A Competency Based MSIS Curriculum

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ABSTRACT

In response to the changing industry demands and increasing diversity of student needs when embarking on IS graduate studies, we determined that a fundamental redesign of the MSIS curriculum was necessary. We saw that the expanding IT universe now has more specialties than ever before while competitive forces simultaneously demand that firms keep costs under strict controls. Facing such pressures, firms demand more from IT professionals in the breadth and depth of their IT knowledge and skills coming from numerous knowledge domains. From these trends and issues we formulated the competency concept that forms the foundation for the new curriculum. A student earns a competency by completing four courses in a module. Now students can choose to pursue multiple competencies and can return to upgrade skills after graduation. We describe the process and issues we faced as well as the competency-based modular curriculum. We end with discussing the remaining issues that we are handling.

Keywords: Information Systems curriculum, IT competency, competency-based curriculum, IT workforce

1. INTRODUCTION

Today, IS faculty throughout the world faces the daunting task of educating professionals in the technologies and methods that will serve their career needs and their organization's requirements. Every successful innovation has spawned numerous job positions that require expertise. While some people will gain such expertise on the job, most people will want to get it from a higher education institution because it confers a level of known quality and reliability on the expertise.

In addition, employers are demanding more varied expertise from their IT professionals. A solitary expertise in one area is no longer a guarantee of success as an IT professional. Because firms shift their IT strategies and tactics in response to competitive conditions, they want employees with multiple skills, or competencies, who can be deployed in scenarios that are not yet known. Furthermore, the economic downturn and the loss of IT jobs to offshore outsourcing have led to enrollment declines in IS programs across the U.S. The multitude of concerns demanded a critical review of IS programs.

In the fall of 2004, IS faculty at DePaul University's School of CTI recognized that the MSIS degree needed an overhaul. Our MSIS program already offered seven concentrations, and yet the changing industry conditions seem to demand more concentrations. Proliferation of concentrations complicates curriculum management and narrows the scope of individual students' career options. Besides we knew we had to expand the number of core topics that all IS graduates needed to know to gain a broad technology foundation. So we embarked on redesigning the MSIS curriculum. We wanted a program that would let students pursue proficiency in more than one skill area, offer graduates follow-up education, and yet be flexible and easily updated for future innovations. We also wanted to develop a mechanism where we could monitor the needs of employers, students, and graduates.

This article discusses our design of a competency-based MSIS curriculum with a modular structure. In the following sections we describe our academic setting, the trends that sparked the redesign and the issues that resulted from the trends, the process we used in developing and implementing the new MSIS degree, and the characteristics of the new degree program. We hope that our experiences can assists others in their endeavors.

2. THE ACADEMIC SETTING

The IS faculty at DePaul's School of CTI is housed in a CIT (organization of computing and information technology) (Berghel and Sallach, 2004). All disciplines that rely on computing technologies are housed together in one academic

organization. Because all disciplines focus on IT in one way or another, our combined IT resources are more efficiently employed. An intellectual synergy exists because of the proximity of peers interested in technological problems. The School of CTI encompasses computer science, network technology, information systems, e-commerce technology, software engineering, distributed systems, computer graphics, human computer interaction, computer security, instructional technology systems, digital cinema, and computer games development. In total, there are 9 Bachelor of Science degrees, two Bachelor of Arts, 11 Master of Science degrees, one Master of Arts degree, three joint MS or MA degrees with other colleges, and a doctorate in computer science. While the MSIS program emphasizes technical courses and skills, it also offers those courses that develop the unique managerial skills needed to successfully design, develop, implement, and operate information technologies.

In the next section we examine the major developments in IT that ignited the curriculum redesign, and review some relevant past MSIS curriculum models.

3. TRENDS AFFECTING IT

In 2000, the job market went from a seller's market, where job offers were plentiful and employers were willing to hire and train people with limited technical acumen, to a buyer's market, where offers are few and a high standard of expertise is expected (VanLengen, 2003). What are the trends behind this shift? Here we detail some business and technical trends that guided our later thinking.

3.1 Business Trends

Several business trends have shaped the demand for IS services and skills:

Cost Containment Pressures. To remain competitive in a global market, firms are pressured to continually lower costs, particularly those costs associated with IS. Faced with such cost containment pressures, an IS department can be regarded as "a factory, with a limited supply of staff hours to meet the company's demand for IS output" (Murphy & Hays, 2003).

Growth of E-Business. Despite the fallout from dot-coms and the post-2000 economic downturn, the digital economy continues to thrive. It grows at a steady pace and has exceeded earlier projections. Forrester Research projects that online retailing during the next six years, 2004-2010, will double and reach a sale volume of $316 billion by 2010[1]. Internet commerce is finally "taking off," (*The Economist*, 2004) and Internet-driven business has become "a real business transformation because it survived the economic downturn" (Mullaney et al., 2003). American and European companies have steadily adopted a wide range of Internet-based business solutions (Varian et al., 2002). Among US companies, 70% of the enterprises in the wholesale/retail and the financial services sector, as well as 88% in telecommunications sector, have adopted e-business solutions such as SCM, CRM, and ERP, to improve productivity, operation efficiency, and customer support.

