Knowledge and Skill Requirements for Information Systems Professionals: An Exploratory Study

E. Reed Doke
Department of Computer Information Systems
College of Business Administration
Southwest Missouri State University
Springfield, MO 65804-0095
(417) 836-4131
Email: ReedDoke@mail.SMSU.EDU

Susan Rebstock Williams
Department of Management
College of Business Administration
Georgia Southern University
Statesboro, GA 30460-8152
(912) 681-0753
Email: rebstock@gasou.edu

ABSTRACT

Information systems professionals commonly progress through several different job classifications during the course of their careers. The purpose of this study is to explore the perceived importance of various knowledge and skills for information systems professionals in different information systems positions. Knowledge and skills important to IS professionals are examined across six IS job classifications. Knowledge and skills related to systems development and interpersonal communication were perceived as essential regardless of job classification. Knowledge and skills related to programming were perceived as very important in entry level IS positions.

INTRODUCTION

A fundamental issue confronting the IS community centers on the knowledge and skills needed by information systems personnel. Rapid technological advances, evolving development strategies, and increasing user involvement add complexity to this important issue. As such, it is becoming increasingly important for IS managers to obtain personnel with the appropriate knowledge and skills in order to meet the growing demands for IS services. Additionally, the knowledge and skills needed within the marketplace have significant implications for academicians and researchers involved with IS curriculum development issues.

Previous research reported in the literature has investigated deficiencies in and the importance of various knowledge and skill items (Cheney and Lyons, 1980; Green, 1989; Kahn and Kukalis, 1990; Nelson, 1991; Padgett, Beise and Ganoe, 1991; Leitheiser, 1992; Womble, 1994; Young and Lee, 1997). These studies, however, fail to address the question: what specific knowledge and skills are required for various IS job classifications? We believe a strong case can be made that different job classifications require different types of knowledge and skills. For example, it is quite reasonable to believe a programmer requires more technical skills than a manager. This point was made in a 1990 survey of 225 IS personnel (Kahn and Kukalis, 1990). The study concluded that nontechnical skills are more important than technical skills for advancement, although technical skills are important for certain jobs.

Most research investigating the importance of various knowledge and skill items has examined either (1) results across the aggregate of IS personnel, (2) a single segment of IS professionals (e.g., systems analysts or IS managers), or (3) differences between IS and non-IS personnel. For example, Nelson (1991) conducted a study involving 275 employees in eight ions to identify deficiencies in six knowledge and skill areas. In this study, "deficiency" was defined as the difference between the perceived usefulness (or importance) of a knowledge/skill area and one=s perceived proficiency in that knowledge/skill area. Nelson=s research involved both IS and non-IS (i.e., end-user) personnel. The study concluded that, in general, IS personnel perceive that they are deficient in organizational knowledge while end-users perceive that they lack sufficient IS-related skills.

A more recent study surveyed 95 IS managers to determine trends in development and technical skills for IS personnel (Leitheiser, 1992). Results indicated that interpersonal skills are and will remain important for developers and that knowledge about CASE tools, database issues, and data communication skills will

become essential. This study, however, also did not attempt) used ads in a popular trade publication to determine highly sought after software and technical skills, while Case, Price and Rogers (1997) content analyzed a large number of classified ads in several metropolitan areas of the southeastern United States. Both studies found a strong demand for competencies in IS design, development and implementation, particularly with respect to COBOL, C++, and Visual Basic. The Harris and Harris study, which concentrated solely on technical skills, also found a high demand for knowledge in client/server, UNIX, and AS/400 operating environments. The findings reported by Case et al. underscored the importance of project management and interpersonal skills, which were mentioned in nearly 30% of the ads in their sample. Neither of these studies considered differences in the knowledge and skills required by various IS positions, and both concentrated primarily on software and related technical skills. Interestingly, both studies all but excluded entry level positions, as most ads required applicants to have two or more years of experience.

