ENTERPRISE INFORMATION SYSTEMS CURRICULUM MODEL FOR MULTIDISCIPLINARY INFORMATION SYSTEMS PROFESSIONALS

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INTRODUCTION

A number of major trends that will impose significant impacts on the education for Information Systems (IS) graduates. In this paper, three important trends are identified to have profound influence on the IS education: the fast changing workplace, information technology revolution and rapidly emerging information systems management philosophies. Responding to these trends, this research proposes a model for the design of a new cross-disciplinary IS curriculum, especially focusing on the integrated enterprise information systems design courses, to well fit up the IS students with required skills and marketable knowledge. With the proposed curriculum model, a new breed of IS discipline, called the *Multidisciplinary Information Systems*, is to emerge and will be playing a pivotal role in the rapidly changing workplace.

BACKGROUND AND LITERATURE REVIEW

It is perceived that a number of important trends are dramatically reshaping the future workplace in many areas (Kiechel, 1993). Among those, the most significant one is that the traditional hierarchical organization will yield to horizontal organization structures (Byrne, 1993 and Baker, 1994). Modern organizations are gradually migrating to decentralized decision-making and streamlining the fundamental business processes. The traditional management pyramid hierarchy will be smashed and the whole organization is being broken down into a number of core business processes that are run by key process teams comprising members from different conventional organization units. This can be referred to as *horizontal corporation* (Byrne, 1993). Based on this notion, instead of creating a structure around conventional business functions, the company will be built around core business processes with specific common business goals, measurable performance objectives, and critical success factors. Key business process teams will make up the principal building blocks of the entire organization. This emerging horizontal organization structure is characterized as flexible networks of knowledge nodes which are interconnected with advanced computers and communication technologies that span across different organizational boundaries (Ives, 1993). In a

horizontal organization, knowledge workers will work collaboratively in self-directed, multidisciplinary teams (BusinessWeek, 1993). As a result, a horizontal corporation will demand people who can think more broadly, thrive on change and challenge, attack on open problems, and most importantly, are well equipped with cross-functional knowledge and skills. It is also suggested that the horizontal organization structure needs a new line of workers who can work and communicate effectively and efficiently with others and fully conceive the role of modern information technologies in knowledge creation, collaboration, and communication (Alavi, 1995). Many recent IS graduates have received complaints from their employers for not being able to envision a bigger picture of the whole enterprise and even entire value systems. This lacking of "enterprise view" will result in the misalignment of their information technology planning with the actual business missions. As a result, most of the fresh IS graduates are usually considered as inadequate team players in performing cross-functional projects. Miscommunications and misunderstanding might occur frequently resulting from this insufficiency of cross-functional versatility. Therefore, a thorough understanding of multidisciplinary knowledge and skills is extremely critical for modern IS graduates as a source of competitive advantages (Slater, 1995).

The U.S. industries are now experiencing fierce pressure of competition from every corner on this planet. The multiplied competitive pressure may mean the gradual decline in market shares for U.S. business. Furthermore, magnifying this tension of ferocious marketing race, the overall productivity in U.S. industries has been dropping in recent years further. This productivity dilemma has been realized as a result of a failure to effectively coordinate the operations of the individual automation of islands in the entire enterprise and supply chain environment to form a synergistic whole. Consequently, this elevated competitiveness has forced many companies to focus on team-oriented organizational structure (Alavi, 1995).

Recently, we have been gradually experiencing another notable shift from the industrial age to the information era. The rapidly emerging computer and information technologies have tremendously alter the way of running business. These eventual implications of information technology revolution are likely to be much more significant and influential than those of the first industrial revolution of the early 1800s. For most today's organizations, the key to success is the ability to effectively use, deploy, and manage those cutting-edge information technologies (ITs) to streamline their key business processes. Some research findings suggest that the current IS curriculums in many universities are not perfectly aligned with actual business requirements and are lag in keeping pace with the critical new IT development (Lee, 1995). IS students are required to possess broader and more in-depth education across various dimensions of emerging ITs. Consequently, how to mold IS students into shape preparing them to be able to race competently on tomorrow's information highway becomes a vital ISsion of the IS education (Leidner, 1995 and Silver, 1995).

Numerous organizations have been encountering a challenge in how to appropriately apply the state-of-the-art business and information systems management philosophies to their information systems planning, design, implementation, and deployment. In this research, some of the emerging management philosophies are suggested to incorporate into the new IS curriculum model, including *Supply Chain Management (SCM)* (Chopra, 2000), *Computer-Integrated Manufacturing (CIM)* (Bedworth, 1991, Hewitt, 1995, and Mitchell, 1991), *Enterprise Resource Planning (ERP)* (Computer Associates 1996, Vollmann, 1993), *Concurrent Engineering (CE)* (DeLorge 1992), *Business Process Reengineering (BPR)* (Cypress, 1994 and Hammer, 1993), and *Total Quality Management (TQM)* (Schonberger, 1987). A more extensive understanding of these management concepts will help IS students spark out-of-the-box thinking in the design and management of contemporary enterprise information systems.

