An Update on the IS/IT Skills Gap

Yongbeom Kim
Jeffrey Hsu
Mel Stern
Information Systems
Silberman College of Business
Fairleigh Dickinson University
Madison, NJ 07940
ykim@fdu.edu   jeff@fdu.edu   stern@fdu.edu

ABSTRACT

Information systems (IS) curriculums have been the subject of debate and discussion, as to their proper planning, design, and implementation. Despite all of the work which has been done in this area to date, there are still arguments whether skills gaps exist between what is being taught in IS curriculums, and what is really needed in the industry. This study examines IS/IT skills gaps from three perspectives: end-users, academia, and IS/IT employers. The goal is to see whether skills gaps exist, and to make specific recommendations in order to alleviate these skills gaps. A survey was administered in the northeastern U.S. to investigate the perceived importance of IS courses, information technologies, and critical IS/IT issues. The survey was analyzed and the results were compared with IS course offerings by AACSB-accredited business schools in the northeastern U.S. and IT staffing surveys and reports. One interesting finding is that project management is a subject area which is not being adequately covered in IS program curriculums, however is considered a highly important skill area by both IS and non-IS industry professionals. In terms of technologies, the most basic and widely used technologies (personal productivity and desktop operating systems) were given high importance. Results related to IS/IT issues showed that security is an issue which should be given greater emphasis in any consideration of IS curriculums. ERP, end-user computing, and the integration of soft skills have also been indicated as being important technologies, skills, and issues based on our findings.

Keywords: IS curriculum, skills gap, project management, IS issues

1. INTRODUCTION

The influence of information systems and information technologies (IS/IT) is ever present in our lives, and even to the extent that they have become ubiquitous. Not only have computers become more powerful, but communications capabilities especially using the Internet now enable a level of reach which span the globe. However, probably nowhere is the influence of technology more important and widespread than in the business world, where computing technologies have helped to keep and maintain both the pace and the global reach of today's business environment. According to the Information Technology Association of America (ITAA), over 10 million members of the US workforce are engaged in IS/IT-related positions (ITAA, 2004).

Career opportunities involving computing technologies have been in the forefront of discussion, especially with its explosive growth during the 1990's, and its subsequent downturn after the burst of the Internet bubble. The explosion of the Internet, new businesses, and technologies has caused a great increase in the number of available entry and higher-level IT positions, however the following downturn resulted in the market contracting and producing a

very difficult job market. This has been supported by published reports, which confirm that hiring and demand for workers in the IS/IT field has been on the decline in recent years. In fact, from 2003 to 2004, the number of IS/IT positions to be filled dropped by roughly 50% (ITAA, 2004).

Compounding the problem is the increased reliance of US companies on outsourcing IS/IT positions to foreign countries, which while helping firms to control costs and improve productivity, has resulted in additional challenges being placed on IS/IT workers (Dibbern et al., 2004; Lee et al., 2003). Because of these profound changes in the industry and job market, it is critically important to examine what kinds of skills and needs are most current and needed in the IT marketplace, and whether IS curriculums are actually meeting these needs.

The needs of the industry often change as quickly as the technologies which are used within the field. Recent employment reports show an increasing demand for IS/IT workers, together with a reduction in the number of unemployed IT professionals (Frauenheim, 2005). In addition, optimism about new positions opening up at start-up firms also suggest a positive outlook. At the same time, the threats of increasing automation together with the

continued reliance on outsourcing cast a negative shadow on job prospects (Frauenheim, 2005). In this kind of ambiguous job IS/IT labor situation and job market, it is necessary to identify critical skills and technologies which are viewed to be in demand both by end-users and employers in the industry. In addition, it is important to examine what kinds of skills and concepts are being taught in IS courses and how they relate to and meet the needs of the IS/IT industry.

This study examines the current state of IS curriculum design and implementation, specifically focused on the identification of any current skills gap which exists from three perspectives (end-users, academia, and employers).

The end-user perspective is focused on what they believe to be the skills, technologies, and issues which are critically important in the marketplace. End-users were selected because it is our belief that they can provide feedback (or input) regarding the curriculum based on their real-world experience (new development, environmental changes, etc.) End-users' feedback can be one basis from which new course offerings are determined when schools cannot afford to offer all IS courses from the curriculum model.