While all of these studies provide valuable insight into general trends and patterns, they do not tell us whether the importance of various knowledge and skill items differ among the various job classifications typically held by IS professionals. The purpose of the current study is to address this gap in the literature. The research reported herein focuses on forty-three knowledge and skill (K-S) items which have been grouped into six broad categories. Specifically, this study was conducted to address three important questions that have not been previously investigated:

1. *Does the perceived importance of the six broad knowledge/skill categories vary across job classifications?*
2. *Does the perceived importance of the 43 individual knowledge/skill items vary across job classifications?*
3. *Which individual knowledge/skill items are perceived to be the most/least important for the various job classifications?*

METHODOLOGY

The survey questionnaire focused on knowledge and skills that are important to persons pursuing a professional IS career. The instrument included items drawn from six broad categories of knowledge and skills, ranging from technical to organizational to managerial areas. These six categories were based on the knowledge/skills taxonomy developed by Zmud (1983) and include:

(1) *Organizational Knowledge* C e.g., knowledge of organizational objectives, purpose, opportunities and constraints, etc;

(2) *Organizational Skills* C e.g., interpersonal behavior, project management, group dynamics, etc.;

(3) *Organizational Unit Knowledge* C e.g., knowledge of the objectives, purpose, and function of the target unit, and its linkages with other organizational units, etc.;

(4) *General IS Knowledge* C e.g., knowledge of hardware and software concepts, IS design and development methodologies, the potential and strategic value of IS, existing IS applications, etc.;

(5) *Technical Skills* C e.g., methods and techniques required to perform IS tasks; and

(6) *IS Product Knowledge* C e.g., knowledge about the purpose, design, use and documentation of existing products.

Thirty of the forty-three survey items (grouped into the six element Zmud taxonomy) were taken from the educational needs assessment instrument developed and validated by Nelson (1991). The remaining thirteen items were drawn from the DPMA Model for a Four Year Undergraduate Degree (1991). These thirteen items were placed within the appropriate category of the Zmud taxonomy, based on the experience and knowledge of the researchers. Items and their groupings are listed in the left hand column of Table 1. Although this research was initiated prior to the release of the IS '97 Curriculum Model (1997), the questionnaire items address all twenty of the significant subareas of the IS curriculum identified in that model, and all five IS curriculum presentation areas. Additionally, questionnaire items relating to eight of the nine "exit"characteristics set forth in the IS '97 Curriculum Model (Communication, Computer Application Systems, Information Technology and Tools, Interpersonal Relationships, Management, Problem Solving, Systems Development Methodologies, and Systems Theory and Concepts) are included in this study. Items relating to the ninth exit characteristic, Professionalism, (which deals with codes of conduct, ethical theory, legal and regulatory standards, international cultures and practices, etc.), were not included in the survey instrument.

Respondents were asked to identify the importance of each of these 43 knowledge and skill items as related to their present position. Their responses were recorded using a seven-point Likert scale where "1" indicates an item which is "of no use", and "7" indicates an item which is "absolutely essential". The instrument used in this study is presented in Appendix A.

Approximately 700 questionnaires were mailed to individuals who had received Bachelor of Science degrees in Computer Information Systems from a major Midwestern university. Ninety-eight usable questionnaires were returned and are included in the analysis, for a response rate of 14%. The majority of the respondents (70%) were male. Only a small percentage (7%) held an advanced degree. Survey respondents represented a wide range of industries, the most common of which were manufacturing and finance. Approximately 60% of the respondents had been in their current organization for 3 years or less, while only 3% had been in their organization 9 years or more. Respondents were fairly evenly split in terms of the IS position held within the organization, with 33% of the respondents coming from entry level and junior positions, 42% from middle level positions, and 22% from senior level and/or management positions. The remaining 3% held widely varying and somewhat atypical positions that "do not fit" into the more commonly found IS positions. Overall, the respondents appear to represent a broad cross-section of IS professionals.

FINDINGS AND DISCUSSION

This study seeks to empirically identify whether the perceived importance of various types of knowledge and skills varies among IS professionals in different job classifications. The responses were initially classified into seven different IS positions, based on the self-reported job titles. The resulting job classifications are: (1) programmer/analyst I (P/A I); (2) programmer/ analyst II (P/A II); (3) programmer/analyst III (P/A III); (4) senior systems analyst (SSA); (5) IS management (ISM); (6) consultant (CON); and (7) other (OTH).

