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The Market for Career Tracks in Undergraduate IS Curricula in the U.S.

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Abstract

The use of Information Technology (IT) in organizations is broad and rapidly growing. With so many technology topics to cover, Information Systems (IS) educators are faced with the challenge of having to design and develop an IS curriculum that best serves both students and industry. IS curricula often adopt a breadth-first and specialization-second approach in which students take a set of core courses in a fundamental body of knowledge followed by a number of electives in a specialization either by their own preference or by a track design offered by the program. The subject of track design has not been a traditional focus of information systems curriculum study, despite the IS Model Curricula 2010's effort to introduce a separation between core and track courses. The current study examines career track data from IS programs in business and management within the United States. The study performed a content analysis of the websites and university catalogs of 401 IS undergraduate programs and identified 241 career tracks in 82 programs. These tracks are analyzed to better understand their composition and anatomy. The results should help current information systems programs to better understand and structure their own curricula.

Keywords: IS Curriculum, Career Tracks, and Specializations

1. INTRODUCTION

As information technology (IT) continues to evolve, Information Systems (IS) educators have to regularly evaluate and revise their undergraduate curricula in order to produce graduates with the knowledge and skills required by a dynamic industry environment. Designing an adequate IS curriculum has become an ever more demanding duty for IS faculties. IS curricula often adopt a breadth-first and specialization-second approach in which a set of generalized core courses in a fundamental body of knowledge is offered and followed by a number of electives in a specialization area. The selection of specialized courses is determined either by student preference or by a track design offered by the program. Since the IT field is becoming far too broad for one individual to master, the IT workforce has been increasingly specialized with IT skills often categorized into an array of specialized skill sets. One of the major challenges in IS curriculum design is to find a proper balance between generalization and specialization in a wide spectrum of IT subjects and to effectively structure the electives into an intellectual arrangement of career tracks. The resulting tracks should be competitive in the

marketplace, administratively manageable, flexible enough to change, and sustainable over time.

Many studies have been conducted to better understand the generalized aspects of IS curricula (e.g., common body of knowledge, core curriculum, core courses, etc.), while the subject of specialization in terms of career tracks has not been a traditional focus. At present, educators have yet to embrace a single curriculum design model and supporting guidance for IS career track development. Still needed is an improved understanding of career track design in practice and its implications for curriculum development.

A classic analysis of the IS literature by Jones (1997) indicates that the study of IS curricula can be approached normatively or descriptively. The normative approach seeks to determine factors for IS that would affect IS curriculum design or to develop norms or standards for IS curricula, while research taking the descriptive approach intends to depict IS courses or programs as they currently exist. This study takes the descriptive approach to the understanding of career track design in IS programs in business and management within the United States.

2. RELATED LITERATURE

Specialization-driven IS curriculum design received early attention from some educators. Lee, Trauth and Farwall (1995, p. 333) argued that "the concept of 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) indicated that the "single career track" IS professional was outdated and that IS programs should be tailored to "allow students to select courses that emphasize the learning units most important to their chosen career path." The 2002 IS Model Curriculum suggested that "IS curriculum design must be driven by a clear vision of the career path for the graduates" (Gorgone et al., 2002). In a subsequent effort, the IS Model Curriculum 2010 devised a new curriculum model which recommends, for the first time, customization of IS curricula for variable local contexts through the specification of career tracks (Topi et al., 2010).

Proponents for IS curriculum with specialization have outlined a list of rationales and advantages for career tracks. As argued by Slazinski (2005), it is more productive for IT students to concentrate their studies in a specific interest area for the job market. In an empirical study, Downey, McMurtrey, and Zeltman (2008) further concluded that offering a career track is a must and will produce better-qualified hires. In Ehie's (2002) survey of industry's expectations for IS curriculum development, it was found that although IS concentrations were located primarily in graduate level programs, a majority of practitioners favored niche areas (or concentrations) in undergraduate curricula. In a study on the decline in IT enrollments by Lenox, Woratschek, and Davis (2008), creating new career tracks was found to be one of the common attempts made by respondents to increase enrollments in IS programs. Offering specialized fields through career track also helps address the local employment needs (Kahn, 2011).