Offshore Outsourcing. Firms have increasingly adopted offshore outsourcing for supplying IS services to contain their costs. Offshore IS outsourcing has also emerged as a mainstream practice to achieve business agility. In the context of global competition, companies can use time zone difference to add a second or third shift. Thus, they can utilize local talents while reducing costs. Industry projections indicate that more than 80% of U.S. companies will explore offshore IS outsourcing and 40% will engage in pilot initiatives (Thibodeau, 2003). These outsourcing efforts will focus initially on low-end "commodity" work, such as legacy application maintenance, enterprise resource planning enhancement, application support, and help desks. Increasingly, companies may also use offshore services for project-based work in Web services and in enterprise system integration and implementation (Morello, 2004). The ITAA (Information Technology Association of America) 2003 Survey finds that programming and software engineering jobs are most likely to go overseas (67%), followed by network design (37%) and Web development (30%) (ITAA, 2004b). All told, offshore outsourcing will have a significant effect on the type and level of demand for IS skills.

Globalization. In the past ten years firms have expanded operations and sales across the globe. This globalization has increased both corporate and consumer IT spending while the consumer markets have become more important to the IT value chain with new wireless and mobile consumer digital devices, content and services (Shiffler, 2004). Recent ITAA (2004a) survey also reveals that multinational firms have used global sourcing to efficiently stage 24x7 operations, customize products and services to meet local needs, and deploy workers and facilities to geographically dispersed and competitive markets.

IT Job Market. During the period from March 2001 to April 2004, the IT industry lost approximately 403,300 jobs, while post-recession job loss accounts for 200,300 jobs (Srivastava and Theodore, 2004). Despite the economic recovery, IT job market is still experiencing slow rebound (ITAA, 2004b), as shown in an analysis of IT marketplace in six key metropolitan areas (Srivastava and Theodore, 2004). These trends have a significant impact on student enrollment in IS programs across the nation.

3.2. Technology Trends

Technology trends have also shaped the demand for IT and its associated services.

The Speed and Number of Innovations. Recently the number and variety of IT innovations increased dramatically. Many of these innovations require new skills for successful implementation and use. Yet, historically many innovations did not succeed due to poor implementation, so firms and IS professionals face risks in implementing these innovations. Currently, the following areas are recognized as trends, yet how many will become established is still unknown. Data mining and analytics is probably the least risky; it has now become a necessity for large corporate users who have been drowning in data. Wireless computing, peer-to-peer computing, and grid computing are still risky for many firms. (Subramanian and White, 2004).

Greater Use of Complex Application Packages. ERP, SCM and CRM are coming closer together with vendors offering modules that will integrate these enterprise systems. For those firms that pursue a "best of breed" sourcing strategy for enterprise systems, middleware is now available for linking disparate applications together (White, 2003). The needs of mid-sized firms are now met with "vanilla" versions of enterprise software (Pender, 2001). Smaller companies may seek service providers for "on-demand" computing. However, the trend toward greater complexity in enterprise computing has emerged as one of the top ten concerns of CIOs[2]

Greater Use of Methodologies Supporting Distributed Systems. Along with the use of object oriented languages such as Java, we see an increased use of object oriented modeling techniques such as UML for systems that will cross servers Distributed systems are now the norm for new applications development and for most enterprise systems. Thus, new IS positions often require knowledge of distributed systems basics. They also require knowledge of the uses and modeling techniques for designing distributed systems handling multimedia.

3.3 Curriculum Models

While numerous IS curriculum models exist, two models provide us insights that were very useful in developing our MSIS curriculum. In the MSIS 2000 curriculum model (Gorgone et al., 2000) one innovation in particular sparked our interest. The innovation was the inclusion of 16 career tracks after 5 core courses. This validated our view that information technology had grown so large, no one curriculum could handle the interests of the various IS professions. The MSIS 2000 curriculum envisioned the career track having four semester length courses that focus on a specialty within IT, such as Global IT Management and Telecommunications.

In 2002, a "generic web-centric Information Systems Masters curriculum model" was introduced (Gorgone and Kanabar, 2002). This new model describes IS as a rapidly changing field that "should integrate new domains of knowledge such as e-commerce and e-business." In this web centric model, the prerequisites also require proficiency in basic business and computer applications. The web centric model emphasizes more core courses than the MSIS 2000 curriculum, including web technology, web programming, building web services and project management in addition to the traditional topics (Gorgone and Kanabar, 2002). Thus there is a core of courses that pertain to a technical IS professional as well as a more managerial IS professional. However, one may consider the web centric IS curriculum as a specialized career track under the MSIS 2000 curriculum.

4. ISSUES FACING IS PROFESSIONALS AND IS EDUCATORS

4.1 Employers' Demands for IS Flexibility

The fierce competition facing most firms drives them to quickly introduce changes to their products and services to meet new customer demands. Many of these changes also impact a firm's IT infrastructure and how such infrastructure supports industry-wide collaboration. Traditional IT planning did not envision a nimble, flexible, and responsive infrastructure. Now IS professionals are asked to master new skills in IT architecture and systems integration, that did not exist a few years ago while still performing old skills. Furthermore, employees are valued for their ability to handle multiple roles, not for having an extensive mastery of only one role.

