

IS/IT Knowledge/Skill sets required by IS/IT Practitioners : findings from Korea

WonHyun Kyung*, SeokHa Koh**

* Department off MIS, Chungbuk National University, space92@cbnu.ac.kr

** Department off MIS, Chungbuk National University, shkoh@cbnu.ac.kr

Abstract – It will not be impossible to develop an Information Systems and Information Technologies (IS/IT) program and a curriculum that represents the true needs of the IS/IT industry until IS/IT educator, reduce the gap perception and IS/IT practitioner's perception of IS/IT knowledge and technical skills that the industry might need. This paper represents and analysis of perceptions about IS/IT knowledge and skills that IS/IT practitioners might consider important. This study is based in Korean. The findings give us a very important lesson for IS/IT academicians that their understanding about the required knowledge and skills for the IS/IT career is not in line with that of IS/IT industry. Classifies the critical knowledge/skill set according to content or domain of knowledge by means of a survey. This is conducted in accordance with what IS/IT practitioners and educators can easily relate. The survey uses this approach and includes four broad categories of critical information Systems and Information technologies (IS/IT) knowledge/skills: IS/IT technology knowledge/skills, organizational and societal knowledge/skills, interpersonal knowledge/skills, and personal trait knowledge/skills.

Keywords: Information Technology, Information System, Curriculum, IS/IT Curricular, MIS

1 Introduction

Recently, Information Systems and Information Technologies (IS/IT) practitioners are experiencing rapid changes in the technologies they use and the business environment in which they are work. These changes are being experienced both in the business environment in which they are working, and in the technologies that they are using. In the past, many IS/IT practitioners chose a single career path as a programmer, analyst, project manager, or IS manager. Now there is a new reality in which there is a wide range of IS career paths [11,15]. The joint committee from ACM (Association for Computing Machinery), DPMA (Data Processing Management Association), ICIS (International Conference on Information Systems) and AIS Association of Information Systems) recommended a “unified” undergraduate Computer Curricular in 2001.

This study can be used as a complement to the aforementioned study to continuously improve the academic curriculum. A curriculum usually includes the

information, such as how many hours should be allocated to various knowledge and skills categories.

Many researchers report a gap between the relative importance of the categories rated by industry and the proportion of the hours provided for the categories by IS/IT curricula[1-11,13-16] Almost all of the researchers regard the curriculum gap as a proof of failure of formal education. They imply that academy failed to provide what was demanded by customers (customers are absolutely right!) and that IS/IT curricula must be redesigned to provide various knowledge and skills in proportion to the quantity demanded by customers.

The curriculum gap by itself, however, may not be an indication of failure. That is, it may be desirable for IS programs not to allocate credits to various knowledge and skills according to their importance alone. This research will investigate what criteria, along with what level of importance should be placed on each criterion, must be considered and how they can be incorporated into curriculum design. In addition, the authors will investigate

the possibility of customizing IS/IT curricula for various IS/IT career paths.

2 Classification of IS/IT Knowledge Skills

In order to develop the necessary question items for our survey instrument, a literature review was conducted both in academics' and practitioners' publications.

The ACM curriculum planning recommendations on IS education were developed over decades based on a taxonomy of knowledge contents classified according to IS technology, IS process, and AACSB common body of knowledge (on Business Management). However, there is no generally accepted classification of IS/IT knowledge/skills nor is there consensus on which knowledge/skills are the critical ones and some are more important than others in the IS profession.

In publishing ACM's curriculum guidelines for a master's level program in information systems development, Ashenurst [1] identified 37 skills and abilities that students in a graduate MIS program should expect to acquire into six categories: people, models, systems, computers, organizations, and society. Todd et al. [14] classified IS knowledge into seven categories: hardware, software, business, management, social, and problem solving, and development methodology. They reasoned that interpersonal/managerial skills are the most important to IS managers. They found that communication and business skills become increasingly important to programmers and system analysts though technical skills are still the most important for programmers.

Nelson [13] classified 30 items into six groups: organizational knowledge, organizational skills, organizational unit, general IS knowledge, technical skills, and IS product. Organizational knowledge and organizational unit groups denote the knowledge related to the specific organization for which an IS practitioner works. Organizational skills denote general skills required working in a team and they imply interpersonal

communication, interpersonal behavior, group dynamics, and project management. He found that IS personnel were deficient in general IS knowledge followed by organizational knowledge, technical skills, organizational skills, IS product, and organizational units (in that order), while end-users were generally feeling deficient in IS knowledge. Lee et al. [11] classified three abilities: ability to learn new technologies, ability to focus on technology as a means (not an end), and ability to understand technological trends into technology management knowledge and other technology related knowledge into technical specialized knowledge. They classified non-technology-related knowledge into business functional knowledge and interpersonal and management skills, letting interpersonal and management skills contain some personal traits; for example, an ability to deal with ambiguity and to be sensitive to self-directed and proactive. They also included the ability to teach others interpersonal and management skills.