Taking a more focused perspective, some studies looked deeper into the design and development of individual career tracks including business analysis (Sidorova, 2007), database management (Slazinski, 2009), enterprise resource planning (Boyle, 2007), healthcare systems (Khan, 2011), information security (Foltz & Renwick, 2011), and telecommunications (Hawk, 2005). From another perspective, two studies collected a wide range of career track data and presented a landscape view of the career design in the U.S. (Hwang & Soe, 2010) and the U.K. (Stefanidis, Fitzgerald, & Counsell, 2013). The U.K. study utilized the IS Model Curriculum 2010 to develop a method for ranking career tracks of undergraduate IS offerings. Finally, from the operational perspective Soe and Hwang (2007) documented an internal curriculum evaluation process aiming at creating proper career tracks.

The creation and maintenance of career tracks is not an easy task. Such an approach is usually constrained by constant technology advances, available department resources, faculty specialties and interests, and credit hour limitations (Tesch, Elaine, & Gerald, 2003; Soe & Hwang, 2007). Owen (2003) also pointed out that as the number of areas of specialization grows and the student's individual desires for their own education factor in, offering career tracks could become more difficult and unmanageable. In the aforementioned

individual career track studies, concerns were frequently raised in regard to the adequate depth (i.e., course content) and coverage (i.e., number of courses) of an individual track and the optimal structure of multiple tracks.

The studies reviewed indicate that the importance of career track in IS curriculum development has been increasingly recognized by the industry and the academics. Although studies exist which focus on individual IS areas of specialization, the current understanding of overall design and arrangement of career tracks in practice is still very limited.

3. METHODOLOGY

This study uses the Web as its primary data source. Use of online information from university websites has three advantages: the return rate is 100%; the respondent's memory or interpretation is irrelevant; and it is timely and cost-effective. This form of content analysis, as a popular research methodology in the electronic age, made it possible to accurately collect and verify career track data by analyzing relevant web-based text with a vast array of IT acronyms, concepts, and themes without the need for researcher intervention (Kim and Kuljis, 2010).

To the best knowledge of the authors, an official list of IS undergraduate programs in business and management does not exist. However, a comprehensive list of business and management schools can be compiled from a thorough Google search using websites such as univsource.com, wikipedia.com, allBusinessSchools.com, and so on. The resulting list of business and management schools can then be further refined using Google to provide a roster of 401 IS undergraduate programs within the United States. Since the purpose of this study is to examine career track design in the United States, both public and private AACSB-accredited and non-AACSB-accredited schools are included. These academic institutions all require students to take a set of pre-defined business courses along with courses in the IS major. The data collected is a snapshot in time from February to May 2013.

Using the compiled list of schools, this study performed a content analysis of the websites and university catalogs of these IS programs to identify those with specializations or career tracks as part of their curriculum structure. When necessary, course listings and contents were carefully reviewed to clarify ambiguous track names and to provide a categorization basis for career track profiling. The data items of each track, including university name, program title, department name, were entered into Excel worksheets for the purpose of categorizing, summarizing and ranking.

4. RESULTS: THE MARKET FOR CAREER TRACKS

This study identified 241 career tracks in 82 or 20.5% percent of the 401 IS undergraduate programs in business and management within the United States. These career tracks, also called *emphases*, *concentrations*, *options*, *models*, *specializations*, *specialties*, *paths*, *certificates*, or *support areas*, have a distinct title and offer a number of cohesive but constrained electives. Many of the IS programs were also found to offer a large number of electives without being grouped into career tracks.

