

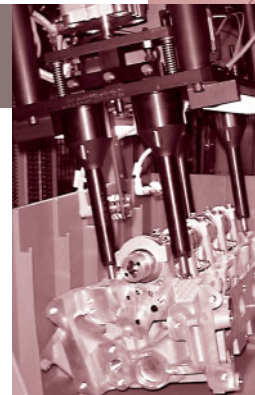


Government of Canada

Gouvernement du Canada

Seven Canadian Firms in Profile

THE PRACTICE OF INNOVATION



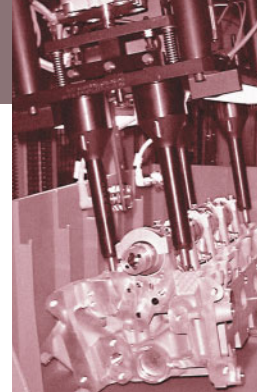
CANADA'S
INNOVATION
STRATEGY



Canada

Seven Canadian Firms in Profile

THE PRACTICE OF INNOVATION



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Contents

Minister's Message	2
Acknowledgements	3
Preface	4
Introduction	6
1. Genesis Genomics Inc.: Scientific Innovation in the Test Tube of the Marketplace	12
2. Ballard Power Systems Inc.: The Power to Change the World	20
3. logen Corporation: Canada's New Alchemists	32
4. Garrison Guitars: Great Ideas Aren't Enough	40
5. Braintech Inc.: Empowering Robots with 3D Vision	48
6. My Virtual Model Inc.: The Virtual Model Product	60
7. Research In Motion Limited: Two Decades of Non-Stop Innovation	68

In February 2002, the Government of Canada launched *Canada's Innovation Strategy* — an ambitious plan to make Canada a world leader in innovation and learning by the year 2010.

The Government of Canada also made a commitment to listen to the views of Canadians. The response was overwhelming, and we received hundreds of written submissions. The engagement process, involving 34 regional summits and dozens of industry and sector round tables, culminated with the National Summit on Innovation and Learning in Toronto in November 2002. In all, more than 10 000 Canadians have helped shape *Canada's Innovation Strategy*.

What we have heard over and over again is that the road to innovation is not an easy one. There are a great many challenges to be overcome before even a great idea can be turned into a product for the marketplace.

The Government of Canada is working on many fronts to create a climate in which innovation and entrepreneurship can flourish. Our goal is to create a culture of innovation and learning in every sector of the economy.

Canadian entrepreneurs are also doing their part. And Canada has a great many companies that are industry leaders, creating world firsts.

In the case studies that follow, you will see how some Canadian firms are meeting the innovation challenge. But more than that, you will learn more about how they have achieved success. Each story is unique and illustrates a different aspect of the innovation cycle. Some are at the early stages of product development, while others have successfully commercialized their product and must now face the challenge of continuous innovation.

Firms seeking to be more innovative can learn from the success of those who have been there and done it, and these case studies may help you pick up a few ideas that make all the difference in your situation. These are remarkable companies whose innovations are moving them to a position of eminence in the global economy. Please take advantage of the opportunity to learn from their experiences.

I hope that you will find these case studies not only useful, but inspirational and entertaining as well.



Allan Rock
Minister of Industry



Acknowledgements

This publication is based on interviews with, and research on, seven Canadian firms that are pursuing the innovation journey. Their experiences and insights will hold valuable lessons for other individuals and firms who are seeking to take their innovative ideas and turn them into reality, whether driven by science, technology, markets or pure passion. Industry Canada is very grateful to the chief executive officers and senior executives of these firms who agreed to be interviewed, profiled and taped on video so their knowledge could be transferred to others, as well as to those who provided additional information or arranged for company visits. Specifically, we wish to thank the following:

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Braintech Inc. — Owen Jones, CEO; and Babak Habibi, President and COO.

Garrison Guitars — Chris Griffiths, CEO; Andy Fisher, Plant Manager; and Dave King, President and CEO, Genesis Centre, Memorial University of Newfoundland.

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My Virtual Model Inc. — Louise Guay, President; and Jean-François St-Arnaud, CEO.

Research In Motion Limited — Michael Lazaridis, Co-CEO; Jim Balsillie, Co-CEO; and Rob Crow, Director, Government and Industry Relations.

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Preface



The Practice of Innovation: Seven Canadian Firms in Profile is part of a larger project that was conceived as an outcome of the National Summit on Innovation and Learning held in November 2002. The summit was the culmination of a year-long process to engage Canadians in a dialogue on the critical policies and actions that would enable the country to enhance its competitive position among the world's developed economies through improved innovation performance. Most of the submissions received by the Government of Canada in response to *Canada's Innovation Strategy*, released in February 2002, were prepared by industry and business associations; universities and colleges; research institutes and technology transfer offices; labour and economic development organizations; and groups representing youth, the Aboriginal community, and small and medium-sized enterprises (SMEs).

In an attempt to gain a deeper understanding of the practical realities of individual firms in pursuit of innovation, including the challenges and barriers they face along the way, Industry Canada commissioned a study of innovating firms. Seven of these firms agreed to participate in an extended project, *The Practice of Innovation*, the objective of which is to transfer their knowledge and experience to other Canadian firms. Collectively, the firms profiled in this publication exemplify the steps necessary to move through the innovation process from idea conception to commercialization. Packaged with two video components, *The Innovation Journey: Seven Canadian Firsts*, and *The Face of Innovation*, and facilitator's guide, the material produced under *The Practice of Innovation*

project provides a comprehensive view of what the innovation journey entails. It will be used to promote an innovation culture, so that more firms will pursue the innovation path; and to provide instruction for students, SMEs, innovation advisers, and others interested in understanding more about the challenges and requirements for firms moving through the various stages of the innovation process.

Readers will meet the chief executive officers and senior executives who are leading their firms through the concept development stage of innovation, the precommercialization stage, the market entry or commercialization stage, and the next cycle of innovation. Each stage requires attention to certain key aspects of taking innovation forward. These are articulated in each of the case profiles. From these, readers will gain perspectives on the factors that are key to successfully undertaking the innovation journey.

Innovation can occur in firms of all ages, sizes, and types, and is as much about improving processes and services as it is about developing new technologies and products. The cases profiled in this publication, for the most part, represent firms with breakthrough technologies and products that can have a dramatic impact on how we live, work, or conduct our daily lives.

Synopsis of Profiled Cases

Case 1: Genesis Genomics Inc. is a cutting-edge biotechnology company, located in the Northwestern Ontario Technology Centre on the campus of Lakehead University in Thunder Bay, Ontario. Their mission? To develop a diagnostic tool at the DNA level that could revolutionize the battle against cancer. They are the only company in the world looking at mitochondrial DNA as a tool for detecting cancer.

Case 2: Ballard Power Systems Inc. is a world leader in developing fuel cell technology. Based in Burnaby, British Columbia, the company has been working on refining fuel cell technology for commercial uses since 1983. Their vision is “power to change the world.” Because of its potential to replace the internal combustion engine, the fuel cell is a disruptive technology and would have a tremendous impact on reducing greenhouse gas emissions.

Case 3: Iogen Corporation is a leading industrial biotechnology company specializing in EcoEthanol™ — a clean, zero-net-carbon-dioxide-emission fuel that can be blended with gasoline and used in today’s cars. Based in Ottawa, Ontario, the company has built the world’s first and only demonstration-scale facility to convert cellulose material, such as straw, into bioethanol, using enzyme technology.

Case 4: Garrison Guitars manufactures guitars made with the revolutionary, patented Griffiths Active Bracing System™, a unibody bracing system made from a glass fibre component. Its guitars are made in a state-of-the-art facility in St. John’s, Newfoundland, using manufacturing technologies not commonly found in guitar production, such as laser cutters, CNC systems and robots.

Case 5: Braintech Inc., based in North Vancouver, British Columbia, is an industrial software maker for automakers. It develops and supports commercial-grade vision-guided robotic automation solutions based on its world’s-first single-camera three-dimensional robotic guidance systems.

Case 6: My Virtual Model Inc., based in Montréal, Quebec, is the world’s leader in creating on-line sales tools for the apparel industry. The company is propelled by its revolutionary virtual model technology, a virtual identity technology that lets users “try on” clothes on-line.

Case 7: Research In Motion Limited, based in Waterloo, Ontario, was the first company in the world to develop interactive paging. This invention led to the development of the company’s BlackBerry™ product, an always-on, always-connected handheld that receives and sends wireless e-mail messages, and that is clearly ahead of anything else on the market.

For the complete set of *The Practice of Innovation* components (the case profiles, the facilitator’s guide and the two video components), contact Industry Canada at the address listed on page ii.

Introduction



What is Innovation?


Innovation is not a well-defined concept. Although definitions exist, it means different things to different people. In the context of this publication, we were interested in finding out more about how executives of Canadian firms viewed innovation, in order to gain a better understanding about how they practised it. The firms selected are primarily ones that have developed what might be called “disruptive technologies.” The products they are developing or have launched on the market have the potential to dramatically change the way things are done, even the way we live. Robots that see in three dimensions; fuel cells that could replace the internal combustion engine; the ability to try on clothes on-line on your own virtual body; automobile fuel made from wheat straw; handhelds that can deliver your e-mail to you anytime, anywhere; guitars made with unibody bracing systems; and a DNA physical that could detect whether cancer is stalking you — these are the dramatic innovations we are talking about. These technologies, based on refinements of both science and conventional methods, have or will revolutionize traditional ways of looking at the world.

The executives of these firms clearly see innovation as more than technology development. They all agree that technology development for the sake of technology development is not very useful. Technology eventually has to find a market — that’s what makes innovation. Firoz Rasul, chairman of Ballard Power Systems Inc., talks about innovation as a process that pervades all parts of the organization. He says it best

in his comment, “Innovation is not just about technology development. Innovation had to be in the way we did our financing, the way we did our marketing and marketing relationships, the way we created strategic partnerships, the way we dealt with government. The innovative nature of doing business for us had to be pervasive in the company, and had to look at more than just technology development.” Research In Motion (RIM) Limited’s co-chief executive officer (CEO), Mike Lazaridis, refers to innovation as a journey. “It’s not a eureka moment,” he says. “It’s like any other art. You have to train for it. You have to get experience for it. You have to discipline yourself. It’s hard work.” According to Chris Griffiths, CEO of Garrison Guitars, “You don’t start and finish innovation. You start it and you never complete it.”

A Portrait of Innovation

The seven firms in this publication are very diverse, although they are all world firsts in what they do. They range in age from 2 years (Genesis Genomics Inc.) to 25 years (logen Corporation) and are in varying stages of the innovation process, some still in the proof-of-concept phase and others already innovating with the next cycle of innovative technologies and products. Some firms are still very small and others quite large. The number of employees in the firms ranges from nine, at Genesis Genomics, to almost 2000, at RIM. Their revenues range from nil to almost \$300 million per year. They are located in small towns or large cities.



Four of the firms were started by teams of two to eight people; the remaining three by individuals. Five of the companies remain founder-led; two, Ballard Power Systems and Iogen Corporation, are in their second generation of leadership, their founders having retired. The vision of the founder(s) is critical to the genesis of each firm and to what it has become. Their curiosity and passion were often a major driver for the firm's march forward. Innovation for these firms very often started with the questions "What if we ...?" or "I wonder if we could ...?" or "What would happen if ...?" Taking action to answer those questions or work on a solution was a major impetus for innovation. Behind this could have been a mixture of inspiration and desperation, a focus on market, technology, or science. Four of the firms were started by scientists and engineers (people with research and technical backgrounds); three by businesspeople. However, regardless of this, founding CEOs eventually hired the expertise they needed — the businesspeople bringing in technologists and researchers, and the scientists and engineers bringing in management and marketing expertise. All firms placed a high value on bringing in a strong chief financial officer.

Four of the companies are privately held and three have gone public (Braintech Inc., Ballard Power Systems and RIM). Braintech raised \$2 million in a private placement in 1993 before it even had an office or staff. Ballard went public in 1993, 10 years after its beginnings and RIM went public in 1996, 12 years after its start. All of these firms have external boards of directors and have made efforts to attract highly credible and experienced people to their boards.

Innovation is Hard — It Takes a Long Time

Getting their innovations to market has taken a long time for most of these firms. Both Iogen Corporation and Ballard Power Systems have been in the game for at least 20 years, on the road to commercializing bioethanol production and fuel cells, respectively. Refining the technology to get the costs down, finding a way to mass produce, and waiting for a ready market have been only some of the major roadblocks for these two firms. Ballard Power Systems is only now on the "cusp of commercialization," and Iogen Corporation is now in the demonstration stage of its bioethanol project. Mike Lazaridis, RIM's CEO, spent more than 10 years investigating, researching and trying to get wireless e-mail to work. Braintech's staff spent the first eight years of the company's life doing research and development (R&D) in a number of areas before finally identifying the opportunity that led to their invention of single-camera three-dimensional vision guidance for robotic applications in automotive plants. It took Chris Griffiths, CEO of Garrison Guitars, six minutes to sketch out his idea for a new guitar construction on the back of a napkin, and six years to get working prototypes and a manufacturing plant in place for his revolutionary Garrison Guitar. According to Robert Thayer, CEO of Genesis Genomics, it will take at least five years to get their DNA diagnostic tool to the marketplace — and that's only if everything goes better than planned.

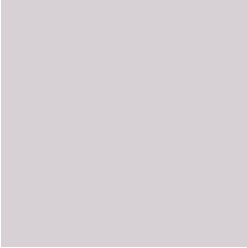
The challenge of innovating can be daunting. Luckily for many of the firms in this publication, the founding CEO was naive about what would be required. Looking back on his journey, Chris Griffiths remarks, "If I knew in April 1995 that I would have to go through what I've gone through to get to where I am today, I never would have done it. Not by a long shot! What kept me going was believing that at any point in the process, we were just a couple of months from success." For others it is the relentless passion to find a solution to a global problem like greenhouse gas emissions or the cancer epidemic that keeps them going. They just don't give up.

The Innovation Journey Costs a Lot of Money

Because innovations such as the ones profiled in these case studies take a long time to get to market, the companies do not generate any revenue from sales during the formative research and development and precommercialization stages. Thus, raising money is a major preoccupation for innovating firms. Debt financing is not a viable option for firms in this stage of development, so they have to look at more innovative sources of funds. This requires strategy. Says Jim Balsillie, Co-CEO of RIM, "We are very systematic in how we fund the company, just like in how we develop our technology and build our markets. You must be ready to get money ... there is a readiness process of networking and having people aware of your company, and having a plan ready and a cash flow driven by assumptions." For all these firms, government has played a key role in early financing. The Industrial Research Assistance Program (IRAP), the National Research Council Canada, and Technology Partnerships Canada were often mentioned as key supporters.



As the companies progressed along the innovation journey, they became less dependent on government funding sources and more dependent on private investors (angels), venture capital, strategic partnerships and public markets. Seed capital in amounts of \$3 million might be enough for a Garrison Guitars to get to market and for a Genesis Genomics to get to the proof-of-concept stage, but significantly greater amounts are required to scale up to meet demand (in the case of Garrison) or to approach full-scale commercialization (in the case of Genesis Genomics). In the latter case, an estimated \$20 million to \$30 million will be required. Companies that have gone public have been able to raise significant amounts of money. This has enabled them to pay all the bills until the technology is transformed into a product that generates earnings. Ballard Power Systems, for example, claims to have raised more than a billion dollars to date. Firms that have not gone public have attracted angel and venture capital, often on a leap of faith, or developed strategic partnerships with large firms whose support significantly accelerated the innovation process. DaimlerChrysler and Ford Motor Company are both equity investors in Ballard Power Systems, and Petro-Canada and the Royal Dutch/Shell Group are equity investors in Iogen Corporation. Several CEOs noted that venture capital is not available to firms in the infancy stages of innovation. Venture capitalists want to see an experienced and professional management team in place, filed patents, working prototypes, and evidence of primary research validating demand. These are requirements not easily met by young, emerging firms still in the R&D stage. Informal investors and government programs are essential to finance their operations. In a few cases, specifically Braintech and Iogen



Corporation, the founder of the firm had substantial personal wealth that could be used to finance the “cash burn” rate of their R&D operations.

All seven companies mentioned the difficulty of raising patient capital since the downturn in the markets in 2000. Lack of capital can be a major barrier to innovation at the precommercialization stages.

The Innovation Process Requires Lots of Non-financial Resources

Particularly in the early stages of innovation, firms need lots of other help. Genesis Genomics, a university research spin-off, and Garrison Guitars both benefited from the resources of university incubation and innovation centres. IRAP assistance also proved invaluable to firms seeking knowledge about specialized technologies. Community support ends up being very important to the capacity of the innovating firms included here to succeed to the levels they have, supplying them with the experts who can help with business planning, patenting processes and technical expertise; experienced businesspeople willing to provide advice, mentoring and angel investments; and government agencies that are willing to invest time and development funding.

A Journey Full of Trial and Error

None of these companies has taken a straight path to innovation success. All admit to a great deal of trial and error, but they have learned from what didn't work and used that knowledge to get to the next point. This may be an iterative process, where incremental innovations build on each other to reach the final product. Says RIM's Mike Lazaridis, “I think innovation is misunderstood. What you start with is not going to be what you are working on when you're successful ... I had no idea where I would end up today. Innovation is not predictable, but the path will be predictable — failures and trying moments — but, if you stick with it long enough and stay focussed, eventually you will make it.” This view is supported by Ryan Parr, vice-president of research at Genesis Genomics, who says, “We have had lots of setbacks along the way. Lots of things could put you behind schedule — science that doesn't work, experiments that fail. The key is not to get discouraged.”

Innovation Requires Discipline and Focus

Companies such as Ballard Power Systems and Braintech talk about the importance of shifting their R&D efforts to focus on customer- or market-driven solutions. Ballard Power Systems emphasized the importance of setting R&D targets and monitoring how well these technology milestones are being met. Firoz Rasul advocates developing technology road maps, followed by product maps and a process of securing validation of the technology/product by customers. Does it work? Will customers want to buy it?

A technology without a market will not bear the fruit of innovation efforts, and so it seems that science and technology-based innovations must eventually focus on practical solutions in the marketplace. Being able to demonstrate that the company is progressing with its technology development is important, particularly when there are outside shareholders. The constant question is “What did you do with the last bunch of money we invested?” Firms have to be able to show they are making progress towards predetermined milestones.

The Importance of On-going R&D and Patents

At the beginning of the innovation process, firms spend almost 100 percent of their capital on R&D. In fact, they raise money with the express intent of doing this. Even once in the market, innovative firms continue to allocate significant portions of their budgets to R&D.

Patents are also extremely important to innovative firms. All of these case study firms have patented technologies. These patents are used as a defensive strategy in a competitive marketplace by firms like Ballard Power Systems (which has more than 1700 patents) and RIM (which has several hundred). A company’s patent portfolio is seen as an asset that allows it to enter a competitive market space with bargaining power and leverage, as well as an asset to create value for shareholders. RIM’s Lazaridis has strong advice about this. “If you are not patenting everything you are working on, someone else might patent what you are working on. Patenting should be a standard operating procedure for your company, a standard operating procedure for your researchers and engineers. If they come up with an idea to solve a difficult problem, then they should immediately apply for a patent,” he says. The patent on the Griffiths Active Bracing System™ was an essential factor in Garrison Guitars’ ability to attract venture capital, and


Braintech’s patents will be one of its key strengths as it rolls out its three-dimensional vision guidance system for robotic applications.

The Importance of Strategic Partnerships

Almost all of these firms have entered into strategic partnerships with large firms in order to secure financing for their R&D, gain access to markets and distribution channels, or obtain technology. Genesis Genomics has partnership agreements with MWG-Biotech in Germany and Nuereka Research Corporation in Sudbury; Ballard Power Systems with DaimlerChrysler and Ford Motor Company; Iogen with Petro-Canada and Royal Dutch/Shell; Braintech with ABB; My Virtual Model with Land’s End, among others; and RIM with Vodafone, BellSouth and others. Finding strategic partners of one sort or another is part of each firm’s direction forward.

Making the Transition From One Stage of Innovation to Another

One of the challenges for all of the firms has been to make the transition from one stage of innovation to another. Moving from concept to precommercialization requires business planning, patent protection, focussing the product-market value proposition, financing, and a management team. Moving from precommercialization (making it work) to implementation (making it and getting it to market) requires an operational base (a plant or otherwise); an expanded employee base; R&D discipline; marketing, technical and strategic positioning expertise; and more financing. Moving from commercialization to the next cycle of innovation requires discipline in technology/product development, financing to scale up and a working environment that supports a culture of continuous innovation. The case studies here show how different



firms have dealt with various transition challenges — for example, moving from being a science-driven firm to a market-driven firm, or shifting from focussing on R&D to focussing on making the technology work in a customer application.

The Role of Serendipity

Finally, the role of serendipity in successful innovation is compelling. In many cases, the innovation breakthrough came as the result of a chance meeting with someone at a trade show, from request for proposals from governments or large firms looking for research or technology solutions, from a change in the readiness of the market or from advancements in technological capacity. In these cases, it was the ability of the CEOs or founders to recognize an opportunity and be willing to act on it to solve a problem and go down the innovation path. The convergence of timing, readiness and technological capacity during the innovation journey cannot be underestimated. One of the best examples of this is found in the Ballard Power Systems profile, although it is also strongly evident in other stories as well.