PURPOSE OF STUDY

When it comes to realizing sustainable *Enterprise Information Systems (EIS)* solutions, as discussed previously, it is often necessary to conduct the systems analysis and design based on different approaches and from various angles. In other words, most of the EIS design problems must be solved from multi-faced, multidisciplinary perspectives. This has pointed to a strong need that the modern IS students not only need to equip with the basic knowledge and skills in their own discipline, but they also require to appreciate and recognize what other disciplines can contribute to their solutions. In addition, students need to learn how to work collaboratively on team-driven projects in a multidisciplinary environment.

Nevertheless, most of the IS applications design educational environments are characterized by strict disciplinary boundaries. Collaboration is seldom taught in traditional IS education. To address this need, this paper proposes a new curriculum model attempting to take down the walls before the IS discipline and other fields of expertise. In this paper, the original concept of the proposed Multidisciplinary IS curriculum model is the consolidation of knowledge from different disciplines. Besides the traditional core courses in information systems, a number of courses of other disciplines are recommended to incorporate into the IS curriculum, including Production & Operations Management, Decision Sciences, Management Sciences, Systems Engineering, and Industrial and Manufacturing Systems Engineering. The new curriculum model will not just be a simple junction of knowledge in those disciplines but a synthetic, holistic one. The proposed curriculum model will dissolve the boundaries between different disciplines, which facilitates the implementation of the so-called horizontal corporation concept. In addition, the new IS curriculum integrates a number of the best of mainstream information technologies (cooperative and collaborative computing, client/server computing, blackboard systems computing and object technology) and management philosophies (SCM, CIM, CE, BPR, TQM, etc.) to meet the current and future needs of multidisciplinary IS education. The proposed model will also create an effective learning experience for students through the critical thinking and

collaborative design and building process. Students can learn to explore novel concepts, tackle new problems, and arise new issues in their application design practice. The proposed curriculum model will give birth to a new tribe of IS graduates, referred to as *Multidisciplinary IS (M-IS)* professionals. These M-IS professionals will be those managers-to-be who will make to order for the new horizontal corporation.

RESEARCH QUESTIONS

As mentioned earlier, the elevated global competitiveness has forced many organizations to focus on team-oriented organizational structure (Alavi 1995). Therefore, it is advocated that the whole business environment should be viewed from a new perspective instead of sticking with the orthodox ways of management. To reflect this advocacy, the first research question addresses in this paper is how we can innovatively restructure the IS curriculums to ensure the success of prospective IS graduates in the team-oriented working environments.

A thorough understanding of multidisciplinary knowledge and skills is extremely critical for modern IS graduates as a source of competitive advantages (Slater 1995). In this paper, the second research question discusses how knowledge from different disciplines should be consolidated and incorporated into the modern IS curriculum, cohesively and holistically.

A more wide-spread understanding of the cutting-edge management concepts will help IS students spark innovative thinking in the design and management of contemporary enterprise information systems. The third research question focuses on exploring the potential applications of some of the most influential management philosophies to deliver a viable EIS design methodology as well as on how the onset of these new management concepts can be best evaluated and applied in the IS academic setting.

METHODOLOGY

The methodology for developing the proposed EIS design curriculum for Multidisciplinary IS education is make up of two key components:

- enterprise information systems design principles
- integrated enterprise information systems design laboratory settings

ENTERPRISE INFORMATION SYSTEMS DESIGN PRINCIPLES

A number of influential management philosophies mentioned previously, including SCM, CIM, CE, BPR, and TQM, are introduced as viable systems design methodologies for the integrated EIS design in an interdisciplinary, collaborative computing environment. Furthermore, the TQM philosophy is specifically recommended as an implementation catalyst for the development of interdisciplinary IS program itself.

Supply Chain Management

The interest in supply chain management (SCM) is dramatically increasing in both business and academic sectors. SCM is a relatively new buzzword in management philosophy. Initially, the notion of supply chain is referred to the flow of materials (or goods) from their sources (the suppliers) to the company of interest. This initial supply chain concept describes the so-called *demand chain* that depicts only a portion of the entire picture. To form a virtual corporation and a true value system, the term has later been escalated to integrate the multiple levels of *supply chains* and *demand chains* into a single concept. A simple model of a supply chain can then be portrayed as the flow of materials (or goods and services), information (data), and funds (payments) in between the suppliers, factories, warehouses, distribution centers, wholesalers, dealers, and the end customers.

