

An Experiential Approach to Preparing Students for Leadership in Managing Technology

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Technology is a fundamental source of competitive advantage. Yet, its management remains a major challenge. This is because effective management of technology not only requires a deep appreciation for technical knowledge but also a high level of proficiency in management skills. Traditionally, engineering schools have trained individuals in technology, and business schools have prepared individuals with management skills. But this disconnected model fails to address the challenges of integration between technology and management. Also, most technology management programs have tended to focus on content-oriented education, which places more emphasis on gaining knowledge rather than the development of skills. Nevertheless, it is clear in the marketplace today that management skills are essential for exploitation of technical knowledge to its full potential.

At the University of Minnesota, we have addressed these challenges with an experiential learning model. Specifically, the course entitled “New Product Design & Business Development” is a university-industry partnership offered jointly by the Institute of Technology (i.e., school of engineering) and the Carlson School of Management (i.e., school of

business). The primary objective of this course is to prepare students for leadership in managing technology in an increasingly multi-functional environment. With this goal in mind, we train our students with the necessary skills for them to become leaders or key members of multi-functional product and business development teams, or members of startup teams for their own businesses or for a client as a technology consultant. Contributing to that objective are the following goals: (1) delivering value to sponsoring companies by developing successful products and businesses (or halting the development of likely losers), and (2) improving the practice of management of new product development itself by enhancing knowledge of that process.

The course is organized as a “technology consulting operation” with the students as members of consulting teams, members of the faculty as the senior partners, sponsoring companies as clients, members of the faculty as senior partners, and all activities supported by an experiential curriculum. Each team is required to develop a working physical prototype of a product and a comprehensive business plan for its commercialization as the final deliverable for their client firm. All generated intellectual property is owned by the

sponsoring company! The following is a brief description of the four key elements of the course: multifunctional team, interdisciplinary faculty, sponsored project, and experiential curriculum.

Multifunctional Team

The course begins in the fall semester with 30-40 graduate students, about half of whom come from engineering disciplines and half from the management school, and continues for nine months until the end of the spring semester. Engineering students include first- and second-year students in mechanical, industrial, electrical, and biomedical engineering who are enrolled in either master of science (MS) or doctoral (PhD) programs in engineering. Management students are typically second-year MBA and MHA (master in health care administration) students concentrating in a wide range of areas including marketing, operations and management science, finance, and information and decision sciences. To provide focus and in-depth learning experience, the class is broken down into five to six consulting teams each assigned to a single product development project. Each team consists of an equal number of engineering and business students to ensure a balance of technical and managerial competency and to foster development of mutual respect for each perspective. In addition, each team includes a dedicated faculty advisor and at least one corporate mentor from the client company. The presence of the faculty advisor ensures close faculty supervision and intimate faculty student interaction. The corporate mentor represents the client perspective and provides the team with access to client resources.

Interdisciplinary Faculty

The course is taught by a team of interdisciplinary faculty to provide a multifunctional view of technology management problem. Members of the faculty team come from marketing, operations, information systems, finance

and entrepreneurial studies within the Carlson School of Management; from mechanical and electrical engineering and the departments of surgery, physiology, radiology and emergency medicine from the Medical School; from independent professionals in the product/business development community; and from practicing attorneys. In addition to presenting the course content to the students, various members of the faculty are also responsible for coaching a project team either as a primary or secondary advisor. Additional mentoring comes from the executives and technical personnel from sponsoring companies. Coaches provide instruction in business creation, product design and development. They also have overall responsibility for seeing that the teams set appropriate, realistic goals and proceed towards them on a timely schedule. The interdisciplinary nature of the faculty team not only brings in a wealth of experience and expertise in the classroom that is not possible with any single instructor, but the team also sets a standard for teamwork for the students. Substantial sharing of project experiences among the entire class and faculty takes place, with frequent project reviews emphasizing specific aspects of each project. The composition of this faculty team has varied over the years somewhat, but not extensively over the past nine years that the course has been offered.

Sponsored Project

Projects are selected very carefully by the sponsoring company in consultation with the course faculty to ensure that they provide the most appropriate educational experience for the students and the greatest chances for successful outcomes for the sponsoring company. To ensure that the primary objectives of the course are met, only projects with a balance between engineering and business challenges are accepted for participation. Also, preference is given to projects that can be completed by a small student team within a nine-month time frame. The best results for all stakehold-

ers appear to come from projects in which the general area of application is identified, but specific product requirements are left to the team to decide so members have an opportunity to conduct complete engineering and business analyses.

Projects may include both industrial and consumer products—almost half of the previous projects involving design of medical devices reflect the dominance of this industrial sector in the greater Twin Cities area. Sponsoring firms include large multi-billion-dollar corporations, mid-size firms, as well as start-ups with less than a million dollar in sales. This cross-section of sponsoring corporation has provided students exposure to a rich variety of issues related to both entrepreneurship and corporate venturing.