The average ratings and standard deviations for each of the survey items aggregated across all job classifications, along with the list of

TABLE 1: Knowledge and Skill Items and Groupings with Means and Standard Deviations

	Survey Question #	Rank	Mean	S.D.
Organizational Knowledge			**5.19**	**1.00**
Organization goals and objectives	1	21	5.48	1.35
Primary organization functions	2	14	5.81	1.14
Important key factors	3	18	5.63	1.27
Environmental constraints	4	30	5.15	1.40
Multinational and global contexts	39	42	3.87	1.70
IT and strategic gain	41	34	4.86	1.56
Organizational Skills			**5.96**	**0.64**
Interpersonal skills	5	1	6.40	0.88
Interpersonal behavior	6	5,6	6.03	0.95
Group dynamics	7	7,8	5.95	1.04
Project management	8	5,6	6.03	1.02
Oral, written & multimedia communications	31	4	6.06	1.13
Managing IS Projects	34	11	5.91	1.22
Using technology to manage information	35	26	5.37	1.31
Organizational Unit			**5.54**	**1.12**
Work objectives	9	13	5.82	1.10
Work unit problems	10	32	5.02	1.38
Links with other work units	11	24	5.41	1.28
General IS Knowledge			**5.56**	**0.80**
IS policies and plans	12	28	5.35	1.28
Fit between IS and firm	13	15	5.72	1.09
Knowledge of existing IS applications	14	12	5.89	1.03
Potential of IS/IT	15	9,10	5.93	1.08
Utilize IS/IT for competitive advantage	16	9,10	5.93	1.28
Privacy issues	17	25	5.38	1.56
IS analysis	32	3	6.18	0.97
IS design and implementation	33	2	6.26	0.97
Types of information systems	38	39	4.46	1.73
Principles of systems theory	42	40	4.45	1.71
Problem solving methodologies	43	19	5.59	1.43
Technical Skills			**4.8**	**0.91**
Programming	18	7,8	5.95	1.47
Use of software packages	19	31	5.04	1.34
Model building	20	37	4.64	1.60
Model application	21	38	4.57	1.65
Data access	22	16	5.71	1.31
Design and development of databases	23	27	5.37	1.59
Telecommunications/data communications	24	35	4.76	1.76
PC computer systems	40	23	5.45	1.55
IS Product Knowledge			**5.16**	**0.95**
Use of specific application systems	25	33	4.94	1.62
Use of office automation systems	26	41	4.13	1.60
Use of operating systems	27	29	5.24	1.61
Preparation of systems documentation	28	22	5.47	1.45
Use and understanding of documentation	29	17	5.65	1.22
IS evaluation and maintenance process	30	20	5.52	1.32
Software engineering concepts	36	36	4.76	1.69
Artificial intelligence	37	43	3.00	1.68

items and their groupings, are presented in Table 1. In general, these findings support the results of previous studies which have examined the importance of knowledge and skill items across the spectrum of IS positions, and suggest that interpersonal skills, knowledge of IS analysis, design and implementation techniques, and project management skills are highly valued, regardless of job classification.

As previously noted, the number of respondents in the "other" category was small (there were only 3), and the types and levels of positions held by these three respondents varied widely. Thus, references to this category are omitted throughout the remainder of this paper.

K-S Group Differences

This section addresses the first research question: Does the perceived importance of the six broad knowledge/skill categories vary across job classifications? Table 2 presents the means for the K-S groups by job classification.

Interestingly, a significant difference in K-S group level ratings among the various job classifications was found in only one of the six K-S categories. Analysis of variance (ANOVA) and the Tukey post hoc test identified a significant difference in the perceived importance of the "organizational knowledge" category between programmer/analyst I (4.50) and senior systems analyst (5.83) positions ($F=2.56$, $p < .0244$). This suggests that senior systems analysts perceived organizational knowledge to be more important than persons holding programmer/ analyst I positions, and supports the notion that knowledge and skills in this group become more important as IS professionals progress in their careers. Overall, organizational knowledge and skills are perceived to be important in all IS positions, even though differences may exist by position. An examination of the rankings given in Table 2 suggests that there is a shift in the relative importance of each category as job responsibilities change. Specifically, the data suggest technical skills become less important and organizational knowledge becomes more important as job advancement occurs, while organizational skills remain important throughout the career development process.

K-S Item Differences

This section addresses the second question: Does the perceived importance of the 43 individual knowledge/skill items vary across job classifications? Table 3 presents the mean responses for each of the six job classifications, listed in order by survey item number.

