Developing a Technology Management Curriculum from the Perspective of Strategic Intent

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Universities throughout the country have become increasingly aware of the competitive environment in which they exist. The emergence of such functional units as extended degree learning programs, satellite extensions, online courses, and corporate education programs and a substantial increase in marketing and advertising campaigns attest to this age of competitive enlightenment. Recent and emerging demographic changes in birth rates and age distribution along with the emergence of colleges that utilize nontraditional delivery methods of educational services are capturing the attention of an increasingly limited pool of students, presenting a real threat to institutional homeostasis. Accordingly, institutions of higher education, similar to their private enterprise counterparts, find themselves with the unfamiliar task of *strategically* competing for students. It is imperative that universities understand the authenticity of this competitive environment and the entropic forces that it produces. Similar to the private sector, universities must realize the importance of developing programs and services that will not only sustain institutional integrity but also lead to competitive advantage. As Levine (2000) stated:

The survival of some institutions… will be increasingly threatened by both domestic and foreign for-profit institutions, as well as nonprofit competitors like libraries and museums that also have entered the educational marketplace. Moreover, technologies are encouraging the rise of global universities, which transcend national boundaries. The most successful institutions will be those that can respond quickest and offer a high quality education to an international student body. (p. 14)

Many different types of organizations are seeking ways in which to strategically utilize technology as a way to enhance their operational effectiveness and efficiency and to gain competitive advantage. However, there is a paucity of technology management programs within universities and colleges that offer comprehensive instruction on this topic. The absence of such programs represents an opportunity for academic institutions to respond to a significant environmental need through the development of a technology management program.

This article has two primary objectives. The first objective is to provide a basic definition for technology management. There is a lack of common understanding and definition of technology management within the academic community. Technology management is more than just a conglomeration of courses. It has an identified body of knowledge that can be taxonomized and operationally defined. Technology management reflects the need to identify and comprehend radical changes that are occurring at historical, technological, and institutional levels of analyses that few perceive with clarity. We contend that it is precisely the ambiguity inherent within the current informational technology revolution that has created a critical need for programs that clarify, illuminate, and serve as a heuristic guideline for practitioners attempting to navigate their organizations through relatively unknown contours of the information age.

The second objective is to discuss how a viable technology management program can be used as a strategy for responding to student-client demands for management programs relevant to technology. We will attempt to describe the need to develop programs within the framework of *strategic intent*, a concept developed by Hamel and Prahalad (1993), which emphasizes the importance of systematically integrating strategy and implementation processes to effectively accomplish organizational objectives directed towards obtaining strategic advantage.

Technology Management Defined

Even though there is empirical evidence that most private and public organizations perceive technology management as something that could help to improve their operations, there is no common or comprehensive interpretation of its meaning found among practitioners and academics (Steele, 1989). Technology management "links engineering, science, and management disciplines to address the planning, development, and implementation of technological capabilities to shape and accomplish the strategic and operational objectives of an organization" (Manufacturing Studies Board, 1986, p. 1). An axial idea inherent within this definition is that technology management is an interdisciplinary field of study. A point to be made here is that the interdisciplinary nature of technology management is more than an academic construct or another cross-functional team approach within management. Rather it is a radically different conceptual and methodological management framework that addresses the critical need to understand the convergence between the idiosyncrasies of an information society and new modes of organization. The industrial era featured vertical and horizontal fragmentation of

tasks and coordination as the primary means of organization. This mode of production represents not only the structure of management practice but consists of the superstructure that permeates institutional, cognitive, and individual action. In short, it became the *industrial paradigm*. This deeply ingrained mindset is a major factor contributing to the inability of individuals to perceive and understand the new integrative principles that are inherent within the information history. This in turn has promoted a fragmented and myopic viewpoint of technology and how it is managed. Steele (1989) stated that there is a

> definite need for an integrated view of technology, which in turn treats it as a closely linked system. This system spans the spectrum from creating new knowledge to servicing a product after it is sold. It includes the work to invent and develop products, the processes needed for their manufacture or delivery to customers, and the information processing inherent not only in all of these activities but also in the functioning

of an entire business. Technology pervades all aspects of an enterprise, and effective management must recognize its pervasiveness and its crucial role in establishing competitive advantage and even survival. (p. 6)

