

Title: Transforming a Technology Management Master's Degree Curriculum into a Successful Inter-Disciplinary Program for the 21st Century Needs of Global Organizations

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Abstract

As organizations develop their hiring plans in the areas of business, engineering technology and management, they are seeking a greater number of individuals with multi-disciplinary skills, competencies and backgrounds to provide them with maximum flexibility for employer assignments, greater diversity in the work force and more effective employees with business, people and technology backgrounds. Most Schools of Engineering today have not yet come to terms with these inter-disciplinary requirements and have not developed programs focused on providing these types of programs that prepare graduates for these kinds of challenges and opportunities.

Based on extensive industry research and confirmed by the "Center for Inter-disciplinary Business, Engineering and Technology Leadership," consisting of senior executives from over 20 small, medium and large companies and organizations such as GE, UBS, Sikorsky Aircraft, Unilever, Deutsche Bank, Bayer, Gartner and others, the University of Bridgeport has transformed its MS in Technology Management into the largest program of its kind in the Northeast with a remarkable two & half year enrollment growth of over 540%.

This paper describes the transformation of the MS in Technology Management Degree Program from a traditionally oriented, narrowly focused engineering management program to a dynamic, flexible and innovative Technology Management program relevant for preparing students for the 21st century workforce. It outlines the program components, how it is synergized and leveraged with programs in business, engineering and other disciplines and how it prepares students to learn the skills, competencies and technologies required by organizations on a global basis. The challenges, growth and results are discussed.

The Challenge and Results

In the Fall 2005, 32 graduate students were enrolled in the MS in Technology Management degree program, out of a total of 360 graduates in the entire School of Engineering at the University of Bridgeport. The Technology Management program was the smallest program in the School of Engineering, which also awarded graduate degrees in Electrical Engineering, Mechanical Engineering and Computer Science and Engineering.

At that time, we conducted a review of the TM program and made recommendations to transform the degree into a modern, relevant and growth oriented program with the following goals:

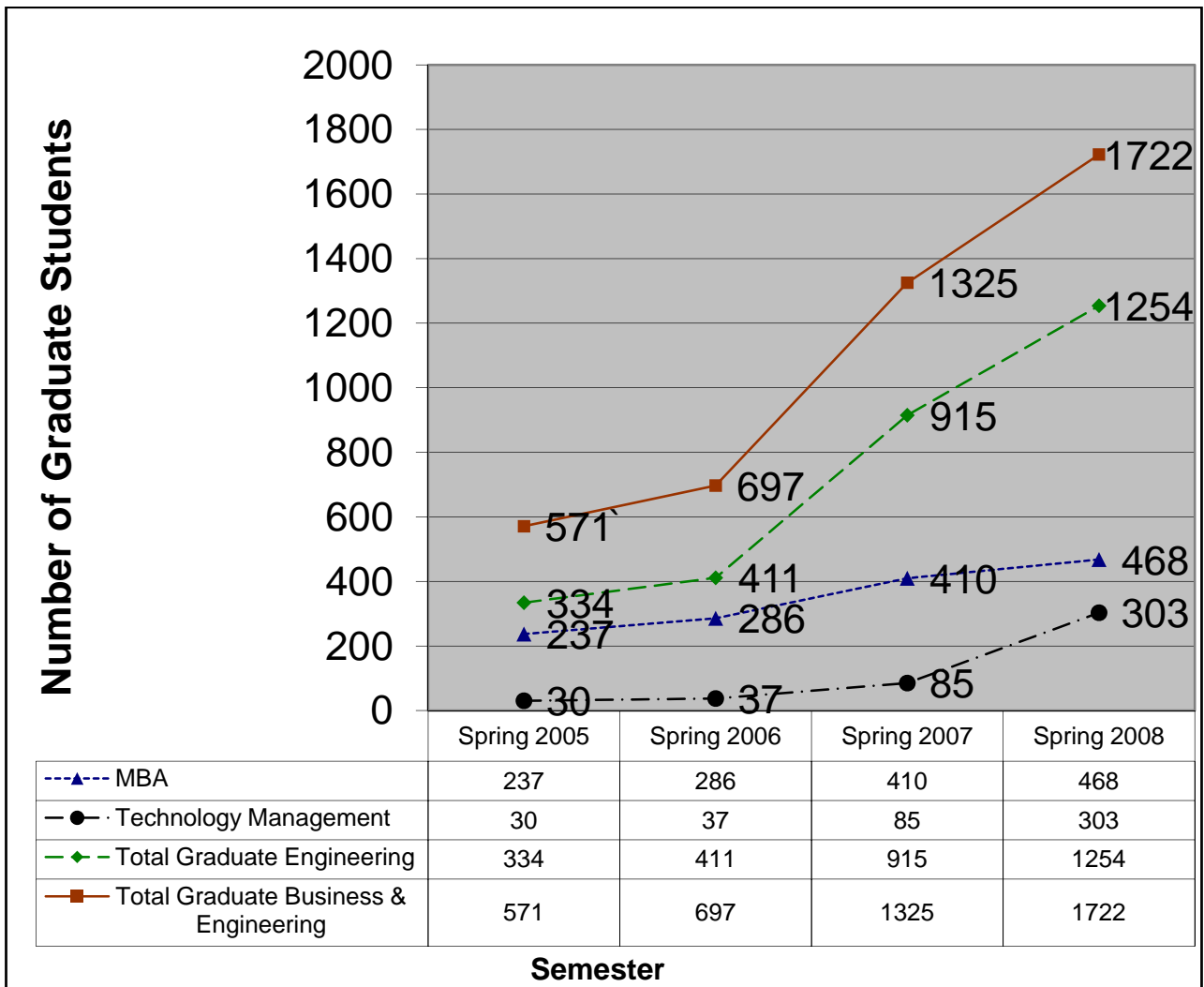
- Attract new career oriented graduate students and develop future industry and technology leaders adept at managing technology dependent organizations, technological change, and skilled in establishing and maintaining superior competitive advantages for their respective enterprises.
- Provide students with a variety of career enhancement options responsive to growing employer and employee needs for multiple competencies and skills in today's and tomorrow's demanding global work place.
- Obtain the commitment and sponsorship of business and government organizations and institutions for our programs, provide internship and job opportunities for our graduates, sponsor research and help to raise funds and support grant opportunities.

- Create an innovative inter-disciplinary education environment for our students to seamlessly and easily integrate courses and concentrations offered by the Schools of Business, Engineering and/or Education & Human Resources.

The results of the TM program transformation have been nothing short of outstanding. In the Spring 2008, the TM program had grown to 303 graduate students for a 2.5 year growth rate of over 540%. The TM program at UB is now the largest in the State of Connecticut and New England and may well be one of the largest in the United States. The growth of the entire School of Engineering in the same period to over 1,250 graduate students (a growth of over 235%), is also, outstanding.

Figure 1 illustrates the remarkable enrollment growth of the TM program, the MBA program and the School of Engineering over the last two + years.

Figure 1- Enrollment Growth for TM, MBA and Graduate Engineering Students -Spring 2005 - Spring 2008



Market Needs

When we reviewed the TM program and factored in the growing needs for more inter-disciplinary education programs, the development team applied many years of business, management, leadership, engineering and technology industry and education experience to the task and asked some difficult questions such as, “Who would we hire today as a future leader in business or engineering or technology or a balance of all for our company? What skills, competencies and attitudes would we look for? What mix of soft skills (people, leadership, and team), technology and business process skills would we expect? What about ethics, integrity, communications, diversity and a better understanding and acceptance of global diversity and cultures and being able to tap virtual global brains located anywhere and anytime? What about acceptance of and the proactive sponsorship of innovation, entrepreneurship, intrapreneurship and managing change? In assessing the market needs for the purpose of re-inventing the contents of the degree program, we always kept these questions in sight.

