Career Track Design in IS Curriculum: A Case Study

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Abstract

An important aspect of undergraduate curriculum in the field of Information Systems is the design and arrangement of specializations or career tracks. Given limited resources and a highly dynamic information technology environment, faculty in Information Systems programs have career tracks face the challenge of designing a career track structure that is not only competitive and marketable but also manageable, flexible, and sustainable. This case study shows how the faculty in a large Computer Information Systems program undertook this challenge by comparing their curriculum with model curricula and with the track curricula of other four-year programs. In order to compare with peer programs, faculty members built a database containing track design data for the 96 baccalaureate Information Systems programs in the United States that have career tracks. They first evaluated their core curriculum, which provides the base knowledge for the career tracks, with the IS 2002 and IT 2005 model curricula. Next, they evaluated their current career track structure in two areas: (1) the current availability of departmental resources to support existing career tracks, and (2) a comparison of the current career track design with track designs of peer programs. The entire faculty reviewed the results of these analyses and agreed to consider changing the track curriculum structure. The department curriculum committee then developed three alternative proposals and presented them to the entire faculty, which reached consensus on one of the proposals.

Keywords: Information Systems education, Information Systems curriculum, career tracks, IS 2002 Model Curriculum, IT 2005 Model Curriculum, case study

1. INTRODUCTION

Information Systems (IS) is a relatively young academic field that manifests many challenges in self-identity (King and Lyytinen, 2004, Lyytinen and King, 2004) that are reflected in IS curriculum design. One definition of the IS field is "the study of the design and management of information and associated technologies in organized human enterprise" (Lyytinen and King, 2004). This definition is broad enough to allow faculty in the field to adapt their curriculum structures to a wide variety of specializations and accommodate the rapid expansion and evolution of information technology, and its effects on organizational activities. A reflection of the youth of the academic field may be that what we term *Information Systems* or *IS* in this paper has two other common names for similar programs in universities: *Management Information Systems* or *MIS*, and *Computer Information Systems* or *CIS*. CIS programs are typically more technical than the other two.

Faculty in IS higher education face a curriculum dilemma: They need to update their curricula to keep up with changing technology and industry trends while they are constrained by available faculty resources and credit hour limitations (Tesch, Crable and Braun, 2003). Because departmental resources are finite, faculty apply the filters of their own technological skills, intellectual knowledge, and interests to structure a curriculum that will benefit students and prepare them to succeed into the future.

There are two essential perspectives to structuring an IS curriculum: offer a broad spectrum of knowledge and skills, or offer options or concentrations in one or more particular subdisciplines. The first approach results in a curriculum with diversity, while the second results in a curriculum with specialization. Career tracks are part of the second approach, in which students first complete some fundamental courses and then choose one or more subdiscipline areas for a more focused plan of study. These career tracks, also called *options*, *concentrations*, *models*, *specializations*, *specialties*, *paths*, *certificates*, or *support areas*, (Hwang and Soe, 2007) generally have a distinct title and offer a number of cohesive but restricted courses and/or electives. Although the diversity and specialization approaches are not mutually exclusive, Lightfoot (1999) points out that they are often in conflict because of the limited length of instruction time, the restricted number of credit hours allowed in an IS program, and the dynamic nature of the IT field itself. These constraints also present a major challenge to IS educators to design career tracks that are competitive and marketable in nature, administratively manageable, flexible when the environment changes, and sustainable over time.

There are arguments in favor of career-driven curriculum design meant to ensure that graduates are ready for long-term careers (Lee, Trauth and Farwall, 1995; Lightfoot, 1999). The *2002 IS Model Curriculum* document recommends that "IS curriculum design must be driven by a clear vision of the career path for the graduates" (Gorgone, Davis, Valacich, Topi, Feinstein, and Longenecker, 2002). However, empirical research in the area of IS career track design is scarce. Ehie's (2002) study concerning industry's expectations for IS curriculum development found that although IS concentrations were located primarily in graduate level programs, a majority of practitioners favored niche areas (or concentrations) in undergraduate curricula. A study exploring the relationship between IS course specialization, initial fulltime job placement, and starting salary found modest support for specialization in IS education. While track differences affected starting salaries, they did not affect job placement rates (Ross, Tyran and Sandvig, 2004).

The case scenario in this paper documents the process a CIS department followed to review its curriculum and revise its career track design. The *background* section describes the university, the department, and its curriculum history. The *research into curriculum change* section describes faculty research into model curricula and a database containing IS career track data for all four-year IS programs across the country. The *curriculum analysis* section covers comparisons with model curricula and with the career track designs of other undergraduate IS programs that have tracks. The *decisions* section describes the process that the faculty followed in reviewing and finally agreeing on track revision after considering three proposals. The paper ends with *conclusions* and *recommendations*.