> ***Curriculum Focus.*** *With the mindset of collaboration and cooperation, a Web-enabling multi-tier client/server computing environment should be provided for IS students to conduct value system-based EIS design project focusing on planning, organizing, and coordinating all the supply chain's basic flows and underlying activities (including procurement, manufacturing planning and control, logistics and distribution, warehousing and inventory management, order management, etc.)*

Computer Integrated Manufacturing (CIM)

The CIM concept (Aguiar 1995) is concerned with utilizing a shared database and computer control to achieve a high level of integrated flow of otherwise stand-alone organizational activities or so-called islands of automation (starting with the initial stages of marketing, sales, forecasting, product model design, planning and encompassing the final stages of manufacturing, packaging, and shipping.) With CIM implementation, those islands of automation are linked into a *distributed processing system*. Applying the CIM concept helps break the barrier among different disciplines, which facilitates the creation of a multidisciplinary arena that synthesizes all previously isolated disciplines for the provision of an optimum, overall system.

> ***Curriculum Focus.*** *A set of CIM laboratory projects is necessary to provide IS students with a powerful tool in procuring a comprehensive portrait of the entire system and exploring underlying integration issues in a CIM environment, such as information integration, functional integration, physical integration, etc.*

Concurrent Engineering (CE)

Conventional design process is considered as a serial process in which the design is passed through the various production modules in the product life cycle. However, if a change in design or any customer requirement is necessary, the design needs to be returned to the antecedent production stage(s) and the process is recurring. This

repetitive process will tremendously attenuate the productivity and production efficiency. As a result, many companies are now engaging more time up front in the inceptive stage of product design cycle in order to save even more time downstream in the subsequent stages of production planning and manufacturing (Shina 1991). Similar to the SCM and CIM concepts, CE emerges to meet this need attempting to tear down the walls between previously autonomous automation units in a typical organization. CE is an original design approach advocating the simultaneous development of products and their related manufacturing and support processes (DeLorge 1992). More precisely, the essence of CE is to form a true marriage of market research, product design, production planning, and manufacturing, to support a much more effective integrated systems design. This approach aims to cause developers, form the outset, to take all elements of the product life cycle into account, embracing both manufacturer and customer requirements in terms of design specifications, manufacturing capabilities, quality, reliability, performance, costs, time, etc.

> ***Curriculum Focus.*** *The CE design component, incorporated with the CIM concept, should be integrated into EIS design laboratory projects by collaborating concurrently multidisciplinary teams in various areas of an integrated system. To put the CE concept into practice, the EIS design teams will learn how to bridge the islands of automation and to cooperate through the marketing, engineering design, production planning, manufacturing, and all the support activities. In addition, a unified process should be built and enforced to ensure all the business requirements are met throughout the entire enterprise. The CE practice will help students ignite innovative thinking in streamlining and reengineering critical processes for the developed enterprise information systems.*

Business Process Reengineering (BPR)

Business operations in modern organizations are becoming more and more intricate. The use of advanced information technologies has been suggested to help tackle this increasing operational intricacy. However, most computerized companies are still suffering from inferior performance due to ineffective business processes and inefficient operations . Without fundamental business reengineering, solely computerizing these ineffective processes cannot completely eliminate the performance deficiency problems. As a result, it is extremely important to have evolutionary uses of the advanced information technologies to make the IT applications as a reactant for a thorough overhaul of the underlying business logistics, operations, procedures, work flows, control mechanisms, and organizational structures.

> ***Curriculum Focus.*** *The potential use of the BPR concept in EIS development projects has two-fold impacts. On one hand, students will learn how to improve business productivity and performance through the use of ITs and computer applications and how the business processes themselves are reengineered. On the other hand, the other focus is on how the BPR concept can be applied in*

improving the quality of information systems by overhauling the systems design and development life cycle. Students will learn how to increase EIS development productivity and performance by applying the BPR principles to both the processes that students use to build computer-based information systems and the business processes that information systems automate. Going through the critical thinking process, without tangling existing principles, concepts, assumptions, methods, procedures, constraints, and resources, students learn to apply the reengineering concept starting from the future and work backward in the systems design projects. Employing the BPR principles, the students further learn to enhance the essential business processes through the effective use of cutting-edge information technologies to achieve breakthrough in performance and efficiency.

