

INFORMATION SYSTEMS PROFESSIONALS FOR THE NEW MILLENNIUM: WHAT EMPLOYERS WANT

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ABSTRACT

One of the greatest challenges facing information systems faculty is keeping pace with the rapidly changing developments in the field. In order to identify the knowledge and skills currently sought by employers in the mid-Atlantic region, employment ads from newspapers in four major cities were analyzed.

Results indicate a demand for organizational, project management and supervisory skills as well as knowledge of business functions. Knowledge and skills related to network operating systems, object oriented programming languages and relational databases were in demand. Newer skills sought include Java and web development. Curriculum implications of these and other findings are discussed and compared with earlier findings.

INTRODUCTION

One of the greatest challenges facing faculty in information systems is keeping pace with the rapidly changing developments in the field. This is vital if our curriculum is going to remain relevant and provide our students with the knowledge and skills required to succeed in the business world.

In order to identify the knowledge and skills sought by employers of information systems professionals, Jacobson and Armstrong (1998) analyzed job advertisements appearing in four major Sunday newspapers in the Mid-Atlantic States during 1995. They found that communication skills and system development skills were considered important to employers. Hardware and software skills related to multi-user, multi-tasking systems were also highly sought, including Unix and networking. C, C++, SQL, COBOL, and Visual Basic were programming languages in high demand, and relational databases, especially Oracle, were areas of expertise required by employers.

REVIEW OF LITERATURE

Since Jacobson and Armstrong (1998) collected their data in 1995, there have been rapid and dramatic changes in the field of information systems. First, the balance between technical expertise and business skills is shifting toward the increasing importance of business skills (Behan, 1999; Fitter, 1998; McGee, 1996; Raths, 1999; York, 1999). Other general job skills mentioned include management skills (Behan, 1999; LaPlante, 1998b; Weldon, 1998) as well as people skills and communication skills (Wagner, 1997).

Second, information systems skills most sought by employers now center around the Internet, including security and firewalls (LaPlante, 1998b, 1999; McGee, 1996; Perlis, 1999; Wagner, 1997; Weldon, 1998), web site development and maintenance (LaPlante, 1998b; Stucker, 1999; Wagner, 1997; York, 1998) and electronic commerce (LaPlante, 1999; Mateyaschuk, 1999; Stucker, 1999; York, 1998). Again, this underlines the importance of combining technical expertise with

business knowledge. Wagner (1997) cites the example of Sachs Health Care Information Specialists, a company that collects and statistically analyzes medical records for hospitals.

Webmasters must understand diverse systems, understand the nature of medical records and confidentiality, be proficient in security and be able to talk to counterparts at Sachs's customer hospitals (p. 1).

In terms of operating systems and operating environments, networking continues to be important (Goff, 1998; Mateyaschuk, 1999; Wagner, 1997; York, 1998, 1999) as reflected in the demand for knowledge of Windows NT and Unix (Goff, 1998; LaPlante, 1998a, 1998b; Steen, 1997a). McGee (1996) mentions the importance of expertise in "older software on new platforms - for example, IBM DB2 database software on Windows NT" (p. 64).

Knowledge and skills related to programming languages that are in highest demand reflect the dominance of the Internet. Most frequently mentioned languages include:

- Java (Battey, 1997; Behan, 1999; Catalano, 1999; LaPlante, 1998a, 1998b, 1999; Perlis, 1999; Wagner, 1997; York, 1998),
- HTML (Catalano, 1999; LaPlante, 1998b; Perlis, 1999; Wagner, 1997; York, 1998),
- C++ (LaPlante, 1998a, 1998b, 1999; McGee, 1996; Wagner, 1997; York, 1998) and Visual Basic (Catalano, 1999; Fitter, 1998; LaPlante, 1998a, 1998b, 1999; Perlis, 1999) as well as
- web-based and object-oriented programming skills in general (Battey, 1997; Catalano, 1999; Fitter, 1998).

Finally, whereas Jacobson and Armstrong (1998) reported the demand was for relational databases in general and Oracle in particular, the focus in the past few years has shifted. Now, the emphasis is on how those databases are used. While relational database skills and Oracle are still in demand (LaPlante, 1998b, 1999; Steen, 1997; Zbar, 1998), employers now want to reap the benefit of those databases through data mining and data warehousing (Behan, 1999; Fitter, 1998; LaPlante, 1999; Rindgard, 1999; Steen, 1997b; Zbar, 1998).

The purpose of this study is to update the Jacobson and Armstrong (1998) data from 1995 to determine what information systems knowledge and skills are currently in demand by business and government organizations in the mid-Atlantic region.