This new integrative perspective of both technology and management has been extremely difficult to grasp, not only among practitioners, but also within academia, whose educational structures, in fact, also reflect the orientation of the industrial paradigm. More specifically, academic processes are organized according to highly fragmented fields of study or disciplines. What emerges from this fragmented context is an academic orthodoxy that implicitly describes an approach for creating courses that appear to be addressing environmental directions and needs. The outcome, however, is normally a disjointed and fragmented course program that does not comprehensively satisfy environmental concerns. This is due in large part to the lack of development of an identified body of knowledge. Universities recognizing the need to incorporate some aspect of tech-

nology management into their curriculum, particularly for their technical programs, have traditionally added one or two courses within already existing programs of study. For example, Stanford University added management training to engineering, Massachusetts Institute of Technology has chosen to integrate management and engineering, and Harvard University has chosen to incorporate technical awareness into its management programs (Bahouth, 1994). However, technology management and the knowledge objectives that it addresses are far too complex for this fragmented approach. It is not one or two courses that can be integrated into existing curricula. Rather, technology management is a discipline in and of itself (Ulhoi, 1996) that contains an interdisciplinary body of knowledge, and when considered as a whole, is far greater than the sum of its disciplinary parts.

Technical Management vs. Technology Management

It is commonplace for technical departments within colleges or schools of technology to define technology manage-

Figure 1. An integrated technology management curriculum.

ment as technical management. However, there is a distinct difference between technology management and technical management. Technology management seeks to:

- Integrate the knowledge of relevant disciplines into one interdisciplinary approach, thus imparting a more comprehensive understanding of the management of technology.
- Develop a macro perspective of the interface between technology, organization, and management.
- Create a broader perspective of technology that goes beyond the boundaries of one's technical orientation.
- Develop technology management skills that are applicable to nonindustrial settings as well as industrial settings.

Technical management, in contrast, is much more narrowly focused within its knowledge base. Its objective is to create an *understanding* of management principles *within* a certain technical area such as engineering or industrial technology. Management topics such as project management would receive considerable attention within technical management. While *technical skills* such as project management would be incorporated within a technology management curriculum, they would be subordinate to its objective of developing cognitive abilities for understanding the new management genome of the information age. This cognitive framework is expressed in Figure 1. This figure describes the need for students to possess an *integrative* understanding of technology and management. More specifically, the wheel circle connects each of the courses and indicates that each of the courses is not an isolated topic of knowledge. Rather, the information that is presented within each course is systematically integrated to the core themes of technology management. This integrative understanding is imperative for managing the paradoxes that exist within the information society. These paradoxes consist of the simultaneous

coordination of:
- Organizational stability and change.
- Quality and work process efficiency.
- Organizational flexibility and standardization of work processes.

These management dichotomies were recognized within the industrial management paradigm as conflicting forces. Within the information age, they are perceived as elements that must be simultaneously integrated in order for an organization to be effective. Indeed, they form the bases for strategic and competitive fecundity (Burgelman, Madique, & Wheelwright, 1995). Technology management concerns itself with the creation of conceptual frameworks that provide instruction on the basic elements of this integrative managerial viewpoint. It further enunciates the ways in which technology can be systematically utilized by organizations as a strategic lever for integrating this dimension into their processes.

Technology management should be approached much more systematically. Systematic program development would include the development of an entire curriculum on this topic and not just a few courses haphazardly scattered throughout the university. Most important, technology management should be thought of as a strategic initiative for the university or schools of technology. We will now direct our attention to this idea.

Strategic Intent and Technology Management

It is well recognized that technology management is a vital skill set for the modern manager. Universities are supposed to be the training fields where managers are prepared for future battles (Bahouth, 1994). Currently, however, there is a discrepancy between what organizations require of their managers in terms of this skill and what universities actually offer. This void within the environment should be seen as a strategic opportunity for universities. Strategy refers to how an organization manages its relationship with its environment

(Robey, 1995). Strategic intent relates to creating strategies with the objective of winning (Hamel & Prahalad, 1993). While universities are familiar with strategy making, the idea of directing this activity towards other educational entities with the "intent" to gain competitive advantage is unfamiliar territory.

The most salient idea underlying strategic intent within the context of this article is that it emphasizes the need for universities to devote more than marginal attention and resources to developing their technology management curriculum.