The academic perspective examines curriculum models which have been developed for undergraduate IS programs. From the employer perspective, the focus is on what kinds of needs employers have indicated as being most important in terms of employment value and in fulfilling the needs of the marketplace.

Based on the results, a number of specific and practical recommendations about how universities can better meet the needs of the industry and employers will be presented. These recommendations include changes, guidelines, and suggestions which are designed to help reduce the current skills gap, and also to propose means by which university curriculums can stay abreast with rapid changes in technology and industry needs.

2. LITERATURE REVIEW

2.1 Skills Gap
The term skills gap has been identified by previous researchers, and can be defined as "the disparity between the quality and adequacy of skills possessed by IS graduates and required by the IS/IT industry." (Scott et al., 2002) As a result, there are fewer skilled workers than are needed to fill the demand (Sargeant, 1988; Leonard, 1999; Farwell Lee and Trauth, 1993). There have been a number of explanations and causes for this skills gap: one is that rapid changes in technology make it difficult for individuals to obtain the requisite level of experience in these before these skills become outdated, and the other is a mismatch between the academic perceptions of needs and requirements (curriculums) and industry skill requirements (Scott et al., 2002; Milton, 2000).
The importance of understanding what kinds of skills gap exist goes beyond how to better prepare individuals to enter the workforce. Many researchers have claimed that there are implications which go further, in terms of failed information systems in part due to the gaps in knowledge and

understanding which exist between end users and IT staff (Mann, 2002). This gap has been discussed as one factor which may contribute to system failures and unsuccessful information systems.

2.2 Issues and Technologies
Aside from IS courses, perceived importance of IS issues and technologies by IS practitioners are examined. There have been many studies of key IS issues which practitioners focus on in order to do their jobs more effectively (Kim, 1998; Kim and Kim, 1999; Brancheau et al., 1996). These studies identified the most critically important issues, and concluded that perceived critical issues change as the technologies change. In the study by Kim and Kim (1999), five new major issues which were not identified in earlier studies included software reengineering and maintenance, client/server computing, IS education/training, the Internet, and legal/ethical issues.

ITAA, Robert Half Technology, and CIO Magazine reported that networking, security, information architecture, enterprise systems, database development, and digital media as technologies with the greatest job growth in the IT industry (ITAA, 2004; Robert Half Technology, 2005; CIO.com, 2005). These reports help to identify which kinds of technologies are most important, and further enable us to make effective recommendations for enhancing IS curriculums.

2.3 IS Curriculums/Courses
Standardized IS curriculums were developed in order to educate students in the necessary skills and knowledge for the current IS/IT job market. Curriculum development for IS began in the early 1970s (Ashenhurst, 1972; Couger, 1973). One of the major models was the DPMA IS'90, and was based on a survey of information systems programs in approximately 1,000 colleges and universities in North America (Longenecker and Feinstein, 1991). This was then followed by the IS'97 model curriculum (Davis et al., 1997) which was a combined effort of ACM, AIS, and AITP. The IS'97 model was widely used, and experienced a wide degree of success. It had become the basis for IS accreditation. This curriculum model was then updated and released as the IS 2002 model (AITP, 2002, 1997). The IS 2002 model is comprised of 11 main courses (10 courses and 1 prerequisite). However, there have been issues relating to how closely these curriculum models (such as IS2002) are in line with the constant and fast changes in the IS/IT industry. More specifically, the question is whether the topics and subjects taught based on the models such as IS2002 are meeting needs of the industry (Lightfoot, 1999; Gambill and Maier, 1996; Ives, 1993).

3. METHOD

The objective of this study is to develop specific recommendations in order to build more effective IS programs that both keep pace with rapid changes in the IS environment, and better reflect industry needs. A survey of IS practitioners was conducted to understand: (1) the perceived importance of IS courses from the IS2002 model curriculum, (2) the perceived importance of information

technologies and software used for IS courses, and (3) the key IS issues for the near future.