METHODOLOGY

Following the Jacobson and Armstrong (1998) study, newspaper ads in *The Washington Post*, *The Sun* (Baltimore), *The Philadelphia Inquirer*, and the *Sunday Patriot-News* (Harrisburg) were analyzed. These cities were selected because this is the area where most of the graduates from the researchers' universities obtain employment. This methodology of analyzing newspaper ads has been used in a number of earlier studies including Athey and Plotnicki (1992), Arnett and Litecky (1994) and Prabhakar, Litecky and Arnett (1995). Issues selected were from the first Sunday in May, June, and July, 1998 since this is the time of year the majority of new recipients of bachelor degrees are seeking entry level employment.

Included in the geographic area represented by these newspapers are headquarters for national and international Fortune 500 corporations, federal and state government agencies as well as regional businesses. Therefore, it would be expected that IS knowledge and skills required for jobs in this area might be similar to those found elsewhere.

Following the protocols used by Jacobson and Armstrong (1998),

the study was limited to ads for business-oriented IS positions placed by organizations for their own work force and to ads placed by consulting firms who hire individuals to work for them If the advertisement was for a specific number of positions with a particular set of skills, each position was counted separately. However, when the number of positions to be filled was not indicated, that skill was counted only once (p. 34).

Once tallied, the results of the current study were classified into the following categories: general job skills, knowledge of business functions, information systems skills, software knowledge, hardware knowledge, and telecommunications knowledge.

RESULTS

A total of 1073 information systems help-wanted ads were tallied from the four major cities surveyed during May, June, and July of 1998. As can be seen in Table 1, the largest number of ads was in the Washington, D.C. area with the smallest number being found in Harrisburg. Ads placed by employment agencies were not included since these organizations are not the ultimate employers of the personnel being sought.

**TABLE 1
NUMBER OF ADS COUNTED**

	BALTIMORE		PHILADELPHIA		WASHINGTON		HARRISBURG		TOTAL	
	1998	1995	1998	1995	1998	1995	1998	1995	1998	1995
May	65	77	119	146	106	263	12	25	302	511
June	78	56	151	137	344	335	15	20	588	548
July	29	49	21	74	123	202	10	22	183	347
Total	172	182	291	357	573	800	37	67	1073	1406

Initially, the ads were grouped into the following categories: general job skills, information system skills, software knowledge, hardware knowledge, and telecommunications knowledge (Jacobson & Armstrong 1998). A category for knowledge of business functions was added to the table for this study. Many ads specified multiple skills and knowledge. The percentage of ads in each category is presented in Table 2.

**TABLE 2
PERCENTAGE OF ADS BY CATEGORY***

	1998	1995
General Job Skills	61%	62%
Knowledge of Business Functions	9%	<1%
Information Systems Skills	242%	85%
Software Knowledge		
Operating Systems & Environments	150%	120%
Programming		
Programming Languages	51%	49%
Fourth Generation Languages	62%	24%
Object-Oriented Programming	58%	37%
CASE & other development tools	12%	21%
Other	9%	2%
Application Packages		
Relational Database	94%	87%
Other	45%	27%
Hardware Knowledge	18%	21%
Telecommunication Knowledge	72%	57%

*Most ads listed more than one skill.

General Job Skills

General job skills were mentioned in 61 percent of ads analyzed. The category of organizational, project management and supervisory skills was the most frequently mentioned, coming in slightly ahead of communication skills (see Table 3). Ten percent of the ads sought "good communication skills" in general. Written communication skills, oral communications skills, and presentation skills were each requested in fewer than 10 percent of the ads.

Information Systems Skills

Information systems skills represent the category most frequently requested, appearing in 242 percent of the ads (most ads listing more than one skill). As shown in Table 4, over one-fourth of all ads specified database design, systems and program development, and user support and training. Web development, a fairly new skill, appeared in 20 percent of the ads.

Software Knowledge

Operating systems. UNIX dominated in this category, particularly in the Washington, D.C. area (see Table 5), followed by Windows NT. These two operating systems clearly reflect the importance of networking in organizations. DOS was still mentioned, but just barely. Harrisburg ads also showed less demand for operating systems knowledge than the three larger cities.

