2000

Comparing Entry-Level Skill Depths Across Information Systems Job Types: Perceptions of IS Faculty

Jeffrey P. Landry
University of South Alabama, landry@cis.usouthal.edu

Herbert E. Longnecker
University of South Alabama, bart@cis.usouthal.edu

Brandon Haigood
Navigator Systems, Inc., bhaigood@navsystems.com

David L. Feinstein
University of South Alabama, feinstein@usouthal.edu

Comparing Entry-Level Skill Depths Across Information Systems Job Types: Perceptions of IS Faculty

Jeffrey P. Landry, School of Computer and Information Sciences, University of South Alabama, landry@cis.usouthal.edu
Herbert E. Longenecker, School of Computer and Information Sciences, University of South Alabama, bart@cis.usouthal.edu
Brandon Haigood, Navigator Systems, Inc., Addison, Texas, bhaigood@navsystems.com
David L. Feinstein, School of Computer and Information Sciences, University of South Alabama, feinstein@cis.usouthal.edu

Abstract

This paper compares and contrasts various information systems (IS) job types based on IS faculty perceptions of the skills that comprise each job type. A total of 148 IS academics took part in a skills survey as part of efforts to update of the IS'97 curriculum model (Davis, et al, 1997; Cougar, et al, 1995). IS academics perceive themselves are preparing students for four predominant jobs, the most prevalent one being information systems analyst. The results indicate that individual and team/interpersonal skills are perceived as needing the most depth for each of four job types studied; IS analysts and database analysts are the predominant job specializations perceived among IS faculty; and the network administrator and application developer roles have the most potential as sub-specializations. Future studies must validate these findings against industry perceptions of job types and their skill requirements.

Introduction

Prior research (Trauth and Farwell, 1993) suggested that there has been an increasing trend towards greater job specialization within the information systems profession due a number of changes in the corporate computing environment. Traditionally, the assumption has been that IS professionals moved along a linear career path from programmer to IS analyst to project manager to IS manager, and that a single curriculum could satisfy this progression. The implication of such a view is to suggest that IS curricula need to become more specialized in order to adequately support industry's need for a more specialized workforce.

This study investigates the question of IS specialization by examining the current thought of IS faculty members with respect to the careers for which they are preparing their students. What are the various jobs for which their students are being prepared? What are the skill sets for each of these jobs? Specifically, the goals of this study are two-fold: (1) to identify the predominant IS job types with which IS academics identify themselves, and (2) to define the skill sets that IS academics believe are associated with each of these job types. "Job type" is the term used here to describe an IS specialization area, based on that specialization's corresponding job in industry. By isolating the various skill depths for different IS jobs, the study may contribute to efforts towards defining a more specialized IS curriculum.

Methodology

A Web-based survey (http://www.is2000.org) was developed to assess the entry-level skill depths for graduates of IS programs as part of efforts to update IS'97. Respondents in the current study were faculty members at universities and colleges worldwide. The respondents were asked to classify themselves according to discipline and job type. The survey sample consisted of 406 faculty members within computing disciplines, of which 148 were classified as belonging to the information systems discipline based on their responses to questions on the survey dealing with the extent to which they identified themselves with descriptions of information systems and information technology disciplines as compared to computer science, software engineering, and computer engineering disciplines. These 148 respondents were used in this study because they represented a IS viewpoint in terms of curriculum issues, since the ultimate purpose of this program of study is to provide a direction for IS curricula.

Once the sub-sample of "true" IS faculty was established, each of the respondents was then classified according to job type. Each respondent was classified based on responses to questions that attempted to match the respondent to a job type thought to be the closest to which he or she was preparing students. Each respondent was asked to select from among a series of job titles and descriptions obtained from an analysis of employment ads. Descriptions of nine IS jobs were obtained: software engineer, database analyst, project administrator, help

desk/technician, IS analyst, network administrator, application developer, system administrator, and computer engineer. Each respondent was classified as belonging to the job type that was "'least to most like me' for my profession, or for those I train."