4.2 Employers' Demands for IS Experience

The demand for IS experience fluctuates with the state of the IS job market. When the market is "tight" with many positions going unfilled, then employers will settle by looking for candidates that have "potential." Employers will supply or pay for the training. When the job market is "loose," then employers demand that successful job candidates have experience under most circumstances. Latest ITAA survey shows that the single most important criteria for IT hiring is "pervious experience in a related field" (ITAA, 2004b). The one exception is when an employer wants expertise in a new area. Undergraduate IS students now routinely enroll in internship programs to gain this experience (Fang et al., 2004).

4.3 Rising Employer Expectations

Yet even with an internship, can a recent graduate be successful in the job market? A recent study indicates that internship and double majors are key items influencing full time job offers for BS graduates (Fang et al., 2004). Some graduate students have told us that they were continuing with MSIS with a specialization in "hot" topics so they would be more successful on the job market. Potential employers have told recent graduates that they need to have more experience. Hence, students continue with an MS immediately after receiving their BS.

4.4 Collaboration across the Industry Value Chains

Networking technology, and the Internet specifically, has made organizational boundaries more malleable. Organizations along an industry value chain have formed business webs, inseparable from the organization itself and the organization's business partners. This trend impacts IS organizations in several ways (Chan and Mirza, 2003). Information systems are now viewed as a web of IS modules that rely heavily on expanded enterprise systems as the backbone. Information plays a critical role in supply chain integration. IS users are more heterogeneous than ever because so many users are outside of the organization. Furthermore, in-house IS specialists' roles are shifting from building and maintaining internal systems to systems integration. These trends imply that IS professionals need to develop deeper understanding about inter-organizational behavior and about the inter-relationship between technology architecture and collaboration strategies.

4.5 Post-Master's Training

Another problem faced by IS professionals is the need to receive more training and skills after receiving their post-graduate degree. These professionals need to upgrade their skills periodically but do not want another graduate degree. They do, however, want documentation of achieving a

desired skill level. Because the technology is complex and requires sustained concentration to master, short one-week courses are rarely appropriate. So, the executive-type program that is popular in business schools is not an appropriate model.

5. PAST RESEARCH ON IS SKILLS

5.1 In-demand IS Skills

Taking a look at the job experiences of IS graduates over the past few years is useful in informing us what concerns of students and the IS market that the MSIS program must address. Looking at surveys from the past ten years on the desirable IS positions, the only constant is change. According to one report, the hottest jobs for BSIS grads are web developer, database administrator, security analyst and UNIX administrator (Davis, 2003). Another report states that some better choices are project management, security, and wireless networking (Hoffman, 2003). Another survey of hiring organizations showed that having skills (in order of preference) in Java, C++, C, C#, and Visual Basic were the most sought.

Outside of programming, competency is highly prized in "operating systems, networking (Web and management), database and SQL, systems implementation and testing, and systems operation and maintenance (VanLengen, 2003)." Yet another study found that a networking-oriented internship was a key item that influenced job offers for recent graduates (Fang et al., 2004).

To discover what the expected IS skills and knowledge would be three years in the future, Noll and Wilkins (2002) surveyed three groups of IS professionals: programmers, analysts and end user support staff. Their results show that business knowledge ranked very high with less emphasis on advanced IS applications among all three groups. Each group quite naturally ranked their own group's skills more highly than the skills of the other groups. Web-based languages outranked traditional languages in importance among programmers (Wilkins and Nolltt, 2000). An earlier study (Lee et al., 1995) also asked programmers, analysts and end-user support professionals to rate the importance of various skills three years in the future. Then the three most relevant knowledge areas for programmers were database modeling/development, software applications development and selection, and structured programming/CASE tools. They also rated SQL and web-based languages such as Perl, CGI, Java Script, HTML higher than Java, Visual Basic and C++ (Lee et al., 1995).

In contrast, a 1998 study shows that systems analysis and design skills, structured programming skills and Visual Basic skills were the most sought after. Because employers were willing to provide specialized training then, "employers found basic technical and 'soft' skills more important than more specialized technical skills when evaluating recent IS graduates for entry-level positions" (VanSlyke et al., 1998).

The 2004 ITAA survey of IT workforce indicates that the technical support and network system design saw the largest year-to-year increases in employment and information security appears to be the area with the greatest potential over the next few years (ITAA, 2004b).

6. CURRICULUM DESIGN PRINCIPLES

From the issues and trends enumerated above, we developed the following principles to guide our redesign of the MSIS degree.