2. BACKGROUND

The case covers a nine-month investigation and decision-making process in the CIS Department at California State Polytechnic University, Pomona (hereafter called Cal Poly Pomona) during the 2006-2007 academic year. Cal Poly Pomona is one of two polytechnic universities in the public California State University system, the largest university system in the United States. The university resides on the former Kellogg Ranch, a rural setting within densely populated Southern California. Cal Poly Pomona prides itself on the high quality of technology education across its colleges. The university motto is "Learn by Doing" and experiential and project-based learning is an important characteristic of a Cal Poly education.

The CIS Department is part of the College of Business, and its undergraduates earn a B.S. degree in Business with an emphasis in Computer Information Systems. In Fall, 2006, Cal Poly had 18,625 undergraduate

students, with 4,258 in the College of Business, of which 551 were specializing in CIS. Graduate programs in business include an MBA program and several Master's programs that include a Career MBA in IS and an MSBA-IS in Information Systems Auditing. Cal Poly offers four 10-week quarters per year. It is a commuter school with a diverse student body. The CIS Department routinely offers classes during the evening to accommodate the many students who work part or full time.

A leading-edge curriculum that makes CIS graduates attractive to the IT industry is part of the culture and tradition of CIS at Cal Poly Pomona. During the late 1970s and early 1980s, CIS faculty members advocated the separation of business programming from computer science (Athey, 1979; Athey and Wagner, 1979, 1980) and were early leaders in the development of a model curriculum that emphasized business applications, known as the *Cal Poly/DPMA Model Curriculum* (Mitchell and Westfall, 1981).

The CIS undergraduate curriculum is highly structured, with a strong prerequisite structure. All students take a common core of classes, which include object-oriented programming, systems analysis and design, telecommunications, web development, and database. Students have two attempts to earn a grade of "C" or better in core courses. Unsuccessful students cannot enroll in courses in which they did not earn a "C" or better in the prerequisites, and have to move into another major. This practice in the core ensures that students acquire a common body of knowledge in IS, and demonstrate the ability and tenacity for an IS career. The gateway course into a career track is a careers course, in which students explore different IS careers, prepare resumes, write papers about different career options, and interact with industry representatives about possible career paths. At the end of this class, students choose a career track and sign a contract in which they take five courses. Once they have completed three track courses, they can take the capstone course, a group senior project with a real customer. As of Fall 2006, the department's undergraduate curriculum offers 12 core courses, including the gateway course and the capstone course, and 18 track courses, spread among four tracks.

The CIS faculty first developed career tracks in 1980. They revise tracks regularly, based on changes in the IT industry and the availability of new faculty to teach courses in different areas. In 1994-1995 they completely overhauled the curriculum to include object orientation. Four career tracks emerged from that revision: *Business Systems Analysis*, *Application Systems Development*, *Executive Support Systems*, and *Telecommunications*. To meet the rise of the Internet, the *Executive Support Systems* track became *Interactive Web Development* in 1997, and all the courses in the track became web-based. In 2003, the *Telecommunications* became *Telecommunications and Networking* to broaden its coverage in the field of data communications, and *Interactive Web Development* evolved again into *Internet Programming and Security* to accommodate yet another new area, Internet Security. Security is a growing area, in which CIS again is a leader, evidenced by its designation in 2006 as a *Center of Academic Excellence* from both the National Security Agency and the Department of Homeland Security.

Due to a system-wide reduction in the number of units to degree in 2006, students now fulfill career track requirements with either five four-unit track courses, or four four-unit track courses and one two-unit directed studies or internship course. A strong internship program makes it possible for all interested students to have a paid IS internship before they graduate.

In Fall 2006, the CIS faculty decided to review its curriculum, given the tradition of continuous curriculum design improvement. The focus in this round of curriculum review was career track design. In the process, the faculty also reviewed the core courses to ensure that students were acquiring a solid foundation before they chose a track in one specialized area. The entire research, analysis, review, discussion, and decision-making process took three academic quarters. Research and analysis occupied Fall Quarter, and the review and discussion process lasted several months, with final decisions taken in late spring.

3. RESEARCH INTO CURRICULUM CHANGE

In considering whether and how to revise the CIS career track structure, faculty re-

viewed two categories of information: the model curricula (Gorgone, et al.) and a faculty-developed database of career track data for IS baccalaureate programs in the United States. The model curricula provide a useful guideline and index for IS curriculum development because they incorporate important curriculum design factors such as business model changes, technology advancement, and job market movement. The repository of the career track data offers a picture of the actual design and development of career tracks across the nation. The department's overall goal was to create a curriculum composed of a core that is solid and a career track structure that is competitive, marketable, manageable, flexible, and sustainable.

Model Curricula

Several collaborative efforts to build model curricula are pertinent to this research effort. The *IS 2002* model curriculum (Gorgone et al., 2002) represents a collaborative effort by the Association for Computing Machinery (ACM), The Association for Information Systems (AIS), and the Association for Information Technology Professionals (AITP). This model proposes an introductory course and 10 courses that offer IS breadth, providing a starting point for any IS curriculum review. Williams and Pomykalski's survey (2004) found that no school required all 10 courses; 85% of the schools required at most six courses; and 64% of the schools required at most four courses. Dwyer and Knapp (2004) describe their department's use of the IS 2002 model curriculum as a starting point in faculty discussions during their own curriculum revision, even though the department faculty chose not to follow the complete model.