Several specific knowledge and skills item means were significantly different by job classification. Statistically significant differences in the perceived level of importance were found for: (1) knowledge about the key factors that must go right if the firm is to succeed (item 3); (2) knowledge about utilizing information systems/information technology to gain a competitive advantage (item 16); (3) knowledge about programming (item 18); and (4) knowledge about data access (item 22).

Knowledge about the key factors that must go right if the firm is to succeed (item 3) means differed significantly by job classification ($F=3.13$, $p<.0079$). This item falls within the "organizational knowledge" category, which as reported in the previous section varies significantly in importance between the senior systems

TABLE 2: K-S Group Importance by Job Classification

	Job Classification												Overall		
	P/A		P/A II		P/A III		SSA		ISM		CON				
	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	SD	Rank
Organizational Knowledge	4.50*	(6)	5.03	(6)	4.98	(6)	5.83	(3)	5.43	(3)	5.69	(2)	5.19	1.00	(4)
Organizational Skills	5.88	(1)	6.03	(1)	5.88	(1)	6.20	(1)	5.84	(1)	6.17	(1)	5.96	0.64	(1)
Organizational Unit	4.91	(4,5)	5.68	(2)	5.63	(2)	5.97	(2)	5.67	(2)	5.00	(5)	5.54	1.12	(3)
General IS Knowledge	4.91	(4,5)	5.31	(3,4)	5.17	(3)	5.52	(5)	4.93	(6)	5.24	(3)	5.56	0.80	(2)
Technical Skills	5.04	(2)	5.31	(3,4)	5.12	(4)	5.56	(4)	5.19	(4)	4.54	(6)	4.80	0.91	(6)
IS Product Knowledge	4.97	(3)	5.24	(5)	5.09	(5)	5.37	(6)	5.18	(5)	5.08	(4)	5.16	0.95	(5)

*significant at .05

TABLE 3: K-S Item Importance by Job Classification (In Item Number Order)

Item Number and Description	Job Classification					
	P/A I	P/A II	P/A III	SSA	ISM	CON
1. Goals and Objectives	5.00	5.33	5.23	6.40	5.75	5.83
2. Primary Functions	5.18	6.00	5.71	6.30	5.94	6.00
3. Key Factors	4.91	5.48	5.45	6.50	6.25	6.00
4. Environmental Constraints	4.18	5.05	5.13	5.80	5.50	5.50
5. Interpersonal Communications	6.55	6.35	6.26	6.50	6.44	6.67
6. Interpersonal Behavior	6.09	6.05	5.97	5.90	6.13	6.33
7. Group Dynamics	5.60	6.00	5.97	5.60	6.00	6.17
8. Project Management	6.50	6.10	5.87	6.70	5.88	5.67
9. Work Unit Objectives	5.63	5.86	5.74	6.40	6.06	5.50
10. Work Unit Problems	4.63	5.62	5.42	6.00	5.69	4.50
11. Links with Other Work Units	4.70	5.57	5.74	5.50	5.25	5.00
12. IS Policies and Plans	4.50	5.43	5.61	6.00	5.00	5.00
13. Fit between IS and the Firm	5.10	5.90	5.68	6.40	5.50	5.83
14. Existing IS Applications	5.82	6.17	5.87	6.10	5.56	5.67
15. Potential of IS/IT	5.45	5.95	5.97	6.60	5.56	6.33
*16. Utilizing IS/IT to Gain Competitive Advantage	5.00	6.30	5.68	6.50	5.69	6.83
17. Privacy Issues	4.91	5.40	5.52	5.80	5.44	4.33
*18. Programming	6.36	6.71	6.03	5.70	5.38	3.83
19. Use of Software Packages	4.82	4.85	5.00	5.40	5.13	5.17
20. Model Building	4.91	4.85	4.33	5.00	4.50	4.83
21. Model Application	4.55	4.90	4.30	4.90	4.50	4.83
*22. Data Access	5.91	6.05	5.43	6.10	5.75	4.33
23. Design & Development of Databases	4.36	5.71	5.32	6.00	5.56	4.17
24. Telecom/Data Communications	4.36	4.43	4.58	5.10	5.50	4.50
25. Use of Specific Applications	5.18	4.76	4.71	5.40	5.25	4.50
26. Use of Office Automation Products	4.10	4.50	3.71	4.30	4.25	4.50
27. Use of Operating Systems	4.36	4.90	5.29	5.90	5.75	5.17
28. Preparation of Documentation for Systems	5.27	5.43	5.52	5.70	5.25	5.33
29. Use and Understanding of Documentation	5.27	5.86	5.58	5.60	5.63	5.83
30. IS Evaluation and Maintenance Process	5.64	5.90	5.74	5.30	4.94	5.17
31. Oral, Written, Multimedia Communications	5.82	6.14	5.97	6.40	5.94	6.83
32. Analyzing Information Systems	6.55	6.27	6.23	6.10	5.75	6.67
33. Design and Implementation of Systems	6.27	6.33	6.32	6.40	5.88	6.33
34. Managing IS Projects	5.91	6.10	6.00	6.40	5.25	5.83
35. Use of Technology to Manage Information	5.00	5.78	5.03	5.90	5.25	5.67
36. Software Engineering Concepts (CASE)	4.64	4.43	4.87	5.10	4.75	5.33
37. Artificial Intelligence	3.27	3.00	2.94	2.90	3.19	2.67
38. Types of Information Systems	4.45	4.10	4.41	5.20	4.88	4.17
39. Multinational and Global Context of Firms	3.64	3.76	3.71	4.40	3.94	4.67
40. PC Computer Systems & Software	5.00	5.10	5.94	6.30	5.19	4.67
41. Use of Information & IT for Strategic Gain	4.10	4.50	4.65	5.60	5.19	6.17
42. Principles of Systems Theory	4.18	4.50	4.32	4.80	4.50	4.50
43. Problem Solving Methodologies	5.82	5.81	5.32	6.20	5.50	5.00