6.1 Defining the Concept of Competency

We started by looking at the concept of a competency which was defined as --"a requisite ability or quality of a student within an academic program, the achievement of which indicates the student's capability or qualification in the area of the competency" (Johnson, 2000). Grant (1979) points out, in a broad curriculum context, that "Competence-based education tends to be a form of education that derives a curriculum from an analysis of a prospective or actual role in modern society and that attempts to certify student progress on the basis of demonstrated performance in some or all aspects of that role. Theoretically, such demonstrations of competence are independent of time served in formal educational settings." (p. 6). Competency involves the demonstration of qualification and capability of performing prospective and actual IT roles in organizations.

In contrast, a curriculum concentration tends to define "an approved set of courses within a major that define a specialty area or specific field of study"[3]. Therefore, a competency is flexible while a concentration denotes that a fixed number of courses is necessary to confer proficiency

According to Boyatzis (1982), individual competence in a firm setting represents "an underlying characteristic of a person, which results in effective and/or superior performance in a job." Researchers have emphasized skill-based approach to competency development because certain skills are critical to a firm's organizational competency. These skills have a lifecycle and need to correspond to a firm's changing needs. Cross-discipline competency centers, in business information and intelligence, process management, systems integration, and business security, have emerged as trends in IS organizations. In this context, competency implies collective knowledge, expertise, relationship, and skills essential for building and sustaining competitive advantage for the business, which goes far beyond technology alone (Morello, 2002). Thus individual IT competencies have to link closely to organizational competency. IT professionals who have multiple competencies are considered more valuable.

6.2 The Need for Multiple Skills

No longer is proficiency in a single area a guarantee for employment. Successful IS professionals need proficiency in many competencies, so they can respond quickly to the changing landscape. The concept of skills portfolios (Nakayama and Sutcliffe, 2001) is an approach to help IS professionals in assessing the level and breadth of their competencies. It recognizes that an IS professional must manage their mix of skills, not just a skill. IS professionals

need to redirect their skills portfolios towards more complex and higher level of competencies.

Lee et al (1995) point out that "… the requirements for IS professionals are becoming more demanding in multiple dimensions... the challenge for educational planners is to design a diversity of IS curricula to meet the career plans of IS professionals. The concept of a generic curriculum to meet the educational needs of all future IS professionals are obsolete." The MSIS degree with concentrations does not have the flexibility to meet the needs of an IS professional who wants concentrations in more than one area.

6.3 Expanding number of IS Positions

In the 1990s, IS executives were forced to handle more projects "covering an increasing breadth of technologies calling for greater and more specialized skills" with fewer people (Niederman et al., 1991). The continuing advancement of IS has resulted in more IS positions and IS skills. In fact, the National Workforce Center for Emerging Technologies (NWCET) 2003 skill standards include well above 100 IS related positions under 8 different career clusters covering database development and administration, digital media, enterprise systems analysis and design, network design and administration, programming/software engineering, technical support, technical writing, and web development and administration (NWCET, 2003).

6.4 The Need for Obtaining New IS Competency

Most MSIS programs are not flexible enough to respond to the velocity of innovations and the changing demands of IS organizations. As an IS professor points out, a "whole new universe" of IT has emerged every three months, each demanding new sets of skills to support and maintain this new universe (Head, 2004). In redesigning our program, we tried to fill unmet needs of traditional MSIS programs by shifting focus on:

- IS competencies in CTO vs. CIO organizations to incorporate more technical skills needed to support technology-driven changes;
- Enterprise systems and technology with a focus on application portfolio management, systems integration, and architecture;
- Stakeholder (i.e., customers, suppliers, partners, and investors) priorities, satisfaction and customer focus versus users within an IS organization that have been the traditional focus of IS professionals;
- The interplay between e-commerce (the e-business web) and IS (knowledge management) disciplines to emphasize the increasing importance of business intelligence for organizational success;
- Permeable organizational boundaries that demand insights about cultural and organizational issues beyond software and technologies;
- Integration of enterprise systems along industry value chains that requires an in-depth understanding about industry structure and strategies; and
- Knowledge about architecture as essential to facilitate strategic alliance that involves technical components as well as complexity of vendor products.

These new foci lead to a demand for multiple and interdisciplinary skill sets that involve a solid understanding about organizational culture, usability of applications and systems, and an architectural framework. Specifically, we envision that IS professionals at the graduate level need to acquire new skills in managing virtual project teams, risk management, knowledge management and business intelligence, and architectural design. In short, stronger and holistic problem solving skills that are based on a broad technical and architectural foundation will be essential.

6.5 Competency Management

Our long-term goal is to extend the MSIS curriculum to our alumni and other IS professionals for post-master's education. As the demand evolves for IS skills, graduates of our programs can return for getting advanced competency training and education to support job changes and career developments. Competency-based modular design may facilitate master's students to develop a continuous learning attitude. A proactive program can manage student competencies through: (1) creating ways to direct students to the appropriate competency modules during the program, (2) monitoring their progress throughout their career, and (3) offering support for post-master's competency development.

7. THE CURRICULUM DEVELOPMENT PROCESS

Eight faculty members from the IS and E-Commerce Technology programs formed a working group to develop the competency based curriculum. This working group took the following steps in formulating the new curriculum: (1) review of model curriculum and conceptualization of competency oriented approach, (2) consultation with industry representatives, (3) consultation with non-IS faculty, and (4) consultation with IS faculty.