The ACM, AIS, and The Computer Society (IEEE-CS) published the output of a cooperative project titled *The Overview Report covering undergraduate degree programs in Computer Engineering, Computer Science, Information Systems, and Information Technology Computing Curricula 2005* (CC2005). This document delineates the differences among these computing degree programs. The areas that were appropriate to the CIS departmental effort, Information Systems (IS), and Information Technology (IT), address organizational needs and usually belong in a business school, the college in which this program resides.

CC2005 differentiates programs in several ways. In contrast to the other computing disciplines of Computer Science, Computer Engineering, and Software Engineering, both IS and IT are more applied and less theoretical. IS is more involved with organizational issues and application technologies, and IT cuts across a spectrum of organizational issues, application technologies, software methods and technologies, and systems infrastructure. The IS discipline emphasizes the integration of information technology solutions and business processes to solve the information needs of organizations. The complementary IT discipline emphasizes technologies more than business needs. While IS graduates need to understand how organizations function, IT graduates focus more on the organization's IT infrastructure to meet the needs of the organizational members. IT specialists can select, integrate, install, customize, and implement a wide range of hardware and software technologies, from email and other communication systems, to networks, security, website design, and multimedia resources.

The *Computing Curricula Information Technology Volume* is the final report of the SIGITE Curriculum Committee 2005 Project (IT2005), undertaken by the Special Interest Group on Information Technology Education (SIGITE) of the ACM. This report outlines the curriculum for the newer IT discipline, discussed in the previous paragraph. The IT curriculum addresses the different emphases in IS careers brought on by technology changes and expansion—the World Wide Web, networking technologies, graphics and multimedia, e-commerce, human-computer interaction, etc. Since the Cal Poly CIS faculty traditionally favor cutting-edge curriculum, they included the IT curriculum model in their research and review.

IS Career Track Database

The database on IS career tracks is the result of secondary research into the curriculum structures of 490 IS baccalaureate programs in U.S. business schools. The list is drawn from schools at univsource.com (www.univsource.com/bus.htm) and is described in Hwang and Soe (2007). The data provide a snapshot in time (October to November 2006) of IS career track structures acquired from IS department websites and

on-line university catalogs in both AACSB-accredited and non-accredited schools.

The curriculum database shows that 96 undergraduate programs had a total of 269 career tracks, varying in numbers from one to 12 tracks per program. Most career track names map to subdisciplines or knowledge areas, such as *Systems Analysis and Design*. A few career track names map to job names, such as *Systems Analyst*.

We analyzed the career track data and identified 11 major track categories, some of which have subcategories within them. (See Hwang and Soe, 2007, for detailed information on IS career track structures and a discussion of our methodology.) Table 1 (Appendix A) lists the track categories and subcategories, and the unique names of the individual tracks and their frequencies in the database. It is immediately evident from the numbers of unique track names—165—that track naming is not at all standardized.

4. CURRICULUM ANALYSIS

This section discusses the CIS department's analysis of their curriculum structure. First the faculty compared the core with the curriculum structures in the model *IS 2002* (Gorgone et al., 2002) and *IT 2005* (Computing Curricula 2005), using information in the *Computing Curricula 2005 Overview Report* to assess coverage of knowledge areas. They then compared the career track structure with data in the career track database.

Comparisons with Model Curricula

In their efforts to revise their curriculum, the CIS Department faculty held an all-day retreat to review the information gathered through the investigation of IS curricula across the nation. They compared the core curriculum with the IS 2002 and the IT 2005 model curricula to determine where the core stood *vis á vis* both. Table 2 lists the courses in the IS 2002 model curriculum and the equivalent courses in the CIS core curriculum, required for all CIS majors.

In their analysis of IS core courses, Kung, Yang, and Zhang (2006) call the initial course category *Introduction to IS*. Their equivalent in the IS 2002 model curriculum combines two courses, IS 2002.1 (Fundamentals of Information Systems) and IS 2002.3 (Information Systems Theory and Practice). They also find a combination of IS 2002.9 (Physical Design and Implementation in Emerging Environments) and IS 2002.10 (Project Management and Practice) to be the equivalent of their last course category, the *IS Capstone Course*. If we follow this precedence and identify IS 2002.1 and IS 2002.3 as equivalent to CIS 310 (Management Information Systems) and IS 2002.9 and 2002.10 as equivalent to CIS 466 (Systems Development Project), then the CIS core curriculum provides adequate coverage of the IS 2002 model curriculum except for IS 2002.4, *Information Technology Hardware and Software*. This course is the one that is least frequently offered (by 7.4% of schools in their survey) according to Williams and Pomykalski's survey (2006).

