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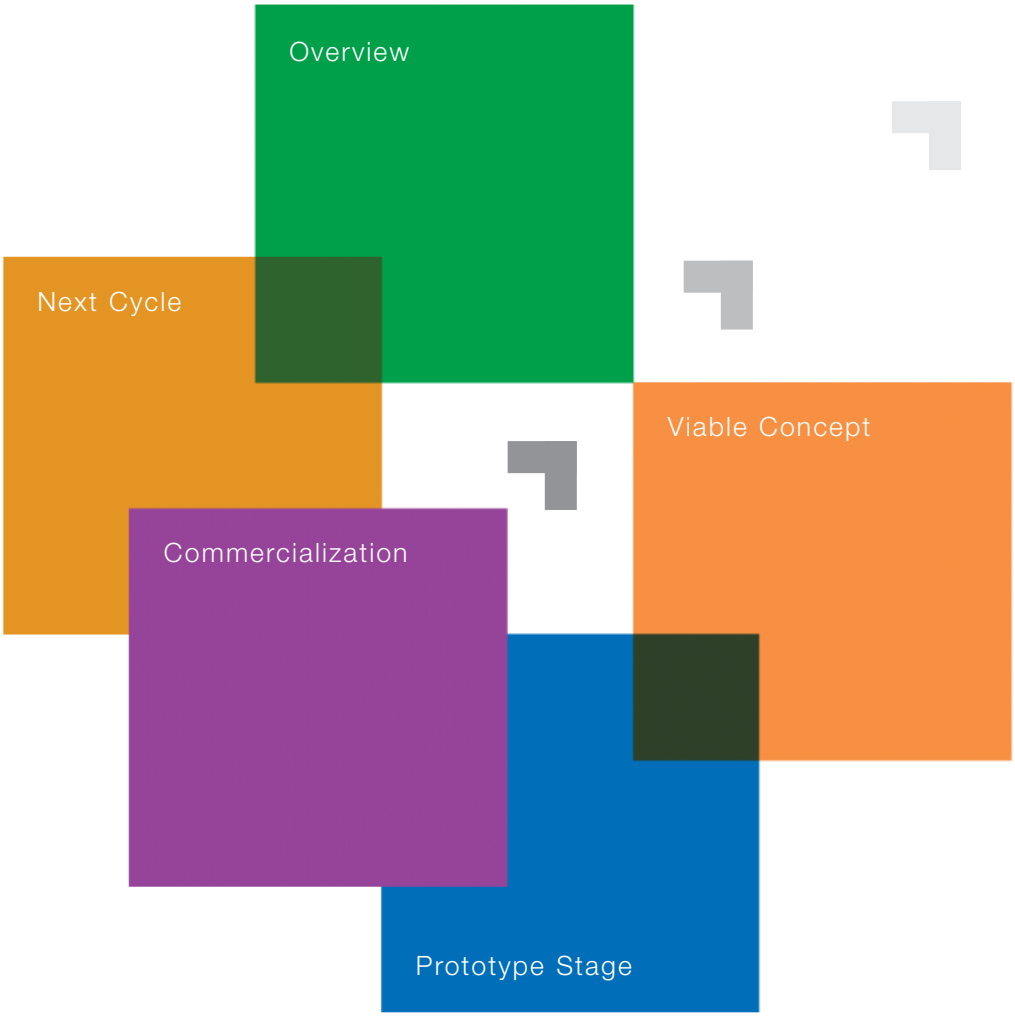
The Practice of Innovation

Seven Canadian Firms in Profile

Facilitator's Guide



CANADA'S INNOVATION STRATEGY

Canada

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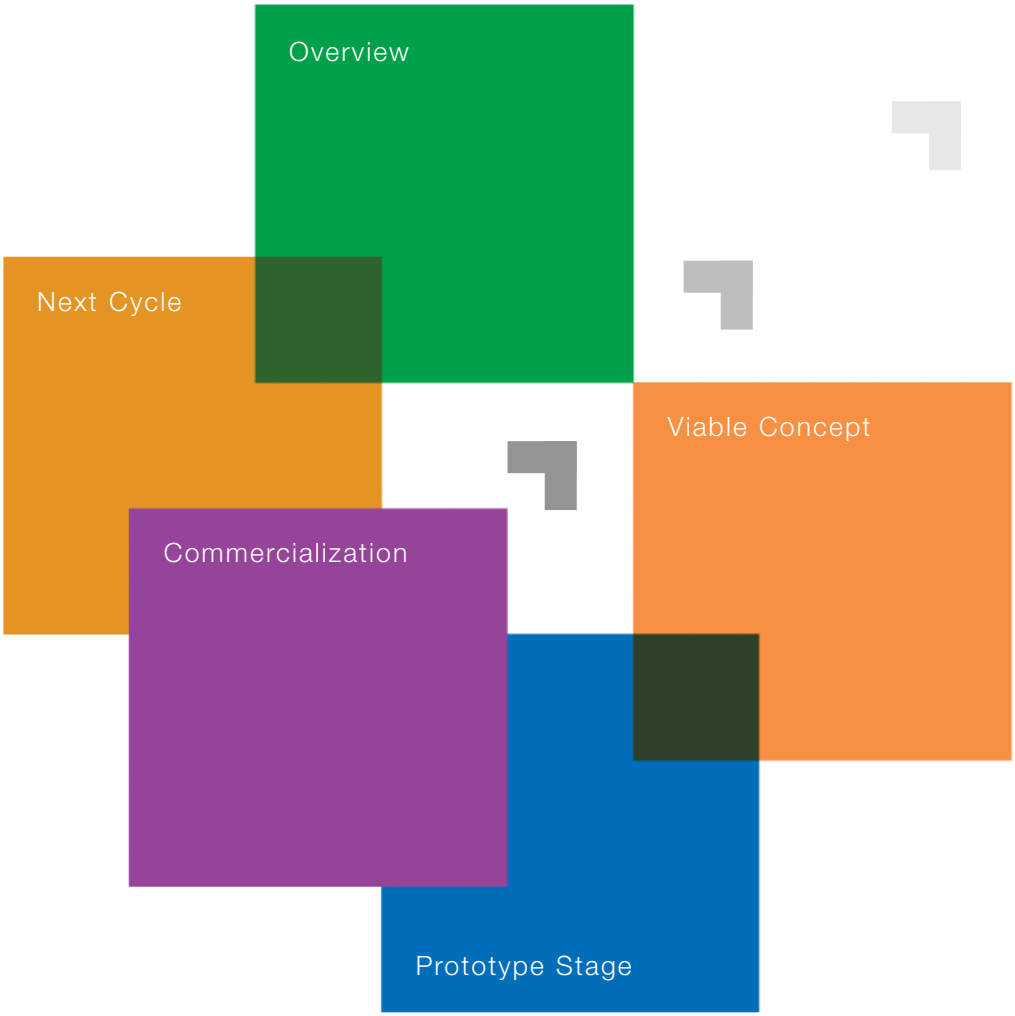

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Information Distribution Centre
Communications and Marketing Branch
Industry Canada
Room 268D, West Tower
235 Queen Street
Ottawa ON K1A 0H5

Tel.: (613) 947-7466
Fax: (613) 954-6436
E-mail: **publications@ic.gc.ca**

This publication is also available electronically on the World Wide Web at the following address:
http://www.innovation.gc.ca

Cat. No. Iu4-38/2-2003E-IN
ISBN 0-662-33821-9
53909E

Aussi offert en français sous le titre *L'innovation en pratique : Profil de sept entreprises canadiennes — Guide de l'animateur.*

Contents

Overview of the **Facilitator's Guide**

The Practice of Innovation package consists of three components:

- *The Practice of Innovation: Seven Canadian Firms in Profile*, a publication containing case profiles of seven innovating firms, each at a particular stage of the innovation process. This publication can be accessed as a PDF or HTML file from Industry Canada's Web site at **www.innovation.gc.ca** and on the CD-ROM titled *The Practice of Innovation*.

- *The Innovation Journey: Seven Canadian Firsts*, a 47-minute video featuring five- to seven-minute vignettes of each of the seven innovating firms. The profiled firms illustrate each of the four major phases of the innovation process from the concept development stage through the prototype stage and the commercial implementation stage to the continuous innovation cycle stage. This video can be used as a stand-alone resource to stimulate an overview discussion of the innovation process or together with individual case profiles to add "life" to the material presented in text format. It is included on *The Practice of Innovation* CD-ROM.

- *The Face of Innovation*, a collection of four 30-minute, in-depth interviews with the leaders of innovating firms. These four videos are available in DVD format as part of *The Practice of Innovation* package.

What Is the Purpose of the Facilitator's Guide?

This guide is intended as an instructional resource for use with *The Practice of Innovation: Seven Canadian Firms in Profile.*[1]

What Is the Structure of the Facilitator's Guide?

This guide is structured in five modules. They can be used in their entirety or as individual stand-alone instructional units.

[1] For a brief outline of the major innovation-process-related insights gleaned from patterns evident in these stories of innovating firms, please read the Introduction section of this publication.

Module 1 is an overview of the innovation process and is accompanied by a 47-minute video *The Innovation Journey: Seven Canadian Firsts*. Modules 2 through 5 deal with each of the four stages of the innovation process and consist of salient discussion points, suggestions for use of two case profiles, and a 30-minute video containing an in-depth interview with the executive officer of one of the innovating firms (see the Case Profile Matrix at the end of this section).

Learners should be instructed to read the case profiles in advance of the class to which they pertain.

The suggested facilitation format for each module will fit a 90-minute time slot of instructional time. This includes time for viewing a video as well as for breakout groups and summary discussions. To reduce the time requirement to cover the material, the facilitator may choose to assign only one case in Modules 2 through 5.

For each case profile, a set of issues and lessons has been drawn from the innovator's approach. The facilitator can inject these issues into the breakout discussion as deemed appropriate.

Of course, the facilitator may wish to approach these case profiles differently, depending on the learning objectives, time constraints and audiences.

How Should the Material Be Used?

The material can be combined in a number of ways for flexible delivery in a variety of instructional contexts. The cases and videos can be used in classrooms as well as in seminars and workshops to examine the strategies of innovating firms and to increase knowledge about demands of the innovation process. The five modules could be offered over a period of five classes, or tailored for delivery in a one- or two-day seminar. Individual case profiles could be assigned as part of other courses in which the topic of firm innovation is being explored.

Who Would Benefit from This Learning Package?

Appropriate audiences would be university students of business, engineering and the sciences as well as owners of small and medium-sized firms. However, the material could also be used to orient innovation officers and advisers, business development officers, technology transfer professionals and academic researchers on major challenges of the innovation journey.

What Innovating Firms Are Profiled in the Case Profiles?

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. This is a spinoff company started around the collective research interests of academics, scientists and medical practitioners. It has nine employees. Its mission? To develop a diagnostic tool at the DNA level that could revolutionize the battle against cancer. It is 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 development of fuel cell technology. Based in Burnaby, British Columbia, the company has been working on refining fuel cell technology for commercial uses since 1983. It has 1300 employees. Its 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. Ballard Power Systems has a commercial production facility and has started to commercialize products powered by fuel cells.