In the next part of the survey, the respondents were asked to indicate the skill depth of 49 skill elements needed over the next three years by graduates from IS programs working in their chosen IS job type. The skill elements were organized around nine broad skill areas as defined in the IS'97 curriculum guidelines (Davis, et al,

Table 1. Factor Analysis of Skill Elements

Factor / Skill Area	**Factor Loading**
Individual and Team Interpersonal Skills	
Learning to Learn	.703
Professionalism-self directed, leadership, time mgt	.699
Personal Skills-encouraging, listening, being organized	.675
Professionalism-committing to and completing work	.671
Teams-team building, vision/mission development, synergy	.652
Communication-oral, written, multimedia, empathetic listening	.642
Ethics-theory/concepts, setting an ethical example	.641
Systems Analysis and Design	
Strategic Utilization of Information Technology	.811
IS Planning	.762
IT and Organizational Systems	.749
Information Systems Analysis and Design	.640
Decision Making	.638
Systems Concepts, Use of IT, Customer Service	.635
Systems Theory and Quality Concepts	.604
Software Development	
Programming-principles, objects, algorithms, modules, testing	.796
Application Development-requirements, specs, developing	.755
Algorithmic Design, Data, Object and File Structures	.747
Problem Solving- identify problems, systems concepts, creativity	.539
Client Server Software Development	.493
Web Development	
Web Page Development-HTML, page editors, tools	.639
Web Programming-thin client, asp, ODBC, CGI, E-commerce	.588
Project Management	
Team Leading, Project Goal Setting	.822
Monitor and Direct Resources and Activities	.776
Coordinate Life Cycle Scheduling and Planning	.728
Apply concepts of continuous improvement	.701
Project Scheduling and Tracking	.547
Business Fundamentals	
Learning Business Process and Environment	.830
Accounting, Distribution, Finance, HR, Marketing, Production	.773
Business Problems and Appropriate Technical Solutions	.727
Database	
Modeling and design, construction, schema tools, DB Systems	.755
Triggers, Stored Procedures, Audit Controls: Design/Development	.732
Administration: security, safety, backup, repairs, replicating	.539
Systems Integration	
Computer Systems Hardware	.757
Networking (Lan/Wan) and Telecommunications	.745
Operating Systems Management-multi platforms/frotocols, NT/ Unix	.736
Computer Systems Software-OS fundamentals, resource mgt concepts	.731
LAN/WAN Design and Management	.695
Systems Configuration, Operation, Administration	.589

1997, p. 48). These nine skill areas are the group of skills that are believed to (1) culminate from the undergraduate educational experience, and (2) most closely match entry-level expectations. The skill elements within each category were obtained from an analysis of Web-based newspaper employment ads and supplemented with pre-requisite skill elements defined in IS'97. On the basis that job ads are a reflection of what skills are valued by employers (Todd, et al, 1995), and in order to reflect currency in the entry-level skill terminology, job ad words obtained in October 1999 were mapped into categories within the nine major skill areas.

The term "skill depth" is used to describe the level of understanding of a learning objective. Skill depth is represented as a hierarchy, beginning with knowledge/recognition and differentiation, and then proceeding upward to comprehension, application, analysis, synthesis, and evaluation (Bloom, 1956). The actual levels used in the survey were taken from IS'97 and adapted from Bloom. For each entry-level skill element, the respondent was asked to rate the depth of skill associated with the chosen job type as follows:

0 - **No Knowledge Required**
1 - **Recognition** of element
2 - **Differentiate** among knowledge elements
3 - **Use** knowledge, with hints, direction and assistance
4 - **Apply** knowledge to new problems without assistance

Factor and reliability analyses were performed on the entire data set of 406 respondents, using SPSS 8.0 for Windows, to assess construct validity. Specifically, the questionnaire items were tested to determine if they fell into the higher level skill categories as intended and behaved as reliable measures of those categories. A confirmatory factor analysis using varimax rotation and the maximum likelihood estimation technique resulted in most of the items factoring as intended. A total of eight skill factors resulted. All of the items had factor coefficients of .5 or higher and no cross-loadings onto other factors. See Table 1. The (Cronbach's alpha) reliability estimates on each of the factors were, with one exception, all .80 or higher, which exceeds Nunally's (1978) acceptability threshold. The lone exception was the lone two-item construct, which had a value of .76. This fell within Nunally's suggested range of .6 to .8 for research in a new area.

Table 2. Predominant Job Types Identified by IS Faculty

Job Type	Frequency	Percent
Information Systems Analyst	61	41.2
Database Analyst	22	14.9
Application Developer	18	12.2
Network Administrator	16	10.8
Project Administrator	6	4.1
System Administrator	6	4.1
Other	19	12.8
Total	148	100

Due to the highly acceptable results from the factor and reliability analyses, the eight higher-level skill categories were chosen as the units of analysis. Each of the various job types identified were then compared and contrasted according to the skill depths for the jobs perceived by the 148 "true" IS faculty members responding to the survey.