Table 3 maps the CIS core to the knowledge areas in the *IT 2005 Body of Knowledge*. Some of the CIS courses are marginal equivalents, covering only a minority of topics in the model course. The CIS curriculum currently does not include an equivalent to *Platform Technologies, Integrative Programming and Technologies,* and *System Administration and Maintenance*, all new areas introduced in the more system/hardware oriented IT discipline. Obviously, changing to an IT curriculum would require major revision of the entire CIS curriculum and require additional faculty resources.

Comparisons with IS Career Track Database

During the December retreat, CIS faculty discussed the current track structure and compared it to the track structures of other programs in the IS career track database.

As a result, several important internal issues and observations regarding track structure emerged:

- The numbers of CIS majors had shrunk from a high of 1300-plus in 1998 and had stabilized at a number between 550 and 600. The number of job opportunities for graduates recently accelerated, but there is a lag in the influx of new majors.
- The numbers of new faculty had not kept pace with the numbers that had retired, so that some tracks lacked the tenure track faculty necessary to sustain track courses into the future.

- The *Networking and Telecommunications* track is very different from the other tracks because it has a highly structured set of courses, with one course building on top of the previous one. This means that students in other tracks cannot take courses that may interest them because they lack the prerequisites.
- The *Applications and Systems Development* track had migrated to web-based and e-commerce applications development, previously the domain of the *Internet Programming and Security* track.
- Courses in the *Internet Programming and Security* track cover applications development only on Microsoft's .net platform, while those in the *Applications and Systems Development* track are on the Java platform.
- The difference between the *Business Systems Analysis* track and the *Applications and Systems Development* track had diminished to the point that only one course differentiated them.
- In the *Internet Programming and Security* track, programming and security had diverged. The CIS Department recently hired a Computer Forensics specialist and could continue to expand its offerings in Security, based on its designation as a *Center of Excellence* in the area. Currently students take web programming and a multimedia course (which includes interface design, web usability and accessibility) as well as two security courses.
- Fewer students seem interested in programming than in the past.

Comparisons with the career track structures of other universities uncovered additional issues:

- On a national level, the CIS career track structure is very competitive because it covers four of the most fundamental and popular track categories (i.e. *Applications Development*, *Web Systems and Technologies*, *Networking and Telecommunications*, and *Systems Analysis and Design*) and one of the emerging track categories in the *Information Assurance* area (see Table 1).
- During the last major curriculum revision in 1994, changing the entire curriculum to object orientation differentiated CIS from most other schools, but by 2006, this competitive advantage had waned.
- In the California State University system, Cal Poly Pomona's CIS career track structure is still one of the most advanced based on the number and the depth of the tracks, but it may lose that edge unless improvements occur.
- The *Networking and Telecommunications* track has more courses than most of its national equivalents, which makes graduates attractive to employers.
- The *Applications and Systems Development* track and the *Business Systems Analysis* track are still two of the most fundamental and essential career tracks throughout the nation (see Table 1). Thus, these two tracks are institutionalized subdisciplines, and qualify as "surf skill" tracks, that are durable into the future. (The concepts of "wave skill" and "surf skill" are borrowed from a student orientation lecture at the University of Arizona [mis.eller.arizona.edu/images/files/MISKickoff.ppt]).
- The *Internet Programming* aspect of the *Internet Programming and Internet Security* track was a "wave skill" track (durable for one to five years) in the past that has evolved into a "surf skill" track.
- The *Internet Security* aspect of the *Internet Programming and Internet Security* track is now a "wave skill" track that likely will evolve into a "surf skill" track at some point in the future.

5. DECISIONS

During its December retreat, the CIS faculty decided not to revise the CIS core curriculum. Analysis of external evidence showed that it maps well to the IS 2002 model curriculum. Moreover, knowledge gaps had been filled and it was quite successful at producing students with a common body of IS knowledge. Instead, the faculty decided to concentrate on revising the career track curriculum structure.

After the retreat, the curriculum committee, which includes representatives from each career track, met to discuss alternatives in

career track revision, and developed three career track redesign proposals. The complete track design proposals that the faculty considered are listed in Appendix B to this paper. The advantages and disadvantages that faculty brought up during the discussion of the track proposals are outlined in the discussion of each proposal.

Proposal I. Refine Current Track Design

The first design (see Appendix B) involves realigning the current career tracks and performing incremental changes. The web-based programming courses in the *Internet Programming and Internet Security* track and those in the *Applications and Systems Development* track would be merged and form a new *Application Development* (AD) track. The Internet Security courses, with the addition of a new Secure Web Development course, would have their own track, *Information Assurance* (IA). The other two tracks, the *Business Systems Analysis* (BSA) and the *Telecommunications and Networking* (TN) Track, would remain unchanged.

