An Analysis of Career Tracks in the Design of IS Curricula in the U.S.

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Abstract

Studies of undergraduate curricula in the field of Information Systems (IS) over the past two decades demonstrate a continual process of development and change. Many factors influence curriculum design, including new technologies and methodologies, and emerging subfields and subject areas. However, one deficit in the literature about IS curriculum issues is the investigation of IS specializations, also referred to as career tracks. These career tracks allow graduates to present themselves to employers as proficient in a career area that is in demand. This study finds that 110 baccalaureate (or approximately 24.4%) of the IS programs in the 450 business schools in the United States offer a total of 304 career tracks. Of these programs, 80.9 percent offer between one and three tracks. The paper classifies career tracks into 11 categories. Analysis shows that although educators within the IS field have structured their career tracks in large part after recognizable IS subfields and areas of studies, track names within categories are not standardized, but instead contain various combinations of keywords. The naming variations that differentiate career tracks suggest that faculty members fashion track names to convey special meanings for their constituencies. The goal of this paper is to present a snapshot of IS career tracks to help IS programs review and revise their own curricula.

Keywords: IS Curriculum, Career Tracks, Specializations

1. INTRODUCTION

As information technologies (IT) continue to advance, Information Systems (IS) faculties regularly re-evaluate and revise undergraduate curricula in order to produce graduates with the knowledge and skills required by the dynamic environment of the modern world of work. In this paper, the term *program* represents organizational units with different names (e.g., department, concentrations, etc.) and the acronym *IS* represents programs that may be called Management Information Systems (MIS), Information Systems (IS), Computer Information Systems (CIS) or Information Technology (IT).

Based on Jones's (1997) analysis of the IS literature, there are two approaches toward the study of IS curriculum: the *normative* and the *descriptive*. The *normative* approach seeks to determine factors that affect IS curriculum design or to develop normative standards for undergraduate degree programs. Factors include educator's aca-

demic background (Sherer, 2002), educator's preferences (Ahmadi and Bradston, 1977), alumni experiences (Davis, 2003; Tesch, Crable, and Brown, 2003), and industry opinions (Ehie, 2002; Gonzenbach, 1998). Normative studies (Maier, Clark, and Remington, 1998; Moshkovich, Mechitov, and Olson, 2005; Golden and Matos, 2006) conclude that certain knowledge areas or skill sets should be part of an IS curriculum. The Association for Computing Machinery (ACM), the Association for Information Systems (AIS), and the Association for Information Technology Professionals (AITP) have developed larger scale normative curriculum models such as IS 2002 (Gorgone, Davis, Valacich, Topi, Feinstein, and Longennecker, 2002) and IT 2005 (*Computing Curricula 2005*). The work of a new task force on a major revision of the model IS curriculum, is reported in Topi, Valacich, Wright, Kaiser, Nunamaker, Sipior, and de Vreede (2008). They expand the model to include courses outside the business school, modifications to outcome expectations and curriculum topics that reflect them, the use of collaborative tools, and separation of core and advanced topics. Our study concerns the latter, the structure of advanced courses in IS curricula. These models provide tools for curriculum development and assessment (Dwyer and Knapp, 2004; Williams and Pomykalski, 2006).

Research taking the *descriptive* approach describes IS courses or programs. Longenecker and Feinstein (1989) assessed the state of IS curricula through a comprehensive survey of undergraduate programs in Canada and the United States (U.S.). Chen, Danesh, and Willhardt (1991) compared computer curricula in AACSB-accredited business schools. Gill and Hu (1999) surveyed 193 IS programs regarding 1991-1996 curriculum changes. Heinrichs and Banerjee (2002) examined IS course titles from AACSB-accredited business schools to determine typical program content and structure. Kung, Yang, and Zhang (2006) examined the core curricula of all AACSB-accredited undergraduate IS programs in the U.S. Other studies compare IS curricula to model curricula (MacKinnon, 2003; Williams and Pomykalski, 2006).