Ten courses and one prerequisite course from the IS2002 model curriculum were included in the survey. In addition, various information technologies and software systems, from operating systems to project management software (that can be used in IS courses) were identified for the survey. In terms of IS/IT issues, survey participants were asked to list five that were considered to be critical and vital over the next three years to their organizations. Using this list of IS courses and technologies, the survey instrument was prepared and pre-tested with MBA IS concentration students, most of whom were full-time IS practitioners, together with several IS educators, in order to test its validity. Their responses and comments were subsequently used to modify the questionnaire.

The modified questionnaire was e-mailed to 230 employees at a company in the manufacturing industry located in the Northeastern United States. The firm has roughly 1400 employees, is privately held, and has multiple offices/facilities. Prospective respondents were asked to rate the perceived importance of each IS course and information technologies, using a five-point Likert-type scale (i.e., 1 for the least important and 5 for the most important), and to list five IS/IT issues that are perceived as critical in the field over the next three years. Also collected was demographic data on the respondents. 85 responses were received (28 from IS area and 57 from non-IS area), representing a response rate of 37 percent. However, 14 responses (1 from the IS area and 13 from the non-IS area) were not usable due to incomplete or improperly recorded information. The remaining 71 responses (27 from the IS area and 44 from the non-IS area) were used as the sample for this study, representing an effective response rate of 30.8 percent. The profiles of the survey participants are summarized in Table 1a and 1b.

4. FINDINGS AND DISCUSSION

4.1. Perceived Importance of IS Courses
The first part of the analysis focused on the perceived importance of courses from both the IS and non-IS groups in three different perspectives: overall perceived importance, groupings based on the perceived importance of courses, and differences in perceived importance between the IS group and the non-IS group. Survey participants were asked to rank the importance of IS 2002 courses using a 5-point Likert-type scale where 5 represented the greatest importance. Data was analyzed using SPSS for Windows version 12.0. Table 2 presents the perceived importance of IS 2002 courses by IS and Non-IS groups.

The results indicate that within each group, and overall, the three most important courses are IS2002.PO (Personal Productivity with IS Technology), IS2002.1 (Fundamentals of all groups, since PC-based software such as spreadsheets, word processing, and related tools are widely used and are considered important in the business world, by both IS and non-IS professionals. IS2002.1, which is an introductory course on Information Systems, also can be regarded as essential since information systems play an important role in

most businesses in the 21st century global economy.

	Number	
Position	IS Group	Non-IS Group
CIO IS	1	
IS Manager	11	
Systems Analyst/Designer	11	
Programmer	0	
Other	4	
Executive Management		4
Middle Management		20
Supervisory		6
Staff		14
Other		0
Totals	27	44

Table 1a: Profile: Employment - Positions

	Number	
Experience in IS	IS Group	Non-IS Group
Less than 1 Year	0	8
1-3 Years	2	8
4-5 Years	4	9
Over 5 Years	21	19
Totals	27	44

Table 1b: Profile: Years of Experience in IS

Of interest is the finding that IS2002.10 is ranked #1 by the IS group and #3 by the Non-IS group. It should be noted that Project Management has never been ranked high in previous studies on key IS issues (Niederman et al., 1991; Brancheau et al., 1996; Kim and Kim 1999), and in a study of 86 Master's of Science programs in IS, only 34% of IS programs offer any kind of project management course, which resulted in a ranking of 5th out of a total of 9 courses (Vijayaraman and Ramakrishna 2001).

University course offerings were researched using the AACSB database of accredited universities to find the most current information on the extent to which project management is being taught in accredited business school undergraduate programs. The criteria for our query consisted of all AACSB universities located in 12 states of the northeastern region of the United States. The universities were defined as all institutions accredited in business, and which offered only Bachelor-level degrees. We used the AACSB's Advanced Search Knowledge Services web page to obtain a list of all institutions which met our criteria. The search yielded 85 universities. MIS curriculums from these universities' websites were downloaded and analyzed. The results of our analysis are summarized in Table 3.

An analysis of the data shows that project management is required by fewer than 50% of the AACSB accredited schools studied. As a result of our survey findings, it seems that a valuable addition to MIS programs would be a project management course (as a required course). This is an example of a mismatch between IS course requirements and industry needs.