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 wheat straw into bioethanol using enzyme technology. Its enzyme manufacturing facility produces genetically engineered enzymes for three major industrial markets on a commercial basis and also supplies a major component in the bioethanol production process. It employs 140 people and has annual sales of $10–12 million.

Case 4: Garrison Guitars is a manufacturer of guitars made with the revolutionary and patented Griffiths Active Bracing System™, a unibody bracing system made from a glass fibre component. These 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, computer numerical control (CNC) systems and robots. Its 65 employees produce 12 000 guitars a year.

Case 5: Braintech Inc. is an industrial software maker for automakers based in North Vancouver, British Columbia. It develops and supports commercial-grade, vision-guided robotic (VGR) automation solutions based on its world's first single-camera, three-dimensional robotic guidance systems. Its proprietary software, eVisionFactory™, will enable the company to penetrate other industrial manufacturing sectors with its three-dimensional VGR systems. It has 25 employees.

Case 6: My Virtual Model Inc., based in Montréal, Quebec, is the world's leader in creating on-line selling tools for the apparel industry. The company is propelled by its revolutionary virtual model software, a virtual identity technology that lets users "try on" clothes on-line. It employs 50 people. The company has developed alliances with a number of major retailers, whose on-line sales have increased substantially since offering the virtual model option.

Case 7: Research In Motion Limited (RIM), 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 hand-held that receives and sends wireless e-mail messages, which is clearly ahead of anything on the market. The company is committed to new-product development based on technological advances and has state-of-the-art research and development (R&D) and manufacturing facilities. RIM employs close to 2000 people.

General Questions to Explore

These case profiles hold many useful lessons for anyone interested in knowing more about the steps to take and the critical factors necessary to move from innovative idea to the marketplace. When using these case profiles for instructional purposes, a number of general questions may be used by the facilitator to stimulate discussion about the strategies that firm leaders adopt at various stages of the innovation process:

- What are the major drivers behind the innovation in this company?
- How did these drivers change as the company progressed?
- At what stage of the innovation process is the company currently operating?
- What are the major barriers or challenges that this company has had to overcome in advancing its innovation? How did it overcome these?
- What are the key elements to the success of the business in achieving its current position?
- What is 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 chief executive officer, what would you do next?

Questions specific to each case are suggested in Modules 2 to 5.

Synopsis of Video Components

The Innovation Journey: Seven Canadian Firsts

This 47-minute video consists of a montage of seven vignettes featuring highlights of the innovation journey of seven Canadian firms.

Their firms represent myriad types of businesses, ranging from environmental technologies to biotechnologies, software and manufacturing. Their markets all are global in nature and range from consumers to industries. Together they depict the array of challenges that leaders of innovating firms can expect to face in the pursuit of innovation. They illustrate a mosaic of lessons learned from dealing with challenges such as searching for a breakthrough idea, refining a technology to meet a market need, proving that a technology "works in practice," mobilizing the resources necessary to realize the innovation in the form of a viable enterprise, financing the long and often expensive journey from R&D to profitability, launching the innovation as a product in the marketplace and establishing a market presence.

Each vignette includes a discussion by the principal(s) of the firm about the critical steps taken in managing stages of the innovation process or the key success elements in making the transition from one stage of innovation to another.

This integrated story of the innovation process is based on the sum of their experiences and insights. The points raised by company principals can be used as a series of "learning moments" in teaching innovation strategies. Each vignette presents the opportunity to reflect on the company's next set of challenges. The video vignettes are arranged in the following sequence.

- Two-year-old **Garrison Guitars**: This vignette emphasizes the concept development, incubation, start-up and commercialization stages of this manufacturing enterprise.

- Two-year-old **Genesis Genomics Inc**.: This vignette focusses on the incubation and proof-of-concept stages of the enterprise as well as the preparation for its projected entry into the pharmaceutical marketplace.

- Four-year-old **My Virtual Model Inc**.: This story demonstrates the continuous innovation cycle inherent in a product (virtual model software) with limitless potential for use in a variety of market applications.

- Ten-year-old **Braintech Inc.**: The vignette illustrates the journey of a research and development (R&D) company that is now rolling out its patented two-year-old, three-dimensional, vision-guided robotics systems and the key factors that have led to its successes to date.

- Sixteen-year-old **Research In Motion Limited**: The focus is on the importance of patenting, the close proximity of its R&D and manufacturing arms, and not giving up, pointing out the irregular path that innovation often takes.

- Twenty-year-old **Ballard Power Systems Inc.**: This vignette depicts the journey of a firm that is on the "cusp of commercializing" its fuel cell technology. It emphasizes the importance of bringing discipline to its R&D activity, developing strategies around patenting, strategic partnering, marketing, and technology development, and managing the transition from concept development to commercialization, including bringing new leadership skills into the firm.

- Twenty-five-year-old **Iogen Corporation**: This profile outlines the ebbs and flows of trying to prove the scalability of production in a demonstration facility, in this case of making bioethanol using enzyme technology. It discusses the importance of its patents, partners, funding support and market readiness.

The Face of Innovation

The Face of Innovation is a series of four 30-minute studio interviews with the principals of four innovating firms. These lively interviews, videotaped in front of an audience, include a brief question-and-answer period with audience members. They provide an "up-front and personal" look at the faces and philosophies behind innovation. The interviews feature the following people.

- Chris Griffiths, president and chief executive officer of Garrison Guitars.
- Louise Guay, president of My Virtual Model Inc.
- Firoz Rasul, chairman of Ballard Power Systems Inc.
- Robert Thayer, chief executive officer, and Ryan Parr, vice-president, research, Genesis Genomics Inc.

Case Profile **Matrix**

Case Profile	Suggested Module	Stage of Innovation Illustrated by Each Case				Video Profile
		Developing a viable concept stage	The prototype stage	Commercial implementation	The continuous innovation cycle	
Seven company video vignettes	Module 1[a]	X	x	x	x	*The Innovation Journey: Seven Canadian Firsts* – 47 minutes
Genesis Genomics Inc.	Module 2 (main case)	x	x			Interview with CEO and VP, Research – 30 minutes
Ballard Power Systems Inc.	Module 3 (main case)	x	x	on the "cusp"		Interview with Chairman (and former CEO) – 30 minutes
Iogen Corporation	Modules 3 and 4 (supplementary cases)	x	x	x		
Garrison Guitars	Module 4 (main case)	x	x	x		Interview with CEO – 30 minutes
Braintech Inc.	Module 2 (supplementary case)	x	x	x		
My Virtual Model Inc.	Module 5 (main case)	x	x	x	x	Interview with CEO and President – 30 minutes
Research In Motion Limited	Module 5 (supplementary case)	x	x	x	x	

[a] The recommendation is to teach Module 1 with the video. If a case is assigned as well, it should be one of the last four cases, because they cover more of the innovation cycle.

Module 1

Overview of
The Innovation Process

Objective:

The objective of this module is to provide an overview of the innovation process, based on the journey of seven innovating firms. The fundamental concepts of the evolution of the innovation process within firms are introduced and illustrated in the video *The Innovation Journey: Seven Canadian Firsts*. This video includes vignettes of the seven innovative companies that are used as case material in Modules 2 to 5.

This module consists of four parts:

- **The Context for Innovation: Why It Is Important:** This part is a general introduction that offers some insight into the nature and importance of innovation. The intent is to get people thinking of innovation in concrete, practical terms and to provide an opportunity to explore issues related to what is needed to follow the journey of innovation within organizations.
  [15 minutes]

- **The Four Stages of Innovation:** This part offers an explanation of the four stages of innovation. Such a framework provides a useful construct for better understanding and identifying the critical elements and actions of each phase of the innovation journey, as well as the key shifts that need to be made as firms move from one phase to another. However, it is important to explain that the four stages do not necessarily follow a sequential, logical progression from A to D via B and C. Innovation must pass through all stages to succeed but, in practice, the stages may overlap and unfold somewhat simultaneously.
  [20 minutes]

- **The 47-minute Video *The Innovation Journey: Seven Canadian Firsts:*** This video includes five- to seven-minute vignettes profiling each of seven innovative firms that are successfully practising the art and science of innovation. Each firm is in a particular phase of the innovation process and illustrates key lessons about the requirements and challenges of this and preceding stages.
  [50 minutes]

- **Preview of the Four Modules:** This part includes suggestions for reading, including referrals to Web sites. The instructor might ask participants to identify one or more innovative organizations that are familiar to them, so that they can work through the ideas presented throughout the program with this organization in mind. This "real" case could be part of an overall assignment for learners to work on during the five modules of this program.
  [5 minutes]

1 – THE CONTEXT FOR INNOVATION: WHY IT IS IMPORTANT

Innovation and Productivity

The leading economies in the world have come to accept that productivity lies at the centre of a country's prosperity and international competitiveness. Economists don't always agree on how — they don't even agree on the right way to measure it. But its general meaning is clear. The more goods and services produced per person, the more prosperous everyone is. The trick, then, is to figure out how to speed up increases in productivity levels.

Productivity can be increased by using automation to perform tasks more efficiently than humans, or by making everyone work harder or smarter. However, automation can be expensive, requiring large outlays of capital, so it's not as easy as it sounds. Making people worker harder or smarter demands strong management skills and a knowledgeable employee base. During the industrial age, the creation and use of capital and the development of scientific management were the major instruments employed to achieve increases in productivity. The post-industrial age is more concerned with qualitative aspects of productivity — and the core concept here is innovation.

The Innovation Culture

Countries and firms today are emphasizing the importance of an innovation culture, one that fosters new forms of organization and power relationships. It is empowering rather than controlling, sees mistakes as an important learning tool rather than as punitive, and is built on trust and shared goals rather than top-down authority. The drive for innovation is changing the face of organizations around the world. Innovation can take various forms and is found in a wide range of organizational and institutional settings. The case profiles used in this material focus on certain kinds of innovation — world-firsts — within the context of private firms. They allow examination of the innovation process in arriving at major breakthroughs. In all of these cases, a new business has been created around the innovation, resulting in employment and value creation for the community in which it is located. These firms are all committed to fostering a culture of innovation to bring technology and product solutions to bear in the marketplace. The interest in these much rarer examples of innovation is that they demonstrate the hard work and clear thinking that are required to take an idea from its earliest beginnings to a product or service that changes the way people organize their lives. As the old saying goes, innovation is 10 percent inspiration and 90 percent perspiration.

Degrees of Innovation

An innovation can be a technological breakthrough, but it doesn't have to be. The technological breakthroughs are easy to grasp as innovations, but they are only one kind of innovation. Innovation comes in three basic degrees of intensity:

- **A Disruptive Technology:** Innovation in this context is a technological breakthrough that changes the way people organize their lives or do things. These breakthroughs are played out at the global level and generally have significant profit potential. Naturally, these types of innovation are quite rare.

- **A Niche Breakthrough:** This is a clear technological development that changes the way a product (or service) is used or even creates a new product. The demand for it is strong enough to support several suppliers of the product, but is not disruptive and its profit potential is not as great. However, it can have a huge impact in its niche market. There are increasing numbers of these kinds of innovation. Often they tend to be absorbed by the dominant players in their industry through acquisition or merger.