Career Track Names

Because career track names convey information about the graduates' preparedness for the IT workforce, choosing proper words for the name is an essential task. Proper track names also enable career track advisors to conduct appropriate advising. The names of the identified tracks are generally combinations of keywords from the IT discipline. The tracks are named after either common IT job titles or subject areas in which the program faculty members specialize. In some cases as explained in the next section, the naming variations also reveal how faculty chose to fashion their career tracks to differentiate or to convey special meanings for their constituencies. However, too much variation would lead to inconsistent track representation and cause confusion for students.

Programs and Number of Tracks

As shown in Table 1, of the 82 programs with track design, the most common offering was two career tracks (42.7%) with slightly more than half offering either one or two tracks (52.5%). This is probably because these designs still offers students a choice while a larger numbers of tracks would require greater academic resources and foster a more complex curriculum design. The median number of tracks offered

was two. Only one program offered as many as nine tracks (1.2%).

Career Track Categories

Number of Tracks	Number of Programs	% of Total
1	8	9.8%
2	35	42.7%
3	14	17.1%
4	12	14.6%
5	5	6.1%
6	7	8.5%
9	1	1.2%
Total	82	100.0%

Table 1. Number of Tracks in Programs with Career Tracks

Track Category	Program Count	% Total
Business Functional Applications	41	17.0%
Information Assurance, Security and Forensics	35	14.5%
IS Disciplines	33	13.7%
Applications Development	27	11.2%
Networking/ Telecommunications	27	11.2%
Web Development	21	8.7%
Business Intelligence	13	5.4%
Systems/Business Analysis	13	5.4%
E-business/E-commerce	11	4.6%
Data/Information Management	10	4.1%
Specialized Information System Studies	10	4.1%
Total	241	100%

Table 2. Track Categories and Number of Offering Programs

One of the major tasks in profiling career tracks is to develop an intellectual and adequate categorization scheme for the tracks. The IS 2010 Model Curriculum (Topi et al., 2010) suggests a group of sixteen career tracks (i.e., application developer, business analyst, business process analyst, database administrator, etc.) which tend to reflect common IT job titles, not careers. Unfortunately, this study found it difficult to usethese job title-denoted tracks to categorize the 241 identified career tracks in practice. Instead, the current study followed an approach used by a previous survey on career tracks by Hwang and Soe (2010) to develop a more practical categorization framework. Such an approach uses track name, track description, track course listing, and individual course content of the tracks as the basis for classification. This approach aims for the right granularity level, so that categories will represent meaningful groups that correspond to IS subfields and topics and represent the content of the track offerings.

Some categories represent more established IS specializations such as Applications Development, Networking/Telecommunications, Systems/Business Analysis, and Data/ Information Management. Some represent relatively new areas emerging within the last decade such as Information Assurance, Security and Forensics, Web Development, and E-business/E-commerce. A significant number of tracks appear in the IS Discipline (IS, MIS, or IT) category which is purposefully created to distinguish the program's other more specialized tracks. The Business Functional Applications category consists of tracks that address the development and use of information systems in various business domains or application scopes. 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. Appendix Table A-2 shows a detailed list of track names within category.

In general, career tracks were found to have a technical orientation echoing a similar finding from a recent study by Stefanidis, Fitzgerald, and Counsell (2012) on career track design in the U.K. Technically oriented career tracks were also found to be more aligned with the industry demand. In an empirical study (Downey, McMurtrey, and Zeltmann, 2006) that compares the critical knowledge and skills offered by IS curricula and those sought by the industry, a practical IS curriculum is the one that is

designed "to make the major technically robust while simultaneously providing a core foundation in both business and IT."

The following subsections briefly discuss each track category in order of size from largest to smallest.