* significant at .05

analyst and programmer/analyst I positions. On the whole, items within this category were generally perceived to be more important by respondents in IS administration/management and in consultant positions. This is supported by the fact that programmer/analyst I participants viewed the importance of the knowledge about the key factors that must go right if the firm is to succeed to be less useful than senior systems analysts and consultants. The programmer/analyst I mean (4.91) was significantly lower than senior systems analyst (6.50) and IS administration/management (6.25) means.

Statistically significant differences across job classifications ($F=2.70$, $p<.0188$) were also found with respect to knowledge about using information systems/information technology to gain a competitive advantage (item 16). This item fell within the "general IS knowledge" category. Knowledge about utilizing information systems/information technology to gain a competitive advantage was perceived to be more important after the entry level position (programmer/analyst I). Consultants, programmer/analyst II and senior systems analysts all perceived this item to be more important. The programmer/analyst I mean (5.00) was significantly less than those of the consultant (6.83), senior systems analyst (6.50), and programmer/analyst II (6.30) means. It is interesting to note, however, that programmer/analyst I and programmer/analyst III respondents did not differ in their perceptions of this item.

Knowledge about programming (item 18) means significantly differed across job classifications ($F=4.48$, $p<.0005$). This item falls within the "technical skills" category. The consultant mean (3.83) was significantly less than those of the programmer/ analyst I (6.36), the programmer/analyst II (6.71), and the programmer/analyst III (6.03) means. Respondents in IS administrative/ management (5.38) perceived knowledge about programming to be less important than programmer/analyst II (6.71). This suggests that, in general, the importance of a knowledge of programming becomes less important, but not unimportant, as IS professionals progress in their

TABLE 4: Top K-S Item Rankings by Job Classification

Item Description	Category	Job Classification P/A I	P/A II	P/A III	SSA	ISM	CON
Interpersonal Communication	Org. Skills	1*	2	2	3*	1	3*
Design/Implementation of Systems	IS Knowledge	5	3	1	6*	8*	5*
Oral/Written Communication	Org. Skills	9*	7	6*	6*	6*	1*
Analyzing Information Systems	IS Knowledge	1*	5	3		10*	3*
Interpersonal Behavior	Org. Skills	6	10*	6*		3	5*
Project Management	Org. Skills	3	8*		1	8*	
Utilizing IS/IT for Comp. Adv.	IS Knowledge		4	3	*		1*
Managing IS Projects	Org. Skills	7*	8*	5	6*		
Programming	Tech. Skills	4	1	4			
Data Access	Tech. Skills	7*	10*			10*	
Existing IS Applications	IS Knowledge	9*	6				
Problem Solving Methodologies	IS Knowledge	9*					
Potential of IS/IT	IS Knowledge			6*	2		5*
Group Dynamics	Org. Skills			6*		5	8*
PC Systems & Software	Tech. Skills			10			
Key Factors	Org. Knowledge				3*	2	10*
Fit Between IS and the Firm	IS Knowledge				6*		
Work Unit Objectives	Org. Unit				6*	4	
Goals and Objectives	Org. Knowledge				6*	10*	
Primary Functions	Org. Knowledge					6*	10*
Use of Operating Systems	IS Products					10*	
Use of IS/IT for Strategic Gain	Org. Knowledge						8*

