REVIEW OF THE STATUS AND AVAILABILITY IN CANADIAN COLLEGES AND UNIVERSITIES OF COURSES OR PROGRAMS DEALING WITH THE COMMERCIALIZATION AND ADOPTION OF SCIENCE AND TECHNOLOGY

Survey Report

March 31, 1990

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Prepared For

The General Business Policies Directorate

Industry, Science and Technology Canada

Ottawa, Ontario K1A 0H5

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Introduction

BACKGROUND

For the past few years concern has been growing over two deficiencies in the education of students enrolled in community colleges and universities in Canada. The first is that students in business or management programs graduate with little or no understanding of the role of science and technology in the operation of a modern economy. Many of these graduates are essentially technologically or scientifically illiterate. The second deficiency is the almost total lack of understanding that graduates of science and engineering programs have about the world of business, including the commercialization and adoption of science and technology.

It appears that Canadian post-secondary educational institutions are contributing to what Lester Thurow (Science, Vol. 18, December, 1987) refers to as the "two cultures". Thurow finds that the two cultures attitude is "peculiar to the Anglo-Saxon world", and leads to biases that handicap both education and industry. The two cultures attitude leads to poorer education in both the sciences and engineering. Split streams in universities and colleges for technical and non-technical subjects mean that students in science and technology have virtually no exposure to business courses, and those in non-technical streams have almost no exposure to science and technology. Thurow notes that this separation of technology and management does not occur in countries such as Japan.

A recent review of the availability of courses on either the management of technological innovation or technical entrepreneurship in Canadian universities (Educating Technological Innovators and Technical Entrepreneurs at Canadian Universities, T.E. Clarke and Jean Reavley, Science Council, May, 1987) showed that only eight engineering faculties in Canada offered these types of courses to their students. Not one science faculty offered such courses to their students. Although courses in these areas were available through some business faculties, few students from science or engineering faculties were able to take them because of timetable conflicts or lack of course prerequisites. Many of the course instructors, especially those in the engineering faculty, felt that their academic careers had not advanced at the same pace as their colleagues due to them teaching in areas that were not accepted as valid by many of their colleagues.

While there is some limited information on the availability of courses or programs on management for engineering students, there is little or no information on the availability of courses concerned with science and technology for community college technology students, or for business or management students in either university or college.

The purpose of this study was to conduct a survey of the major universities and colleges in Canada to determine the status and availability of courses or programs for technical and non-technical students that provides each group with an understanding of the commercialization and adoption of science and technology.

METHODOLOGY

This survey was conducted in two phases: the first phase involved sending a distinctive survey questionnaire to the following educational institution officials (number of questionnaires mailed):

- university deans of engineering (33)
- university deans of science (43)
- university deans of business/commerce (34)
- college deans of technology (53)
- college deans of business administration (49)

The covering letter and questionnaire sent to science deans, stated that the interest in the availability of courses was in the context of honours science students or graduate students, while the covering letter and questionnaire to college deans was to determine the availability of courses of concern to this survey for students enroled in programs equivalent to Ontario's three year business or technology programs.

In addition, publications such as "Cahiers de L'Enseignement Collegial 1988-1989", which provides a complete overview of program course content for Quebec Colleges d'enseignement general et professionel (CEGEP: Colleges of General and Vocational Education) was reviewed.

In the second phase, a sampling of individual professors or instructors identified in the first phase as offering pertinent courses were contacted to determine their willingness to take part in a more detailed telephone interview on their courses and the students who take them. Only people who taught courses specifically related to technological innovation (TI), technical entrepreneurship (TE), or new product development or marketing (NPM) were contacted for interview. These instructors were also asked to submit a course outline for inclusion in an appendix to this report.

Educational institutions that reported joint activities between faculties were asked to send material describing their joint programs.

PHASE ONE FINDINGS

AVAILABILITY OF UNIVERSITY COURSES CONCERNED WITH THE MANAGEMENT OR ROLE OF SCIENCE AND TECHNOLOGY

Table One: Courses Reported By Respondents

University	TI	TE	NPM	COM	T&S	E. EC.
Alberta	2	2	1		*	*
U.B.C.					*	*
Calgary	1	4		*	*	*
Carleton	6				*	*
Concordia				*	*	
Dalhousie	1			*		
Ecole Poly.	5	1	1		*	*
Guelph			1	*	*	*
Lakehead	1					*
Laurentian				*	*	*
Laval	1					
Lethbridge	1					
McGill		1			*	
McMaster	1		2	*		
Manitoba	1	1		*		
Memorial	1				*	

Table One: Courses Reported By Respondents (cont'd)

University	TI	TE	NPM	COM	T&S	E. EC.
Moncton				*		*
New Brunsw.				*	*	
Ottawa	3		3	*	*	*
Québec - Ab	1					
Québec - Mon	5	1				
Québec - TR	1	1				
Queens	1	1				
RMC				*	*	*
Ryerson			1		*	
St. Fran. X.	1					
St. Mary's				*		
Saskatchewan	2			*	*	
Sherbrooke		1				
TUNS	1					
Toronto	3	2		*	*	
Trent				*	*	
Victoria				*	*	
Waterloo	1	1				
Western	1	1	1		*	
Wilfred L.	3		1			
York	2					

TI - Technological Innovation
TE - Technical Entrepreneurship
NPM - New Product Marketing
COM - Communications course for engineers/science students
T&S - Technology and Society
E.EC. - Engineering Economics
* - Reported one or more course available

Table One provides a list of universities offering courses of interest to this study. Only courses reported by the respondents are indicated. It can be safely assumed, however, that most, if not all, engineering faculties in Canada offer courses in either technology and society or engineering economics to their students as part of their complementary studies program.

Engineering Perspective

All 27 respondents to our initial questionnaire or follow up phone call to the engineering deans indicated that their engineering students have access to business courses provided by the university's business faculty. Several indicated specific courses that provided students with communication skills.

The access of university engineering students to non-technical courses is facilitated by the fact that the Canadian Engineering Accreditation Board (CEAB) requires that all engineering students take approximately one-half year of Complementary Studies courses (i.e., non-technical courses) in their four year program. Compulsory courses dealing with the impact of technology on society fall into this category. The complementary studies requirement provides a window for engineering students to take courses on the commercialization of technology, in particular, and business courses, in general. It also provides an incentive for the engineering faculties to develop their own courses on the role of technology in society and on the management of technological innovation/entrepreneurship, rather than relying solely on the business faculties for required courses. Courses on the management of technological innovation or entrepreneurship provided by or in the engineering faculty are listed in Table Two.

A representative of the CEAB, stated that the CEAB does not have any explicit policy on the teaching of courses on technological innovation or technical entrepreneurship to engineering undergraduates. This lack of policy appears to cause some confusion among engineering faculties about the acceptability of such courses. One engineering instructor who teaches a course dealing with technological innovation and entrepreneurship felt that, "The CEAB does not consider these courses acceptable for certification of 'least resistance' lines of study. It is very difficult to make these courses 'core' rather than electives".

Table Two: Reported Courses Offered In Engineering Faculties

University	Course Title	Year Est.	Instructor/ Contact
Alberta	Managing in a Technical Environment	1986	J. Spraque
Alberta	Engineering, Business and Society#	1987	J. Whiting
Alberta	Project Management and Entrepreneurship#	1983	J. Whiting
Ecole Poly.	Innovation and Technical Entrepreneurship	1980	R.A. Blais
Ecole Poly.	Technology Transfer	1982	J. Bonhomme
Ecole Poly.	Management of R&D and Technological Innovation	1990	P. Guite
Ecole Poly.	Marketing of New Industrial Products	1980	C. Zuccaro/ M. Langlois[d]
Ecole Poly.	Technology and International Competition	1990	R.A. Blais
Ecole Poly.	Technical Entrepreneurship	1990	J.C. Martin
Ecole Poly.	Graduating Essay on an Innovation or Entrepreneurship Project	1980	R. A. Blais
Lakehead	New Venture Feasibility#	1990	M. Oosterveld/ Brad Rush
Laval	Introduction to the Management[b] of Technology	1982	P.-H. Roy
McGill	Entrepreneurship for Engineers	1989	W.H. Ellis[d]
Queen's	Market Oriented Design	1969	R. de Pencier
Saskatchewan	Managing Technology for Competitive# Advantage	1988	Larry Ayres
TUNS	Managing Technological Innovation	1986	M.J.C. Martin[c,d]
Toronto	Innovation and Entrepreneurship for Engineers	1977	J. C. Paradi
Toronto	Management of Technology, Entrepreneurship and Small Business	1990	J.C. Paradi
Waterloo	Patenting for Engineers	1986	A.M. Hale
Waterloo	Technical Entrepreneurship	1984	R.H. Grasley

Open to both business and engineering students
b Graduate and undergraduate version
c On sabbatical, course not offered this year
d Instructor is from a business faculty

In addition to the courses listed above, Ecole Polytechnique offers a course entitled "History of Science and Modern Techniques" to its engineering students, the University of Toronto has a course entitled "History of Technology and Engineering", and the University of Calgary offers a course entitled "Introduction to Engineering and Construction Management". These courses do not, however, appear to deal with commercialization of science and technology.

Engineering Management Programs

Only three engineering management programs were identified at Canadian universities.

The University of Ottawa has had a diploma program in engineering management for many years, but in 1988, the university upgraded the program in engineering management to a Masters degree program.

In 1990, the University of Alberta's one year Masters of Engineering Management Program was modified to allow easier access to engineering students in disciplines other than mechanical engineering, where it had its beginnings. Business oriented courses in this program are given by engineering faculty.

Memorial University has a diploma program in engineering management for post graduate students and working engineers.

Joint Engineering-Business Programs

While all engineering respondents reported that their students have access to undergraduate courses in the business faculty, a few engineering faculties have developed formal joint programs with the faculty of business.

Alberta

The Faculty of Engineering has entered into an agreement with the Faculty of Business to permit some business students to take some engineering courses, and for engineering students to have guaranteed access (10-15 seats) to first year M.B.A. courses offered in the business faculty. A series of "stand-alone" engineering courses that require no prerequisites are open to business students.

The University of Alberta is also presently developing a combined, two year, masters of engineering and M.B.A. program.

U.B.C.

The University of British Columbia is presently developing a two year Masters of Engineering in Advanced Technology Management. The first term of the course consists of selected business courses drawn from the first year of the M.B.A. program plus specialized graduate level courses in engineering. The final term includes graduate level business courses. During the 15-18 months of the program, participants attend workshops on technological innovation. A comparable masters degree in science is described in more detail in the next section.

McMaster

One of the longest running engineering and business programs available is McMaster University's five year undergraduate Engineering and Management Program. The graduates of this program receive a fully accredited Engineering degree plus commerce courses equivalent to the first year of an M.B.A. program.

The program's first students graduated in 1975 and enrolments are presently restricted to 75 per year.

Ottawa

Several of the courses listed in the Engineering Management Program calendar are, in fact, M.B.A. level courses provided by the University of Ottawa's business faculty.

In-house Engineering Faculty Initiatives

Carleton

In 1988, Carleton University, developed a "Concentration in Management" for the engineering students. In addition to some general undergraduate business courses offered by the business faculty, the engineering faculty offers, or will be offering, the following courses:

- Industrial Engineering (ENG 94.320)
- Engineering Applications of OR (ENG 90.460)
- Principles of Finance (ENG 90.461)
- Organizational Behaviour II (ENG 90.462)

Successful completion of the management concentration allows direct entry into Carleton's Masters of Management Studies Program.