- This solution reflects the benefits of having career tracks (which originated in 1980), and is congruent with departmental culture, which emphasizes keeping career track curriculum design up to date with emerging technologies and methodologies.
- It makes students in the IA track more competitive because they can take a greater selection of specialized courses in Information Assurance. With the new course *Secure Web Development*, the track will provide students with essential training in application security as well as infrastructure security.
- The AD track is a logical and natural outgrowth of the current track structure as web-based application programming and traditional windows-based programming have become alike in today's business applications. This new AD track also can serve as a flexible base to accommodate changes in applications development in the future without creating new tracks.
- The multimedia for the web course, which includes graphical user interface (GUI) design, and web usability and accessibility, would be a prerequisite to these advanced programming courses. Education in these areas of human-computer interaction would benefit all of the students interested in developing modern business applications.
- This proposed curriculum structure is very manageable because the new design only causes minimal change to the existing structure. The only new course, *Secure Web Development*, will replace another web development course
- The change makes students in the AD track more competitive and marketable because they learn web-based programming in both the Java and the .net environments and receive much-needed education in the development of GUI design techniques that are accessible to disabled users and usable for all users.
- The new track structure is more sustainable because the AD, BSA, and TN tracks cover the three most essential and fundamental IT areas that should remain stable for a reasonable period into the future.
- The entire curriculum becomes more competitive and marketable because it combines three fundamental tracks with an independent IA Track in an emerging, highly specialized, and prominent subdiscipline.

Of course, there are also several potent arguments against this solution:

- This career track redesign is relatively inflexible in terms of allowing students freedom to create their own plans of study and take courses in different areas that interest them.
- This solution does nothing to relieve faculty workload, and requires the same intensity of faculty time and resources.
- It does not address the current student disinterest and disinclination to study programming and systems analysis and design, a mind-set students seem to acquire in the CIS core classes.

Proposal II. Course Cluster Design

The second proposal for changing the CIS track structure involves ripping the tracks into smaller clusters of two or three courses. This structure would allow students to specialize in multiple areas and satisfy their de-

sire to diversify. Some students already take extra courses that interest them to accomplish this goal.

There are a number of arguments in favor of this solution:

- It is more flexible than the current track structure and allows students to create their own plans of study.
- This IS curriculum design is very innovative, compared to other career track designs in the career track database.
- Faculty would have flexibility in modifying, adding, and dropping courses as interests evolve and technological changes occur.
- Faculty would have flexibility in dropping courses and clusters in which students are not interested, and in adding ones in which they are interested.

There are also valid arguments against this solution:

- Since this track structure is untried, it carries greater risks.
- Small cluster modules might increase the complexity of student programs of study and require more faculty coordination and advising.
- This solution does not reduce faculty workload, unless faculty use the opportunity to trim clusters in which students are disinterested, and thereby reduce the numbers of options for students and the variety of faculty course preparations.
- Faculty would have to do more advising, as cluster advisors would replace track advisors.

Proposal III. Cafeteria Design—No Tracks

The third proposal is the most radical of all because it would remove career tracks from the curriculum structure. This change would put the CIS Department in line with most baccalaureate IS programs, which do not offer career tracks.

There are some compelling arguments in favor of this solution.

- Students would be free to make their own plans of study and take courses that really interest them.
- Faculty members would no longer need to carry the burden of track coordination, which includes acting as advisor for all students in the track.
- Over time, individual courses that do not interest students or seem relevant to their future careers will wither for lack of enrollment.
- Faculty members would have more flexibility in adding new courses as new technologies and methodologies become available, and would no longer have to delete a course in a track when they add a new one.
- Students would have greater flexibility in enrolling in whatever advanced courses are offered on the days and at the times they can enroll in them, and thus have more flexibility in managing their schedules.
- The teacher of the careers course, the gateway into the tracks that requires students to research and select a track and sign a track contract, would have more flexibility in the course content.

However, this solution was the most controversial for faculty in the department for a number of reasons.

- It defies the traditional culture of the CIS Department, which has attained recognition for its advanced curriculum structures, and faculty are reluctant to make such a radical change.
- Students might not have the prerequisite knowledge to do well in advanced courses for which they are currently required to take a prerequisite course.
- Students might not have the intellectual ability or judgment to make their own plans of study, and might end up with an incoherent study plan.
- Student input, appropriate or not, might become the major determinant in curriculum design. Students might choose the easiest or most convenient courses, not ones that would prepare them for coherent careers.

- Faculty members would have to spend more time and effort advising students on advanced courses of study.
- As unpopular classes drop away, individual faculty members might have to retrain and learn to teach classes in which they have no expertise and little interest.
- The nature and content of the careers course would have to change, and might lose its current power as a gateway into a track.

The committee that devised these proposed changes met sporadically through a period of five months and discussed many alternatives before offering the three proposals described above. Different faculty members presented each proposal at a faculty meeting in late Spring. The track proposal presentations were very animated and the discussion was one of the best in which the department had engaged during the entire academic year. The arguments for and against each track proposal are included in the discussions of the track proposals above. At the end of the discussion, the faculty voted for their favorite solution. Two individuals voted for the no tracks option and two for the clusters option. An overwhelming majority voted for the first option, to reorganize two of the existing tracks. Although the vote was not unanimous, the entire faculty seemed satisfied with the solution.

6. CONCLUSIONS AND RECOMMENDATIONS

What recommendations and conclusions can we draw from this effort?