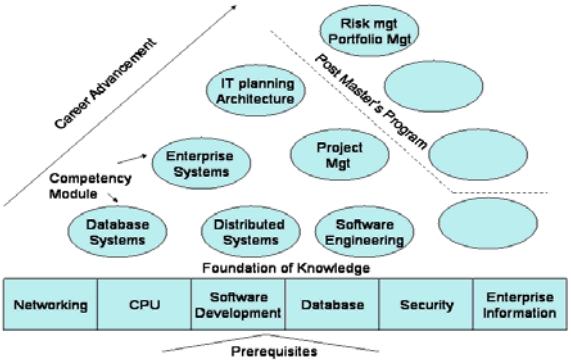

Figure 1. Conceptual Model for Competency-Based MSIS Curriculum

7.1 Conceptualization of a Competency-Based Curriculum

The working group identified changing demand for IS skills and multiple competencies as discussed in section 4. The group also recognized the constraints in discipline-oriented curriculum models that are characterized by limited

flexibility and a prescribed career track. The working group then proposed a multi-level competency approach to allow students with different levels of IS experience and different career goals to develop multiple competencies according to their unique needs. The original conceptual model is depicted below in Figure 1:

7.2 Consultation with Industry Representatives

Members of the working group also sought insights and feedback from industry IS professionals, including several of our alumni board members, to seek their input regarding IS competencies. Supported by a facilitator and a groupware application, we developed lists of broad competencies for technical, analytical, and managerial positions at different levels. In addition to the traditional IS emphasis on analytical skills, business acumen, and basic technical skills, industry participants highlighted the importance of prior IS experience, depth in one or more specific technologies, a passion for technology and business, broad-based problem solving skills, project management, facilitation and negotiation skills, and a "thirst" for continuous learning. We found that using focus groups supplemented with groupware was an effective and time efficient method for getting a wide range of insights on IS competencies. Using interviews would take more time than our tight schedule allowed. We wanted to implement the program by Autumn, 2004 which did not give us much time for either interviews or a survey.

7.3 Consultation with non-IS Faculty Members

Once the initial list of competencies was identified, the working group consulted faculty members in disciplines outside of information systems to seek their input on the component courses that constitute the relevant competency module. This step helped to ensure that each competency module would consist of courses that were necessary for developing the recognized proficiency in that area. Also, such consultation efforts resulted in some modification of prerequisites for several courses in HCI, software engineering, e-commerce technology, and computer science. Now IS students can acquire IS competencies in more areas. Administratively, course sharing across several disciplines could increase class size and ease the impact of enrollment decline. Consultation with faculty outside of IS discipline also strengthened the tie between IS and other disciplines.

7.4 Consultation with IS Faculty Members

The working group then consulted IS faculty members in designing two new courses—enterprise information and the technical fundamentals for distributed information systems—for the foundation phase of the new curriculum. These two new courses (as described in section 8.2), along with software engineering and database design courses for the foundation phase, replace three existing required IS courses (systems analysis, systems design, and IS operations and services). However, some IS faculty members expressed reservation about these changes as several existing courses would be phased out. Replacing traditional IS courses with non-IS courses will also result in a smaller range of course offerings in the IS programs. Eventually, IS faculty members agreed to accept the new IS curriculum within a broader context of changing IT industry needs and to leverage the rich and diverse resources in a CIT school (Berghel and Sallach, 2004).

8. THE COMPETENCY-BASED CURRICULUM

The revised MSIS 2005 curriculum encompasses thirteen quarter courses at the graduate level after the prerequisites have been met. The curriculum is structured into three phases: (1) prerequisite phase, (2) foundation phase, and (3) advanced phase. At the advanced phase, students can choose 8 courses from 19 competency modules, plus a capstone course to complete the degree. Each phase of the curriculum is outlined below.

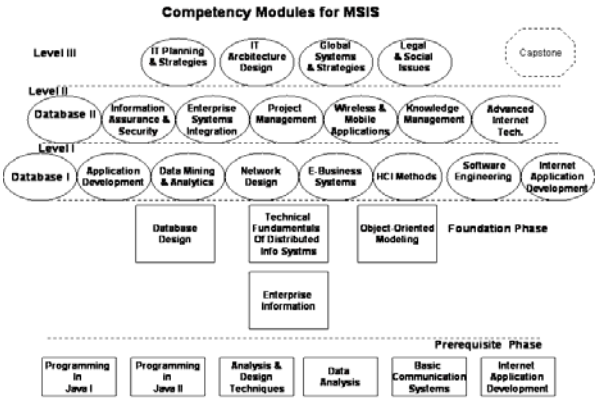

Figure 2. Finalized Competency Modules of MSIS

8.1 Prerequisites – up to 6 courses

Students need to take up to 6 courses in the prerequisite phase before entering the graduate level course work. As a set, these six courses prepare student with basic technical and analytical skills to undertake advanced learning. Students with demonstrated knowledge and work experience can be waived from any of the following six courses:

- Programming in Java I and II: Two courses in Java to help students build programming skills in a single language;
- Data Analysis: A course on statistical methods and packages to prepare students for business analytics;
- Analysis & Design Techniques: An introduction to traditional systems analysis and design concepts and techniques for entry level IS functions;
- Basic Communication Systems: An introduction to data, voice, and network technologies to provide basic knowledge for distributed systems;
- Internet Application Development: Introduction to developing database driven Internet applications using server-side technologies.