They found that non-technological knowledge is more important than technical skills. They also found that university curricula lag in updating critical new technologies such as networks and telecommunications and that IS/IT graduate require more breadth and depth of education across the dimensions of technology, business, and human relations. Table 1 shows the various authors' classifications. The lack of a common classification taxonomy and terminology made the job of constructing our survey instrument difficult and the authors had to rely on sampling question items from several sources and as well as on the authors' own knowledge.

3 Purpose of this study

The purpose of this survey is to classify the critical knowledge/skill set according to content or domain of knowledge to which IS/IT practitioners and educators can easily relate. Using this approach, four broad categories of critical IS knowledge/skills are included in this survey. These four categories include:

1 IS technology knowledge/skills. The basic knowledge/skills considered in this category can be grouped into three subgroups: IS technology, IS management, and IS development methodology. Factors considered in the first subgroup include hardware-related, packaged products, operating systems, networking/

Table I. Classifications of IS/IT abilities/knowledge/skills

Authors	Categoriis
Ashenhurst [1]	People, models, systems, computers, organizations, society
Couger et al. [4]	Communication, computer applications systems, information technology and tools, interpersonal relationships, management, problem solving, development methodologies, system theory and concepts. Professionalism
Koh et al. [5-10]	IS/IT Knowledge/skills set (19~21 items), IS/IT technology/skills set (24~29 items)
Lee et al. [11]	Business functional knowledge, interpersonal and management skills, technology management knowledge, technical specialty knowledge
Leitheiser [12]	(developer skills) interpersonal, analysis & design, programming, business, environment, programming language, specific application, database and data communication, software, hardware, advanced applications
Nelson [13]	Organizational knowledge, organizational skills, organizational unit, general IS knowledge, technical skills, IS product
Todd et al. [14]	Hardware, software, business, management, social, problem solving, development methodology
Young & Lee [16]	Interpersonal skills, programming languages, development & management of applications, operating systems, network and communications, personal computer tools

communications software, and programming languages. IT vision/ strategy and related technological trends are the important considerations in the second subgroup. Finally, the last subgroup mainly deals with the issues such as specific analysis, design, development, and implementation methodologies/approaches.

2 *Organizational and societal knowledge/skills.* The considered knowledge/skills of this category are those associated with specific functional areas, specific organizations, specific industries and accompany 's general operating environment.

3 *Interpersonal knowledge/skills.* The required knowledge/skills included in this category are: interpersonal behavior skills, interpersonal communication capability, international communication capability, and related teaching/training skills.

4 Survey Process

The data were collected from IS/IT practitioners at two times (November 2004 and May-June 2005). Following two pilot tests of the questionnaire, the survey instrument was mailed and submitted to cheong-ju city IS/IT practitioners. A follow-up mailing was made to non-respondents. Recipients were assured that all data were confidential and that aggregate results were to be reported. And then we visited chung-buk region's IS/IT practitioners and capital region's IS/IT practitioners. A total of 315 questionnaires were gathered after visiting. Excluding two invalid questionnaires, total of 313 records were used for the analysis. See Table II for more detail.

Table II. Demographics of IS/IT practitioners

	Percentage
Number of percentage of employees information	
Number of employees	
under 5	24.4
6 - 10	28.9
11 - 20	13.3
21 - 50	31.4
51 - 100	0.6
Rank of respondents and Percentage information	
Ranks of respondents	
staff	33.7
Assistant manager	35.6
Manager	18.1
General manager/Deputy General manager	7.6
Director and Over	1.3
Length of respondent's service and percentage	
Length of respondent's service	
Under 1 year	10.8
1 - 3	22.5
4 - 5	24.8
6 - 10	24.8
11 - 20	13.3
21 - 30 and over	3.2
Types of Jobs and percentage information	
Types of job (multiple entries allowed)	
operator	8.9
System programmer	28.7
System analyst	18.2
Network manager	13.7
e-business software/tool manager/operator	17.2
End user supporter	18.5
Consultant	13.4
Other is/it specialist	29.0

