Session 2642

Industry/Academia Collaboration: Developing a New Master of Science in Technology Management Degree Program

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Abstract

The University of St. Thomas graduate programs serve a working adult population centered in the Minneapolis/St. Paul metropolitan area. Degree programs in business, software, manufacturing systems and engineering are provided through a multitude of delivery modes including traditional classes, company on-site classes, use of remote public locations and distance learning. Strong ties exist between the university and industry, including the use of many adjunct faculty from industry.

While many needs of students and industry are being well met, feedback from these stakeholders indicated there was one area not being covered, particularly for the many high tech companies in the area. That need was in the area of strategic management of technology.

A team from the graduate academic programs and industry was formed to investigate the problem and develop a solution. This working group developed a flow chart of the technology decision process, identified the activities and skills needed at each stage of the process and tied those to topics and courses. The result is a Master of Science in Technology Management degree program.

The draft of this program was then reviewed with many local industries, which made revisions and the final draft sent to local industry leaders for written comment. The resulting support has been widespread, from a broad spectrum of industry. The need has been verified and introduction of the program is being greeted with enthusiasm.

Introduction

It should come as no surprise to anyone that there are two, interdependent major changes occurring in our economy. One is the rapid development of technology of all types: obvious examples are in microelectronics, telecommunications and biotechnology, and there are many less well-publicized examples such as new materials developments.

The other major area of change is globalization of business of all types.¹²³ We constantly see expansion not only of sales to all areas of the world, but manufacturing and product development as well.

¹ Thurow, Lester, <u>Head to Head</u>, Wm. Morrow, 1992.

² Khosrowpour, M. and Karen Loch, "Global Information Technology Education: Issues and Trends." Series in <u>Global Information Technology Management</u>, 1993.

³ Yates, Loyd, "Management of Technology in the United States: An Overview of Selected Issues", <u>Journal of</u> <u>Studies in Technical Careers</u>, V14(2), pp. 75-86, 1992.

It is not a coincidence that globalization and technology are interdependent. Globalization relies on technology to expand. To compete on a global basis requires responsiveness and speed provided by technology developments in telecommunications, manufacturing systems, software, etc., for increased speed in product development and exchange of information throughout the supply chain. It also requires improved use of other new product and process technologies.

Similarly, technology is driven by the desire to globalize. To become or remain competitive, industries must adopt new technologies faster than their competition. Companies must incorporate appropriate new technologies into their products and into their manufacturing and business processes. The relationship is synergetic.

At this time, technology is ahead of the game. We have been incredibly successful at developing technology. There is more technology available than industry knows what to do with. This is reflected in the increased number of degree programs being developed to meet the need for training in technology management.⁴⁵⁶

However, with the proliferation of technology, and the rapid pace of change in technology, there is a great deal of uncertainty. Uncertainty about which technologies will dominate, uncertainty about what the competition is doing; uncertainty about how to assimilate new technology, and when to discard the old.

And that is the problem. How can industry manage technology? How can it make decisions in a timely manner that can make or break their business? The risks are great, the rewards even greater.

It was this situation that led to the development of the new Master of Science in Technology Management degree program at the University of St. Thomas (UST). UST has been purposefully responsive to industry over the past twenty years by developing graduate programs for working adults. It has introduced Graduate Programs in Management, Software, Manufacturing and Engineering which rank among the leading programs in enrollment in the US, and which have been well-received by industry.

UST has dealt very well with many aspects related to technology development and globalization. Two options available to students have been an MBA with a concentration in Manufacturing, and a Master of Science in Manufacturing Systems. While these have met part of the need, increasingly students and industry have asked for a more focused degree on technology management. They are experiencing challenges in managing and leading change in an environment fraught with uncertainty. They want to address today's challenges, helping their managers cope. And they want to develop future leaders, their managers of strategy. This situation contains many of the aspects identified by Lester Thurow in *Head to Head.*^{*i*} Thurow

⁴ Kocaoglu, Dundar, "Engineering Management: Education Strategies for Leadership in Technology Management", <u>Industry and Higher Education</u>, Vol. 10(6), pp. 332-36, Dec. 1996.

⁵ Campbell, Adrian and Malcolm Warner, <u>New Technology, Skills and Management</u>. <u>Human Resources in the</u> <u>Market Economy</u>, Routledge, Chapman and Hall, 1992.