8.2 Foundation. – 4 courses

The foundation phase encompasses four courses that prepare students to pursue competency modules in the advanced phase.

- Enterprise Information is a new gateway course that introduces the student to the fundamentals of information systems, basics of organizational behavior, and the interrelationships, methods, and

technologies used by information systems groups to meet the information needs of enterprises. The course starts with an examination of the basics of enterprises information needs: the role of the value chain, the profit paradigm, and information infrastructure flows are explored. Then attention turns role of software methods, programming and security as supporting technologies. Topics include enterprise systems, commerce systems, project management, sourcing decisions, IS risk management, services and operations performed.

- Database Design: This course focuses on requirement formulation and analysis, conceptual design, implementation design, physical design, with an emphasis on data modeling techniques and tools.
- Object Oriented Modeling: This course emphasizes object-oriented modeling techniques for analysis and design. It surveys several alternative approaches and the relationship between these modeling techniques and the features of object-oriented languages.
- Technical Fundamentals of Distributed Information Systems: This course introduces students to distributed information systems, including architecture of distributed information systems, networking, communication protocols, operating system support, remote method invocation, web service, and security in distributed information systems.

8.3 Advanced Phase: Competencies (8 courses)

Competency modules reflect a student's choice of career path, and level of complexity in a student's skills/job responsibilities. The student can attain two or more competencies by taking at least four courses listed under each competency module (see Appendix). Because some courses are shared by several competency modules, it is possible for the student to attain more than two competencies. Students can select appropriate modules based on their background and career goals. When a competency does not exist, a student with faculty advisor's approval can also design a personal breadth competency consisting of four to eight courses.

At present there are 19 competency modules defined. These competency modules are grouped into three levels that reflect the complexity of responsibility and the skills requirement demanded in an IS organization. Individual students may choose competency modules at the level that correspond to their work experience, desired job responsibilities, and career path. For example, a student who is interested in becoming an enterprise system integrator could choose competency modules in enterprise systems integration and project management.

8.4 Advanced Phase: IS Capstone Course

Students are also required to take an IS capstone course towards the end of their degree. This capstone course emphasizes planning and management of information technologies and related resources at the corporate level. Topics covered include assessment of information technologies, tracking emerging technologies and trends, managing portfolio resources and matching them to business needs, technology transfer, end-user computing, outsourcing, theoretical models, strategic applications, and strategic IT planning.

9. OUTSTANDING IMPLEMENTATION ISSUES

We launched this competency-based curriculum in Fall 2004. Numerous students have transferred to the new program and are enthusiastic about the flexibility and structure of the new program. However, we are still working with the university administration on how completion of a competency will be documented for students and their employer. Now that the program is offered, we are preparing survey instruments to evaluate how well the program is received and what needs are unmet. We also plan to promote our program to the community at large because there are many graduates of MS programs who want to upgrade their skills in new technologies.

10. CONCLUSION\

This paper presents the process we used to develop a competency based MSIS curriculum. We detailed the trends with their resulting issues that guided our efforts. Various business and technology trends have reshaped the landscape of IT needs and the future of IT workforce education. At the graduate level, our proposal for a flexible and competency-based modular approach seems promising in addressing the changing demand of IT skills. Competency-based professional education has been implemented in the preparation of teachers, physicians, nursing, social workers, lawyers, and accountants (Olsen, 1979). Whether the IT industry is moving toward outcome and performance certification, some fields, such as software engineering, have begun to emphasize certification. A dialog between academicians and the industry is called for to articulate industry expectation of IS competency and how universities can meet such needs in their MSIS programs. . Our MSIS curriculum initiative represents an innovative endeavor to address both current and future needs of IT workforce. As our program is housed in an organization of CIT, it may be challenging for MSIS programs housed in business schools to adopt the model. We intend to conduct research of firms, our alumni, and current students in order to evaluate the curriculum framework, component competency modules, and strategies for helping students managing their IT competencies over their career life cycle. We hope the empirical studies will shed new lights for IS educators interested in competency-based IS education.

11. ENDNOTES

1. Forreseter Research Press Release, August 23, 2004. http://www.forrester.com/ER/Press/Release/0,1769,937,00.html
2. Presented at the SIMposium 2004, annual conference of Society of Information Management, September xx, 2004, Chicago.
3. University of New Mexico Curriculum Terminology Glossary, p. 3. Available at: http:''www.unm.edu/~oir/CurriculumTerm/Glossary3-30-04.doc

12. REFERENCES

Berghel, H. and Sallach, D. L. (2004), "A Paradigm Shift in Computing and IT Education," Communications of the ACM, Vol. 47, No. 4, pp. 83-88.