> The concept also encompasses an active management process that includes: focusing the organization's attention on the essence of winning, motivating people by communicating the value of the target, leaving room for individual and team contributions, sustaining enthusiasm by providing new operational definitions as circumstances change, and using intent consistently to guide resource allocations. (Hamel & Prahalad, 1993, p. 22)

In short, in addition to first recognizing that technology management could be used to ascertain competitive advantage, the key to effective deployment would be to systematically link its strategic intent and its implementation to daily management practices (Mintzberg, 1994; Witcher & Butterworth, 1999).

A General Framework for Establishing Strategic Intent for Technology Management

Modern day organizations face a very dynamic environment for which it is imperative to rethink antiquated strategies that were more aligned to stable conditions. In general terms, this environment requires strategies that will deal with the issues of:

- Flexibility
- Innovation
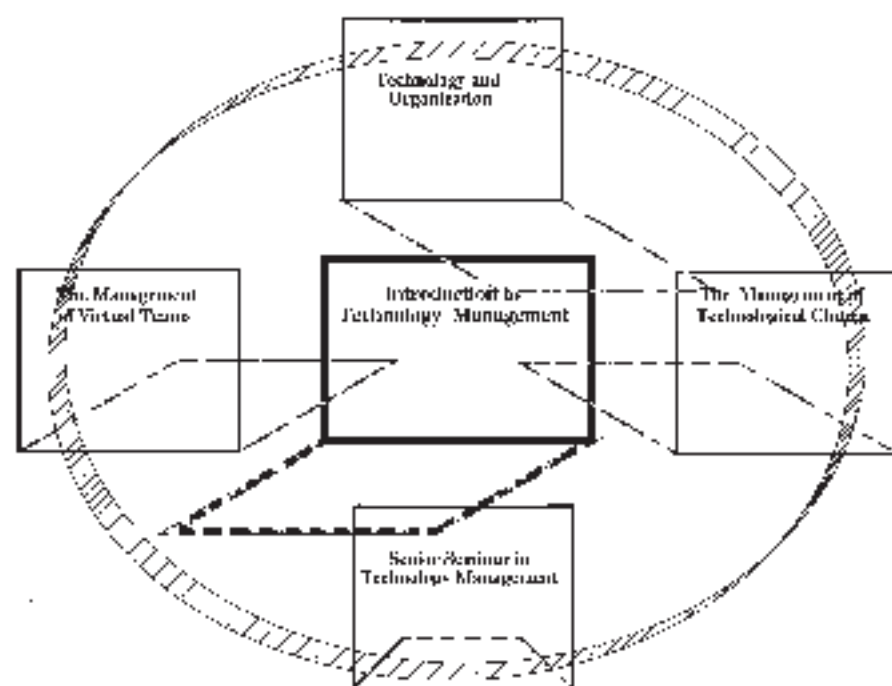- Product cycle time
- Quality

Table 1. Proposed Technology Management Curriculum Core of Courses.

Course 1 Introduction to Technology Management	Course 2 The Management of Technological Change	Course 3 Technology and Organization	Course 4 The Management of Virtual Teams	Course 5 Senior Seminar in Technology Management
• Linking the Environment, Technology, & Mgt. • The Interdisciplinary Structure of Tech. Mgt. • The New Management Paradigm • An Overview of New Manufacturing Technology and Management • An Overview of New Information Technology and Management • Theories of Technology Management	• A Socio-Technical System Approach to Techn. & Organizational Change • Strategic Intent and Technological Change • Technology Planning and Implementation • Human Resource Mgt. and Technological Change • Quality Processes	• Technology and Departmention • Organizing for Flexibility • The Matrix Organization • The Meta-Business • Platform Teams • Information Tech. and New Org. Designs	• Characteristics of Virtual Teams • Computer Mediated Communication • Electronic Coordination Mechanisms • Analyzing Groupware • Managing Telecommuters • New Supervisory Practices	• The Strategic Management Process • Developing Strategic Intent in Tech. Mgt. • Project Mgt. & Information Technology in Strategy Implementation • Senior Project

The authors will attempt to establish a conceptual discussion on technology management relative to strategic intent by utilizing these concepts as guidelines.