Conclusions

The investigation into the curriculum structures of baccalaureate programs throughout the country revealed that less than 25 percent have career tracks. It also showed that the local CIS track structures were more structured, required more courses within the CIS Department, and therefore placed more demands on faculty resources than tracks in many other programs (Hwang and Soe, 2007). There is a downside to this achievement, since faculty workload to maintain such a demanding track structure is higher than it would be without tracks.

The Fall research period culminated in an all-day faculty retreat that resulted in the decision to leave the CIS core curriculum alone, since comparisons to the IS 2002 model curriculum showed that students were mastering a solid common body of knowledge in the core. However, the track structure was out-of-date, and the faculty curriculum committee agreed to formulate possible solutions. When the proposals were presented to the entire faculty at the end of the academic year, they discussed each option, and reached consensus on a solution.

The faculty decided to refine the current career track structure because it fulfilled their goal of creating a design that is competitive, marketable, manageable, flexible, and sustainable. The faculty rejected the track cluster model, which was the most innovative approach, and the cafeteria model, which represented the most radical change. The consensus was that they were too risky and might result in uninformed student choices and track course decisions made for convenience issues such as class scheduling.

Recommendations

Our major recommendation to other IS departments, whether they have career tracks or not, is that they periodically review their curriculum design as technologies and methodologies evolve. Comparing a program's curriculum against the model curricula provides a useful starting point for this process. Although the curriculum change process is often painful and time consuming, in the end the curriculum best represents the faculty and their ultimate dedication to educating students.

The on-going model curriculum committee recently indicated that its next effort is model career track design ("IS Curriculum Wiki", 2007). Their initial proposal for discussion includes a list of 17 career tracks named for job types (e.g., *Applications Developer*), rather than IS subdisciplines (e.g., *Applications Development*). Our findings show that an overwhelming majority of career tracks are named for subdisciplines, specializations, or niche areas rather than job types (244 out of 269 career track names). Therefore, our first recommendation would be that the model career track design team consider using discipline-based track names rather than job types, to make the model curriculum more appealing to the existing programs

with career tracks. One can speculate on the reasons why programs choose to name their tracks after IS subdisciplines. Perhaps it is important to faculty to name career tracks after areas in which they specialize themselves. They also may believe IS subdiscipline names change less often than job names.

Currently career track naming and definition is idiosyncratic throughout the 96 schools that have career tracks. This finding suggests that faculty members may craft career track names and define career tracks to differentiate their program resources and to market their graduates. Career track names would undoubtedly be more comparable in the IS profession and academic world if they were standardized, based on model curriculum design, but the programs that currently have career tracks might have to be convinced that standardization is worth the costs of curriculum redesign.

Beyond track naming, the very definition of what constitutes a career track is not standard. There is wide variation in the numbers of courses required, in what courses are required, whether courses are within the program or in related disciplines, and in the degree of track structure. The model career track design assumes that career tracks are built on top of the model core curriculum, even though most program curricula are not comparable to the IS 2002 model curriculum. We found that some career tracks are defined beginning with the first course in the sequence and others begin after the students finish a common core. The proposed model career track design also ignores the situation in which multiple IS disciplines are co-located in one organizational unit, which may differentiate its career tracks as CIS, CS, MIS, and/or IT.

Despite these possible problems, we applaud the model career track design effort. Defining a model career track design could help the IS field resolve its self-identity crisis. Currently career tracks are not comparable from program to program. Programs without career tracks might be encouraged to develop them and programs with career tracks might improve their curriculum design by redesigning tracks using the model. This effort should improve IS education overall.

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8. **APPENDIXES**

Appendix A. Table 1

Table 1. Track Categories and Track Names

1. Applications Development	***49***	
Applications Development	6	
Applications Programming	1	
Business Applications	1	
Business Systems	2	
Client/Server Systems	1	
Corporate Systems Development	1	
Developer/Analyst	4	
Development	4	
Enterprise Systems Development	1	
Industry	1	
Programmer Analyst	4	
Programming	7	
Programming/Analysis	1	
Project Lifecycle Management	2	
Project Management	1	
Project/Technical Management	1	
Software Development	2	
Software Development/Quality	1	
Software Engineering & Database Design	1	
System Development	5	
System Engineering	1	
Technical Aspects	1	
2. IS Disciplines	***41***	
Computer Information Systems	**5**	
Computer and Information Systems	1	
Computer Information Systems	4	
Information Systems	**7**	
Business Information Systems	1	
Information Systems	6	
Management Information Systems	**14**	
Information Systems Management	1	
Management Aspect	1	
Management Information Systems	9	
Management of IS	1	
Strategic Management of Information Systems	1	
Systems Integration and management	1	
Computer Science	**6**	
Information Technology	**8**	
3. Web Technologies/E-commerce	***38***	
Web Technologies	**24**	
Interactive Web Development	1	
Internet Programming & Security	1	
Internet Technologies	1	
Digital Art	1	
Digital Graphic Design and Multimedia	2	
Multimedia	1	
Software & Web Application Development	1	
Web & Database Administration & Management	1	
Web Design	1	
Web Design and Management	1	
Web Developer	1	
Web Development	3	
Web Development & E-Commerce	1	
Web Engineering	1	
Web Site Design	1	
Web Systems Development	1	
Web Technologies	1	
Web/Information Systems	1	
Web/Network Development & Administration	1	
Web-based Solutions	1	
Web-Based Systems	1	
E-commerce	**14**	
E-Business Management	1	
E-Business Technologies	1	
E-Commerce	1	
E-Commerce & Internet Technology	1	
eCommerce Technology	7	
Electronic Commerce	1	
Internet Commerce	1	
Marketing & E-Commerce	1	
4. Networking/Telecommunications	***33***	
Networking	**28**	
Advanced Networking	1	
Computer Networking	2	
Data Communications	2	
Enterprise Networking	1	
Network Administration	1	
Network Administration & Management	1	
Network Application	1	
Network Communications	1	