Ecole Polytechnique de Montréal

Ecole Polytechnique de Montréal is the only university with a fully integrated program of engineering courses and courses dealing with technological innovation/entrepreneurship that can be taken as a "minor" in the engineering faculty. Instructors for their courses are drawn from faculty at the Ecole, the University of Québec at Montréal, and from private sector firms. This "minor" is under the direction of Roger Blais.

University of New Brunswick

At the time of writing this report, the engineering faculty of the University of New Brunswick is the only university in Canada with a chair in technological innovation and entrepreneurship. Called the ACOA Chair in Technology Management and Entrepreneurship, the chairholder will be expected to develop a post-degree diploma program in technology management and entrepreneurship. The diploma program will consist of three core courses (technology management, technical entrepreneurship, technology management seminar of guest speakers) plus two technical electives. U.N.B. has recently appointed Dr. Alan McLean as holder of the Chair.

Toronto

The engineering faculty of the University of Toronto is planning to develop a series of courses for undergraduate students dealing with business/innovation topics. This effort is under the direction of Dr. J.C. Paradi.

Victoria

The engineering faculty of the University of Victoria presents a non-credit seminar series on technical entrepreneurship. They make extensive use of guest speakers. This series resulted from requests from their students. The engineering respondent hopes that this series will eventually evolve into a course. Dr. Don Scott, on sabbatical from the University of Waterloo where he pioneered the development of a technical entrepreneurship course for engineers, will be giving a technical entrepreneurship course at the university in the Winter of 1991.

Science Perspective

The following information is based on the 31 replies received from science deans or their designates.

Almost all of the science respondents reported that their honours science students have access to general business courses or courses to improve their communication/presentation skills that are offered by faculties other than engineering.

In some cases these courses are the same as those open to undergraduate engineering students.

Table Three provides a list of technology-oriented courses that are offered within science or other faculties. Students from science, business or engineering can take these courses as electives.

Only one of the science respondents (Carleton University) reported that their science faculty has developed and/or offers courses on technological innovation/entrepreneurship to the honours science students.

Table Three: Courses Offered Within Science Faculties for Science/Business/Engineering Students

University	Course Title	Year Est.	Faculty	Instructor/ Contact
Calgary	Product and Technology Design	1989	Env. Des.	D. Thompson*
Carleton	Interactions in Industrial Society	1972	Science	P. Kruus
Carleton	Technology and Society: Assessment	1981	Science	P. Kruus
Carleton	Technology and Society: Forecasting	1981	Science	P. Kruus
Carleton	Technology and Society: Innovation	1984	Science	W. Sheridan

* Faculty of Environmental Design

Joint Science-Business Programs

Some science faculties have developed or are developing joint programs with their business faculties. These joint programs involve the business faculty offering general business courses in some format to the science students. In only one case, does the joint program involve the development and presen-

tation of courses specific to technological innovation or technical entrepreneurship to science students. The general business courses being offered to the science students will not necessarily provide them with any substantive information about the commercialization of science and technology.

U.B.C.

The University of British Columbia is developing a two year M.Sc. in Advanced Technology Management. This course is the science faculty version of the engineering faculty M.Eng. in Advanced Technology Management. Where engineering students would take graduate level engineering courses, science students would take graduate courses in their scientific discipline.

This program, which was prompted by the recommendations contained in a Science Council of Canada Background Study entitled, "Educating Technological Innovation and Technical Entrepreneurs in Canadian Universities" (Clarke and Reavley, 1987) has the following objectives:

- Impart graduate-level engineering or scientific expertise to individuals with baccalaureate degrees in Science or Engineering;
- Provide management skills which are particularly well suited for high technology companies; and
- Provide experience in the utilization of advanced engineering, scientific and management skills.

Entrants to the M.Sc. program will, in the first year, take 9 units (6 courses) drawn from the first year of the business faculty's M.B.A. program in addition to graduate level courses in science or engineering, as appropriate. During the following summer, the participants are expected to serve an internship with an organization, working on the commercial and managerial aspects of an industrial project. In the following Winter session, the participants will take graduate level business courses. Throughout the 15-18 months of the program, the students will attend weekly workshops to discuss issues in technological innovation. Only one new course is envisaged to be developed for this program. It will be in the area of Technological Innovation and Entrepreneurship.

McGill

McGill University has developed a program called "Minor in Management for Science Students" that will, if approved, be offered for the first time in September of 1990. This program will allow science students to take selected general management courses from the business faculty. Students who take a major in

a particular scientific discipline will be able to continue in that field in graduate school.

Waterloo

The University of Waterloo, has developed a four year Honours Science and Business Program in cooperation with the business faculty at Wilfrid Laurier University. The business courses constitute some of the core courses for the first year of WLU's M.B.A. program. Graduates of the science and business program can enter WLU's M.B.A. program after obtaining some business experience. One of the objectives of this program is to produce M.B.A. students with strong science backgrounds.

Wilfrid Laurier

Wilfrid Laurier University has a package of business courses, known as the Administrative Option, for honours science students. This program attempts to provide students with an overview of the various functional areas of business organizations. Courses are taught by instructors in WLU's School of Business and Economics. Honours science students wishing to take the option may require a 5th year to complete all program requirements.

Windsor

The University of Windsor has a new B.Sc. program, entitled Science, Technology and Society, that allows students to take a mix of courses from the science, arts and business faculties.

With the exception of the U.B.C., McGill and Wilfred Laurier initiatives, students graduating from the combined science/business programs are not generally expected to go on to graduate school in science and eventually conduct scientific research.

Business Perspective

Most of the 18 respondents to our survey of business faculty deans reported that their students had access to courses dealing in some manner with the commercialization or strategic adoption of technology. It may be assumed that the other 16 business faculties that did not reply do not have such courses available to their business students.

Table Four provides a list of courses offered by the business faculties in the areas of management of technological innovation/entrepreneurship, new product development or application of technology to business.

Table Four: Reported Courses Dealing With Technological Innovation or Entrepreneurship or New Product Marketing

University	Course Title	Year Est.	Instructor/ Contact
Alberta	Product Management & Product Development	1986	H.C. Young
Alberta	Internal Corporate Venturing[a]	1989	Charles Lee
Alberta	New Ventures Management	1982	Charles Lee
Calgary	New Venture Entrepreneurship[b]	1976	Ed McMullan
Calgary	Understudying Entrepreneurial Success	1989	Ed McMullan
Calgary	New Venture Marketing	1984	W.A. Long/J. O'Grady
Calgary	New Venture Planning	1984	W.A. Long
Carleton	Technology and Business Strategy	1986	A.J. Bailetti/J.R. Callahan
Carleton	Management of Technology & Innovation	1987	A.J. Bailetti
Carleton	Management of Technological Innovation	1990	A.J. Bailetti
Dalhousie	Managing Technological Innovation and Entrepreneurship	1975	M.J.C. Martin[c]
Guelph	Management in Product Development	1988	V.J. Roth
Lakehead	New Venture Feasibility#	1990	M. Oosterveld/ Brad Rush
Lethbridge	Managing Technology and Organizational Change	1989	U.E. Gattiker
McMaster	Innovation	1977	P.M. Banting
McMaster	Product Marketing[b]	1985	R.G. Cooper/ E. Kleinschmidt
Manitoba	Process of Technological Innovation	1987	M. Bartell
Manitoba	Technological Entrepreneurship	1984	Brian Owens
Memorial	Management of Technological Innovation	1985	M. Skipton
Ottawa	Industrial and Technology Marketing[b]# (3 courses: one in French)	1986	P. Laurent/ A. Samson/ M. Arrufat
Ottawa	Technology Policy and R&D Management#	1986	J. de la Mothe

Ottawa	Innovation, Technology and Finance	1989	J. de la Mothe
Ottawa	Managing Technological Risk#	1984	J.C. Nash
Quebec (Abitibi)	Management of Technology in an Organization	1989	Pierre Sauve
Quebec (Montreal)	Technology and Innovation	1980	R.E. Miller
Quebec (Montreal)	Technical Entrepreneurship	1990	R.E. Miller
Quebec (Montreal)	Economics of Technological Change	1990	Chris DeBresson
Quebec (Montreal)	Public Policy and Innovation	1991	Chris DeBresson
Quebec (Montreal)	Management of Technology	1990	Jorge Niosi
Quebec (Montreal)	Innovation and Organization	1989	Jorge Niosi
Quebec (Montreal)	Management of Technological Development	1991	Jorge Niosi
Quebec (Trois-Rivieres)	Creativity, Innovation, and Entrepreneurship	1987	J.-B. Carriere
Quebec (Trois-Rivieres)	Entrepreneurship and Innovation in Small-Medium Sized Enterprises	1989	J.-B. Carriere
Queen's	Management and Technology	1976	P. Richardson
Ryerson	Management of New Products	1986	Peter Wilson
St. Francis X.	Technology and Change	1986	R. Kent Young
Saskatchewan	Technology Policy and the Management of Entrepreneurial Technology Companies	1990	David Boag
Sherbrooke	The Entrepreneur and the Creation of an Enterprise	1971	J. Robidoux
Toronto	Automated Manufacturing Systems	198?	Saresh Sethi
Toronto	The Business of Software	1986	Ron Baecker[e]
Western	Management of Technology[b]	1970	A.R. Wood
Western	New Enterprise Management[c]	1972	R. Knight

Western	Industrial Marketing[b]	1978	Terry Deutscher
Wilfrid Laurier	Management of New Technology[b]	1984	Hamid Noori
Wilfrid Laurier	Human Resources Management for Technological Innovation	1986	Bruce Fournier
Wilfrid Laurier	Marketing High Technology	198?	D.L. Blenkhorn
Wilfrid Laurier	Innovation	1988	P. Banting**
York	Strategic Management of Technology Based Firms	1984	J. Dermer
York	International Technology Transfer	1989	A. Supapol

a Summer seminar/coop course open to graduate engineering students and 1st year M.B.A.'s
b Graduate and undergraduate version
c On sabbatical, course was not offered this year
e Instructor is in the engineering faculty

* Has not been offered in three years.
** On faculty at McMaster University
\# Open to both business and engineering students

In addition to the courses listed above the calendar of the University of Manitoba lists a course entitled Management of R&D but it has not been given in four to five years.

The only university business faculties with major concentrations in either technical entrepreneurship or technological innovation are at the University of Calgary and the University of Québec at Montréal (UQUAM). The UQUAM is developing a concentration in the management of technological innovation at both the undergraduate and graduate level in the business faculty.

Carleton University's School of Business offers a Master of Management Studies that emphasizes productivity innovation and management of technology. However, the program relies heavily on general business courses. In addition, Carleton is in the final stages of obtaining the Ontario government's approval to offer a Ph.D. program in Management of Technology. They hope to have this program in operation by September, 1991.

Extension University Courses

Many of the courses described above are open to outside participants who just wish to take selective courses.

Several universities reported that they have developed special programs dealing with the management of technological innovation that are offered on an extension or continuing education basis. The University of Western Ontario has offered a two week "Executive Marketing Program for Technology Based Businesses" every Spring since 1988. This program is designed for experienced executives who are involved in marketing of technology-based products or services.

Simon Fraser University through its Continuing Studies Applied Science Program offers a study program for managers in high-technology industries entitled, "Management Skills in Advanced Technology". This program consists of six 3-4 day sessions spread over eight months dealing with such topics as economic and financial analysis, managing technology, project management, communications skills marketing, raising capital, and innovation and entrepreneurship. Most of the lecturers are drawn from the business community.