- **A Process Innovation:** This type of innovation has a much smaller impact than the two previous types and is a hallmark of organizations with an innovation culture. Often, process innovation does not necessarily change a product or how it is used, but the innovator is able to compete with a lower cost base or a more effective marketing strategy. In other words, it tends to give firms a competitive edge against competitors who have access to the same or similar core technology. Process innovation is omnipresent — it is the grist of day-to-day competition in tough marketplaces.

2 – THE FOUR STAGES OF INNOVATION

The four stages of innovation are:

- developing a viable concept
- the prototype stage
- commercial implementation
- the continuous innovation cycle.

Almost all innovations can be traced through these stages, but the process is never as logical and tidy in practice as it is in theory. The theory is useful because it demonstrates effectively the process of innovation, but innovating firms — by nature — don't do things by the book. Some companies embark on the next stage before they have finished the previous one. Some companies combine the first two stages by using prototypes to prove the viability of their concept. A company with multiple products (often spinoffs from its principal product) may have several different products in different stages at the same time. Some companies may even skip Stage 3 by licensing their innovation to another company, so that they can remain a research and development

(R&D)-based firm and avoid the task of creating the infrastructure for an operating company. But in all these cases, the innovation itself passes through the four stages, each of which presents different challenges and demands different skills. As the firm approaches the next stage of the innovation cycle, firm leaders start preparing the firm for the demands and requirements of that stage. It is therefore important to be able to recognize the transition points.

The facilitator is directed to the introductory sections of each of the next four modules for further discussion points around the definition of each of these stages of the innovation process.

Stage 1 – Developing a Viable Concept

An innovation is based on more than an idea. It is something that is implemented — it must have actually happened — and creates something that did not exist or improves on something that exists. Ideas for innovations come from a number of sources: some are based on a person's research or work experience, a decision to try to solve a global challenge (such as a reduction in greenhouse gas emissions), simple curiosity or a "wondering" imagination, and sometimes a fortuitous set of circumstances or chance meetings. Firms differ in how long they stay in the phase of developing a viable concept. This depends on the complexity of the idea and the research or technology behind it, the time needed to identify the right opportunity around the concept and to recognize that it has the potential to be a "winner," the state of complementary technology development around the concept, the time needed to identify a market application for the concept, the firm's ability to raise sufficient funding to finance the development of the idea into a viable concept, and the difficulty in getting a business structured around it. Innovating firms need lots of support to develop their conceptual ideas: research knowledge, business advice and technical assistance, to name a few. They look for information, support and financing within university environments, government offices, industry groups and the local business community. As the concept takes shape, they may need help with patenting, intellectual property issues and business plan development. Generally, this stage ends with the formation of a company and the establishment of an R&D process to develop the concept further, including the hiring of researchers or technologists. Is it possible to make it work? How? What problem can it solve in the marketplace? Is it technically feasible to make and sell?

Refer to the first section of Module 2 for more description.

Stage 2 – The Prototype Stage

In this phase of the innovation process, the concept is refined and further developed to prove its feasibility. This might take the form of a prototype or a test facility, a market test that establishes an adequate market at the price for which the product or service can be delivered, or a demonstration of the adaptation of some technology to a point where it performs to the specifications set out in the concept or by a potential customer. Can the technology or solution be proven? Can production be scaled up to commercial levels? This stage involves a lot of experimentation as well as trial and error. While research skills are just as important in Stage 2 as they are in Stage 1, the research effort needs to be managed a bit differently. At some point, discipline must be added to R&D efforts; for example, developing technology roadmaps linked to product development roadmaps. Also a range of other skills, competencies, resources and financing partners must be added in Stage 2. Seeking validation of the technology solution from potential users or customers can be a critical component of this stage.

Refer to the first section of Module 3 for more information.

Stage 3 – Commercial Implementation

In this stage, the prototype is expanded to commercial proportions, and the product is brought to market. At this stage, the company often has to make a number of transitions. These may include changing the leadership and management structure, adding new skills to the team, preparing the company for the investment market to raise funds, and strengthening alliances to gain access to the distribution channels, markets and other infrastructure that will enable the firm to leverage its efforts and generate a revenue stream.

Refer to the introductory section of Module 4 for key considerations and needs at this stage of the innovation process.

Stage 4 – The Continuous Innovation Cycle

Innovative companies regard their first innovation breakthrough as only the foundation of an innovation cycle that could lead to new products and services in directions that are often unexpected. Substantial and continuous efforts are needed to retain a leadership position in its technology. If the in-house researchers cannot maintain the technological edge, then the company has to buy new technology or hire the people who are familiar with it. It is very important at this stage to implement incentives and structures that foster a culture in the firm for continuous innovation.

Refer to the introductory section of Module 5 for more description of this stage.

3 – THE 47-MINUTE VIDEO *THE INNOVATION JOURNEY: SEVEN CANADIAN FIRSTS*

The facilitator should show the video. There are several “learning moments” in the seven vignettes, and the facilitator is encouraged to choose one or two points in the various vignettes where the video can be stopped to illustrate and discuss points made above (at the discretion of the instructor). Learners should be instructed to identify the stage of the innovation process illustrated by each vignette, the challenges or barriers overcome at each of the stages, the key elements needed to push a company through each of the four stages, as well as evidence of the genesis of the innovation idea and its early concept development.

4 – PREVIEW OF THE FOUR MODULES

- Brief description of the structure of each module.

- References to Web sites and other material (including course material).

- Required reading before the next module (the case profiles of Genesis Genomics Inc. and Braintech Inc.).

- Each participant should be asked to identify one or more people or organizations that are successful innovators and to use them as additional examples to those given in the course.

Module

Stage 1 – Developing a **Viable Concept**

Objective:

The objective of this module is to consider how ideas for innovative new products/technologies emerge and how companies develop these ideas into viable concepts with market potential.

The instructional components for Module 2 include:

- Video profile of Genesis Genomics Inc., based on interviews with principals of the company.
- Genesis Genomics Inc. case profile.
- Braintech Inc. case profile.

This module consists of four parts:

- **Discussion of Definitions:** This part is intended to establish the difference between an idea and a viable concept for an innovation. The facilitator's notes include sources of ideas and what it takes to move from the idea to the viable concept. A reference to patents is also included.
  [15 minutes]

- **Discussion on Developing a Viable Concept:** The participants form breakout groups to discuss issues raised by the facilitator in the context of the case profiles of Genesis Genomics and Braintech (which they should have read previously) as well as the innovative person or organization they were asked to identify in Module 1. They should be allowed 15 minutes for discussion, then one minute each to report on their findings. This section explores where ideas come from, how people work together in developing workable concepts and what issues are involved in refining a concept to make it commercially feasible.
  [20 minutes]

- **Viewing a Video on Genesis Genomics:** The video profile features an interview with two of the principals of the company, the chief executive officer and the vice president for research. Still in the proof-of-concept stage, this company has not yet completed Stage 1. The 30-minute video should be paused at four points (to be chosen by the facilitator) where the issues to be raised in the subsequent discussion can be broached.
  [35 minutes]

Participants form four breakout groups to discuss the four issues identified during the showing of the video. They should be allowed 10 minutes for discussion and should be given one minute each to report their findings on the issues and the lessons. The facilitator can augment their reports from the notes provided below.
[15 minutes]

- **Preview of the Next Module** (Optional).
  [5 minutes]

1 – DEFINITIONS

The Difference Between an Idea and an Innovation

An innovation originates from an idea, but an idea is not an innovation. An idea is something that exists in someone's mind; an innovation is something new that has happened. A viable concept is an idea that one or more people have refined, put into the context of current realities and connected to available resources to the point where they can demonstrate how they will be able to take the necessary actions to turn that idea into reality as a viable and sustainable operation.

There are millions of ideas around the world at any time. Some of them have the potential to be viable; more have the potential to be viable but do not have the people behind them who can make it happen. So an idea has to be developed before it becomes an innovation.

So what is viable and sustainable? Usually, it is a business that can make a profit, either because it is a new way for a business to reach potential customers more efficiently or at a lower cost, or because it has introduced something new to the market that has a large demand. So an innovation is something that is implemented — it must have actually happened — and it creates something that did not exist or makes something that exists better.

An innovation can be a technological breakthrough, but it doesn't have to be. The technological breakthroughs are easy to grasp as innovations, but they are only one kind of innovation. The true nature of innovation is a culture more than an event. It is a process that breeds innovative events or breakthroughs; it is a way of living and thinking. By that definition, however, it is difficult to define, because it is new and therefore breaks existing rules or conventional wisdom.

In this guide, we have not focussed on aspects of an innovative culture. Instead, we are examining the innovation process in arriving at major breakthroughs. The interest in these much rarer examples of innovation is that they demonstrate the hard work and clear thinking that are required to take an idea from its earliest beginnings to a product or service that changes the way people organize their lives. In other words, they have huge commercial potential, so they are tested and developed in the commercial marketplace, which measures their success or failure with a detached, cold logic, free from cant or politics.

A Definition

The first stage of the innovation process is the development of an idea into a concept that has the demonstrated potential to be commercially feasible. The idea must be fleshed out to the point where technical, financial and management considerations have been incorporated into the concept, so that the practical application of the concept can be clearly plotted.

Intellectual Property and Patents

Often, it is important to protect viable concepts with a patent. A patent does not protect ideas — it protects a viable concept, including both the theory and the process to make it work. Some points to consider about patents:

- Patents are not armour-plated. They can be plagiarized in other countries or people can find loopholes in the description of the patent, allowing them to copy it legally. Sometimes people just copy it anyway, hoping the owner of the patent won't bother to sue. Therefore, patents have to be defended, sometimes at great expense, just to scare off people who don't mind breaking the law.

- Assuming those pitfalls are taken care of, a patent only buys time. Other innovations will follow, and the patent is likely to be surpassed at some point by the next generation of technology. The best defence of a protected technology is ultimately to keep leapfrogging into the next generation.

- Because of the high stakes that are often involved, conflicts of interest are rampant with patents, so it is best to entrust the filing of patents to recognized experts and to pay for it yourself.

2 – DISCUSSION: DEVELOPING A VIABLE CONCEPT — GENESIS GENOMICS INC. CASE PROFILE

In this section, the participants form breakout groups to discuss as many of the four or five questions below as the facilitator deems appropriate. Each group has a 15-minute discussion on their assigned topics in the light of the case profiles of Genesis Genomics and Braintech (which they should have read beforehand). Each group makes a one-minute report of their discussions. The participants should also keep in mind the innovative organizations or people whom they know and who they were asked to identify at the end of module 1.

Video and Case Profile of Genesis Genomics

The analysis and discussion of the Genesis Genomics case can be based on the following framework. The four issues raised should be matched with pauses in the video, during which the issues can be introduced (though not discussed until after the video is shown and the breakout groups are formed).