Previous studies suggest that there is continuity in curriculum development and that many factors influence IS curriculum design. However, one important aspect of IS curriculum design not previously studied is the design and arrangement of specializations or career tracks. A representative panel at the Americas Conference for Information Systems (AMCIS) in 2007 (Topi, Valacich, Kaiser, Nunamaker, Sipior, de Vreede, J.G., and Wright, 2007; Topi et al., 2008) are recommending that the next model include career tracks. Our study adds to this discussion by describing current career track structures in IS baccalaureate programs in business schools in the United States.

2. CAREER TRACK DESIGN IN IS CURRICULUM STRUCTURE

The dilemma in constructing IS curricula is that faculty constrained by resources and unit requirements must try to reflect industry trends and technology developments (Tesch et al, 2003, p. 40). Because resources are finite, IS curriculum structure reflects an intellectual filtering of knowledge and skill elements by faculty who decide what students should learn for their future careers.

There are two essential perspectives toward IS curriculum structure: a broad spectrum of knowledge and skills—a curriculum with *diversity*—or concentrations in one or more particular subdisciplines—a curriculum with *specificity*. Programs may construct their curricula along this continuum, depending on their resources, the interests of faculty, and institutional values, which may require faculty to devote time to research rather than curriculum development. The career track model is a specialization model in which students first complete some fundamental courses and then specialize in one or more sub-discipline areas. Career tracks, also called *emphases*, *concentrations, options, models, specializations, specialties, paths, certificates, clusters*, or *support areas*, have a distinct title and offer a number of cohesive but constrained electives. Although diversity and specificity are not mutually exclusive, conflict occurs because of limited instruction time, restricted credit hours, and the dynamic nature of the IT field (Lightfoot, 1999). These constraints, moreover, present a major challenge to IS educators to design career tracks that are competitive, administratively manageable, flexible, and sustainable over time.

Career-driven curriculum design has its adherents. Lee, Trauth and Farwall (1995, p. 333) argue that "a generic curriculum to meet the needs of all future MIS professionals is obsolete, and different IS curricula should be tailored to meet the needs of different IS careers." In an analysis of the dilemma between the fad and the fundamental in IS education, Lightfoot (1999, p. 48) suggests that the "single career track" IS professional is outdated and that IS programs should allow students to choose courses that are important to their chosen career paths. In their discussion of the development of the IS 2002 Model curriculum, the authors (Gorgone et al., 2002) emphasized that IS curriculum design incorporates a vision of the graduates' career paths**.**

Empirical research into the effects of IS career design is scarce. Looking at industry expectations for curriculum development, Ehie (2002) indicates that MIS concentrations occur mostly in graduate level programs, while practitioners in the study favored undergraduate curriculum design with niche areas or concentrations. Ross, Tyran, and Sandvig, (2004) explored the relationship between IS course specialization and initial full-time job placement and starting salary. Their study lends modest support to the position that specialization in IS education matters.

While graduates specializing in a *system development* track had significantly higher starting salaries than those in an *IS infrastructure* track, course specialization did not have a significant relationship to job placement rates.

The rest of this paper lays out our methodology, presents and discusses our findings, and presents our conclusions and recommendations.

3. METHODOLOGY

This study uses a web listing of 711 business schools in the U.S, available at univsource.com (http://www.univsource.com/bus.htm). We used this list, because it receives regular updates and maintains a current list of schools. This study is a snapshot in time (February to May 2009), since catalogs and even program websites may lag curriculum changes. At the time of data collection, 450 U.S. business schools had baccalaureate IS programs. Since the purpose of this study is to review career track design, we include both AACSB-accredited and non-AACSB-accredited schools.

We reviewed each program's website to identify those with specializations or career tracks as part of their curriculum structure. If the website did not provide sufficient information, we explored the university's online catalog. We entered career track information and its associated course information into a Microsoft Access database for analysis. Use of online information from school websites has three advantages: the return rate is 100%; the respondent's memory or interpretation is irrelevant; and cost-effective.