In general, we also established the following wish list for the graduates of the TM program to be able to accomplish once they were in the workforce:

- Identify and evaluate the impact of relevant changing technology and managing those changes effectively in organizations.
- Develop strategies and plans to identify, develop and implement innovative technological based solutions.
- Manage the effective planning and execution of those technology based initiatives and the integration of their results into the mainstream of an enterprises’ strategy, processes and operations.
- The application of technology to create wealth as in successful entrepreneurship and/or intrapreneurship initiatives.
- Develop future leader and managers.
- Develop, lead and motivate high-performance and diversified global teams.
- Champion and sustain innovation initiatives and environments.
- Manage accelerating change proactively.

As part of our market research, we reviewed about 20 leading edge university programs offering either graduate TM or equivalent degrees such as Engineering Management, Management of Technology, Manufacturing Management, Information Technology well as MBA or MS degrees offered by leading edge business schools relating to some aspect of technology (e.g. Information Technology, Health Care Management and Technology, Supply Chain Management, New Product and Venture Creation, Entrepreneurship and others. We focused on universities that had both Schools of Business or Management and Engineering. Some of the schools that were reviewed included: Carnegie Mellon, Columbia, Stanford, University of California, MIT, Stevens Institute of Technology, Polytechnic University, University of Maryland, University of Connecticut, Syracuse University, Worcester Polytechnic, George Tech, Case Western and others.

The University of Bridgeport formed the Center of Inter-disciplinary Business, Engineering and Technology Leadership (CIBETL) to validate the need for more effective inter-disciplinary education programs to meet the growing employment needs of industry and government organizations. The CIBETL Executive Board of Advisors consists of senior executive and management professionals from the private and public sectors to provide advice and guidance on the direction and content of the CIBETL graduate education programs from an industry perspective. The responsibilities of the CIBETL Executive Board are as follows:

- Help shape the direction of inter-disciplinary education and training by suggesting ideas for new courses, degree and certificate programs.
- Support important research in the inter-disciplinary business, engineering, education technology fields through grants, contributions and other services.

- Fund raising and in kind services such as equipment/hardware/software donations or time allocated to help market the UB programs.
- Give guest lectures, participate in colloquiums and/ or consider becoming an executive-in-residence
- Hire interns, hire graduates, sponsor students to the program, etc.

Select CIBETL member companies, include Applied Engineering Products, ATMI, Avon, Boehringer-Ingelheim Pharmaceutical, Cigna, Columbia University Graduate School of Business, Connecticut Center for Advanced Technology (CCAT), EMCOR, ESPN, Fuji Film, USA, Gartner, GE Corporate, GE Asset Management, GE Real Estate, Halbrecht Lieberman, IPC Corp., People's Bank, Perdue Pharma, Pitney Bowes, Oracle, Sikorsky Aircraft, TNT Expense Management, UBS Financial, Unilever and others.

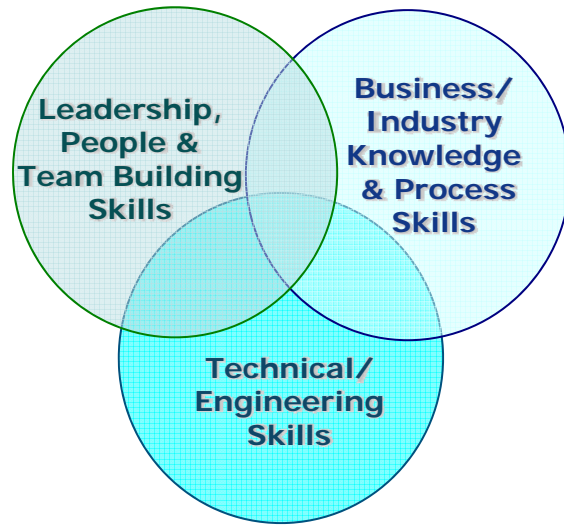
We conducted a survey of these and other companies to better understand what characteristics and skills they look for in business, engineering and technology graduates. The respondents checked the attributes (all that applied) in the following order of importance:

- 70% Ability to communicate (oral and written) more effectively
- 59% Strategic thinking, planning and marketing
- 54% Ability to lead and motivate staff and teams
- 50% Understanding business processes, operations and basic financial knowledge
- 22% Understanding industry trends & business strategy
- 14% Thorough knowledge of technology options
- 12% Negotiation skills
- 12% Technical proficiency

During our research, we discovered that many of the engineering universities did not offer courses in many of the above areas. We also conducted a short survey of select UB engineering school graduate alumni, who were in the work force. They strongly supported and re-enforced the findings identified by the CIBETL board organizations.