Boyatzis, R.E. (1982), The Competent Manager: A Model for Effective Performance, John Wiley & Sons, New York.

Chan, S. and Mirza, A. (2003), "A Framework for Defining E-Business IT Skills Portfolio," in Sarmento, A. (Ed.) Issues of Human Computer Interaction, IRM Press, pp. 111-135.

Chaudhury, A. and Rao, H. R. (2000), "E-Commerce Technologies and Information Systems Curricula," Journal of Information Systems Education, Vol.11, No. 1-2, pp. 1-33.

Davis, D. C. (2003), "Job Titles, Tasks, and Experiences of Information Systems and Technologies Graduates from a Midwestern University," Journal of Information Systems Education, Vol. 14, No. 1, pp. 59-68.

The Economist (2004), "E-Commerce takes off," The Economist, May 13.

Fang, X., Lee, S., Lee, T. E., and Huang, W. (2004), "Critical Factors Affecting Job Offers for New MIS Graduates," Journal of Information Systems Education, Vol. 15, No. 2, pp 189-216.

Gorgone, J. T., Gray P, Feinstein, D. L., Kasper, G. M,, Luftman, J. N., Stohr, E. A., Valacich, J. S. and Wigand, R. T. (2000), "MSIS 2000: Model Curriculum and Guidelines for Graduate Degree Programs in Information Systems," Communications of the Association for Information Systems, Vol. 3, No.1, pp. i-103.

Gorgone, J. T. and Kanabar, V. (2002), "Masters in Information Systems: A Web-Centric Model Curriculum," Proceedings of IS2002 Informing Science + IT Education Conference. http://proceedings.informingscience.org/IS2002Proceedings/papers/Gorgo236WebCe.pdf.

Grant, G. (1979), "Implications of Competence-Based Education," in Grant, G., Elbow, P. Ewens, T., Gamson, Z., Kohli, W., Neumann, W., Olsen, V., and Riesmann, D. On Competence: A Critical Analalysis of Competnce-Based Reforms in Higher Education, Jossey-Bass, Inc., San Francisco, CA

Head, B. (2004), "University Challenge," The Sydney Morning Herald, August 31.

Hoffman, T. (2003), "Big Outsourcing Shift Predicted for IT Jobs," Computerworld, January 27. http://www.computerworld.com/careertopics/careers/story/0,10801,77881,00.html.

ITAA (2004a), The Impact of Offshore IT Software and Services Outsourcing on the U.S. Economy and IT Industry, Information Technology Association of Americia (ITAA).

ITAA (2004b), "Adding Values…Growing Careers: The Employment Outlook in Today's Increasingly Competitive IT Job Market," Information Technology Association of America (ITAA).

Johnson, D. W. (2000), "Competency-Based Educational Program Effectiveness Assessment," Journal of Information Systems Education, Vol. 11, No. 3-4, pp. 6-11.

Lee, D. M. S., Trauth, E. M., and Farwell, D. (1995), "Critical Skills and Knowledge Requirements of IS Professionals: A Joint Academic/Industry Investigation," MIS Quarterly, Vol. 19, No. 3, pp. 313-340.

Morello, D. (2002), "The Future of Competency Centers: An Outward Focus," Gartner Research Notes, TU-16-1890, July 18.

Morello, D. (2003), "CIO Alert: 2003 Offshore Outsourcing Predications Focus on Impact to the IT Profession," Gartner Research Notes, IGG-01012003-03.

Mulder, M. C., Litke, D. K., co-chairs (1999), ISCC'99: An Information Systems-Centric Curriculum '99 Program Guidelines for Educating the Next Generation of Information Systems Specialists, in Collaboration with Industry. http://www.iscc.unomaha.edu.

Mullaney, T., Green, H., Arndt, M., Hof, R., and Himelstein, L. (2003), "The e-biz surprise." BusinessWeek, May 12.

Murphy, C, and Hayes, M. (2003), "Squeezed." InformationWeek, April 14, pp. 34-42.

Nakayama, M. and Sutcliffe, N. (2001), "IT Skills Portfolio Research in SIGCPR Proceedings: Analysis, Synthesis and Proposals," Proceedings of ACM SIGCPR 2001 Conference, pp. 100-113.

Noll, C. L. and Wilkins, M. (2002), "Critical Skills of IS Professionals: A Model for Curriculum Development," Journal of Information Technology Education, Vol. 1, No. 3, pp. 143-154. http://jite.org/documents/Vol1/v1n3p143-154.pdf

NWCET (2003), Skill Standards for Information Technology, 2003 Edition. Bellevue, WA: The National Workforce Center for Emerging Technologies.

Olsen, V. (1979), "Employing Competence-Based Education for the Reform of Professional Practice," in Grant, G., Elbow, P. Ewens, T., Gamson, Z., Kohli, W., Neumann, W., Olsen, V., and Riesmann, D. On Competence: A Critical Analalysis of Competnce-Based Reforms in Higher Education, Jossey-Bass, Inc., San Francisco, CA.