Business Functional Applications

Forty-one tracks (17.0%) specialize in the development and use of information systems in such business functional areas as *Accounting*, *Finance*, Marketing, *Enterprise Computing, Operations*, and Office Administration. The goal of these tracks is to prepare students to bridge the gap in organizations between the IT function and the other particular business functions. Besides the more established specialty tracks such as *Geographic Information Systems* (GIS) and *Healthcare systems*, other niche tracks include *Industrial Computer Applications, Organizational Information Systems*, and *Managerial Applications*.

Information Assurance, Security and Forensics

There are 35 programs (14.5%) offering career tracks specialized in *Information Assurance, Security and Forensics*. The emergence of these tracks could be a result of the recently increased demand for graduates knowledgeable in information security due to the 9/11 event and information auditing required to comply with the Sarbanes Oxley Act, a legislation enacted in response to the high-profile Enron and WorldCom financial scandals to protect shareholders and the general public from accounting errors and fraudulent practices in the enterprise. As a newer IS subfield, variation of track names in this category is inevitably wide. Another explanation is that the terms *information security*, *computer security* and *information assurance* are frequently used interchangeably. To make the track name more distinguishable, the study also found that "cyberbase" as a more modern word is used in the *Cyberbase Security* track and "digital" as another flashy term is used in the *Digital Forensics* track.

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, data recovery, 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.

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 pursuing 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.

IS Disciplines

Thirty-three (13.7%) tracks were identified in this category. These tracks serve to distinguish the program's other more specialized tracks. For example, a particular IS program may offer an Information Assurance track to separate its Management Information System track.

Further content analysis on the course offerings indicate that *Management Information System* (MIS) programs generally prepare students to work with IT to manage business information assets, *Computer Information Systems* (CIS) programs educate students in the development, operation, and maintenance of computer-based IS, and *Information Technology* (IT), as a more recent addition, emphasizes hardware, technology integration and deployment, and interoperability.

Applications Development

Twenty-seven (11.2%) programs have tracks in *Applications Development*, a more traditional and established area. Accordingly, track names in this category are more standard as some general IS concepts such as problem solving, design, programming, and development are frequently used. For the same reason, precise IT job titles such as "Developer" and "Programmer Analyst" are also being used as the track name.

In this category, students develop broad knowledge in systems design, computer programming, database management, and project management. In terms of programming skills, students are usually required to take one

or two programming languages and/or specialize in a variety of development environments, such as interactive or event-driven programming.

Networking/Telecommunications

Networking and Telecommunications (27 or 11.2%) represents the infrastructure perspective of IT including technical and management skills necessary to develop and manage computer and telecommunications networks. As another more established IS subfield, track names in this category can be combinations of the word network(ing) or telecommunications and common keywords such as "administration," "analysis," "design," "development," "engineering," "security," and "management".

Because of its emphasis on infrastructure components, courses often are offered in conjunction with other disciplines such as Communications, Computer Science, and Electrical Engineering programs. Review of course offerings also reveals that Networking and Telecommunications tracks are not necessarily different.

Web Development

This specialization (21 tracks or 8.7% of the total) arose during the explosion of the Internet computing in the 1990s. *Web Development* tracks provide the educational foundation and skills to design, develop, and implement Web-based applications.

Tracks with "Presence" and "Design" in their name focus on the client-side development of websites, while those without generally emphasize on server-side, database-driven Web applications development or both. In a few cases, Web applications also include e-commerce applications. In one particular track called "Web and Mobile Development," mobile applications development is part of one course offering. To differentiate, one track uses "i-Business" applications instead of "Web applications".

Students in this track category generally take courses in the subjects of Web design, Web programming, database management, and multimedia. Deeper tracks cover Web server operations, website administration, and Web standards and Protocols. Since modern Web development largely utilizes packaged development environments such as ASP.net, PHP, and JSP, the use of computer languages is also required in the course offerings. The addition of these languages can be expected to result in an overlapping skill set required by the Application Development track.