Discussion of Genesis Genomics' Approach in Stage 1

This company is an apt study of how much work it takes to develop an idea to the point where it can be described as a viable concept. Genesis Genomics is in the proof-of-concept stage; therefore, the concept is not proven. Part of the analytical exercise is to identify potential risks in the approach adopted by the founders. In assessing this venture, participants should be ready to suggest different approaches or possible redirections in their strategy.

Stage 1 – The Concept

Genesis Genomics had not completed Stage 1 at the time of writing. The scientists who do the research have a clear vision of what they want to create and they know that it will be a major money-spinner if they succeed. Although they are the only biotechnology company looking at the potential of mitochondrial DNA analysis as a diagnostic tool for the detection of cancer, they also know that there are many other scientists around the world working in cancer research, any one of whom might beat them to the punch. So they are proceeding as rapidly as they can. They are driven by their vision of revolutionizing the battle against cancer. In January 2003, they hoped to complete Stage 1 by the end of the year, having started their company at the end of November 2001. They had raised three-quarters of the financing for Stage 1 by the time they were halfway through.

Issues and Lessons

1. What are the risks in this venture?

The Issues: In a competitive field such as biotechnology, it is common for several teams of researchers to be working in the same field in different laboratories around the world. As the research advances, their results are communicated through journals of science and each team accelerates its efforts to win the race and be the first to achieve the breakthrough. It can come down to a matter of days between two teams, with the winner taking all. The major risk is therefore to spend a lot of money only to be upstarted by a competitor. The other risk, of course, is that they may never discover the map they are looking for. These risks apply mostly to the investors. For the researchers, the risk is their time and opportunity cost.

The Lessons: The best teams in innovations in disruptive technology are very focussed on the technology that will lead them to their goal, but they organize their work in such a way that it leaves several doors open if one should shut.

2. How should the members of a concept development team be chosen?

The Issues: Research groups are often formed of teams of scientists — mapping DNA and isolating insulin are two good examples among many. A team of one suffers from isolation; a team of many suffers from the risk of becoming unmanageable or being overwhelmed by political infighting. On the other hand, every innovation needs input from many sources and it is sometimes better to have that input in-house rather than from outside sources.

The Lessons: Genesis Genomics has carried the size of research teams to the extreme with seven or eight researchers. The choice of these researchers was not made for the specific contribution each could bring to the table in the context of a predetermined research objective, but for the compatibility of their fields of research. On this basis, they negotiated among themselves an appropriate research goal for their team, a common and combined outcome. This is the approach that is usually best suited to mitigating the risks referred to above. It will be interesting to see if this large team brings an expanded intelligence to the project or proves to be impossible to manage. How will they handle one of their colleagues if he/she is perceived to not be pulling his/her weight, or if there are disagreements about how intellectual property is being used?

3. How much should innovators do themselves? Should they bring in others to help them?

The Issues: Technology-oriented people rarely have all the skills needed to run a business organization. The skills that are needed include the organization of a start-up business, the resolution of issues surrounding intellectual property, financial and management expertise, preparation of a business plan, marketing skills, and the promotion of the company and its visions to potential partners. These areas are normally completely absent from the experience of most researchers, especially academics. It is vital that the innovators gain access to these skills — either by hiring the appropriate people, or by consulting appropriate outside sources.

The Lessons: These scientists understood from the start where their expertise lay and they brought in partners to handle the areas where they did not have the necessary expertise. Unlike many groups of academics, they were fortunate in having a natural leader, who is able to motivate people to work together; this is often not possible. They also sought the advice, counsel and support of major consulting firms, a technology transfer office, local business people and members of the medical community.

4. How good were they at raising money?

The Issues: A major technological breakthrough such as the one contemplated by Genesis Genomics invariably requires major funding to enable it to spend the years necessary to prove the concept and secure all the necessary approvals to enter the marketplace. The keys to successful financing include (but are not limited to) preparation of a credible business plan including the identification of competent people to run all aspects of the venture, support from knowledgeable people in the local community, support from credible organizations familiar with the science and/or the technology, and strategic partners. Usually the support of government research and development funding can add to credibility as well as provide critical mass. The best financing approaches build support from the bottom up and may change as the business moves from proof-of-concept to other phases of pre-commercialization.

The Lessons: These scientists were effective in assessing their financial needs and then going out and raising the money. They understood early on the scale of their enterprise. They built their financing base methodically. They first sought seed financing from their own university and their local community, then they obtained significant amounts of government funding. At the time of the case, they had raised about three-quarters of their first-stage target of $3.3 million. If they complete Stage 1 with a viable concept, according to their projections, it will take $30 million to take the business to the end of Stage 2, when it will be ready to be rolled out in full production. This is, again, methodical and realistic planning, which will improve their chances of attracting the public and private funding they need. If the proof-of-concept does not prove successful, what then?

3 – BRAINTECH INC. CASE PROFILE

Summary of Braintech Case Profile

The founder and CEO, Owen Jones, was conscious of the need to create an innovation culture, which he did by hiring leading engineers and by motivating them to push the envelope, keeping them at the leading edge of their technology. This is a powerful magnet for attracting top researchers — plus the usual stock options that all technology companies had at that time.

Stage 1 – The Concept

There was no early vision in Braintech. Its founder was an early rider of the high-tech wave in the 1990s, employing creative people to see where it would lead, in the hope he would hit the jackpot one day. The first step in developing a jackpot product was the result of a chance meeting with someone who had developed a great technology — the early versions of electronic vision, or object recognition and classification. Although he didn't really understand the technology, the two of them started Braintech, and Jones did an initial public offering (IPO) to fund the research. The company successfully explored several different research paths in search of the right opportunity and, at the end of the first five years, was at the forefront of electronic vision technology, generating some revenues from contract work, but had no breakthrough product. The true calling came when Jones met a second person with an interesting high technology background — robotics. Braintech then became the convergence of two branches of technology that the owner happened to meet and put together.

Very quickly, Braintech's demonstrations of its "seeing robots" caught the attention of an industrial giant, ABB, which was to become its major channel partner and the guarantor of its excellence. This is a vital strategic alliance, without which it is doubtful they would have made the breakthrough in the auto industry, when it competed for a Ford Motor Company project. A few months later, Braintech knew what its breakthrough product was.

With ABB, Braintech made the transition from being focussed on research and development (R&D) and technology to being focussed on customers and markets. The proof of the technology was not long coming through a series of both small and large contracts. The relationship with ABB allowed them to complete the validation of their concept with ABB's clients, while at the same time build their prototype 3D vision guided robotics system and their platform software eVisionFactory™.

Discussion of Issues and Lessons from Braintech

1. Where do the seeds of great innovations originate?

The Issues: Great ideas and innovations almost never emerge in a vacuum. There is a tide in the ocean of ideas that brings innovation to shore when the circumstances are right — everything from the convergence of a body of complementary or supportive research in several different places around the world, to a market maturing for the product, to sudden events that trigger a change in the way of thinking. Many ideas are copies or adaptations of something that is done in a different context; others are the next logical step in a long sequence of ideas; and still others involve identifying a technology that should exist, then working at research until a way is found of creating it. It is rare that an innovation can be traced to a single person. Often it is the collision of ideas between two creative people — or more. Sometimes it is the dream of a single person that matures with the contributions of others. But every successful innovation has an individual behind it, whose leadership, determination and skill push it through to completion.

The Lessons: Braintech is a textbook case of innovating by putting two creative minds together. Jones and his engineer-trained president and chief operating officer (COO). Each one was brilliant on his own account; together, they made a breakthrough of three-dimensional, vision-guided robotics. It took the CEO, Jones, to put together the team of researchers and scientists, and then to give them the freedom to combine in their own way.

2. What is the best balance between giving researchers freedom to go where they want and setting specific goals for research outcomes?

The Issues: In passing from idea to viable concept, the research outcome may be known in advance (goal-oriented), or the outcome may be whatever the researchers come up with, using their technical skills (researcher-oriented or technology-oriented). The organization and management of researchers depends partly on the challenge they are given. For major technological breakthroughs, for example, hard work alone will not always provide the solution, so the researchers tend to be given more creative scope. In creative imitation, on the other hand, where researchers are taking a technology that is commonly used in another industry and applying it to their own industry for the first time, researchers need to be more focussed and goal-driven.

The Lessons: Braintech was researcher-oriented for a long time while it trolled for a suitable product. During this period, the researchers were given full rein. When the second key researcher (later becoming the COO) was added, the company settled on the target of its research and development agenda. From that point, it became primarily goal-oriented as it advanced its technology to meet customer specifications. This represents excellent management of researchers in navigating the phases of developing a viable concept and making it work.

3. How do firms attract and retain the most talented researchers?

The Issues: The key challenge for any innovator is to find top researchers in their field. Top researchers want to feel they are at the leading edge of their discipline and they want their colleagues to challenge them. Since they live in the world of ideas, they are motivated by supportive, challenging environments and a sense of purpose. When every department in a company is looking for new and better ways of doing their job, one person's innovation is a plus to everyone — and it's no big deal to discard an innovation that didn't work. Important components of this culture include a management style that encourages personal initiative and disbands military hierarchies, and a cooperative spirit that encourages people to share their ideas, avoiding an emotional resistance to new ideas (also known as the dreaded NIH syndrome, for Not Invented Here). Financial rewards are also important, both in terms of salary and the opportunity to share in the profits of the firm.

The Lessons: Braintech's leaders understood how to motivate researchers and were flexible in the way they managed them in different phases of the innovation process. They created a positive environment, with informal dress, impromptu recreation and a tolerant attitude for off-the-wall directions in research. The owner believed that adequate financial incentives such as stock options and a free-flowing office would be enough to encourage his researchers to do their best for the company. He was right.

4. What is the best way to enter into strategic alliances?

The Issues: A strategic alliance with a major firm brings significant advantages — financial and human resources as well as a powerful marketing capacity and established expertise in the technology. But for a major firm to want a strategic alliance with a smaller firm, the latter must have something that it wants badly. Usually, that's an innovative technology. The danger for a smaller firm is that its research agenda becomes skewed to the big firm's priorities or that the big firm co-opts the technology and then drops the smaller firm. To create a productive alliance, both parties need to have a clear idea of what they bring to the table, what they have to offer and what they want to achieve. Also, the smaller firm needs to be competently protected by its patents.

The Lessons: Braintech entered into a strategic alliance at just the right time. It had demonstrated its technology (although it needed to work on its refinements), so what it needed most was access to markets and the opportunity to work on adjusting their technology to solve particular client problems. ABB fit that bill and

benefited itself by being able to provide a superior product to its customers. ABB managed the alliance to the benefit of both. The big breakthrough client, Ford Motor Company, came to them as a result of the ABB alliance. These alliances produced critical outcomes for the small but ambitious company.