4. FINDINGS/DISCUSSION

Numbers of Tracks

We found career tracks or specializations in 110 or 24.5% percent of the 450 IS programs. Table 1 (Appendix) shows the frequency of school programs with different numbers of career tracks. An overwhelming majority (80.9%) had one to three tracks. One program had 10.

Career Track Names

A review of career track names reveals that most programs name career tracks using combinations of keywords from IS subfields and/or IS referent disciplines. In some programs, track names reflect referent disciplines, such as *Accounting*, or *Operations Management.* Georgia Southern University's IS major, for example, chose ten track names that reflect recognized subfields and referent IS disciplines: *Accounting Information Systems*, *Business Application Development*, *Business Intelligence*, *Electronic Commerce*, *Enterprise Resource Planning Systems*, *Enterprise Security*, *Human Resource Information Systems*, *Logistics Information Systems*, *Technology Entrepreneurship*, and *Technology Sales and Marketing*. Another approach names tracks for specific jobs that graduates might seek. The IS program in Suffolk University named its two tracks after jobs: *Information Technologist* and *Business Analyst*. Many programs utilized a combination of names reflecting subfields and careers.

Our analysis of career tracks uses the names that program faculty members chose for the career track, based on their reputations,

values, and expertise (Lightfoot, 1999). Names convey information about the preparedness of the graduates for the IT workforce. IS faculty members belong to a common academic field, which has agreed-upon subfield names. Generally, track names contain keywords that indicate the category in which they belong. The naming variations that faculty chose to differentiate career tracks indicate that they fashion names to convey special meanings for their constituencies.

We found it difficult to classify tracks by course content, because what constitutes a career track varies widely from one program to another. Frequently, all students take a common core before selecting a career track, but some programs define a separate start-to-finish curriculum for each track. Of the end-of-program career tracks, some require four or five specialized courses and others require only two courses. Sometimes two tracks in the same school differed only by one course. In addition to looking at track names, we reviewed the course content of many career tracks for two reasons: (1) for information about the typical course content for the findings section of this paper, and (2) to clarify where an ambiguously named track belonged. Examining the content of these tracks provided a classification based on the preponderance of courses listed.

Career Track Categories

We organized tracks into categories, first based on their *names* for the reasons above. In our classification of tracks, we aimed for the right granularity level, so that categories represent meaningful groups that correspond to IS subfields and topics, and represent the content of the track offerings. Table 2 (Appendix) summarizes the track categories and the numbers of institutions with programs within. Table 3 (Appendix) includes a detailed list of track names within categories, showing the variety of IS career track names, each of which may require somewhat different skill sets. This variety, as well as the numbers of overlapping courses within two career tracks in the same program, suggests that IS practitioners require a variety of knowledge and skills as their careers progress.

Table 2 lists the numbers of programs that have career tracks in each track category. Some categories represent more established IS specializations such as *Applications Development*, *Networking and Telecommunications*, *Systems/Business Analysis*, *Information Management*, *End-User Support/ Training*, and *Decision Support Systems*. Some represent relatively new areas such as *Web Technologies/E-commerce* and *Information Assurance*. The largest *IS Discipline* category contains tracks (CIS/CS/IT/MIS*)* that by-and-large are not as specialized as those in the other track categories. The *Business Functional Applications* category consists of tracks that address the development and use of information systems in different business environments. Finally, the *Specialized Information Systems/Studies* category includes tracks emphasizing a variety of specific information systems or studies that individually do not have a sufficient number to constitute a separate category. The following subsections discuss each track category in detail in order of size from largest to smallest.

IS Discipline (CIS/CS/IT/MIS)

There are 75 tracks (24.7%) in this category (Table 3). *Computer Information Systems* (CIS) has 26, *Management Information Systems* (MIS) has 22, *Information Technology* (IT) has 15, and *Computer Science* (CS) has 10. These tracks are less-specialized discipline-based tracks.