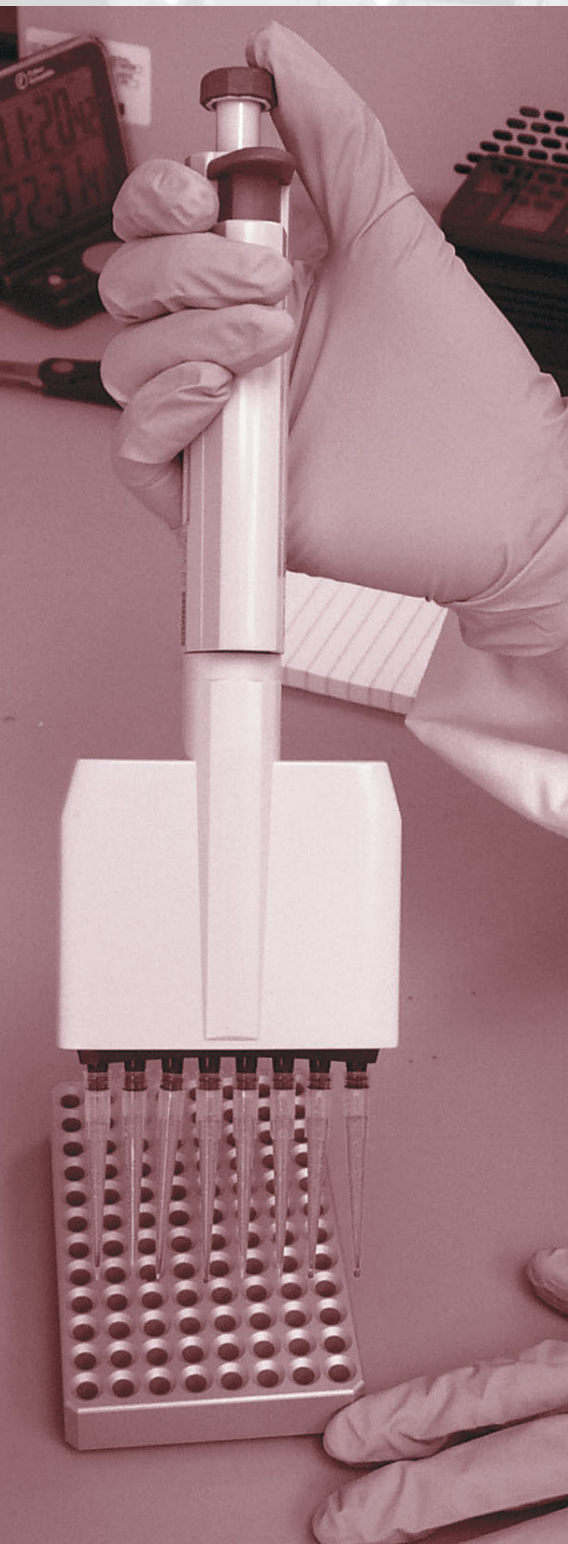
Useful Questions to Explore

Although written in a story format, the case studies that follow hold many useful lessons for anyone interested in knowing more about the steps to take and the critical factors necessary to move from having innovative ideas to taking on the marketplace. While reading through these case studies, readers are asked to consider the following set of questions:

- What were the major drivers behind the innovation in this company?
- How did these drivers change as the company progressed?
- What were the major barriers or challenges that had to be overcome by this company in advancing its innovation? How did they overcome these?
- What stage of the innovation process is the company currently at?
- What were the key elements to the success of the business in achieving its current position?
- What will be needed to get the company to the next stage of innovation? What are its major challenges likely to be?
- If you were the company's CEO, what might you do next?

of the Marketplace

Scientific Innovation in the Test Tube



GENESIS GENOMICS INC.

The founders of Genesis Genomics first moved beyond the world of science into the world of business by doing what comes naturally to serious innovators: they made an investment. What was that very first investment? Their Sunday afternoons.

There were seven or eight founders, depending on whom you ask. Among them were scientists from Thunder Bay's Lakehead University, the University of Newcastle School of Medicine, the Northwestern Ontario Regional Cancer Centre, and medical practitioners. Each were involved in some aspect of molecular research. One day, in a lab, a group of these researchers and scientists started throwing guesses around about a subject all of them were passionate about: what kind of investment might be needed to come up with a DNA-related early diagnostic test for various kinds of cancers, and how long it would take to do in a normal university research environment.

The consensus was seven to ten years and \$77 million — an amount they all knew was well beyond what they would ever get access to within the confines of academic circles. They knew they had good science to develop, based on their work with mitochondrial DNA (mtDNA). The group thought they might even have science to sell, so when someone said, "Let's form a company," there was general agreement.



“We want to find the IEN cells [precursors to tumor cells] before these cells even transform into tumor cells. We want to tell you whether a disease is stalking you. We want to eradicate the process of radiation therapy and chemotherapy as much as possible.”

Bob Thayer, CEO

Genesis Genomics Inc. is a cutting-edge biotechnology company originating and operating in Thunder Bay, Ontario, with strategic partners in Europe and the United States. Genesis Genomics' mission is to develop DNA-based detection tools with extreme sensitivity to the presence of a myriad of diseases caused by alterations in DNA — the blueprints of life. Its main initial focus and efforts are directed against cancer: specifically, prostate and skin cancer. It is a spin-off company based on research being done at Lakehead University, and the only one of its kind in the world focussed on mitochondrial DNA for cancer detection. For more information, visit www.genesisgenomics.com

As Bob Thayer, one of those scientists and now Genesis's CEO recalls, "It is very questionable now how serious we really were when we made that statement. But why not? We were confident. Confidence, of course, is what you have before you understand a situation."

None of the group had any business experience. Their career experiences were all in academia and science. They were very creative people who had made some fascinating discoveries, but they had done so within the confines of what Thayer admits had always been "a safe setting."

Gestation

The group started getting together on Sunday afternoons in the spring of 2000 at Thunder Bay's Northwestern Ontario Regional Cancer Centre, pondering how to convert science into commerce. Their mission? To develop a diagnostic tool for the DNA level that could revolutionize the battle against cancer on a global scale.

They found out that Lakehead University had recently established an Innovation Management Office, which had a mandate to encourage the transfer of academic

“Mitochondria, which contain enzymes needed for respiration and energy production, are structures found in DNA-containing cells.”

technology breakthroughs to the private sector.¹ The group invited Barbara Eccles, a lawyer who had been appointed as the office’s Technology Transfer Officer, to their next Sunday meeting, and made their scientific pitch, which was, in a nutshell:

- Mitochondria, which contain enzymes needed for respiration and energy production, are structures found in DNA-containing cells.
- MtDNA is less complex than the DNA found in a cell’s nucleus — it contains fewer than 17 000 base pairs instead of 3 billion.
- MtDNA is, therefore, far less expensive and time-consuming to analyze than nuclear DNA.
- Changes in nuclear DNA, such as those that occur when cancer starts to alter cell structure, are communicated at a very early stage to the adjacent mtDNA.
- MtDNA, therefore, serves as a shortcut, or an index, to the workings of the nucleus, and can be an indicator of the health of nuclear DNA.

1. The Innovation Management Office of Lakehead University was funded in early 2000 with a \$1-million grant from the Natural Sciences and Engineering Research Council of Canada’s (NSERC) Intellectual Property Management Program, which is aimed at stimulating the transfer of university-based research and development to the marketplace. The program is funded through NSERC, the Social Sciences and Humanities Research Council of Canada, and Canadian Institutes of Health Research. Genesis Genomics was assisted by the office’s Start-Up Company Program.

- By studying sequential changes in mtDNA in samples taken from biopsies, and blood and other body fluids of volunteers who 1) show no clinical signs of cancer, 2) are in early stages, and 3) are in late stages, researchers should be able to detect a pattern similar to a road map of genetic change.
- If this road map is accurate, health care practitioners should be able to compare a person’s mtDNA with the road map to discover whether DNA taken from a patient’s lung, breast, prostate or other body part is similar to cancer-free mtDNA, precancerous mtDNA, or mtDNA of more advanced stages of cancer.

If the assessment is done early enough, doctors may be able to treat patients before cells become cancerous. That would amount to a “genetic physical” — testing body fluids in search of changes in a person’s genetic code, in the hope of pre-empting mutations into cancerous cells.

In Thayer’s words, “We want to find the IEN cells [precursors to tumor cells] before these cells even transform into tumor cells. We want to tell you whether a disease is stalking you. We want to eradicate the process of radiation therapy and chemotherapy as much as possible.” This is what Thayer and the others told Eccles. Their plan was to start with tracking prostate cancer, and move into other major cancer fields, including skin, breast, cervical and lung cancer.

Eccles, to their relief, was excited. She foresaw the promise of the very first commercial science spin-off nurtured to a significant extent at Lakehead University. “If the concept works, it has the potential to change the face of diagnostics around the world,” says Eccles.

But, if Eccles’ response represented a great moment, it was a moment that signaled the beginning of years of hard work. The founders now had to face the unknown world of business, a world that over the next two years would sometimes seem almost as difficult to unravel as DNA itself. Their first job was to turn scientific theory into something that could be demonstrated as a workable detection tool.

Eccles' critical role was to take this group of scientists, help them define the idea, determine what the product was, evaluate the concept, and assess whether it was a licensed technology, or whether there was real potential for a spin-off venture. After that, she helped them find management, work through the business planning process, schedule activities and determine how much financing was needed.

“Genesis is like putting together a puzzle. We know what we want it to look like in the end, but we need a lot of pieces to pull together,” says Eccles.

Another important thing Eccles did was help sort out the intellectual property (IP) ownership issues associated with the rights of seven or eight researchers and Lakehead University. The university's IP policy specifies that researchers own the IP rights to their research, but that the university has the right to share in profits from its commercialization or sale. Instead of exercising that right with the Genesis Genomics team, the university chose to become a shareholder in the numbered holding company in which members of the research team

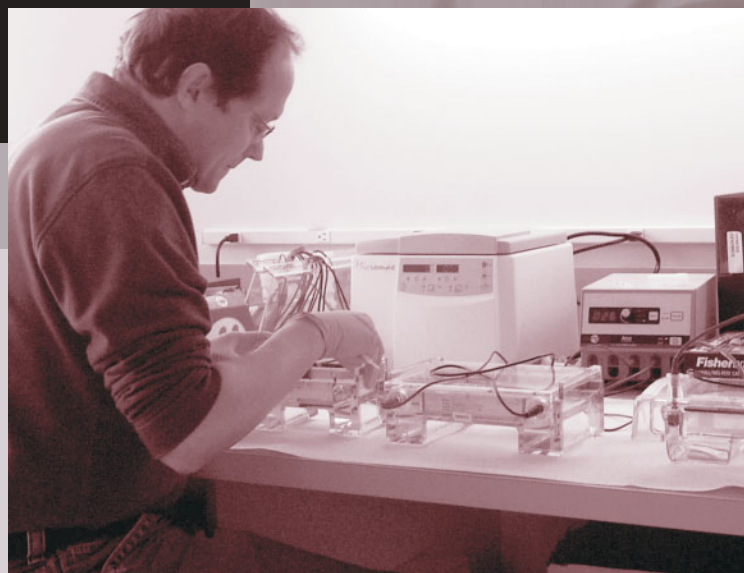
all vested their individual IP rights. In turn, the holding company licensed the IP to Genesis Genomics.

Moving Science and Commerce Through Their Start-Up Phases

In the fast-moving world of biochemistry, the Genesis founders knew that they had to move forward quickly on both the scientific and business fronts. While incorporated in June 2001, Genesis would remain a business without a product until it had scientific “proof-of-concept” — testimony from third-party peers that it had a product of proven medical value. This would also prove it had commercial value.

As with most businesses, personal skills were critical, which is why Thayer was named acting CEO. The company knew that it would eventually need an experienced CEO to impress the venture capital community, but, in the early going, Thayer had some obvious qualities that helped the company on both the scientific and business levels.

“Genesis is like putting together a puzzle. We know what we want it to look like in the end, but we need a lot of pieces to pull together.”



He had represented Canada at the 1968 Olympics in Mexico City as a wrestler, and had gone on to coach Canada's 1976 and 1980 Olympic wrestling teams. He was the country's national wrestling coach for two years, and coached both football and wrestling at the university level. Here was a man who knew how to communicate, and motivate.

In the words of Genesis Genomics' vice-president Ryan Parr, "Bob is a really good people person. Whenever he negotiates with physicians, he is able to engender a lot of excitement and confidence." Thayer also had a PhD in kinesiology and biochemistry, and a research interest in mtDNA mutations associated with aging and prostate cancer.

Parr, with a PhD in biological anthropology and more than 20 years of research experience in recovering and sequencing mtDNA (paleo-DNA), and in the problems of cancer becoming resistant to drug therapy, became the vice-president of research. The company also added two key shareholders and scientists to the team during the early development stage, to move the science forward and develop the IP. Mark Birch-Machin, a biochemist and leading skin cancer researcher from the United Kingdom and Keith McKenney, a prominent molecular biologist and bioinformatics specialist from George Mason University in the United States.

Getting doctors, and their patients, to help out was crucial. While there was no visible commercial competitor on the horizon focussing on detecting cancer through the use of mtDNA, the Genesis founders knew that, in the exploding field of biotechnology, time was of the essence. Northwestern Ontario doctors from the Thunder Bay Regional Hospital and the Northwestern Ontario Regional Cancer Centre responded brilliantly. At the start of 2003, the new firm had more than 100 patients participating in its initial sequencing in prostate cancer.

The company also needed labs for its scientists, and facilities to house its nine employees. Fred Gilbert, president of Lakehead University, sped up construction of facilities so the new company could be housed in the university's new Northwestern Ontario



Technology Centre, which is next to some of the top biotechnology research facilities in North America. The university structured the final phases of the centre's construction around the needs of Genesis Genomics. It also gave Thayer time off from teaching for nine months to work on developing the spin-off company.

So quickly has the science begun moving from theory to proof-of-concept that Parr estimates Genesis will have that proof well before the end of 2003, and could well have a product ready for the marketplace within three years.

Parr feels that having a small home town has helped. "It might have been harder to do what we did in a small region, but at the same time, it is easier to get access to business leaders. And we got lots of business advice and mentoring from them and attracted some of their investment," he says.

The Business Side of Genesis Genomics

"At the end of the day," says Thayer, "this is a business and, as much as we're committed to the research, and excited about the research, we've got to be successful as a business in order to survive, in

“We started identifying potential partners, because we really didn’t want to duplicate something that already existed and we wanted to focus on our core competence — research in the area of disease diagnosis, and development of the information data base.”

order to accomplish the science. And that’s a pretty stark reality when you’re used to working in a university ... we had very limited business skills ... I shouldn’t say limited — probably none.”

The first biotechnology company in Northwestern Ontario (and still one of only two), Genesis quickly got some very helpful people and institutions on its side from right in Thunder Bay. To start, instead of haggling over patent rights and how big a share it would take in the company, Lakehead University settled for a 10-percent ownership. Eccles continued to work feverishly on the company’s behalf, signing on as Genesis’s vice-president of corporate affairs. Local business leaders were also extremely helpful, offering both advice and contacts that brought in seed investment money from other parts of Canada and abroad.

Genesis also brought in a retired senior partner from Ernst & Young, Ken Bruley, as their chief financial officer, and benefited from the university’s appointment of Bruce LaBelle, a senior investment advisor from BMO Nesbitt Burns Inc. and a member of the university’s board of governors, as its representative on the Genesis board of directors. But the company’s leaders knew they would have to go beyond Thunder Bay for both expertise and to forge alliances.

From the beginning, the founders decided to focus on what they knew well — sequencing a genetic map — and get outside help to ensure they ended up with a top-flight business plan, tight patent protection, and a marketing ally who could produce the diagnostic hardware to apply their science in doctors’ offices and hospitals around the world.

To develop a business plan, Genesis’s founders worked with Ernst & Young’s Toronto office for about five months. When they sought advice from a knowledgeable professor on where to seek patent assistance, she pointed them again to Ernst & Young. Putting the initial patents in place took six months.

Two of Genesis’s principals borrowed \$50 000 from a local bank to finance the \$15 000–20 000 cost of the business plan and to pay for the initial patenting processes.

As for an international marketing ally who could provide them with the technology that would make their data useful, Thayer said that Genesis went hunting early on. “We started identifying potential partners, because we really didn’t want to duplicate something that already existed and we wanted to focus on our core competence — research in the area of disease diagnosis, and development of the information data base.” After more than a year and a half of negotiating, Genesis entered an agreement to provide German medical devices giant MWG-Biotech Inc. with the necessary genomic data to deliver the diagnostic tools. “They already have the technology in place,” Thayer says. “We are negotiating to bring it in-house.”

Funding and Managing

Bridging capital was obviously needed to move to the proof-of-concept breakthrough the company is counting on before the end of 2003 — the company’s target being spring 2003.

The federal government’s Industrial Research Assistance Program (IRAP) was one of Genesis’s early supporters, providing \$133 000 in funding following

“A lot of scientists around the world share our confidence in the potential of mtDNA to answer some very important questions about diseases. So the risk is manageable.”



an arduous evaluation process. More important than the money IRAP provided was a side effect: the National Research Council Canada (NRC) did due diligence to ensure that an IRAP investment in Genesis made sense, meaning that Genesis emerged from the process with the equivalent of an early NRC seal of approval — always useful for attracting investors.

Genesis also presented its business plan to the board of directors of Thunder Bay Ventures, a Community Futures Business Development Corporation, which came through with \$125 000 in equity financing. FedNor, the regional development agency for Northern Ontario, put in \$875 000 in September 2002, and 20 private angel investors added more funds.

By October 2002, the company had attracted about \$2.5 million of the \$3.3 million it hopes to raise from investors to get from the science stage to proof-of-concept.

A management team also had to be put in place to solicit funding, plan strategies and make day-to-day company decisions. By early 2003, Genesis had a board of directors, a scientific advisory board and a management board. The management board,

featuring a chief financial officer, vice-president research, vice-president business development, vice-president corporate affairs, and a comptroller, meets every two weeks and deals with day-to-day issues. “We want to run ourselves like a publicly traded company,” says Thayer, “because that’s what we want to be.”

The Future

The immediate goal for Genesis is to reach the proof-of-concept stage with its science. Then there’s attracting the next round of financing to take proof-of-concept to market. Genesis will be looking to attract \$30 million over the next three years, if its results are promising. The company also wants to attract a permanent CEO with a solid track record in the business community, and recruit more board members with business experience.

Finally, it will be important for Genesis to investigate which would be the best strategic alliances. The decision on which company Genesis signs up with to provide a platform for delivering the DNA resequencing system will be crucial, as will the capacity of any

partner to market that system. In February 2003, the firm announced a collaborative venture with NEUREKA Research, a Sudbury, Ontario research organization with experience in clinical trial procedures and expertise in coordinating approvals with organizations such as the United States Food and Drug Administration.

In November 2002, Genesis was named one of the three most promising businesses in Canada after being assessed as part of the University of Toronto's Innovation Foundation National Innovation Challenge Business Plan Competition. The forecasted sales potential for Genesis Genomics is in excess of \$3 billion in the North American, European and Asian markets. Unlike the false sense of confidence that Thayer and his colleagues first felt in the lab when they decided to go commercial, he now feels genuine confidence that Genesis will be able to market the smarts of its founders. "There is always risk," he says with a smile, "but a lot of scientists around the world share our confidence in the potential of mtDNA to answer some very important questions about diseases. So the risk is manageable."

According to Thayer, universities are full of good ideas, but unless they break out of the university environment they will realize no benefit to the community or to society. Most university research stays inside university confines because faculty are motivated foremost by the advancement of their academic careers.

"It's really invigorating to get out of the university environment," says Thayer. "When you get out of the university environment, you can really make things move." However, both Thayer and Parr admit that innovation, for them, has been a very difficult process of getting other people to believe in their idea and accessing funding. "We have had lots of setbacks along the way. The key is not to get discouraged. Lots of things could put you behind schedule — science that doesn't work, experiments that fail," says Parr.

Thayer and Parr also caution other entrepreneurs not to be daunted by the day-to-day details of a business. "It's important to realize that these things happen to all businesses and you have to work through them.

For a spin-off company, you have to come to the realization that 'business is war,' and that's just part of the learning process," says Parr. But, add the two Genesis founders, without all the support and cooperation they received from the local community, the university, local investors, government offices, and local doctors, the journey may not have been possible.

“It's important to realize that these things happen to all businesses and you have to work through them. For a spin-off company, you have to come to the realization that 'business is war,' and that's just part of the learning process.”

Genesis Genomics Inc.

1294 Balmoral Street, Suite 310

Thunder Bay ON P7B 5Z5

Canada

Telephone: (807) 346-8100

Fax: (807) 346-8105

Web site: www.genesisgenomics.com

E-mail: roy.wittock@genesisgenomics.com

The Power to Change the World



BALLARD POWER SYSTEMS INC.

Few companies in recent memory have been confronted with steeper barriers to success than Ballard Power Systems Inc. Few companies have depended more on innovation than Ballard to make those barriers crumble.

Will non-stop innovation make Ballard Power Systems a business winner when fuel cell technology sweeps into the marketplace, in the same way it has proven the company a clear winner in developing the technology? Time will tell. Any examination of the incredible hurdles Ballard Power Systems has overcome in the past two decades, however, shows the great strides it has made. Despite a series of daunting challenges, Ballard has managed to keep moving in one relentless direction — toward the future.

This Vancouver-based firm has for two decades been a relentless innovator striving to replace incumbent technologies. Ballard Power Systems' march forward has unfolded under two eras of leadership.¹ The first was led by the man whose name is still on the door — Geoffrey Ballard. The second era belongs to Firoz Rasul,

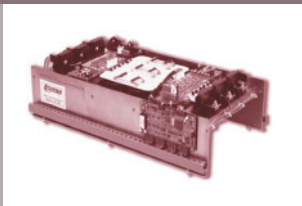
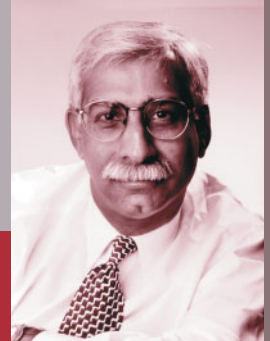
1. There are at least a few issues that will always remain in dispute about Ballard Power Systems' history. Anyone wishing to assess them might start by reading *Powering the Future* (1999), by Tom Koppel, and the article "Waiting for the Revolution," in the January 31, 2003, edition of *ROB Magazine*.