5. How do you raise money for research in Stage 1?

The Issues: Most formal investors prefer not to invest in a company until it has a proven product and it has established all the infrastructure to run the company — a business plan, all the necessary human resources, an experienced management team, patent protection and customers who are ready to buy if they have not already done so. To raise financing before that infrastructure exists is extremely difficult. As a result, most financing for innovative technologies and products is secured in Stages 2 or 3. But it can be done in Stage 1 — if the technology has very big potential and patent protection, or if the company owner can inspire investors with his or her vision. The main exception to this rule is government, which has traditionally been an important investor for early-stage, long-shot innovations that have strategic importance for their jurisdiction, particularly at the R&D stage. The other major exception has been the extraordinary half-decade at the end of the 1990s, when the high technology boom attracted billions of dollars; this enabled many good ideas (and some not-so-good) to get funding relatively easily. While this gave life to a number of firms that would not otherwise have got off the ground, it has also resulted in a high degree of risk adversity that may make Stage-1 financing difficult for some years to come.

The Lessons: Braintech could not have gotten its start without the high technology boom of the 1990s, when it was able to raise $2 million in a private placement for a project that had barely been defined. Braintech was able to use this money wisely to fund years of experimental R&D. The company also benefited from the fact that its CEO was willing (and able) to be its major “angel investor” during the latter years of its R&D stage. The fact that it has now developed viable products puts it in a good position to attract Stage 3 financing.

4 – PREVIEW OF THE NEXT MODULE

- Referrals to Web sites and other materials that can add to what was learned in this module.

- Participants should be asked to read the case profile of Ballard Power Systems Inc. and Iogen Corporation, both featured in the next module.

- The next module deals with Stage 2 of the innovation process — the prototype stage.

Module

Stage 2 – The Prototype Stage

Objective:

The objective of this module is to lay out the parameters of the prototype stage of the innovation process and to establish why it may be a necessary element of the innovation process.

Instructional components for Module 3:

- Video profile of Ballard Power Systems Inc. based on 30-minute interview with Firoz Rasul, CEO since 1989 and Chairman of the Board since 2003.
- Ballard Power Systems Inc. case profile.
- Iogen Corporation case profile.

This module consists of four parts:

- **Discussion of Definitions:** This part is intended to establish what the prototype stage is, what major purposes it serves, and factors involved in successfully executing this stage of the innovation process. [10 minutes]

- **Discussion on Delivering a Prototype:** The participants form breakout groups to discuss issues raised by the facilitator in the context of the case profiles of Ballard Power Systems and Iogen Corporation (which learners should have read previously) as well as the innovative person or organization they were asked to identify in Module 1. They should be allowed 15 minutes for discussion, then one minute each to report on their findings. This section explores the issues that must be faced in moving into Stage 2, which requires the concept developed in Stage 1 to be proved and validated as a working model. [20 minutes]

- **Viewing a Video on Ballard Power Systems:** This company has not yet completed Stage 1 for its principal research objective, but it has entered Stage 2 for several of its spinoff products. The 30-minute video interview with Firoz Rasul, Chairman of Ballard Power Systems, could be paused at four points (to be chosen by the facilitator), where the suggested issues can be debated. [35 minutes]

Participants form four breakout groups to discuss the four issues identified during the showing of the video and in the case profiles. They should be allowed 15 minutes and should be given one minute each to report their findings on the issues and the lessons. The facilitator can augment their reports from the notes provided below.
[20 minutes]

- **Preview of the Next Module** (Optional).
  [5 minutes]

1 – DEFINITIONS

In the prototype stage of the innovation process, the concept is adapted and developed to prove its feasibility. This might take the form of a prototype or a test facility, adaptation of some technology to a point where it performs to the specifications set out in the concept, or a market test that validates the technology or its application in the marketplace and establishes an adequate market at the price for which the product or service can be delivered.

The purpose of the prototype stage is to ensure that what works in a beaker, on a bench or in a laboratory can be produced and will work in the more systemized environment that comes with mass production. Often it involves bringing in new, unrelated technologies to solve technical problems and bringing into the company a change in leadership and management.

The skills required to function effectively in Stage 2 can be quite different from those required for Stage 1:

- **A more disciplined approach to the management of research and technology development is needed.** With a viable concept in hand, the company must apply itself to making that concept work. This requirement demands more focussed targets and milestones for technology advancement and less free-form fundamental research. The formulation of technology and product roadmaps may be necessary and useful. Links with potential users of the technology/product may also be necessary in order to validate the application of the technology in solving real and practical problems in the marketplace.

- **Product development must be balanced against technology development.** Decisions may have to be made on whether to develop products from subsidiary technologies or to focus all the effort on the main research direction.

- **Management needs skills to develop infrastructure for administration, marketing, finance and planning.** As the company takes operational shape, it needs the ability to price its products for market, to acquire distribution channels and to build an operational infrastructure.

- **Operational skills are needed to translate laboratory performance into factory performance.** They may require new, unrelated technologies and an assessment of operating differences when the scale of production is increased by a large factor.

- **A more strategic approach to financing is needed.** The company may have to plan more strategically for the infusion of cash necessary to finance what may be an expensive and lengthy process of proving that the technology works and that it can be turned into a product. This plan will likely have to identify several sources of funding from government, private investors and public markets.

- **Large, strategic partners must be acquired.** Strategic partners may need to be attracted to accelerate the company's ability to access complementary technologies, marketing and distribution channels, and investment. These kinds of investors influence the way a company manages itself because they expect a more formal approach to planning and implementation. This change in focus has to be reconciled to the less formal approach prevalent in a research operation.

In other words, a research company must transform itself as it enters Stage 2. This raises issues about its leadership and its financing. Often, there are disruptive changes at this point. If the company was founded by scientists and technologists, they may have to bring in a more sophisticated management team; if founded by people with business backgrounds, they will have to bring in scientists, engineers and technologists.

2 – DISCUSSION: BUILDING A PROTOTYPE — BALLARD POWER SYSTEMS INC. CASE PROFILE

The analysis and discussion of Ballard Power Systems can be based on the following framework. The issues raised should be matched with pauses in the video, during which the issues can be introduced (though not discussed until after the video is shown and the breakout groups are formed).

Discussion of Ballard Power Systems

Ballard is pursuing the ultimate "big bang" innovation — the replacement of internal combustion engines with a zero-polluting fuel cell technology powered by hydrogen. The winner of this race will transform the world's consumption of energy, making billions of dollars in the process. The company was an early pioneer, developing the basic building blocks of the technology (it has 1700 patents already). However, the field now has become crowded, with many companies working on the same technology. It is only a matter of time — and the challenge for Ballard is to convert its early lead and strong foundation of technological progress into achieving the final breakthrough before anyone else.

Over the past 20 years, the company has gone through three phases in Stage 1, starting with a researcher-driven profile, then moving on to goal-driven technology advancement and finally to customer-driven product development. It has consumed almost $1 billion already and continues to need a lot more money as it searches for the breakthrough in its core research goal of producing a practical, affordable car engine powered by fuel cells. Until this is achieved, the company will not make a profit.

It has followed the strategy of commercializing the technology wherever possible to generate as much revenue as possible for generating more financial resources and for attracting potential investors.

Stage 2 – The Prototype Stage

Ballard has a number of products in various phases of Stage 2. In early 2003, the company was divided into four divisions, two of which (power generation, and electric drives and power conversion) had already advanced into Stage 2. The transportation division — the company's *raison d'être* is a fuel cell engine for cars — has sold a number of early prototypes. However, it has not yet completed Stage 2, as it has not developed a practical and affordable fuel cell engine for cars.

Ballard has proven the use of fuel cells as an energy source to power selected mass transportation vehicles such as buses. Its fuel cells have been supplied to a number of automakers to test in fleets of cars. A small number of spinoff products are now about to enter the roll-out stage — products such as a component of automatic transmissions, electric power drives and power electronics. While these products have a very strong order book, Ballard is still completing the infrastructure that will enable it to embark on full-scale commercial production of these products. It opened its first full-scale manufacturing facility in 2000. Ballard's first mass-produced fuel cell product is the Nexa™ portable generator, which was launched by the company in 2001.

Issues and Lessons

1. To what extent should spinoff technologies be transformed into stand-alone products?

The Issues: In many programs of technological research, it becomes necessary to acquire or develop subsidiary technologies in the course of developing the principal technology. Sometimes these technologies can turn out to be more valuable than the principal one. In other cases, they may be valuable in their own right, but less important. And in still other cases, they are interim technologies that will become obsolete as the principal technology advances. When subsidiary technologies are developed into stand-alone products, they divert technical and management resources into the task of steering them through the innovation process, and there is some risk that the principal technological effort may suffer as a result. However, it may be worth the effort if the subsidiary technology has excellent prospects and if it has the potential to contribute to the principal technology through its profits or its infrastructure.

The Lessons: Ballard has followed a similar course to Iogen Corporation (see below) — with one big difference: its spinoff products are not integrated into its principal technology. The electric drives and components of automatic transmissions may have a future as stand-alone products, but they are marginally related to the fuel cell research. On the other hand, their products such as the buses powered by fuel cells and stand-alone power generators are demonstrations of the principal research — and will become less important to Ballard as the technology advances. In the first case, the stand-alone products will not sustain the company in its principal goal,

but they do provide revenues and sustainable businesses. In the second case, the spinoffs are primarily demonstrations of the intermediate technology and serve to provide comfort to investors.

2. When is the best time to bring in customers as strategic partners?

The Issues: The major automobile companies, along with several others such as Inco Limited, have spent many millions of dollars researching battery technology for electric cars. They have all failed to make any progress. All the world's major car companies have been examining alternative power sources for decades, pressured by governments to reduce pollution. The fuel cell is only one of many — and all of the alternative energy purveyors have been trying to get the auto companies as strategic investors. The fact that DaimlerChrysler and Ford Motor Company have made such large investments in Ballard is as much a sign of their confidence in fuel cells as it is in Ballard. However, this puts Ballard under enormous pressure, because the major companies will go elsewhere at the drop of a hat if they see something better coming down the road.

The Lessons: Ballard's situation is the opposite of Iogen's. Whereas the oil companies are threatened by the potential for alternative fuels, automobile companies are allies of Ballard in seeking new ways to power cars. This has not always been the case: in earlier years, the automakers tried to suppress fuel cell research. Bringing in future customers as strategic investors is therefore a major boost to advancing the technology. However, the auto companies don't have all their eggs in one basket, so Ballard has to keep pushing the envelope.

3. To what extent does an R&D company have to adjust its management culture in order to be more attractive to investors?

The Issues: Investors in Stage 2 require a more businesslike approach, as mentioned above. However, the acquisition of these managerial skills should normally serve as a balance of and supplement to the research skills that are the basis of the company's strength. While it is true that research skills must necessarily pass under more disciplined management as the technology matures, the timing of the transition is important — if the discipline is imposed too early, it can limit the creativity still needed to make a breakthrough but, if it is imposed too late, the company will fail from lack of focus.

The Lessons: Ballard understood the need to impose managerial discipline. In fact, the company deposed its founder CEO and brought in a new CEO whose skills were in the area of disciplined management and focussed "technology advancement." Firoz Rasul imposed tight disciplines on Ballard, which was a major factor in attracting the funding necessary to continue the research. However, the success in attracting the major car companies as investors has led to a further adaptation of its management style, with the emphasis passing to product development from technology advancement. Only results will make it clear whether the timing was right in shifting the focus of the research effort.