Associated with McMaster University is the Management of Technology and Innovation Institute which offers a series of seminars/courses designed to increase the productivity and effectiveness of technology-based companies. Among the seminars offered by MTI are:

- Winning at New Products
- Effective Technology Transfer
- The Management of Technology
- Profit from Information Technology
- Managing Development Projects
- Meeting the Technology Challenge

Instructors for these seminars are drawn from several universities and from the private sector.

It should be noted that in addition to university based or associated courses, there are a limited number of courses concerned with the management of technological innovation or scientists and engineers that are offered by either private companies or government agencies. For example, Stargate Consultants Limited for the past 17 years has offered courses dealing with the management of research and development personnel. This year the Canadian Centre for Management Development (CCMD), located in Ottawa, has started offering two courses for government scientists and engineers on leadership, and management of government research and development. Instructors on the CCMD courses are drawn from CCMD staff, government departments/agencies and Stargate Consultants Limited.

Plans to Develop New Courses

As noted previously, the engineering faculties at Carleton, U.B.C., U.N.B., and Toronto are actively developing new courses concerned with either technological innovation or technical entrepreneurship.

Eight science faculty respondents mentioned that they had at least thought about the development of such courses. One respondent stated, "There has occasionally been talk of a management of technology course but we lack the expertise and the idea is still too fuzzy". Another respondent questioned the need for the development of such courses for science students when he said, "No - we are scientists, not businessmen". Only U.B.C. mentioned that one new course concerned with technological innovation and entrepreneurship will be developed as part of their masters program in advanced technology management.

Only five business faculty respondents reported that they were considering the development of these specialized courses.

Feedback from Employers

Eleven of the engineering respondents reported that they had received feedback from employers who wanted engineering students to have exposure to business/communication or technological innovation courses. A U.B.C. respondent commented, "Yes, we carried out a survey (of employers) and obtained a very positive reaction to our proposed M. Eng. in Advanced Technology Management. A University of Saskatchewan respondent said, "Employers have noted the need for more management courses. The University has had a strong program in oral and written communications for many years - employers agree with the need for this type of program". McMaster University is under pressure from employers to expand its engineering/business program from 75 seats to 100.

Most of the science respondents, however, reported no feedback from employers about the need for business/innovation courses for their honours science students. This is not surprising because at most universities, there is no effective mechanism for science faculty to learn about the views of employers. As one respondent stated when asked about feedback from employers, "Very little, probably because there are few ways in which employers can make this sort of input". The University of Manitoba does seek employer input, and in the case of computer science students employers have said, "our students need more real world experience".

Only a few business respondents mentioned receiving positive feedback in favour of science/technology oriented courses for the business students.

Barriers to Offering Business or Technological Innovation Courses

There are no major barriers to offering or allowing engineering students to take existing business courses in the business faculty. The only difficulties occur if there are timetable scheduling problems or the courses have prerequisites. This latter problem can occur where courses are offered at the graduate (M.B.A.) level. Lack of space in the business classes can also be a problem.

While one-half of the respondents considered that there were no barriers or impediments to the development and presentation of technological innovation/entrepreneurship, or communications or management courses to science or engineering students, the others felt that, in the case of courses more specific to either technological innovation or entrepreneurship, considerable barriers did exist in the form of lack of both human and financial resources. The lack of resources to develop courses and hire appropriate faculty to teach them were mentioned most often by science respondents. One science dean stated that, "Current university funding makes it very difficult to introduce any new initiatives. With our 1½ % budget cut this year, we are trying to identify anything that can be discontinued". Another dean pointed out that, "We simply do not have the faculty to teach such courses. Our faculty must concentrate on giving courses within their discipline. We all see the need for more programs in the way you describe, but there is no money in the system to allow it".

The major barrier to honours science students taking non-science courses is the lack of time in their heavy program schedules. One science dean stated the problem this way, "Although these courses are available to all science students, very few actually take them. Honours programmes are usually highly structured and concentrated in the discipline, leaving little room for non-science electives. Departments are usually not willing to allow too many courses outside the narrow honours area". Another dean said, "Unfortunately, few of our honours science students enrol in the (administration) option, mostly because there are so many required courses in our science programs already ...".

Business students face no real barriers, except for timetable clashes, to take innovation type courses, if they are offered in the business faculty. Several course instructors contacted during the second phase of this study mentioned, however, that the word "technological" in the title of their courses appeared to scare off many business students, especially those that did not have any background in science or engineering. There appears to be a technology phobia among many business students. There also appeared to be some difficulty with business students receiving credit for "business" courses taught outside the business faculty.

A majority of business faculty respondents considered that lack of both human and financial resources were a major impedi-

ment to the development of technological innovation or technical entrepreneurship courses. One dean, when asked about the existence of barriers to the development and presentation of technological innovation or entrepreneurship courses for business students, stated the problem as follows "Money, Tom, money -- we would like to hire someone just like you with expertise in this area. However, we are reluctant to invest in this area when we can't meet all our current needs. A meaningful commitment requires a full-time appointment at $60,000. plus benefits. We don't have it and no one is giving us a million dollar endowment for that purpose".

RESULTS FROM COLLEGES

Replies to the initial questionnaire to college deans of business, and technology were received from 58 colleges from B.C. to Newfoundland.

AVAILABILITY OF COLLEGE COURSES CONCERNED WITH THE MANAGEMENT OR ROLE OF SCIENCE AND TECHNOLOGY OR GENERAL MANAGEMENT OR COMMUNICATION

Technology Perspective

None of the 33 technology faculty respondents reported that they presently have any courses dealing with the management of technological innovation or technical entrepreneurship for technology students. Centennial College in Ontario reported having a course entitled "Science, Technology and Society" which appears to be the equivalent of the technology and society courses available to most university engineering students.

The Marine Institute in Newfoundland and the community college in Saint John, New Brunswick reported that they were developing courses on entrepreneurship and innovation for inclusion in their technology programs.

Only one college, the British Columbia Institute of Technology, reported it was developing, in cooperation with the business faculty, a post-diploma program in the area of Management of Advanced Technology. A short description of this program is contained in the business section.

In the area of general business courses, and in particular, courses designed to improve the communications skills of the technology program graduates, the situation is quite different. Twenty-four of the technology respondents reported that courses concerned with either general or technical communications were available to students, and in many cases, were compulsory. Seventeen of the engineering respondents stated that general business management courses were available to their students.

In some of the technology programs in the community colleges in Québec, students may take elective courses offered through the business faculties. These tend to be mainly in the areas of human resources management or general management.

Business Perspective

As noted earlier, only B.C.I.T. has a joint faculty venture to develop a post-diploma Management of Advanced Technology Program. It is hoped that this program will be offered in January, 1991. It will include the following courses:

- Total Quality (OPMT 710)
- High-Technology Processes (OPMT 750)
- Evaluating Technology (OPMT 761)
- Implementing Technology (OPMT 762)
- Marketing Technological Products/Services (MKTG 720)
- Financial Planning for Technology (FMGT 731)
- Strategic Manufacturing (OPMT 730)

Some colleges such as B.C.I.T., George Brown (Ontario) and NBCC - Moncton reported having courses in product development or product planning. The Moncton respondent said that students registered in their marketing option are involved in a marketing project that deals with a "new invention".

The respondent from Fanshawe College in Ontario stated that within the computer science and information/data processing program was a course entitled Emerging Technology [CPTR - 403].

In general, the business faculties of the community colleges do not offer courses specific to commercialization of science and technology. While many have entrepreneurship or small business courses they do not appear to have a technology element.

Feedback from Employers

Unlike the universities, colleges have an extensive network of industrial advisory committees to provide them with input from employers and industry associations. In general, each technology or business program in a college has its own industrial advisory committee.

While few of the business respondents reported that their advisory committees had requested course content dealing with science and technology, the majority of the technology respond-

ents did report that their committees had requested business courses be part of the technology program, especially courses dealing with communications and interpersonal relations.

Barriers to Offering Business or Technological Innovation Courses

A majority of both business and technology respondents mentioned that the two major barriers to the development and presentation of business-type courses for technology students and innovation-type courses to business students were lack of money to develop courses and hire people to teach them, and lack of time in the students' curricula to place courses. There was concern that if these courses were included, some main line discipline courses might have to be dropped. As one technology respondent commented, "A major ongoing issue is one of providing time in the program for learning activities of this (non-technical) type. Program staff generally tend to see course content of this nature as 'nice to have' as compared to technical information which is viewed as required".

PHASE TWO FINDINGS

Phase Two of this study consisted of telephone interviews with university instructors who teach courses in the following areas: management of technological innovation (TI), technical entrepreneurship (TE), or new product marketing/industrial marketing (NPM). No college instructors who taught courses in these areas were identified.

Information was obtained from twenty university instructors who teach courses in business faculties and thirteen instructors who teach these courses in engineering or science faculties.

These instructors taught a total of 35 courses of interest to this study.

Level	TI	TE	NPM
Graduate	9	1	4
Undergraduate	15	4	2

Of these 35 courses, 14 were taught in engineering or science faculties. [i.e., 11 TI, 2 TE, 1 NPM]

University

Number of Students Taking Courses

The availability of courses dealing with the commercialization or strategic adoption of science and technology does not imply that large number of students are graduating from universities with the knowledge of how science and technology, and business are integrated. One of the reasons for this is that, in most cases, the courses are elective rather than compulsory.

The instructors were asked how many people, on average, take their courses. The results are shown in Table Five.

Table Five: Course Enrolment Levels

		TI		TE		NPM	
		Range	Av.	Range	Av.	Range	Av.
Bus:	Grad.	9-65	25	--	25	14-60	38
	Und.	9-40	21	25-35	30	**	35
Eng/ Sci.	Grad.	10-11	11	--	--	--	--
	Und.	15-105	43	14-132	*	--	15

* Average is meaningless - only two courses
** One course taught in eight sections (8 x 35)

The enrolment levels of women in these courses appears to be faculty dependent which most likely reflects the larger number of women enroled in business programs rather than engineering or science programs. In the business faculties, on average, women comprise 30 - 40% of the technological innovation classes, 20 - 25% of the entrepreneurship classes, and 24 - 50% of the marketing classes. In the engineering and science faculties the comparable numbers are: 14 - 20% in the technological innovation classes, less than 10% in the entrepreneurship classes, and approximately 25% in the new product marketing classes.

Less than 15% of the students take the elective courses in the management of technological innovation/entrepreneurship. Two major exceptions to this are the course on technical entrepreneurship offered to engineers at the University of Waterloo that attracts approximately 130 students per year, and is taught in two sections, and the new product marketing course taught in the business faculty at Ryerson that attracts in excess of 200 students.

It should be remembered, however, that almost all engineering students must take at least one course on the impact of engineering on society. Some science faculty respondents also mentioned that their students must take at least one course dealing with science and society. These courses are not, however, a substitute for courses on the commercialization or adoption of new technologies.

Marketing of the Courses

In general, the course instructors did not make any great efforts to market their courses to students in other faculties. The major reasons for this lack of marketing effort were that they already had enough students from their own faculty in their classes, or that the course would not be considered by the other faculty as a credit course and hence those students would not be interested in spending time in a non-credit course.

Course Survivability

One concern this study addressed was whether the courses on technological innovation or entrepreneurship or new product marketing would continue if the present instructor was to cease teaching the course. In some sense this is a measure of whether the institution considers the course to be an integral part of the training of their students, or a side course, "Nice to have" but not essential.

In an earlier study conducted in 1987, it was found that most of these courses did not receive strong institutional support and that they were taught by dedicated "mavericks" who, despite lack of encouragement by colleagues, felt strongly enough about the need for such courses that they taught them, sometimes as an overload course (Clarke and Reavley, 1987).