Results

The results showed that IS academics, by far, perceive that they are training students to become information systems analysts. Database analyst was the next most popular choice, followed by application developer and network administrator. These four job types, because they all had significant numbers of respondents, were further analyzed with respect to perceived skill depths. The frequency of each job type, as aggregated from respondent data, is reported in Table 2.

Table 3. Faculty Perceptions of Entry-Level Skills (Aggregate)

Skill Category	No. of items	N	Mean	Std. Dev.	Cronbach's Alpha
Individual and Team/ Interpersonal Skills	7	126	3.6	.60	.88
System Analysis and Design	7	144	3.2	.55	.90
Software Development	4	130	3.1	.78	.81
Web Development	2	131	3.1	.85	.76
Project Management	5	128	3.1	.90	.92
Business Fundamentals	3	144	3.0	.79	.92
Database	3	133	2.9	.82	.85
System Integration	6	127	2.7	.83	.88

The next phase of data analysis examines skill depths in general and for each job type. First, the skill depths for each of the eight skill categories were estimated for the aggregate of 148 IS faculty respondents (see Table 3). Then, the perceived skill sets for each of four job types were evaluated. See Table 4 and Figure 1.

Table 4. Faculty Perceptions of Entry-Level Skills by IS Job Type

Skill Category	IS Analyst	Network Administrator	Database Analyst	Application Developer
Individual and Team/ Interpersonal Skills	3.6	3.4	3.7	3.3
System Analysis and Design	3.3	3.3	3.2	2.9
Software Development	3.2	2.5	3.3	3.4
Business Fundamentals	3.2	2.9	3.1	2.7
Project Management	3.2	2.9	3.3	2.3
Database	2.9	2.4	3.3	2.8
Web Development	2.9	3.0	3.2	3.2
System Integration	2.5	3.5	2.6	2.4

As Table 2 indicates, the skill category individual and team/interpersonal skills was rated by IS faculty as needing the most depth for all types of students. This is not surprising since these types of skills are consistently being mentioned by industry as the most important skill of all new hires.

When the skill depths were broken down by job type, ANOVA and post-hoc t-tests were performed using SPSS to determine similarities and differences in skill depths among jobs. With respect to individual and team/interpersonal skills, there were no statistically significant differences detected, as respondents preferred high skill depth for all four job types. With respect to systems analysis and design skills, the IS faculty who identified themselves as IS analysts preferred more depth than respondents who identified themselves as application developers. In the area of software development, IS faculty who responded as network administrators preferred less skill than all three other job types. The business fundamentals and web development skill areas revealed no statistically significant differences among the job types. Database analysts preferred more database skill than did network administrators. Application developers preferred less project management skill than both IS analysts and database analysts. Finally, and predictably, network administrators preferred more systems integration skill than the other three job types.

Faculty respondents who identified themselves as IS analysts and database analysts were most alike with no statistically significant differences among skill depths across all skill categories. IS analysts and database analysts also had fairly consistent skill depths across all areas as well. This would suggest that the current entry-level skill areas, as defined in IS'97, are well designed for the analyst role, or else the respondents believed that it is the nature of the analyst role to know a lot about everything.

Network administrators and application developers are the most "specialized" in their own ways. Network administrators prefer less software development skill than the other job types, while more system integration skill than all other job types. The implication is that network administrators should focus less on programming courses and more on system integration courses. Application developers, interestingly, were noteworthy in that they did not prefer more skill than any other job type in any area, including the area of software development. However, application developers did perceive less of a need for skill in certain areas. In particular, application developers preferred less of a need for systems analysis and design skill than did IS analysts, and less in project management than did both the IS analyst and the DB analyst.