MIS programs prepare students to work with IT to manage business information assets. CIS programs educate students in the development, operation, and maintenance of computer-based IS. CS tracks offer software engineering, computing techniques and underlying computing theories. Only CS tracks organizationally co-located with IS programs are included. Information Technology (IT), a more recent addition, emphasizes hardware, technology integration and deployment, and interoperability, defined in the 2005 model curriculum (*Computing Curricula: Information Technology Volume*. 2005). In general, MIS is managerial, while CIS IS, CS, and IT are technical. Managerial and technical tracks often are coupled in the career track structure, juxtaposing an MIS with a CIS or CS track.

Predictably, tracks in this category include a wide spectrum of business and technical IS courses. Some tracks broaden students' technical expertise with courses in CS, IT, or other technology-oriented disciplines in ex-

ternal programs or colleges. The new model curriculum task force will reflect this structural aspect of many IS programs (Topi et al., 2007, 2008).

Web Technologies/E-commerce

This specialization (44 tracks or 14.5% of the total) arose during the explosion of the Internet in the 1990s. Tracks in both *Web Technologies* (29) and *E-commerce* subcategories (15) overlap in terms of business knowledge and Web technologies. *Web Technologies* tracks provide the educational foundation and skills to design, develop, and implement Web-based applications, whereas *E-commerce* tracks prepare students to analyze e-commerce systems and design and implement Internet applications. Common goals are to prepare graduates as technology liaisons between businesses and the Internet or between customers and suppliers.

E-commerce track names tend to be similar: *Electronic Business, Electronic Commerce*, Internet Commerce. *Web Technologies'* track names vary widely, usually including *Internet* or *Web* combined with IS keywords such as *Design*, *Applications*, or *Systems*. The variety may reflect the relatively recent emergence of the subfield. *Graphic Design* and *Multimedia* belong here because of their importance for Web development.

Students in the *Web Technologies* tracks generally take courses in the subjects of Web-design, Web-programming, database management, and multimedia. Deeper tracks cover Server Operations, Web Site Administration, Web Standards and Protocols, and Telecommunication Systems and Networking. Since most *E-commerce* systems are either Internet-based or Web-based, course offerings in these tracks emphasize e-commerce, but differ little from the Web Systems and Technologies tracks. Frequently, students in one emphasis take courses in the other.

Applications Development

Forty-two (13.8%) programs have *Applications Development* tracks, which prepare students for professional careers in the design, development, and deployment of information systems. Track names reflect concepts from programming and application development, such as *Programming*, *Systems*, and *Development*. Two tracks encompass the entire system-development-life-cycle (SDLC) using *Project Lifecycle* and *Project Management* in their names. *Programmer Analyst* is a common job title and track name. Tracks use the names of specific classes of applications, such as *Client-Server 3-Tier Development*.

In this track category, students develop broad knowledge in systems design, computer programming, database management, and project management. In terms of programming skills, students take one or two programming languages and/or specialize in a variety of development environments, such as interactive or event-driven programming. Many require user interface design, multimedia, and web design. Some programs include elective courses in Decision Support Systems, Network Modeling and Simulation, or Quantitative Analysis.

Networking and Telecommunications

Networking and Telecommunications (33 or 10.9%) represents the infrastructure perspective of IT including technical and management skills necessary to develop and manage computer and telecommunications networks. The most common names are *Networking* and *Network Management*. Names vary widely with combinations of the word *Network*(*ing*), or *Telecommunication*s and keywords such as *Design*, *Analysis*, *Management*, etc.

Courses cover multiple facets of networking, including analysis, design, development, administration, security, and management. Others cover diverse network systems (LAN, WAN, Internet, mobile, wireless, etc.) or different network operating systems (Windows, Linux, UNIX, etc.). Courses often are offered in conjunction with technical Communications, Computer Science, or Electrical Engineering programs. Review of course offerings also reveals that *Networking* (28) and *Telecommunications* (5) tracks are not necessarily different.