It was noted that four courses identified in the 1987 study were not being taught this year; three, because the instructors were on sabbatical, and one because the instructor had left academia. Table Six reports the results of asking the instructors whether their courses would cease, or would be taught by others, if they were to leave.

Many of the instructors stated that if they were to leave their universities, their courses would not be taught by anyone else. There was simply no one else who had either the expertise or interest in teaching them. Only at Ecole Polytechnique, the University of Québec at Montréal, the University of Alberta, and Wilfred Laurier did instructors believe that they would be replaced as their courses had become an integral part of the programs. Since the new product marketing courses are very similar to industrial marketing courses that have been around for a long time, it is not surprising that these course instructors can, and would be more easily replaced.

Table Six: Reported Viability of Courses

Viability		TI	TE	NPM	Total
Cease	Bus.	8	3	0	
	Eng.	8	3	0	22
Cont.	Bus.	4	0	5	
	Eng.	2	0	0	11

Several engineering instructors commented that, regardless of student demand, with the tightening pressures on university budgets, courses outside the mainline offerings in engineering would be under threat of cancellation if budgets became tighter.

Engineering instructors also commented that they did not feel that they were adequately rewarded for developing and teaching these courses to engineering students. They also felt that even if they had the funds to conduct research on the management of technological innovation or entrepreneurship, they would get little credit from colleagues or from the university promotion system. The following are illustrative comments from the engineering instructors:

> "No appreciation or recognition, there is no support for research; it would not be considered legitimate"
>
> "No brownie points for teaching this (entrepreneurship area"
>
> Faculty would not consider research (in innovation) as legitimate, at promotion time. I consider this an extra-curricula type course. Don't get much official recognition of the value of the course at promotion time.
>
> "Good support at dean and upper levels but resistance from conservative faculty members in business and engineering faculty"

Similar views were noted in the 1987 study. Engineering instructors felt little support from colleagues and some felt that teaching these courses had seriously affected their academic careers.

Is There a Role for Federal Support?

Course instructors were asked if there was a role for the Federal Government to assist in developing and presenting these courses, or in helping to encourage their adoption at other universities.

The overwhelming answer to this question was to provide money. There is a desperate need for financial support for:

- development of Canadian course material, including cases
- for travel, especially international, so that instructors can meet their counterparts in other countries
- for the training of new instructors

Several respondents mentioned that they hoped that the Technological Innovation Studies Program that they had used in the past, could be re-instated. This Program, administered by the Department of Industry, Trade and Commerce, provided funds for research in the areas of management of technological innovation, and technical entrepreneurship. It also provided funds for Ph.D. and masters degree scholarships in these areas. It was cancelled in 1985 as part of the department's general budget cuts.

During this phase of the study, it was clear that many of the instructors had not met, and in some cases, were not even aware of, their counterparts in other areas of Canada. As a result, instructors were asked their opinion on the value of the Federal Government supporting a 1½ day workshop so that they could get together and exchange information. Ninety percent of the respondents believed that such a workshop would be of value. A business faculty instructor remarked, "A conference would be of enormous value. It would get people together and give visibility to the field".

SUMMARY

This survey has identified 74 regular university and approximately 12 private or continuing education courses concerned with the management of technological innovation, new product development and technical entrepreneurship. Twenty of these courses are taught in engineering faculties, an increase of seven from 1988. Since 1988, there has been an increase of 19 courses in business faculties, but only one new course in science faculties. A major growth in courses is occurring at the University of Québec at Montréal as part of their effort to development a concentration in technological innovation.

In 1987 only eight engineering faculties offered such courses; in 1990 ten faculties will offer courses and by 1991 several more will offer them.

Although the number of courses available to university students is significant, the number of students who take these courses is relatively small (less than 15%) because these courses tend to be elective rather than compulsory. Science students are the least likely to take these courses.

While there appears to be a growing awareness of the need to provide science students with an understanding of the world of business, it does not appear that this awareness has reached a point where the science faculties are making a distinction between general management training, and training in the area of management of technological innovation. (i.e. to provide their students with management skills and knowledge more appropriate to the effective commercialization of science and technology).

The provision of business courses or combined science/business programs for science students appears, with some exceptions, to be aimed at general science students and not at honours science students who can be expected to go on to graduate school in science, and eventually manage R&D laboratories. Science faculties, such as at U.B.C. and McGill, seem to be content to rely on the business faculties to provide general business courses.

Ten engineering faculties, however, have recognized the distinction between general business courses and courses that deal with the special problems of managing technological innovation or technical entrepreneurship. In addition to general management courses offered by the business faculties, these engineering faculties offer their own courses on technological innovation or technical entrepreneurship.

At the moment, it does not appear that community colleges in Canada have courses concerned with the management of technological innovation or technical entrepreneurship. College business faculties do not appear to have developed such courses either for

their own students or for those in the technology faculties. B.C.I.T., however, is presently developing a program that will provide courses on technological innovation and several other colleges are planning on including entrepreneurship courses in their technology programs.

One disturbing factor is that where a professor leaves or is on sabbatical, their specialized courses, with a few exceptions, are not picked up and taught by others. These courses on the management of technological innovation/entrepreneurship are usually taught by very dedicated professors who are mavericks in the academic system. They teach these courses because they have strong beliefs that they are important to the careers of the students, rather than because the academic institution or their colleagues see the value of the courses. The major exceptions are at the University of Québec at Montréal, Ecole Polytechnique de Montréal, University of Alberta and at Wilfrid Laurier University where the courses have been accepted as part of the institutions' offerings and the instructors believe that if they left, their courses would be taught by others.

The main barriers mentioned by both college and university respondents to offering courses concerned with the management or role of science and technology are the lack of resources to develop courses and to hire appropriate instructors, and the tight schedules that honours science students face at many universities, and technology students face in the colleges. The ever tightening budgets are making it very difficult to establish new, non-technical courses. There is great reluctance in both universities and colleges to drop science/technical courses in favour of business/innovation courses.

Another barrier to the adoption and spread of these courses is the reluctance of many engineering, business and science professors to accept the courses as valid and important to the development of successful engineers, scientists and business personnel. The interdisciplinary nature of many of the courses does not fit into the functional slots that academics are accustomed to using when approving courses. One business instructor who teaches a technological innovation course had to fight his faculty's administration in order to be allowed to teach it. The practical and real-world nature of these courses also scares traditional academics. Many of the instructors make extensive use of guest lecturers to illustrate the literature, and in fact, many of the instructors are themselves outside lecturers, with outside employment. An engineering instructor who teaches an entrepreneurship course noted that there was a high demand for such courses but a hindering factor is resistance from other faculty.

Many of the instructors interviewed during this study stated that money was in very short supply for the development of course material, for research, and for the development of Canadian cases. Several instructors, especially in engineering faculties, noted the lack of funds to travel to conferences concerned with

technological innovation. Many of the instructors felt that the Federal Government could assist them by providing financial resources. As one instructor stated, "The Federal Government needs to recognize that these courses tend to be orphans and need special nurturing".

It is evident from this survey that there is a lack of networking or contact among the course instructors across the country. Many had not even heard about people teaching or conducting research in the same areas.

As noted earlier, there is a general lack of knowledge about the vast pool of literature on the management of technological innovation, new product marketing, and technical entrepreneurship. This lack of knowledge is especially prevalent in science faculties and universities or colleges that do not currently offer technological innovation or entrepreneurship courses. Without knowledge about the pertinent literature, colleges and universities will fall back on general management literature which is not totally appropriate for educating scientists, engineers and technologists in the commercialization or strategic adoption of science and technology.

Science and technology is the engine of a modern economy and Canada's economic future will depend on our post-secondary educational institutions graduating students who are comfortable in the combined world of science and technology, and business.

We cannot any longer afford the luxury of graduating students in business who believe that science and technology is something to be left to scientists and engineers, and scientists and engineers who believe that management is just applied common sense and requires little or no study. Successful technological innovation or technical entrepreneurship requires knowledgeable people who understand both the scientific/technical and business contribution.

UNIVERSITY
COURSE DIRECTORY

TECHNOLOGICAL INNOVATION,
NEW PRODUCT MARKETING,
AND
TECHNICAL ENTREPRENEURSHIP
COURSE OUTLINES

University of Alberta

MANAGING IN A TECHNICAL ENVIRONMENT

Instructor/contact: Jim Spraque — Tel: (403) 492-4412

Faculty: Engineering — Course: MEC E 613

Level: Graduate — Established: 1986

Comment: This is a core course in their Masters degree program in Engineering Management.

Topics:

Systems design (design of fully integrated systems)

Forecasting

Project operations (organizing and managing engineering projects; comparison of matrix and traditional organizations)

Personnel management (motivation theories, management styles and theories)

Starting a new business

Major reasons for business failure

Management by objectives (implementation and problems)

Text: The Art of Managing Technical Projects
Melvin Silverman

University of Alberta

ENGINEERING, BUSINESS AND SOCIETY

Instructor/contact: Jerry M. Whiting — Tel: (403) 492-2867

Faculty: Engineering — Course: ENG G 505

Level: Undergraduate — Established: 1987

Comment: This elective course is open to both business and engineering students, as part of a joint agreement between the engineering and business faculties. Aproximately 10% of the class is made up of business students, with one or two students from the science faculty.

Topics:

The nature and scope of engineering

Technical feasibility and operating control

Economic feasibility and cost control

Safety engineering, management and loss control

Future energy needs - problems and opportunities

Population growth, malnutrition and the quality of life

The environment and the quality of life

Economic evolution - Survival of the fittest

University of Alberta

PROJECT MANAGEMENT AND ENTREPRENEURSHIP

Instructor/contact: Jerry M. Whiting (403) 492-2867

Faculty: Engineering Course: ENG G 502

Level: Undergraduate Established: 1983

Comment: This course is open to business students as part of the business-engineering faculty agreement.

Topics:

Business organizations

Opportunities, rewards and pitfalls for project managers and entrepreneurs

Project management

Report preparation and microcomputer aids to project management

Starting a small business

Dealing with project team employees

Safety and loss management

Financing small business

Operating a small service business

Text: No assigned text.

University of Alberta

PRODUCT MANAGEMENT AND PRODUCT DEVELOPMENT

Instructor/contact: H. Clifton Young Tel: (403) 492-5340

Faculty: Business Course: MARK 569

Level: Graduate (M.B.A.) Established: 1986

Comment: Earlier versions of this course were taught in 1974, 1975 and 1976.

Topics:

Environment of product management

Effects of change on people

Third wave: the changing society

What is product management

Tools for product/service management (product life cycle)

Product development process (concepts and generalizations)

Concept evaluation and pricing

Commercialization

Structure, public policy, the future and product and program evaluation

Product line management (product line maintenance and construction)

Text:

New Products Management
Merle Crawford
Irwin, 2nd edition, 1987

Product Policy: Cases and Concepts
Richard Cardozo
Addison Wesley, 1979

University of Alberta

NEW VENTURES MANAGEMENT

Instructor/contact: Charles Lee — Tel: (403) 492-2225

Faculty: Business — Course: OA 672

Level: Graduate (M.B.A.) — Established: 1982

Comment: This course is concerned with the type of experience that entrepreneurs encounter in conceiving and launching a business. It uses a combination of experiential exercises, interactions with members of the business community skilled in start-ups, and the development of a business plan for a specific new product as the teaching methodology.