In our TM program modernization efforts, we wanted to assure that the Master's Program was designed to develop leaders adept at managing technology dependent organizations, technological change, and skilled in establishing and maintaining superior competitive advantage for their respective enterprises. The UB Technology Management Program was specifically designed to develop inter-disciplinary skills and competencies in: the management of technology dependent businesses and enterprises, global markets and business development, leadership and people skills, new product, service and venture creation, managing change and innovation proactively, strategic, tactical and project planning and execution and many other skills. The program integrates the following disciplines as illustrated in Figure 2:

Figure 2 - Inter-Disciplinary Business, Engineering, Technology & Leadership Competencies



The Transformation of the MS in Technology Management Degree Program as Part of the Newly Formed Graduate Studies Division

As with most universities who want to institute major change involving multiple programs and schools, each headed up by a Dean, we formed a committee of high powered and action oriented faculty members, department heads and deans representing the Schools of Business, Engineering and Education to facilitate the development of multi and inter-disciplinary courses and programs that would leverage the offerings of all of the participating schools and facilitate the promotion and delivery of these programs from a marketing and administrative perspective. We also recognized that we could achieve economies of scale by cross-listing courses in several programs.

The Graduate Studies Division at the University of Bridgeport was formed in 2006 and is comprised of the Schools of Business, Engineering and Education & Human Resources.

It was established to offer new and exciting inter-disciplinary graduate degree concentrations, dual graduate degree options and professional graduate certificates in a variety of growth oriented fields. These innovative inter-disciplinary programs provide students with a variety of career enhancement options responsive to growing employer and employee needs for multiple competencies and skills in tomorrow's demanding global professional work force.

The School of Engineering at the University of Bridgeport offers the M.S. in Technology Management. Based on the market research we conducted in 2006, we completely redesigned the core course curriculum and offered 27 new or revised industry relevant concentrations to UB students. The Technology Management program requires a minimum of 31 credits to earn a graduate degree. Many of the core courses were redesigned to cover multiple, but yet inter-related topics as validated by the CIBETL Board. In addition, we developed a number of new courses and concentrations such as

environmental and energy management, program and project management, bio-technology sciences and management, service management and engineering and others based on industry and market input. The degree requirements are listed in Figure 3:

Figure 3 -MS – Technology Management Core Courses & Elective Concentration Choices*

TM Core Courses	Choice of Concentrations & Electives (27 Choices)**
<ul style="list-style-type: none"> • Marketing, Entrepreneurship & Innovation • Total Quality Management & Continuous Process Improvement • Finance & Accounting for Managers • Leadership, Teams and Managing Change • Global Program and Project Management • Business Policy and Strategy – Capstone and/or Project • Introduction to Graduate Studies (1 credit) 	<ul style="list-style-type: none"> • Bio-Technology Management • Computer, Networking, DBMS & Software • Data Base Management Systems • Electronic Commerce • Entrepreneurship & New Venture Creation • Environmental & Energy Management • Health Care Management & Administration • Information Technology Management • Manufacturing Management • New Product Development & Commercialization • Program & Project Management • Service Management & Engineering • Strategic Sourcing & Outsourcing • Supply Chain & Logistics Management • +++++
Required Courses: 7 Courses for Degree	4 Electives – Can be chosen

