A Study of the Demand for Information Technology Professionals in Selected Internet Job Portals

Kai S. Koong
Lai C. Liu
Computer Information Systems
Southern University at New Orleans
New Orleans, Louisiana 70126, USA

Xia Liu
FYI.Net, Incorporated
Houston, Texas 77027, USA

ABSTRACT

The demand for information technology (IT) professionals has grown rapidly in the last decade. Parallel to this increasing need for IT personnel is the continuous change in the type of skills that are brought about by innovations in cutting edge technologies. However, the type of new IT skills and knowledge needed to keep companies competitive in the global market extend beyond the ability to apply the updated hardware and software to make business processes more efficient. Communication excellence and managerial expertise are just two of the other more commonly needed skills demanded by employers. This study identifies and classifies information technology related job listings that are disclosed in the databases of two leading e-recruiting services. Two secondary variables, written and oral communications and experience, were also collected and examined in this study. The results of this research should be of interest to job seekers, human resources administrators, career counselors, corporate trainers, information systems consultants, labor attorneys, immigration and naturalization officers, and agency recruiters. Educators will find the outcomes of this study useful for the design and development of new curricula that can prepare students for the job market. Students will find this study particularly helpful since the trends identified in this research can have important implications for them in their selection of elective courses and in choosing a track for specialization.

Keywords: IT Job Skills, Information Technology Expertise, e-Recruiting, Computer Personnel

1. INTRODUCTION

As businesses compete in the agile global environment, information technology (IT) professionals are assigned more important and mission critical tasks (Chen, Namit, & Willhartdt, 1992; Kim, 1998; Mackowiak, 1991-1992). Such mission critical tasks include using the information systems to identify new market segments, areas for cost reductions, and processes for automation so that production time can be reduced. With each successful use of IT to solve those business problems and opportunities, management is becoming more and more dependent on the IT function for the purpose of making decisions and for routine operations. As a result of this dependence on the IT function, there has been an increase in the need for more IT professionals nation-wide. In fact, the number of workers in the computer and software industries alone "… has almost tripled in the past decade" (Wilkins & Noll, 2000, p. 105).

In the decade prior to the new millennium, the demand for IT professionals exceeded the supply of qualified persons for several years. In 1999, there were 722,158 unfilled IT jobs in the United States. It is predicted that the shortage will grow to about 846,901 jobs by 2002 (Goodwin, 2000). While it is true that the economy has slowed down since the last quarter of 2000, many companies are still hiring persons with critical IT skills while other workers are being laid off (Armour, 2001; Gladwin, 2001).

2. STATEMENT OF THE PROBLEM

Irrespective of industry type, highly skilled workers are often awarded lucrative salaries, increases, and bonuses. In the tight IT labor market, it is therefore no surprise that companies are "paying top dollars for top skills" (Leslie, 2000). As a matter of fact, the sole use of financial incentives to encourage employee loyalty and retention may not be insufficient. To effectively manage the IT staffing function, companies are using a diversity of monetary and non-monetary incentives (Murray, 1999; Stokes, 2000)

From the perspective of employers, the higher pay offered to IT staff is well deserved. Computer vendors are continuously coming up with new versions of hardware and software that contain new features and expanded capabilities. New problems and opportunities are also rapidly surfacing in the workplace (Edwards, 2000). For IT professionals, these innovations and changes mean that they must engage themselves in professional development continuously by participating in re-certification programs, seminars, workshops, briefings, conferences, and courses to remain marketable. Keeping up with the technology is a daily reality. Their marketability and longevity in the IT profession is often determined by the life cycle of the hardware and software that demands their specialty. The key to maintaining ones' marketability is to always have cutting edge expertise that is in demand.