Business Intelligence

Thirteen tracks (5.4%) are categorized in the area of Business Intelligence. In coping with the explosive growth of digital data stored in computer databases, this track focuses on the leveraging of the information and knowledge assets to develop more competitive strategies and make better decisions. The two most common track names are Business Intelligence and Business Analytics, with four programs each. Because of their quantitative and analytic orientation, the majority of these tracks are hosted by departments with multiple disciplines in business including management science, operations management, decision sciences, and accounting.

Students in this category are required to take courses in subjects such as statistical analysis, database management, database applications, business modeling, data mining, decision support, and a few others. Common tools used in this regard include SPSS, SAS, Excel, and Microsoft Project.

Systems/Business Analysis

Business/Systems Analysis is another long established career specialization (13 or 5.4% of tracks). Traditionally, systems analysts use their knowledge and skills to solve information problems. 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 the students' business analysis skills, some tracks require courses in other business domains such as decision support, cost accounting, or simulation.

E-business/E-commerce

Eleven (4.6%) tracks are in the *E-business/E-commerce* category. Tracks in this category tend to be similar: Electronic Business, Electronic Commerce, and Internet Commerce. While two tracks focus precisely on the marketing side of the e-business/e-commerce, several others allow students to take elective courses from the marketing department. In an interdisciplinary approach, one track called "Electronic Business Marketing" creates an electronic business marketing program that combines a well designed course set from both the marketing and the business information systems department.

Since E-commerce systems are frequently either Internet-based or Web-based, course offerings in these tracks emphasize e-commerce, but differ little from the Web Development tracks. Thus, students in one emphasis may take courses in the other.

Specialized Information System Studies

There are 11 (4.1%) tracks in the *Specialized information Systems/Studies* category that 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 decision support, end-user computing, IT leadership, e-government, and project management.

One track named *Information Architecture* is in the special area of designing and implementing information systems that support and enable business strategies and operations. The track addresses topics covering concepts such as usability, information design, component-based design, and enterprise systems.

Data/Information Management

Data/Information Management (10 or 4.1%) concentrates on the organization, storage, retrieval, and employment of business data and information. Tracks in this category have names that emphasize design, development, administration, management of data and information. Course offerings address the spectrum of data concepts such as data structures, data warehousing, data communications, database design, database administration, and database management. On the information side, courses in the track cover information networking, information technology, information problem solving, and information systems planning and policy.

Two special tracks in this category expand the traditional concept of data. In one special track called "Data Media and Design," computer graphics is considered as another major element of data largely developed in the digital media. In another track called "Information and Knowledge Management," information and knowledge are viewed as an integral unit in the production of today's digital products, digital service, and social media.

Career Tracks vs. Industry Job Market

How meaningful are career tracks to future employment? To answer this question, this study mapped the eleven career tracks categories to the top areas for hiring entry-level IT workers as described in a recent, longitudinal study by Aasheim, Shropshire, Li, and Kadlec (2012). Appendix A-1 shows the results of the comparison.

The Aasheim et al. study (2012) analyzed 282 responses from IT managers to determine planned hiring needs for entry-level IT workers during the coming year. The results were grouped into hiring areas with the top 12 categories and their planned hiring rates as shown.

Not all tracks mapped to top hiring areas. Since only the top 12 entry-level IT hiring areas are listed, it is not surprising that some tracks, which are by definition specialized, do not all map to these high demand occupations. Tracks that represent regional employment and/or local faculty interests, for instance, may serve important regional needs but would not necessarily map to top hiring trends.

Of the track categories identified in this study, two categories, *IS Disciplines* and *Specialized Information System Studies*, describe tracks which do not appear targeted at a top hiring occupation. Tracks in the IS Disciplines category represent more traditional subdisciplines (IS, MIS, IT) within the field and generally exist to distinguish the program's other more specialized tracks. Specialized Studies represents such areas as decision support, end-user computing, IT leadership, e-government, and project management.