***Minimum Total Credits Required = 31 for Graduation**

The Technology Management degree prepares a student for many career choices and allows students to tailor their education options to prepare them for rewarding careers in business, engineering, consulting and/or management. The exciting and innovative degree concentrations include: Accounting; Automation and Robotics; Bio-Tech Management; CAD/CAM; China/India Trade; Computer Communications and Networking; Corporate, Government and Information Security & Continuity Management; E-Commerce; Entrepreneurship and New Venture Creation; Environment and Energy Management; Finance; Global Business and Marketing; Global Program and Project Management; Health Care Management & Administration; Human Resources Management; Information Technology; Intellectual Property Management; Management and Operations; Manufacturing Management; Modern Data Base Systems; New Product Development and Commercialization; Service Management and Engineering; Software Engineering; Strategic Sourcing and Vendor Management; Supply Chain Management and Wireless and Mobile Communications.

UB’s Technology Management program emphasizes hands-on involvement with business management and technology issues and opportunities through case studies, internships, and team and individual research projects. The program has established very strong relationships with industry in the last few years through an active Center for Interdisciplinary Business, Engineering and Technology Leadership Industry Advisory Board and intensive networking with local, regional and global companies.

Nothing happens in academia without great faculty. In the TM program, we are fortunate to have several faculty members who are top in their field and have helped to grow the program through their excellent teaching, research and service efforts.

To market these programs, we used both traditional and new ways to market our program. We also recruit heavily from the international arena. Over the past two years, the growth in size, reputation, quality, introduction of new and innovative career oriented programs, courses and research outcomes has been extraordinary. Student teams from the TM and MBA programs have won first prize in the State of Connecticut “Business Plan” competition in the last 4 out of 5 competitions and were awarded a total of over \$10,000 in prizes. The competition is open to all Connecticut based universities (e.g. Yale, UCONN, etc.) and is co-sponsored by the Connecticut Venture Group, Connecticut Innovations and the Department of Economic Development in the State of Connecticut.

The New Dual Graduate Degree Programs Linking the Schools of Business and Engineering

Another finding of our research was that companies were also interested in students who earned more than one Master’s degree. This further supported the inter-disciplinary nature of and direction of our programs and led us to the development of the dual graduate degree program options.

The Graduate Studies Division of the University of Bridgeport offers several dual graduate degree programs, offered jointly by the Schools of Business, Engineering and Education and Human Resources. Current dual degree offerings include the MBA (Masters of Business Administration), and M.S. degrees in: Computer Science; Computer Engineering; Electrical Engineering; Technology Management; Mechanical Engineering and Instructional Technology.

Dual Graduate Degree Programs typically reduce total required credit hours by eliminating redundant course requirements, which significantly accelerates the completion of two, often complementary, degrees more efficiently and with significant cost and time savings for the students.

Candidates for Dual Graduate Degree Programs are typically required to complete a total of 48 credit hours to satisfy the requirements of two masters’ degrees. Some Dual Graduate Degrees require a different number of credit hours. Figure 4 identifies the available dual graduate degree programs:

Figure 4 – Inter-disciplinary Dual Graduate Degrees offered by the Schools of Business, Engineering and Education

C.S./CpE	C.S./MSIT	CpE/MSIT	M.E./MBA
C.S./E.E.	CpE/E.E.	E.E./M.E.	M.E./T.M.
C.S./MBA	CpE/M.E.	E.E./MBA	T.M./MBA
C.S./M.E.	CpE/MBA	E.E./MSIT	T.M./MSIT
C.S./T.M.	CpE/T.M.	E.E./T.M.	Counseling & HR/MBA

*Legend: C.S. = Computer Science; CpE = Computer Engineering; MSIT = MS in Instructional Technology; M.E. = Mechanical Engineering; E.E. = Electrical Engineering; TM = Technology Management; MBA = Masters of Business Administration

The dual degree program prepares a student for many career choices and allows students to tailor their education options to prepare them for rewarding careers in business, engineering, consulting and/or education. A growing number of courses are also cross-listed between several of the above departments (ME and TM; MBA and TM, etc) so that students can easily register for them, without getting the prior permission of the department heads thus saving time, sharing teaching resources and reducing the overall cost of operations.

The dual degree program has also experienced steady growth over the last year and is attractive to both students and corporations.