While it is true that the IT job market in general is good for job seekers, persons with a certain type of expertise or combinations of expertise may be able to attain more lucrative offers than others. For example, at the current time, individuals with expertise in Java Server Page, XML, Java, Active Server Pages, C++ / C, Oracle Developer 2000, Visual C++, Microsoft Visual Basic, TCP / IP, IPX, Oracle, and SQL Server were especially needed. According to a number of reports, persons who are skilled in the use of these IT tools are found to receive better compensation than their counterparts (Kim, 1998; Maier, Clark, & Remington, 1998). For prospective job seekers, the key to higher compensation is to know what expertise to focus on when marketing themselves to corporate recruiters.

Institutions of higher education have often responded well to the needs of industry. Information systems as well as computer sciences curricula have been undergoing major changes based on the recommendations of their respective accreditation agencies and research reports. A number of insightful studies reported by educators and industry practitioners such as Mackowiak (1991-1992), Chen, Namit, and Willhartdt (1992), Kim (1998), Arnett, Litecky, and Prabhakar (1998), Wilkins and Noll (2000), Leslie (2000), Lee, Trauth, & Farwell

(1995), Srinivasan, Guan, & Wright (1999), and Jacobs (2000) deserved attention. In general, these studies found that educators are being blamed for teaching obsolete IT skills because the expertise acquired by graduates is not matching with the needs of companies. A reason for this problem is that institutions of higher education or accreditation agencies are used to redesigning their curriculum only once every four or five years (Gambill, 1998). In the new millennium, the curriculum cycle may have to be shortened. Moreover, the types of new IT skills and knowledge needed to keep companies competitive in the global market also extend beyond the ability to apply the updated hardware and software to make business processes more efficient. A growing number of companies are demanding that their new hires have certain organizational skills that include some form of managerial abilities, business skills, people skills, project team skills, and oral and written communication skills (Wilkins & Noll, 2000; Mackowiak, 1991-1992; Jain & Paul, 1998; Klein & Means, 1993).

3. STATEMENT OF OBJECTIVES

Innovations in computing hardware, software, and networks will continue to drive the need for skilled IT workers that can use cutting edge technologies to solve emerging business problems. The types of expertise needed by companies in the new millennium are expected to change as new technologies are brought into the market. However, current expertise needed by companies are good indicators of the types of IT skills that current and future IT professionals should have in order to be marketable in a competitive labor market.

The primary purpose of this study is to examine the IT job market. Specifically, this study examined the types of expertise needed of new employees. Two other variables, communication skills and prior experiences were also analyzed. The results of this research should be of interest to job seekers, human resources administrators, career counselors, corporate trainers, information systems consultants, labor attorneys, immigration and naturalization officers, and agency recruiters. Educators will find the outcomes of this study useful for the design and development of new curricula that can prepare students for the job market. Students will find this study particularly helpful because the skills identified in this research can have important implications for them in their selection of elective courses and when choosing a track for specialization.

4. METHODOLOGY

Two Internet job databases, Monster.com and HotJobs.com were selected as the data gathering sources for this study. Collectively, the two Internet job

databases account for over 90 percent of the online new job seekers market and they are also widely accepted as the two leading e-recruiting providers in the world (Boone & Julian, 2001; Boyle, 2000). The use of Internet job databases for collecting job related information is not new. Markey, Liu and Koong (2000) and Arnett, Litecky, and Prabhakar (1998) found that many companies are actually engaged in e-recruiting practices. However, this study is different from the two previous studies in that the complete set of data used was gathered from Internet job databases that have a nationwide clientele from diverse industry segments. The previous two studies included data from localized newspapers and job listings from Fortune 500 Company Web sites. Another major difference and contribution of this study is inherent in the amount of data collected and the longer period covered. The data set consisted of 300 observations that were collected over a ten-week period. The first 150 sets of data were collected during the last five weeks of 2000. The remaining data sets were gathered during the first five weeks of 2001.

A systematic random sampling procedure was used for gathering the data from the two Internet job databases. The targeted population for this study is considered infinite because the number of jobs listed can change daily. Even though the sample size was computed to be 292, it was rounded to 300 to get 15 observations from each database each week. The formula and the parameters used for calculating the required sample size for this study were:

$n = (z / i) \wedge 2 * p * (1 - p)$.