It should also come as no surprise that the IT Help Desk hiring area is without a career track category. This follows since a college degree is typically not a requirement for entry-level work in this area. The Bureau of Labor Statistics (2013) indicates "Some college, no degree" as the minimum level of education for work in this career track.

All nine of the remaining track categories map to top hiring areas. Some tracks can be seen to have a direct match with a single hiring area (e.g., business intelligence) while others tracks, with different titles (web development vs. e-business), appear to target the same hiring area of Web Design & Development.
Networking/Telecommunications tracks appears well designed to support a high demand for jobs in the area of telecommunications with a planned hiring rate of 34.5%. Applications Development and Business Functional Applications tracks appear well placed with jobs in programming/software engineering showing an expected hiring rate of 33.5%. Data/Information Management tracks directly support the hiring area for database workers with a planned hiring rate of 29.9%. Information Assurance, Security and Forensics tracks support hiring for workers in the area of information security with a hiring rate of 29.4%. Systems/Business Analysis tracks support the need for hiring workers in the area of systems analysis & design with a hiring rate of 25.3%. Business Intelligence tracks should find their students looking forward to employment in the business intelligence area with a hiring rate of 23.2%. Finally, both the Web Development and E-Commerce tracks appear well suited to support employment in the area of web design & development with a planned hiring rate of 22.2%.

What is surprising is the apparent discrepancy between two top hiring areas and the lack of career tracks to support them. The Aasheim study indicates that the rapid growth of cloud computing and its heavy use of online storage and virtualization have created a strong hiring demand for graduates to support these services. In spite of this growth, it appears not enough is being done to support graduates with skills in the areas of Storage (22.7%) and Virtualization (21.7%).

5. CONCLUSIONS AND RECOMMENDATIONS

This study performed a descriptive analysis of 401 undergraduate IS program in the United States (in business and management within the United States,) yielding a snapshot of track design at 82 programs with 241 career tracks. General conclusions are listed in the following subsections, followed by recommendations for future study.

Programs and Number of Tracks

Only 82 (20%) of the 401 undergraduate programs examined in this study offered career tracks in their curriculum designs. The most common offering was two career tracks (47.2%), probably because this design still offers students a choice while a larger numbers of tracks would require greater academic resources and foster a more complex curriculum design. Only one program offered as many as nine tracks (1.2%). Based on recent entry-level IT hiring data, tracks do appear well matched to place graduates in high demand occupations in the field. Of the top twelve hiring areas identified, career tracks appear targeted at placing graduates in nine of these areas. Several top hiring areas do not appear to have matching career tracks and these areas deserve closer examination by IS faculty.

Track Naming

As might be expected, track names often reflect the names of established subfields within the IS discipline. Names such as Application Development or Systems Analysis & Design are found among the 241 career tracks offered. It is also common to find track names, which described possible careers paths such as Systems Analyst. More often than not, track names are a blend of an IS subfield such as Networking and one or more generic keywords such as Management.

Of particular interest is the wide range of variation in the career track names being used. The vast majority of track names are unique to the school or program offering it. Even in a traditional IS subdiscipline such as Application Development, 14 of the 18 track names, or 78%, are used only once. The category of specialized studies contains 10 career track offerings and all are unique to their institutions. In total, 145 of the 170 career tracks identified in this study, or 85%, have unique names.

Apparently faculty either do not review track names from other programs or prefer to distinguish their school by using names that invoke meanings that are so specialized to their reputations, values, and expertise that duplication is unlikely. Taken together, the wealth of career track names should make a clear statement regarding the preparedness of the graduates for their future employment.

Track Categories

A careful review of the relevant data revealed that the 241 career tracks under study can be grouped into 11 career track categories. Of these 11 categories, only five represent the more traditional or standard areas of study within the field. These five are Application Development, Data/Information Management, IS Disciplines (IS, MIS, IT), Networking/Telecommunications, and Systems/Business Analysis. The remaining career tracks are a reflection on the dynamic nature of the field and demonstrate how faculty are working to maintain and update these specialized areas as the field changes. New and rapidly evolving areas of study such as Information Assurance, Security and Forensics and Web Development speak well of the ongoing innovation to curricula being done by faculty across the country.