3 – IOGEN CORPORATION CASE PROFILE

Summary of Iogen Corporation Case Profile

This company's main research goal is to develop a manufacturing process that can produce affordable renewable energy for use in cars. To succeed, it needs two things: a government-induced environment that forces a shift into ethanol, and sufficient cost efficiencies that bring its cost into line as a viable competitor with gasoline. At this point, this environment does not exist in Canada, although it is well advanced in Europe and, to a lesser extent, in the United States. The Royal Dutch/Shell Group has made a major investment in the company, indicating that the potential of this research is real.

In developing the technology for the production of ethanol from waste products (wheat straw and corn cobs), Iogen has developed excellent, high-quality enzymes that have applications in other industries. This has become a business in its own right, with profitable sales and a full-scale commercial plant. This business does not provide an adequate return on the money invested in Iogen to date, so it cannot be said to be in Stage 3 for the company as a whole. But the technology is distinct from the core technology and is a stand-alone spinoff. The company's mid-term strategy is to license its core technology once it has been perfected and to retain the enzyme business as a permanent operating company that can supply the licensed ethanol plants.

Stage 2 – The Prototype Stage

Iogen has built a $40-million demonstration plant that can process 25 tonnes of wheat straw a day. Its backers include Petro-Canada Corp. (for $16 million) and the federal program Technology Partnerships Canada (for $10 million). This is the only plant of its kind in the world and it has demonstrated the scalability of the technology. The Royal Dutch/Shell Group has also invested $46 million in this venture.

In the enzyme research, the company perfected applications of the enzymes in three industries: pulp and paper, animal feed and textiles. These were proved to be effective and commercial. They are stand-alone products for the research conducted as part of the ethanol program.

A major constraint on the company's growth has been the ability to find enough people with the necessary skills in everything from accounting and marketing, through spreadsheet analyses and science. The CEO is very conscious of the need to acquire these skills to lead the company from a research company to an operating company.

Discussion of Issues and Lessons from Iogen

1. Why did Iogen spend more than $40 million to build a demonstration plant? Why not go straight to commercial implementation?

The Issues: It is a very big leap from a working model of a process to a full-scale commercial plant. The main issue is scalability — the degree to which each step in the manufacturing process can be increased in size and throughput without altering the outcome. In some cases, it is possible to make the leap in one stage — if the technology is in use elsewhere and has demonstrated its scalability, for example. However, if the technology is entirely new, scalability is a big issue. What works on a model may not work in mass production. The point of a demonstration plant is to test the scalability of each step in the manufacturing process. This may require a great deal of further innovation to adapt the technology to refine the process and obtain the required scalability.

The Lessons: Since Iogen's technology is completely new, it had no choice but to build a demonstration plant. What works in a beaker in a lab may not work in a giant plant being fed hundreds of tonnes of wheat straw a day. By exposing its manufacturing map to a test of scalability, it can alter its processes to facilitate scalability before it rolls out its first full-scale plant.

2. What factors dictate the choice of strategic investors?

The Issues: All the oil companies have to be interested in renewable energy, since major breakthroughs in this technology could threaten their entire business. The key question for these giant companies is whether they should:

- try to do all the research themselves, so that they have full control of the emerging technologies (and all of the profits) or
- hook up with many smaller, more innovative firms to guarantee that they will have a stake in whichever one emerges with the best technology.

For the innovators, the important considerations are:

- the degree to which they believe the giant firms will be comfortable with letting them earn significant profits from the success of their research and
- the assistance the giant firm can provide in large-scale manufacturing processes.

In some cases, giant firms may seek to gain access to the technology so that they can control it alone. Patents are clearly the main bargaining chip in this game.

The Lessons: Iogen has achieved a desirable result by acquiring the Royal Dutch/Shell Group as a full partner that has invested in the company rather than in the technology. An important part of Iogen's strategy is deciding not to compete with the giants by going into the business of large-scale manufacture of ethanol. In the first place, giant companies run those plants more effectively and, secondly, by seeking only a royalty on its technology, it is less threatening to the oil companies. In addition, Iogen needs to have a distribution infrastructure for the sale of bio-ethanol at the pumps.

3. What skills are required to enable a company to succeed in Stage 2?

The Issues: The objective of a prototype is to demonstrate not only that it can work outside the laboratory, but also that mass producing the product can be done at a cost low enough for there to be a market at that price. This therefore requires the company to develop its management infrastructure, including human resources, finance, marketing and operations skills. In particular, the skills required to raise financing are different from those in Stage 1; in Stage 2, raising funds demands someone who can demonstrate businesslike strengths and who has the ability to work with large strategic partners. In terms of more specific skills required for developing prototypes, the company needs project management skills and the ability to identify unrelated technologies that are required to develop a product capable of mass production to solve all the science and technology-related problems that may arise.

The Lessons: Once it emerged from Stage 1, Iogen understood quickly that it needed a wide range of non-scientific skills to carry it forward. The CEO indicates that they have devoted a lot of time to the search for appropriate non-scientific skills and that the slow pace of finding them represents a major constraint on the firm's growth. This includes outside board members, public relations experts and a chief financial officer.

4. To what extent should spinoff technologies be transformed into stand-alone products?

The Issues: In many programs of technological research, it becomes necessary to acquire or develop subsidiary technologies in the course of developing the principal technology. Sometimes these technologies can turn out to be more valuable than the principal one. In other cases, they may be valuable in their own right, but less important. In still other cases, they are interim technologies that will become obsolete as the principal technology advances. When subsidiary technologies are developed into stand-alone products, they divert technical and management resources into the task of steering them through the innovation process, and there is some risk that the principal technological effort may suffer as a result. However, it may be worth the effort if the subsidiary technology has excellent prospects and if it has the potential to contribute to the principal technology through its profits or its infrastructure.

The Lessons: Iogen has developed the creation and manufacture of enzymes into a stand-alone product. This is generating profits for the company's ongoing research program but, more importantly, Iogen has crafted a creative strategy for its enzymes business, since it will become the company's principal operating business when it starts licensing its principal technology to giant firms.

4 – PREVIEW OF THE NEXT MODULE

- Referrals to Web sites and other materials that can add to what was learned in this module.

- Participants should be advised that Iogen Corporation will be the case profile for the next module as well as this one — but for observations relating to Stage 3, of course. They should also be instructed to read the Garrison Guitars case profile.

- The next module is Stage 3 — commercial implementation.

Module

Stage 3 – **Commercial** Implementation

Objective:

The objective of this module is to explore how innovative companies take a technology that has been satisfactorily demonstrated by a prototype or has been proven through proof-of-concept, and then build the infrastructure to roll out the innovation as a full-scale, profitable business. This includes generating customer-driven markets for the technology or product.

The instructional components for Module 4 include:

- Video profile of Garrison Guitars, based on interviews with principals of the company.
- Garrison Guitars case profile.
- Iogen Corporation case profile (which was also recommended for use in Module 3; here in Module 4, the profile is used to demonstrate additional lessons learned for Stage 3).

This module consists of four parts:

- **Discussion of Definitions:** This part is a guide to an exploration of the principal issues involved in scaling up a prototype to a fullfledged production system.
  [10 minutes]

- **Discussion on Implementing the Technology as a Commercial Operation:** The participants form breakout groups to discuss issues raised by the facilitator in the context of the case profiles of Garrison Guitars and Iogen Corporation (which they read for the previous module) and the innovative person or organization they were asked to identify in Module 1. They should be allowed 15 minutes for discussion, then one minute each to report on their findings. This section explores the issues that must be faced by a firm in moving into Stage 3, which requires the prototype of Stage 2 to be satisfactorily demonstrated as technologically and commercially viable; that is, it can be produced to meet customer specifications and needs.
  [20 minutes]

- **Viewing a Video on Garrison Guitars:** This company has now completed Stage 3. The 30-minute video should be paused at four points (to be chosen by the facilitator) where the suggested issues to be discussed can be broached.
  [35 minutes]

  Participants form four breakout groups to discuss the four issues identified during the showing of the video. They should be allowed 15 minutes and should be given one minute each to report their findings on the issues and the lessons. The facilitator can augment their reports from the notes provided below.
  [20 minutes]

- **Preview of the Next Module** (Optional).
  [5 minutes]

1 – DEFINITIONS

In this stage, the prototype is expanded to commercial proportions and the product is brought to market. This step demands further financing of the project, putting together the right management team, building the infrastructure to produce the technology or product, and creating the marketing and distribution systems to launch the product/technology into the market. Commercial implementation requires a viable business model, a full-scale business plan and professional management. This requires mastery of the following issues:

1. Developing operational competence:

- meeting cost criteria in equipping the production facilities
- hiring, motivating and training key staff
- creating the necessary supplier networks
- ensuring that the production values of the prototype can be scaled up to a full-scale commercial plant
- solving any technical problems in the scaling-up process.

2. Acquiring new production technologies:

- new technologies, machinery and equipment that are unrelated to the innovation are usually required in setting up a full-scale production facility.

3. Financing the costs of the new production facility:

- this usually requires much more money than has been raised so far and it demands very detailed plans and projections.

4. Establishing a marketing function:

- ensuring the market is ready for the product (in many cases with new innovations, the customers have to be educated or nurtured)
- ensuring the market is defined and accessible
- securing strategic customers that will establish the firm in the marketplace
- devising a sound plan to compete, especially if the market is dominated by very large corporations.

5. Developing a production strategy:

- taking account of the competition, it may be necessary to form strategic alliances or to subcontract key elements in the production or distribution processes in order to compete effectively.

2 – DISCUSSION: COMMERCIAL IMPLEMENTATION — GARRISON GUITARS CASE PROFILE

The analysis and discussion of Garrison Guitars can be based on the video and the case profile. The issues raised should be matched with pauses in the video, during which the issues can be introduced (though not discussed until after the video is seen and the breakout groups are formed).

Video and Discussion of Garrison Guitars Case Profile

In this innovation, the entrepreneur already had a business making guitars in the traditional, hand-crafted ways. The innovation was derived from that business and the idea for the innovation was entirely his.

Many of the technologies the entrepreneur brought to the manufacture of guitars were well-established in other industries but unheard of in his own, so he had to acquire a lot of new skills in order to navigate each of the first three stages. This case can be used to illustrate all stages of the innovation process; the focus here is on the commercial implementation stage.

Stage 1 – Developing a Viable Concept

The trigger for this innovation was the entrepreneur's desire to manufacture guitars in a way that would reduce the costs while not compromising quality. The founder took this trigger a lot further than the idea of simply mechanizing the production process, however. He invented a new design for his guitar that unified the internal bracing system and used composite glass fibres instead of wood to make it. It turned out that this innovation not only made the production process amenable to mass production, but also improved the sound resonance of the guitar.

The journey from idea to demonstrated, feasible concept was a long one, because he had to learn new trades — injection moulding and materials technology, among others — as well as learn to write business plans and raise financing. He learned these skills by consulting extensively with available sources of help in government, university and technical institutes, as well as by visiting several major manufacturing plants in North America to see how they organized their production. None of his technology was new, but it was the first time anyone had thought of applying it in his industry.