Information Assurance

Course offerings within *Information Assurance* tracks are increasing (28 programs or 9.2%) because of increased demand for graduates knowledgeable in computer security (since 9/11) and information auditing (since Sarbanes Oxley). There are 23 tracks in *IS Security* and five within *IS Auditing*.

Again, in this newer subfield, track names vary widely. The most common names in the *IS Security* subcategory are *Information Assurance*, *Information Security*, and *Security*.

Graduates from these specializations assist businesses in the design, implementation, and management of secure information systems and networks. Fundamental subjects include networking, data communications, network security, information security, database security, e-commerce, and ethics. More specialized courses include encryption, cryptography, computer forensics, computer crime, risk management, emergency management, penetration testing, intrusion detection and incident response, and access control. The subject's interdisciplinary nature requires courses from Informatics, Computer Science, and Justice and Law Administration.

Tracks in IS Auditing prepare students to audit computer-based systems. Since the knowledge required in this area includes accounting practices and accounting information systems, students pursing this specialization usually take some accounting courses. In fact, Accounting majors may make this concentration one of their study options, while IS students may consider a second major or minor in Accounting with Auditing as a concentration.

Business Functional Applications

Twenty-four tracks (7.9%) specialize in the development and use of information systems in such business functional areas as *Accounting*, *Administration*, *Enterprise Resource Planning*, *Finance*, and *Operations Management*. A common goal is to prepare students to bridge the gap in organizations between the IT function and particular business functions. *Accounting* tracks train students in the design and use of accounting information systems. Tracks specializing in *Administration* stress the integration of people, procedures, and technology to produce information in the office environment. The *Enterprise Resource Planning* tracks prepare students to assist companies in the selection, implementation, and support of large, complex ERP systems, such as SAP, that integrate business processes across an entire organization. The *Finance* tracks focus on knowledge of standards and practices for acquisition of financial information as well as the ability to select and implement technology to support this activity. Finally, the *Operations Management* tracks prepare IT specialists with skills to manage operations in high-technology business environments that integrate business processes across the supply chain.

Information Management

Information Management (17 or 5.6%) concentrates on the organization, storage, retrieval, and employment of business data and information. Most tracks have names that emphasize *design*, *development*, *administration*, *management*, and *decision support* of *data* and *information*. Course offerings address the subjects of data concepts, data structures, data warehousing, data modeling, database design, database administration, and database management.

Business/Systems Analysis

Business/Systems Analysis is an established career specialization (13 or 4.3% of tracks). Traditionally, systems analysts use their knowledge and skills to solve information problems, using IT to meet individual and collective needs of organizations. Business Analysts work directly with management and users to analyze, specify, design and implement business applications. The *Systems Analysis* tracks typically use a combination of *System*(*s*) and *Application* with *Analysis* or *Analyst* in the track name.

Students in this track take courses in the areas of information planning, information engineering, database management, data modeling, IT Architecture, software quality control, systems security, and/or project management. To enrich student's business analysis skills, some tracks require courses in other business domains such as decision support, cost accounting, and simulation.

Specialized Information Systems /Studies

Fourteen tracks (4.6%) in the *Specialized information Systems/Studies* category represent a variety of specific information systems or studies that individually lack the numbers to constitute a separate category. These tracks represent specializations in such areas as education, spatial systems, healthcare systems, human factors, consulting, and technical sales. Many required

courses in specialized areas in schools or colleges other than business.

End User Support/Training

End User Support/Training (8 or 2.6%) is a rather small subfield that developed with the advent of desktop computers during the 1980s, remained popular in the early 1990s, and has since dwindled. These tracks emphasize technical training and documentation, and end user support and management.

Decisions Support

Decision Support is a recognized subfield of IS that was prominent in the early 1990s. However, today there are few undergraduate tracks in this area (8 instances or 3%). These tracks emphasize the use of *decision science*, *information system*, or *information technology* to provide automated and computerized decision support.