- The confidence level was set at 95 percent so $(z) = 1.96$
- Acceptable error (i) = .025
- Estimated proportion of job listings that required technical skills (p) = .95

To be consistent, a five-step procedure was used to gather the data. A detailed description of the individual processes or steps is provided below:

1. Access the home pages of the respective Web sites, Monster.com (http://www.Monster.com) or Hot-jobs.com (http;//www.HotJobs.com).
2. First, select the tag called Job Search. Second, select the specific channel. In Monster.com, select the option called Information Technology. Then select the time period for extraction. In Hot-Jobs.com, select the option called Technology. Then select the next sub option called Information Technology and select the time for extraction.
3. First, extract the first job listed on each of the Internet job database. Second, observe the total number of jobs listed on the database for that day. An interval of 30 was used for gathering the rest of the data needed because there were at least 450 jobs listed each time the data was collected. On

days when the total number of jobs listed was less than 450, the total number of jobs listed was divided by 15. The quotient was rounded to the nearest smaller number and that was the interval used for extracting the other 14 observations for that day.
4. Classify the skills demanded in the job descriptions into the respective categories. Consistent with the works of Wilkins and Noll (2000), Leslie (2000), and Arnett, Litecky, and Prabhakar (1998), the jobs were classified into the following five categories:
   - Programming Languages (examples: C / C++, Java, and Visual Basic).
   - Web Development (examples: ASP, DHTML / HTML / XML, and COM.
   - Database (examples: Oracle, JDBC, and Access).
   - Networking (examples: Windows NT, WAN/LAN and Novell).
   - Operating System and Environments (examples: Windows 95/98/2000, Unix, and OS2).
5. Examine if the two secondary variables, communication skills and experience requirements, are indicated in the job description.

Two major hypotheses were examined in this study. The first hypothesis was related to the distribution of the different IT jobs that were advertised. The second hypothesis dealt with the secondary variables collected. Chi-square tests were used for examining the two hypotheses because the statistical tests involved observed and predicted proportions and ranges (Koosis, 1997). The two hypotheses used were stated as follows:

Ho (1): The jobs were equally distributed across all categories.

Ho (2): The secondary variable (communication or experience) examined was indicated as a critical expertise.

5. FINDINGS

One hundred and fifty jobs were extracted from each of the Internet job databases, Monster.com and Hot-Jobs.com. Each extraction was carefully examined to make sure that there were no duplicates and classified into one of five categories. One of the most interesting observations is that an overwhelming majority of the jobs require multiple skills in a certain category. For example, a job would clearly identify Visual Basic as the programming language needed. However, the description also indicated that candidates with experiences in Java would be given preference. It is also extremely common to have job descriptions that fit two or more categories. For example, a job would specify that the position involves developing Web applications using SQL and SQL Server. Ideally, the candidates should also have work experiences in a Windows NT

environment. This is the main reason that some of the computed totals in Table 1 exceeded 300, the actual number of jobs extracted.

The following Table 1 shows the classified outcomes from the 300 jobs. The categories and their related job skills are presented in descending order of occurrences. The category that has the largest number of job skills was programming languages. This category was followed by Web development, Database, Operating System and Environments, and finally, Networking. A more detailed analysis of the tallied results is presented below:

1. Three hundred and five job skills were indicated in the 150 jobs extracted from Monster.com. Two hundred and ninety-two job skills were found in the other 150 jobs posted in HotJobs.com. Collectively, the 300 jobs showed a total of 597 job skills. Irrespective of the total figures used, each job is computed to have an average of two job skills. In other words, most jobs require multiple skills within a certain category or from a number of categories.

