as a market.

3. What is the role of government?

- CRTI—a new government security organization, is a model that could be used in other science areas. CRTI's role includes the following:

    - Bringing industry, departments and agencies together
    - Doing risk assessment—what are the needs of the responders
    - Technology acceleration—create federal and industry partnerships to accelerate what's being done.

- Reduce taxes

- Create sales and marketing tax credits (similar to S&T credits)

- Give special consideration to SMEs during the procurement process.

- Create targeted missions focused on niches—huge "Team Canada" missions have limited benefit. Organized government efforts to substantive opportunities to show the value of Canadian products to overseas markets.

- Expand IRAP support to include marketing.
- Offer Canadian marketing executives the same personal income tax benefits as are received by foreign executives who come to Canada.
- Create more private sector presence in government R&D programs (too much focus on "academic"/not-for-profit organizations).
- Create incentives and rewards-based programs to achieve penetration of innovation.

4. How can we facilitate acceptance for new products?

- Technology showcasing at the regional level for new products.
- Forums to acquaint small companies with government decision makers.
- Technology champions in government departments (for leading-edge products without competition). Advocates can advise on development. This also helps to build a relationship with potential clients in government and gives the government advance knowledge of products.
- Create a dedicated group of people to assess products that have potential for use by the Canadian government.
- Hold symposiums where government can communicate their needs to companies.

Workshop II: Business Strategies to Create New Product Markets

Chair: Jacques Lyrette, Administrator, Economic Development Corporation, Ville de Gatineau

The purpose of this workshop was to explore various companies' business strategies for introducing new products in new markets. Panellists shared their experiences in developing and building strategies for creating awareness in new products and new markets, including specific strategies to gauge consumer interest and attitudes, and how to change them. The workshop concentrated on what companies themselves can do. Panellists were asked to address the following questions:

1. What are some of the successful strategies used by companies for new markets?

2. What are the pitfalls to avoid when designing your business strategy for the new markets?

3. How to assess the validity of potential new markets?

4. Cost for entering such markets?

Panellist 1: Dr. Ron Britton, President & CEO, Fuel Cells Canada

Fuel Cells Canada is the national advocacy group for the fuel cell and hydrogen industry. Fuel Cells Canada is based in the Vancouver area, which has the largest concentration of Canadian companies involved in fuel cell and hydrogen technology. It has 55 members and an operating budget of about $1 million a year. Its mandate is to accelerate commercialization of the technology for the entire industry.

Introduction

- At Fuel Cells Canada, I focus my attention to the market. I have some market-facing questions, which I think are indispensable in business plans. This talk tries to identify the key things in a marketing plan that help you decide whether you have any right to try to start a company based on technology as a starting point.

Industry roots

- Through early government involvement, the fuel cell industry got started in Canada. The modern day practical realization of the industry was strongly supported by federal and provincial government investment in the early days. In recent years, there has been little financial support for this industry other than in the private sector. The private sector invests about $200 million a year in Canada. Government's current direct allocation is probably in the $10-15 million a year range.

Defining your market

- A good starting point for any business strategy is: What is the market? You've got a technology that appears to work, but what are you testing it against? Is the market a fuel cell stack? Is it the appliance the stack is used in? Is it the fuel supply? Or is it electricity management?

- My point is that there are many different markets. You better know which one you're going after. Some of the early people in the fuel cell industry thought they had something for every market. Their underlying belief is that if you offer everything from cradle to grave, you will get a large market share and have more scope for success. The problem is, you will never raise enough capital to deliver four or more different technologies to the market at the same time.

- Next question: who is the competition? What are you really competing against? Is it a plug in the wall? If so, that's a really tough competitor. We're all used to wall plugs. People don't really care where the electricity came from, who made it, or whether it made greenhouse gases. Or is your competition a battery—like a watch battery, a laptop computer battery, or the battery that a soldier carries around. Knowing the competition defines what your cost competition is.