Students pursuing this specialization learn analytic tools and problem-solving techniques to support decision making throughout the organization with the use of business models, corporate knowledge, and business intelligence. Students also learn the design, development, and use of DSS or other computerized applications that conduct sophisticated analyses of business problems and organizational performance. Common course topics in this category include database management, data warehousing and data mining, business networks and telecommunications, and DSS. Interestingly, although Group Decision Support Systems (GDSS) have been an important area of IS research, there are no undergraduate tracks with that name.

5. CONCLUSIONS/RECOMMENDATIONS

Our descriptive analysis of 304 career tracks, which presents a snapshot of track design at 110 baccalaureate business schools in the U.S., yields the general conclusions in the following subsections, followed by some recommendations for future study.

Numbers of Tracks

Almost all IS programs with tracks (80.9%) have one to three, probably because larger numbers of tracks require more complicated curriculum design and greater academic resources. Therefore, we conclude that most programs with career tracks have resources to support only a small number.

Track Naming

Track names often reflect the names of established subfields in the IS field, such as *Systems Analysis and Design*, or possible careers for which students are preparing, such as *Network Administrator*. While track names within a category may vary, they often combine keywords applicable to the subfield (*Network*) with generic IS keywords (*Analysis*). Apparently, faculty fashion names to reflect not only track course content, but also career opportunities to benefit graduates. In older, more established subfields, track names vary less. In newer subfields, such as *Information Assurance* or *Web Technologies/E-commerce*, track naming is less standard. This finding suggests that faculties do not review track names from other programs, especially in newer subfields. More variation exists in tracks named after careers than in ones named after IS subfields.

The variety suggests that names invoke meanings that the program's faculty members deem representative of their reputations, values, and expertise, and provide information about the preparedness of the graduates for the IT workforce.

Track Structure

Our review of career track structure reveals that there is no consistent track structure among baccalaureate schools in the U.S. Tracks with the same or similar names may include very different courses of study. Some have a core curriculum that all students take, followed by specializations that require as few as two or more than four courses. Other programs structure each track separately and include all courses a student must take to fulfill track requirements from start-to-finish. While we did not classify career tracks based on their course content, we did review course content for many tracks and found that no consensus among IS programs on the *number* of courses that constitute a career track or on the *specific courses* that belong in a career track with the same name.

Some tracks are more interdisciplinary, and require specialized courses from other disciplines within the university. Some tracks

are structured; others are flexible, even to the point where students define the entire track content, together with a faculty advisor.

In some programs, two tracks may have course requirements that are mutually exclusive, and in others, two tracks may contain almost the same set of courses with one or two courses that vary between them.

While the IS programs in this study are all within business schools, they may not be free-standing programs but may be partnered with one of their referent disciplines, such as Accounting, which influences curriculum options. As a field, IS has had to adapt to incredible changes in IT and its effects on organizations as well as fluctuating demands for IS graduates. All of these issues undoubtedly affect IS organizational units and IS program structure. The proposed model curriculum (Topi, 2007, 2008) is addressing the issue of track content, which may lead to more standardization in tracks.

Track Categories

Our analysis uncovered 11 categories of career tracks. Among them, seven represent more established IS subfields, which might be considered the *standards* in the field of IS: *Applications Development*, *IS Disciplines (CIS/CS/IT/MIS)*, *Systems/Business Analysis, Networking/Telecommunications*, *Information Management*, *Decision Support*, and *End-User Computing/Training*. This suggests that within the IS field, educators have structured their career tracks in large part after recognizable IS subfields and areas of study, even though they have not chosen to use standard track names within categories.

Two categories (*Web Technologies/E-commerce* and *Information Assurance*) reflect more recent IT areas, where there have been or continue to be many career opportunities. The fact that there are abundant career tracks in relatively recent subfields, and that the numbers in *End User Computing/Training* and *Decision Support* are dwindling, demonstrates that programs with career tracks update them as new subfields emerge and older ones decline.