Total Quality Management (TQM)

One of the important trends which will reconstruct the prospective workplace is the move from a product-oriented business paradigm to a service-oriented or customer-oriented business paradigm (Schonberger 1987). Addressing this trend, TQM will play an important role in moving the companies to a higher level of business achievement. Generally, TQM refers to a complete organization-wide commitment to a customer-focused continuous improvement in the quality of its services. Through TQM training, students exercise to develop customer-oriented applications through teamwork and collaborative efforts. In addition, they learn to streamline the computer-based systems development life cycle by continuous improvement and problem solving processes.

Curriculum Focus and Setting. *Not only TQM can be used to train IS students to be the future leaders of quality management, more significantly, but this concept also can be adopted to run the IS program itself. Based on the feedback from students and faculty members as well as the expectations of the industrial society, the TQM philosophy can be applied to the continuous improvement process in the development of higher quality IS courses.*

RECOMMENDED INTEGRATED ENTERPRISE INFORMATION SYSTEMS DESIGN LABORATORY SETTINGS

As one of the integral parts of the new IS design-based curriculum, a model of integrated EIS design laboratory settings is proposed, especially for the development of *Distributed Client/Server Based Enterprise Resource Planning (DCS-ERP)* systems. Three important keys to the success of the laboratory implementation are identified as:

- A series of collaborative project-based laboratory assignments are necessary for students to fully practice the synthesized use of the suggested management philosophies and information technologies for the design of integrated, concurrent, and cooperative information systems for effective enterprise resource planning in a horizontal corporation environment.

- To create comprehensive, interdisciplinary applications, besides the IS students, the diverse participants from other disciplines are required to be in a team to complete complex information systems and cross-functional business application building projects.

- A simulation-based implementation tool is needed in order for students to receive their lab exercises in simulation environments to precisely fine tune the developed systems and keep them more in line with the business requirements in real world.

Collaborative Learning Environment

As mentioned previously, there is an increasing trend of decentralized decision-making in today's business. IS managers need to help smooth the transition from mainframe-driven central computing systems to cooperative and distributed computing systems. As companies go from vertical to horizontal structures, cross-disciplinary professionals are most wanted functioning as team coordinators. Pertinent projects are needed to provide IS students with computer-assisted cooperative work environments for collaboration in an synchronous mode among students in a core project team. With the use of CIM and CE concepts, students are put into cross-disciplinary teams conducting projects and case studies to simulate the cooperative workplace in a real-life company, where designers, engineers, managers, work hand in hand with employees from marketing, sales, and finance divisions.

Client/Server Computing Environment Design

The main purpose of this systems design building block is to assist students in harnessing the power of client/server (C/S) computing technology in designing integrated information systems as the core of computer network for rendering mission-critical enterprise-wide business solutions. A number of design components should be included in the design projects including distributed client/server database systems, computer networks, Intranet as well as Internet applications. Using the C/S technology, the entire lab computing configuration is broken down into client and server components. This will facilitate the implementation of collaborative application development and fully support the CIM and CE concepts. In the lab design projects, students will learn how to integrate the front-end client office software packages and the back-end server packages to fully exploit the flexibility, economy, and easy-of-use of micro-computers as well as the powerful processing and storage capabilities, higher degree of manageability and security, and resource sharing capabilities of larger computers such as mainframes or minicomputers. In this manner, students running their desktop/laptop computers on campus, at home, or on the road are allowed to access to the system across any network and are able to consolidate information from the inside the local area network as well as from the outside networks, and from the Internet. As a result, the proposed lab settings

are capable of supporting two basic types of team-based learning environments (local collaborative and distance collaborative telelearning).

To implement the TQM, CIM and CE concepts, a specific message exchange server is also indispensable to provide such essential communications functions as electronic-mail, group scheduling, electronic calendaring, and groupware capabilities (including bulletin boards, task management, and project tracking.) This will make it easier for students to share key information on the progress of lab project development. In addition, one of important components needed to be brought to the classroom is to let students exercise to establish strategies on how end-user development tools fit into corporate systems development and how they integrated with the use of backend server software tools.

CONCLUSIONS

The potential of adapting the recommended advanced information technologies and management philosophies to the process of multidisciplinary IS systems design-based EIS curriculum development is favorable. However, to ensure the success of this implementation, strong and continuing commitment among the people involved is extremely important. In the early implementation stage, the core team might contain only IS faculty members and students. Eventually, more students and faculty members from other disciplines will be expected to participate in the TQM continuous improvement process of curriculum development. To achieve directed change during the new curriculum development process, it is required to establish a planning group. The planning group must act to collect information, evaluate alternatives, and make decisions with respect to the perceived choices. An interdisciplinary program should be established through a cooperative effort. People involved might include but not limited to IS students, other business students, students from other disciplines, faculty, related industry people, as well as AACSB and ABET advisor(s).

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