Market characteristics

- How is the market structured? Are you targeting consumer markets? Are you looking at the whole market for portable appliances, or a particular sector of the portable appliance market? These all have different value equations that will define how much customers can afford to spend on power. There are also the microelectronics and transportation markets. Are you targeting

commercial markets (e.g., shipping, aircraft, heavy duty trucks, commercial vehicles)? These have different value drivers than somebody's personal automobile or laptop computer.

- Are you targeting defence markets? In Canada, the defence industry is modest, so U.S. companies have a tremendous advantage here. The defence community can generally afford to spend a lot more on new technology than consumers. In the U.S., it's also a big enough potential market that there are large economies of scale. Are you targeting stationary power markets? This is the domain of large utilities. Until a few years ago, all of the large Canadian utilities were owned by governments.

Special interest groups

- Who are the special interest groups or early adopters? The defence industry is often an early adopter of new products. Governments are another early adopter. You need to think about the special needs of early adopters and what they want out of the technology.

Information sources

- Startup companies are often unsure where to find the market information they need. Prominent sources include market research and industry trade reports. If it's good quality information, it often costs a lot of money, which can be difficult for startups. Fortunately, potential competitors may use the Internet as a way of promoting their own products and companies. There is an enormous amount of free intelligence available on the Internet that just takes some effort to find.

The value proposition

- After investigating your target market, do you have a value proposition? Have you got a legitimate reason to expect the market to want to buy your product? Using a defence example, we learned that the cost of a gallon of diesel fuel used by an Abrams tank in the middle of the Iraq War was $400. For the people who are trying to deploy logistics, fuel and heavy artillery in the middle of a war, the cost of fuel is incredibly important. If you can show them how to save 50 per cent using a fuel cell, that means they need to haul around 50 per cent less fuel.

- Some business plans are really short on market intelligence and long on technology and intellectual property. IP is critically important to get started. But the really critical thing is your marketing plan. Your value as a company is in the market, it's not inherent in the IP.

Identifying partners

- Who can be partners to help mitigate risk? Potential partners include:

    - Strategic partners (large market owners, competitors, value chain participants, IP barriers)
    - Government partners (first purchasers, policy change, confirmation of value)
    - Other stakeholders groups (environmental groups, other NGOs)

- The battery industry sees fuel cells as a competitor. But the battery industry may actually be a key partner for the fuel cell industry. Most cars now run on one little 12-volt battery and a complicated internal combustion engine. In the future, cars will have many sophisticated batteries and a fuel cell, and that hybrid will be your power supply. So there's a giant new market for battery companies and they are far better established than most fuel cell companies.

Panellist 2: Brian Foody, President, Iogen

Iogen specializes in applying biotechnology to natural fibres. Iogen makes industrial enzyme products for the pulp and paper, textiles and animal feed industries. The company also develops technology to manufacture ethanol from cellulose in order to produce clean fuel with zero CO2 emissions. It has partnerships with the Royal Dutch Shell Group, Petro-Canada and Hoffman-Laroche.

The case of the exciting new market

- A new enzyme is discovered that can help eliminate chlorine from the paper-bleaching process. This is a very big deal. People had found dioxins in paper; it was a major environmental issue for the industry. There were fears of hundreds of billions of dollars in capital expenditures. There is a potential market of hundreds of millions of dollars. What's going to happen with this business?

- The race is on to find a solution. In Lane One, Competitor A is the world's largest enzyme company, with $1 billion a year in sales in essentially this niche. Company A pursues the market with direct sales through their own sales force. They create a new dedicated division. Off they go.

- Competitor B is the number two player in the enzyme business. They are the high-tech enzyme leader. They're a little smaller—$200 million in annual sales—but are growing quickly. They have a strategic alliance with a multi-billion dollar specialty chemical company. So they bridge their technology capabilities with a company that is involved in and knowledgeable about the market.

- Competitor C is one of the world's leading commodity chemical producers. They have a new internal biotech initiative and have allied with a major university to develop world-leading products. They have a direct sales force that also serves key customers.