** indicates a tie in rank*
Note: In this table, A1@ indicates the highest ranked item

TABLE 5: Table 5: Lowest Ten K-S Item Rankings by Job Classification

Item Description	Category	Job Classification P/A I	P/A II	P/A III	SSA	ISM	CON
Artificial Intelligence	IS Products	1	1	1	1	1	1
Multinational/Global Context	Org. Knowledge		2	2	2*	3	2
Use of Office Automation	IS Products	3*	6*	2*	2	3	7*
Use of IT for Strategic Gain	Org. Knowledge		3*	6*	9		
Principles of Systems Theory	IS Knowledge	5*	6*	5	4	4*	7*
Environmental Constraints	Org. Knowledge		5*				
Telecom/Data Communications	Technical Skills		7*	4*	8	7*	7*
Design of Databases	Technical Skills		7*			3*	
Use of Operating Systems	IS Products	7*					
Types of Information Systems	IS Knowledge	10	3	7	9	8	3*
Software Engineering (CASE)	IS Products		4*		7*	7	
Use of Specific Applications	IS Products		9	10			7*
Use of Software Packages	Technical Skills		10*				
Model Building	Technical Skills		10*	6	6	4*	
Model Application	Technical Skills			4	5	4*	
IS Evaluation/Maintenance	IS Products				10	9	
IS Policies & Plans	IS Knowledge					10*	
Programming	Technical Skills						2
Privacy Issues	IS Knowledge						5*
Data Access	Technical Skills						5*
Work Unit Problems	Org. Unit						7*

** indicates a tie in rank*
Note: In this table, A1@ indicates the lowest ranked item

careers. Knowledge about programming was more important to programmer/analysts I, II, and III than to consultants. In addition, IS administration/management perceived programming to be less important than programmer/analyst II participants.

Knowledge about data access (item 22) means also differed significantly by job classifications ($F=2.18$, $p<.0526$). This item also falls within the "technical skills" area. The programmer/analyst II mean (6.05) for this item was significantly higher than the consultant mean (4.33), suggesting that knowledge about data access may be more important to IS professionals earlier in their careers. This is very reasonable considering that data access may be associated with programming.

Most/Least Important K-S Items

This section focuses on the third research question: Which individual knowledge/skill items are perceived to be the most/least important for the various job classifications? Tables 4 and 5 present the top ten items and lowest ten items, respectively, for each of the six IS job classifications included in this study.

Highest ranked knowledge and skills. In all cases, about half of the ten highest ranked knowledge and skill items were from the organizational skills grouping in Table 1. These included interpersonal communications, interpersonal behavior, oral, written and multimedia communications, and management of IS projects. Interpersonal communications, interpersonal behavior, and oral, written and multimedia communications knowledge and skills were included as one of the most important by participants in all six job classifications. Systems development knowledge and skills (analyzing information systems, and design and implementation of systems) were also among the highest ranked items in the top ten regardless of job classification.

Programming, data access, and problem solving methodology knowledge and skills are among the highest ranked items for programmer/analyst I personnel. Eight of the highest ranked knowledge and skills for programmer/analyst I were included in the highest group for the programmer/analyst II classification. Knowledge of existing IS applications and utilizing IS/IT to gain a competitive advantage replaced interpersonal behavior and problem solving methodology in the highest ranked knowledge and skills group for programmer/analyst II.

Group dynamics, potential of IS/IT, and PC computer systems and software knowledge and skills were among the highest ranked items for programmer/analyst III. Key factors that must go right for the firm to succeed, fit between IS and the firm, and work unit objectives were among the highest ranked knowledge and skills for senior systems analysts.