Innovation and Quality

Strategically speaking, the innovation of products and services is intended to create global leadership for an organization among its competitors. The authors strongly believe that a technology management program can create this result for a university if packaged correctly. Quality factors dictate the content of the program. Quality would pertain to the need for creating a program that fully addresses the concerns of the external client while simultaneously maintaining a clear sense of academic integrity. Although courses exist within several disciplines that reflect some dimensions of technology management, a core of classes is needed that more fully represents the integrative nature of technology management.

Table 1 illustrates an example of the type of courses that this core could com-

prise (this core may be utilized at the undergraduate or graduate levels). Taken altogether, these courses emphasize the need to explore technology, management, and organizational change at deeper levels of analyses than traditionally practiced. This is a dimension that is unquestionably missing within many programs, yet is critical for shedding light on the new management paradigms of the information age. The first course within this core, Introduction to Technology Management, sets the conceptual framework for the entire program by attempting to delineate the processes of aligning history, technology, and social organization that is imperative to understanding effective organizational change within the 21st century. It also provides a broad understanding of the impact of new technology on management systems and processes. (For example, what is the impact of new developments in bioengineering on the food industry and what impact does it have on the ability to obtain strategic advantage?)

While various courses are offered in other disciplines that relate to these factors, they exist in isolation. This course brings these ideas together in *one* course with the *specific* intention of integrating them into technology management.

Course 2 describes the structure and processes for systematically planning and implementing technological change. This course integrates micro, intermediate, and macro levels of organizational analyses. Course 3 provides an overview of how to strategically align technology and organizational design. It represents the macro approach to technology management.

This core provides more comprehensive coverage on emerging technological topics such as "virtual teams" (Course 4). This topic is so new that it questions the fecundity of traditional management frameworks and principles currently being taught in colleges of business. It certainly deserves more than the peripheral attention commonly given within management courses.

The primary objective of the final course within this sequence of core classes, Seminar in Technology Management, is to give students the opportunity to integrate the knowledge ascertained within the other four courses. This will be accomplished by using experiential group projects that realistically simulate the integrative management perspective of technology management. Creating linkages between corporations and other organizations with this course will greatly facilitate the realism and learning objectives of these projects. The course will give comprehensive instruction on project management. However, project management is deployed within this class as a technological lever for accomplishing the group projects as opposed to a stand-alone course.

The authors feel that this core balances the need for academic integrity and practical relevance. Equally important is its ability to incorporate both manufacturing and service-type organizations. The majority of technology management programs are directed at the manufacturing/engineering market. The service sector accounts for approximately 70% of the gross national product within the United States, and it also utilizes around 80% of all information technology equipment and software produced (Bahouth, 1994). However, the service sector has been relatively unrecognized within technology management. Approaching the service sector definitely has the potential of affecting strategic advantage (Porter, 1994).

Another salient dimension of quality pertains to the importance of actively interfacing with external organizations for determining their technology management needs. This means that universities will have to take their product *to the market*, which challenges traditional expectations that the market will accept whatever universities produce. As stated by Fawcett, Smith, and Cooper (1997),

firms fail in their quest for competitive success because they too often fail to recognize and understand customers' real needs—making the identification of appropriate competitive priorities very difficult—and they are unable to focus their efforts and resources on activities that add real and distinctive value. The essence of competitive success can thus be summarized as selecting customer appropriate strategic priorities and then developing the corresponding operational excellence that leads to high levels of customer value. (p. 411)

Although the authors are referencing the private sector, these comments are directly applicable to institutions of higher education. This requires the need to strategically create flexibility within the university's operating structure and delivery system.

Flexibility and Product Cycle Time

Flexibility refers to an organization's capability of adapting rapidly to the demands of its environment (Cambell, 1998; Upton, 1995). This encompasses the ability to:

1. Produce different services and products simultaneously.
2. Alter the rate in which services and products are produced.
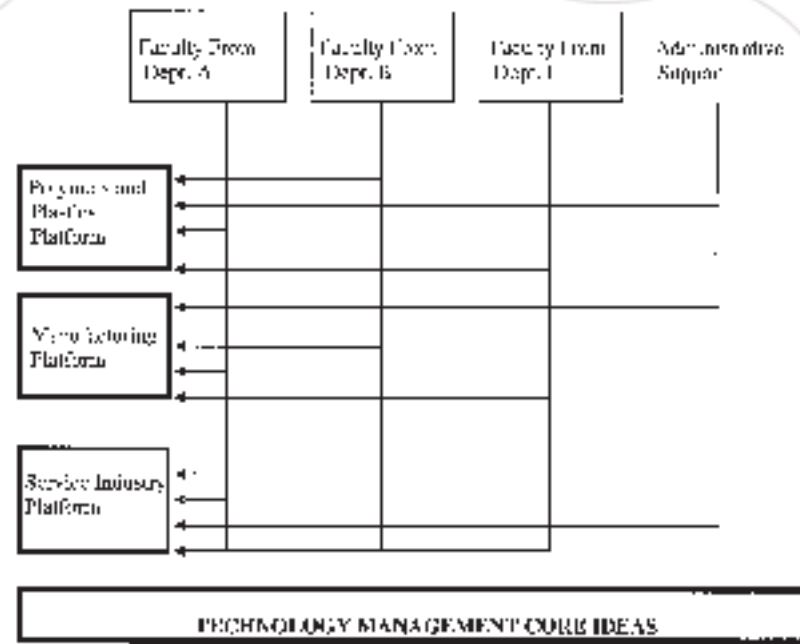3. Adapt to varying delivery rates of services and products.

The organization's structure, processes, and technology primarily affect these dimensions of flexibility. The highly fragmented and specialized structures commonly found within academia are not amenable to establishing the flexibility that is needed to adapt the technology management core (and electives) to the specific demands of varying clientele. Furthermore, it does not facilitate the reduction of cycle time, which is clearly a strategic factor. Product cycle time refers to the time it takes to design a product or service, test it, and deliver it

to the market or client. These concepts as they apply to academia relate to developing and delivering new programs. Fragmentation of structure also undermines this capability. The problem is accentuated by course adoption polices, organizational culture, and political battles commonly found among academic disciplines involving the protection of subject domain.

Establishing strategic intent for a technology management program would involve radical changes within academic structures in order to create processes that would lead to flexibility. This would require the development of true interdisciplinary structures that would integrate relevant knowledge and processes and reduce the time for program development and delivery. Using private industry as an example, Chrysler's platform team structure, which consists of individuals representing all the relevant functions for designing, prototyping, and manufacturing a line of automobiles, has enabled the corporation to secure competitive power though innovative design and the reduction of product design cycles (Kisiel, 1998; Lutz, 1994). Universities can accomplish similar outcomes with a technology management program by developing interdisciplinary platforms consisting of both faculty and support functions from relevant disciplines and administrative groups within the college and/or university aimed specifically towards identified client needs. This would allow the university to take better advantage of its "core competency" (Hamel & Prahalad, 1994) of diversified knowledge which in and of itself can be considered a strategic factor.

Figure 2 presents a hypothetical example of a platform team structure that is based on the objective of developing market-oriented technology management programs within the College of Technology at Eastern Michigan University. Three development platforms are illustrated: polymers and coatings, manufacturing, and service industries.

Figure 2. Model of a technology management platform structure.

Each platform would consist of faculty from relevant departments within the College of Technology who would be responsible for:

• Market analyses of the type of technology management programs that organizations within each sector are requesting.
• Utilizing the technology management core of classes as an organizing framework, develop customized technology management programs based upon specified organizational needs.
• Developing the administrative processes necessary to support the developed programs.

We recognize that there are a large number of administrative tasks and obstacles that must be systematically planned for in order to operationalize this type of structure. We don't have the space in this current article to discuss these matters. Our intent is to postulate a possible academic structure that would have the capability of supporting the dynamic processes cited within our framework of strategic intent.

Concluding Remarks

The ideas presented within this article are only intended to alert academic planners of the possible competitive benefits of raising their technology management programs to the strategic level. This will require systematic research on the ways in which other institutions are approaching this subject in order to accurately formulate a technology management strategy and objectives (Hitt, Tyler, Hardee, & Park, 1995). Universities have commonly focused on the advertising dollars spent by other educational institutions and have adjusted their advertising budgets accordingly. However, this is not a complete definition of competition. In other words, competing refers to competing for the future by creating innovative services and products that exceed those of the competitors. Technology management represents such a product.

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