Programming languages. More than half of the ads requested a knowledge of fourth generation and object-oriented programming languages. As shown in Table 6, SQL was mentioned in one-third of the ads; C++, in 29

**TABLE 3
PERCENTAGE OF ADS FOR GENERAL JOB SKILLS**

	BALTIMORE		PHILADELPHIA		WASHINGTON		HARRISBURG		TOTAL	
	1998	1995	1998	1995	1998	1995	1998	1995	1998	1995
Organizational and Project Management/and Supervisory	27%	13%	30%	17%	21%	10%	8%	9%	24%	12%
Communications Skills Total*	33%	28%	19%	26%	21%	26%	24%	21%	22%	26%
Communications (General)**	1%	10%	11%	15%	9%	10%	11%	10%	10%	11%
Written	9%	9%	4%	5%	6%	6%	8%	5%	6%	6%
Oral	7%	9%	4%	6%	4%	8%	5%	5%	4%	7%
Presentations	2%	0%	1%	1%	2%	3%	0%	2%	2%	2%
Problem Solving and Analytical Skills	12%	6%	6%	8%	7%	5%	8%	10%	7%	7%
Interpersonal Skills	8%	8%	5%	8%	6%	7%	5%	15%	6%	8%

* The total may not equal sum of subdivisions due to rounding. ** Ads specified "good communications skills."

**TABLE 4
MOST FREQUENTLY MENTIONED INFORMATION SYSTEMS SKILLS**

	1998	1995
Database design	29%	4%
Systems and program development	28%	7%
User support and training	27%	12%
Testing	22%	7%
Web development	20%	0%

**TABLE 5
PERCENTAGE OF ADS FOR OPERATING SYSTEMS AND OPERATING ENVIRONMENTS**

	BALTIMORE		PHILADELPHIA		WASHINGTON		HARRISBURG		TOTAL	
	1998	1995	1998	1995	1998	1995	1998	1995	1998	1995
UNIX	39%	29%	41%	23%	53%	42%	11%	27%	46%	35%
Windows NT	37%	7%	34%	7%	29%	10%	14%	8%	31%	9%
Windows 3.x*	24%	23%	24%	23%	20%	31%	14%	24%	22%	27%
Netware OS	13%	9%	11%	6%	14%	8%	3%	10%	13%	8%
CICS	12%	7%	17%	8%	8%	8%	5%	25%	11%	9%
JCL/CLP	5%	4%	5%	2%	6%	5%	0%	12%	5%	4%
DOS	3%	14%	3%	12%	2%	14%	0%	18%	3%	14%

* All versions of Windows except Windows NT and X-Windows.

percent; COBOL and Visual Basic, in 23 percent. Harrisburg differed markedly from the other cities, with COBOL most in demand in that region. Java has very quickly gained popularity, appearing in 22 percent of all ads.

Relational databases. Relational database skills were sought in 94 percent of all ads surveyed. Leading the list was Oracle, mentioned in over one-third of all ads (see Table 7). Other requested databases included DB2, MS Access and Sybase.

Hardware Knowledge

Requests for hardware knowledge appeared in 18 percent of all ads surveyed. The two most frequently mentioned platforms were the AS400 (8 percent of ads) and mainframe (7 percent). These low numbers are probably due to the fact that this study focused on ads for business information systems professionals, rather than computer science professionals.

Telecommunication Knowledge

Almost three-fourths of all ads sought employees with telecommunications knowledge. Knowledge of LANs (16 percent) and WANs (12 percent) was most in demand, followed by Novell (8 percent), TCP/IP (7 percent) and Internet (6 percent).

DISCUSSION

When compared to Jacobson and Armstrong's data collected in 1995, the number of total ads had dropped by almost 25 percent from 1,406 ads in 1995 to 1,073 ads in 1998. As shown in Table 1, this decrease occurred in all four regions, with the greatest drop in Harrisburg (down 45 percent) and the smallest in Baltimore (down 6 percent). It has been suggested that one possible explanation for this decrease is that recruiting is gradually moving to the Internet (Behr, 1999; LaPlante, 1998b).

Although there was a decrease in the total number of ads, many ads specified multiple skills and knowledge. Thus, the categories of information systems skills, software knowledge, and telecommunications knowledge showed increases, while general job skills and hardware knowledge decreased slightly (see Table 2). A new category called "Knowledge of Business Functions" was added for the 1998 data, reflecting an increase in the need for information systems professionals to have a

broader view of the organization. In 1995, less than 1 percent of the ads mentioned a need for knowledge of business functions, compared to 9 percent in 1998.

Communication skills are almost always the general job skills most sought after by potential employers (e.g. Chow, Dick & Edmundson, 1994; Jacobson & Armstrong, 1998; Ray, Stallard & Hunt, 1994). In the current study, however, communication skills (22 percent of ads) took second place to organizational, project management and supervisory skills (24 percent) by a slight margin.