Table III. Summary of required Knowledge/skills : Ranking

	N	Mean	Ranking
Creative thinking (involve analysis, evaluation and reasoning)	309	3.90	1
Critical thinking (involve analysis, evaluation and reasoning)	310	3.80	2
Interpersonal communication skills (oral and written)	308	3.78	3
Interpersonal behavior skills	307	3.74	4
Personal motivation and working independently	308	3.68	5
Operating system	309	3.62	6
Programming languages	308	3.61	7
Knowledge of Database and Data Warehouse	307	3.53	8
IS/IT technological trends	309	3.50	9
Networking/communication/security software and languages	309	3.49	10
Hardware	309	3.37	11
Visions about IS/IT for competitive advantage	307	3.34	12
Packaged products (spreadsheet, word processing, etc)	308	3.25	13
International communication ability (foreign languages and cultures)	309	3.16	14
Implementation, operation, and maintenance issue(documentation etc.)	308	3.10	15
Knowledge of specific organizations (your own company, your host company, etc)	307	3.05	16
SDLC (Software Development Life Cycle) methodologies	308	3.02	17
Knowledge of specific functional areas (finance, marketing, production, etc)	308	2.87	18
Knowledge of Application Program (ERP, SCM, MRP tools)	307	2.86	19
Environment (economic, legal, etc)	307	2.71	20
Knowledge of specific industries (retail, automobile, textile, etc)	307	2.23	21

5 Data analysis

This manuscript starts with performing the analysis by ranking all of the factors in the data result collected. As a result, the readers can clearly learn the different importance of all the factors in terms of the aforementioned four areas, ‘the required knowledge/skills’, ‘the possessed knowledge/skills’, ‘the required technology/skills’, and ‘the possessed technology/skills’.

As shown in Table III (required knowledge/skills), the top five required skills in ascending ranked order are creative thinking(1), critical thinking(2), interpersonal communication skills(3), interpersonal behavior skills(4), personal motivation and working independently(5).

It is interesting to notice that the five least required knowledge skills are knowledge of specific industries(21), environment(20), knowledge of application program(19), knowledge of specific functional areas(18), SDLC methodologies(17). This finding clearly matches with current educational trends and curricular needs.

The industries are always looking for the future employee with strong interpersonal skills, better oral and written communication capabilities, critical and creative thinking capabilities, and a pleasant personality or working attitude.

Still, in the IS/IT field, strong technical knowledge such as data communications, computing architecture and hardware, and programming languages are not the major requirements, even though the current technology trend is moving toward a better global networking society.

Further, international communication capability and knowledge of general operating environment are still not receiving sufficient attention in the IS field compared with other functional disciplines such as marketing and management.

By further examining the ranking for the information presented in Table IV (possessed knowledge/skills), the top five possessed knowledge/skills listed in sequence include the following, ‘Interpersonal behavior skills’, ‘packaged products’, ‘operating system’, ‘creative thinking’.

This additional information vividly speaks of the importance of certain knowledge/skills about the popular software products and application packages, which IS practitioners need in order to perform related tasks/functions.

Now, attention will be placed on the data set of required and possessed technology/skills. Tables V and VI are provided respectively for further analysis. The five most critically required technology/skills, as presented in Table

Table IV. Summary of possessed knowledge/skills : Ranking

	N	Mean	Ranking
Interpersonal behavior skills	308	3.28	1
Packaged products (spreadsheet, word processing, etc)	309	3.21	2
Operating system	309	3.18	3
Creative thinking (involve analysis, evaluation and reasoning)	310	3.18	4
Interpersonal communication skills (oral and written)	309	3.14	5
Personal motivation and working independently	309	3.13	6
Critical thinking (involve analysis, evaluation and reasoning)	310	3.13	7
Programming languages	308	3.05	8
Hardware	309	3.02	9
Networking/communication/security software and languages	309	2.86	10
Knowledge of Database and Data Warehouse	307	2.85	11
IS/IT technological trends	310	2.68	12
Visions about IS/IT for competitive advantage	309	2.58	13
Knowledge of specific organizations (your own company, your host company, etc)	308	2.54	14
Implementation, operation, and maintenance issue(documentation etc.)	309	2.48	15
Knowledge of Application Program (ERP, SCM, MRP tools)	308	2.44	16
SDLC (Systems Development Life Cycle) methodologies	306	2.43	17
International communication ability (foreign languages and cultures)	309	2.37	18
Knowledge of specific functional areas (finance, marketing, production, etc)	308	2.32	19
Environment (economic, legal, etc)	308	2.22	20
Knowledge of specific industries (retail, automobile, textile, etc)	308	1.92	21