Dennis Campbell, CEO

“Despite a series of daunting challenges, Ballard has managed to keep moving in one relentless direction — toward the future.”

Firoz Rasul, Board Chair



Ballard Power Systems Inc., headquartered in Burnaby, British Columbia, is recognized as the world leader in developing, manufacturing and marketing zero-emission proton-exchange membrane (PEM) fuel cells. Ballard commercializes fuel cell engines for transportation applications, and fuel cell systems for portable and stationary products. Ballard is also commercializing electric drives for fuel cell and other electric vehicles, power conversion products, and natural gas and hydrogen generator sets. It is a Tier 1 automotive supplier of friction materials for power train components.

The company’s goal is to convert its technology leadership into market leadership by being the leading supplier of high-quality, low-cost, PEM fuel cells and related products, and by being the first to offer these products in mass markets where they have potential to capture a large market share. For more information, see www.ballard.com

who has reigned as chief executive officer (CEO) since 1990, and in March 2003 handed over the role of CEO to Dennis Campbell while remaining chairman of the board. Both Geoffrey Ballard and Firoz Rasul have had a profound influence on Ballard Power Systems, and both have helped move the company to a position where it can revolutionize how we produce energy. A third era is about to begin under Campbell, the company’s former president and chief operating officer.

Beginnings

Geoffrey Ballard, with a PhD in geophysics, came together with Keith Prater, a young electrochemist, and Paul Howard, a young engineer, in the 1970s in Arizona, when Prater and Howard agreed to help Ballard try to develop a rechargeable, lightweight

lithium battery. Various clients invested in the project, which the three men transferred to Vancouver in 1977. Although their principal business at the time was producing batteries, the dream of a rechargeable lithium battery became mired in complexities that proved too difficult to overcome.

In 1983 the three men, located in crowded company quarters in North Vancouver, were still pursuing their dream of developing a better energy technology.

With research and development (R&D) funds drying up for the rechargeable battery project, Ballard, Prater and Howard kept their eyes open for other opportunities to keep the small company going. They considered producing computer-assisted design and manufacturing equipment, using their carbon dioxide laser to

engrave giftware products, or developing specialized polymers. Part of this search for opportunities involved looking at potential sources of government money. Their eventual work on fuel cells was almost an accident. One day, Howard came across a Department of National Defense (DND) request for proposals for bids to produce a low-cost solid polymer fuel cell (later to become known as the proton-exchange membrane [PEM] fuel cell²). Here was a request for proposals in an area in which they had technical competence — electrochemistry — and the government was willing to fund it.

The \$500 000 for the DND project was only available because the Trudeau government had been diverting oil revenues into the National Energy Program, its response to the perceived oil supply crisis at the time. The investment was funneled into a questionable technology because of the insight of a few key people in the federal government, and a few outsiders with some influence in the government, who had been scientifically alert enough to believe in PEM technology. Secondly, it was sheer coincidence that the federal government was about to connect with a team of

Ballard researchers who had never before worked on fuel cells.

The concept of bringing hydrogen and oxygen together to create energy first occurred to British scientist Sir William Grove in the 1830s. Grove demonstrated that, when steam is brought into contact with platinum, it decomposes into hydrogen and oxygen. He also experimented with electrolysis — passing an electric current through water to create hydrogen and oxygen. When Grove was disconnecting an electrolytic cell in his lab one day, he noted a reverse flow of current. Therefore, he surmised, it should be possible to combine oxygen and hydrogen to create electricity. He later demonstrated a bank of 50 stacked fuel cells, which did generate a current. However, they did not produce enough energy to compete with galvanic cells or storage batteries.

The modern version of the process still used platinum-coated electrodes, but forced the gaseous ions through a solid polymer (an ion-exchange or proton-exchange membrane) instead of an electrolyte. New molecules cannot be created without exchanging ions between molecules, and the membrane is at the hub of this exchange. The current need for noble metal (such as platinum) catalysts on electrodes, and the cost of



2. The PEM fuel cell is based on the truism that hydrogen and oxygen, when forced together to create water, also create energy. It had been recognized for well over a century that the principle was workable, but it was also expensive, requiring a catalyst like platinum and a very sophisticated PEM.

developing sophisticated membranes, currently makes the technology more expensive than incumbent energy conversion devices. While it was used nervously in the Gemini space program, scientific focus shifted to developing alternative fuel cells that would use cheaper components. Nobody ever quite pulled it off, but they kept trying. Meanwhile, General Electric, which had developed the PEM used in Gemini, had washed its hands of the program, and the PEM had pretty much slipped into the shadows, until the Ballard team decided to put in a proposal to DND.



Improving the Mousetrap

Not only did the Ballard research team have no idea how to build a better mousetrap, they had limited experience in building the mousetrap that already existed. When first presented with the idea of responding to the DND's request for proposals, Geoffrey Ballard is reputed to have said, "What's a fuel cell?" The first rule of science and business, of course, is to pick the brain of anyone who has already attempted what you are trying to do. Prater flew to the Los Alamos National Laboratory in New Mexico, where limited research was still being done on PEM cells and their applicability to transportation, to do just that. He also visited scientists at universities in Alberta and British Columbia. Geoffrey Ballard sent emissaries to Ottawa to discuss the project. In the end, the

Ballard team showed they knew enough about fuel cells to do the work that DND expected them to do. They won the \$500 000 contract, which gave them 28 months to build three prototype fuel cell stacks in the 50–150 watt range.

The hard work then began. The three founders kept working on the company's main source of revenue — batteries, and hired others to work on the fuel cells. David Watkins, a 29-year-old chemical engineer with a degree from the Technical University of Nova Scotia ran the project. Danny Epp, a British Columbia Institute of Technology (BCIT) engineer and Ken Dircks, another young BCIT graduate with expertise in instrumentation, also joined the team. Finally, they hired David McLeod, who turned out to be a driving force in the plant and managed relationships with Ottawa, securing renewals of the original contract.

Geoffrey Ballard showed he could be incredibly respectful of employees who proved themselves. While he frequently asked questions and offered suggestions to his new team, Ballard let them move the project forward on their own terms. Driving everyone at the company towards the technology that would eventually become Ballard Power Systems became a shared passion. Based on early results, everyone in the organization believed that fuel cells could become the internal combustion engine of the future, mitigating the world's voracious production of local air pollutants and greenhouse gases that were poisoning the atmosphere.

Making the Science Work

The team tinkered, and tinkered and tinkered. Their first fuel cell, cobbled together with parts handed down by the Los Alamos National Laboratory that Prater had visited, was only about 7.5 centimetres on each side. There was much joy and backslapping all around when they got it to make a light bulb glow. A scientific progress chart of what happened from there would fill a book.

During the execution of the DND contract, the biochemistry and engineering required to stack fuel cells and make them work in harmony came a long way. Ballard Power Systems' founders were smart enough to invest some of their own money and extra time into this development, in the interest of gaining at least part ownership in the research results, as everyone realized that this was no ordinary R&D project.

They engineered a better system to disperse the water by-product of the reaction. They reduced the amount of expensive platinum needed for electrodes. They switched to an improved membrane. They sorted out problems with carbon monoxide "poisoning" on electrodes. They improved stacking engineering. They just never quit, working long hours, urged on by their sense of discovery. By the end of the DND contract, Ballard had surpassed the contract's requirements.

In *Powering the Future*, McLeod says this about Geoffrey Ballard: "He's crazy in a lot of respects, because you have to be. You have to have this absolute, blind commitment to the thing that transcends everything. There's skill in giving a Watkins what he needs. You've got to stroke these people, make them believe that what they're doing is really important stuff. And, of course, if that ingredient exists, miracles happen."³

Geoffrey Ballard might have started his fuel cell journey by asking "What's a fuel cell?" but he had the foresight to recognize its potential, thinking "If we could substitute ordinary materials and bring the costs down, we could have the engine of the future."

The Miracle

Finally, during the follow-up DND contract in 1986, Ballard Power Systems reached a breakthrough point. They were building 12-cell stacks and had developed the PEM fuel cell to the point that it was producing four times as much power as it ever had when huge companies had spent huge amounts of money trying to develop it. This meant one thing: they were into automobile territory. Not that this cell could power an automobile, but they had shown that a fuel cell could potentially do this. The scientific community was stunned. At a fuel cell conference in Arizona, McLeod remembers a top official from the U.S. Department of Energy watching a Ballard poster demonstration of what they had achieved. "My God," he said. "We've been backing the wrong technology."



3. Tom Koppel, *Powering the Future* (John Wiley & Sons Canada, 1999).

In the early days, there were many challenges. According to Geoffrey Ballard, “We knew the technology and we didn’t think there were 10 people in the world who knew it was going to dominate the world. You knew it was. You could just feel it. Perhaps I more than anyone else. I just had a sense.”⁴ But he knew he needed to find markets for the Ballard technology. The question was, which ones? The company passed up on the idea of niche markets for fuel cells.

“We’re going after the two biggest marketplaces. And on the way we’re going to abuse what is actually the world’s biggest industry, which is the oil and gas industry. We didn’t know how hard it would be to do this. And if we’d ever figured out how hard it really would be, it would have been so daunting we never would have started,” says Ballard.⁵ As the technology progressed, the power, automobile, and oil and gas companies, threatened by the possibility of this alternative energy source, aggressively resisted the introduction of the fuel cell.

Over the coming years, the company would keep making good money from batteries, but it was the fuel cell division that was the focus of everyone’s attention. By the end of the 1980s, a huge transition within the company was in order. It needed to raise capital. A trusted local venture capitalist, Mike Brown, a founder of the Vancouver-based Ventures West venture capital company, took a look at Ballard Power Systems. Ventures West, together with the Business Development Bank of Canada, made an initial investment of \$1.3 million in Ballard Power Systems. Says Brown, “We wanted to determine if the science was going to stand up to rigorous engineering examination, if the technology could be furthered along the path they anticipated, and if it presented an opportunity to change the way we powered energy and did things. Local air quality and climate change were

4. Tom Koppel, *Powering the Future* (John Wiley & Sons Canada, 1999), p. 126.

5. *Ibid.*, p. 126.

“If we could substitute ordinary materials and bring the costs down, we could have the engine of the future.”

two big challenge areas, and the Ballard group had the most interesting technological capability and understanding of how the engineering would work of anybody else we could find.”

This initial investment provided enough financing for about 21 months, at the end of which time another injection of \$7.5 million would be needed. By then, in early 1989, Brown knew, and had convinced Ballard’s founders, that, to raise the huge amounts of money needed to get the fuel cell to market, and to attract strategic partners, they would need a different kind of leadership. Ballard, Prater and Howard were scientists and entrepreneurs, but that wouldn’t be enough. The three didn’t have the backgrounds needed to raise and manage huge amounts of cash, and administer a company that would just keep growing. They needed a CEO and a capable management team that would be trusted by the business community.

The next infusion of capital into Ballard Power Systems, by now a small firm with 13 employees, would come with Firoz Rasul at the helm.

Preparing Ballard for Commercialization of its Fuel Cell Technology

Firoz Rasul had a bachelor's degree in industrial engineering from Hatfield Polytechnic in England and a master of business administration from McGill University. He had cut his teeth at General Foods and Black and Decker, then become vice-president of marketing and sales for Mobile Data International, a B.C. manufacturer of data-collection devices, of which Ventures West was an equity partner. Brown introduced Rasul to Ballard Power Systems.

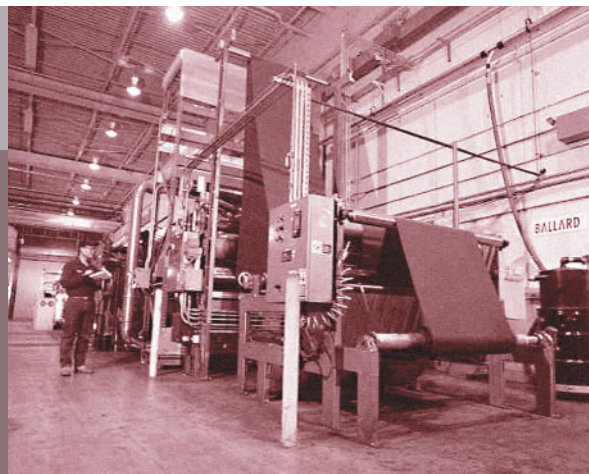
Both Rasul's intelligence and moral views appealed to Geoffrey Ballard and the other founders. While it was difficult for Ballard and his colleagues to give up the strategic direction of the company, they knew the time had come. Rasul had limited knowledge of fuel cells at the time, but, having done some research, he believed they had the power to change the world, and he saw a totally unique opportunity to be part of the change. It was a gamble for the marketing genius, however.

Rasul had to raise a lot of money for a company that was years from having a product that could perform at anywhere near the level of the internal combustion engine, or at anything less than many times the cost.

Rasul saw his challenge as one of balancing strategies in all aspects of the company — the technology, the marketing, the patents and the financing. He quickly started bringing new people into the company, filling management positions with experienced specialists. "We needed people who understood an early stage development company and how to help grow the company. We offered stock options to employees to make it attractive for them to work for us and we found ways to advance the technology by combining different talents," says Rasul.

"When I came into the company, it was a technology looking for a market," says Rasul. "We had to shift the emphasis to the customer, who would define the product for us, and, from that, we would understand the technology needed to take that product to market. That had to be the starting point. It was a different

“We wanted to determine if the science was going to stand up to rigorous engineering examination, if the technology could be furthered along the path they anticipated, and if it presented an opportunity to change the way we powered energy and did things.”



emphasis than the company was used to, and a shift in the way we planned technology development. We had to look for consistent methodological advancements, more progression in results and outcomes. Technology development and innovation isn't about breakthroughs, it's about a road map that you lay out, and against which you achieve various milestones as you move forward to achieve the goal you want. It's not just some eureka moment in the lab. This is a new thinking that I had to bring to the company."

Under Rasul's leadership, the company developed a technology road map that laid out a technology advancement strategy, as well as a product development road map. Both would be integrated with the company's intellectual property strategy. Ballard Power Systems put into place a systematic method for deciding which technologies to pursue and fund, and which to abandon — a process Rasul describes as being a very difficult exercise. They also implemented a technology validation process by having potential users confirm that what the company was working on would actually be attractive to them. "Technological advancement just for the sake of advancement wasn't important," says Rasul. "What was important was how to turn that into commercial reality, and that could only be confirmed by people who were prepared to pay good money to buy those advancements. We had to introduce this into our culture."

From 1992 to 1994, a number of subscale and full-scale projects were developed to demonstrate the Ballard technology. In 1993 the company succeeded in fulfilling a contract from the B.C. government to build a fuel-powered demonstration bus. Many in the company thought it was too soon, fearing the huge risk of public failure if it didn't work. But the bus did work, and demonstrated to the world that Ballard was way out in front in developing fuel cells.

Rasul figured the company would need \$100 million to \$250 million of development financing over a number of years. He wanted to avoid debt financing, so he had to diversify the company's financing sources.

Available funding options included profits from the battery division, private investors, government contracts, and strategic alliances with larger firms. He wisely worked to reduce the company's reliance on government R&D contracts, which he acknowledges were crucial in the company's early days and necessary to make it attractive to investors. Proving himself superb at raising money, Rasul started by targeting pension funds, which tend to take the longer view as investors, and focussed on getting customer contracts through strategic alliances. He pulled in \$17.8 million from investors before taking the company public in June 1993.





The initial public offering raised another \$17.8 million at a debut price of \$8 per share. This added to Rasul's plate the job of managing shareholders and investors, and being accountable to them for the company's performance in meeting targets and milestones. Ballard Power Systems went back to the public markets in 1994 and 1996, raising another \$90 million. From 1994 to 1996, another \$40 million was generated from a variety of federal, provincial and U.S. government contracts to do things such as develop fuel cells for submarines (DND), hybrid fuel cells for electric auto engines (U.S. Department of Energy), methanol fuel cells for buses (U.S. Department of Transportation) and a test fleet of six fuel cell buses (Chicago Transit Authority and Coast Mountain Transit [formerly TransLink] in Vancouver).

The company needed discipline in a number of other areas. As Geoffrey Ballard slipped into the background, and eventually into retirement, Rasul knew it was time

to get more structured about meeting R&D targets. Ballard Power Systems had succeeded in the early days because inventive people were allowed to pursue their goals without a lot of structure. But investors would demand a company mature enough to set deadlines for progress and meet them, and Rasul was determined to show that kind of discipline.

Rasul admits that strategic alliances and partnerships have been critical to Ballard Power Systems. "We were a very small company in a field of giants, so we needed strategic alliances and partners so we could leverage other people's efforts. We could never do it on our own. It was their money, their knowledge, their manufacturing capability, their marketing understanding, their service infrastructure. It was their technology development that was complementary to what we were trying to do. All of that had to come together for us to succeed, and in the mid-1990s we started major initiatives to put together some key strategic

relationships that allowed us to gain access to the capabilities that we could not replicate, or that would be too expensive for us to create, and the market understanding that we could never have,” he says.

Ballard Power Systems wanted the prestige of relationships with automotive giants, and it wanted to learn more about the technology required to integrate a fuel cell power plant into a functioning automobile. To achieve this, Rasul took a chance in sharing technology with Daimler-Benz, the prestigious German auto maker that has since merged with Chrysler. In 1993, Ballard Power Systems and Daimler-Benz signed a joint venture agreement, with Daimler-Benz committing \$35 million over four years, and with targets including putting a prototype series of vehicles on the road by 1996–97. Those targets were met. As a result of Ballard’s technological success, in April 1997 Daimler-Benz bought 25 percent of Ballard Power Systems’ stock for \$198 million, at \$35 a share. Ballard was allowed to license its technology to other automotive companies, and Daimler-Benz was allowed to develop its own fuel cell technology if it so wished. In 1997, Ford Motor Company bought another 15 percent of Ballard for \$600 million.

Today, Ballard Power Systems has the broadest and most advanced portfolio of intellectual property in the PEM fuel cell industry, including more than 1640 patents covering more than 550 different inventions worldwide. Since 1995, when Ballard announced its latest fuel cell stack had topped the critical power density that the U.S. government had estimated was required for use in automobiles, the company has supplied light-duty automotive fuel cells to Ford Motor Company; DaimlerChrysler; Honda Motor Co., Ltd.; Nissan Motor Co., Ltd.; Mazda Motor Corporation; General Motors Corporation; Hyundai Motor Company; Volkswagen; and others.

Rasul has proven himself every bit as innovative in moving the company forward along a winning business track as Geoffrey Ballard had been in getting it off the ground. “Innovation is not just about technology development. Innovation had to be in the way we did our financing, the way we did our marketing and marketing relationships, the way we created strategic

partnerships, the way we dealt with governments. Innovation, for us, had to be pervasive in the company and had to look at more than just technology development,” comments Rasul. He adds that keeping a spirit of innovation and entrepreneurship alive as the company grows, both organically and through acquisition, and across countries and cultures, is a challenge. One of the ways they have tried to do this is by developing a unifying discipline, with a common set of product-development and technology-development processes, and a common set of disciplines and methodologies that allow the company to practise technology development and product development in the same way regardless of location.

Major developments have occurred in the company since 2000. Focussed on building their capabilities as a low-cost, high-quality, high-volume manufacturer, the company is making the transition from hand-built prototypes to automated, volume-oriented processes. Ballard Power Systems’ first fuel cell manufacturing facility, a 10 220-square-metre plant in Burnaby, B.C. that opened in 2000, is the world’s first volume manufacturing facility for PEM fuel cells, and provides an additional competitive advantage for Ballard in bringing its fuel cell products to market. The move is enabling Ballard to work on fundamental improvements in design, materials and processing, further driving the company’s product innovation and expanding its manufacturing strength.

Selling commercial fuel cell products is Ballard Power Systems’ primary goal. Its focus is to transform Ballard’s technology and manufacturing strength into commercial success. The company’s first commercial product, the Nexa™ power module, the world’s first volume-produced PEM fuel cell, was launched in 2001. Ballard has also started selling commercial products based on component technologies being developed for their fuel cell products (for example, a carbon-fibre product that is used in the automatic transmission of more than 20 million automobiles). To bring all aspects of fuel cell systems into one company, Ballard acquired and integrated XCELLIS Fuel Cell Engines and Ecostar Electric Drive Systems into

Ballard's operations, allowing them to leverage their technology investments, and develop better products faster and more economically. Both DaimlerChrysler and Ford reaffirmed their commitment to Ballard by agreeing to 20-year, non-compete, exclusive supply agreements. Part of this deal includes an infusion of cash into the company, and increased representation on the Ballard board of directors. In 2002, Ballard Power Systems started selling electric drives and power electronics. Orders for Ballard products totalled more than US\$157 million in 2001, indicating significant progress towards commercialization.

Ballard has come a long way. In late 2002, Honda introduced their first two fuel cell vehicles, powered by Ballard, which will be placed in fleet use with the City of Los Angeles. DaimlerChrysler has announced a 60-car fleet of vehicles, also powered by Ballard, that will go into the hands of customers beginning in 2003. Thirty Mercedes-Benz Citaro buses, powered by Ballard's heavy-duty fuel cell engines, are being delivered to 10 European cities as part of the European Fuel Cell Bus Project. Ford recently stated its intention to place 60 Focus FCV fuel cell vehicles on the road starting in 2003. According to Rasul, it has taken longer than anyone had expected to get a number of

different fuel cell products on the market, but, he says, Ballard Power Systems is now on the "cusp of full-scale commercialization," as its fuel cell products approach commercial reality. The company's strategy now is to actively develop the Ballard brand, and to support awareness of the promise of fuel cell products and their benefits to the broad, end-user marketplace.