Recommendations for Future Research

One area of future research would be to determine if IS graduates who pursue a career track have better employment prospects than those who do not. More empirical data is need to understand the comparative prospects of the 80 percent of the programs not offering career tracks at all. Career tracks require coordination and oversight. Possible differences in this regard may lie in the size of the programs in terms of both students and faculty, AACSB accreditation status, demands on faculty time for research, and part-time vs. full-time faculty composition. One of the limitations of this paper is that even though it can be expected that business schools use their websites as the primary media for communication, the website might, in fact, not reflect current course offerings.

More research is needed on the occupations and career paths of IS graduates who pursue a specialization track. The approach used in this study was to map career tracks to top hiring areas and these results look promising. Capturing actual hiring data and comparing these results with graduates' areas of specialization could help programs determine the effectiveness of their career tracks. Many campuses have a career center responsible for monitoring the placement of graduates and this would a good place to start with data collection.

This study did not examine the qualification of the career track in terms of the depth and breadth of coverage provided. In this regard, what does it take to be called a legitimate track? An area of future research should compare career track structures to determine which structures IS faculty prefer.

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Appendix

Table A-1: Comparison of Career Track Categories with Aasheim's Areas for Hiring Entry-level IT Workers

Aasheim Entry-Level IT Hiring Area	Hiring* Rate	Track Category in this Study
IT Help Desk	45.9%	
Networking	34.5%	Networking/Telecommunications
Programming/Software Engineering	33.5%	Applications Development Business Functional Applications
Database	29.9%	Data/Information Management
Security	29.4%	Information Assurance, Security and Forensics
Systems Analysis & Design	25.3%	Systems/Business Analysis
Business Intelligence	23.2%	Business Intelligence
Web Design & Development	22.2%	Web Development
Web Design & Development	22.2%	E-business/E-commerce
Storage	22.7%	
Virtualization	21.7%	
Enterprise Resource Planning Systems	20.1%	Business Functional Applications (ERP)
Disaster Recovery	17.5%	Information Assurance, Security and Forensics (Computer Security)
		IS Disciplines (IS, MIS, IT)
		Specialized Information System Studies

* Hiring rate measured respondents (n=194) intention to hire entry-level IT workers within a given area during the following year. More than one area could be selected so percentages total greater than 100% as shown.

Table A-2: Track Names within Categories

Business Functional Applications	**41**
Accounting	**7**
Accounting	2
Accounting & Information Systems	5
ERP	**9**
Enterprise Information Systems	
Enterprise Resource Planning	1
Enterprise Resource Planning Systems	1
Enterprise System	4
Enterprise Systems (ERP) Technology Management	1
Enterprise Systems and Enterprise Resource Planning	1
Finance	**3**
Finance	1
Financial Management Systems1	1
Financial Systems	1
GIS	**3**
Geographic Information Systems	3
Healthcare	**4**
Health Informatics and Information Management	1
Health Information Systems	2
Healthcare Information Systems	1
Marketing	**2**
Marketing & Information Systems	2
Office Admin	**3**
Administrative management	1
Microsoft Office Specialist	1
Office Information Systems	1
Operations	**7**
Logistics Information Systems	1
Operations and Supply Chain Management	1
Retail Management and Technology	1
Supply Chain and Operations	1
Supply Chain Information Systems	1
Supply Chain Management	1
Supply Chain Management Systems	1
Others	**3**
Industrial Computer Application	1
Managerial Applications	1
Organizational Information Systems	1