Network Design & Administration	1	
Network Design & Management	1	
Network Development & Management	1	
Network Engineering	1	
Network Management	4	
Network Specialist	1	
Networking	6	
Networking & communication systems	1	
Networking/Administration	1	
Networks	1	
Telecommunications	**5**	
Business Telecommunications	1	
Telecommunications Analysis	1	
Telecommunications & Computer Networks	1	
Telecommunications & Information Management	1	
Telecommunications Systems	1	
5. Information Assurance	***25***	
IS Auditing	**4**	
Accounting Information Systems Audit	1	
Audit	1	
Information Systems Auditing	1	
IT Audit & Control	1	
IS Security	**21**	
Computer Security	1	
Computer Security & Computer Forensics	1	
Criminology Informatics	1	
Digital Forensics	1	
Enterprise Security	1	
Information Assurance	4	
Information Assurance & Computer Security	1	
Information Security	3	
Information Security Management	1	
Information Systems Security, Auditing & Crisis Response	1	
Infrastructure Assurance	1	
Networking and Security	1	
Networks and Cybersecurity	1	
Security	3	
6. Business/System Analysis	***19***	
Business Analysis	**8**	
Business Analysis	4	
Business Analyst	3	
Business Systems Analysis	1	
Systems Analysis	**11**	
Implementation and Analysis of Algorithms	1	
Information Systems Analysis & Design	1	

Object-Orientation	1	
Systems Analysis	2	
Systems Analysis & Design	5	
Systems Analysis & Development	1	
7. Business Functional Applications	***19***	
Accounting	**3**	
Accounting	1	
Accounting Information systems	2	
Administration	**2**	
Administrative Management	1	
Office Information systems	1	
Enterprise Resource Planning	**6**	
Enterprise Systems	2	
Enterprise Resource Planning (ERP)	2	
Enterprise Information Systems	1	
Enterprise Management	1	
Finance	**3**	
Finance	1	
Financial	1	
Financial Systems	1	
Operations Management	**5**	
Industrial/Manufacturing Systems	1	
IT Infrastructure Operations & Management (TOM)	1	
Logistics Information Systems	1	
Operations / Supply Chain Technology	1	
Operations Management	1	
8. Information Management	***15***	
Data Management	2	
Database	1	
Database Administrator	1	
Database Analyst	1	
Database & Decision Support	1	
Database Design & Development	1	
Database information systems	1	
Database Management	3	
Databases	2	
Information Management	2	
9. Specialized Information Systems/Studies	***14***	
Education	**3**	
Business & Information Technology Education	1	
Education	2	
Human Factors	**3**	
Human-Computer Interaction	2	
Psychology	1	
Health Care Systems	**2**	
Health Care Informatics	1	

Health Care Information Systems	1	
Spatial Systems	**2**	
Geographic Information Systems	1	
GIS/Spatial Systems	1	
Others	**4**	
Integrated Science, Business & Technology	1	
Military Systems Specialist	1	
Technical Sales	1	
Technology Entrepreneurship	1	
10. End User Support/Training	***8***	
Computer Support Specialist	1	
Computer Technical Support	2	

End User Computing Systems	1	
End User Support Specialist	1	
Technical Training	1	
Technical Writing	1	
User Systems Management	1	
11. Decision Support Systems	***8***	
Decision Sciences	2	
Decision Support & Knowledge Management	1	
Decision Support Systems	1	
Decision Technologies	1	
Business Intelligence	2	
Intelligence & Decision Support	1	