397

IS2002 Curriculum Courses	Overall Rank (Mean)		IS Group Rank (Mean)		Non-IS Group Rank (Mean)	
IS2002.P0 Personal Productivity with IS Technology	1	(4.07)	3	(3.78)	1	(4.25)
IS2002.1 Fundamentals of IS	2	(3.77)	2	(3.93)	2	(3.68)
IS2002.2 Electronic Business Strategy, Architecture and Design	4	(3.38)	5	(3.67)	4	(3.20)
IS2002.3 IS Theory and Practice	7	(3.10)	11	(3.07)	5	(3.14)
IS2002.4 IT Hardware and System Software	6	(3.27)	6	(3.52)	6	(3.11)
IS2002.5 Programming, Data, File and Object Structures	11	(2.65)	10	(3.19)	11	(2.32)
IS2002.6 Network and Telecommunications	9	(2.92)	7	(3.37)	9	(2.64)
IS2002.7 Analysis and Logical Design	5	(3.30)	4	(3.70)	7	(3.05)
IS2002.8 Physical Design Implementation with DBMS	8	(4.07)	7	(3.37)	8	(2.73)
IS2002.9 Physical Design and Implementation in Emerging Environments	10	(2.86)	9	(3.33)	10	(2.57)
IS2002.10 Project Management and Practice	3	(3.7)	1	(4.22)	3	(3.45)

Table 2: Perceived Importance of IS2002 Courses

In fact, in a recent IT staffing survey of IT executives (CIO 2005), project management was ranked #1 among non-technical skills and ranked #2 among technical skills in demand in IT organizations. Moreover, in a case study using the IS2002 model curriculum as a resource in curriculum revision (Dwyer and Knapp, 2004), student focus groups felt that project management was a needed course in the IS program. In support of this, project management has been given greater attention in the recent IS education research, as evidenced by papers which examine what is being taught in project management courses (Du, Johnson, and Keil, 2004) and the integration of project management component into the IS curriculum (Reif and Mitri, 2005).

If the eleven courses in the IS2002 model can be divided into categories which differed statistically based upon perceived importance, the results can be used as a guideline for schools to decide which courses should be considered first when they cannot offer the full eleven courses in their curriculum. Since the survey responses are ordinal, the Wilcoxon Signed Ranks test (for the first two courses) and the Friedman test (for three or more courses) were used to test for differences. Courses were added to a category sequentially in descending order by the means of their responses, one at a time and tested until the last course to be added resulted in a condition where it was not of equal importance to the remainder of the category. If this was the case, a new category was then created beginning with the course which produced the negative finding. Our findings as determined by the IS group are illustrated in Table 4.

Description	Number of Institutions	Percent
Project management course required	10	11.8
Project management course not required	45	52.9
No MIS major/concentration	17	20.0
No B.S. business program	6	7.1
Ambiguous information	7	8.2

Table 3: AACSB Institutions which Require Project Management for MIS Concentration/Major

Category I: Courses Rated as Having Higher Importance for IS Curriculums	Category II: Courses Rated as Having Lower Importance for IS Curriculums
Project Management Fundamentals of IS Personal Productivity with IS Technology Analysis and Logical Design Electronic Business Strategy, Architecture and Design	IT Hardware and System Software Network and Telecommunications Physical Design Implementation with DBMS Physical Design and Implementation Programming, Data File and Object Structures IS Theory and Practice

Table 4: Course Category Results from the IS Group

For schools that develop or modify course offerings for IS majors, the courses in Category I should be considered first. Courses in Category I indicate a tendency towards a mix of fundamental courses such as fundamentals of IS and personal productivity with IS technology, the most critical course s such as project management and systems development (analysis and logical design), and newer technology-related course such as e-business.

The courses in the second category are focused towards more technical and fundamental background courses. The results of the non-IS group are not as clear as those of the IS group. However, it should be noted that the non-IS group has a different perspective given their experience outside of the IS field. In general, personal productivity was certainly considered the most important course, given the fact that productivity software is used by end-users, regardless of their particular job function or industry. Fundamentals of IS, and Project Management formed the next group, which can be considered to be skills and concepts which are useful to end-users in many different industries. The remainder of the importance attributed to the group comprising programming, networking, and physical design.To determine whether perceived course importance between IS and non-IS groups were identical, the Mann-Whitney U test was used, where means were considered equal if Z had an absolute value less than 1.96. The results are summarized in Table 5.