The percentage of ads specifying one or more information systems skills tripled between the 1995 data and 1998 (see Table 4.). Database design jumped from four percent of ads to 29 percent, and systems and program development skills from seven percent to 28 percent. Web development, which had not appeared in the 1995 data, represented 20 percent of the ads, establishing a significant presence in three years.

In terms of operating system software, UNIX maintained its dominance, although Windows NT more than tripled from 9 percent of ads to 31 percent (see Table 5). This seems to suggest as more organizations are becoming networked, they are opting for Windows NT over UNIX. Demand for Windows 3.x decreased (from 27 percent to 22 percent), as might be expected, since it runs on top of DOS.

Among programming languages, demand for SQL doubled between 1995 and 1998 (see Table 6). Also showing a large increase in demand were C++, COBOL, and Visual Basic. Java, which had not been mentioned in the 1995 ads, was requested in 22 percent of the 1998 ads.

Oracle continued to dominate the relational database requests, increasing from 20 percent of ads surveyed in 1995 to 37 percent in 1998. DB2 and MS Access also showed increases (see Table 7).

There was a significant increase in the number of ads for telecommunications knowledge, from 57 percent to 72 percent. As might be expected, the specific knowledge sought in this category related to networking.

Curriculum Implications

These findings have several direct implications for curriculum planning and program content. First, the

numerous and significant changes over a three-year period suggest that not only is it vital that faculty monitor the environment and keep in touch with the needs of

business, but that this monitoring must occur on a frequent and regular basis. Such monitoring will enable

TABLE 6
PERCENTAGE OF ADS FOR PROGRAMMING LANGUAGES AND DEVELOPMENT TOOLS

	BALTIMORE		PHILADELPHIA		WASHINGTON		HARRISBURG		TOTAL	
	1998	1995	1998	1995	1998	1995	1998	1995	1998	1995
SQL	30%	8%	35%	16%	34%	19%	5%	12%	33%	16%
C++	23%	12%	20%	12%	36%	20%	8%	9%	29%	16%
COBOL	28%	12%	30%	15%	18%	13%	22%	34%	23%	15%
Visual Basic	24%	10%	27%	13%	21%	16%	16%	10%	23%	14%
Java*	17%		15%		28%		5%		22%	
C	22%	18%	22%	18%	21%	26%	5%	10%	21%	22%
PowerBuilder	5%	5%	11%	10%	7%	14%	5%	12%	7%	12%
RPG	10%	4%	8%	5%	1%	2%	5%	10%	4%	3%

*Did not appear in 1995 ads

TABLE 7
PERCENTAGE OF ADS FOR RELATIONAL DATABASES

	BALTIMORE		PHILADELPHIA		WASHINGTON		HARRISBURG		TOTAL	
	1998	1995	1998	1995	1998	1995	1998	1995	1998	1995
Oracle	31%	15%	44%	16%	37%	23%	16%	10%	37%	20%
DB2	17%	6%	20%	9%	12%	10%	14%	15%	15%	9%
MS Access	15%	3%	11%	7%	12%	10%	8%	8%	12%	8%
Sybase	10%	8%	9%	9%	11%	12%	0%	5%	10%	10%
Informix	8%	2%	4%	5%	5%	6%	0%	0%	5%	5%
Fox Pro	5%	6%	5%	4%	4%	8%	0%	9%	4%	7%

faculty to update curriculum and course content so that they remain relevant. Not doing so means that a curriculum can quickly become outdated.

Second, the appearance in this study of a demand for knowledge of business functions suggests the need for a balance between business courses and IS courses. The business courses required should include courses in

organizational and project management skills as well as supervisory skills. Communication skills should also be stressed throughout the curriculum.

Third, Internet related skills need to be introduced, including web development and Java. These skills will be useful for students in locating jobs advertised on the web and in performing on-the-job activities.

Finally, students must be prepared to become lifelong learners, being willing to acquire new skills and knowledge after they graduate. They must "thrive on change and ambiguity" (Stepanek, 1999, p. EB54). According to the vice president of strategic development at Accompany, an on-line buying club, "We're not interested in people who can only deal in black and white. They'd slow us down." (Stepanek, 1999, p. EB54) A quality program in information systems should therefore provide students with a good conceptual foundation on which they can continue to build throughout their careers.

Limitations and Future Directions

Although this study analyzes ads from a limited geographic region, that region includes state and federal government agencies, national and international headquarters for Fortune 500 companies, and regional organizations. Therefore, this job market might be expected to be similar to other geographic regions. In fact, the results of this study are consistent with what is reported in the literature. The only knowledge and skills

which were cited in the literature and which did not show up explicitly in this study were security and fire walls, and data mining and data warehousing. Additional studies in other geographic regions are needed. For example, the results of this study showed that Harrisburg differed from the other cities in terms of demand for programming languages and a knowledge of operating systems. This suggests that IS faculty need to determine local demands as well as national demands when developing curriculum.