The Future of Ballard Power Systems

There isn't much disagreement in the scientific community that hydrogen is the fuel of the future, and that PEM fuel cells will play an important role in that future. Fuel cells have clearly emerged as the zero-emission technology of choice for the automobile industry, with all major players in the industry having active fuel cell vehicle development programs under way. In January 2002 the U.S. government announced the FreedomCAR program focussed on fuel cells, and followed that with the Hydrogen Fuel Initiative announced in January 2003 to address the storage, production, and development of the hydrogen fuel infrastructure required for fuel cell vehicles. This is only one of a number of government programs in the United States and other countries focussed on assisting the commercialization of fuel cells for the transportation and power generation sectors.

There are still important steps to be taken to get people hooked on hydrogen and fuel cells, including developing hydrogen refueling stations to provide fuel for fuel cell vehicles similar to the way gas stations now service gasoline-powered cars. In March 2000, Ballard Power Systems was worth \$18.5 billion. In fall 2002, with the collapse of the stock market, the value of its share capitalization decreased substantially. In late 2002, Dennis Campbell announced that Ballard was cutting its work force by nearly 30 percent, and cutting its estimated 2002 "cash burn" of \$279.5 million to between \$122 and \$142 million in 2003. Campbell said he would focus on "clearly defined deliverables," with an overriding objective of completing the company's transformation from a technology-focussed R&D organization into a customer-focussed production organization. The company currently expects to be EBITDA (earnings before

“Our vision is Power to Change the World. We are a power company because we make something that produces electricity. But the product and the technology we work on will change the world because fuel cells are revolutionary.”

interest, taxes, depreciation and amortization) profitable by 2007. "Our goal is to become the company known for replacing the internal combustion engine," says Campbell.

As to where the company is in 2003, Rasul comments, "Our vision is Power to Change the World. We are a power company because we make something that produces electricity. But the product and the technology we work on will change the world because fuel cells are revolutionary. They are a paradigm-shifting technology. Not only do they offer us electricity in a way we've never seen before, but it's environmentally clean and highly efficient, so we can start looking at applications we've never thought about before. In that way, it's revolutionary and enabling. That vision and that possibility, that potential, is what drives the company — that passion to make that happen, knowing that, with our success in introducing this technology, we will change the world, we will make a difference. That is a prospect that not many technology companies can have."

Rasul continues, saying, "We are at a threshold and getting ready for our customers to put products on the market. We supply original equipment manufacturers (OEMs) who decide when to take the product to market. We are now working with our customers to help them meet their plans to lay out the product for commercial markets. We are at a crossroads for the company."

In the meantime, no one can discount the impact Ballard Power Systems has had on spawning a fuel cell industry. Over the past 20 years, Vancouver has emerged as a world leader in fuel cell technology, and in the hydrogen economy. In fact, Mike Brown, now with Chrysalix, a venture capital firm dedicated to making investments in fuel cell businesses, emphatically restates his early view that Ballard, as an organization, was unlikely to succeed in isolation. There are now many more companies working on fuel cells — an estimated cluster of about 60 companies in Vancouver alone. Such companies are emerging to fill the gaps and unfold the fuel cell industry in areas such as exhaust, control parts, fuel cell testing, fuel cell infrastructure and venture capital. The National Research Council Canada has established

an innovation centre on the University of British Columbia campus, complete with a hydrogen lab, to further R&D advancements in the fuel cell industry. The Government of Canada, in cooperation with the B.C. provincial government and industry partners, including Ballard, has funded Fuel Cells Canada, a not-for-profit industry association to promote fuel cells and develop a strategy to commercialize the technology. The government has also established the Canadian Transportation Fuel Cell Alliance to facilitate and fund the development of fuel cell vehicle infrastructure.

Such efforts will no doubt continue to support an emerging fuel cell cluster, and advance Canada's and Ballard Power Systems' positions as world leaders in developing and commercializing fuel cell products.

Ballard Power Systems Inc.

4343 North Fraser Way

Burnaby BC V5J 5J9

Canada

Telephone: (604) 454-0900

Fax: (604) 412-4700

Web site: www.ballard.com

E-mail: webmaster@ballard.com



Alchemists

New

Canada's

IOGEN CORPORATION

When it comes to curbing pollutants, EcoEthanol™, Iogen's unique bioethanol product, is a very exciting fuel. Emissions of the greenhouse gas carbon dioxide (CO₂) are significantly cut when vehicles fill up with fuel containing ethanol, which is produced from plant life rather than hydrocarbons.

But the ethanol used in most "green" gasoline mixes offered at gas stations is produced from grains such as wheat or corn. The downside to ethanol produced from these grains is that it steals from the planet's stock of food resources. Ottawa-based Iogen Corporation avoids that by producing bioethanol from the stalks of grains and other waste biomass, such as straw, grass, etc., instead of from the grain kernels themselves.

When people talk about Canadian-based firms built around innovation, Iogen Corporation appears on everybody's list. In the words of Jeff Passmore, Iogen's executive vice-president, "We are the only company in the world up to now that has been able to take by-product fibre and turn it into a form of bioethanol with 90 percent lower greenhouse gas emissions than gasoline."

Not only has Iogen been able to make breakthroughs in alternative fuels — to the point that it now has a \$40-million demonstration plant up and running on the



Brian Foody
President



“ We are the only company in the world up to now that has been able to take by-product fibre and turn it into a form of bioethanol with 90 percent lower greenhouse gas emissions than gasoline.”



Jeff Passmore
Executive vice-president

Iogen Corporation is a leading industrial biotechnology company specializing in EcoEthanol™ — a clean, zero-net-CO₂-emission fuel that can be blended with gasoline and used in cars today. Based in Ottawa, the company has built the world's first and only demonstration-scale facility to convert cellulose material such as wheat straw into bioethanol using its patented enzymes manufactured in an adjacent enzyme manufacturing facility. It employs about 140 people and generates revenues around \$10–\$12 million per year, mostly from the sale of its industrial-use enzymes. For more information, see www.iogen.ca

outskirts of Ottawa — it has also produced breakthroughs in the textile, pulp-and-paper, beverage and livestock feed industries. The type of enzymes that Iogen develops as catalysts capable of turning plant waste into fermentable alcohol can also be used to break down fibres and produce useful products in these other industries. In fact, Iogen has helped keep its ethanol research and development (R&D) going by selling these enzymes to companies in other industries.

“People usually think of ethanol when they think of us, which is just fine,” says Patrick Foody Sr., the visionary founder of Iogen, now retired. “But if you read magazines or books, drink fruit juices or beer, or wear jeans or T-shirts, there is a good chance that Iogen has made direct contact with you, most days of your life.” Iogen's patented enzymes are used to reduce chlorine content in pulp and paper while producing the same level of whiteness, to prewash denim, and to improve the digestibility of feed for chickens and pigs.

Today, Iogen is still mainly a family-owned company, with annual revenues estimated at around \$10–12 million a year. But the company is poised to make a much bigger dent on the marketplace. In January 2003 the firm announced that its EcoEthanol™ demonstration facility was successfully processing 25 tonnes of wheat straw per week into fermentable sugar and was on track to produce 320 000 litres of ethanol annually. No one has ever used modern enzyme technology to successfully convert cellulose material such as straw into fermentable sugar on this scale before, and Iogen's success has affirmed its global leadership in a highly complex biotechnology process.

“This is a major first for Iogen, and a major first for green fuels,” says Iogen president Brian Foody. “This brings us one step closer to commercialization, and one step closer to a truly green fuel at the pump.” How Iogen got to this stage after Patrick Foody Sr.'s vision first came to him in 1978, and where Iogen will go from here, are both worth pondering for anyone interested in translating innovation into profits.

At the Beginning

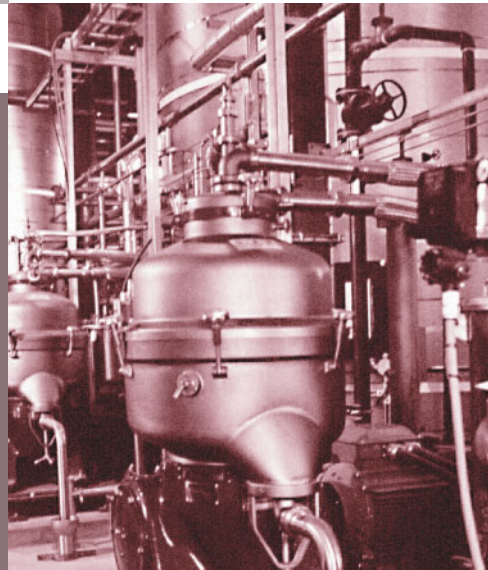
Patrick Foody Sr. emigrated from Ireland in 1952 and was trained as an engineer. He had become a multi-millionaire through investments made through his Montréal-based holding company, Techcapital Group. Foody Sr. had been involved in start-ups in several areas, including engineering, software and biotechnology. Iogen began as a hobby for him. It turned into an expensive hobby. Of the more than \$85 million it has cost to get Iogen to the stage it is now at, more than \$20 million came from Foody Sr.'s own pockets. One area of biotechnology — renewable energy — was to become as much a passion for him as an investment.

In 1973 the big fear was that the world was going to run out of food, as the prestigious Club of Rome had direly predicted. If the world wasn't producing enough food for humans and animals, Foody Sr. wondered whether the coarse, brittle fibres in wood chips could be softened somehow and made into edible animal feed. Since the chemical fingerprints of wood and starch were remarkably similar, he hypothesized that wood chips could be converted into a food source, if

he could solve the fibre problem. In 1974, he started Iotech Corporation, with three employees, to pursue this potentially lucrative opportunity. The food crisis didn't happen, but, a few years later, by using steam explosion, Iotech did find a way to convert wood chips into animal feed. The technology evolved into a leading method for treating fibre to make it more digestible to enzymes.¹ As it turns out, this is also one of the key technologies in the cost-effective manufacturing of bioethanol, although Foody wouldn't start thinking about making alcohol fuel until 1978.

That year, he was introduced, through his son, to Henry Bungay, a chemical engineering professor at Rensselaer Polytechnical Institute who also happened to be head of a research program on alcohol fuel for the United States government. As it turns out, the technology Foody Sr. had developed provided a solution to a problem U.S. university researchers were working on in converting fibres to sugar and then to alcohol fuel. When Foody Sr. presented Bungay with some mushy bits of wood, cooked in steam to break them down, and told him his assessment of how important this concoction could be if mixed with the proper enzymes to produce alcohol, Bungay was quick to grasp the importance of the concept. They started to work together on the problem of genetically

“The work we did to understand how enzymes break down fibres had allowed us to identify solutions to the puzzle of producing ethanol.”



1. Enzymes are active proteins that can increase (catalyze) the rate of biochemical reactions. They are natural chemicals made and used by living organisms, but are themselves non-living.

modifying micro-organisms to produce more durable enzymes that could resist the high temperatures in the steaming process. “The work we did to understand how enzymes break down fibres had allowed us to identify solutions to the puzzle of producing ethanol,” comments Foody Sr.

By the late 1970s, it appeared that the world’s oil supply might be running dangerously low. Foody Sr., compelled by this second global crisis, was ready to take on the mission of producing a green fuel. With funding from his own company, Foody Sr. sought alliances with oil and other biotechnology companies to further develop bioethanol technology. In 1983 the Foody family built the world’s first fully integrated pilot plant to convert one tonne per day of wood chips into ethanol using enzyme-based technology. The cost of the project came to \$7.8 million, \$2.7 million of which came from Natural Resources Canada. However, the prediction of a global oil shortage too proved to be off the mark. In 1986 oil prices collapsed, interest in the bioethanol solution waned and Foody Sr. eventually ran out of both potential markets and eager financial partners for his plant.



A Business, Not a Hobby

A shift of gears was needed in the 1990s to save the company, but, as Passmore points out, that wasn’t as difficult as it might have been. “Oil didn’t go to \$80 a barrel, but, in the process of making ethanol from fibre, we learned a lot about enzyme technology. And enzymes, of course, attack and break down natural fibres, and a lot of companies (especially in the fields of pulp and paper, beverages, textiles and livestock feed) need to do that. So we, fortuitously, backed into an enzyme business We employed the same kinds of micro-organisms that secrete enzymes to attack fibre in these other areas as we did in turning fibre into sugar to create clean fuels,” he says. Forced to look for markets to survive, the company quickly worked to secure government research contracts for possible industrial uses for the company’s enzyme technology. It was six years before logen introduced its first commercial product: an enzyme to help clarify

apple juice. Then, in 1994, the National Research Council Canada partnered with logen to develop genetically engineered enzymes for the pulp and paper industry.

By the late 1990s, logen led the world in manufacturing and selling enzymes for specialty applications in pulp and paper, textiles, and animal feed markets. It now racks up sales close to \$12 million a year doing this. In the meantime, not much was happening in its ethanol plant, but Foody Sr. was hooked on the idea of renewable energy sources. Then, in the late 1990s, people started to worry about climate change caused by the emission of greenhouse gases. And logen found its market.

Foody Sr. had always been worried about the environmental impact of burning fossil fuels, but suddenly lots of influential people started to worry along with him. If the first and second crises that seemed to cry out for logen had faded into the background, the world environmental crisis appeared like it would be on the front burner for centuries to come. With the signing of the Kyoto protocol, logen's bioethanol technology once again rose in prominence.

Financing the Dream

Foody Sr. could not fully fund this process himself without risking his family's finances, including, as he points out, the education of his six children. Some funding came from the sale of enzymes, but logen's revenues from enzyme sales weren't enough to cover the full cost of its ethanol R&D. Other backing came

from research partnerships with government institutions such as the National Research Council Canada, Natural Resources Canada, and Agriculture and Agri-Food Canada, with each side typically investing 50 percent of research costs. Total government funding is estimated to have been about \$18 million. Significant amounts also came from strategic partnerships with oil and gas companies such as Petro-Canada and the Royal Dutch/Shell Group.

By 1997, logen, whose offices were housed on a 1.2-hectare site next to Ottawa's Macdonald-Cartier International Airport, was producing enzymes that most energy analysts agreed were superior to anything the company's competitors had developed.

That year, logen signed a deal with Petro-Canada for \$15.8 million that would let logen buy more land and build the commercial demonstration plant that is now the company's centrepiece, converting 25 tonnes of straw a week into bioethanol. An additional \$10 million in funding, in the form of repayable loans from future profits, came from Technology Partnerships Canada, a branch of Industry Canada. The remainder of the \$30 million required came from logen itself.

logen's good relationship with the Canadian government continued to bear fruit. In March 2002, the company was awarded a three-year, \$2.7-million, cost-shared research contract to develop improved enzymes, with logen putting up \$2.7 million of its own in funding. Government participants in the project included Technology Early Action Measures, a component of the Climate Change Action Fund; Natural Resources Canada; and Agriculture and Agri-Food Canada.

But, as market production came closer to becoming a reality, it became clear that logen needed a significant new injection of funding. Later in 2002, after eight months of negotiations, logen and the Royal Dutch/Shell Group announced that Shell would pay \$45.5 million for a 22-percent interest in logen. Foody Sr. called the partnership "one of the most important milestones" in the history of his company, and the "beginning of a new era" in the production of environmentally friendly vehicle fuels. The deal with Shell has helped logen complete the demonstration phase and is funding market and feasibility studies in five European countries.





“We start with bales of wheat straw or cobs of corn. We bring them into the plant and add enzymes, which turns the straw to sugar, and the sugar is converted to alcohol — ethanol for use in cars. The process that we have to make the enzymes work as efficiently as they can is very complicated.”

With the Shell announcement, Patrick Foody Sr.'s 30-year-old dream appeared to be on the brink of becoming a marketplace reality.

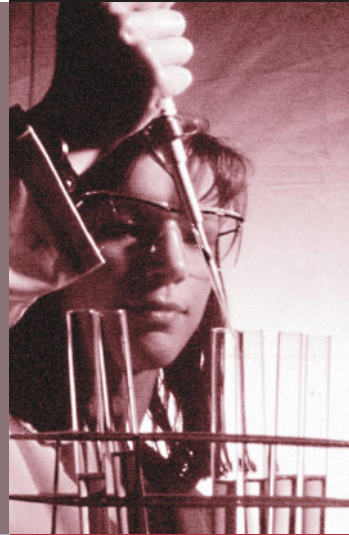
What Made It Work?

The road to Iogen's current position has been paved with technological challenges. The R&D process of its ethanol business has gone through four stages:

1. R&D with test tubes and beakers;
2. Bench testing using 14-litre tanks;
3. Batch processing in a pilot production plant, using 1500-litre tanks; and
4. The current demonstration stage, involving completion of a \$40-million plant in Ottawa processing 25 tonnes of wheat straw per week.

Passmore explains that it can get complicated. “We start with bales of wheat straw or cobs of corn. We bring them into the plant and add enzymes, which turns the straw to sugar, and the sugar is converted to alcohol — ethanol for use in cars. The process that we have to make the enzymes work as efficiently as they can is very complicated,” he says. “Enzymes are just catalysts — proteins, like you find in your saliva that help you break down bread and digest it. Enzymes break down dead trees in nature, but we are trying to speed up nature. We design the engineering around the enzyme process and the enzymes around the engineering process. Sometimes the enzymes don't perform as well as we had hoped they would, so that means adjusting the engineering process. Our scientists have to keep talking to our processing engineers, and vice versa, in order to come up with the optimal commercial development.”

“We have patented pretreatment, enzyme technologies and enzymatic hydrolysis. As a result of these patents, we are putting more fibre through our plant than anybody else in the world.”



At the beginning of 2003, logen employed 140 people, almost half of them involved in the laboratory process of extracting the best kinds of enzymes, and many others working in engineering, building systems to make those enzymes produce the best bioethanol product most efficiently. logen continues to focus on solving engineering problems around how enzymes work to convert fibre to sugar, and scaling up the production process toward commercial viability.

The demonstration facility provides the opportunity to assess what works and what doesn't, and to prove the technology. “We always knew you could take enzymes to treat fibre and turn wood into sugar. That's not the issue,” says Passmore. “It's at what cost and whether it can be done in an industrial-scale environment quickly. We need supplies of straw, financing, an off-take for the ethanol, a market and an affordable price. The total cost of a commercial bioethanol plant would be about \$200 million.” The final stage for logen, of course, will be full commercialization. “We are at that point now with Shell,” says Passmore. “If the technology works, we can build a business case for commercial viability in at least three countries. But making the transition to commercialization depends on the world's willing-

ness to go to bioethanol.” logen envisions a commercial facility with the capacity to process more than 2000 tonnes of feedstock per day to produce more than 220 million litres of bioethanol per year.

Passmore has several explanations for what has brought logen to the brink of success. The first, of course, is the vision of the man company employees call “our patriarch” — Patrick Foody Sr. “He is a man with a vision. He wanted to see the world go to a cleaner energy fuel. This vision inspires a whole bunch of people at logen,” says Passmore.

Then there is the flexibility the company showed when it became apparent that the spectre of dwindling food stocks and oil stocks was overstated, and would not bring in the investment cash needed to keep the company going. Selling enzymes to other industries helped get it over that hurdle.

Good patent protection — both for the enzymes themselves, and the engineering process to convert them for gasoline products — was also vital. “Our discovery patents have been very important,” says Passmore. “We have patented pretreatment, enzyme technologies and enzymatic hydrolysis. As a result of these patents, we are putting more fibre through our plant than anybody else in the world.”



The willingness to go out and partner with a big firm when the time came also proved vital to Iogen. “Don’t be afraid to go out and seek strategic investments,” Passmore advises. “Realize that you’re going to have to give something up to get them to invest, but make sure you have some good, smart people on your side of the negotiating table.”

Passmore believes that Iogen’s focus on hiring smart people was crucial. By this, he not only means the scientists and engineers, but also the negotiators, marketers and communicators with the savvy to keep reminding government how important the technology could be to Canada’s future, and business experts who understand something about rolling out commercial development plans and getting them into the marketplace. “All of these skill sets are important to get the product into the marketplace,” says Passmore, who adds that finding skilled people remains a challenge.

In any discussion of what is important to Iogen’s future, Passmore underlines how important it is for the Canadian federal government to make a strong push toward environmental reform. “The issue [for us] now is market pull ... and often that pull is created by government policy,” he says. Passmore notes that European governments, in particular, are creating pro-environment policies, and explains that Iogen is looking at the various value propositions offered by governments in European countries in deciding where to set up future commercial facilities.

The Future

Iogen’s future is now — or at least not too long off. Passmore says the company expects to become part of an operating company to produce EcoEthanol™ for the mass marketplace. However, he says, “Once we’ve got one or two plants under our belts, Iogen intends to focus on licensing bioethanol technology broadly through turnkey plant construction partnerships.” The company will earn additional income from licence fees and the supply of enzymes designed for its licensees’ plants.

A 30-year-old gamble, built on a dream and fuelled by passion, finally looks close to paying off — for Iogen’s founder, his family and everyone who likes to breathe.

Iogen Corporation

8 Colonnade Road

Ottawa ON K2E 7M6

Canada

Telephone: (613) 733-9830

Fax: (613) 733-0782

Web site: www.iogen.ca

E-mail: info@iogen.ca



Great Ideas Aren't Enough

GARRISON GUITARS

The rapid growth in global sales being racked up by Garrison Guitars flows from one breathtaking stroke of innovation. The seed for success for the Newfoundland manufacturer of acoustic and electric guitars came from the idea for a radical new guitar structure originally scribbled on the back of an airline napkin.

How revolutionary was that concept, sketched in 1995 by Chris Griffiths, the company's founder? In the words of Griffiths, who was 22 at the time: "When we launched the Garrison Guitar with its Griffiths Active Bracing System in 1999, the CEO of our biggest competitor told me that this was the biggest innovation in the entire history of the acoustic guitar."