The results show that the groups view the relative importance of the IS2002 courses quite differently. While 55% of the courses have the same relative importance between the groups, 45% show differences in the relative importance across the two groups. One interesting result is that only two of the three courses with the highest rankings in both groups were of equal importance between the groups. These two courses are Fundamentals of IS and Personal Productivity with IS Technology. Appropriately, they are required of all students in most business curriculums.

Project management is not viewed with equal importance between the groups. IS professionals ranked this course as the most important while non-IS professionals rank it third in importance, and their means are not the same. The groups' perception of importance differed most with course Programming, Data File and Object Structures. This finding makes sense when one considers that this course includes material which seems obscure to the non-IS professionals, but much more important and relevant to IS professionals.

4.2 Perceived Importance of IS/IT Technologies
The next important result is in evaluating the perceived importance of IS/IT technologies, which include various kinds of software and technology areas. The individual responses were classified into eight categories, which are presented together with the results in Table 6.

The results show that personal productivity software, together with desktop operating systems, top the list. This seems to be logical, since both of these are the most widely used technologies, whether someone is working in the IS/IT field, or not. This is followed by network management and operating systems (Novell Network, Windows 2000, etc.),

project management (MS Project, for example), and database software (MS Access, for example). These are also widely used software applications in business. The results also show that project management is somewhat less important for the non-IS group, and that networking and database management are clearly of greater importance to IS group respondents. The technology categories of internet/web development, programming languages, and systems analysis are clearly more specialized, and have importance to a smaller category of users, many of whom use these on a regular basis.

4.3 Analysis of Critical Issues
In previous work related to the development of IS/IT curriculum design, it was indicated that the role of critical issues is important in determining what courses to offer (Kim, 1998; Kim and Kim, 1999; Brancheau et al., 1996). Respondents were asked to list five IS/IT issues which they consider critical in the near future, and in relation to the needs of business IS curriculums. The responses were then collated and counted. The following table summarizes the results based on rankings by frequency. A total of 86 issues were listed by respondents as critical IS/IT issues for their organizations. Table 7 shows the ranks of the top 10 individual critical IS/IT issues, based on the number of frequencies listed by respondents. Security and disaster recovery was ranked #1, enterprise resource planning (ERP) and training were tied #2, quality (information) control was ranked #5. The ubiquitous presence of information systems in our networked environment increases the importance of the security and disaster recovery issue, which is reflected and ranked #1 in this survey. Anderson and Schwager (2002) found that security was an important emerging issue, and identified certain IS security issues which should be emphasized. More recently, according to a 2004 survey by the Information Technology Association of America (ITAA), information security is the area with the greatest IT job growth potential over the next three to five years.

Compared with previous studies on key IS issues, the ERP issue is ranked highly, reflecting recent trends in software systems which are designed to bring about significant business benefits from the effects of integration across business functions and units. The IS education and training issue was not ranked highly in previous studies, but has a rather high ranking, #2, in this survey. This result shows that the importance of end user computing and training is growing. Recent surveys by CIO magazine (CIO, 2005) and Robert Half Technology (roberthalftechnology.com, 2004) also show the importance of end user support and training.

As a further analysis, these 86 issues were grouped into categories derived from key IS issues used in previous studies (Niederman et al., 1991; Brancheau et al., 1996; Kim and Kim 1999), which resulted in 17 grouped IS/IT issues. Table 8 shows the rankings of 17 grouped critical IS/IT issues based on respondents' listing frequencies.