Topics:

- Elements of a business plan
- Market research - primary and secondary
- Patents and intellectual property
- Financiers' criteria for business plan evaluation
- Venture team formation
- Technology transfer

Text: New Venture Creation
Timmons, Smollen, Dingee
2nd edition, Irwin, 1985

University of Alberta

INTERNAL CORPORATE VENTURING

Instructor/contact: Charles Lee — Tel: (403) 492-2225

Faculty: Business — Course: OA 686

Level: Graduate (M.B.A.) — Established: 1989

Comment: This summer coop-type course focuses on new product screening within major companies. Students spend the first week receiving an overview of the new ventures function, including a two-day seminar on new product management. The balance of the summer will be spent working in a company with periodic meetings with instructors.

Topics:

Market research - primary and secondary

Patents and intellectual property

New product development seminar (R.G. Cooper)

Texts:

New Venture Creation: Entrepreneurship in the 1990s
Jeffry Timmons
3rd edition, Irwin

Marketing High Technology: An Insider's View
William Davidow
Free Press

University of Calgary

The following courses are a sample of the 13 courses offered that deal with the area of entrepreneurship. All of these courses deal, in one way or another, with entrepreneurship topics as they apply to technology based enterprises. Information about the entrepreneurship courses under their New Venture Development program can be obtained by contacting either W. Ed McMullan or Wayne Long at (403) 220-6117.

NEW VENTURE ENTREPRENEURSHIP

Instructor/contact: W. Ed McMullan Tel: (403) 220-7143

Faculty: Management Courses: MOHR 481/781

Level: Undergraduate/M.B.A. Established: 1976

Comment: This course, offered at the undergraduate and graduate level aims to provide an overview of the process of initiating a new venture and developing it into an ongoing enterprise.

Topics:

Entrepreneurship and society

Entrepreneurial personality

People and team building

Opportunity identification and assessment

Correlates of success and failure

Networking and information

Communications skills

Raising capital

New venture marketing

New venture strategy

Growth strategies and internationalization

Company culture and the management of growth

Texts:

New Venture Strategy
Karl Vesper
1990

Made in Japan: Akio Morita and Sony
Akio Morita
London: Fontana/Collins, 1987

University of Calgary

NEW VENTURE MARKETING

Instructors/contacts: Wayne A. Long — Tel: (403) 220-7247
J. O'Grady — 220-7440

Faculty: Management — Course: MRK 785

Level: Graduate — Established: 1984

Comment: Originally developed in 1974, this course underwent a major revision in 1984. This is a project course that requires the completion of an in-depth new product/service feasibility study.

Topics:

New venture and new product development

Feasibility and screening

Marketing and design

Production and design, and cost

Entrepreneurial skills

Financial projections

Text:

New Products Management
C. Merle Crawford
Irwin, 2nd edition, 1987

University of Calgary

NEW VENTURE PLANNING

Instructor/contact: Wayne A. Long Tel: (403) 220-7247

Faculty: Management Course: POEN 783

Level: Graduate Established: 1984

Comment: This course was originally developed in 1975 and underwent a major revision in 1984.

Topics:

Marketing strategy at start-up and beyond

Financial alternatives - pro's and con's

Management control systems during growth

Financial plans

Sharing ownership with employees?

Identification of support programs and their value

Manufacturing and operating plans - critical risks

Franchising vs independent start-up

Critical start-up issues

Texts:

Entrepreneurship & Enterprise Development
Raymond Kao

University of Calgary

UNDERSTUDYING ENTREPRENEURIAL SUCCESS

Instructor/contact: W. Ed McMullan Tel: (403) 220-7143

Faculty: Management Course: MOHR 799.01

Level: Graduate Established: 1989

Comment: Students are expected to spend, on-site, in excess of 40 hours studying a successful entrepreneur and his or her company.

Topics:

Why understudy success?

The entrepreneurial mindset

The entrepreneurial career

Challenges in growing firms

Standardizing operating performance

Expanding strategically and opportunistically:

- strategic choices
- timing and limits to growth
- environmental factors
- planning

Professionalizing management

Corporate entrepreneuring

Texts:

The Winning Performance: How America's High-Growth Midsize Companies Succeed
D.K. Clifford and R.E. Cavanagh
New York: Bantam Books, 1985

Think and Grow Rich
N. Hill
New York: Fawcett Crest, 1960

Hyper-Growth: The Rise and Fall of Osborne Computer Corporation
A. Osborne and J. Dvorak
New York: Bar, Camelot, Discus and Flare Books, 1984

University of Calgary

PRODUCT AND TECHNOLOGY DESIGN

Instructor/contact: Dixon Thompson Tel: (403) 220-6601

Faculty: Environmental Design Course: EVDS 683.45

Level: Graduate Established: 1989

Comment: This course explores the concept of environmental impact assessment of products and technologies. The impacts of products and technologies will be assessed from extraction and processing of raw materials through manufacturing, packaging and marketing, use and disposal. Transportation and energy demands will be investigated. Wastes and recycling options will be a major concern.

Carleton University

TECHNOLOGY AND BUSINESS STRATEGY

Instructors/contacts: A.J. Bailetti/
J.R. Callahan Tel: (613) 788-2370/2372

Faculty: Business Course: BUS 42.595

Level: Graduate Established: 1986

Comment: This course is designed for working managers and for students in the Masters in Management Studies program. The course is structured around three components: extensive readings, weekly seminars, and the preparation of a business plan.

Topics:

Technology strategy (incorporating technology into business strategy)

Forecasting
- measurement of technology
- growth models
- trend extrapolation and Delphi methods

Technology business and its environment
- government policy
- regulation
- social impact of technology

Marketing
- market positioning
- market segmentation
- new product introduction
- licensing

Developing new businesses
- resource identification and acquisition

Managing innovative systems
- factors that contribute to success
- difficulties experienced in maintaining an innovative environment

Text:

Strategic Managment of Technology and Innovation
Robert A. Burgelman and M.A. Maidique
Irwin, 1988

Carleton University

MANAGEMENT OF TECHNOLOGY AND INNOVATION

Instructor/contact: A.J. Bailetti Tel: (613) 788-2370

Faculty: Business Course: BUS 42.467*A

Level: Undergraduate Established: 1987

Comment: The objective of this course is to study the planning, development and implementation of technological capabilities for the purpose of attaining the strategic and operational goals of the firm.

Topics:

Important problems in the management of technology

Link between technological capability and competitive advantage

Elements of technology strategy

R&D resource allocation

Marketing technology

Integration of technology strategy with business strategy

New product development - success and failure criteria

Management of R&D organizations

Technology transfer mechanisms

Differences between managing scientists and business personnel

Internal corporate venturing

Venture capital start-ups and entrepreneurship strategy

Product development cycle

Text:

Strategic Management of Technology and Innovation
R.A. Burgleman and M.A. Maidique
Irwin, 1988

Carleton University

MANAGEMENT OF TECHNOLOGICAL INNOVATION

Instructor/contact: A.J. Bailetti Tel: (613) 788-2370

Faculty: Business Course: BUS 42.590

Level: Graduate (MBA,MMS, MPA) Established: 1990

Comments: This course is designed to provide a comprehensive overview of the latest theory and research on the process of technological innovation and on the management of technology in the decentralized firm.

Topics:

Production of basic science and issues in applied research

Technology and market driven exploratory programs

Key players in the management of technology

Intra-firm technology transfer

Deployment of technology

Dimensions of technological change

Decision process in technological innovation

Evaluating technological programs

Commercializing technology

Science and technology policy

Technology in service industries

Texts:

The Process of Technological Innovation
L.G. Tornatzky and Mitchell Fleischer
Lexington, MA: D.C. Heath & Co., Lexington Books, 1990

Managing Technology in the Decentralized Firm
Albert H. Rubenstein
New York: John Wiley & Sons, 1990

Carleton University

The following three courses are offered in the Science Faculty under their Technology, Society and Environment option. Students from science, business and arts faculties can register for these courses.

TECHNOLOGY AND SOCIETY: ASSESSMENT

Instructor/contact: Peeter Kruus — Tel: (613) 788-4483

Faculty: Science — Course: 59.401

Level: Undergraduate — Established: 1981

Comment: This course consists of a series of guest speakers speaking on the following topics.

Topics:

- History of technology assessment
- Risk analysis - definitions and assessment
- Assessment of nuclear power safety
- Basics of benefit/cost analysis
- Methods of regulating technology
- Regulations of drugs in Canada
- Potential and control of biotechnology
- Communications technologies and their regulation
- Assessment of transportation
- Environmental impact assessment
- Resource management in Canada's north
- Automation and employment
- Technology transfer problems
- Export of technological hazards

Text:

Assessment of Technological Hazards
Peeter Kruus

Carleton University

TECHNOLOGY AND SOCIETY: FORECASTING

Instructor/contact: Peeter Kruus — Tel: (613) 788-4483

Faculty: Science — Course: 59.402

Level: Undergraduate — Established: 1981

Comment: This course makes extensive use of guest lecturers.

Topics:

- Survey methods
- Successes and failures of forecasting
- Trend extrapolation, substitution
- Science fiction and forecasting
- Expert opinion, design of Delphi
- Normative forecasting
- Forecasting at National Defence
- Impact of forecasting in government
- Relevance trees, implications wheels
- Research, invention and innovation
- Economic forecasting
- Self-fulfilling forecasts
- Planning in business and industry
- Futures and forecasting activities

Text:

Methods and Uses of Forecasting
Peeter Kruus and D. Taylor

Carleton University

TECHNOLOGY AND SOCIETY: INNOVATION

Instructor/contact: William Sheridan (Outside lecturer) Tel: (613) 995-7383

Faculty: Science Course: 59.403

Level: Undergraduate Established: 1984

Comment: This course makes extensive use of guest lecturers.

Topics:

- Forecasting
- Industrial design
- Lobbying for technology
- User friendly design
- Entrepreneuring
- Hazard assessment
- Intrapreneuring
- Government assisting innovation
- Labour response to innovation

Texts:

Engineering Ethics
J.T. Stevenson
Canadian Scholars Press, 1987

Contempory Moral Controversies in Technology
A.P. Iannone, Ed.
Oxford University Press, 1987

Fast Forward and Out of Control
Heather Menzies
Macmillan of Canada, 1989

Dalhousie University

MANAGING TECHNOLOGICAL INNOVATION AND ENTREPRENEURSHIP

Instructor/contact: M.J.C. Martin Tel: (902) 494-7080

Faculty: Management Course: MBA 6553

Level: Graduate Established: 1975

Comment: This course was not give this year at either Dalhousie or TUNS as Dr. Martin was on sabbatical in England.

Topics:

The technological and entrepreneurship process

Defining the technological base and strategies of the firm

Forecasting future technological markets

The R&D setting - creative thinking

Project evaluation and selection

Project management and control

Project needs and personal development of staff

Transferring the project from R&D to manufacturing

Matrix management

Entrepreneurial setting - incubator organizations

Stimulating entrepreneurship in large organizations

Developing a technology base in the Atlantic provinces

Text:

Managing Technological Innovation and Entrepreneurship
M.J.C. Martin
Reston, VA: Reston Publishing, 1984

Ecole Polytechnique de Montreal

The following courses offered in the Engineering faculty are part of the technological innovation "minor" that engineering students can take in addition to their engineering specialty.

INNOVATION ET ENTREPRENEURSHIP TECHNOLOGIQUE
(INNOVATION AND TECHNICAL ENTREPRENEURSHIP)

Instructor/contact: Roger A. Blais Tel: (514) 340-4232

Faculty: Engineering Course: SH 400

Level: Undergraduate Established: 1980

Comment: This course is the first in the series.