Stage 2 – The Prototype Stage

The prototype stage was very expensive, since he needed a special injection moulding machine and he needed to make a prototype before he could complete the patenting process. He also had to win acceptance within the industry at its most important trade show in Los Angeles; without this acceptance, no one would buy guitars with such a revolutionary production process.

He had some difficulty attracting venture capital to finance Stage 2. First, he had to prove that his new guitar design was technically feasible and that it would be accepted in the marketplace. However, he persisted and persuaded a venture capitalist to advance a quarter of a million dollars that he needed so he could complete Stage 2.

The success of this stage hinged entirely on obtaining intent-to-purchase commitments from distributors at a major trade show. He came back with 56 000 orders; this was enough to get him out of Stage 2, as the investors had insisted that he obtain a minimum of 7000 orders.

Stage 3 – Commercial Implementation

Having obtained the financing for a full-scale manufacturing facility, it took about two years to get the plant running at full capacity, producing 50 guitars a day. Although Garrison Guitars had hand-built functioning prototypes, it was a long road to perfecting all the pieces of the puzzle for a mass production process. The firm hired the appropriate expertise (including an engineer who had worked for one of the government agencies that had helped to finance it). Together they had to find ways to apply a whole range of existing technologies to their new application, including machine tools, ultra-violet paints, robots and lasers. At every stage, they had to improvise, experiment and innovate.

Stage 4 – The Continuous Innovation Cycle

Garrison Guitars has not demonstrated its entry into Stage 4 yet, but it has laid a solid foundation for it, by instituting an innovation culture in the company. Management is decentralized with major responsibilities being assigned to the heads of each division. The CEO is also consciously encouraging people to be unafraid of making mistakes in the course of trying new things — and he is committed to continuous innovation in the course of very rapid growth.

Issues and Lessons

1. To what extent does producing a prototype resolve the manufacturing issues inherent in the roll-out of a full-scale production process?

The Issues: A prototype can usually be made almost by hand. A commercial plant has to be systematic, so that quality and reliability are built into the process. It is usually a question, therefore, of acquiring a range of skills and methodologies to recreate the product on a large scale.

The Lessons: Garrison Guitars found that the manufacturing expertise required for Stage 3 was far beyond what was required in Stage 2. It identified several technologies and many operational systems that it needed to acquire before it could make its plant run effectively. By definition, the necessary techniques had never been applied to the production of guitars, so it was all new. It is a good example of just how challenging it can be to take a product from prototype to commercial implementation.

2. What is the best way to handle the acquisition of new skills and/or new technology at this stage?

The Issues: There are three ways to acquire new expertise or technology: buy it, hire someone with the requisite knowledge, or persuade someone to show the way for free. Sometimes it is necessary to buy a company in order to employ some of its key people. Buying technology is usually too expensive for smaller or younger companies, so the most common techniques are to hire the right people and ask a lot of questions of knowledgeable people.

The Lessons: Garrison Guitars was highly effective in obtaining advice on the adaptation of technology to its needs and was very flexible in its search for the right technologies for its full-scale plant. The CEO admits he "took a lot of wrong paths," but he hired the people he needed and gave them the responsibility to make decisions. The result is an operational team with depth.

3. What are the steps necessary to successfully launch a new product on the market?

The Issues: In order to attract the financing necessary for construction of a production facility, the firm has to prove that a market exists for the product.

The Lessons: Garrison Guitars' CEO was able to prove a market for his new guitar by demonstrating his hand-built prototypes at a trade show and gaining letters of intent to purchase. He effectively secured more than 56 000 such letters from distributors at the largest guitar trade show in the world before he even had a building. He had a year to honour those commitments but, with these in hand, he was able to secure the venture financing necessary to build the plant and move into production. He was able to meet the orders he had, but there is still a year-long waiting list of orders. The demand for his guitars exceeds the capacity of this plant to produce them. This is a good position for a firm to be in but, at the same time, Garrison Guitars must seek new investment to expand the plant capacity so the firm can grow.

3 – IOGEN CORPORATION CASE PROFILE

Summary of Iogen Corporation

This company's main research goal is to develop a manufacturing process that can produce affordable, renewable energy for use in cars. To succeed, it needs two things: a government-induced environment that forces a shift into ethanol, and sufficient cost efficiencies that bring its cost into line as a viable competitor with gasoline. At this point, this environment does not exist in Canada, although it is well advanced in Europe and, to a lesser extent, in the United States. The Royal Dutch/Shell Group has made a major investment in the company, indicating that the potential of this research is real.

In developing the technology for the production of ethanol from waste products (wheat straw and corn cobs), Iogen has developed excellent, high-quality enzymes that have applications in other industries. This has become a business in its own right, with profitable sales and a full-scale commercial plant. This business does not provide an adequate return on Iogen's investment to date, so it cannot be said to be in Stage 3 for the company as a whole. But the technology is distinct from the core technology and is a stand-alone spinoff. The company's mid-term strategy is to license its core technology (the bioethanol plant) once it has been perfected and to retain the enzyme business as a permanent operating company that can supply the licensed bioethanol plants.

Stage 3 – Commercial Implementation

Iogen already has a plant up and running for the production of enzymes. Annual sales are approaching $12 million and the plant is profitable. The cash flow from this plant contributes to the research and development (R&D) for the ethanol program.

Iogen is also embarking on the commercial implementation of a full-scale ethanol plant, which is expected to cost $200 million. The Royal Dutch/Shell Group is a major contributor; it has invested $46 million in Iogen in return for 22 percent of the company. The company expects to build two or three of these commercial plants and then, once they are running smoothly, to license the technology to people who may want to build similar plants in other countries. Iogen would be the sole supplier of enzymes to these ethanol plants, which would leave the enzyme business as Iogen's principal operating business.

Issues and Lessons

1. What skills are required for the stage of commercial implementation?

The Issues: Once a company is in the commercial market for its product, its focus shifts to the customer. For what was once a research organization, this is a significant change, because the factors that drive its management become external rather than internal. This stage demands marketing skills, distribution channels, quality control systems and purchasing departments, to name just a few. These skills are not the same as those required in Stage 2: the prototype stage needs people who understand marketing and can do a market feasibility study, for example, whereas a Stage-3 company needs people who can create a marketing and distribution infrastructure and manage customer relationships.

The Lessons: Iogen is clearly conscious of the need for skills such as these. Its executive officers note that the lack of adequate non-scientific skills is a major restraint to growth. However, Iogen has chosen a strategy where many of the skills requirements are taken care of by its strategic partners. By licensing its principal technology to giant companies and by seeking to be the major supplier of enzymes to these licensed plants, it has devised a strategy whereby the limited number of clients minimizes the requirement for its own marketing and distribution infrastructure. However, it still needs a strategy for promoting and marketing the company.

2. Is it a good idea to take a spinoff technology into Stage 3, rolling out a commercial product, before the same is done for the core technology?

The Issues: The danger in taking spinoff or intermediary technologies to Stage 3 too early is that the move may divert management resources into the sideshow and away from the main event. On the other hand, one can argue that it creates cash flow, which can help the principal technology, and that it develops the operational skills needed later for the principal technology when it is ready to move into Stage 3.

The Lessons: Iogen had a number of sound reasons for deciding to push ahead with commercialization of its enzyme business. Firstly, the market for ethanol had come and gone before, so there was some risk in putting all its eggs into this basket. Secondly, the enzyme business is a separate business from the ethanol business, with different clients and a much smaller scale. Thirdly, the enzyme business will become its principal business once it licenses its technology for ethanol plants.

3. How should a small company compete with giant global corporations when its product has global applications?

The Issues: The most realistic solution to this problem is to not compete. By securing access to the financial, marketing and human resources of giant corporations, small companies can extend the reach of their technology enormously. However, linking up with a giant corporation has its own kinds of risks. Giant corporations are not usually comfortable being beholden to small companies and may seek ways to circumvent the small company's advantage. Also, giant companies may prevent the small company from finding other clients, or may find these other clients for their own account. And giant companies may use their access to the technology of the small firm to develop the next generation of the technology for themselves, thereby excluding the small firm.

The Lessons: Iogen has entered into agreements with several oil firms. One of them, the Royal Dutch/Shell Group, has bought a share of the company rather than the technology, thereby allowing Iogen to retain full control over the technology. Iogen has retained all its options so far, which gives it good bargaining power.

4. Why should Iogen move its bioethanol business into Stage 3? Would it not be safer to license its technology immediately instead of building a few of its own plants first?

The Issues: Since Iogen intends to license bioethanol plants after it has built a couple itself, it seems like a lot of work to ramp up all the necessary operational skills for a large business that will not be allowed to grow.

The Lessons: The answer to this is not in the case profile, but the participants may be encouraged to speculate on the reasons. There are several possible reasons. The move ensures better protection of the patent if the firm has taken the technology to the commercial stage where all the potential bugs have been ironed out. The firm obtains better negotiating power with the giant companies if it has the option of running its own plants in the event the giant companies are not prepared to offer reasonable terms for the licensing agreement. The firm would like to consolidate its dominance in its technology while it waits for governments to pass regulations that will create a large market for ethanol.

4 – PREVIEW OF THE NEXT MODULE

- Referrals to Web sites and other materials that can add to what was learned in this module.

- Participants should be advised that My Virtual Model (MVM) and Research In Motion (RIM) will be the case profiles for the next module.

- The next module is Stage 4 — the continuous innovation cycle.

Stage 4 – The Continuous **Innovation Cycle**

Objective:

The objective of this module is to explore how innovative companies continue to pursue innovation, even after they have taken a new technology through all the stages of innovation to create a commercial business.

The instructional components for Module 5 include:

- Video profile of My Virtual Model Inc., based on interviews with principals of the company.
- My Virtual Model Inc. case profile.
- Research In Motion Limited (RIM) case profile.

This module consists of four parts:

- **Discussion of Definitions:** This part is intended to explore how the innovative behaviour of leading-edge firms evolves after they have successfully navigated the first three stages in the innovation cycle with their initial technology or product.
  [10 minutes]

- **Discussion on Moving into the Continuous Innovation Cycle:** The participants form breakout groups to discuss issues raised by the facilitator in the context of the case profiles of My Virtual Model and Research In Motion (which they should have read previously) and the innovative person or organization they were asked to identify in Module 1. They should be allowed 15 minutes for discussion, then one minute each to report on their findings. This section explores what drives innovators as they move into Stage 4, which requires their original innovation to be operating successfully and profitably.
  [20 minutes]

- **Viewing a Video on My Virtual Model:** This company is now functioning aggressively in Stage 4, acquiring and applying many new technologies. The 30-minute video should be paused at four points (to be chosen by the facilitator) where the suggested issues to be debated can be broached.
  [35 minutes]

Participants form four breakout groups to discuss the four issues identified during the showing of the video, bearing in mind the case profile, which should have been read previously. They should be allowed 15 minutes and should be given one minute each to report their findings on the issues and the lessons. The facilitator can augment their reports from the notes provided below.
[20 minutes]

- **Wrap-up.**
  [5 minutes]

1 – DEFINITIONS

Having brought the innovative product or service successfully to market, the innovative company then needs to launch itself into the continuous cycle of an innovative culture, where innovation becomes a way of the firm's existence. Innovative companies regard their first innovation breakthrough as only the foundation of an innovation cycle that could lead to new products and services in directions that are often unexpected. A company that innovates once and does no more research and development could soon be overtaken and die, even if it is protected by a patent (with very rare exceptions).