One category, *Business Functional Applications,* stresses individual business functional areas. One catchall category, *Specialized Information Systems/Studies*, includes very specific information systems and studies, which may reflect faculty interests and differentiate programs in order to attract students and employers.

Recommendations

This analysis shows that programs that have career tracks tend to modify their tracks as IT changes. These programs thus need to periodically scan the environment and the career opportunities available to students, and revise track structures and names to reflect these changes. Capturing a periodic snapshot of track specializations in order to develop a longitudinal record of career track trends could help programs with tracks in their revision efforts.

A possible area for future research is a comparison of the characteristics of programs that have career tracks with the 80 percent of programs that do not have career tracks. Possible differences may be the numbers of majors, the numbers of faculty, AACSB accreditation status, requirements for faculty research, currency of the curriculum, and percentages of faculty who are part- or full-time.

We did not compare track categories with model curricula in this study. The IS 2002 Model Curriculum (Gorgone et al., 2002) and the IT model curricula (Computing Curricula 2005; Computing Curricula: Information Technology Volume. 2005*)* include lists of suggested courses and subject areas that belong to each. They do not discuss career tracks per se, but the newest model curriculum task force is including specializations in the model (Topi et al., 2007, 2008). An area of future research should compare career track structures with these model curricula to a snapshot of IS career tracks to see whether IS faculties are adopting the new curriculum.

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Appendix

Table 1. Numbers of Tracks in Programs with Career Tracks

Number of tracks	Frequency of Programs	% of Total
1	11	10.0%
2	55	50.0%
3	23	20.9%
4	10	9.1%
5	5	4.5%
6	3	2.7%
7	2	1.8%
8 or 9	0	0.0%
10	1	0.9%
Total	110	100%

Table 2. Track Categories

Track Category	Number of Programs	% of Total
IS Disciplines (CIS/CS/IT/MIS)	75	24.7%
Web Technologies/E-commerce	44	14.5%
Applications Development	42	13.8%
Networking /Telecommunications	33	10.9%
Information Assurance	28	9.2%
Business Functional Applications	24	7.9%
Information Management	17	5.6%
Specialized Information Systems/Studies	14	4.6%
Systems/Business Analysis	13	4.3%
End User Support/Training	8	2.6%
Decision Support	6	2%
Totals	304	100%

Table 3. Track Names within Categories

IS Disciplines (CIS/CS/IT/MIS)

Computer Information Systems	**26**
Computer and Information Systems	1
Computer Information Systems	17
Computer Systems	1
Information Systems	6
Information Systems and Technology	1
Management Information Systems	22
Information Systems Management	1
Management Aspect	1
Management Computer Systems	2
Computer Science	**10**
Computer Information Science	1
Computer and Information Science	1
Computer Science	8
Information Technology	**17**
Business Information Systems	2
Business Information Technology	1
Computer Information Technology	1
Information Technologist	1
Information Technology	10
Information technology management	1
Information Technology Service Management	1
Management Information Systems	**22**
Information Systems Management	1
Management Aspect	1
Management Computer Systems	2
Management Information Systems	13
Managerial	2
Systems Integration and management	1
Business Systems	2
Total	**75**

Web Technologies/E-commerce

E-Commerce	**16**
E-Business	2
E-Business / E-Commerce	1
E-business and Multimedia	1
E-Business Technologies	1
E-Commerce	4
E-Commerce and Internet Technology	1
E-Commerce Technology	1
Electronic Commerce	2
Electronic Commerce Systems	1
Internet Commerce	1
Virtual Business	1
Web Technologies	**28**
Digital Arts and Multimedia Design	1
Digital Graphic Design and Multimedia	1
Internet	1
Internet Technologies	1
Marketing & E-Commerce	1
Multimedia and Animation Design	1
Multimedia and web publishing	1
Publications Specialist	1
Web	1
Web Design	3
Web Design and Management	1
Web Development	6
Web Development/E-Commerce	1
Web Site Design	1
Web Systems Development	1
Web Technologies	1
Web/Information Systems	1
Web/Internet Software Development	1
Web/Network Administration	1
Web-based Solutions	1
Web-Based Systems	1
Total	**43**