Topics:

New technologies and technological opportunities

Innovation cycle and the industrial revolution

Prospective technology: review of forecasting methods

Entrepreneurial economy and innovative practice

Invention, innovation and R&D: Revenue Canada criteria

International R&D activity and its effects

State of innovation: entrepreneurial traits

Business plan and analysis of value

Licencing - evaluating an invention

Essential knowledge of marketing

New industrial products

Financing innovative projects

Innovative strategies

Managment of innovation in an enterprise

Importance of small-medium sized firms in the ecomony

Text:

Innovation et entrepreneurship technologique
R.A. Blais
1989

Ecole Polytechnique de Montreal

GESTION DE LA R-D ET DE L'INNOVATION TECHNOLOGIQUE
Management of R&D and Technological Innovation

Instructor/contact: Pierre Guité — Tel: (514) 340-4720

Faculty: Engineering — Course: IT-400

Level: Undergraduate — Established: 1990

Comment: This course was originally developed in 1986 with the title Technology Forecasting and Development. It has been completely redesigned in 1990.

Topics:

R&D and technological innovation: is it possible to manage it?

Linear models vs systemic models

Gatekeeping and the importance of information

Empirical approach

Creativity and design

How do the Japanese manage R&D?

Rigid vs flexible management systems

Organization of personnel: key roles

The concept of "champion"

Scheduling, budgeting and project management techniques

Linking R&D/marketing and production

Networking mechanisms: cooperative R&D

R&D and technological innovation: the environmental challenge

Text:

Survol de modèles de gestion de l'innovation technologique
Pierre Guité

Ecole Polytechnique de Montreal

MARKETING STRATEGIQUE DE NOUVEAUX PRODUITS
STRATEGIC MARKETING OF NEW PRODUCTS

Instructors/contacts: Michel Langlois Tel: (514) 987-3862
Cataldo Zuccaro (514) 987-4432
(Outsider lecturers: on faculty of UQUAM)

Faculty: Engineering Course: IT-500

Level: Undergraduate Established: 1980

Comment: Both Drs. Laglois and Zuccaro are on the faculty of the University of Quebec at Montreal, but do not teach a technology based marketing course at their university.

Topics:

Marketing - marketing concept, impact of the marketing concept on the enterprise

Elaboration of the marketing plan - strategic role of the marketing plan

Strategic analysis of the marketplace and competitors

Studying the marketplace

Behaviour of the consumer

Development models of new products

Life cycle of products and the marketplace

Price strategies

Management of marketing communication - market pull/push

Marketing strategies and performance - Newprod/PIMS

Texts: Numerous reference texts including:

Winning at New Products
Robert G. Cooper
Holt, Rinehart, and Winston, 1986

Essentials of Marketing High Technology
William Shanklin and John K. Ryans Jr.
Lexington, MA: Lexington Books, 1987

Ecole Polytechnique de Montreal

TECHNOLOGIES ET CONCURRENCE INTERNATIONALE
TECHNOLOGY AND INTERNATIONAL COMPETITION

Instructor/contact: Roger A. Blais Tel: (514) 340-4232

Faculty: Engineering Course: SH 550/SH 555

Level: Undergraduate Established: 1990

Comment: This course consists of two sessions, one in the fall and one in the winter. It makes extensive use of outside lecturers) The second session is an industrial mission by the students to a foreign country. In 1991 it will be Germany.

Topics:

Political economics - U.S.-Canada Free Trade

Europe 1992 and Japan

Developing countries

Canadian economy and Quebec

International commerce

International R&D activities

International management

Multinational enterprise

Technological strategies of firms

Technology transfer

Ecole Polytechnique de Montreal

TECHNICAL ENTREPRENEURSHIP
TECHNICAL ENTREPRENEURSHIP

Instructor/contact: J.C. Martin (Outside lecturer) Tel: (514) 843-7693

Faculty: Engineering Course: IT-510

Level: Undergraduate Established: 1990

Comment: This course is a major revision of a previous course entitled Entrepreneurship and Management of an Emerging Enterprise, established in 1980.

Topics:

Entrepreneurship in Canada and Québec compared with the situation in the U.S.A.

The role played by research centres in the creation of entrepreneurs: incubators and spin-offs (Route 128, Boston, Silicon Valley, Kanata, Montréal)

The questionable basis of an enterprise

Choice of partners: legal aspects and government exingencies

Launching an enterprise: franchising, buying a licence or buying an existing firm

Sources of ideas and innovation

Production plan, business location and equipment leasing

Business plan

Budgeting, control of investment, sources of short and long term credit

Venture capital

Importance of human resources, leadership and motivation of employees

Importance of strategic planning for the entrepreneur and the enterprise

Ecole Polytechnique de Montreal

TECHNOLOGY TRANSFER

Instructor/contact: M.J. Bonhomme (Outside lecturer) Tel: (514) 340-4232

Faculty: Engineering Course: SH 510

Level: Undergraduate Established: 1982

Topics:

Definitions, players and scope of technology transfer

Transmitters and receivers of technology

Selection, training and role of technology transfer agents

Technological innovation

Mechanisms employed in technology transfer

Legal and commercial aspects of technology transfer

Types of technology transfer

Text:

Transfert technologique; Notes du professeur M.J. Bonhomme

University of Guelph

MANAGEMENT IN PRODUCT DEVELOPMENT

Instructor/contact: Victor J. Roth Tel: (519) 824-4120 X3071

Faculty: Consumer Studies Course: 26-404

Level: Undergraduate Established: 1988

Comment: This course makes use of the MARKSTRAT simulation game.

Topics:

Classifications of product development

Initiating factors of product development

Product life cycle concept

Corporate strategy plan

Role of research and development

Defining market opportunity

Idea generation and screening

Product design

Technical development

Advertising/promotional development

Pretest market

Test marketing

Product launch/product management

Texts:

Essentials of New Product Management
G.L. Urban, J.R. Hauser and N. Dholakia
Prentice Hall, 1987

Markstrat 2 Manual
J.C. Larréché and H. Gatignon
Scientific Press

Lakehead University

NEW VENTURE FEASIBILITY

Instructor/contact: Martin Oosterveld/ Brad Rush Tel: (807) 343-8795

Faculty: Engineering and Business Course: ES 4215

Level: Undergraduate Established: 1990

Comment: This course is open to students in either Engineering or Business. Course was originally entitled Creativity and Technological Innovation but the word "Technological" scared away business students. Course consists of case study exercises, presentations by practitioners, and a real-time field project working on a current innovation.

Topics:

- Individual and industrial creativity
- Process of technological innovation
- Opportunity assessment
- Strategies and procedures for developing new products and processes
- Market introduction

Text:

Winning at New Products
R.G. Cooper

Universite Laval

INTRODUCTION AU MANAGEMENT DE LA TECHNOLOGIE
(INTRODUCTION TO THE MANAGEMENT OF TECHNOLOGY)

Instructor/contact: Paul -H. Roy Tel. (418) 656-3566

Faculty: Engineering Course: GCH-17087

Level: Undergraduate/graduate Established: 1982

Topics:

- Management of technology
- The process of technological innovation
- R&D/marketing interface
- Japanese experience with technological innovation
- Technological substitution
- Rate of imitation of innovations
- Price/performance analysis
- Dynamics of cost competitiveness
- Technological forecasting and planning
- Strategic planning
- Impact of technology on a corporation
- Role of technology in a corporation's strategy

University of Lethbridge

MANAGING TECHNOLOGY AND ORGANIZATIONAL CHANGE

Instructor/contact: Urs E. Gattiker Tel: (403) 329-2169

Faculty: Management Course: MGMT 3380

Level: Undergraduate Established: 1989

Comment: This courses deals with the impact of technology on the workplace.

Topics:

What is technology and what is technology management

Managing innovation in an organizational setting or what fosters innovation

Innovation, technology and performance

How does technology affect the individual and one's work environment

National culture, technology acceptance and organizational change

How does equality and social comparison processes affect technology-induced organizational adaptation

Managing organizational change

What factors affect the skill component for effective technology management

Organizational change and work: what are the best strategies to be used to increase quality of work life

Text: Managing Technological Development: Strategic and Human Resources Issues
U.E. Gattiker and L. Larwood, eds.
New York: De Gruyter, 1988

McGill University

ENTREPRENEURSHIP FOR ENGINEERS

Instructor/contact: W.H. Ellis (514) 398-7247

Faculty: Management Course: 276-465B

Level: Undergraduate Established: 1989

Comment: This course is given in the engineering faculty.

Topics:

Entrepreneurs, strategic planning for small business

Forms of ownership

Franchises

Starting/buying a business

Financial record

Cash flow management

Profit for planning

Building the business

Potential sources of funds - equity, debt

Taxes and the small business

Location and layout and physical facilities

Inventory control and controlling crime

Computers and small business

Risk management

Managing people

Marketing

Basis of business law

Government regulation and assistance

Text:

Effective Small Business Management
N.M. Scarborough and T.W. Zimmerer
Merrill Publishing Co., 2nd edition, 1988

McMaster University

INNOVATION

Instructor/contact: P.M. Banting — Tel: (416) 525-9140 X3969

Faculty: Business — Course: BUS P724

Level: Graduate (MBA) — Established: 1977

Comment: Originally presented as a seminar series; approved as a regular MBA course in 1986.

Topics:

Canadian environmental influences on innovation

Organizational influences on innovation

Entrepreneurship and intrapreneurship

Technological forecasting

Research and development

Patents and intellectual property

Marketing innovation

Industrial design

Product/service market entry strategies

Diffusion of innovation

Information requirements for innovation

Strategic partnering

Gating processes

Text:

Managing Technological Innovation and Entrepreneurship
Michael J.C. Martin
Reston, VA: Reston Publishing Co., Inc., 1984

McMaster University

PRODUCT MARKETING

Instructor/contact: E.J. Kleinschmidt Tel: (416) 525-9140
R.G. Cooper 525-9140

Faculty: Business Courses: 4MC3/M735

Level: Undergraduate and Graduate Established: 1985

Topics:

- New products - problems and remedies
- New product process
- Generating new product ideas
- Evaluating new product proposals
- Defining the product concept
- Designing the launch strategy
- Target market selection
- New product strategy

Text:

Winning at New Products
R.G. Cooper
Holt, Rinehart, 1986

University of Manitoba

PROCESS OF TECHNOLOGICAL INNOVATION

Instructor/contact: Marvin Bartell — Tel. (204)474-8423

Faculty: Administration — Course: 27:735

Level: Graduate — Established: 1987

Topics:

The creative process and the creative personality

Facilitators and inhibitors in the creative process

Organizational design characteristics to achieve innovative products

Financial, economic and legal aspects of technological innovation, including patent law

Social implications and effects of public policy towards research, invention and innovation

Canada's orientation to innovation and its relation to other countries

University of Manitoba

TECHNOLOGICAL ENTREPRENEURSHIP

Instructor/contact: B.E. Owens — Tel: (204) 943-6333

Faculty: Administration — Course: 27:305

Level: Undergraduate — Established: 1984

Comment: This course started out as a readings course. It makes extensive use of technology oriented cases.

