In today’s industrial business environment there is increasingly high demand for engineers capable of integrating modern business practices with enhanced skills in engineering design and manufacturing processes, and knowledge of rapidly changing technology. Equally, working engineers and their employers, interested in acquiring such new and enhanced skills, want access to post-graduate programs that provide academically stimulating yet "real-world" content in a format that can be accommodated with minimal negative impact on business and personal responsibilities and obligations.

The Advanced Design & Manufacturing Institute (ADMI) Master of Engineering in Design & Manufacturing with emphasis on business management is a relatively new, part-time, modular M.Eng. program specifically created to address the needs of engineers working in industry. It provides engineers with opportunity to upgrade engineering design, manufacturing and technological skills, gain management skills and develop enhanced business acumen ... while effectively balancing work and personal life. A particularly remarkable element of the ADMI model is that it is based on the initiative of leading universities to present the program in a cooperative partnership.

To follow is an overview of this very interesting and successful program.

**ADMI Program Design, Development and Operation**

The ADMI M.Eng. program is a partnership of the engineering and business schools of five leading Ontario universities: McMaster University, Queen's University, the University of Toronto, the University of Waterloo, and the University of Western Ontario.

The ADMI concept was conceived by professors in the Department of Mechanical and Industrial Engineering at the University of Toronto in concert with like-minded colleagues at the other partner universities and executives at Materials & Manufacturing Ontario (MMO), one of the province of Ontario Centres of Excellence. The program was conceived after university/industry interface activities continually indicated an industry perspective that
graduate engineers, though well-versed in engineering fundamentals, are often weak in highly desirable contemporary skill areas of product and process design, manufacturing process management, business management principles and techniques. The need was consistently identified for a creation of a more well-rounded engineer with skills and attitudes appropriate for today's fast-changing, demanding business environment.

An extensive series of interviews with key industrial companies was conducted to identify industry engineering capability and skill needs as a basis for determining the focus and content of courses to be presented in the proposed program, and to determine the level of evident interest in the proposed program.

Following the process to define the program structure and operating principles, negotiate partnership terms among the founding universities, develop curriculum and engage professors to be course leaders, a detailed brief proposing establishment of a Joint Masters Degree Program in Design and Manufacturing was prepared and submitted to the Ontario Council for Graduate Studies. OCGS approval was received and the ADMI program was inaugurated in the fall of 2000 with promotion of the program to engineering alumni of the four founding partner universities. Program admissions began to take place in late 2000 and the first course, Design for Manufacturability, was presented in March/April of 2001.

**ADMI Operating Structure**

As the ADMI program concept took shape, it was determined that effective management of the program would be best accomplished through a separate umbrella structure to manage operation of the program on behalf of the partner universities. The ADMI office, which is located at a neutral site rather than on the campus of one of the partner universities, was established with an Executive Director to provide overall direction, program management, marketing, promotion, course scheduling, course revenue sharing accounting, as well as university/student/industry liaison.

The ADMI Executive Director reports to the ADMI Board of Directors which is made up of the President of Materials & Manufacturing Ontario, the Dean of the Faculty of Engineering at each partner university, the Dean of the business school of one partner university and five senior representatives from industry.

The ADMI office/partner university operating relationship is supported through a Program Committee with senior representatives form the Department of Mechanical Engineering at each partner university, plus a business school representative and representatives from industry. The Program Committee is responsible for course identification, schedule approval, course quality management and program support at each university. Committee members are the key contact for program issues at the partner universities. Each university has also established program administrative support to administer internal elements of the program (course registrations, maintenance of student records, etc.)
Admission Requirements

Requirements for admission to the program are essentially a minimum "B" grade-point average in an honours undergraduate engineering degree or science equivalent from a recognised university, plus a minimum of three years industry experience.