In addition to providing a product design and business development project, our agreement with sponsoring companies requires them to provide (1) company personnel to work as mentors with the student-faculty team, (2) support for the project at levels comparable to their internal projects, and (3) payment of a course fee that partially offsets the extra cost of instruction for this course. In return, sponsoring companies have exclusive ownership of all intellectual property that may be developed in the course of the project including one or more working prototypes, a detailed engineering report, and a complete business plan. A list of completed and on-going projects and the names of the sponsoring companies are available on-line at the course Web site.

Experiential Curriculum

The curriculum combines intensive project work with classroom instruction designed to integrate technical knowledge and management skills, as well as to encourage reflection and learning from these experiences that can be generalized. The course content is designed around a new product design and business development project. Students are required to identify market opportunities, develop product concepts, assess

technical and market feasibilities of the concepts, develop a working prototypes and ultimately a single comprehensive implementation-ready business plan. Specifically, students are required to provide two sets of major deliverables: (1) a product concept and a report assessing its feasibility at the end of the fall semester and (2) a working prototype and a business plan at the end of the spring semester.

Unlike the traditional content-focused approach to learning, the content is not delivered as lectures. Instead, the course content is delivered through a process that consists of a series of workshops, guest speakers, student presentation, and extensive project works. The deliverables present a set of tangible outcomes to focus on and play a key role in the learning process. The four major deliverables (e.g., product concept, feasibility study, working prototype, business plan) are broken down into a series of smaller interim deliverables that can be completed in a one to four week time-frame. Workshops and guest speakers are keyed to each interim deliverable so that students can immediately apply concepts presented in class to practice. The process requires students to go through a series of action and reflection sequences individually and collectively, and at the same time, make progress towards completion of the major deliverables. The process helps the students not only to learn what to do but also how to do it. A detailed description of the interim deliverables and the associated course topics are available at the course Web site.

The course meets twice a week, on Mondays and Wednesdays. It is scheduled early in the morning between 8:00 a.m. and 9:30 a.m. to avoid potential scheduling conflicts with the diverse group of academic and business executives. The timing also allows part-time MBA students to participate in this course. Students meet as a class to participate in workshops, listen to guest speakers, make presentations, and share information with the class on Mondays. They meet as a team with

their faculty advisor and executive mentor on Wednesdays. Teams usually have an additional meeting every week without any faculty supervision. Thus, in addition to their own projects, students participate continuously in constructive critiques of others' projects; and in presentations, case discussions, and workshops that help them learn about the product and business development process itself.

This course differs from typical classroom courses in new product/business development in that it includes both didactic instruction and a full-scale project supported by sponsoring companies' dollars and personnel. It differs from typical project-driven courses for several reasons: the degree of classroom-based instruction, the full exposure students have to both to their own projects and to those of all other teams, the sense that projects consist of real-world activities in which the university-industry team acts as an outsourced product development unit, and the duration of the course—an entire academic year. This "experiential learning" activity differs from cooperative programs in which students alternate working for a single company with formal coursework in that our course integrates both coursework and project activity on- and off-campus, and exposes students to the detailed workings of multiple project teams. The course is entirely managed on-line. All documents related to this course including syllabus, schedule, description of all deliverables, past and present projects, is available on-line at www.npd.bd.umn.edu.

Conclusion

We described an experiential approach to preparing students for leadership roles in managing future technologies. The course titled "New Product Design & Business Development" is an example of university-industry collaboration for preparing the next generation of leaders. The course has been a win-win proposition for the University of Minnesota as well as for the business community. For the university, the

course offers a unique opportunity to the students for sharpening their business and technical skills on a real product development project under the close supervision of a faculty advisor and an executive mentor. For the corporate sponsors, the program provides access to a talented pool of students and a world-class faculty for addressing their technology management problem. During the past nine years, students have completed close to 50 projects for the sponsoring companies, leading to several patents and new products introductions. Nevertheless, the primary products of this course are the students with their balanced perspective of technology and management.

During the past nine years, more than 300 students have graduated from this course. Although the course is focused on new product design and business development, the knowledge and skills acquired by the students have a much wider applicability. Students have learned to manage projects, assess the potentials of new technologies and markets, prepare budgets and financial plans, design prototypes, and develop manufacturing plans. In addition, the students develop skills in working in teams, communication, and leadership. Overall students' evaluation of the course has been extremely positive and the placement record has been exciting. In addition to receiving job offers from sponsoring companies, these students are sought by companies who place a premium on managers who are at home in both business and technical worlds.

Importantly, the course has also produced significant goodwill between the local business community and the university and is often cited as a model for university-industry collaboration. Several published articles in academic journals and newspaper stories have recognized the success of this course. Following are some anecdotal evidence of its success:

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Institute Meetings

The 35th Annual Meeting of the Institute will be held November 20-23, 2004, at the Boston Marriott Copley Place Hotel in Boston, Massachusetts. The submission deadlines were: Refereed papers, April 8, 2004; abstracts and proposals, May 1, 2004. Contact: Kenneth E. Kendall, Program Chair, Rutgers University, School of Business-Camden, 227 Penn Street, Camden, NJ 08102, 856-225-6586, dsi2004@crab.rutgers.edu.