2. Out of the 300 jobs, 163 job skills were found to fit into the Programming Languages category. Only 5 programming languages were found in the 163 job skills. About 95 percent of the job skills were on C/C++, Java and Visual Basic. There were seven indications for COBOL skills and one for Pascal. Collectively, the job skills in the Programming Languages category accounted for about 27 percent of the total number of job skills. These outcomes provided strong evidences to show that the market for traditional programming languages is on its way to extinction.

3. Six types of Web Development skills were found in the 300 jobs. There were SQL, DHTML/HTML, ASP, JavaScript, VBScript, and COM. Collectively, these job skills accounted for about 24 percent of the total number of job skills. SQL and DHTML/HTML are the two dominant job skills in this category. Together, they account for about 57 percent of the job skills in the Web Development category.

4. The first two categories, Programming Languages and Web Development, are categories that have a heavy emphasis on algorithm development and coding. These two categories alone accounted for about 51 percent of the total number of job skills identified. In other words, a majority of the jobs posted require excellent coding skills involving contemporary languages.

5. The five types of Database skills extracted were Oracle, SQL Server, Access, JDBC, and DB2. Oracle is clearly the dominant skill needed by recruiters. It accounted for half of the job skills in

the Database category. The two Microsoft products account for about 39 percent of the job skills this category. DB2 skills were indicated only 7 times by recruiters.

6. In the Operating Systems and Environment category, there was a demand for only two types of operating systems, Unix and Windows (95/98/2000). Surprisingly, there was not a single job listing for any of the mainframe-based operating systems.

7. Similarly, the Networking category showed a need for only two types of skills. About 81 percent of the Networking related descriptions were for Windows NT skills. The other 19 percent require some type of WAN/LAN expertise.

Apart from the skills and categories examined, it can also be said that both the Internet job databases are equally good sources for locating job search information. Both the e-recruiting services produce a relatively similar number of job skills. Monster.com did show more jobs that indicated Web development, Database, and Networking requirements. However, HotJobs.com has more Programming Languages and Operating Systems and Environments related jobs listed. Moreover, the differences in the number of jobs identified were minor and do not appear to fit any logical trends.

Two other variables, communication skills and experience requirements, were also collected and tallied. These two secondary variables were used to analyze the growing need for non-technical skills among IT professionals. The outcomes are reported in Table 2.

About 84 percent of the 300 jobs indicated prior experience in the job descriptions. Counted among the 250 occurrences were jobs specifying the amount of experience time desired as well as those that indicated preference for candidates with prior experiences. This high number of jobs requiring prior experience was consistent with the findings reported in earlier studies (Markey at el, 2000; Edwards, 2000). Surprisingly, only about 27 percent of the jobs indicated communication skills, both oral and written, as a requirement. This small percentage was not consistent with the outcomes reported in earlier research (Mackowiak, 1991-92; Klein & Means, 1993). Collectively, it can be said that many of the jobs indicating communication skills as a requirement also included prior experiences in the description. The proportion of can be said that many of the jobs indicating communication skills as a requirement also included prior experiences in the description. The proportion of jobs indicating both the non-technical skills in the job description is about 1 out of 4.

Table 1 - Tally of Skills in Each Category

Categories and Type of Skills		Monster.com	HotJobs.com	Total	Percent
Programming Languages:		80	83	163	27
C/C++	59				
Java	56				
Visual Basic	40				
COBOL	7				
Pascal	1				
Web Development:		72	69	141	24
SQL	44				
DHTML/HTML	36				
ASP	26				
JavaScript	22				
VBScript	9				
COM	4				
Database:		58	48	106	18
Oracle	50				
SQL Server	28				
Access	11				
JDBC	10				
DB2	7				
Operating System and Environments:		45	51	96	16
Unix	77				
Windows 95/98/2000	19				
Networking:		50	41	91	15
Windows NT	74				
WAN/LAN	17				
Total		305	292	597	100

.