Table 2. IS 2002 Curriculum Design for IS majors Mapped to CIS Core Curriculum

IS 2002 Model Curriculum Courses		**CIS core equivalents required of all majors**
P. Prerequisite		
IS 2002.P0	Personal Productivity with IS Technology	CIS 101 Introduction to Microcomputing
A. Information Systems Fundamentals		
IS 2002.1	Fundamentals of Information Systems	*CIS 310 Management Information Systems
IS 2002.2	Electronic Business Strategy, Architecture and Design	CIS 311 Interactive Web Development
B. Information Systems Theory and Practice		
IS 2002.3	Information Systems Theory and Practice	**CIS 310 Management Information Systems and CIS 328 Information Systems Careers
C. Information Technology		
IS 2002.4	Information Technology Hardware and Software	None
IS 2002.5	Programming, Data, File and Object Structures	CIS 234 Object-Oriented Programming CIS 304 Intermediate Java Programming for Business
IS 2002.6	Networks and Telecommunications	CIS 307 Business Telecommunications
D. Information Systems Development		
IS 2002.7	Analysis and Logical Design	CIS 235 Introduction to Object-Oriented Systems Analysis & Design
IS.2002.8	Physical Design and Implementation with DBMS	CIS 305 Database Design and Development
IS 2002.9	Physical Design and Implementation in Emerging Environments	CIS 466 Systems Development Project
E. Information Systems Deployment and Management Practice		
IS	Project Management and Practice	CIS 466 Systems Development

Table 3. IT 2005 Body of Knowledge Mapped to CIS Core Curriculum

IT 2005 Body of Knowledge	CIS Core Equivalents or partial equivalents
ITF. Information Technology Fundamentals	CIS 310 Management Information Systems
HCI. Human Computer Interaction	CIS 311 Interactive Web Development
IAS. Information Assurance & Security	None
IM. Information Management	CIS 305 Database Design and Development
IPT. Integrative Programming & Technologies	None
NET. Networking	CIS 307 Business Telecommunications
PF. Programming Fundamentals	CIS 234 Object-Oriented Programming CIS 304 Intermediate Java Programming for Business
PT. Platform Technologies	None
SA. System Administration & Maintenance	None
SIA. System Integration & Architecture	CIS 235 Introduction to Object-Oriented Systems Analysis & Design CIS 466 Systems Development Project
SP. Social & Professional Issues	CIS 310 Management Information Systems CIS 328 Information Systems Careers
WS. Web Systems & Technologies	CIS 311 Interactive Web Development

Appendix B. Proposals

Proposal I
Refine Current Track Design

Design: Merge the Internet Programming sub-track with the Application Software Development track. Create an independent Information Assurance track.

1. Application Development (AD) Track

Required:
CIS 338 Client/Server Applications Development with Visual Basic
CIS 421 Multimedia Applications on the Web
CIS 424 Advanced Java Programming for Business
Choose 2 from the following:
CIS 284 Programming with C++
CIS 406 Rapid Systems Development
CIS 415 Advanced Object-oriented Systems Analysis and Design
CIS 451 E-commerce Application Development
CIS 491 Secure Web Development
CIS 400 or CIS 443 Internship

2. Information Assurance (IA) Track

Select 5 from the following:
CIS 433 Information Systems Auditing
CIS 467 Network Security
CIS 471 Internet Security
CIS 481 Computer Forensics
CIS 491 Secure Web Development
CIS 400 or CIS 443 Internship

3. Business Systems Analysis (BSA) Track

Select 5 from the following:
1. CIS 338 Client/Server Application Development
2. CIS 345 Data Modeling
3. CIS 406 Rapid Systems Development
4. CIS 415 Advanced Object-Oriented Systems Analysis and Design

5a. CIS 400 Special Study or CIS 443 Internship or
5b. Select one upper division CIS course from the following: CIS284, CIS347, CIS424, CIS433, CIS451, CIS471, and CIS481.

4. Telecommunications and Networking (TN) Track

Required:
1. CIS 347 Local Area Networks
2. CIS 417 Wide Area/Voice Networks in Business

Select 3 from the following:
1. CIS 427 Mobile Communications and Wireless Networks
2. CIS 437 Network Management
3. CIS 447 Multi-vendor Inter/Intra Networking
4. CIS 467 Network Security
5. CIS 400 Special Study or CIS 443 Internship

Proposal II
Course Cluster Design

Design: Create clusters of 2 to 3 courses and let students choose 2 clusters.

Clusters *(examples)*:

Cluster 1 - Internet Programming

CIS 421 Multimedia Applications on the Web
CIS 451 E-commerce Application Development
CIS 424 Advanced Java Programming for Business

Cluster 2 - Internet Security

CIS 491 Secure Web Development
CIS 471 Internet Security

Cluster 3 – Auditing and Forensics

CIS 433 Information Systems Auditing
CIS 481 Computer Forensics

Cluster 4 – Advanced Computer Applications

CIS 338 Client/Server Applications Development with Visual Basic
CIS 424 Advanced Java Programming for Business
CIS 406 Rapid Systems Development

Cluster 5 – Computer Networks

CIS 347 Local Area Networks
CIS 417 Wide Area/Voice Networks in Business
CIS 447 Multivendor Inter/Intra Networking

Cluster 6 – Telecommunications

CIS 417 Wide Area/Voice Networks in Business
CIS 427 Mobile Communications and Wireless Networks
CIS 437 Network Management

More Clusters 7, 8, 9, …

Proposal III
Cafeteria Design

Design: Allow students to create their own plan of study under faculty guidance.