IS administration/management highly rated items related to knowledge about the primary functions of the firm and those concerning the goals and objectives of the firm. The use of information and IT for strategic gain was included in the highest ranked knowledge and skills for the consultant classification.

Lowest ranked knowledge and skills. All participants ranked artificial intelligence, use of office automation, principles of systems theory, and types of information systems among their least important items. Surprisingly, five of six job classifications included multinational and global context of firms and telecommunications/data communications among their lowest ranked items. This is contrary to conventional wisdom, which suggests that the importance of global IS issues and telecommunications is at an all time high and continuing to increase. One possible explanation is that telecommunication technologies and related transnational IS issues are highly technical in nature, and as such require specialists trained well outside the limits of typical IS curriculums. It is also possible that our sample represents an anomaly with respect to this skill area. Future replication of this study will be needed to clarify this issue.

The use of information and IT for strategic gain was included among the ten lowest ranked items for the three programmer/analyst classifications; however, this knowledge was included in the highest ranked group for consultants. Environmental constraints, design and development of databases, and use of operating systems were ranked in the lowest group for programmer/analyst I.

Knowledge about software engineering concepts (CASE), use of specific applications (i.e. accounts payable), and model building were among the lowest ranked by those in the programmer/analyst II position. Programmer/analyst III participants also ranked knowledge about model application in their lowest rankings, as did IS administration/management and consultants.

Senior systems analysts included information system evaluation and maintenance among their lowest ranked items. Programming, data access, privacy issues and work unit problems were among the lowest ranked knowledge and skills items for the consultant category.

SUMMARY

Data analysis supports the view that job roles and demands drive the K-S requirements of IS professionals. Specifically, a review of job progressions from entry level jobs (programmer/analyst I) through middle career positions (senior programmer/analyst) to top management show a shift in importance attached both to particular K-S categories and to specific items. These shifts coincide with expected job demands. For example, an initial need for technical knowledge among programmer/analyst I would be expected as part of a production oriented team. Further, as responsibilities broaden and supervisory/management responsibilities increase, emphasis on technical skills and general information systems knowledge are crowded aside by added concerns for organizational knowledge and skills. One would expect this pattern to accompany increased managerial work responsibilities (Mintzberg, 1973). Confirmation of this approach (work drives K-S ratings) is reflected by the ratings given by the consultants in this study. They gave lower ratings to items of works groups, programming, data access, model applications, etc. These reflect their lack of work responsibilities in an environment demanding teamwork and development of specific applications.

Focusing on specific K-S items revealed a few widely valued skills. In particular, communication skills in various forms (oral, written, interpersonal, etc.) were of use to all respondents. Moreover, "analyzing information systems" as well as the "design and implementation of systems" was widely valued. By contrast, several K-S items were of much lesser importance among the respondents. Among these lesser valued items were types of information systems, multinational information systems, telecommunications, principles of systems theory, and knowledge of office automation systems.

These findings have importance for anyone educating IS professionals. The implications include the reality that technical skills are needed initially to successfully perform on the job. As a career develops, more managerial knowledge and skills are necessary. This means that attention to both technical and managerial knowledge and skills is needed. In time, initial technical skills will in all likelihood be displaced by organizational and managerial concerns. This has implications for initial university degree program education and for subsequent management development training among IS professionals.

Finally, our findings also give rise to a number of questions to be addressed in future research. For example, future studies are needed to determine whether there is difference in the perceived importance of various knowledge and skill items for organizations in different parts of the country, for organizations of different sizes, and/or among organizations in different industries. Replication of the study will help to identify evolving trends and "shifts" in the

knowledge and skill areas considered most important by practitioners, and as such will provide guidance for the improvement of university curriculums and industry training programs.

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APPENDIX A

Knowledge/Skill Needs Questionnaire
Information Systems Professionals

Demographic Data

Sex: Male_____ Female _____ **Education (Highest Level):** Bachelor's Degree _____ Master's Degree_____

Years in Present Organization: ___ **Company Name:** _____ **Company Size (# Employees):** _____

Industry: _____

Current Department: _____ **Previous Department Assignment(s):** _____

Job Title(s) (Initial to Current): _____

INSTRUCTIONS: Please rate how useful (important) you believe proficiency in each item is for YOU to successfully perform YOUR job. For each item, circle a number from one to seven indicating the importance of the item from "of no use," represented by "1," to "absolutely essential," represented by "7." NOTE: Proficiency is defined as being advanced in knowledge or ability.