Applications Development

Applications Development	5
Business Application Development	2
Business Applications	1
Business Programming	2
Client-Server 3-Tier Development	1
Computer Programming	2
Development	3
iBusiness Application Development & Management	1
IT Project Management	1
Object-Oriented Program Design and Modeling	1
Program Development	1
Programmer Analyst	4
Programming	5
Programming Skills	1
Project Lifecycle	1
Software Development	2
Solutions Developer	1
Systems Engineer	1
Software Engineering And Database Design	1
Systems Development	3
Technical	2
Technical Aspect	1
Total	**42**

Networking/Telecommunications

Networking	**28**
Computer Networking	1
Network Administration	1
Network and Enterprise Management	1
Network and Security	2
Network Application	1
Network Design and Management	1
Network Development and Management	1
Network Engineering	1
Network Management	5
Network Specialist	1
Network Technician	1
Network Technologies	1
Network/Systems Administration	1
Networking	6
Networking Administration	1
Networking and communication systems	1

Networks and Cybersecurity	1
Systems Administration	1
Telecommunications	**5**
Business Telecommunications	1
Data Communications and Administration	1
Telecommunications & Computer Networks	1
Information Technology Infrastructure	2
Total	**33**

Information Assurance

IS Audit	**5**
Audit	1
Information Technology Auditing	1
Information Systems Auditing	1
Information Systems Auditing and Control	1
IT Audit & Control	1
IS Security	**23**
Computer Forensics	1
Computer Security	2
Cyber Security	1
Digital Forensics	1
Enterprise Security	1
Forensic Computing	1
Information Assurance	5
Information Assurance and Computer Security	1
Information Security	2
Information Security Management	1
information systems security	2
Infrastructure Assurance	1
Internet Security	1
Security	2
Security Information Systems	1
Total	**28**

Business Functional Applications

Accounting	**5**
Accounting	2
Accounting Information Systems	3
Administration	**4**
Administration/Management	1
Information Processing	1
Office Administration	1
Office Information systems	1
Finance	**3**
Finance	1
Financial Systems	2
Operations Management	**5**
Logistics Information Systems	1
Management Science and Computer Systems	1
Operations / supply chain technology	1
Operations Management	1
Supply Chain Management Systems	1
Enterprise Resource Planning	**7**
Enterprise Information Systems	1
Enterprise Resource Planning	2
Enterprise Systems	3
Enterprise Systems Development	1
Total	**24**

Information Management

Data management	2
Data Storage Management	1
Database Administrator	1
Database Analyst	1
Database and Decision Support	1
Database Design and Development	1
Database Design and Management	1
Database information systems	1
Database Management	2
Database Technologies	1
Information Management	5
Total	**17**

Specialized IS/Studies

Applied IT	1
Business & Information Technology Education	1
Consultant	1
General Systems Studies	1
GIS/Spatial Systems	1
Health Care Information Systems	1
Human Information Systems	1
Industry	1
Integrated Science, Business and Technology	1
IT Consulting	1
Psychology	1
Specialized Computing	1
Technology Entrepreneurship	1
Technology Sales & Marketing	1
Total	**14**

Systems/Business Analysis

Business Analysis	**7**
Business Analysis	3
Business Analyst	2
Business Application Analysis	1
Business Systems Analysis	1
Systems Analysis	**6**
Systems Analysis and Design	4
Systems Analysis and Development	1
Systems Analyst	1
Total	**13**

End User Support/Training

Computer Support Specialist	1
Computer Technical Support	1
End User Computing Systems	1
End User Support Specialist	1
End User Training	1
End-User Support	1
Systems Support	1
Technical Support	1
Total	**8**

Decision Support

Business Intelligence	2
Decision Sciences	1
Decision Support & Knowledge Management	1
Decision Support Systems	1
Decision Technologies	1
Total	**6**