- And then come the startups:

    - Competitor D decides to more or less go it alone. Relative to the others, it has a strong customer applications focus.
    - Competitor E partners with a paper company and with a specialty chemicals firm.
    - Competitor F allies with another major commodity chemical firm that serves this market.

- So there are a variety of strategies—a mix of who knows what and how companies are tackling it.

And the winner is …

- With a 90 per cent worldwide market share in a business that hasn't yet approached the potential originally expected, do we have company A, B, C, D, E or F? The right answer is Company D: IOGEN. We are the firm that now has dominant share in this marketplace. Between 10 and 15 per cent of all the white paper made in North America is now made with our technology.

- How did this happen? If you look at all the alliance building etc., how did company D win the race?

- First, a critical element was our customer focus. IOGEN didn't really do it alone. But rather than forming an alliance, we worked very closely with a specific customer—a major research lab with one of our lead customers. We worked with them intimately, so that when the lab shut down, we actually hired a number of their staff.
- Second, after the first wave of products came out, we put together a substantial alliance with the National Research Council that helped us develop a second generation of products.

Lessons learned

- A successful business strategy involves structuring the value chain of activities: structuring who does what from beginning to end, and deciding who does what activities.

- The critical lesson we learned is that the lynchpin activity to create a new product market is to truly understand the customer need. I don't just mean "understand" it, I mean "really understand" it. You have to understand it down to your heart. Not only that, you have to understand it so well that when a customer standing next to you hears what you have to offer, he wants to take out his wallet and give you all his money. Not only that, but he is going to feel happy about it.

- It's not enough, when you tackle a problem, to have the right résumés or the right alliances. Those things are not what ultimately deliver value. You have to roll up your sleeves, focus on your customers, really understand them and work hard to meet their needs.

Panellist 3: Paul Renaud, President, Lanigan Group

The Lanigan Group helps build sustainable businesses by helping them focus on customer value.

- The only way to be successful in the marketplace is to know your customer. I'm going to talk first about how not to create new product markets. I will then hone in on some successful strategies.

The pitfalls

- The most common reason why companies are not successful is they forget that the only source of positive cash flow is the customer. You can dress up all the accounting you want, get all the venture capital funding you want, and incur all the bank indebtedness you want. But at the end of the day, the only way to create value for shareholders is by generating positive cash flow from customers.

- It would therefore seem intuitive to have a customer focus. In fact, the most common reason why there's such a high failure rate with innovation in the technology sector is companies forget some very basic things. They are:

    - Markets are made up of customers. Markets are not created by technology. Industries are created by technology. Industries exist to serve customer needs.
    - Customers' needs do not change rapidly. Customer needs are enduring. What changes is the opportunity to use technology to satisfy those needs. An investment in understanding the customer is an investment well spent, because that insight will allow you to leverage and innovate new technology after new technology in satisfying those customer needs.

The risks

- Knowing the risks is the first step in avoiding them:

    - The safest thing you can do is to evolve an existing product for an existing market because your technology risk is low and your risk of understanding the market is low. You already have a source of revenue and a basic understanding of your customers.
    - The level of risk increases if you try to adapt an old technology to a new market or introduce a new technology to existing customers.
    - The most dangerous thing is to try to create new products for new markets.

Two ways to fail

- You can fail to understand the customer needs.

- You can fail to master the technology that you're innovating on.

Two ways to succeed

- The safest thing is to acquire a market-proven product. The most common exit strategy for a company is to be acquired by a larger company that hasn't figured out how to succeed in the market, and doesn't want to take on the risk.

- Value-driven market entry: you need to be passionately customer-driven. You need to understand the key customer values, dissect them to the point that you can measure them, and frame your products and innovations accordingly.

Falling in love with technology

- Many companies get enamoured with a technology and assume that everybody else will share their enthusiasm. You often see a tremendous amount of technical innovation and then a lot of running around to find a customer who will buy the technology. This doesn't work very well.