The 2005 International Meeting of the Decision Sciences Institute will be held in July 3-6, 2005, at the IESE Business School, University of Navarra, in Barcelona, Spain. Submission deadline is February 1, 2005. Contact Marc Sachon, IESE Business School, University of Navarra, Barcelona, Spain, dsi2005@iese.edu.

The Asia Pacific Region will hold its 2005 Annual Meeting on June 28 - July 1, 2005, at the Grand Hotel in Taiwan. See the APDSI Web site at <http://www.calpoly.edu/~eli/apdsi/>

The Mexico Region will hold its 2004 Annual Meeting on October 11, 2004, at The University of the Americas in Cholula, Puebla, Mexico. Submission deadline was June 30, 2004. Contact Program Chair Felipe Burgos, The University of the Americas, Cholula, Puebla, Mexico, dsi@mail.udlap.mx.

The Midwest Region will hold its 2005 Annual Meeting on April 14-16, 2005, at the Radisson Hotel in Toledo,

Ohio. Submission deadline is January 21, 2005. Contact Program Co-Chairs Janet L. Hartley, Department of Management, Bowling Green State University, Bowling Green, OH 43403, (419) 372-8645, fax: (419) 372-6057, jhartle@cba.bgsu.edu; Mark Vonderembse, Department of Information, Operations and Technology Management, University of Toledo, 4044 Stranahan Hall, Toledo, OH 43606, (419) 530-4319, fax: (419) 530-2365, mark.vonderembse@utoledo.edu.

The Northeast Region will hold its 2005 Annual Meeting on March 30-April 1, 2005, at the Sheraton Society Hill Hotel in Philadelphia, Pennsylvania. Submission deadline is October 1, 2004. Contact Program Chair Fariborz Y. Partovi, Drexel University, Department of Decision Sciences, 101 N. 33rd Street, Academic Building, Philadelphia, PA 19104, (215) 895-6611, fax: (215) 895-2907, Partovi@drexel.edu. See the NEDSI Web site at <http://www.nedsi.org>.

The Southeast Region held its 2005 (35th) Annual Meeting on February 23-25, 2005, at the Raleigh Marriott Crabtree Valley in Raleigh, North Carolina. Submission deadline for regular papers and abstracts is September 20, 2004; the deadline for student papers is November 1, 2004. Contact Samia M. Siha, Program Chair, Kennesaw State University, 1000 Chastain Road, Building 17, Kennesaw, GA 30144, (770) 423-6709, fax: (770) 423-6606, siha@coles2.kennesaw.edu. See the Southeast Homepage at <http://www.sedsi.org>.

The Southwest Region will hold its 2005 Annual Meeting on March 1-5, 2005, at

the Hyatt Regency, Dallas, Texas. Submission deadline is September 15, 2004. Contact Chang-tseh Hsieh, SWDSI Program Chair, University of Southern Mississippi, Box 5178, Southern Station, Hattiesburg, MS 39406, (601) 266-4641, fax: (601) 266-4642, hsieh@cba.usm.edu. See the Southwest Homepage at <http://www.swdsi.org>.

The Western Region will hold its 2005 Annual Meeting on March 22-26, 2005, at The Sutton Place Hotel in Vancouver, B.C., Canada. Submission deadline is October 1, 2004. Contact Program Chair Bruce C. Raymond, Montana State University-Bozeman, College of Business, 412 Reid Hall, Bozeman, MT 59717-0004, (406) 994-4333, fax: (406) 994-6206, braymond@montana.edu, <http://www.wdsinet.org>.

Call for Papers

8th Annual International Conference of the Society of Operations Management will be held in Mumbai, India on December 17-20, 2004. Deadline for submission of the papers is October 1, 2004. Contact Jatinder N. D. (Jeet) Gupta, guptaj@uah.edu. <http://cas.uah.edu/guptaj/cfpsom.pdf>.

Conference of the Association for Business Simulation and Experiential Learning (ABSEL) will be held March 16 - March 18, 2005, at the Grosvenor Resort in Orlando, Florida. Submis-

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"One of the most innovative business school programs nationwide." (National newspaper)

"Students get experience that does not get any more real-world." (CEO of a company)

"You're really in the trenches and you can make a difference." (MBA student)

The success of this course is very much dependent on the close collaboration between the business, engineer-

ing, and medical schools, as well as the local area business community. Therefore, it should be possible to implement a similar course in any university having a business and an engineering school, access to a business community, and the spirit of collaboration among these partners. Finally, careful attention must be given to the contractual agreement between the sponsoring company and the university to manage expecta-

tions and to avoid unanticipated problems. However, the most important factor for the success of an educational program of this nature is the respect and the trust of the participating engineering and business school faculty for each other.

Web link: "New Product Design & Business Development" course documents, www.npdbd.umn.edu ■