Future studies also need to include job postings on the Internet to determine whether positions requiring different skills and knowledge are found on the Internet or if ads on the Internet duplicate those found in newspapers. This would involve analyzing web sites that are associated with newspapers as well as those specifically created to post job openings. On-campus recruiters might also be surveyed. By using a variety of sources it should be possible to obtain a more complete and accurate picture of the information systems skills and knowledge sought by employers so that faculty can better prepare their students for a career in a dynamic field.

REFERENCES

- Arnett, K. P. & Litecky, C. R. (1994). "Career Path Development for the Most Wanted Skills in the MIS Job Market." *Journal of Systems Management*, 45 (2), 6-10.
- Athey, S. & Plotnicki, J. (1992). "A Comparison of Information System Job Requirements in Major Metropolitan Areas." *Interface: The Computer Education Quarterly*, 13 (4), 47-53.
- Bathey, J. (1997, November 17). Labor shortage means hot IT job market in Southern Texas. *InfoWorld*, 19 (46), 151.
- Behan, M. (1999, April). Technology Careers in the 21st Century. *Beyond Computing*, 80 (3), 1-8.
- Behr, Peter. (1999, September 27). By the Numbers. *Washington Post*, p. F30.
- Catalano, C. (1999, March 8). AS/400: Substance over style. *Computerworld*, 33 (10), 83.
- Chow, J, Dick, G.T., & Edmundson, B. (1994). Industry Satisfaction with IS Graduates in the 1990s: An Empirical Study. *Proceedings of the International Academy for Information Management*, 153-174.
- Fitter, F. (1998, November 9). Data in, opportunities out. *Computerworld*, 32 (45), 93.
- Goff, L. (1998, June 29). Networking's need-to-know skills. *Computerworld*, 32 (26), 87.
- Jacobson, C. McK. & Armstrong, R. A. (1998). What information systems employers want: An analysis of job advertisements in the Middle Atlantic States. *Journal of Education for Management Information Systems*, 5 (1), 32-40.
- LaPlante, A. (1998a, June 15). The top skills. *Computerworld*, 32 (24), 88-89.
- LaPlante, A. (1998b, October 5). America's most wanted. *Computerworld*, 32 (40), 73-75.
- LaPlante, A. (1999, April 5). Upping the ante. *Computerworld*, 33 (14), 56-57.
- Mateyaschuk, J. (1999, March 1). No end in sight for surge in IT job growth. *Information Week*, 723, 80.
- McGee, M. K. (1996, January 1). Hot skills in '96: Internet, client-server, and networking experts top lists of the most wanted. *Information Week*, 560, 64.

- Perlis, D. (1999, January 29). Better-trained workers needed, says survey. *Central Penn Business Journal*, 3 ff.
- Prabhaker, B., Litecky, C. & Arnett, K. (1995, Jan/Feb). Boom times ahead! *Journal of Systems Management*, 46 (1), 24-28.
- Raths, D. (1999, April 19). Next-century skills. *InfoWorld*, 21 (16), 97-98.
- Ray, C.M., Stallard, J.J. & Hunt, C.S. (1994, January-February). Criteria for Business Graduates' Employment: Human Resource Managers' perceptions. *Journal of Education for Business*, 69 (3), 140-144.
- Rindgard, J. (1999, April 5). Database careers. *InfoWorld*, 21 (14), 87.
- Steen, M. (1997a, October 27). Networking's visibility increases. *InfoWorld*, 19 (43), 115.
- Steen, M. (1997, November 24). Database skills highly sought after. *InfoWorld*, 19 (47), 99.
- Stepanek, M. (1999, November 1). How fast is net fast? *Business Week*, EB52-EB54.
- Stucker, H. (1999, February 1). Insurer need for IT skills rising. *National Underwriter*, 103 (5), 5 ff.
- Wagner, M. (1997, June 16). IS job market demands more than technical skills. *Computerworld*, 31 (24), 1.
- Weldon, D. (1998, September 28). Virginia is hiring: Feast or famine. *Computerworld*, 32 (39), 84.
- York, T. (1998, November 30). 1999 career outlook. *InfoWorld*, 20 (48), 90.
- York, T. (1999, January 18). Shift in IT roles ahead. *InfoWorld*, 21 (3), 75-76.
- Zbar, J. D. (1998, January 12). The recruiters' view. *Computerworld*, 32 (2), 76.