Table 2 - Communication Skills and Experience Indications

Secondary Variable	Monster.com	HotJobs.com	Total	Percentage Required
Communication Skills	33	48	81	27%
Prior Job Experiences	121	129	250	84%
Communication Skills and Prior Experience	29	42	71	24%

The first hypothesis related to the equidistribution of jobs among the five categories was rejected. To be considered proportional, each category should show an average of about 20 percent of all the job skills listed. However, this was not the case. The first two categories were over 20 percent (27 and 24 percent respectively) and the latter three categories were under 20 percent each (18, 15, and 16 respectively). A Chi-square test was used to test this hypothesis. The probability value was computed to be 1.39327E-06. It is much lower than 0.05.

The second hypothesis produced mixed results. The first variable, communication skills, was only indicated in 27 percent of the jobs listed. The critical values of the Chi-square of 25 percent, 50 percent, and 75 percent for this variable were 0.48, 31.74, and 92.16 respectively. The smallest number fell in the 25 percent range. For the variable, communication skills, this hypothesis was not rejected. For the variable, prior experience, this hypothesis was also not rejected. The critical values of the Chi-square of 25 percent, 50 percent, and 75 percent for this variable were 408.33, 66.67, and 2.78 respectively. The smallest number fell in the 75 percent range. Communication skills and experience were indicated only in about 24 percent of the jobs listed. The critical Chi-square value was outside the 25 percent range. Irrespective of the cut off range used, prior experience is definitely a critical factor that determined the marketability of IT professionals. If the critical range is extended to 25 percent, communication skills can also be accepted as

an important market variable.

6. CONCLUSIONS AND IMPLICATIONS

In general, this study found many similarities in outcomes with previous studies. For example, many of the job categories and skills reported by Markey, Liu, and Koong (2000), Leslie (2000), and Arnett, Litecky, and Prabhakar (1998) are found in the jobs extracted from the two databases used for this study. Of particular importance is that a great majority of the jobs required the ideal candidate to have multiple classes of skills or multiple categories of skills. From a job seeker's perspective, it is advisable to have multiple job skills or categories of skills because it can increase a person's marketability. For educators, this market trend suggests the need for integrating a variety of cutting edge software and hardware into the curriculum because it can enhance the employability of graduates. For this reason, faculty members will definitely have to find a balance between teaching broad concepts versus teaching particular application skills in their curriculum. A possible solution is to integrate a variety of software tools into the classroom experience.

Further analysis of the IT job market also indicated that the majority of the job openings are not equally distributed across all categories. Over half of the job opportunities are in the areas of Programming Languages and Web Development. Both these areas require expertise with logical development, application integration, and code generation using contemporary languages. Job seekers entering the market for the first time may want to specialize in these two areas because of the larger proportion of jobs available. In addition, jobs listed in these two categories are usually entry level opportunities.

One of the most interesting outcomes obtained in this study is the low to almost non-existence in market demand for traditional programming languages, mainframe, and IBM related expertise. This study found that COBOL was indicated 7 times and Pascal only once. Surprisingly, there was not a single indication for OS/2, MVS, CICS, JCL, and CMS. These findings suggest that many of the skills that were related to the Year 2000 Problem may have become obsolete. Information technology professionals that have expertise in these obsolete areas may want to retrain themselves immediately. Institutions of higher education that are still teaching these obsolete skills in their core information systems courses may also want to update their curriculum to better meet the needs of prospective employers.

Experience, a secondary non-technical variable, examined in this research was found to be a very important factor. Over 80 percent of the jobs indicated this requirement. This overwhelming number of jobs requiring prior experiences shows that most companies are in the market for new hires that can generate a return on their investment quickly. For graduates, it is definitely essential and wise to participate in internships and cooperative education programs because these opportunities are usually counted as experience by most recruiters.

Even though only 1 out of about 4 jobs indicated communication excellence as a requirement, it should not be overlooked by job seekers. Twenty-seven percent is still a relatively large indicator. Moreover, this secondary variable can always be the factor that sets the winning job applicant apart when the technical skills of all the candidates are compatible or for IT jobs that are more management oriented in their scope.