- Morgan Stanley studied every single technology IPO over the last 22 years in North America. Only 1 in 20 startups made it to an IPO, and only 1 in 20 of those companies actually created shareholder value afterwards. (Fifty-five per cent of the IPO companies destroyed shareholder value.) So the overall success rate is 0.25 per cent or 1 in 400. To put this in perspective, there are 1400 to 1600 technology companies in Ottawa. Assuming this 0.25 per cent success rate, out of 1600 tech companies there will only be three or four winners—if all the startups follow this model.

- Clearly, we need to change these odds. Fortunately, there are ways to do so. You need to understand what the customer truly needs, create value by innovating against those needs, and deliver that to the marketplace.

Value-driven market entry

- Focus on what customers want to buy. This is not as simple as asking customers what they want to buy.

- Take the time to understand your market's needs. This means understanding why customers need what they need. Research customer values and map these values to guide your technological innovation.

- Ensure that your product features enable customer values.

- Adopt a sustainable, repeatable, proven approach. The most successful medical devices company in history is Cordis. In 1993, their revenue was $223 million. From 1994 to 1995, they followed this kind of process and introduced 12 new angioplasty catheters to dramatically increase their market share around the world. By 1995, their revenue was $443 million. In 1996, they introduced the arterial stent and earned $1 billion.

Panellist 4: Daniel Trépanier, President & CEO, Quake Technologies Inc.

Quake Technologies is a fabless semiconductor component company founded in April 2000. Quake is a world leader in 10 Gigabit Ethernet physical layer chips. Its customers include Cisco, Intel and Nortel. Quake specializes in making the high-performance elements used at the front end of Ethernet networks.

Introduction

- At Quake, we are victims of being a bubble company. We were funded during the boom years. How you do things in a boom period is very different than how you do things during a slowdown period.

- We have about 70 to 80 per cent market share. However, most of our customers have been struggling. Total funding for our company was about $48 million initially. We persuaded some strategic investors to buy into our company, which really helps us through the hard times.

What is Ethernet?

- Ethernet is the backbone of the Internet and the most pervasive enterprise networking technology today. Almost everyone today has 100 Mb/s Ethernet on his or her desktop computer and 1 Gb/s Ethernet is used in the "IT closet." Last year, 10 to 20 million 1 Gb/s Ethernet ports were sold for use in desktop computers. This drives a need for bigger pipes on switches and servers. Quake Technologies is helping with that transition.

Economic cycles matter!

- We found that it was a very different matter managing our business in 2002 and 2003 than it was in 2000. A new technology market strategy is highly sensitive to the state of the economy.

- In a "pull" situation, market demand exceeds supply. Being first to market is key. The number one and two players win the most economic profits while the others fight for the rest.

- Implications: spend what it takes to be first

    - Garner the resources you need to execute.
    - Establish relationships where suppliers want to see you succeed.
    - Align yourself with the right customers and get visibility into end-user needs.

- In a push situation, supply exceeds market demand. Survival is key. Being first can be helpful but it can also be fatal. If you are first, you need to make sure you have the legs to survive the down cycle.

- Implications: make sure every dollar you spend creates value.

    - You can hire excellent people.
    - Suppliers are hungry for business but their resources may be limited.
    - Align yourself with the right customers to get visibility into end-user needs.

Strategies

- Partner with suppliers, customers and competitors. Participate in industry standards groups and technical demonstrations. Make sure the 800 lb. gorilla has an incentive to work with you.

- Evangelize. Publish technical papers. Present papers at industry, investor and Innovation Roundtable conferences. Present the merits of your solution to all who will listen.