Interested individuals apply for admission to the program using an online Preliminary Application Form found on the ADMI website www.admicanada.com. A particularly appealing element of the ADMI program allows individuals to apply for admission through their choice of any one of the present five partner universities. The preliminary application provides enough information for the university to make an initial decision on the appropriateness of the individual and, if deemed potentially "admittable", the individual is directed to complete and submit a full application package.

Once admitted, program participants are free to register in and receive credit for courses presented by any of the partner universities … allowing for access to professors from many universities rather than just one, and for creation of an M.Eng. program customised to satisfy each individual’s personal and professional needs and interests. Upon completion of degree requirements, participants receive the Master of Engineering in Design and Manufacturing from their university of admission.

Courses, Modular Format and Presentation Schedule

The course curriculum is structured in two streams: Technology and Processes Stream and Business Management Stream. Each stream contains about 15 courses, from which a total of 12-14 courses are presently offered annually. Courses are cycled through the program schedule to be presented on a more or less 18-month basis. While there are courses that are informally "core" to the program, the curriculum is constantly evolving as additional courses may be to be added in response to industry and student needs and interests. Similarly, some courses may not receive repeat presentations if their relevance to ADMI program intent and direction becomes in question. One beneficial characteristic of ADMI Business Management Stream courses is that they are developed and presented with an engineering environment perspective and are highly focused, through course material outline, projects and case studies, on the realities of business life for working engineers.

Courses presently offered in the Technology & Processes Stream include:
- Design for Manufacturability
- Design Methodologies
- Ergonomic Engineering
- Computer Aided Design
- Forensic Engineering & Failure Analysis
- System Maintenance
- Conceptual Design Studio
Courses presently offered in the Business Management Stream include:

- Advanced Project Management
- Management & Control of Quality
- Manufacturing Management: Organisational Behaviour
- Management Skills Development
- Principles of Technical & Professional Communication
- Basic Tools for Technology Transfer
- Strategic Management of Technology
- Technological Entrepreneurship
- Financial & Managerial Accounting
- Logistics & Supply Chain Management
- Manufacturing Business Strategy
- International Business
- Business-to-Business Marketing

Generally, courses are not delivered on the campus of the presenting university but in the excellent training facilities of a major consulting engineering firm and a conference center located in the centrally-located Sheridan Science & Technology Park in Mississauga, on the western edge of Toronto. Exceptions are technical courses that require access to specialised labs and equipment and are presented on the campus of the presenting university.

Each ADMI course is two 4-day modules running Thursday morning through Sunday afternoon. As such, the student must give-up two personal weekend days while being away from his/her workplace for two days. This balance of personal and business time for course attendance has proven to be highly valued by both the student and his/her employer. Between modules there is a 5-6 week period intended to allow Module 1 learning to become established, provide a period for students to work on a between-module assignment and to allow conduct workplace responsibilities with minimal course intrusion. Depending on the nature of the course, there may be a second assignment to be completed after Module 2 and/or there may be a final examination.

Class size is targeted at 20-25 participants. Courses are designed to be highly interactive with case studies, group and individual work, guest lecturers from academia and guest speakers from industry. While the academic standards are very high and the courses are academically demanding, as required for a masters-level program, course content is also designed to focus on "real-world" industry issues and applications.
The ADMI program is not semester-based. An individual may apply for admission at any time, be admitted at any time and then begin to take scheduled courses that best suit his/her needs and interests. Other than the nominal application fee charged by the universities to facilitate the application process, there is no up-front cost to become admitted to the ADMI program. Cost is incurred on a per-course basis. The student pays a course fee for each course taken. The Course Fee is paid prior to course start along with a Course Materials Fee to cover the cost of textbooks, case studies, course notes, etc.

The Course Fee is the only source of revenue for the ADMI program, which must operate as a fully cost-recoverable business entity. Course Fee revenue is shared among the partner universities using a formula which directs 50% of an individual student's Course Fee to go to the partner university presenting the course, 30% to the ADMI office for ongoing program management and promotion, and 20% to the university though which the individual was admitted to the ADMI program.