Of the grouped listing of issues, it is interesting to note that effective IS development is #1 and that managing end-user computing is ranked #4. In recent literature, the importance of soft skills (communication and interpersonal) for both IS development and training/user support has been emphasized

Course	Mann-Whitney U	Z	Asymp. Sig. (2-tailed)	Means Equal?	IS Professionals	Non-IS Professionals	DIFF
IS2002.3 IS Theory and Practice	567.0	-0.33	0.74	Yes	3.07	3.14	-0.06
IS2002.1 Fundamentals of IS	519.5	-0.93	0.35	Yes	3.93	3.68	0.24
IS2002.4 IT Hardware and System Software	510.0	-1.03	0.30	Yes	3.52	3.11	0.40
IS2002.2 Electronic Business Strategy, Architecture and Design	481.5	-1.39	0.16	Yes	3.67	3.20	0.46
IS2002.P0 Personal Productivity with IS Technology	447.5	-1.85	0.06	Yes	3.78	4.25	-0.47
IS2002.8 Physical Design Implementation with DBMS	437.0	-1.96	0.05	Yes	3.37	2.73	0.64
IS2002.7 Analysis and Logical Design	418.5	-2.16	0.03	No	3.70	3.05	0.66
IS2002.10 Project Management and Practice	412.5	-2.27	0.02	No	4.22	3.45	0.77
IS2002.6 Network and Telecommunications	408.0	-2.28	0.02	No	3.37	2.64	0.73
IS2002.9 Physical Design and Implementation in Emerging Environments	382.5	-2.60	0.01	No	3.33	2.57	0.77
IS2002.5 Programming, Data, File and Object Structures	367.5	-2.76	0.01	No	3.19	2.32	0.87

Table 5: Equality of Course Importance between Groups - Mann-Whitney U Test

Technology	IS Group	Non-IS Group	Combined
Personal Productivity	4.16	3.96	4.06
Desktop O.S.	3.83	3.89	3.86
Network Management & O.S.	2.19	1.30	1.74
Project Management	2.15	0.93	1.54
Database	2.05	1.03	1.54
Internet/ Web development	1.73	0.90	1.32
Programming Languages	1.58	0.64	1.11
Systems Analysis	0.83	0.11	0.47

Table 6: Perceived importance of IT and software

and given attention. While the possession of "hard" technical and technology skills is definitely a needed component in these two areas, it has been recognized that soft skills also play a very important role (Litecky, Arnett, and Prabhakar, 2004; Miller and Luse, 2004; Crews and McCannon, 2000; Wilkins and Noll, 2000). More specifically, the needed soft skills included coherent writing, ability to ask appropriate questions, effective oral communications skills, and collaborative teamwork skills (Miller and Luse, 2004).

5. LIMITATIONS

It would be useful to note several limitations of our survey

and its analysis. First, it should be noted that all of the respondents were from one manufacturing company with multiple locations in the Northeastern United States. This may limit the generalizability of the results for both industry and geographic region. One future research area is to extend this study by including other geographic regions and different industries with more respondents.

Individual Critical IS/IT Issue	Rank(Frequency)
Security and disaster recovery	1(27)
ERP	2(12)
Training	2(12)
Quality assurance/control	4(11)
Document (information) control	5(9)
Project management	6(6)
Validation	7(5)
Database Management	8(4)
Application integration	8(4)
Productivity	8(4)

Table 7. Top 10 Individual Critical IS/IT Issues

Second, we studied schools and programs located in the same geographical region as survey respondents. AACSB schools were used to ensure that data were collected from IS programs with acceptable levels of quality and consistency. It is acknowledged that a study of non-AACSB accredited

schools may yield interesting results and insights. Non-AACSB schools may offer a greater range of IS courses, especially when considering programs from a school or college of Information Systems/Technology. A study of these schools and programs may be a worthwhile area for future research, either on their own, or as a comparison with AACSB accredited institutions.

Finally, this study focused on undergraduate IS programs. This restriction is imposed because of the scope of our research study. Future research may be extended to graduate IS programs.

5. CONCLUSIONS

This study has examined current IS curriculum needs and skills gaps from the perspective of end-users, academia, and employers through a survey of end-users, IS curriculum models, and reports by employers. There are some important findings in this study. First, there is a clear need for project management course in IS curriculums. While this course is part of the IS 2002 curriculum model, it appears that many universities have not yet implemented this course in their programs. It is recommended to consider this course first when schools consider changes in their course offerings. In connection with this, universities may want to explore courses which provide some preparation or background for one of the project management certifications, such as that offered by the PMI (Project Management Institute).