Workshop 11 Recommendations

1. Key issues

- Understanding the customer/markets
- Understanding the competition
- Understanding the problem you're trying to solve
- Defining the "white space" (customers needs/markets do not change)

Commentary

- *Markets can be multi-faceted. There are niche markets, consumer markets, commercial markets, industrial markets, defence markets, etc.*
- *Understand who the competition is and what they offer. Being small doesn't mean you won't succeed.*
- *Understand what the client needs and the problem you're trying to solve.*
- *The white space is what you choose to target. Recognize that customers' needs don't change as fast as you may think. What changes is the opportunity to use technology to satisfy those needs.*

2. Successful strategies

- Customer focus
- Adaptability/flexibility to economic realities
- Listening
- Bridging the gap
- Partnerships
- Strategy for the value chain/structure for the value chain

Commentary

- *Adapt your business strategy to suit economic realities: surviving downturns requires different approaches than thriving in boom periods.*
- *Learn to listen to what your client is saying. We are often so focused on trying to sell our product that we forget to listen to their needs.*
- *Approach partnerships in a strategic way.*
- *Understand the structure of the value chain. What value do you bring to your customer?*

3. Pitfalls to avoid

- Technology jargon
- Selling product features as "benefits"
- Too much risk (market risk + technology risk)
- No link to customer need (forgetting the customer)
- Too much focus on IP/alliances, not enough focus on product

Commentary

- *If you fall in love with your own technology, you may forget your customer focus.*
- *Avoid selling the features of a product instead of what the product will do for your customer.*
- *Taking on both market risk and technology risk is the most dangerous strategy to follow.*
- *If you focus too much on partnerships and alliances, you may forget about the customer that is going to pay for your product.*

4. Validation

- Get customers to pay money
- Do I have a value proposition?
- Climb into customer's issues
- Validate "market" and broader requirements with customer

Commentary

- *The best form of validation is a paying customer.*
- *Climbing into a customer's issue means understanding the customer's needs.*
- *Always listen to what the market is telling you. Don't fall into the trap of thinking too narrowly.*

5. What should the government do?

- Incentives to translate R&D into products
- Customer research support
- Change our institutions
- Responsiveness/reaction time

Commentary

- *Government institutions have difficulty changing. Faced with new realities, they're slow to adapt. It takes a long time to change legislation, programs, and how government does business.*

Appendix A:
Roundtable VIII Agenda

April 28th, 2003

18:00 – 20:00 **Networking Reception with Guest Speaker**
Dr. Terry Matthews – CEO, March Networks
"New Product Markets through Technology Convergence"

April 29, 2003

Morning Plenary Session

8:00 - 8:15 **Opening Remarks**
Arvind Chhatbar, Executive Director,
Regional Innovation Forum

8:15 - 8:45 **Welcoming Remarks & Official Opening**
Dr. Arthur J. Carty, President, NRC &
Co-Chair, Regional Innovation Forum

Kirk Mandy, Co-Chair, Regional Innovation Forum &
Co-Chair of The Ottawa Partnership

Yves Ducharme, Mayor, City of Gatineau

Presentations by Keynote Speakers

8:45 - 9:10 *"Climate Change: A Storm of New Products"*
Chris Henderson, CEO, The Delphi Group

9:10 - 9:35 *"Hydrogen Powering the Future – Bold Steps to Reality"*
Dr. Bragi Árnason, (Professor "Hydrogen") Science Institute,
Icelandic New Energy
Dr. Thornsteinn I. Sigfusson, Chairman, Icelandic New Energy

9:35 - 10:00 *"Breaking the 'Chicken & Egg Conundrum' in Getting the Infrastructure in Place"*
Jon Slangerup, President and CEO, Stuart Energy Inc.