Within the next 6 to 12 months, the findings provided clear evidence to show that there will be a couple of major changes in the IT job market. First, the 74 cases requiring Windows NT expertise will be moving toward Windows 2000. Windows NT will no longer be vendor supported after December 2001. Second, the 19 cases in the Windows 95/98/2000 market will also see a major change. Most likely, this market will change to Windows 98/2000/ME/XP because Microsoft Office XP that was launched during the summer of 2001 does not run on Windows 95. As companies migrate to new hardware that is loaded with Windows XP in late 2001 or upgrade their software to Microsoft Office XP, demand for Windows 95 expertise can be expected to decrease dramatically. For individuals specializing in Windows NT and Windows 95, this is the time for them to be retrained in Windows 2000 and Windows XP.

Alumni and current students can learn two other major lessons from the bias toward work experiences and the great need for contemporary programming tools found in this study. First, individuals who have graduated must participate in continuous education to maintain their marketability. Everyone must constantly learn new tools and seek to enrich their work experiences. For example, individuals who have taken courses in Visual Basic or C++ may need to learn VB.Net and C#.Net in the future. Therefore, one crucial question which students should always ask prospective employers is how continuous education is supported.

Last but not least, both the e-recruiting databases appear to be equally good sources for finding computer related job information. They both appear

to have a similar number of jobs, be it by categories or by the type of specialized skills identified. Each of the online databases also has its respective market areas where there are more job skills listed. Monster.com had more Web development, Database, and Networking skills listed. HotJobs.com has more Programming Languages and Operating Systems and Environments skills listed. However, the slight market differences are probably incidental. Prospective job seekers as well as corporate recruiters can expect both database services to be equally useful for meeting their e-recruiting market needs.

7. LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

While this study deepens and broadens the current body of knowledge on the market for IT professionals, there are a couple of limitations. The data was collected from the two leading e-recruiting providers in the world only and the collection period lasted merely 10 weeks. Including less known e-recruiting services and having a longer collection period may be a fruitful area of investigation. However, an inclusion of less known databases and a longer data collection time may require a different research design than the one that was employed in this study. Second, consistent with earlier studies, the data set was classified into five categories. A similar study examining the IT market in an even broader sample of categories may serve to further extend and enhance these findings. Finally, augmenting the teaching of broad concepts with particular application skills is easier said than done. Finding the balance can be a rather difficult task. A study relating to this balance will definitely provide useful instructional insights to educators. It may also help bridge the gap between academicians and practitioners.

8. REFERENCES

Armour, S. [2001], "Companies Hire Even As They Lay Off." USA Today, May 15, A1.

Arnett, K., C. Litecky, and B. Prabhakar [1998], "A Longitudinal Study of IS Job Skills: 1992 – 1998." http://www2.msstate.edu/~kpal/wanteds98/sld001.htm.

Boone, C. and E. H. Julian, [2001], "The Top 10 Worldwide eRecruiting Providers." IDC Bulletin # W24138. [On-line]. http://www.itresearch.com/alfatst4.nsf/UNITOCX/W24138?OpenDocument

Boyle, H. [2000], "Newbies to Employment Market Going Online." Labor Daze 00-30, p. 2.

Chen, J., K. Namit, K., and J. A. Willhardt [1992], "Career Expectations and Concerns of Minority CIS Students." Interface, 14, (1), pp. 17-22.

Edwards, J. [2000]. "Redefining IT Career Paths for the New Millennium." Computer, 33, pp. 16-20.

Gambill, S. E. and J. L. Maier, J. L. [1998], "CIS/MIS Curriculums in AACSB and Non-AACSB Accredited Colleges of Business." Journal of Information Systems Education, 9, pp. 59-62.

Gladwin, L. [2001], "Dot-Com Bust A Mixed Bag for IT Staffing." Computerworld (39), May 7, p. 38.