Second, as a result of our further analysis using the Wilcoxon Signed Ranks test and the Friedman test based on the IS group survey rankings, eleven courses in the IS2002 curriculum model were divided into two groups. Courses in the first group represent topics of greater importance and current relevance, and they are Project Management, E-business, Personal Productivity, System Analysis/Design, and the Fundamentals of IS. For schools that are developing or modifying their course offerings for IS majors, these courses should be considered first to reflect industry needs.

Third, newer technologies which could include project management software and Internet/web development languages and technologies, were not perceived to be important by either group (IS and non-IS). It appears that the focus is currently on more established and functional technologies such as personal productivity software, networking, and desktop operating systems. Our study results reflect industry trends. For instance, according to the Information Technology Association of America (ITAA) annual workforce development survey (ITAA, 2004), technical support and network systems design and administration saw the largest increase in jobs.

Fourth, security, ERP, training (end user computing), and quality assurance are ranked as the top four critical issues according to our survey. At this time, there are no separate courses to deal with these issues in the curriculum model. To reduce the gap between course offerings and industry needs, it is necessary to consider courses that focus on security, ERP, end user computing, and quality assurance.

For the effective implementation of IS curriculums, it is essential to have continuous feedback from academia, employers, and end-users. The results of these findings can help universities to improve and update their IS curriculums, create better-trained IS students for the competitive job market, and enable firms and recruiters to effectively hire staff with current, up-to-date skills.

6. REFERENCES

Anderson, J.E. and Schwager, P.B. (2002). "Security in the Information Systems Curriculum," Journal of Computer Information Systems, Spring, 16-24.

Ashenhurst R.L., ed. (1972). A Report of the ACM Curriculum Committee on Computer Education for Management. ACM, 1972.

Association of Information Technology Professionals. (2002) IS 2002: Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems. Association of Information Technology Professionals.

Association of Information Technology Professionals. (1997) IS'97: Model Curriculum and Guidelines for Undergraduate Degree Programs in Information Systems. Association of Information Technology Professionals.

Brancheau, J.C. and Wetherbe, J.C. (1996). "Key Issues in Information Systems Management," MIS Quarterly, 20(2), 225-242.

CIO.com. (2005). January 2005 IT Staffing Update. Accessed (online) on January 31, 2005 from http://www2.cio.com/research/surveyreport.cfm?id=83,.

Couger, J. (1973) "Curriculum Recommendations for Undergraduate Programs in Information Systems," Communications of the ACM, 16, 2, Dec. 1973, p. 727-749.

Crews, T.B. and McCannon, M. (2000) "Comparison of Communications Skills Needed by Information Systems Undergraduates and Graduates as perceived by Information Systems Professionals," Journal of Information Systems Education, 11(3-4), 2000.

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

Dibbern, J., Goles, T., Hirscheim, R., Jayatilaca, B. (2004). "Information Systems Outsourcing: A Survey and Analysis of the Literature, " *The DATA BASE for Advances in Information Systems*, 35, 4, Fall, 6-102.

Du, S. M., Johnson, RD, & Keil, M. (2004). "Project Management Courses in IS Graduate. Programs: What is being taught?" Journal of Information Systems Education," 15, 2.

Dwyer, C. and Knapp, C.A. (2004). "How Useful is IS 2002? A Case Study Applying the Model Curriculum," Journal of Information Systems Education," 15, 4, 2004.

Farwell, D. Lee, D. and Trauth, E. (1993). "The IS Expectation Gap: Industry Expectation versus Industry Preparation," MIS Quarterly, 17, 3.

Frauenheim, E. (2005). "Tech Jobs Rise on East Coast," *CNET News .com*, June 23, 2005.

Gambill, S. and Maier, J. (1996). "CIS/MIS Curriculums in AACBS-accredited colleges of business," Journal of

Education for Business, 71, 6.

ITAA- Information Technology Association of America. (2004). Adding Value...Growing Careers: The Employment Outlook in Today's Increasingly Competitive IT Job Market, September 2004.

Ives, B. (1993). "Educating Tomorrow's Business Leaders About Information and Information Technology," MIS Quarterly, 17, 3, 27-34.