Information Assurance	**35**
Audit	**5**
Audit	1
Information Systems Auditing	1
Information Systems Auditing and Control	1
IT audit & Control	1
IT Auditing	1
Computer Security	**27**
Computer Information Systems and Security	1
Computer Security	2
Cyber Security	1
CyberSecurity	1
Enterprise Security	1
Homeland Security	1
Information Assurance	5
Information Assurance and Computer Security	1
Information Security	6
Information Security and Architecture	1
Information Security and Assurance	1
Information Security Management	1
Information Systems Security	1
Infrastructure Assurance	1
Insurance Security & Assurance	1
IT Risk Consultant	1
Security	1
Forensics	**3**
Computer Forensics	2
Digital Forensics	1
IS Disciplines	**33**
Business Information Technology	1
Computer Information Systems	5
Generic CIT	1
Information Systems	10
Information Technology	5
Information Technology Management	1
Information Systems	1
IS Management	1
Management & Information Systems	1
Management Information Systems	6

Application Development	**27**
Application Development	6
Business Application Development	1
Computer Programming	1
Developer	1
Development	1
Information Resource Specialist	1
Information Systems Development & Implementation	1
IT Applications Development	1
Problem Solving & Programming Techniques	1
Programmer/Analyst	2
Programming	1
Software and Web Application Development	1
Software Design and Development	1
Software Development	2
Software Engineering and Database Design	1
Systems Analysis, Design, Implementation and Management Knowledge	1
Systems Design/Development	1
Systems Development	3

Networking /Telecommunications	**27**
Networking	**24**
Data communications, networking and distributed processing	1
Information and Communications Technology	1
IT Infrastructure Operations and Management	1
Network Administration	2
Network Administration and Management	1
Network and Enterprise Management	1
Network Design and Administration	1
Network Development and Management	1
Network Engineering	1
Network Management	2
Network Security Analysis	1
Network Technology Specialist	1
Networking	5
Networking & Information Security Knowledge	1
Networking and Security Emphasis	1
Networking Systems	1
Networks and Cybersecurity	1
System Administration	1
Telecommunications	**3**
Telecommunications & Information Management	1
Telecommunications and Computer Networks	1
Telecommunications and Networked Systems	1

Web Development	**21**
Enterprise Web Development	1
i-business application development & management	1
Internet technologies	1
Web	1
Web and database administration and management	1
Web and Mobile Development	1
Web Application Development for Business	1
Web Applications Developer	1
Web Based Applications	1
Web Design	1
Web Development	5
Web Presence Management	1
Web Technologies	1
Web/System Administration	1
Web-Based Systems	1
Website Design	1
Website Development	1

Business Intelligence	**13**
Business / Data Analytics	
Business Analytics (4)	
Business Analytics Knowledge	
Business Intelligence (4)	
Business Intelligence Analyst	
Business Intelligence and Analytics	
Data Mining	

Systems/Business Analysis	**13**
Analysis	**1**
Analyst	1
Business Analysis	**5**
Business Analysis	4
Business Systems Analyst	1
Systems Analysis	**7**
Information Systems Analysis and Design	3
System Design Emphasis	1
Systems Analysis and Design	1
Systems Analyst	2

E-Business/E-Commerce	**11**
e-Business	1
E-Business and E-Commerce	1
E-business and Multimedia	1
E-Business Management	1
E-Commerce	2
E-Commerce Marketing	1
Electronic Business Marketing	1
Electronic Commerce	1
Electronic Commerce Systems	1
Internet Commerce	1

Data/Information Management	**10**
Data / Technical Analyst	1
Data Analytics	1
Data Base Management Systems	1
Data Management	1
Data Media and Design	1
Database Administration	1
Database Design and Development	1
Database Management	1
Information and Knowledge Management	1
Information Architecture	1

Specialized IS Studies	**10**
Database and Decision Support	1
Decision Management	1
Decision Support Systems	1
E-Government	1
End User Training	1
End-User Computing Systems	1
Global IT leadership & management	1
Project Lifecycle	1
Project Management	1
Solutions Architecture	1