To achieve this state of grace, the company needs to consider these actions:

- making substantial and continuous efforts to retain a leadership position in its technology — or its success will merely create an opportunity for a competitor
- keeping its patents up to date and enforcing them
- buying relevant technology if it cannot develop it in-house
- entering into strategic alliances with large firms to protect market or technology positions
- setting aside funds for an R&D budget as a priority for maintaining its competitive position
- watching competitors very closely for innovations and unexpected initiatives
- making it a priority to create the next generation of products or processes that will make the current generation obsolete — or a competitor may do it instead.

The continuous innovations may take many other different directions that are not limited to the initial breakthrough. To suggest just a few:

- In the course of bringing its innovation to market, companies may develop special expertise that can be spun off as independent products (this can happen earlier in the cycle, as previous case profiles have shown).

- Often a product that has been successfully sold in one market can be adapted to another market with only minor changes in the product.

- A company that develops strong ties with its customers will sometimes find those customers have other needs that it can meet with only minor additions to its field of competence.

2 – DISCUSSION: THE CONTINUOUS INNOVATION CYCLE — MY VIRTUAL MODEL INC. CASE PROFILE

The analysis and discussion of My Virtual Model can be based on the video and the case profile. The issues raised should be matched with pauses in the video, during which the issues can be introduced (though not discussed until after the video is shown and the breakout groups are formed).

Discussion of My Virtual Model (MVM) Video and Case Profile

As an Internet software development company, MVM is deeply committed to technologies that move faster than any technology in history — those utilizing the Internet. MVM could not afford to dally in any of the stages of innovation, so its strategy has been to speed up the innovation process, blurring the distinctions between the stages. At every stage, it started moving into the next stage before it had completed the previous one.

MVM is essentially a one-product company, based on its virtual identity model, but it has developed — and will develop — that one product in an almost unlimited process of refinement and expansion. Even in its development stage, the concept of the product was always fairly clear. Therefore, the R&D was a focussed search for the technology that would make it commercially viable. This is unlike many innovative companies, whose early-stage R&D is science- or technology-oriented rather than product-focussed.

Once MVM had entered Stage 4, the company's approach to R&D was more in line with conventional practice, in the sense that its technological development was aimed at specific outcomes. But the president still does it a bit differently. She is reverting, in a sense, to the inspiration of her childhood imagination, following wherever her imagination leads her in the evolution of her product, adding more and more innovative features — and then asking her researchers to find the technology to make it work.

MVM was able to succeed because it harnessed the strength of a powerful vision of one of the founding partners to the solid foundations of a good business partner. This is a good illustration of the power of a partnership with complementary skill sets and temperaments.

This case illustrates well all stages of the innovation process but this module will focus on the last stage of the innovation process — the continuous cycle.

Stage 4 – The Continuous Innovation Cycle

Having achieved profitability — and therefore the ability to sustain the company — MVM is again straddling stages. MVM was already in the continuous innovation cycle, long before it reached breakeven. Throughout Stage 3, its researchers and technologists did not delay second-tier innovations while they tried to complete the development of the original innovation. The virtual model is adding features and capabilities several times a year, in a steady progression of refinement and expansion.

Issues and Lessons

1. What are the advantages of buying technology rather than developing it in-house?

The Issues: One of the first rules in the continuous innovation cycle is to stay abreast of all technologies that have any relevance whatsoever to the innovator's products — and even some technologies that are not relevant, but could be. The decision on whether to pursue any particular technology hinges mainly on cost and timing. It is usually preferable to keep the research in-house, but there may not be enough time to complete the R&D, or the skills of the researchers may not be appropriate. Sometimes it is very expensive to buy technology — which is fine for a giant company, but may not be practical for a smaller one. The company can either hire someone with the requisite knowledge or persuade someone to enter into an alliance. Sometimes it is necessary to buy another company in order to employ some of its key people.

The Lessons: MVM is very conscious of the need to acquire technology in a timely fashion. It indicates that it will buy technology wherever necessary — usually from a potential partner in a new development of the virtual model — but it still maintains a strong R&D operation.

2. How do firms go about developing the next generation of a product or technology?

The Issues: Continuous product development is often driven by one of two forces — an R&D team that keeps coming up with new wrinkles, or customers who suggest new features that they would like to see. Working with customers is doubly effective, because it consolidates the relationship and attracts new customers. And sometimes competitors show the way. Ideally, a company should be pursuing all three avenues if it wishes to keep its edge.

The Lessons: MVM has no serious competitors, so its product development is confined to the first two approaches, both of which it pursues very aggressively.

3. How is the ongoing R&D in Stage 4 financed?

The Issues: The first innovation breakthrough often takes longer and is more complex than subsequent innovations. Once a firm has a successful, profitable operation, its R&D tends to be much more focussed and specific, which means the budget for R&D usually has shorter-term horizons and clear cost–benefit objectives. In this

context, the firm has to decide how much of its R&D can be funded by internal cash flow. It is best if the gross margin is big enough to carry the entire R&D budget, but this is not always the case. Successful firms strive to increase sales to a level where all R&D can be self-financed, but other sources of financing have to be secured. An R&D budget would not normally be allowed to put the company into the red unless a source of financing had already been established. Innovating firms will often try to raise money from investors when markets are strong, so that they will have reserves available for R&D even when markets are weak.

The Lessons: MVM raised a very large amount in the middle of the dot-com boom, which carried its R&D through the subsequent bust. In early 2003, the company expected to break even at its current level of R&D spending, so future sales increases will put it in the black. It has chosen a disciplined approach to R&D funding, insisting that any proposed project should generate a new product within a year.

4. Once a company is in the continuous cycle of innovation stage, how far can it go?

The Issues: Companies that get to the point of launching their significant innovations in the marketplace can make large sums of money very quickly. For some, this is a good time to sell the company and take their profits. For others, the profits provide the platform for the next leap in innovation, which may generate even more profits. Each step upward, however, takes more time and more money, especially in the areas unrelated to R&D, such as management of human resources, dealing with shareholders and financial institutions, sales and marketing. Often, it becomes important to split responsibilities so that the R&D and technology side and the business side of the enterprise can get on with their own responsibilities without interfering with each other. However, the two sides have to be able to interface effectively in order to avoid schisms in top management.

The Lessons: MVM — like RIM — has co-CEOs, one of them the business partner and the other the technology or product visionary. In both cases, these two partners have very different skill sets and temperaments, but both communicate well and have a productive partnership. As a result, both can see no limit to their growth. The two partners in MVM see the company reaching sales of more than $1 billion. These companies are vital to the future economic strength of Canada.

3 – RESEARCH IN MOTION LIMITED CASE PROFILE

Summary of Research In Motion (RIM)

Research In Motion has created a disruptive technology, where the stakes are highest and the competition is fiercest. It therefore had to adopt an extraordinarily innovative and flexible approach to the development of its principal product, the BlackBerry™.

It has rolled out intermediary products as the technology has allowed. In other words, it has traversed the four stages on individual products, but each of these has been, in a sense, part of the development of the core technology, which reached fruition in the BlackBerry™ product.

It has straddled stages all the way. This is unavoidable in high-tech companies dealing in disruptive or niche breakthroughs. But it requires very successful fund-raising. RIM was able to do this, initially with a lot of government support in the early to mid-1990s, then with huge public share offerings on the stock market, starting in 1996.

Stage 4 – The Continuous Innovation Cycle

Since coming out with the BlackBerry™, RIM has continued to add features that keep it at the leading edge of the market. The competition, however, has been ferocious and RIM has had to fight patent protection battles in the courts as well as in the marketplace to keep its lead. These are characteristic of the struggles for market dominance in a very young market. The race goes to the company that comes out with the most rapid stream of continuous new innovations. Patents do not necessarily provide iron-clad guarantees — the ultimate guarantor is a stellar R&D operation as well as aggressive marketing and partnering strategies.

To avoid having to take on the huge telecoms alone, RIM chose to license its disruptive technology in a defensive strategic alliance with Nokia Corporation, which it expected would enable it to hold onto profits from the technology as it entered the mainstream.

In the meantime, RIM's researchers have dozens of new products in the pipeline. It may be that the BlackBerry™ will be only the first of a long line of innovative products in the wireless communications industry.

Issues and Lessons

1. How important are patents to an innovative firm?

The Issues: Patents are essential for any technology-based company, as they are the only way of transforming intellectual property into a bankable asset. They are not very expensive to file, but they can be expensive to defend — and they have to be defended or everyone will ignore them. Even then, the most valuable patents are sometimes challenged by many people who would like a piece of the action; some claim they had invented the idea previously; others claim patents for a similar technology that surpasses it; other people just copy the technology, hoping for a rich settlement out of court to cease and desist.

The Lessons: RIM has a company policy to patent the work it is doing as much as possible, and it has filed several hundred patents. This gives the company a competitive advantage and stronger bargaining position in a marketplace dominated by giants. However, its patents have been challenged in a number of cases, and it has had to dispute the merits of those claims and pursue the complainant. RIM does what it has to do — that is one of the costs of being successful.

2. Why would RIM license its technology to its competitors?

The Issues: The costs of promoting, marketing and distributing a highly innovative new product are immense. If RIM were to go it alone, it would have to raise a very large amount of money to compete in the global market of cell phones and the Internet. The alternative is to enter into strategic alliances with competitors, licensing some of the technology to them and keeping the elements that are less subject to global competition. In this scenario, RIM ensures a piece of some of the action rather than trying to maintain its place in all of the action and risking being shut out by the giant telecoms.

The Lessons: RIM has chosen strategic alliances with competitors, which entrenches its technology into the mainstream. However, it still retains control of the software for the servers, which synchronizes data between hand-helds and corporate and wireless networks.

3. Should a company that has reached Stage 4 concentrate on the next generation of its main product, or diversify into other products?

The Issues: If a product is capable of further development into the next generations, it is usually essential to continue development of the core product; otherwise competitors will leapfrog the technology and eliminate that business. So the choice is really between continuous, aggressive R&D to maintain a competitive edge or to profit from selling the technology to a larger company as soon as it has been successful. As for diversifying, any company that maintains a strong R&D department will probably wind up diversifying — as innovations in one area of R&D often lead to others — resulting in a "layering of innovations," one building on and leading to another.

The Lessons: RIM is a ferment of new ideas, led by its co-CEO Mike Lazaridis. In the company's early days, it had three or four business lines but, with a breakthrough invention, the company identified the innovation that would focus it on its main product opportunity, the BlackBerry™. Its current strategy is to innovate with the next generation of refinements and extensions to the BlackBerry™ product. However, this innovation may lead to new areas for the company in the future.

4 – WRAP-UP

- Referrals to Web sites and other materials that can add to what was learned in this module.

- Other issues deemed appropriate by the facilitator.