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

Kim, Yongbeom, and Kim, Youngjin, (1999). "Critical IS Issues in the Network Era," Information Resources Management Journal, 12, 4, 14-23.

Lee, J., Huynh, M., Kwok, R., and Pi, S. (2003)."IT Outsourcing Evolution- Past Present and Future," Communications of the ACM, 46,5, 84-89.

Leonard, L. (1999). "Survey Shows Skills Gap Still a Problem." Information Technology Association of Canada (online), accessed at http://www.itac.ca.

Lightfoot, J. (1999). "Fads versus Fundamentals: The Dilemma for Information Systems Curriculum Design," Journal of Education for Business, September/October 1999, pp. 43-49.

Litecky, C., Arnett, K. and Prabhakar, B. (2004). "The Paradox of Soft versus Hard Skills in IT Hiring Decisions," Journal of Computer Information Systems, 45,1, Fall , 65-77.

Longenecker, H.E. and Feinstein, D.L. (1991). "On Establishing Excellence in Information Systems." Journal of Information Systems Education, 3,1, Spring 1991, 26-31.

Mann, J. (2002). "IT Education's Failure to Deliver Successful Information Systems: Now is the Time to Address the IT-User Gap," Journal of Information Technology Education, 1,4, 2002.

Miller, R.A. and Luse, D.W. (2004). "Advancing the IS Curricula: The Identification of Important Communications Skills Needed by IS Staff During Systems Development," Journal of Information Technology Education, 3, 2004, 117-131.

Milton, T. (2000). "Cross training the answer to e-commerce staff shortages." Computer weekly (electronic). Accessed at Reed Elesevier Business Publishing, 17 February 2005, at http://www.cw360.com/.

Niederman, F. Brancheau, J.C., and Wetherbe, J.C. (1991). "Information Systems Management Issues for the 1990s," MIS Quarterly, 17(4):475-500.

Reif, H. , Mitri, M. (2005). "How university professors teach project management for information systems," Communications of the ACM, 48 (8): 134-136.

Robert Half Technologies (2005). "Safety First." Accessed Online, www.roberthalftechnology.com, February 25, 2005.

Sargeant, T. (1988). "The Systems Developer—Is there a Future?" Accessed from IT Web Limited (online). 9/1. http://www.itweb.co.za/sections/techforum/1998/9809011256.asp.

Scott, E., Alger, R., Pequeno, S., and Sessions, N. (2002) "The Skills Gap as Observed between IS Graduates and the System Development Industry- A South African

Experience." Proceedings of the IS2002 Conference, Informing Science, 1403-1411.

Vijayaraman, B.S. and Ramakrishna, H.V. (2001). "Masters of Science Programs in Information Systems: Match Between the Model Curriculum and Existing Programs," Journal of Information Systems Education, 12, 1, 23-30.

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

AUTHOR BIOGRAPHIES

Yongbeom Kim is an Associate Professor of Information Systems at Fairleigh Dickinson University. He received his B.S. and M.S. in electrical engineering from Seoul National University, and M. Phil and Ph.D. in information systems from the Stern School of Business of New York University. His research interests include performance evaluation of interactive computer systems, enterprise resource planning, and IS education. His work has been published in the Journal of Management Information Systems, Information Processing & Management, Information Resources Management Journal, Business Process Management Journal, and Journal of Information Systems Education.

Jeffrey Hsu is an Assistant Professor of Information Systems at the Silberman College of Business, Fairleigh Dickinson University. He is the author of numerous papers, chapters, and books, and has previous business experience in the software, telecommunications, and financial industries. His research interests include human-computer interaction, e-commerce, distance learning, IS education, and business intelligence. Dr. Hsu received degrees including a Ph.D. from Rutgers University in Information Systems, an MBA from Rutgers, and a M.S. in Computer Science from the New Jersey Institute of Technology.

Mel Stern is a Lecturer at the Silberman College of Business, Fairleigh Dickinson University. He teaches graduate and undergraduate courses in Management Information Systems and Operations Management. His previous industry experience has been in the insurance and manufacturing industries. His research interests include IS education, Internet applications for manufacturing systems, and mass customization. He received a M.S. in Industrial Engineering from New York University.

**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.