More Career Choices and Opportunities for Inter-disciplinary Degree Students

Based on the remarkable growth and success of the inter-disciplinary focused TM and Dual Graduate degree programs so far, we are providing greater flexibility and choice for our graduate students. In fact, some students will decide on technical careers, while others will decide on management and consulting careers, while still others may choose entrepreneurship and start their own businesses or choose a combination of the above. Figures 5 and 6 illustrate the various career choices we have prepared our graduating students for, depending on their objectives, interests, capabilities and motivations:

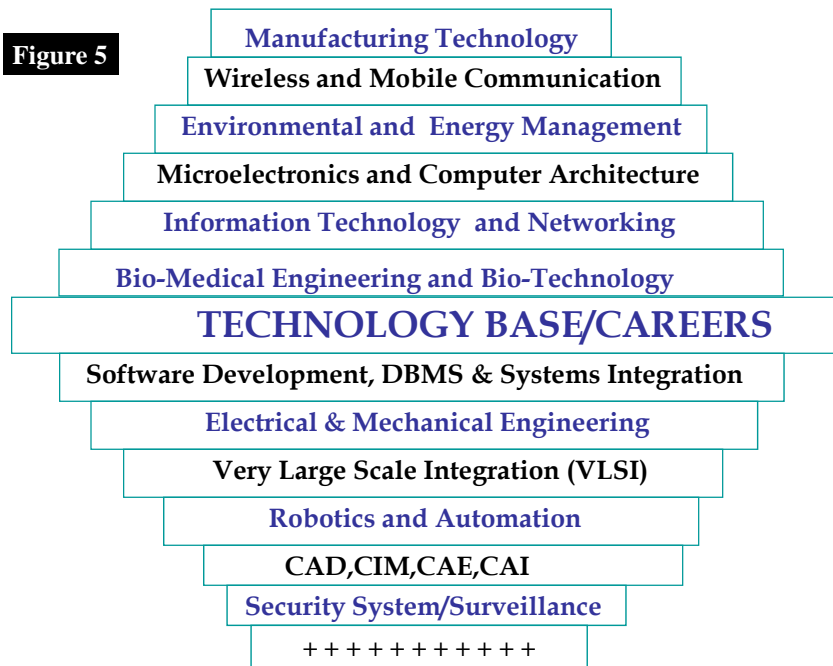


Figure 6



What's Next?

Success is a wonderful thing. We will continue to refine and update the TM program in terms of new and industry relevant courses and concentrations and continue to grow it organically and through alliances with other international universities. We plan on expanding our cross-listed courses in multiple disciplines.

We also believe that a PhD Program in the broad area covering Management of Technology as an interdisciplinary program with a core set of courses and multiple concentration tracks integrated across several graduate schools represents an appropriate next step for the University of Bridgeport on our journey to become a world class education institution. This will include the Schools of Business and Engineering at a minimum, and perhaps others as well.

Biographical Information

Dr. Gad J. Selig is the Director, MS in Technology Management and Dual Graduate Business/Engineering/Technology Degree Programs at the University of Bridgeport. He teaches graduate courses in Business Strategy, Marketing (including Internet Marketing), Information Technology, Global Program and Project Management, Entrepreneurship, New Product Development and Commercialization, Strategic Sourcing and Outsourcing, Leadership and Managing Change. He has authored two books and over 50 articles and conference proceedings. His graduate student teams at the University of Bridgeport won the State of Connecticut Business Plan competition two years in a row. He earned degrees from City, Columbia, and Pace Universities in Economics, Engineering, and Business. He is a dynamic and popular speaker at industry conferences in the U.S. and abroad. He is currently writing his third book, which should be published in 2008.

Dr. Selig is also the Managing Partner and founder of GPS Group, Inc., a consulting, research and education firm that focuses on strategic marketing and growth, business and technology transformation, new product development/product management, IT strategy and governance, program/project management and strategic sourcing. Clients include Fortune 1000 companies and government agencies. Dr. Selig holds a Top Secret Clearance with the U.S. Federal Government.