Griffiths doesn't believe that figuring out how to build a better mousetrap is a big deal. "My philosophy is that ideas are a dime a dozen.... It's the execution of ideas that turns my crank."

Still, it would be difficult to make the case that Griffiths would be enjoying the success he is today if he hadn't come up with the insight that he sketched on that napkin. The idea was based on the concept that the resonance from an acoustic guitar could be refined and purified. The guitar itself could be strengthened, thought Griffiths, if the structure of the guitar were unified in an



Chris Griffiths, CEO

“I wanted to do something really different and really innovative, not because I thought that ‘innovative’ was a buzzword that I could latch onto, but because I wanted a competitive advantage.”



Garrison Guitars manufactures high-quality acoustic guitars in its 1850-square-metre, state-of-the-art manufacturing facility in St. John’s, Newfoundland, for worldwide distribution to international markets. Its guitars are constructed using the patented Griffiths Active Bracing System™ and the patented Griffiths Integrated Blocking System™. These innovations replace the more than 30 wood pieces found in traditional guitar bracing systems with one glass-fibre component, revolutionizing the guitar manufacturing process. The company has 65 employees. For more information, see www.garrisonguitars.com

unprecedented way. The entrepreneurial bonus was that both the manufacturer and the customer would profit if a quality guitar could be produced at a lower cost.

When Griffiths explains why Garrison Guitars is such a raging success, he points first to his willingness to trust, listen to, and depend on people who understand the essential ingredients of technological and commercial success, and can adapt them to new situations. He also points to the importance of pursuing a “path that you truly love.”

Old-fashioned homilies aside, Griffiths says he believes in innovation. “I wanted to do something really different and really innovative, not because I thought that ‘innovative’ was a buzzword that I could latch onto, but because I wanted a competitive advantage,” he says.

In short, Griffiths, the boy inventor, has turned into Griffiths, a young man who meshes age-old business truths with some non-traditional business practices. This may prove that innovation can sometimes be as much about a savvy melding of old and new values as about technological breakthroughs — and that it is a mistake to define it in narrow ways.

Taking It From the Top

Garrison Guitars started its life as a one-person repair shop run by 19-year-old Chris Griffiths in 1993. It has grown into a 1850-square-metre factory, employing 65 people, all of whom, says Griffiths, are entrepreneurs. The proprietor has been playing guitar since he was 12, and before he was out of his teens he was making 20 acoustic guitars a year, all handcrafted in the painstaking way that he had been taught at a

course he took from a master craftsman in Grand Rapids, Michigan. These were good guitars, but, when Griffiths set up a guitar repair and retail shop, he also sold mass-produced guitars, many of which he felt didn't offer the value for the prices they demanded.

One day a professional engineer from Memorial University named Andy Fisher (now plant manager at Garrison Guitars) dropped in to have his guitar repaired. While talking with Griffiths, Fisher mentioned he knew a little bit about computer-aided design (CAD) and computer-aided manufacturing (CAM). "Well, that's great, man," Griffiths said to himself, "but I've got my little chisels, and I've got my little stack of sandpaper, and I'm trained to make [guitars] one at a time"

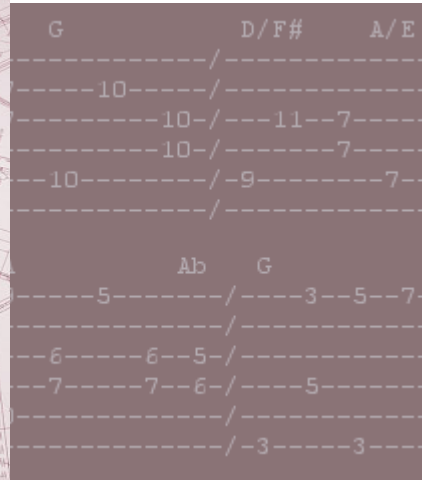
But Griffiths had been curious all his life, and he couldn't shake thoughts of the possibilities of computer-aided guitar design out of his mind. "Luckily [Fisher] dropped back in, and I said to him 'you've got to tell me more about this.' And the more he told me, the more excited I got," says Griffiths. "I've got a real appetite for doing things better, and I was disappointed in the quality of the guitars people were paying \$800 for. I am obsessive about asking ques-

tions, so I figured I'd just keep going until he told me to stop. But he didn't."

One thing led to another. Griffiths decided he wanted to find a way to mass produce good guitars at a significantly lower price than quality guitars were being sold for. He applied for and received a grant from the National Research Council Canada (NRC), spending much of it on a tour of North American guitar factories. "I decided if I wanted to mass produce a better guitar than is being produced now, I had better find out how they are produced now," he says.

As Griffiths, Fisher and another engineer toured plants they noticed that the manufacturing process wasn't much different than at Griffiths' little shop, except that there were assembly lines. The acoustic guitar industry was locked in the technology of the 1960s. The light bulb lit up in Griffiths' head: "We were flying home and I thought, what if we combined all the components that are pieced together to make a guitar and made them all out of one piece? And what if we used composite material [for the interior structure] instead of wood?" So he sketched. He then turned to Fisher and challenged him to tell him why his concept wouldn't work. Fisher scrutinized the napkin, pondered it, and smiled.

“We were flying home and I thought, what if we combined all the components that are pieced together to make a guitar and made them all out of one piece?”



So started what is now described on the Garrison Guitars Web site in this way:

The Griffiths Active Bracing System™ is a revolutionary method of guitar construction. By integrating the binding, kerfing, bridge plate and all the braces into one glass fibre component, the top is activated by having all parts vibrate in unison. It also provides enhanced structural stability that would have taken hours to construct using traditional production techniques. A single-unit brace means no matter where you create a vibration inside the guitar, the resonance has an uninterrupted path to travel throughout the instrument.

The neck of your Garrison Guitar bolts through the neck block with machine screws into two high-quality inserts. Not all that uncommon. Except ... your neck block is also made from long-strand glass fibre that “locks-in” to the bracing system. This achieves two things. First, it allows for significant tone transfer between the neck and the body of the guitar. Second, it transfers stress. The tension of the strings on the neck joint is shared with the entire bracing system so the neck block doesn’t have to work all on its own. Stronger. More consistent. Intelligent.



The Grind

The Garrison Guitars factory of today is a showcase for technological progress. It is equipped with the latest robotics, laser-cutting, computer-controlled milling and ultraviolet finishing equipment. A unique projection-moulding technology creates skeletal structures for guitars in 45 seconds, compared to the traditional assembly-line process, which takes between two and two and a half hours.

However, the journey has taken a long time. It took Griffiths six minutes to sketch the concept behind the process, but six years to bring it to fruition — with a lot of help from friends and professional experts. He also had some money saved. “The very important decision I made very early on was to take any money I made from my repair shop and put it back in the business,” says Griffiths. “I realized that if I didn’t get greedy, the stronger a foundation I would have, and the more independent and self-sufficient my business would be.”

Still, Griffiths needed help; a lot of help. He turned again to the NRC, which helped him translate his guitar concept into three-dimensional drawings. The NRC also eventually helped him build a prototype and put manufacturing structures into place. Griffiths credits the Industrial Research and Development Institute in Ontario with introducing him to injection moulding techniques and plastics technologies.

The Genesis Centre at Memorial University, designed to incubate innovative, high-technology companies, helped the start-up develop injection-moulding processes and access materials. For several months, Griffiths worked out of an office at the centre, next to his prototype development facility.

“When he came and presented his idea to our board,” says David King, the Genesis Centre’s president and CEO, “Chris had the qualities we were looking for in an entrepreneur — a vision of where he wanted to take his company, the use of new technology, and

plans to export internationally. We worked with Chris to take his strengths in marketing and add the financial aspects that would lead to the manufacturing capacity to build his guitars and produce a world-class company here in Newfoundland. We helped him do a business plan so he could promote the concept to venture capitalists and give them the opportunity to invest in his operation.”

Access to capital was the next hurdle. Griffiths’ business plan projected that he would need \$3.5 million to build a

factory in St. John’s. But when Griffiths presented this plan to venture capitalists, they told him they wouldn’t invest in the venture until he had a prototype of his guitar, the patents to protect it, a management team in place, and primary market research to prove there was demand for his guitars. The injection-moulding equipment he needed to produce the prototype alone would cost \$150 000. At the same time, Griffiths had to pursue a patent for his Griffiths Active Bracing System, which would also cost money. In addition to his own investment, Griffiths got financial assistance from the Atlantic Canada Opportunities Agency and two angel investors. Still, he needed more money. He had drained both his own wallet and the resources of his little guitar shop, which was teetering close to bankruptcy.

At the Point of Financial Desperation

Griffiths went back to the venture capitalist who had told him that he wouldn’t get the millions of dollars he needed to go to the marketplace until he had everything a competitive company needs to get started. Griffiths was only halfway there, if that.

“I pleaded with him to make a decision now to invest \$250 000 in my company, which was what I needed to finish the prototype, complete the patenting process and launch the guitar at a major trade show in Los Angeles. I argued that I had worked on the things that I had been told I needed to do and that, if they would help me out now, they had the promise of being part of a multimillion dollar company. And he said yes.”

The trade show was to take place in Los Angeles in January 2000. Griffiths now had an inventory of five prototype guitars. He planned to take himself, two employees from his shop, and two friends, “who would pretend they worked for a company that didn’t exist,” and demonstrate the guitars.

Shortly before his departure, Griffiths’ investors told him he would have to come back from the show with letters of intent for the purchase of 7000 guitars if the





“The task of bringing the technology together with the process of making the bracing system was fascinating.”

rest of the business plan financing was going to proceed. “I said ‘that’s ludicrous — I’ve got four days, and a company that doesn’t exist. I can’t do that,’” says Griffiths. “And here’s where the guerilla marketing/desperation kicked in.”

Griffiths contacted the trade show and asked for a list of the 2200 buyers that would be attending the show. He direct-mailed every one of them, asking for a meeting to demonstrate his guitars. Then he faxed them. Then he e-mailed them. Then he and some volunteers phoned them. Before he left for Los Angeles, he had arranged 112 meetings.

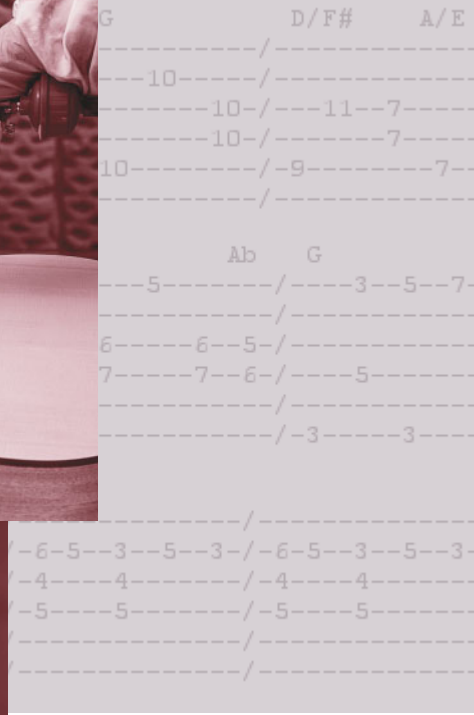
When Griffiths returned from the show he still had no company, no manufacturing facilities and no financing. Nor did he have letters of intent for 7000 guitars. Instead, he had them for 56 000, and a year to get his product on the market.

Setting Up the Plant

Based on Griffiths’ success at the trade show, the venture capitalist invested the rest of the money needed. Griffiths leased a 1850-square-metre warehouse space in Donovan’s Industrial Park in Mount Pearl and set about installing a high-technology manufacturing facility to produce his innovative guitar. The first thing he did was hire Andy Fisher, a Masters in Engineering and the Industrial Research Assistance Program officer who had helped him with his CAD designs. Fisher had experience with robotics and lasers as well, a real asset in the automated plant Griffiths wanted.

The next challenge was to actually produce the guitars. According to Fisher, “We were experimenting with a new way of building guitars that had never been tackled before. The first people we hired were technologists to support the design, a diverse technical team with different backgrounds, none in guitar making. We walked

“You don’t start and finish innovation. You start it and you never complete it.”



through how one might take on this brilliant concept for a new guitar construction, which had never been put into production, and actually realize the benefits of the design.”

“The task of bringing the technology together with the process of making the bracing system was fascinating,” Fisher continues. “We made the initial prototypes with our brand new, never-been-seen-before braces, with old techniques. The challenge, then, was to take all the innovation that had been developed in the guitar’s bracing system and bring it into a production facility. We looked at all the different techniques for doing this, including the traditional building of guitars, but we steered away from believing that this was the only way to do things.”

The team went to machine tool shows that had nothing to do with guitars to find ways to solve the challenge of manufacturing, not just the challenge of guitar building. Ultraviolet (UV) curing of paints was tackled in a way that no one else had done at the time in order to fit into Griffiths’ cost structure and way of producing. The entrepreneurs turned to lasers to cut the guitar tops and backs with the accuracy they

needed. They also purchased a used robot and made adjustments to it so it could be used to handle each guitar in the UV paint room. “We knew it could be done and we just had to find a way to do it, so we brought in people who knew how. We took a lot of wrong paths,” admits Fisher, “but we had a lot of wins.”

By the end of 2002, the factory was producing 50 guitars a day with 44 production employees, in considerably less manufacturing space than that of traditional guitar producers. Their innovative production process has achieved significant productivity improvements.

“You don’t start and finish innovation. You start it and you never complete it,” says Griffiths. “What I am most proud of is the attitude and culture of innovation in our accounting department, our filing systems and the plant floor. Philosophically and commercially, each of our five departments run their own operations, much like entrepreneurs. By doing this, we took the hard job of starting a guitar company from scratch in a 1850-square-metre building and getting to production of 50 guitars a day as quickly as possible, and broke it into manageable pieces. Each team leader could have the confidence to manage their own

370 square metres, without being overwhelmed with the task of managing the company as a whole.”

“The company isn’t me,” says Griffiths. “It’s 65 people. And they’re all entrepreneurs. If it wasn’t for the people around me, I never could have survived it emotionally, technologically or commercially. I recognize that I make mistakes, and I try to create an environment where my employees feel comfortable making their own mistakes, because that’s how I learned.”

As of March 2003, Griffiths’ factory was building Garrison Guitars at a rate of 12 000 annually. His major markets are now in the United States, Europe and Japan, but some very notable Canadians are also helping increase the company’s profile with their very visible strumming fingers, including Alanis Morissette, Tom Cochrane, The Tragically Hip and Blue Rodeo. The company is private, so profits are a company secret, but Griffiths smiles broadly when the issue comes up.

Looking Back and Into the Future

Looking back, Griffiths reflects, “If I knew in April 1995, that I would have to go through what I’ve gone through to get where I am today, I never would have done it. Not by a long shot. What kept me going was believing that at any point in the process, we were just a couple of months away from success.”¹

“I wanted to do something really different so we would have a strategic advantage that would guarantee success. The challenge now is to attract new investment so we can ramp up production to meet excess demand for the Garrison Guitar. But I won’t do this at the price of quality. Once we achieve that, the sky is the limit as to where we are going to grow from there. My short-term objective is to increase production and to cherry pick really good partners as distributors. We are very passionate about building Garrison Guitars as a brand to be associated with innovative technology in an industry that is entrenched in tradition — to make it a value choice for consumers,” concludes Griffiths.

1. On the Garrison Guitars Web site, <http://www.garrisonguitars.com>, see “Chris’s Corner,” where Griffiths shares his ups and downs in the guitar business.

According to Griffiths, by the time Garrison Guitars’ investors get out of the business, the value of their original investments will have increased to \$20 million. What then? “If Garrison Guitars is not on the cusp of something new, then, quite frankly, I won’t be interested,” says Griffiths with a smile. “My advice to innovators would be that you don’t have to do anything on a particular path in a particular way, but you do have to follow the path you love.”

“My advice to innovators would be that you don’t have to do anything on a particular path in a particular way, but you do have to follow the path you love.”

Garrison Guitars

P.O. Box 13096

St. John’s NL A1B 3V8

Canada

Telephone: (709) 745-6677

Fax: (709) 745-6688

Web site: www.garrisonguitars.com

E-mail: info@garrisonguitars.com



Empowering Robots with 3D Vision

BRAINTECH INC.

It isn't a secret that many modern manufacturers are cutting costs by replacing workers with robots on their factory floors. Vancouver's Braintech Inc. is the first company to give those robots three-dimensional vision or "eyes." This capacity to "see" is radically changing the scope of possibilities for using these robots in automotive plants. But, as dazzling as Braintech's technology is, there is another story here. Braintech is a prime example of how genius is never enough in the business world. Braintech was started in 1993, but it was not until 2002 that it had its first full year of marketing and selling a finished product, albeit a revolutionary one for industrial manufacturing. It is a story about hard work, luck, vision, perseverance, planning and good people. Founder and chief executive officer (CEO) Owen Jones describes himself as "a west-coast businessman, bootstrapping all the way, always trying to innovate, to get involved in new things." "It's taken a lifetime of getting here," he adds.

Braintech has finally managed to forge its way to its future. After almost 10 long years of doing most things right, Jones feels he has only tasted the first bite of success. "There are some very interesting markets within vision-guided robotics," he says. All it will take for Braintech to exploit these markets is still more great technology ... plus more hard work, luck, vision, perseverance, planning and good people.



Founder and CEO Owen Jones

“There are some very interesting markets within vision-guided robotics.”

Braintech Inc. is a Vancouver-based industrial software maker for automakers. It develops and supports commercial-grade vision-guided robotic (VGR) automation solutions based on its world's-first, three-dimensional (3D) robotic guidance systems for a wide range of flexible and adaptive manufacturing operations. Based on a single conventional charged coupled device (CCD) video camera, single-camera 3D technology is ideally suited for robotic handling applications involving precisely manufactured parts, such as engine heads, manifolds and the like. For more information, see www.braintech.com

The Vision-Guided Robotic Industrial Revolution

Braintech's vision-guided robotic (VGR) solutions are marketed under the brand name PathFinderVGR. Using unique single-camera three-dimensional technology, the company's most innovative solutions aid robots in performing complex jobs never before performed by robots, such as engine-head transfer and engine-head decking in automotive plants.

The key to Braintech's future success will be its eVision Factory™ (eVF), a powerful universal software platform for managing VGR solutions. By including all the building blocks from previously developed VGR systems, eVF means engineers won't have to re-invent

the wheel when starting work on a new solution. The eVF platform works much like the Adobe software used to manage photo applications. It assembles all the plug-ins so programming can be done faster, better and for less money. Braintech intends to make eVF the software standard for the VGR industry, licensing it to top integrators around the world in each industry.

Complete automated assembly using VGR promises increased factory up time, greater productivity, improved quality, increased safety and reduced ergonomic injury claims by workers. The result is lower costs for manufacturers. Using eVF software, Braintech's PathFinderVGR solution can easily be reconfigured to handle a variety of applications.



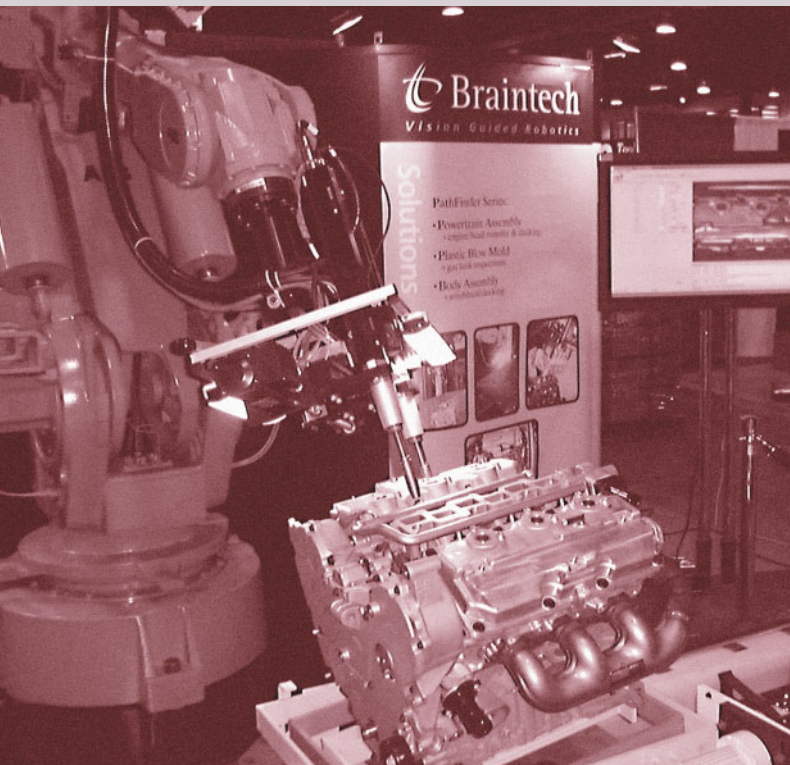
A Touch-and-Feel Beginning

Jones has been involved in the software industry for more than two decades, but has made three clear shifts in his career, each time adding significantly to his portfolio of knowledge, experience and abilities. In the 1970s, Jones studied history, not computer science, at university. He spent the first part of his career managing construction projects. In the 1980s he decided to get involved in the computer science industry, and retrained as a technician and programmer. Over the years, he gradually shifted into the marketing end of the industry, gaining experience in management information systems, national distribution channels, and sales and marketing for companies, including IBM. He did business on an international level, both with government and private sector clients. He was even involved in a Euro-equity market deal as he helped take one of his employer companies public, an experience he was later able to apply in the case of his own start-up firm. In 1995 he took a job as CEO at Sideware Systems Inc., then a promising start-up developing Internet-based customer relations technology.

By that time, Jones had become a self-confessed software junky. An entrepreneur at heart, the dream to one day become his own independent software vendor began to percolate. He was constantly looking for ideas and opportunities to produce something that was both new and would have widespread market demand. The genesis of Braintech happened fortuitously. In mid-1993, while representing an employer at a trade show in the United States, Jones was introduced to Willard Olson, a scientist and revolutionary thinker in artificial intelligence who was working for Motorola at the time.