Topics:

- Entrepreneurship
- Entrepreneurs and opportunity (focus on technology)
- Marketing for entrepreneurs
- Accounting and finance for entrepreneurs
- Strategic planning
- Technology seminar
- Personnel, operations and advisors for entrepreneurs
- Federal industries
- Personal management for entrepreneurs

Memorial University

MANAGEMENT OF TECHNOLOGICAL INNOVATION

Instructor/contact: Michael Skipton Tel: 9709) 737-8509

Faculty: Business Administration Course: BUS 9322

Level: M.B.A. Established: 1985

Topics:

The technological innovation process

Technology and industrial innovation in the macro-environment

Corporate/business strategic approach to technological innovation

Organization resources, processes and management analysis for technology and innovation

Organization(s) and innovation - processes and linkages, communications and coupling

Corporate strategic leadership and management of innovation

Implementing innovation through functional areas:
- marketing
- research and development orientation
- manufacturing/service and administrative operation

Entrepreneurship and venturing

Government and industrial innovation

Text:

Readings in the Management of Innovation
M.L. Tushman and W.L. Moore (eds.)
Cambridge, MA: Ballinger Publishing, 2nd edition, 1988

University of Ottawa

TECHNOLOGY POLICY AND R&D MANAGEMENT

Instructor/contact: J.R. de la Mothe (Outside lecturer) Tel: (613) 995-6579

Faculty: Administration Course: ADM 6367

Level: Graduate Established: 1986

Comment: This course makes extensive use of guest lecturers and is open to students in the Engineering Management program.

Topics:

Economic organization and technological change

The science system

Innovation and theories of the firm

Basic science and economic growth

Uses and abuses of science indicators

R&D investment and international trade

Patents and the diffusion of technology

Strategic mergers and acquisitions

University of Ottawa

INNOVATION, TECHNOLOGY AND FINANCE SEMINAR

Instructor/contact: John de la Mothe (Outside lectuerer) Tel: (613) 995-6579

Faculty: Administration Course: ADM 6393C

Level: Graduate Established: 1989

Comment: This seminar is open to students in the Engineering Management program.

Process of technological innovation

Process of financial innovation

Impact of innovation of industrial structure

Impact of diffusion on market structure

Financing of technical innovation

Strategic alliances and joint ventures

Technology and financial innovation

Financial market structure, innovation and regulatory change

Financial innovation and capital formation

University of Ottawa

INDUSTRIAL AND TECHNOLOGY MARKETING

Instructor: M.A. Arrufat (Outside lecturer) Tel: (613) 829-7556

Faculty: Administration Course: ADM 6326

Level: Graduate Established: 1986

Comment: This graduate course is open to students in the Engineering Management program.

Topics:

Definition of industrial marketing

Key differences with consumer marketing

Organizational buying process

Assessing and estimating market opportunities

Strategic issues in business to business marketing

Differences between marketing products and services

Definition of high technology

How technology affects business to business marketing

Key aspects in marketing of high technology products

New product introductions

Product management - R&D, engineering and production linkages

Business marketing channels and logistics

Pricing of industrial products

Business marketing communications: advertising and sales promotion, personal selling

Text:

Business Marketing Management: A Strategic View of Industrial and Organizational Markets
Michael D. Hutt and Thomas W. Speh
NY: Holt Reinhardt and Winston, 3rd edition, 1989

University of Ottawa

MARKETING INDUSTRIEL ET TECHNOLOGIQUE
(Industrial and Technology Marketing)

Instructor/contact: Paul Laurent Tel: (613) 564-5845

Faculty: Administration Course: ADM 4724

Level: Undergraduate Established: 1986

Comment: An English language section of this course ADM 4324 is taught by Alistair Samson.

Topics:

Characteristics of industrial marketing

Differences between industrial marketing and consumer or international marketing

Understanding and control of commercialization methods apropriate in the industrial context

Analysis of the industrial environment and marketplace

Analysis of potential industrial markets

Strategies appropriate to industrial marketing

Text:

For ADM 4724

Industrial Marketing Management
Robert W. Haas
Kent Publishing Co., 1986

For ADM 4324

Industrial and Organizational Marketing
M.H. Morris
Merrill Publishing Company, 1988

University of Ottawa

MANAGING TECHNOLOGICAL RISK

Instructor/contact: John C. Nash Tel: (613) 564-6825

Faculty: Administration Course: ADM 6381

Level: Graduate Established: 1984

Comment: Course is open to engineering students.

Topics:

Introduction to risk

Measures of risk

Estimating the probabilities of events

Simulations, analogies, fault or event tree analysis

Estimating the consequences - probability * cost

Expected value criteria, minimax and regret criteria

Perception of risk

Consequences for public policy and private behaviour

Benefit/cost approaches to risk management

Decisions when there are multiple objectives

Case studies in: transportation, medicine, radiation hazards, and pharmaceuticals

University of Quebec - Abitibi-temiscamingue

GESTION DE LA TECHNOLOGIE DANS LES ORGANISATIONS
MANAGEMENT OF TECHNOLOGY IN AN ORGANIZATION

Instructor/contact: Pierre Sauvé — Tel: (819) 762-0971

Faculty: Administration — Course: ADM 3230

Level: Undergraduate — Established: 1989

Comment: This course uses a team teaching approach.

Topics:

- Management of production
- Engineering and manufacturing
- Technology teams
- Management of maintenance
- Sociological impact of new technology on the firm
- Managing the introduction of new technology

University of Quebec - Montreal

TECHNOLOGIE ET INNOVATION
TECHNOLOGY AND INNOVATION

Instructor/contact: Roger Miller (Outside lecturer) Tel: (514) 861-9031

Faculty: Administration Course: MBA 8014

Level: Graduate Established: 1980

Comment: Dr. Miller also leads a doctoral seminar on technology and strategy as well as teaching an undergraduate course in technical entrepreneurship.

Topics:

Technology and economic development

Technological dimension of the evolution of industries

Dynamic competitiveness of newly emerging industries

Dynamic competitiveness of growth industries - innovation cycle

Launching an enterprise

Venture capital

Technology and strategy

Management of research and development

New product development

Internal ventures

Public policies and technological innovation

University of Quebec - Montreal

ECONOMICS OF TECHNOLOGICAL CHANGE

Instructor/contact: Chris DeBresson Tel: (514) 987-3424

Faculty: Administration Course:

Level: Undergraduate Established: 1990

Comment: This course was taught previously at Concordia University.

Topics:

Does technology determine?

Choice of technique

The slow process of learning by doing

Technical systems and irreversibility of change

Economic factors affecting technical change

Diffusion of innovations

Needs' and effective demands' influence

Factor induced innovations

Economies of scale and scope, and trajectories of technical development

Scientific research and new technical opportunities

Space and time: spatial clusters

Texts:

The Economics of Industrial Innovation
Christopher Freeman

The Diffusion of New Industrial Processes
L. Nasbeth and G. Ray

Invention & Economic Growth
Jacob Schmookler

The Economic Analysis of Technological Change
Paul Stoneman

University of Quebec - Montreal

GESTION DE LA TECHNOLOGIE
MANAGEMENT OF TECHNOLOGY

Instructor/contact: Jorge Niosi Tel: (514) 987-8392

Faculty: Administration Course: ADM 6210

Level: Undergraduate Established: 1990

Comment: Mr. Niosi is director of the Centre de recherche en développement industriel et technologique (CREDIT).

Topics:

Definition and boundaries of technology

Competitive strategy of firms: technology and industrial organization

Technology in the firm: organization for R&D and internal technology transfer

Technological innovation: industrial manufacturing and services

Cooperative technological innovation efforts

Managment of technical innovation in the firm

The public environment facing an innovative firm: politics of competition and cooperation, R&D, government purchasing, etc.

Technological innovation and employment

International management of technology: international environment and technology transfer

Transfer of technology by multinationals

University of Quebec - Montreal

INNOVATION ET ORGANISATION: GESTION DE LA TECHNOLOGIE
INNOVATION AND ORGANIZATION: MANAGEMENT OF TECHNOLOGY

Instructor/contact: Jorge Niosi Tel: (514) 987-8392

Faculty: Administration Course: ADM 2000

Level: Undergraduate Established: 1989

Topics:

History of technology and technological development

Industrial structure and technological change

Economic development: competition and technology

Invention, innovation and economic change

Management of technical change

Company strategies and R&D

Managment of technology in the public sector: industrial, technological and science policy

University of Quebec - Montreal

LE MANAGEMENT DU DEVELOPPPEMENT TECHNOLOGIQUE
MANAGEMENT OF TECHNOLOGICAL DEVELOPMENT

Instructor/contact: Jorge Niosi Tel: (514) 987-8392

Faculty: Administration Course: ADM 8138

Level: Graduate Established: 1991

Comment: This is an M.B.A. research course.

Topics:

Definition and boundaries of technology

Patents, inventions and innovations

Organization of R&D in the firm

R&D and other functions in the firm (e.g. R&D and marketing)

Allocation of resources

Use of public and private sector resources and information in support of technological innovation

University of Quebec - Trois-Rivieres

CREATIVITE, INNOVATION, ENTREPREURNIAT
(Creativity, Innovation and Entrepreneurship)

Instructor/contact: J.-B. Carrière — Tel: (819) 376-5080

Faculty: Administration — Course: ADM 6001

Level: Graduate — Established: 1987

Topics:

Traditional approaches to entrepreneurship

From the economic role to the managerial role of the entrepreneur

The determinants and characteristics of entrepreneurial behaviour

Entrepreneurship and management

Creativity and its determinants

The creative process

Management of creativity

Creativity techniques

Innovation and technology

Product, process and service innovation

Government policies

University of Quebec - Trois-Rivieres

ENTREPRENEURIAT ET INNOVATION DANS LA P.M.E.
(Entrepreneurship and Innovation in the Small-Medium Sized Enterprise)

Instructor/contact: J.-B. Carrière Tel: (819) 376-5080

Faculty: Administration Course: GAE 1002

Level: Undergraduate Established: 1989

Topics:

- Entrepreneurship and innovation
- The entrepreneurial process
- Apprenticeship and entrepreneurial competence
- Required physical resources
- Required human resources
- Entrepreneurial opportunities
- Elements of innovation
- The innovative process
- Barriers to innovation
- Keys to successful innovation
- Types of innovation: product, process, service
- Innovative enterprise

Queen's University

MANAGING INNOVATION AND TECHNOLOGY

Instructor/contact: Peter Richardson Tel: (613) 545-2339

Faculty: Business Course: BUS 976

Level: Graduate Established: 1976

Comments: This course involves a limited number of guest speakers

Topics:

- Innovation and technology in society
- The firm: innovation and the entrepreneur
- Successful innovation
- Project selection and termination
- Project planning and control
- Technology transfer
- Managing organization change
- Technology based strategies
- The role of research and development
- Managing the innovative corporation
- Implementing new technology
- Innovation - the challenge

Queen's University

MARKET ORIENTED DESIGN

Instructor/contact: R.D. de Pencier Tel: (613) 545-2586

Faculty: Applied Science Course: MECH 492

Level: Undergraduate Established: 1969

Comment: Course underwent a major revision in 1983/84. Students are divided into small groups and each group will design a product and a business plan to make that product a "reality" in the competitive marketplace. Course is divided into three segments: lecturer/speaker portion; seminar/presentation portion; and a lab or project portion.

Topics:

Business associations and legal issues

Description of business plan and it preparation

Accounting, taxation, and income planning

Marketing/distribution/retailing

Financing and financial planning, objectives and strategies

Operations, human resources, and start-up plans

Product search and selection - idea generation

Creativity and invention and design approaches

Industrial design and designers

Intellectual property issues - patents, trademarks, copyright, industrial design

Sources and evaluation of venture ideas

Texts:

New Venture Strategies
Karl H. Vesper
Prentice-Hall,

Starting a Business in Ontario
M.I.T.T., Ontario Government

Ryerson Polytechnical Institute

THE MANAGEMENT OF NEW PRODUCTS

Instructor/contact: Peter Wilson (Outside Lecturer) Tel: (416) 979-5000 X6745

Faculty: Business Course: MKT 730

Level: Undergraduate Established: 1986

Topics:

- Review of "In Search of Excellence"
- New product process
- New product strategy
- Concept generation - overview and methods
- Concept evaluation and product development
- Product and market testing
- Market testing and financial evaluation
- Market launch and control
- Market plan tracking and control
- Organizational strategy
- Public policy and politics

Text: New Products Management
C. Merle Crawford
Homewood, IL: Irwin, 2nd edition, 1987

St. Francis Xavier University

TECHNOLOGY AND CHANGE

Instructor/contact: R. Kent Young Tel: (902) 867-3942

Faculty: Business Administration Course: BUS 469

Level: Undergraduate Established: 1987

Comment: The focus of this course is on the adoption and use of information technologies (I.T.).