Pender, L. (2001), "Faster, Cheaper ERP," CIO Magazine, May 15. http://www.cio.com/archive/051501/faster.html

Sherer, S. A. (2002), "Academic Departments of Information Systems Faculty in the U.S," Journal of Information Systems Education, Vol. 13, No. 2, pp. 105-115.

Shiffler, G. (2004), Global Economy Gains Steam in 2Q04 Scenarios. Gartner Research, June 3.

Srivastava, S. and Theodore, N. (2004), "America's High Tech Bust," Center for Urban Economic Development, University of Illinois at Chicago. Available online at: http://www.washtech.org/reports/AmericasHighTechBust/AmericasHighTechBust.pdf

Subramarian, R. and White, B. (2004), "Three "Hot" Emerging Technologies: What They Are, and What They Mean for IS Education," Information Systems Education Journal, Vol. 2, No.7, pp. http://isedj.org/2/7/index.html.

Thibodeau, P. (2003), "Offshore Outsourcing Is Relentless," Computerworld. Available: http://www.computerworld.com/managementtopics/management/outsourcing/story/0,1080

VanLengen, C. A. (2003), "CIS Curriculum Development Post-Dot-Com," Information Systems Education Journal, Vol. 1, No. 7. http://isedj.org/1/7/index.html.

Van Slyke, C., Kittner, M. and Cheney, P. (1998), "Requirements for Entry-Level IS Graduates: A Report from Industry." Journal of Information Systems Education, Vol. 9, No. 3, pp. 7-11.

Varian, H., Litan, R., Elder, A., and Shutter, J. (2002), The Net Impact Study: The Projected Economic Benefits of the Internet in the United States, United Kingdom, France and Germany. Available: http://www.netimpactstudy.com.

White, W. (2003), "What Is Middleware and What Are The Business Implications of Its Use?" Darwin Magazine, October. Available at http://www.darwinmag.com/read/100103/question13.html

Wilkins M. L. and Nolitt, C. L. (2002), "Critical Skills of IS Professionals: Developing a Curriculum for the Future," Journal of Information Systems Education, Vol.11, No. 3-4, pp. 105-110.

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Appendix 1. Competency Modules and Component Courses

Competency Module	Component Courses
Database Design I	Database technologies, database design, database programming, database administration and management, data warehousing and data mining
Database Design II	Object-oriented databases, distributed database systems, advanced database concepts, data warehousing and data mining, project management
Application Development	Object-oriented enterprise computing, software development process, requirements engineering, project management, usability engineering, structured document interchange and processing, enterprise systems implementation, Web-site engineering, advanced scripting techniques
Software Engineering	Object-oriented software development, Object-oriented enterprise computing, software development methods, distributed software development, software architecture, project management, usability engineering
Data Mining & Analytics	Web data mining for business intelligence, knowledge discovery technologies, data analysis and regression, decision support systems and intelligent systems, intranets and portals, knowledge management systems
Network Design	Basic communication systems, computer networks and data systems, local area networks, telecommunication design and management
e-Business Systems	Web site engineering, intranets and portals, Internet supply chain management, secure electronic commerce, customer relationship management technologies, e-commerce technology capstone and practicum
HCI Methods	Foundations of human-computer interaction, analysis and design for HCI, prototyping and implementation, usability engineering, usability evaluation methods
Internet Application Development	E-Commerce Web site engineering, advanced scripting technologies, usability engineering, structured document interchange and processing, mobile commerce technology, e-marketplace technology, project management
Information Assurance & Security Design	Business continuity and disaster recovery, computer networks and data systems, network security, secure electronic commerce, social issues of computing
Enterprise Systems Integration	Enterprise systems, enterprise system implementation, Intranets and ports, Internet supply chain management, customer relationship management technologies, mobile enterprise, project management
Project Management	Project management, enterprise systems, enterprise system implementation, groupware and virtual collaboration, information technology consulting, information services and operations
Wireless/Mobile Applications	Mobile commerce technology, mobile enterprise, usability engineering, usability issues for handheld devices, software development for mobile and wireless systems
Knowledge Management	Knowledge management systems, Intranets and portals, intelligent information retrieval, foundations of artificial intelligence, decision support systems and intelligent systems
Advanced Internet Technologies	Mobile commerce technology, peer-to-peer technology, e-marketplace technology, e-business technology practicum
IT Architecture Design	Mobile enterprise, enterprise architecture and design, system design and implementation with distributed object frameworks, object-oriented software development, enterprise component architecture, software architecture, security architecture, distributed database systems, computer networks and data systems, telecommunication systems design and management
IT Planning and Strategies	Mobile enterprise, enterprise architecture and design, global information technology, project management, social issues of computing, information systems capstone, e-commerce technology capstone
Global Systems & Strategies	Enterprise system implementation, social issues of computing, global information technology, information services and operations, information systems capstone, e-commerce technology capstone
Legal & Social Issues	Legal aspects of information technology, legal aspects of e-commerce, social issues of computing, enterprise system implementation, telecommunication regulation, policy, law and standards

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