⁶ Magney, John, "Preparing Technicians for the Management of Technology," ATEA Journal, Vol. 23(4), pp. 8-11, Apr-May 1996.

maintains that, to become globally competitive, we need to develop leaders who are comfortable with technology and understand the challenges of managing cultural change. Explicit in this belief is that education is the most important component of this challenge.

Industry/Academia Team

A team from industry and the graduate programs in business, software, manufacturing and engineering was formed in the summer of 1996. The work of this team has been critical to the creation of a timely, relevant program.

Students currently have two choices for degree programs, which partially address technology management issues. They are a Master of Manufacturing Systems Engineering (MMSE), Master of Science in Manufacturing Systems (MSMS) or a Master of Business Administration (MBA) with a concentration in manufacturing. The initial input from students was that they wanted a degree program with 1) more technology than the MBA with a manufacturing concentration and 2) more business than the Master of Science in Manufacturing Systems. See Figure 1 for the relative positioning of each degree. Student Decision Level refers to the strategic importance of decisions which students are responsible for in their company.



Figure 1 – Student Decision Level vs. Program Technical Depth Masters Level Degree Programs at UST

Growth of students in the current degree programs has been following the typical performance curve for a need, which is beginning to be met by new technology. The signs were clear that a new S-curve was upon us, Figure 2.

Performance Curves for Two Generations of Technology



Source: SRI International

Figure 2 – Performance Curves for Two Generations of Technology

Early discussions within the industry/academic team identified the need to develop a model for the technical decision process that is needed to manage technology. A six-step process was identified as the primary model. It is shown in Figure 3. For each step in the process, we developed associated activities, skills and knowledge necessary to carry out that function.

Technology Management

Process Flow Diagram



Figure 3 – Technology Management Process Flow Diagram

From this analysis, a list of topics was developed which were subsequently formed into courses and a curriculum. For example, for Identification of Technology Needs and Applications, the analysis shown in Figure 1 emerged.

Block Activities	Recognition of new technologies needed in the market. Most will be market driven; some will be technology driven; still others will be futuristic. Methods to identify are paramount.
<u>Skills</u>	 Understand core business technology Market understanding Organizational skills Technology forecasting and assessment Management of technical people Managing the informal organization Inter/intranet systems Environmental scanning
<u>Courses</u>	 Marketing Technology forecasting and assessment Environmental safety Management of technology and innovation Knowledge resources

Figure 1 – Identification of Technology Needs and Applications

This curriculum was then compared to other technology management and similar degree programs in other institutions throughout the world. In a sense, it was reassuring to find that our process led to very similar content as other curricula, yet it was developed from local needs. There are two primary, and we believe significant, differences with our program. One is that this program will be very applications oriented, as are our other graduate programs, using industry-experienced personnel as faculty. They bring a real-world flavor that has been a distinguishing characteristic of our offerings.

The second significant difference is the incorporation of the Aspen Executive Seminar experience in our program. The University of St. Thomas is one of few organizations outside Aspen that offers this program for executives. Using selected writings of great classic and contemporary thinkers as the starting point, students discuss the enduring ideas and ideals of world civilization, the problems and opportunities of today and the issues to be faced in the years ahead. The readings, covering such universal human concerns as justice, freedom, economic equity, community, leadership and democracy, function as case studies in leadership and leadership values. It is believed that this broad foundation is a requirement to develop judgment skills needed for the wise management of technology.

Industry Review

To test the model, presentations were made to over 20 executive groups in local industry. The Twin Cities is home to many excellent companies such as Honeywell, 3M, Medtronic, Cargill, Seagate Technology, ADC Telecommunications, General Mills and scores more. It is from these

companies that our students come. Therefore, it is to these companies that we went to validate our model.

The response was very strong. While there were suggestions made for modification, the basic approach was extremely well received. We found that many companies were looking for just this kind of curriculum, particularly for professional development of their leadership. The team working on this proposal, driven by input from students, had developed a "product" that seems to meet a current market need.

With this input, small modifications were made, a final curriculum was developed and the degree was positioned as shown in Figure 4. The final proposal was then sent to key industry leaders for comment. Hosts of letters of support have resulted. While it was not a surprise that the level of interest was high, it was somewhat of a surprise of the extent of interest. We expected engineering and manufacturing groups to be interested: we were surprised and delighted to see the strong response received from Intellectual Property and Information Management functions.



Figure 4 – Degree Program Overlap Chart

In retrospect, it really is no surprise. All functions within the business enterprise are feeling the impact of technology growth and globalization, and all are challenged to take action. The manufacturing enterprise is not just he factory floor anymore, it is part of the larger supply chain, Figure 5.