	Perceived Usefulness						
	of no use						absolutely essential
Knowledge about							
1. The goals and objectives of the organization (the corporate-wide business entity) is	1	2	3	4	5	6	7
2. The primary functions of the organization is	1	2	3	4	5	6	7
3. The key factors that must go right if the firm is to succeed	1	2	3	4	5	6	7
4. The environmental constraints that the firm operates within(e.g. government regulation, competition) is	1	2	3	4	5	6	7
5. Interpersonal communications is	1	2	3	4	5	6	7
6. Interpersonal behavior is	1	2	3	4	5	6	7
7. Group dynamics is	1	2	3	4	5	6	7
8. Project management is	1	2	3	4	5	6	7
9. Work unit objectives is	1	2	3	4	5	6	7
10. Work unit problems is	1	2	3	4	5	6	7
11. Links with other work units is	1	2	3	4	5	6	7
12. IS policies and plans for the firm is	1	2	3	4	5	6	7
13. The fit between IS and the firm is	1	2	3	4	5	6	7
14. Existing information systems applications is	1	2	3	4	5	6	7
15. The potential of information systems/information technology is	1	2	3	4	5	6	7
16. Utilizing IS/IT to gain a competitive advantage is	1	2	3	4	5	6	7
17. Privacy issues (re: database, etc.) is	1	2	3	4	5	6	7
18. Programming is	1	2	3	4	5	6	7
19. The use of software packages (i.e., spreadsheet, database, word processing, etc.) is	1	2	3	4	5	6	7
20. Model building is	1	2	3	4	5	6	7
21. Model application is	1	2	3	4	5	6	7
22. Data access is	1	2	3	4	5	6	7
23. The design and development of databases is	1	2	3	4	5	6	7
24. Telecommunications and data communications is	1	2	3	4	5	6	7
25. The use of specific application systems (i.e., accounts payable, inventory, human resources, etc.) is	1	2	3	4	5	6	7

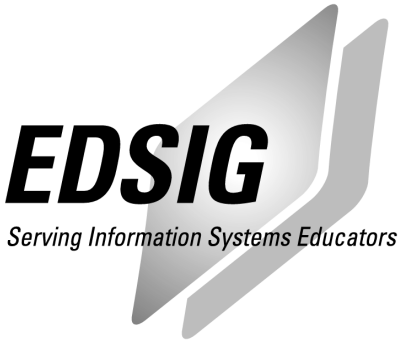
—Continued on next page—

APPENDIX A

Knowledge/Skill Needs Questionnaire
Information Systems Professionals
(continued)

26. The use of office automation products (i.e., desktop publishing) is	1	2	3	4	5	6	7
27. The use of operating systems (i.e. DOS, UNIX, etc.) is	1	2	3	4	5	6	7
28. The preparation of documentation for systems is	1	2	3	4	5	6	7
29. The use and understanding of documentation is	1	2	3	4	5	6	7
30. The IS evaluation and maintenance process is	1	2	3	4	5	6	7
31. Communicating in a variety of settings using oral, written & multimedia techniques is	1	2	3	4	5	6	7
32. Analyzing information systems is	1	2	3	4	5	6	7
33. The design and implementation of systems is	1	2	3	4	5	6	7
34. Managing information systems projects is	1	2	3	4	5	6	7
35. How technology is used to manage information within organizational structures is	1	2	3	4	5	6	7
36. Relevant software and hardware engineering concepts, including Computer Assisted Software Engineering (CASE) is	1	2	3	4	5	6	7
37. Artificial Intelligence is	1	2	3	4	5	6	7
38. Types of information systems (transaction processing, MIS, decision support, expert systems, etc.) is	1	2	3	4	5	6	7
39. The multinational and global context of today's organizations is	1	2	3	4	5	6	7
40. PC computer systems with current end user software to solve problems within an organization is	1	2	3	4	5	6	7
41. How information and information technology is exploited for strategic gain is	1	2	3	4	5	6	7
42. The principles of systems theory is	1	2	3	4	5	6	7
43. Different problem solving methodologies to analytically formulate a solution is	1	2	3	4	5	6	7

Information Systems & Computing
Academic Professionals



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