Olson had worked out a visual system that produced an extremely high level of probability in identifying and classifying objects. Classification, of course, is essential to developing artificial intelligence, the branch of computer science that lets computers simulate such aspects of human intelligence as speech recognition, deduction, inference, creative response, the ability to learn from experiences, and, generally, the ability to make inferences given incomplete information.

As Jones explains, “Willard was doing research on how the brain receives and stores information, and had come up with a set of algorithms, using fuzzy math, to measure and classify objects. So I said to Willard, ‘Let’s start a company and take your algorithms to market.’” Jones admits he didn’t know much about the science behind Olson’s invention, but he did recognize that it might have some significant marketplace applications, and he had some money from stock options to invest in a start-up company. He also knew how to take a company public. Olson and Jones signed a deal in 1993 that gave Olson an immediate payback for his invention. Jones incorporated Braintech in December of that year, immediately raising \$2 million in a private offering to fund pure research around Olson’s science. There was enough money to keep the company busy in the laboratory, turning over stones in the continual process of trying to figure out the best road to marketplace success.



“We started around handwriting recognition, optical character recognition, facial recognition, video recognition — extracting data from videos that companies could use. We started to create around video and the recognition of objects in video. We did some research projects for companies. For Sunkist [Growers, Inc.], we were able to classify fruit by characteristics like density of rind, density of pulp, and so on. For Johnson & Johnson, our technology scanned laser cuts in their stent production process to see if they were properly done.”



The Research Phase

Jones knew there were plenty of applications for Braintech's visual classification capacity. He also knew, from talking to other software vendors, that, in order to be successful, he would have to create an innovative new technology and build products with it that the marketplace would want. He was looking for the very best route to success. Between 1995 and 2000, he says, "We went down some pretty exotic paths."

"I hired four or five scientists and engineers — some very interesting characters," says Jones. "We started around handwriting recognition, optical character recognition, facial recognition, video recognition — extracting data from videos that companies could use. We started to create around video and the recognition of objects in video. We did some research projects for companies. For Sunkist [Growers, Inc.], we were able to classify fruit by characteristics like density of rind, density of pulp, and so on. For Johnson & Johnson, our technology scanned laser cuts in their stent production process to see if they were properly done."

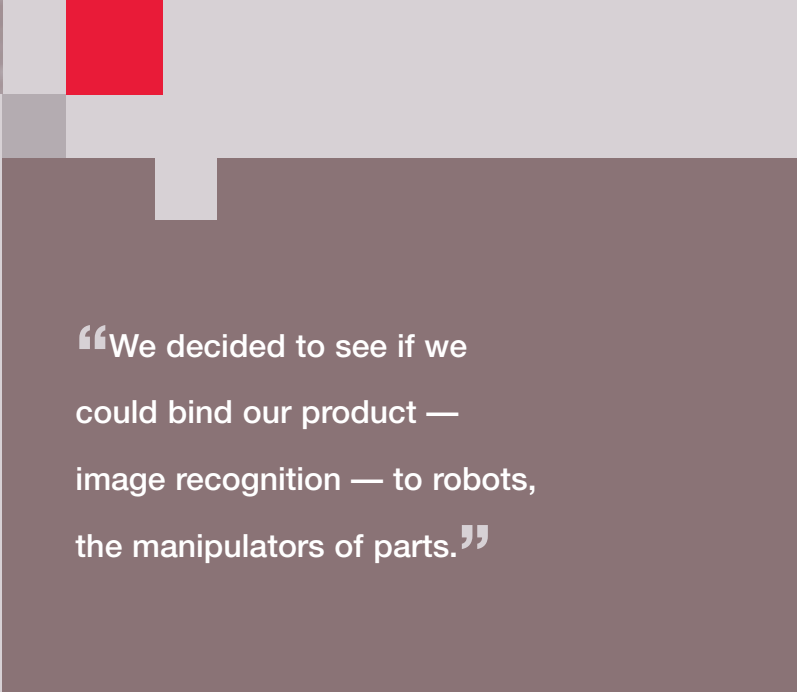
Throughout this long exploratory voyage, Braintech was mainly a research company, offering its technology to clients. Jones recognized early in the game that he would eventually have to come up with a product

to sell if he wanted to realize his aim of being a successful independent software vendor. While the company was trying to figure out what its ultimate product might be, it worked to do two things: keep researchers happy and optimistic about the future of the company, and make the marketplace aware that the company had the kind of technology in place that would eventually lead to a great product.

Jones was still working for Sideware Systems, and, by this time, its CEO, so his Braintech employees were key to Braintech's future. "The core of fostering a culture of innovation is getting good people," says Jones. "How you get good people is a real challenge for a new company. You've got people who have invested their time getting master's [degrees] and PhDs, and they want a career with a good company. They're looking for opportunities. The value of a small company as opposed to a large company is that the work is more satisfying. As a technologist, you're immediately involved in core development, and you don't have to go through years of apprenticeship. It's an attraction for some, where security is not their main problem." In addition, the research was stimulating, he says. "We were at the forefront of image analysis, we built our own image libraries. We just gained vast layers of expertise in fuzzy math and image analysis." Jones' pursuit of success was single minded, making it clear to his team that their research would some day bear fruit in the marketplace. His determination was infectious. "One of the nice things about Braintech," he says, "is that we feel we're all rowing in the same direction."

Jones attracted bright people by offering them healthy salaries and stock options. He encouraged some of those with master's degrees to get their PhDs, and ran a typical software operation, where casual dress and impromptu basketball games were the norm. Not surprisingly, staff turnover was low.

As for maintaining a positive corporate image during Braintech's five years of researching and experimenting, Jones became a firm believer in trade shows. "Trade shows are an art," he says. "It's not a matter of going in there and standing in front of your booth and



expecting people to fall in love with what you have. There are various parts to the art — know who's attending the show, make sure your message is understandable, develop relationships with the media. We did this over a number of years. We gave ourselves visibility, even though we had no customers and no real product. We gave ourselves a level of credibility through our continued presence.”

At the end of the 1990s, Braintech was at the forefront of image analysis technology, and had established its credibility in the science. The company was growing organically and Jones kept going to the markets to raise money to continue his research and development in search of the right opportunity. Its only government research funding came in the form of a \$100 000 Industrial Research Assistance Program grant from the National Research Council Canada around 1998, for work Braintech was doing on a “Braintron classifier.” The company still only had six employees.

The Breakthrough

Braintech's first big break was based on a combination of intuition in the laboratory, a lucky encounter at a trade show, and shrewd hiring. In 1998 Jones brought in Babak Habibi as vice-president of engineering. Habibi had an interesting combination of qualifications. He had earned a Master of Applied Science in robotics and control from the University of Waterloo. Before that, he had taken a minor in management science while earning his Bachelor of Applied Science in mechanical engineering. He had worked with a Montréal robotics company for five years, and brought expertise in motion control sensor systems and spatial movement robotics, and industrial applications experience to his new Braintech role.

“We decided to see if we could bind our product — image recognition — to robots, the manipulators of parts.”

Under Habibi's guidance, Braintech started to focus on robotics. “On a leap of faith,” says Jones “we decided to see if we could bind our product — image recognition — to robots, the manipulators of parts. We developed a lab system where we had a Canadian-made robot take parts out of a bin, place them on a conveyor system, take parts off the conveyor, and put them back into a bin. We started to gain a tremendous understanding in this area.”

Then came what Jones calls “the company's lucky moment in time.” In early 1999, Braintech demonstrated its new robot system at a robotics trade show. It caught the attention of the general manager of ABB Flexible Automation, a division of ABB (Canada). ABB is an international technology firm that operates on many different fronts, serving customers in the power transmission industry. ABB developed the very first industrial robot more than 25 years ago and has a reputation as an innovator in the automation industry. It is

also a major supplier of robotized automation solutions, products, systems, and services, mainly serving the automotive, foundry, consumer goods, metal fabrication, and plastics markets.

ABB got excited about Braintech's technology, now clearly on its way to becoming a product. Jones, in turn, got very excited about ABB's willingness to back up its enthusiasm with a business partnership. Jones had the entry into the marketplace that he needed. "We entered into a sales and marketing agreement to sell our vision-guided technology and robotics solutions with ABB to their customers," says Jones. "That has been a tremendously successful opportunity. It really was a lucky moment for the company — that this person discovered what we had and made the decision to use it. We refocused the company around that event."

The very first contract with ABB related to developing identification and location systems for robots. The arrangement with ABB generated contract revenue for Braintech, while, at the same time, giving the emerging company time to do further work on its new vision robotics technology and try to develop it as a market. "If we wanted to be a software vendor, we had to be a first mover. This could be it," thought Jones at the time.

Time to Focus

In fall 1999, Braintech narrowed its mandate. It became a developer of software giving robots the capacity to use video images to perform industrial operations. The company, says Jones, began to focus entirely on the automotive business and its new relationship with ABB. The path Jones had been searching for was before him. Other possible avenues were relegated to the company library for the foreseeable future.

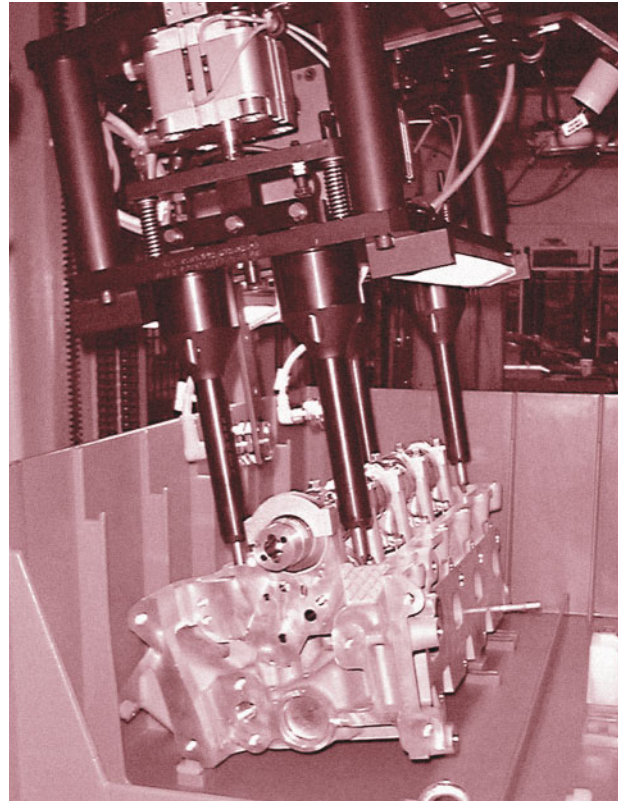
“The status quo method was based on non-guided robots or assembly-line gantries that relied on parts to be always presented in the same position by means of mechanical fixturing devices. Fixturing devices are expensive, require constant maintenance, and were outright unfeasible in bins.”

In the early months of their relationship, ABB brought Braintech along slowly. At first, it had its new partner develop solutions for smaller customers. As those solutions proved themselves, ABB gained confidence. By 2000, Braintech was taking on projects with ABB's larger customers in the automotive industry. One early success involved creating equipment that could detect small flaws in products emerging from the plastic blow-mould process.

In late 2000, Jones decided to leave Sideware Systems and run Braintech on a full-time basis. After years of working for other people, he was finally on his way to becoming an independent software vendor. He used the wealth generated from the sale of his Sideware Systems shares to become Braintech's angel investor. For the next two years, Jones would finance Braintech's monthly cash burn to the tune of \$200 000 per month.

Then came Braintech's first really big opportunity. Ford Motor Company — one of ABB's most important customers — had moved to a fully automated plant in its parts assembly operations. The plant was using CNC (computer numerical control) machines to provide flexibility and a faster response to production changes. But a key challenge remained: moving parts from semi-constrained bins to the production line and back to the bins after production. Engineers decided to see if they could use robots to overcome this challenge, but robots at the time only had two-dimensional vision. With no depth perception, they wouldn't be able to properly grasp randomly positioned parts out of a bin. Could this challenge be overcome?

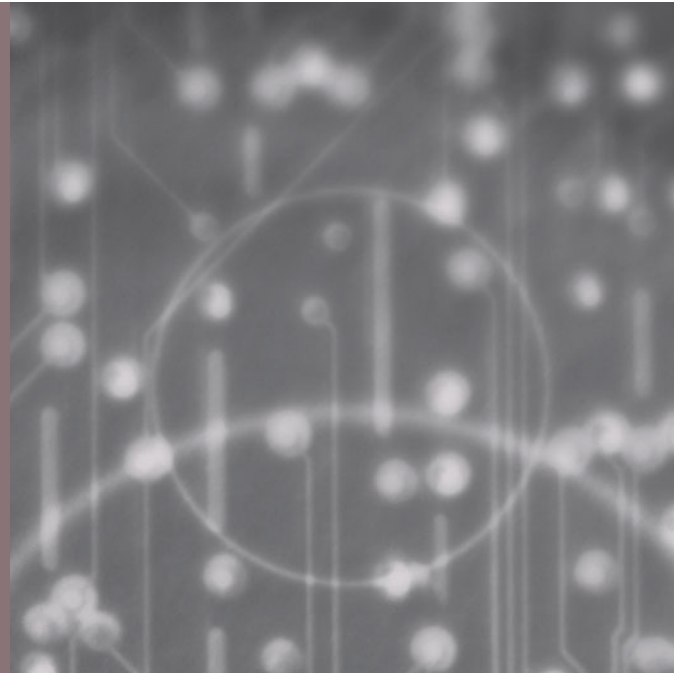
Robots were not new at Ford, but, as Jones describes the situation, "The status quo method was based on non-guided robots or assembly-line gantries that relied on parts to be always presented in the same position by means of mechanical fixturing devices. Fixturing devices are expensive, require constant maintenance, and were outright unfeasible in bins." Ford expressed genuine interest in vision-guided technology. It issued a request for proposals to all major robot manufacturers, who in turn queried machine vision suppliers around the world, inviting them to demonstrate a solution.



Braintech responded. Part of their rationale for working on the vision-guided technology that might solve Ford's problem was the belief that it was possible for robots to see in three dimensions. The Ford proposals request, however, would require an invention on Braintech's part. The good news for Jones was that Habibi was up to the task.

Habibi knew that the bulk of what was known about machine vision and image processing came from an area called "inspection of semiconductor wafers and chips." Because of the nature of those problems, a lot of the science and solutions were in two-dimensional vision. Any three-dimensional capabilities that had been developed used lasers and structured lighting, but problems with both specialized lighting and lasers made the technology difficult to deploy in a plant environment. Previous experiences with the use of vision-guided robots in manufacturing plants during the 1980s had not been very positive because of these problems. Says Habibi, "When we identified we were faced with this problem coming from the Ford Motor Company, it was pretty clear to us that this was a real opportunity if we could differentiate

“We knew we had the beginnings of it ... We’ve just been adding layers and layers to the original concept to make it usable in the plant environment ...”



ourselves by not using those pieces of the solution that had traditionally caused problems, like structured light. So I went to the library at Simon Fraser University and did some casual research of academic research papers, and I found a paper that told us it was theoretically possible to use a single camera without any structured lighting to find the 3D location of an object. So we knew we had the beginnings of it ... and ever since then, we’ve just been adding layers and layers to the original concept to make it usable in the plant environment, to automate a lot of the set-up and configuration aspects of it.”

The bad news was that Braintech was about to come up against by far the biggest barrier it had ever encountered: fierce opposition from firms making the already existing technology.

What Braintech and ABB recommended to Ford was that it go with three-dimensional, natural vision. “We said, ‘Come at this from a new angle’ — basically from natural vision, which uses perspectives, seeing the relationships between objects and space. We presented our full concept to Ford, and they gave us the job,” explains Jones.

But not before the firms selling the old technology tried to cast doubt on Braintech’s capacity to solve the problems. As Jones recalls, “What they did was to say ‘It’s too small a company, with unproven technology. Why should you adopt that new technology over ours?’”

“We had the support of some ABB people and [Ford’s] project manager, and Ford research put us through very rigorous tests. Six-sigma testing tests you for every condition. You have to come out 99.999967 percent right, at a minimum. And our technology passed all the tests. That was a year ago,” he says.

Finally, a product — a three-dimensional vision guidance system for robots, a paradigm shift in using robots in the manufacturing process. Essentially, the solution is based on single-camera three-dimensional algorithms that use a single, still image from a compact CCD video camera mounted on the robot’s end-effector to calculate the full three-dimensional location of a part (i.e. x, y, z position and roll, pitch and yaw angles). The controller uses this information to guide the robot’s hand, and interprets each part correctly for grasping or performing other robotic functions.

Braintech applied to patent its invention. Jones knew there would be greater demand for Braintech's solution as a result of automakers losing pricing power and looking to achieve cost savings in the production process. He hired an analyst to assess the market potential of Braintech's VGR. The estimate? An annual market opportunity of \$160 million to \$348 million annually over the following five years for VGR automotive powertrain systems alone. Jones projects that he can gain 30 percent of that market share by 2006. In 2001, Braintech more than quadrupled its number of engineers and scientists, from 6 to 25.

Jones recognized that the time had come to split the company into two areas of responsibility. Habibi, in his new roles as president and chief operating officer, would handle development and operations focussed on building systems and products offering total solutions centred on VGR, as well as maintain relationships with customers. Jones, as CEO, would concentrate on building a strategy to raise the large amounts of new money that would be needed to develop and market Braintech's new products around the world.

After signing the ABB agreement, Jones and Habibi made the crucial decision to concurrently develop guidance technology and a VGR software platform. The product was eVF, which is, essentially, a universal software platform capable of generating a wide range of applications for VGR. Braintech's vision for eVF is to create a standardized operating environment for all companies deploying VGR, and to license eVF to top integrators within each industry around the world. Braintech's research shows the number of robots currently being deployed to be in excess of 25 000 per year. This is the climax of Jones' long-held vision. The challenge now will be to train as many engineers as possible on the eVF so they will have the ability to create and deploy VGR solutions in their factories. The "e" in eVF refers to e-support. Braintech's goal is to provide 24-hour-a-day, 7-day-a-week support for Braintech VGR systems using the Internet as a communication backbone.

Braintech has sensed the direction in which it should be heading since before Ford even decided it needed to replace its robotics technology. When Ford made that decision, Braintech was able to quickly put together the software solution that the company wanted, a perfect example of the collision of innovative technology, a manufacturing problem in search of a solution, and market readiness. "As it turns out," says Jones, "it all converged." Fifteen Braintech systems are now up and running at three Ford plants, demonstrating that their three-dimensional vision guidance system works. Habibi adds, "We have figured out through our experience that our path is going to be one of three-D, vision-guided robotics, for at least the medium term. And so we want to focus on that."

“We have figured out through our experience that our path is going to be one of three-D, vision-guided robotics, for at least the medium term. And so we want to focus on that.”

Braintech's first full year of marketing and selling a finished product was 2002. Its business plan projects an exponential growth in revenues from its less than \$1 million per year base in 2002. The company's goal is to sell 100 vision systems for 20 different applications to different end users. Focussing on its strategy to support the efforts of its channel partners, Braintech plans to hire additional sales personnel, increase the frequency of its attendance at targeted trade shows, and increase its advertising in industry trade publications. The immediate aim of much of this is to increase awareness about Braintech and its VGR solutions among automotive engineers.

Moving into the Future

One of the most critical moments in Braintech's triumph at Ford came when ABB stepped forward and signed a guarantee that Braintech was capable of providing the product it promised. "We were very fortunate to have a channel partner with a good reputation," says Jones appreciatively.

In 2001, Braintech signed on with a second channel partner, with an Asian impact: the huge, Japanese-based Marubeni Corporation. The memorandum of understanding between the two companies grants an exclusive licence to Marubeni for Braintech's eVF system for all of Japan, and non-exclusive rights for other industrialized countries in the region. The agreement was expanded in June 2002 to give Marubeni exclusive license to manufacture and distribute Braintech's VGR systems. Under the brand name

ROBONAVIGATOR™, Marubeni intends to develop and fully integrate VGR solutions with best-of-breed industrial computer systems and vision technologies, using eVF. At the time of the announcement, Marubeni's general manager for production machinery said Braintech's superior three-dimensional technologies were the next giant leap in manufacturing automation, answering the industry's need to lower the cost of production without losses in quality.

With Marubeni as a partner, Braintech plans to build about a hundred total turnkey solutions. Their first is in the assembly of torque converters. "The way it's done now, you have a dish — the housing — and little fin-like veins. And a person puts in 200 veins on each dish. Robots with vision can do that. Marubeni is a means to build those solutions, and a channel, in Asia, to sell them," says Jones.

And Further into the Future

After breaking through every barrier standing in its way, Braintech faces the one that Jones has long known was coming. "The barrier we face now is growing the company," he says.

Jones is faced with the same stumbling block that every firm wishing to go to the public for more funds must face. "The difficulty today is that there is no exuberance in the financial markets," he says. "To get capital today is a daunting task." Still, there is no alternative to raising money if Braintech is going to blossom into the international powerhouse that Jones envisions, rather than a branch of somebody else's company.

"We've delivered in a commercial forum. We've gone through a whole year of examination of what it takes to deliver a viable product as an alternative to what's there. You have to be able to move quickly, because you're dealing with these [assembly] lines, and they don't like to turn a switch off We're pretty well there now," says Jones. "We had to understand what constitutes the total solution — it's training systems, it's support systems, it's relationships with all the right people in the plants and the corporation. What we have brought into auto making is the most complex

"We've broken through and gained this level of credibility, and we have to manage that."

piece of technology the automakers have ever embraced, ever And it's working. It's in three plants, and it's working. And that has triggered an avalanche of interest from all the other automakers. We've broken through and gained this level of credibility, and we have to manage that."