Course Leaders and Instruction Teams

For each course the Course Leader is a professor from one or another of the partner universities. Typically the Course leader will create an instruction team consisting of one or more academic colleagues often from a number of universities as well as guest speakers from industry. ADMI Course Leaders and associate professors are widely-recognised in their field of expertise and are highly industry focused.

Program Participants (Students)

ADMI program participants represent a wide range of industry sectors and large corporations through to smaller companies. They typically carry position titles such as "Project Engineer", "Design Engineer", "Maintenance Engineer", "Development Engineer" and various "Manager" titles. As well, a small portion of program participants hold senior positions (Vice President, President, etc.) in their companies or run smaller entrepreneurial businesses.

Most students indicate that they are involved in the program to develop enhanced skills to further their career opportunities as well as to pursue academic and professional interests and to develop enhanced professional and industry engineering credentials.

Most participants receive at least a degree of financial support for their involvement in the program from their employer. This may be full to partial financial support as well as time-off to attend classes.
Degree Requirements

To fulfil requirements for the M.Eng. degree, ADMI program participants must successfully complete a total of 10 courses with a minimum of 5 courses from the Technology & Processes Stream and a minimum of 2 courses from the Business Management Stream. The majority of participants have chosen to take a 5 technical stream and 5 business stream courses to receive the optimal benefit of a balanced technical/business program … though more technically-focused individuals often choose to select courses more heavily weighted to the technical stream.

To maintain active status in the program, participants as required to complete a minimum of 2 courses each year. Typically, program participants complete 3-4 courses each year and, on average, are taking about 2.5 years to complete the program and earn their M.Eng. degree.

Results and Benefits Achieved

There is no question that the ADMI program has hit upon an important niche in the continuing education of working engineers. Admission numbers have grown steadily and, now that the program is established and reasonably-well recognised, future growth is expected to become exponential. The program has received rave reviews from program participants, industry, course instructors and university administrators.

- As of March 2004, there are about 170 individuals admitted to and active in the ADMI program. Many individuals admitted to the program have been referred by a present or graduate program participant. To date, there have been a total of about 25 graduates from the five partner universities.

- Since program inception, close to 40 high quality courses have been successfully presented for which student course evaluations have indicated an excellent overall average rating of 4.25 out of 5.0.

- Participants consistently indicate that the modular-format nature of the ADMI program is the only format that would allow them to pursue a post-graduate degree. Students are highly complimentary of the opportunity the program offers for access to professors and instructors from all of the partner universities and their instruction team associates from other universities and industry. They feel they are getting the “best of the best” in terms of course material and instruction. As well, participants consistently identify the high value of interaction with fellow engineers as classmates as a key personal and professional benefit of the ADMI program.

- The class-size target of an average of 20+ participants per course is now consistently achieved.
The partner universities have seen full-return of their initial start-up investment dollars and are realising bottom-line profit from delivery of ADMI courses.

Professors (course leaders) and their instruction teams have gained valuable experience and personal benefit from teaching classes comprised of very bright, highly-motivated individuals with a wide range of experience of industry experience. As well, there is indication of academic contact with companies represented by program participants leading to research or consulting contract opportunities. The ADMI office is regularly approached by professors, who have learned about the ADMI program, offering to present a course.

Additional universities have expressed interest in the ADMI program and the University of Windsor is in process of becoming the sixth ADMI partner university.

**Key Lesson Learned**

Given the real and perceived challenges associated with 5 universities working together successfully in a co-operative fashion, the key factor in ADMI success to date was establishment of a separate business entity (the ADMI office) to direct the "business" of running the ADMI program. The business-like, customer-driven approach of the ADMI office provides an important vehicle and program structure to ensure balance among academic, industry and student needs and interests.

The ADMI Program is an excellent model of successful leverage of partner universities to present an academic program highly-valued by both participants and their employers. It appears to reflect a style of industry-focused post graduate engineering education that has a high potential for success in other jurisdictions.