Topics:

How I.T. is making a difference

An edge in existing markets

Market innovation

Why smart management of I.T. is crucial for competing in today's economy

The environmental context: why smart management of I.T. is only part of the challenge

Strategic framework for effective technology management

The migration of information technologies

Making a strategic commitment to I.T.

Impact of I.T. on the organization

Impact of I.T. on the workforce

Empowering people

Change

Implementing I.T.

Project management

Text:

Mastering Technology: A Management Framework for Getting Results
R. Monger
New York: The Free Press, 1988

University of Saskatchewan

MANAGING TECHNOLOGY FOR COMPETITIVE ADVANTAGE

Instructor/contact: Larry Ayers — Tel: (306) 966-5366

Faculty: Engineering — Course: CE 898

Level: Graduate — Established: 1988

Comment: This course is taught by the case method.

Topics:

Recognizing technological opportunities

Managing the design process

Managing technological manufacturing

University of Saskatchewan

TECHNOLOGY POLICY AND THE MANAGEMENT OF ENTREPRENEURIAL TECHNOLOGY COMPANIES

Instructor/contact: David Boag* Tel: (306) 966-8434

Faculty: Commerce Course: MBA 898

Level: Graduate Established: 1990

Comment: Course includes a team project to examine government policy towards the development of Saskatchewan technology.

Topics:

Orientation and the growth of the small and medium-sized technology companies

Government and quasi-government support of technology industries

Review of Saskatchewan and Government of Canada programs in support of advanced technology companies

Case studies in technology evolution (e.g. Cambridge, Silicon Valley, etc.)

* Effective January 1, 1991, Dr. Boag will be Director of the School of Business at the University of Victoria.

University of Toronto

INNOVATION AND ENTREPRENEURSHIP FOR ENGINEERS

Instructor/contact: J.C. Paradi — Tel: (416) 978-6924

Faculty: Engineering — Course: CHE 457S

Level: Undergraduate — Established: 1977

Topic:

- Profile of the entrepreneur
- Venture search
- Innovation/invention
- Small business environment
- Legal forms of organization
- Business plan
- Market research - source of data
- Exporting and importing - foreign trade
- Sales and marketing
- Finance - venture capital, bank, private placement, public offering
- Franchising
- Financial and accounting controls
- Management and leadership styles
- EDP risk/management
- Business and the law - competition act, licences, patents, trademarks, industrial design
- What makes a business tick - Monomaniac with a mission

Text:

Small Business Management Fundamentals
A.J. Szonyi and D. Steinhoff
McGraw-Hill, Ryerson, 3rd edition, 1987

University of Toronto

MANAGEMENT OF TECHNOLOGY, ENTREPRENEURSHIP AND SMALL BUSINESS

Instructor/contact: J.C. Paradi — Tel: (613) 978-6924

Faculty: Engineering — Course: APS 141S

Level: Undergraduate — Established: 1991

Comment: This course is the first of a set of four, one to be given in each year of the four year Engineering curriculum. The following are the tentative topics to be presented.

Topics:

Canadian business environment

Characteristics of an entrepreneur

Search for the product or service

People/management styles

Business risk management

Franchising

Export and import

Government effects on business

Product and/or service - product life cycle

Environmental issues

Role of R&D in Canadian industry

Board of directors - role, responsibilities

Computerization

University of Toronto

THE BUSINESS OF SOFTWARE

Instructor/contact: Ron Baecker Tel: (416) 978-6983

Faculty: Management/Computer Science Courses: BUS 2001
CSC 454/2527

Level: Graduate (BUS 2001 & CSC 2527) Established: 1986
Undergrad. (CSC 454)

Comment: Makes extensive use of guest speakers.

Topics:

Computer and software industries

Software business definition and planning

Software market and product planning

Management of innovation, R&D and software development

Software product marketing

Software sales and sales management

Marketing communications and technical writing

Software product manufacturing and support

Financing and financial management of high technology ventures

Human resource management

Development of high technology industries

Texts: Entrepreneurship - Ten Commandments for Building Growth Companies
Mr. Brant, 1982

Business Plans that Win Dollars: Lessons from MIT Enterprise Forum
Rich and Gumpert

University of Waterloo

TECHNICAL ENTREPRENEURSHIP

Instructor/contact: Robert Grasley (Outsider) Tel: (416) 222-0753

Faculty: Engineering Course: GE 352

Level: Undergraduate Established: 1984

Comment: Originally developed and presented at York University in 1979. Course makes extensive use of films produced by the instructor.

Topics:

The Canadian business scene

Psychologicl aspects of entrepreneurship

You and your business - finding a "fit"

Inventions, innovations and novel ideas

Indentifying your market

Organizing and planning your venture

Business structures for new ventures

Forecasting tools and electronic spreadsheets

Capital structures in new ventures

Developing your business plan

Buying a business or franchise

Failure: the downside of venturing

Text:

Ontario Industrial Innovation Centre/Waterloo Enterprise Planning System

University of Waterloo

PATENTING FOR ENGINEERS

Instructor/contact: Alan M. Hale Tel: (519) 885-1211 X3335

Faculty: Engineering Course: ME 502

Level: Undergraduate Established: 1986

Comment: Course makes use of guest lecturers.

Topics:

Intellectual property overview dealing with:
- patents
- copyright
- trademarks
- industrial design
- trade secrets

Foreign patent protection

Computerized searching of patents

Technology licensing

Intellectual property litigation

Patentability search

Claims writing

Preparation of a patent application

Text:

Patent It Yourself
David Pressman
CA: Nolo Press, 1989

University of Western Ontario

MANAGEMENT OF TECHNOLOGY

Instructor/contact: Albert R. Wood Tel: (519) 661-3227

Faculty: Business Course: 474/674

Level: Undergraduate and Graduate Established: 1970

Comment: This course is taught by the case method and makes use of guest speakers from high technology firms.

Topics:

Technological innovation process

Project selection and termination decisions

New product and process development

Impact of new processes on the firm - timing and implementation

Management of new product projects

Project organization, planning and control

Role of the project manager

Technological strategies

Texts: Readings in the Management of Innovation
M. Tushman and William Moore, eds.
Marshfield, MA: Pitman Publishing, 1982

Managing Technological Innovation and Entrepreneurship
M.J.C. Martin
Reston, VA: Reston Publishing Co, 1984

University of Western Ontario

NEW ENTERPRISE MANAGEMENT

Instructor/contact: Russell M. Knight Tel: (519) 661-3299

Faculty: Business Courses: 642/442

Level: Graduate and undergraduate Established: 1972

Comments: These courses were not presented this year because the instructor was on sabbatical leave. This course is taught by the case method.

Topics:

Exploring for new enterprise opportunities

Developing a management team for the new enterprise

Evaluating the potential success of a venture

Sources of financing for a new venture

Text:

Entrepreneurship and New Venture Management: Readings and Cases
Ray Kao and R.M. Knight
Pretice Hall, 1987

University of Western Ontario

INDUSTRIAL MARKETING: MARKETING TO ORGANIZATONS

Instructor/contact: Terry Deutscher Tel: (519) 661-3277

Faculty: Business Course:

Level: Graduate Established: 1978

Comment: This course is taught by the case method and makes use of the business simulation INDUSTRAT.

Topics:

Managing organizational buying behaviour

Managing industrial product/market strategy

Making industrial marketing systems work

Managing technical innovation and new products

Devising and executing an industrial marketing strategy (employing the INDUSTRAT simulation)

Wilfred Laurier University

MANAGEMENT OF NEW TECHNOLOGY

Instructor/contact: Hamid Noori — Tel: (519) 884-1970 X2556

Faculty: Business — Courses: BUS 465/655

Level: Undergraduate and graduate — Established: 1984

Topics:

Technical, social and economic issues concerning the acquisition and implementation of new technology

Productivity and quality improvement

Product/process interface

Strategic importance of new technology

Texts:

Managing the Dynamics of New Technology: Issues in Manufacturing
Hamid Noori
Prentice Hall, 1990

Readings and Cases in the Management of New Technology
Hamid Noori and Russell Radford
Prentice Hall, 1990

Wilfred Laurier University

HUMAN RESOURCES MANAGEMENT FOR TECHNOLOGICAL INNOVATION

Instructor/contact: Bruce Fournier Tel: (519) 884-1970 X2883

Faculty: Business Course: BUS 598

Level: Graduate Established: 1988

Comment: This course is a special linking course to familiarize engineers with the human resources side of technological innovation management. This course is given in May to mid-August so that engineering students from other universities such as Waterloo, who have taken business courses during their engineering program, can enter into the final year of Wilfred Laurier's M.B.A. program.

Topics:

Management: what is it

Human resources management workshop

Organizational change

Goal setting and action planning

Leadership

Job design/organization design

Organization culture

Reward systems

Performance management

Wilfrid Laurier University

MARKETING HIGH TECHNOLOGY

Instructor/contact: David L. Blenkhorn Tel: (519) 884-1970 X2467

Faculty: Business Course: BUS 562

Level: Graduate Established: 198?

Topics:

Introduction to new/high technology and the realities for the marketer

Characteristics and potential of new/high technology

The impetus for technology adoption

Technological innovation and new product design

Developing a technology strategy

Productivity and quality: the better mousetrap

Justification and adaptation processes of new technology

Organizational implications of new technology

Managing change: integrating people and technology

The social issues of new technology

The government and new technology

A dynamic analysis of adapting new technology: the marketer's role

Texts:

Marketing High Technology
William L. Shanklin and John K. Ryans Jr.
Lexington Books, 1984

Managing the Dynamics of New Technology
Hamid Noori
Prentice Hall, 1990

Readings and Cases in the Management of New Technology
Hamid Noori and Russell W. Radford
Prentice-Hall, 1990

York University

STRATEGIC MANAGEMENT OF TECHNOLOGY-BASED FIRMS

Instructor/contact: Jerry Dermer — Tel: (416) 736-2100

Faculty: Administrative Studies — Course: PLCY 6971Y

Level: Graduate — Established: 1984

Topics:

- Strategy-technology linkage
- Competing in technology-driven industries
- Technological evolution
- Industry evolution
- Managing new products
- Managing new ventures - intra and extra corporate
- Managing the technologically-innovative firm
- Managing scientists and R&D
- Planning, resource allocation and control systems
- Role of government/international perspective

Texts:

Soul of a New Machine
T. Kidder
Avon, 1981

Managing Technological Innovation and Entrepreneurship
M.J.C. Martin
Reston Publishers, 1984

York University

INTERNATIONAL TECHNOLOGY TRANSFER

Instructor/contact: A.B. Supapol — Tel: (416) 736-2100

Faculty: Administrative Studies — Course: ECON 6950W

Level: Graduate — Established: 1989

Topics:

- Overview of international technology transfer
- R&D, international trade and economic growth
- International technology transfer - major issues
- Overseas R&D and reverse technology transfer
- Resource costs of technology transfer
- Licensing and joint ventures
- License negotiations and restrictions
- Technology transfer and world development
- Technology and public policy: Canadian issues