"My job now is to make the company attractive to investors," he says. "It's like you're going out on a new date and you've got to dress up. So I've dressed the company up. We consolidated the stock, rolled it back five to one to make it more attractive. We have added some very impressive people to our board of directors. We have good relations with KPMG, our auditors. It's very important to be seen as structurally sound these days. So we're forging relations with potential investors in a number of ways. And I think I'll have the right financial partners pretty soon."

All indications are that Braintech's technology will radically change the automotive industry. What's the value? Up to a 90-percent decrease in employees, and 100 percent quality in production. "With eVF, the company has a platform that is infinitely adaptable to vision-guided systems. It brings a new level of quality assurance and capacity to this marketplace. That's the brilliance of Braintech from a product point of view. We've done that before our competitors are even thinking about it, and we've done it at a higher level than anyone thought was possible," Jones says proudly. "And we have devised a way to support eVF over the Internet. We have developed, in-house, a mechanism to remotely support all our systems worldwide. And it's a breakthrough piece of software. We're able to connect through firewalls, into plants, and we're able to manage these things. It's built as a Web service using MS.net architecture, and that's what everybody wants."

For the near future, Jones foresees gradual growth in revenues for a period, to establish credibility, and to let Braintech continue to work on custom applications of its three-dimensional VGR systems and launch eVF. He envisions six months to a year of market education, "and then demand takes off. I'm optimistic, we'll have a 2004 takeoff!"

Then, he says, Braintech will look beyond the automotive industry into other manufacturing fields. One he has been considering is security, where vision-guided robots might serve as a pre-entry sensor at U.S. borders with Canada and Mexico. "We're actually pursuing that," he says.

Technologically, Jones believes that Habibi has the capacity to lead the company into exciting new fields. "The areas I'm very interested in are force-feedback and mobility (robots with eyes, hands and feet). That would open up a whole new set of assembly tasks that we can't do today. With [today's robots], they just kind of grab. We need ones that feel. That's all about sensors and algorithms that emulate the brain. We'll tackle that from a natural feeling point of view. How do you do that? It's a fuzzy thing," says Jones. The math may be fuzzy, but Jones' vision for Braintech is definitely clear.

Braintech Inc.

102-930 West 1st Street

North Vancouver BC V7P 3N4

Canada

Telephone: (604) 988-6440

Fax: (604) 986-6131

Web site: **www.braintech.com**

E-mail: **info@braintech.com**



The Virtual Model Product

MY VIRTUAL MODEL INC.

The model on the screen looks pretty much like the models you might see in any catalogue — but with one rather startling difference: their shape is more or less identical to your own. The bulges are all in the right places, even if the posture is a bit better than yours. The model's hair colour and style are similar to yours, too, and it's wearing almost identical glasses. It's enough to send a little chill down your spine.

It's not just there to give you a kick, however; it has a very practical purpose. Right next to the model is an assortment of clothes — blouses, skirts, accessories, pants, wind jackets, etc., all in a range of possible colours. A few clicks of the mouse and the assortment is bigger yet. Actually, if you keep looking, there's as much as an entire store could stock. All you have to do is point at the item you like, drag it to the model, and drop it. Voila! The item is fitted to the model and you have a good idea of how it would look on you. A couple more clicks and it's yours.

When shoppers visit a Web site where they can create their own virtual model, they try on up to 60 different items per visit. That's better than spending a whole day darting in and out of the changing room. It works for the retailer, too; people who visit the Land's End Web site, the first catalogue retailer to use the virtual model technology, are 34 percent more likely to buy something than if they just drop into the store, and they spend 13 percent more, on average.



Jean-François St-Arnaud, CEO

“We have a great partnership,” says St-Arnaud. “We are very different — and sometimes we have [heated] discussions, but we need each other. No one person can do it all themselves.”

Louise Guay, President



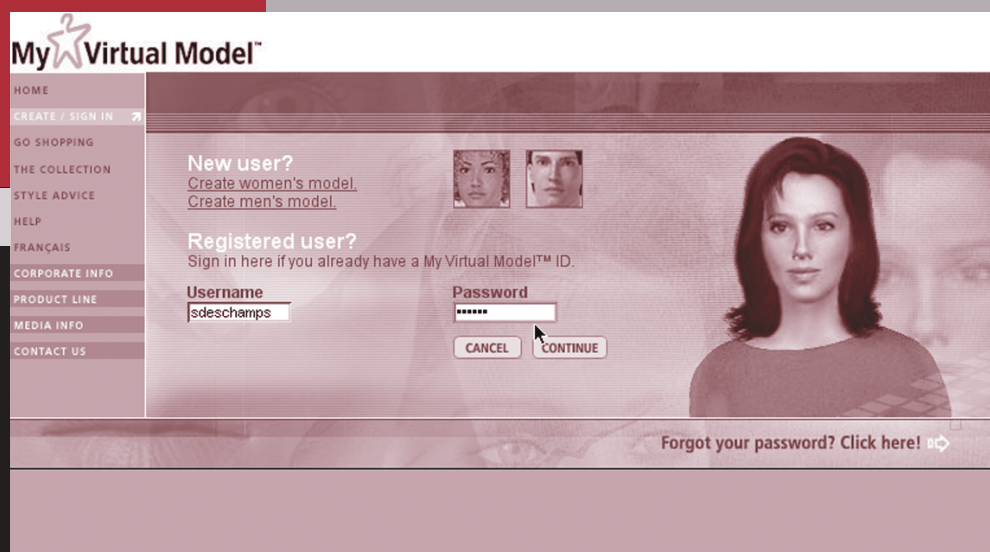
My Virtual Model Inc. (MVM) is the world leader in selling on-line tools for the apparel industry, with more than 15 clients, including Land’s End, Levi’s, Sears, Kohl’s, the Home Shopping Network and Lane Bryant. MVM’s revolutionary virtual model uses virtual identity technology to provide users with personalized shopping tools to “try on” clothes on-line. Based in Montréal, MVM serves more than 4 million consumers, who try on more than 100 million garments per year using MVM technology. For more information, visit www.mvm.com

The company that creates the models is My Virtual Model Inc. (MVM), based in Montréal. It is led by co-founders Louise Guay and Jean-François St-Arnaud. MVM opened its doors in 1998 and has built the technology from scratch.

To create the virtual model, the programmers had to design a kind of electronic body sock, with markers at every key point where the body’s shape changes. That means hundreds or thousands of markers on a starter virtual body. Together, the combined effect of these markers, when they are shown on the screen, is like the wire frame that sculptors use to hold their clay, except that there are hundreds of lines defining the body, showing its every curve and nuance. The trick in programming this intricate modeling process is in figuring out the basic body types, then asking the user to fill in a form that gives all the information necessary to assign a body type that fits that individual user perfectly. It’s a bit like what a tailor would ask before making a suit — height, weight, length of arms and legs, waist and chest measurements, and so on.

The resulting virtual body is not a clone of yours, but it is as close as most users want to get. The technology exists to scan a person’s body and translate the readings into a carbon copy of their body, but this is not necessarily a great idea. The scanner shows, rather brutally, every idiosyncrasy of your body, detailing some aspects with a bleak precision that you might prefer be more muted. People who have seen electronic versions of their bodies from scanned images often say they would rather no one else saw it. The MVM technology gives a more forgiving replica of its users’ forms. Virtual bodies can still be created in MVM software using input from scanned images, but the final products still reflect the MVM version. The final result may not advertise your every aberration, but it’s still a close resemblance. Or at least it can be. When the virtual model welcomes a new user, it says, “I will look like you as much as you desire. If you lie to me, I will lie to you.”

“I will look like you
as much as you desire.
If you lie to me,
I will lie to you.”



The electronic markers then have to be rendered. That means that the relationship of every single marker has to be established to every other marker in the virtual body. This lets you see the model in three dimensions in a way that the body keeps its shape and perspective when seen from many different angles. For example, it lets the body assume different poses without losing its integrity, or lets it turn around just like a model on a runway.

Once the virtual body has been created, it is ready to be fitted with clothes. But, first, the clothes also have to be digitized. This is done through the same process used to create the body. The key elements of the garment are fitted to the appropriate parts of the body, and adjusted to the right size. You can even ask for tight-fitting or loose-fitting clothes. When a particular style of garment is dragged from a display and dropped onto the body, the markers on the digitized garment connect with the markers on the virtual model and come up with a fit. It's like a mirror instead of a computer screen in front of you.

The technology is extraordinarily precise and time consuming. When MVM created its first virtual models for Land's End in 1998, they were almost cartoons, and gave only a rough impression instead of demonstrating how the clothes fit. It was cute, but not cute enough for Land's End customers, who wanted more lifelike models, with appropriate skin tones and realistic bodies and garments. Land's End encouraged MVM,

however, making a strong commitment to the project. By early 2003 the virtual model was entirely lifelike. The faces, however, are still generic, although users can choose their own face sizes and shapes, and skin colours.

Creating this lifelike image was initially a major task for every single new virtual model. Over the years, however, MVM has developed a wide range of automated processes that have drastically shortened the process, enabling it to cope with huge volumes. In the early days, it took one person four weeks to digitize a garment (at a cost of about US\$2000). Now, one person can do 30 or 40 garments a week.

So far, MVM has created 4 million virtual models, and it is adding 300 000 a month. By early 2003 more than 100 million garments had been fitted on MVM models.

The Start of the Innovation Journey

The story of the virtual model goes back to 1990, when Guay and St-Arnaud joined forces to start a multimedia firm called Public Technologies Multimedia Inc. (PTM). They had both just emerged from unsuccessful partnerships, so they were nervous about embarking on another one. Perhaps that caution worked to their advantage, because their partnership has turned out to be very successful. The two have

completely different characters, but, rather than compete against each other for power and status, they capitalize on their differences to ensure they have all the skills they need to run a successful business.

Guay is intense, passionate and driven. The virtual model is her dream and MVM is her life, her purpose. She provides the vision. St-Arnaud is more of a manager and a businessman. He looks after the finances and the administration.

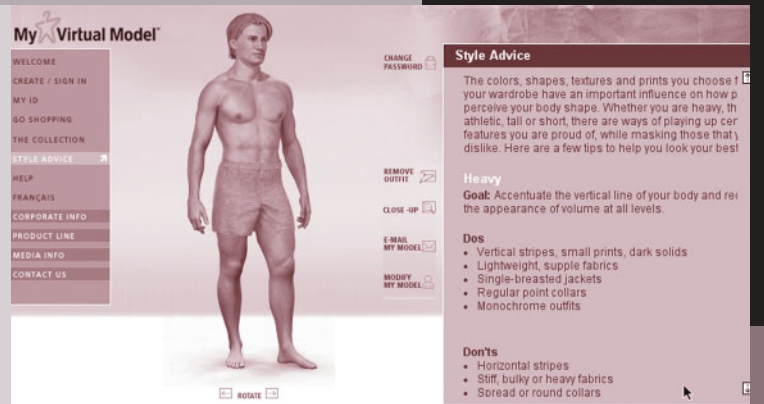
“I’m very passionate,” says Guay. “He’s calm and he has great credibility when we’re in crunches.”

“We have a great partnership,” says St-Arnaud. “We are very different — and sometimes we have [heated] discussions, but we need each other. No one person can do it all themselves.”

PTM provided multimedia services to corporations when multimedia was still very new. It created Web sites for major firms such as Bombardier. When the ice storm hit Quebec in 1998, PTM created a Web site to help Hydro Québec communicate with its affected customers. The company pioneered the use of CDs for corporate messages. Within a few years, PTM was the largest multimedia agency in Canada, with annual sales of almost \$4 million and 60 employees.

Toward the end of the 1990s, however, several things happened to make it change direction. St-Arnaud realized that growing a service company is very hard work. Revenues depended on how many hours they could bill, so there was little room for leverage. “If you want significant growth, you need a product,” he says. But what product?

The idea for their product emerged from discussions with one of PTM’s clients, Boutiques San Francisco, which was concerned that women were not using the Internet. This was before the dot-com revolution, but it was already apparent that the World Wide Web was going to change the way people did business. Guay decided to find new ways of making shopping on the Internet more comfortable for women.



The idea resonated with Guay, for whom it was the perfect idea, the materialization of a lifelong dream. “From the time I was a little girl,” she says, “I was fascinated with multiple personalities. I was surrounded by parents and adults who did not try to repress my imagination, and the world was a stage for me. But I didn’t want to produce other people’s plays — I wanted to produce my own. My parents encouraged me in this direction. I had cameras, media, theatre ... I was lucky.”

As Guay grew older and discovered how many sides there were to her own character, she became interested in the idea of living all her potential lives. “I became a mystery to myself,” she says. “Was I a writer or a producer? An actor or an observer? A teacher or a student? I wanted to be many of these things.”

After she graduated with her first degrees, in philosophy and aesthetics, Guay got a job with the CBC, writing the screenplay for a children’s puppet show. Her creative biases were apparent — the puppets appeared on screen in a highly experimental exploration of the boundaries between reality and virtuality. Guay has managed to retain the boundless imagination of her childhood, though it is now packaged in a mature, even hard-edged business sense. “I am an adult now, mature,” she laughs, “but I still have my imagination.”

In the early 1980s, after giving a speech in Montréal, Guay met a man from the Centre international de recherche, de création et d’animation, located in Villeneuve-lès-Avignon, in southern France. He suggested she come to the centre and she jumped at the chance, spending a year there as researcher in residence. This gave her the impetus to start her PhD in multimedia communications at the Université de Paris. For her thesis, Guay created the Pocket Museum, which would become the genesis of the virtual model. It was the first thesis ever presented on a laser disk, and it was Guay’s first foray into virtual identity.

The Pocket Museum was an electronic museum containing images of 4000 masterpieces. The user could visit the museum to look at these pictures, but with a twist — they could create their own virtual identity and become part of the electronic visit. They could put themselves into the picture with Mona Lisa, or sit at the feet of a European monarch lolling in the faux countryside with his family. The user became part of the art, and the art came alive.

The technology of virtual reality was in its infancy then, but people knew they were looking at something special with Guay’s project. She needed a lot of money to pay for the programming of the Pocket Museum, so she went to see Marcel Masse, who was then Canada’s federal Minister of Communications. “He believed in me,” she says. “He could see that the technology offered a path to understanding. It was *souveraineté sans frontières* [independence without borders].” Masse invested in the Pocket Museum, alongside government departments in France and Italy and corporations such as Sony, Philips and Apple.

In Canada, it was produced with the Canadian Museum of Civilization and distributed to many retailers in Ontario and Quebec, in many ways laying the foundation for what would come a decade later. When Boutiques San Francisco planted the seed of the virtual model, and the two partners started talking about changing the direction of PTM, the Pocket Museum

“We wanted to be number one in the market. When you’re at the top of the list, you get 60 percent of the market and most of the resources.”





acted as the basement for the building that would become MVM.

Guay completed her first virtual model in 1997, and she and St-Arnaud took the plunge in 1998. They sold their multimedia business and kept only the 25 employees who they thought could adapt to the new mission. They named the new business My Virtual Model Inc. Guay, armed with her firm conviction that her vision had the potential to change the world, plunged into the United States market, seeking customers.

“It takes a lot of courage to do that,” says St-Arnaud, “just walking into their offices and asking for their business.” But it was during the glory years of the dot-com revolution and nothing was impossible — especially for investors. Dazzled by the potential of the Internet, sober companies were pouring billions of dollars into an ocean of proposals, any one of which might hit the jackpot. MVM met the criteria as an idea with legs and raised several million in funding, mostly from Telesystem Ltd. (the holding company for Charles Sirois) and the Caisse de Dépôt et Placement (the company that invests the funds of the Quebec Pension Plan and of all the pension plans for Quebec’s civil servants).

By this time, MVM had won Land’s End, J. C. Penney Inc., Disney, Macy’s and Mattel as customers, and several more companies were interested. (By early 2003 the list of customers would also include Levi’s, Sears, Kohl’s, the Home Shopping Network and Lane Bryant, among others.) The company took off rapidly, growing to 250 employees and \$10 million in annual sales, but with large losses because of its huge investments in research and development (R&D).

“We were not concerned about profits,” says St-Arnaud. “We wanted to be number one in the market. When you’re at the top of the list, you get 60 percent of the market and most of the resources.” So MVM’s emphasis was on staying ahead of the pack and keeping an intense R&D focus, which accounted for 30–40 of its employees.

Then the bubble burst.

“It was *souveraineté sans frontières* [independence without borders].”

Surviving the Dot-Com Crash

“The shareholders changed their orientation,” says St-Arnaud. “Now they wanted us to be profitable.” It forced massive and painful changes on MVM. They laid off 210 people, reducing the staff to 40, while their annual sales plunged to about \$5 million.

It took a couple of years to regain their equilibrium under the new rules. But they held on, unlike many dot-com companies that had not built up enough steam while the going was good to carry them through the hard times. By early 2003, MVM had reached the point where they were breaking even; they also approached their shareholders to renegotiate their shareholder agreement to let the company go forward on an equitable basis. Sales for 2003 were projected once again as \$10 million, but with only 60 employees, 10 of them working full time in R&D. The company was spending about 20 percent of its revenues on R&D (excluding R&D tax credits).

The company’s revenues come from three sources:

- The digitization of garments. MVM charges its clients US\$200. This activity used to be very expensive and is now making a reasonable margin.
- A 20¢ charge for every visit by a user to the client’s site. Each visit can include up to 60 fittings, but the incremental cost to MVM is minimal.
- Integration services to the client (to integrate the virtual model into their Web site). MVM charges US\$100 per hour for this.

With reasonable gross margins and a cash flow that can support their ongoing operations, MVM has established a solid business model that can sustain profitable growth. Once a company has reached the point where its R&D expenses are covered by revenues,

further growth will only increase its capacity for R&D, which, in turn, will entrench its market leadership. St-Arnaud says MVM's annual sales could pass \$50 million by 2008, perhaps reaching as much as \$75 million.

For an Internet company such as MVM, its success depends ultimately on how well it manages its R&D. The biggest challenge faced by such firms is encouraging the creativity of their researchers, within a framework of disciplined financial controls. MVM has made that transition too. St-Arnaud says he won't approve R&D spending unless the researchers can deliver a usable product within a year.

The mover and shaker in product development is undeniably Guay. "I am in charge of the product," she says, "but I am not the product manager." However, she is very familiar with the state of the technology and what it can and cannot do. "They can't fool me," she says, with a glint in her eye. But she knows what she wants, and she knows what is achievable. Guay sets the vision, and sets goals for what she wants her product to do. The product manager then manages the process of development. The product manager is a member of the management committee, so the status of all projects is under constant surveillance. However, Guay often talks directly with the researchers. She also speaks to the entire company on a regular basis.

"It's a difficult balance to maintain," she says, "and the secret is communication. They have to understand what we're talking about. You have to communicate, delegate, give responsibility, or you can't grow. And everyone needs to understand that the business side is part of the adventure."

An essential part of the success of this formula, however, is all the money that was poured into research in the boom years. The experience gained from that research has given MVM enormous technological power. It has automated many of its technical processes, cutting programming times by 100 times and more. This gives it a significant edge in the industry.



"A competitor could never raise the millions we raised now," says St-Arnaud. "But, in the meantime, we have the technological base to do everything more cheaply and more quickly than our competitors. It'll take them a long time to catch up."

MVM has a few competitors in the United States, but both Guay and St-Arnaud feel they have a formidable lead over them. None of them have the range and depth of customers that MVM has, for example, and, in the industry magazines, My Virtual Model usually comes out on top in comparison shopping.

But that can vanish very quickly if the two partners ever slacken their pace. MVM has to make sure it stays at the top of the list. So it is pushing ahead as fast as it can, with a stream of innovations that will make its virtual model more and more effective. The two most important innovations that will emerge in the near future are real faces and intelligent virtual models.

Most people didn't have digital cameras in early 2003, but Guay expects that access to digital cameras will soon become commonplace. This will let MVM add users' actual faces to their virtual identities.

The Future

In the next few years, MVM models will also become more and more intelligent, and will be linked to different systems and data bases on the Internet. "They will extend our reach into the connected world," says

“You have to communicate, delegate, give responsibility, or you can’t grow. And everyone needs to understand that the business side is part of the adventure.”

Guay. “They will recognize our preferences from the decisions we make and they will provide intelligent recommendations to us, using those preferences and the data available on the Internet. They will augment reality. We’ll be extended through virtual reality. They will be able to walk, and talk; they will have voice recognition. It is true CRM (customer relationship management).”

Guay is not concerned about barriers to developing the technology to get these results. MVM’s strategy is to acquire technology through partnerships. They are now talking with cosmetics firms about developing the technology to create lifelike faces to which cosmetics can be applied. “We are focussing on one particular company now,” says Guay, “but we are talking to several. It’s the same for artificial intelligence. We are talking to several companies in this field too. Customers are not used to this new way, and everyone wants access to it. We are like a magnet. We attract the technology we need.”

Guay and St-Arnaud don’t have any preferences for how they acquire new technology — it might be through revenue sharing or a joint venture, or just through an exchange of technology. As long as they remain on the leading edge, they are confident they will be able to attract the technology they need.

Guay sees no limits to what virtual identity technology can do. She sees it as the tool that people will use to take their lives to a whole new level. Both she and St-Arnaud believe MVM could become a billion-dollar company,

and both want to ride their wave all the way. “It’s only in retail now,” says Guay, “but it can be in everything.”

“With these virtual models, the customer becomes the centre of the action, and the world revolves around the customer — not the other way around,” she says. “The virtual models will be like our avatars [a Hindu term for the earthly embodiments of deities or souls], which can play out our fantasies, free from reality, so we can use the full power of our imagination. The lightness of the mind — that’s the beauty of the human mind. You create yourself. Everyone all over the world reacts the same to this idea: they like it. It’s empowering. People can perfect their model with input that they design and implement themselves. It is evolutionary, interactive, sensitive, alive.”