Goodwin, B. [2000], "Government Slashes Red Tape to Let in Overseas IT Workers." Computer Weekly, May 11 [On-line]. http://www.findarticles.com/cf_1/m0COW/2000_May_11/62790463/print.jhtml.

Jacobs, P. [2000], "From the Classroom to the Real World – Partnerships Between Schools and Businesses Are Helping to Alleviate the Shortage of IT Talent." InfoWorld, March 27, p.. 2.

Jain, H. and S. Paul [1998], "Retooling Information Technology Professionals." Journal of Information Systems Education, 9, pp. 15-19.

Kim, Y. [1998], "A Study of Key IS Issues for Effective IS Programs." Journal of Information Systems Education, 9(1-2), pp. 35-38.

Klein, G. S., and T. L. Means [1993], "User interfacing: A communication Course for MIS Majors." Interface, 15(3), pp. 15-21.

Koosis, D. J. [1997], Statistics, a Self – teaching Guide. John Wiley & Sons, Inc., 4th edition, p. 105.

Lee, D., E. M. Trauth, and D. Farwell, D. [1995], "Critical Skills and Knowledge Requirements of IS Professionals: A Joint Academic/Industry Investigation." MIS Quarterly, 19, pp. 313-340.

Leslie, G. [2000], "Computer World's 7th Annual Skills Survey." Computerworld, December 04, pp. 56-61.

Mackowiak, K. [1991-1992], "Skills Required and Jobs Available for CIS Majors." Interface, 13(4), pp. 9-14.

Maier, J. L., W. J. Clark, and W. S. Remington [1998], "A Longitudinal Study of the Management Information Systems (MIS) Job Market." Journal of Computer Information Systems, 39(1), pp. 37-42.

Markey, S., Lai C. Liu, and Kai S. Koong [2000], "Some Observations on Web-Based Recruitment by Selected Fortune 500 Companies." Proceedings of Information Systems Education Conference, November 9-12, on CD/ROM.

Murray, J. [1999], "Successfully Hiring and Retaining IT Personnel." Information Systems Management, 16(2), pp. 18-24.

Srinivasan, S., J. Guan, and A, L. Wright, A. L. [1999], "A New CIS Curriculum Design Approach for the 21st Century." Journal of Computer Information Systems, 39(3), p. 99-106.

Stokes, S. L. [2000], "Attracting and Keeping IT Talent" Information Systems Management, 17(3),

pp. 8-16.

Wilkins, M. L. and C. L. Noll [2000], "Critical Skills of IS Professionals: Developing a Curriculum for the Future." Journal of Information Systems Education, 11(3-4), pp. 105-110.

AUTHOR BIOGRAPHIES

Dr. K. Koong is a Director and Professor of Graduate Studies Program in Computer Information Systems at Southern University at New Orleans. Some of his publications have appeared in *Accounting and Financial Systems, Electronic Commerce Advisor, Information Executive, Interface, International Journal of Computer Applications in Technology, The Journal of Computer Information Systems, and The Journal of Information Systems Education*.

Dr. L. Liu is an Associate Professor of Graduate Studies Program in Computer Information Systems at Southern University at New Orleans. She also has publications in *Accounting and Financial Systems, Electronic Commerce Advisor, Information Executive, Interface, International Journal of Computer Applications in Technology, The Journal of Computer Information Systems, and The Journal of Information Systems Education*.

Ms. X. Liu is a software engineer at FYI.Net in Houston, Texas. She holds a Master of Science degree in Computer Information Systems from Southern University at New Orleans. She specializes in the area of Web development and also has extensive experiences with SQL Server, MySQL, COM, Windows NT and PHP applications.

Information Systems & Computing
Academic Professionals

EDSIG
Serving Information Systems Educators

STATEMENT OF PEER REVIEW INTEGRITY

All papers published in the Journal of Information Systems Education have undergone rigorous peer review. This includes an initial editor screening and double-blind refereeing by three or more expert referees.