Supply Chain Model



Figure 5 – Supply Chain Model

In some respects, those trained in engineering may be in the most able to adopt the changes in technology. Yet many with non-engineering education are also challenged to manage change, which is largely a cultural issue subject to the widely varied responses of individuals to change, most of which is negative. Machiavelli observed some 500 years ago that "*There is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success, than to take the lead in the introduction of a new order of things, because the innovator has for enemies all those who have done well under the old conditions, and lukewarm defenders in those who may do well under the new.*" More recently a veteran philosopher, speaking on the same subject, was quoted saying "I've been around a long time; I've seen a lot of change: and I've opposed darn near all of it." In managing technology, it is clear that the task ahead is not trivial.

Summary

The University of St. Thomas's Technology Management Program is a new master's degree program offered by the Department of Manufacturing Systems and Engineering with course offerings jointly by the Graduate Programs in Manufacturing Systems and Engineering, the Graduate School of Business and the Graduate Programs in Software.

The importance of technology, both as an asset and as a determinant of success for the total enterprise, is a core concept of the Master of Science in Technology Management Program. The program is dedicated to the linkage of technical and business cultures as integrated functions of the technology-based organization and to the establishment of an innovative environment which will include the creation to application spectrum of technology development.

In order to bridge the gap between technology and business domains, the program has a strong cross-functional focus that rests upon coursework from technical and managerial disciplines. A Capstone Course and an Aspen Institute leadership workshop for synthesis of this integrated learning experience provide the opportunity.

The audience will be the degreed individuals with (or seeking) engineering management, manufacturing management or general management responsibilities with strategic leadership positions in manufacturing, science-based or technology dependent firms.

There are six recurrent themes framed by the objective of integrating the technological and business cultures:

- 1. Integrating technology into the organization's strategic plan;
- 2. Promoting cross-disciplinary team building and total quality management;
- 3. Managing technology-driven change;
- 4. Promoting an environment conducive to change;
- 5. Developing integrated systems; and
- 6. Promoting global thinking.

The program deals with the issues and methodologies involved in innovation, technology transfer, bringing new technologies to market, the integration of technology into the strategic objectives of the firm, managing technical resources, finance, international science and technology and business issues, and many other subjects critical to business success. The courses have broad systems with technology focus and business courses with emphasis on technology strategy and implementation.

The curriculum for this degree increases career competency in the strategic management of technology in an intellectually rigorous program that promotes cultural awareness. As in our other programs, applications are stressed to show relevance and verify theory. An ethical approach to business is embedded in every course and encourages the pursuit of lifelong learning. The program is being initiated as a result of the local industrial community's need, driven by the rapidly changing technological environment. This degree program, like other graduate degree programs at the University of St. Thomas, fulfills a niche market need for specialized knowledge and skills.

There are some key objectives that are part of each course in the curriculum, without which the program will not completely fulfill its mission. In addition to specific knowledge and skills developed in each course, all have embedded the following:

- Develop confidence
- Increase risk-taking ability
- Instill quality in every aspect of the enterprise
- Build ethical responses into all decision-making

It is through the selection and training of faculty that these objectives must be accomplished. Industry-experienced instructors who have first-hand knowledge of the implications of decisions are the heart of the current programs, and will continue to be in the Technology Management program. Our major challenge will be in recruiting and developing this cadre of faculty. Past experience indicates we will succeed at this goal.

Endnotes

¹ Thurow, Lester, <u>Head to Head</u>, Wm. Morrow, 1992.

² Khosrowpour, M. and Karen Loch, "Global Information Technology Education: Issues and Trends." Series in <u>Global Information Technology Management</u>, 1993.

³ Yates, Loyd, "Management of Technology in the United States: An Overview of Selected Issues", <u>Journal of</u> <u>Studies in Technical Careers</u>, V14(2), pp. 75-86, 1992.ⁱⁱ

⁴ Kocaoglu, Dundar, "Engineering Management: Education Strategies for Leadership in Technology Management", <u>Industry and Higher Education</u>, Vol. 10(6), pp. 332-36, Dec. 1996.

⁵ Campbell, Adrian and Malcolm Warner, <u>New Technology, Skills and Management</u>. <u>Human Resources in the</u> <u>Market Economy</u>, Routledge, Chapman and Hall, 1992.

⁶ Magney, John, "Preparing Technicians for the Management of Technology," ATEA Journal, Vol. 23(4), pp. 8-11, Apr-May 1996.

Biography

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