“If we have social problems, we can work through them with our virtual models. We will be able to stage ourselves, accepting more challenges than we would in reality,” adds Guay. “Our virtual model will be almost someone else. It is not a clone of us. It has all our characteristics, but it will have its own intelligence.”

It’s just what Guay dreamed of as a little girl — exploring multiple personalities, fulfilling different aspects of our characters free from the limitations we impose on ourselves.

My Virtual Model Inc.

80 Queen Street

Montréal QC H3C 2N5

Canada

Telephone: (514) 523-9966

Fax: (514) 523-0100

Web site: www.mvm.com

E-mail: busdev@myvirtualmodel.com



Two Decades of Non-Stop Innovation

RESEARCH IN MOTION LIMITED

No Canadian invention has dazzled North American technology aficionados in recent decades like the BlackBerry.

This five-ounce handful of instant personal communication is still best known as the top portable e-mailer around. But the latest BlackBerry models also incorporate a phone, an organizer, and a browser for both corporate data and the Internet.

Research In Motion (RIM) founder Mike Lazaridis calls the BlackBerry a “synch engine” because “it synchronizes data across a mobile work force.” Whatever you call it, don’t call it a pager. That’s old-fashioned, and goes back to RIM’s early description of its breakthrough handheld technology.

The BlackBerry is one of Canada’s most visible high-technology success stories. Several rival companies have tried to outperform RIM’s BlackBerry with their own multitasking handhelds. RIM has actually given some of them a fighting chance, but for a price. In 2002, RIM began licensing its famous thumb-controlled keyboard to two of its main rivals, Palm and Handspring.



Founder Mike Lazaridis

“The BlackBerry is a ‘synch engine’ because ‘it synchronizes data across a mobile work force.’ Whatever you call it, don’t call it a pager. That’s old-fashioned, and goes back to RIM’s early description of its breakthrough handheld technology.”

Research In Motion Limited (RIM) is a leading designer, manufacturer and marketer of innovative wireless solutions for the worldwide mobile communications market. It develops integrated hardware, software and services that support multiple wireless network standards, and provides platforms and solutions for seamless access to time-sensitive information, including e-mail, phone, Short Messaging Service (SMS) messaging, and Internet and intranet-based applications. Its award-winning products include the BlackBerry™ wireless platform, the RIM Wireless Handheld product line, and software and hardware licensing agreements. Based in Waterloo, Ontario, RIM also has offices in the United States, Europe and Pacific Asia. For more information on RIM, see www.rim.com or www.BlackBerry.com

Was it a wise business decision? RIM argues that a company can spend a lot of money fighting contestable patent protection in the courts, or it can start earning income from judicious licensing. Besides, as company representatives point out, the BlackBerry is more than a thumb-friendly keyboard.

The BlackBerry has several technical advantages, such as always-on receipt of e-mails without the owner having to stop and pull down messages, as well as simple elegance. Keyboard look-alikes aren’t likely to change the perception anytime soon that the Canadian company still has the coolest product out there. One executive for Motorola, which also offers a handheld, even expressed frustration in a recent interview that the BlackBerry seems to have developed “a cult following.”

Technology writer George Emerson reviewed the new BlackBerry 6710, a wireless phone/e-mail handheld, for the *Globe and Mail’s ROB Magazine* in early 2003. He called it “without a doubt, the best in its class,” and raved about RIM’s ability to keep things simple at the same time it makes the technology’s tasking capacity more complex. “Functions that are complicated on other phones, like call-forwarding, three-way calling or jumping back and forth between held calls, are intuitive on the BlackBerry,” wrote Emerson. The BlackBerry is RIM’s core revenue driver. It continues to be recognized as the corporate standard for wireless data communications in North America across a wide range of industries and government agencies, and, in 2002, entered European and Asian markets in a big way.

“We were doing wireless point-of-sale integration with another company’s radios. I remember thinking, ‘Hey, we can build a better radio than this.’ And we did. That got us into paging, and we turned ourselves into experts in terms of the specifications of the paging network. We soon realized that, even though it was designed for one-way communication, you could incorporate a back channel so messages could go both ways.”

There is no doubt that RIM has been producing brilliant, elegant wireless technology that has analysts singing its praises. The big question is, how does a little Canadian firm with close to 2000 employees keep outperforming the big players? Succeeding as the cult of the moment is one thing. Continuing to make profits in one of the most cutthroat markets in the world over the long term is a far bigger challenge. And so far RIM has been doing well. Sales increased from \$12 million to \$294 million between 1997 and 2002, putting RIM a far cry from its \$500 000 revenue base in 1992.

Early Eureka!

The brain of Mike Lazaridis, RIM’s founder, president and co-chief executive officer, buzzed with electronic vibrations during his high school days in Windsor, Ontario. So keen were Lazaridis and his buddy, Doug Fregin (now vice-president, operations, at RIM) on technology that they spent one whole summer helping unpack, set up and boot up all the new technology that their teacher/mentor had ordered for the fall term. It would set a pattern that would become almost a mantra at RIM: follow your curiosity, and you’ll jump out ahead of the pack.

Lazaridis believes every human being is innately innovative in everything they do, and that this innovation needs to be fostered more in the education system. “It is very important to develop intellectual capacity and a mastery of the tools you need to take ideas as far as you can,” he says.

Lazaridis is also eternally curious about what makes the world work. “If you look back through history, every industrial revolution has come from a breakthrough in theoretical physics,” he says. In fact, later in RIM’s history, Lazaridis decided to help fuel future revolutions by founding Perimeter Institute for Theoretical Physics with a \$100-million commitment matched by \$10 million each from Fregin and RIM co-CEO Jim Balsillie.



“The BlackBerry is really the culmination of more than 10 years of investigating and researching and trying to get wireless e-mail to work. We always knew the experience was addictive. We had to make it practical.”

In 1984, while Lazaridis was still attending the University of Waterloo, he and Fregin founded Research In Motion as an electronics and computer science consulting business. If there was ever a company name that reflected the philosophy of continuous innovation, this had to be it. Within four years, RIM became active in the transmission of wireless data and setting up wireless point-of-sale customer terminals using radio waves.

Lazaridis remembers RIM's initial point of transformation well. “We were doing wireless point-of-sale integration with another company's radios. I remember thinking, ‘Hey, we can build a better radio than this.’ And we did. That got us into paging, and we turned ourselves into experts in terms of the specifications of the paging network. We soon realized that, even though it was designed for one-way communication, you could incorporate a back channel so messages could go both ways. We recognized that what we had figured out was revolutionary, because you were only supposed to be able to push a paging message in one direction. We invented a way that you could reply to a page, and the rest is history,” he says.

So began RIM's entry into the wireless data industry. It was also the beginning of years of work refining systems that could work for days instead of hours, all with the very limited batteries available to wireless transceivers.

Those early years at RIM also involved long hours of research, refining and brainstorming. Lazaridis' brilliance shined. Bob Crow, now RIM's director of government and industry relations, says that the BlackBerry's graceful, simple design masks incredibly complex engineering. “This guy is a genius, and he has surrounded himself with minds like his,” says Crow. But all those great minds found themselves bashing against a very formidable wall. Unlike Moore's Law, which states that the number of transistors on a semiconductor chip will double every year, the battery power on which wireless communication is so dependent is not easily expanded. Nor is the available radio spectrum, the pipeline of the wireless world.

Lazaridis and his colleagues had to become pioneers in the rational use of battery power, as well as the clever use of bandwidth. The latest BlackBerry is quick and efficient at receiving messages, despite the fact that it operates on about the equivalent of 28.8 kilobytes per second, which is an antiquated norm for desktop computers. “This really was rocket science,” says Crow. RIM developed engineering that would let a first-generation BlackBerry run for three weeks or more on a single AA battery feeding a lithium-ion battery that is still the BlackBerry's main power source. That technology, plus the masterful use of a '90s-style, 32-bit Intel 386 processor in a way that the chip is only used about one percent of the time, represents engineering prowess at its finest.

In addition to brains, it took a lot of hard slugging to put RIM at the top. “The BlackBerry,” Lazaridis told a *Business 2.0* reporter a couple of years ago, “is really the culmination of more than 10 years of investigating and researching and trying to get wireless e-mail to work. We always knew the experience was addictive. We had to make it practical.”

Behind all the engineering in the BlackBerry project was a vision that went beyond the industry's ambitions. In the years when RIM was moving toward the BlackBerry, wireless projects weren't all that unusual. "But it was a consulting industry, not a product industry," Lazaridis points out. "A customer had to take products from tens to hundreds of different companies and weave them into a solution."

Lazaridis believed that his potential customers craved small, user-friendly hardware with a secure and reliable system of transmission — a technology that would keep everyone in the loop, no matter where they were or what access they had to standard computer servers. The first RIM wireless handheld, the Inter@ctive Pager, was ready to go in 1996. It wasn't quite the little bundle of joy it is now — it was more the size of a triple cheeseburger than a friendly little sandwich. But it was revolutionary, it filled a need, and it just kept getting better.

The Entrepreneurial Side

RIM had attracted early financial help from a number of sources. A Government of Ontario New Ventures loan got the business off the ground, with matching funding being provided by Lazaridis' parents in Windsor. By 1992 the company had 8 to 10 employees, sales of about half a million dollars a year, and three or four different business lines. At that point, Lazaridis knew he needed to bring in someone to handle the business end of things if the firm was to take off. "We had already done a lot of good work, but it became clear to me that I was best at moving the engineering forward," he says. "I needed a business partner if I was going to move the business forward at the same time. This is when I met Jim Balsillie [now RIM's chairman and co-chief executive officer], who I could see was as creative on the business side as our team was on the science side. It didn't take me long to figure out that he was the guy I wanted."



“Our approach was to create very marketable products — something that could really solve problems today.”

Balsillie, a chartered accountant with a Harvard MBA and experience working with major North American firms, is competitive. Once athlete of the year at the University of Toronto, and an active triathlete, he is not known for paying deference to firms that are often 20, 30 or 40 times the size of RIM.

In the early days, says Crow, RIM was into several exotic and exciting technologies, but chose to concentrate rather than diversify. "Both Mike and Jim have a healthy respect for their competitors. You aren't going to beat everybody in every category, so they decided that focus would be one of the keys to RIM's competitive success," he says. This is part of the discipline Balsillie brought to the company — a focus on the wireless end of the business, playing on the convergence of mobility and digital data. "Our approach was to create very marketable products — something that could really solve problems today," says Balsillie. "We made the right bets. You don't see them with certainty, but, with foresight, you are always playing this positioning game, this execution game,



this sensing game, this adapting game, and this adoption game for affinity. It's all about systematically improving yourself in your position in a sector that you think is going to be important."

Balsillie also brought his own investment into RIM. In addition, the company's University of Waterloo connections helped facilitate a contribution from the Industrial Research Assistance Program in the neighbourhood of \$100 000 in 1994. More funding came forward from the Business Development Bank of Canada (then the Federal Business Development Bank), and the Innovations Ontario Program provided them with close to \$300 000. Early on, Lazaridis negotiated an investment from Ericsson, the Swedish telecommunications giant, and Balsillie helped attract almost \$2 million in financing from COM DEV, a local technology company based in Waterloo. They raised another \$36 million from a special warrant in 1996, the largest technology special warrant at the time. Realizing it had a winner with the BlackBerry handheld, RIM went public later in 1996, and raised an

additional \$115 million when it listed on the Toronto Stock Exchange in 1997. Another \$250 million came into the firm when it listed on the NASDAQ in 1999, which RIM followed with a \$900-million share issue in November 2000.

During all of this, the federal and provincial governments helped out as well. RIM obtained \$4.7 million from the Ontario Technology Fund and, in 1998, received \$5.7 million from Industry Canada's Technology Partnerships Canada, which provides investments repayable out of future profits, to develop the next generation of handhelds. This was followed by another \$33.9 million in 2000. RIM has also made use of the Government of Canada's Scientific Research and Experimental Development investment tax credits, which, for RIM, amounted to almost \$12 million in 2002 alone. RIM seeks out external sources of financing to promote the development of future generations of concepts and designs. "We are very systematic in how we fund the company, just like in how we develop our technology and build our markets," says Balsillie. "You must be ready to get money ... there is a readiness process of networking

and having people aware of your company, and having a plan ready and a cash flow driven by assumptions. It's not just 'Gosh, let's go get a cheque.' It isn't like that. It's a very systematic exercise. We are active in keeping the capital markets up-to-date and aware, and are always talking to the analysts."

RIM's original entry strategy into the marketplace was to offer their handheld device products to alliance partners, like Bell South, to integrate into their own operations. They later introduced the BlackBerry product that comprises handhelds, behind-the-firewall enterprise server, and infrastructure to relay between wireless networks and the Internet. As Balsillie explains, "That was definitely a spectacular step forward — the convergence of a lot of evolving technologies. The company got into the business of creating wireless software protocol stacks and application interfaces, and that's what BlackBerry is — a very sophisticated distributed set of wireless protocol stacks and application interfaces. It's just all the suite

you need and all the distribution you need to connect what you need connected. So, in a sense, that sort of redefined the value proposition and really catapulted us forward in terms of a very, very valuable market and a very, very defined brand But we still got that market through alliances with great technology companies like Microsoft, Lotus, IBM and Sun, and outstanding wireless carriers like Rogers, Bell Mobility, Cingular, T-Mobile, Motient and AT&T."

RIM's patent strategy has been very important to its growth. The company's portfolio of several hundred patents is an asset that has allowed it to enter a competitive market space, and gives it bargaining power and leverage to offset against royalties that will be paid. Lazaridis has strong advice to give about this. "If you are not patenting everything you are working on, someone else might patent what you are working on. Patenting should be a standard operating procedure for your company, a standard operating procedure for your researchers and engineers. If they come up with an idea to solve a difficult problem, then they should immediately apply for a patent," he says.



“Licensing is a natural evolution for a company that has a robust research and development (R&D) and discovery portfolio.”

Balsillie makes an observation about the importance of timing. If the BlackBerry had come out a couple of years earlier, it may not have been very interesting because e-mail wasn't as popular yet. "It was the right time for us to do that because the offering and the market opportunity and the value proposition and the uniqueness stood on its own merit. We did it at that time and we certainly have no regrets. It appears, in hindsight, to have been a very wise strategy," he says.

By the end of 2002, the number of BlackBerry subscribers had reached almost 500 000; more than 14 400 organizations were using it. RIM expects strong subscriber growth in 2003 because many of its telecommunication carrier partners have brought next-generation networks on-line.

Of great interest to all analysts has been RIM's decision to license some of the most winning features of the BlackBerry model, including keyboard features, to Palm and Handspring. That announcement was followed by another — that Nokia, which controls 40 percent of global handheld markets, will release BlackBerry software on its more expensive phones. While Nokia is integrating RIM's "terminal" software into these phones, it does not have the rights to incorporate or resell BlackBerry server software, which synchronizes data between handhelds and corporate and wireless networks. This area has been a RIM money-maker.

Balsillie says having BlackBerry terminal software on millions of Nokia handhelds should create demand for RIM's middleware and increase the subscription revenues RIM earns from wireless carriers. *ROB Magazine* analyzes it this way: "Revenue from server software and per-user subscription-sharing accounts for 55 to 60 percent of RIM's revenues; the bet is that, while hardware and software licences will only add incremental revenues, they will help seed demand that will lead to server and subscriber revenues."

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Is the move to software sales an innovation driven by the mother of much invention: hard times? Balsillie says that while licensing is part of the innovative process, RIM's decision is not driven by desperation. "Licensing is a natural evolution for a company that has a robust research and development (R&D) and discovery portfolio," he says. "If you want to continue to focus and move forward, you use your capital to do that. And part of your capital is your intellectual property. You can sit on your intellectual property and keep spending money in court to defend it. Or you can put it to use creatively outside your own firm. If you can license it selectively without endangering the future of your own products, and bring in a lot of money to keep moving forward, why not?"



“Innovation-in-Motion” Keeps RIM Moving Ahead

Does all this mean that RIM will have nowhere else to go after the BlackBerry loses its cult status? “Not at all,” says Crow. “Keep your eyes peeled. We’ve got plenty of new things in the pipeline.”

The truth is that Lazaridis couldn’t stop inventing new technology if he tried. He won both an Oscar and an Emmy for inventing DigiSync, a special film-tracking process. When his second child was about to be born, several years ago, he took some time off. But his brain didn’t, and he worked out a series of algorithms that determined the best component placement for his home entertainment system. He confesses that he only “stopped tinkering with it” when he had what some of his acquaintances have described as the best home theatre in the world. Lazaridis has been quoted as saying, “I don’t think I could ever stop tinkering with the BlackBerry.”

Not surprisingly, RIM hires people with similarly inquisitive minds. “We’ve got great creative people from Canada, for sure, but also from around the world. And we make a point of getting together nearly every week and throwing around ideas about where we go next, what can we do,” says Balsillie. “We’ve never had trouble recruiting bright people, and keeping bright people. Our turnover rate is less than one percent. That’s unheard of. So that tells you that there’s always a sense of challenge to do new things in a new way in the air, or we wouldn’t keep these people. They’d get bored.” RIM’s location close to the University of Waterloo allows it to take advantage of a talent pool of knowledgeable and highly skilled young people. On the business side, it hires the best financial and marketing people from prime North American companies and business schools for its top executive positions.

RIM invests a significant portion of its revenues in ongoing R&D. This amounted to 16.8 percent of sales for the 2002 fiscal year. More than 600 people are employed in its new state-of-the-art R&D facility, which comes complete with research, testing and certification labs to facilitate new product development

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and help speed up the time to market for new products. “You don’t just do research for the sake of ‘Gee, it’s intriguing,’” says Balsillie. “It’s got to have some market context. If it’s got some core technical benefit that is disruptive, can fit within the product, and allow us to enhance or redefine the value proposition, that is totally cool.”

RIM went through a lot of transition in 2002. They opened a new 18 300-square-metre manufacturing facility in Waterloo, with the capacity to produce six million units a year, and made the transition to SAP (an enterprise resource planning system). They also added General Packet Radio Service wireless handhelds to their product portfolio, a technology that lets handhelds operate on the protocol for cellular phones in about 140 countries, including throughout Europe. The new product has opened international markets for RIM in the United Kingdom, the Netherlands, Germany, Ireland and Italy. New innovations are constantly coming out of RIM’s R&D pipeline as the company tries to stay at the leading edge of technology and penetrate new markets in both Europe and Asia. To do this, RIM relies on its strategy for developing strategic alliances with such companies as Nextel Communications, Telecom Italia Mobile in Italy, T-Mobile in Germany, and Vodafone in the U.K. Carrier relationships also

exist with telecommunication firms in Hong Kong and Australia. In addition, RIM made their Java Development Environment available at no charge, so three million Java developers worldwide can now build applications to support the BlackBerry. The company handed out more than 4700 developer kits for Java, the programming language, at a conference in San Francisco in June 2002. RIM doesn’t want to have to create all the possible extensions for the BlackBerry itself. “We couldn’t possibly figure all of this out,” says Lazaridis. “There are a thousand niches out there, and they’re going to have to be developed by other people.”

RIM’s stock prices soared into 2000, but, like most high-technology stocks, RIM was bruised in the markets soon afterwards. The company had to make big changes to its marketing strategy and its business model to react to downgrades by stock-pickers, increased competition, and delays in new wireless network infrastructure that RIM’s latest products depended on. However, 2002 sales continued to climb, increasing by 33 percent over the 2001 level. According to a *ROB Magazine* article in February 2003, a debt-free balance sheet, new products that leapfrog the competition and, most importantly, critical endorsements of BlackBerry technology and its new business model, have contributed to RIM’s continued revenue growth and growing subscriber base.

“There are a huge number of execution issues to keep up the growth and to accelerate the growth,” explains Balsillie. “It’s the ERP (enterprise resource planning) system, the chief operating officer system for the production and engineering, expanding the plant, expanding the sales and marketing, expanding the customer care, getting the technology done on time ... marketing programs to get done There is a lot to do.” Lazaridis insists that the company is evolving the technology everyday. RIM’s restless creativity is one of the reasons Lazaridis isn’t worried about huge competitors snuffing out his company’s marketplace advantages. “[Competing companies] keep coming at us, but we’ve done a lot of the heavy lifting, and that counts for a lot,” he says. “They’ll have to do at least some of their share of the lifting, and, in the meantime, we’re moving on.” Locating its manufacturing plant close to its R&D facility has given RIM a strong competitive advantage in getting

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products to market faster than other companies who manufacture offshore. One of the company’s major challenges now is translating the technology they design into manufacturing processes, asking “Can we make it? Can we market it?”

RIM has consistently won awards for its product innovations. For example, in 2002, InfoWorld named the BlackBerry 5810 gadget of the year and best wireless product of the year, and the RIM 957 product of the year and best handheld of the year. The BlackBerry wireless solution received 2002’s M.I.T. Sloan eBusiness Award in the disruptive technology of the year category — an award that recognizes technology that has begun to, or has the potential to, positively disrupt our daily lives. *ROB Magazine* runs a poll every year on Canada’s most respected companies. RIM placed first in one of the most important categories going these days: innovation. But, cautions Lazaridis, “Innovation and entrepreneurship are largely misunderstood. Innovation and entrepreneurship is a process, a discipline. It’s one you either want to do or you don’t. It doesn’t just happen. You don’t have a eureka moment. It’s like any art — you have to train for

it and you have to get experience for it. You have to discipline yourself. It’s hard work, and it pays off if you stick to it. It took RIM a long time. We started in 1984 and took a long time to get success, but all along we were innovative. It’s a journey.”

Research in Motion Limited

295 Phillip Street

Waterloo ON N2L 3W8

Canada

Telephone: (519) 888-7465

Fax: (519) 888-7884

Web site: www.rim.com

E-mail: webinfo@rim.net