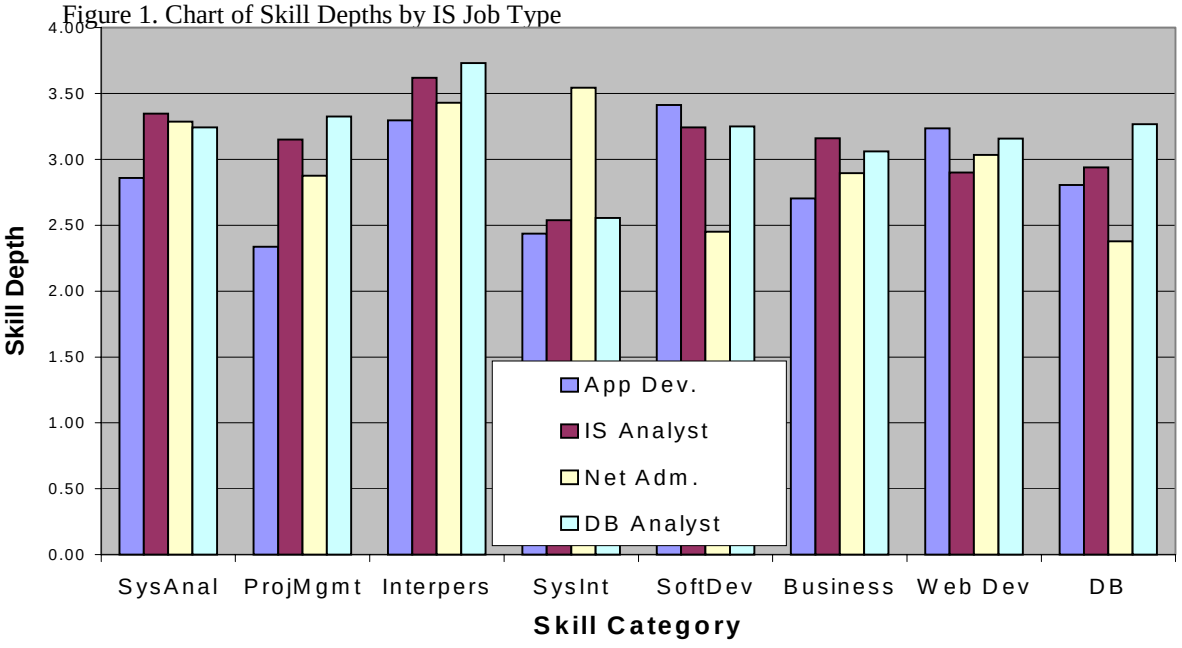
Conclusions

Implications for curriculum development include providing useful information for developing specializations, and how to address the different needs of various IS job types. The primary specialization areas preferred by current IS faculty, in order of popularity, include: IS analyst, application developer, database analyst, and network administrator. The findings suggest that course offerings for IS analysts and database analysts ought to be similar, and that the network analyst needs considerably more training in the system integration area than the other three areas. A surprising finding was that application developers perceived less of a need for project management skill and systems analysis and design skill than did the other job types. The respondents seemed to

believe that these skills should be reserved for the analysts, and not be as much of a concern for the developer. The findings suggest that the IS analyst job is a linear progression beyond the developer role, since the job needs the same or more skill depth across all areas.

This study focused solely on perceptions of IS academics, which is relevant for questions dealing with IS educational/curriculum development issues. As such, the study addresses the job skills question rather introspectively, in terms of "who are we training in IS?" and "what are we teaching them?" These results, however, need to be compared and contrasted with industry's perspective on comparative skill depths, and then compared to other job skills literature that provide industry-academic comparisons (Lee and Trauth, 1995; Trauth and Farwell, 1993). One of the objectives of future studies ought to be to determine what skill elements, if any, are missing, as well as which career paths are currently missing. In addition, industry-education gaps in skill sets should be identified.

Figure 1. Chart of Skill Depths by IS Job Type



References

Bloom, Benjamin S. (ed.), The Taxonomy of Educational Objectives: Classification of Educational Goals. Handbook 1: The Cognitive Domain. McKay Press, New York, NY, 1956.

Cougar, J. D., Davis, G. B., Dologite, D. G., Feinstein, D. L., Gorgone, J. T., Jenkins, M., Kasper, G. M. Little, J. C., Longenecker, H. E. Jr., and Valachic, J. S. "IS'95: Guideline for Undergraduate IS Curriculum," MIS Quarterly (19:3), 1995, pp. 341-360.

Davis, G. B., Gorgone, J. T., Couger, J. D., Feinstein, D. L., and Longenecker, H. E. Jr. "IS '97 Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems," ACM, New York, NY and AITP (formerly DPMA), Park Ridge, IL, 1997.

Lee, D. M. S. and Trauth, E. M. "Critical Skills and Knowledge Requirements of IS Professionals: A Joint Academic/Industry Investigation," MIS Quarterly (19:3), 1995, pp. 313-344.

Nunnally, J. *Psychometric Theory*, McGraw-Hill, New York, 1978.

Todd, P. A., McKeen, J. D. and Gallupe, B. "The Evolution of IS Job Skills: A Content Analysis of IS Job Advertisements From 1970 to 1990," MIS Quarterly (19:1), 1995, pp. 1-27.

Trauth, E. M., Farwell, D. W. "The Expectation Gap: Industry Expectations Versus Academic Preparation," MIS Quarterly (17:3), 1993, pp. 293-307.