10:00 – 10:15 **Coffee Break**

10:15 – 10:40 *"New Technologies and Issues in Health Market"*
Rod Bryden, CEO, World Heart Corporation

10:40 – 11:05	*"Bioinformatics – A Convergent Technology with Opportunities"* Dr. M. Vidyasagar, Executive Vice-President, (Advanced Technology), TCS
11:05 - 11:30	*"Intelligent Transportation Systems – An Open Marketplace"* Pierre Bolduc, Vice-President, Delcan Transportation Systems Division
11:30 - 11:55	*"Burgeoning Security Sector – A Mecca for New Products"* Michael Lum, Senior Sector Development Officer, Defence Industries, Industry Canada
11:55 - 12:10	**Q & A Session**
12:10 - 13:40	**Luncheon with Guest Speaker** *"Convergence of Technologies – Lessons from the Silicon Valley Experience"* Doug Henton, President, Collaborative Economics, U.S.
13:45	**Afternoon Workshop Sessions**

Concurrent Workshop 1
Overcoming Barriers in Developing New Product Markets

Chair of Panel:	Gilles Patry, Rector, University of Ottawa
Panelists	*Joel Shaw,* CEO, BioDentity Systems Corporation *Chris Henderson,* CEO, The Delphi Group *Bob Moses,* President & CEO, PCI Geomatics *Sonny Lundahl,* Vice-President, Research & Development, AMITA Corp.

Concurrent Workshop 2
Business Strategies to Create New Product Markets

Chair of Panel:	Jacques Lyrette, Administrator, Economic Development Corporation, Ville de Gatineau
Panelists	*Ron Britton,* President & CEO, Fuel Cells Canada *Brian Foody,* President, IOGEN *Paul Renaud,* President, Lanigan Group *Daniel Trépanier,* President & CEO, Quake Technologies Inc.

15:45	**Coffee Break**
16:00	**Closing Plenary** Co-Chaired by *Dr. Arthur J. Carty* and *Kirk Mandy*, Co-Chairs of the Regional Innovation Forum

Wrap-Up Discussion and Review of Workshop Sessions

17:30	**Cocktails**
18:30	**Dinner**
20:00	**Awards Celebration**

Appendix B:
Regional Innovation Awards Celebration

The Regional Innovation Forum VIII celebrated the fourth Regional Innovation Awards Celebration. The awards recognize the Ottawa Region's best innovators for their contributions to the community through economic growth, improving the region's image as a centre of dynamic R&D, or enhancing living conditions of society in general.

Innovator of the Year: Franz Plangger

At CML Technologies Inc., Franz Plangger developed the first small digital switch for use in air traffic control and mobile radio. This switch achieved its greatest success when Mr. Plangger and his engineering team adapted it to the 911 service. Today, the switch and products derived from it have been installed in more than 750 communities in North America. More than 1000 police, fire, ambulance, secret service, security and other services use this technology for mobile radio applications. Under Mr. Plangger's leadership, this innovative digital switch technology has created more than $25 million in sales and 170 jobs. Mr. Plangger today runs SolaCom Technologies Inc.

Innovation of the Year: Ionalytics Corporation

Ionalytics designs and manufactures a dynamic ion-filtering instrument for drug discovery within the pharmaceutical and proteomics industries, the company's first target market. Based on FAIMS technology, the instrument attaches to mass spectrometers, enabling lab professionals to reduce drug development time by improving the efficacy of their research data. The team includes seasoned business leaders, respected scientists and engineers with years of product development and support expertise. The company's collective talent and expertise has resulted in a customer-oriented culture and a high performance instrument that will bring new drugs to market more quickly, helping to position Ottawa-Gatineau as a world-leading cluster for excellence in life sciences.

Lifetime Achievement Award: Dr. Peter Morand

Peter Morand is considered the 'archangel of life sciences industry' in the National Capital Region. Dr. Morand came to Ottawa in 1961 after completing his post-doctoral work with Prof. Sir Derek Barton, a Nobel Laureate at the Imperial College in England. He has founded numerous companies and organizations that have provided the fabric for a viable life sciences cluster in this region, including the Ottawa Life Sciences Technology Park, the Canadian Science & Technology Growth Fund, Adherex Technologies Inc., Cadherin Biomedical Inc. and Inno-Centre, Ottawa. He continues to devote his energies to provide mentorship and advice to companies, institutions and all levels of government to promote growth of companies.

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