Table V. Summary of required technology/skill sets : Ranking

	N	Mean	Rank
PC Operating systems (WIN98, WINXP, win2000, etc.)	309	3.72	1
Client-server based database tools (MSSQL, Oracle, etc.)	308	3.61	2
Presentation graphics tools (Power point)	309	3.57	3
Database Query languages (SQL)	308	3.49	4
Word processing tools (Ms word)	309	3.41	5
Internet/navigation browser(IE Explorer, Navigator, etc)	305	3.41	6
Spreadsheet tools (MS EXCEL, Lotus, etc.)	309	3.35	7
Mark-up languages (HTML, XML, etc.)	310	3.15	8
Electronic mail tools (outlook express, Lotus notes, etc.)	309	3.11	9
Server-mainframe operating system (Sun Solaris, AIX, Linux, etc.)	307	3.04	10
Dynamic web page production tools (JSP, ASP, PHP, etc)	308	3.03	11
Object oriented programming languages (C++, JAVA, etc)	307	3.01	12
e-business software tools (ERP, SCM, CRM, etc.)	305	2.99	13
Software project/configuration management tools(MS project 2000)	307	2.77	14
High level procedural languages (C, Pascal, Cobol, etc.)	308	2.72	15
PC based database tools (MS Access)	308	2.63	16
Data warehouse/mart tools	306	2.56	17
CASE/structured programming tools (ER-win, together, etc)	306	2.48	18
Multimedia/graphic production tools (Photoshop, Flash, etc.)	309	2.46	19
Software modeling languages (UML)	307	2.43	20
Telecommunication tools (WAP, Bluetooth, etc.)	306	2.16	21
Statistics tools (SAS, SPSS, Minitab, etc.)	305	2.05	22
Expert systems/shells	306	2.03	23
Simulation/optimization tools (Stella, Lingo, etc.)	305	1.77	24

Table VI. Summay of possessed technology/skill sets : Ranking

	N	Mean	Rank
PC Operating systems (WIN98, WINXP, win2000, etc.)	310	3.64	1
Internet/navigation browser(IEplorer, Navigator, etc)	306	3.49	2
Word processing tools (Ms word)	310	3.47	3
Presentation graphics tools (Powerpoint)	310	3.35	4
Spreadsheet tools (MS EXCEL, Lotus, etc.)	310	3.24	5
Electronic mail tools (outlook express, Lotus notes, etc.)	310	3.15	6
Database Query languages (SQL.)	308	3.02	7
Client-server based database tools(MSSQL, Oracle, etc.)	309	2.98	8
Mark-up languages (HTML, XML, etc.)	308	2.91	9
Dynamic web page production tools (JSP, ASP, PHP, etc)	307	2.63	10
Server-mainframe operating system (Sun Solaris, AIX, Linux, etc.)	308	2.57	11
Object oriented programming languages (C++, JAVA, etc)	309	2.51	12
PC based database tools (MS Access)	309	2.45	13
High level procedural languages (C, Pascal, Cobol, etc.)	308	2.44	14
e-Business software tools (ERP, SCM, CRM, etc.)	306	2.37	15
Multimedia/graphic production tools (Photoshop, Flash, etc.)	307	2.25	16
Software project/configuration management tools(MS project 2000)	306	2.14	17
CASE/structured programming tools (ER-win, together, etc)	304	2.01	18
Data warehouse/mart tools	306	1.98	19
Software modeling languages (UML)	306	1.89	20
Telecommunication tools (WAP, Bluetooth, etc.)	305	1.75	21
Expert systems/shells	305	1.63	22
Statistics tools (SAS, SPSS, Minitab, etc.)	305	1.60	23
Simulation/optimization tools (Stella, Lingo, etc.)	304	1.42	24

V, are ‘PC operating systems’, ‘client-server based database tools’, ‘presentation graphics tools’, ‘database query languages’, ‘ word processing tools’.

Clearly, the most important technology/skills required in today’s environment are closely connected with IS/IT practitioner’s Job environment and tools. In general, the aforementioned five technology/tools are all designed to improve productivity and enhance better communication and coordination, which will improve organizational efficiency and effectiveness. It is also interesting to note that three tools (word processing, spreadsheet manipulation, and graphics presentation) are actually supported by the Microsoft office product.

Five required technology/tools in the order of least importance are simulation/optimization tools(24), expert systems/shells(23), statistics tools(22), telecommunication tools (21), software modeling languages(20).

In terms of possessed technology/skills set (Table VI), the five most important ones are PC operating system(10) internet/navigation browser(2), word processing tools(3), presentation graphics tools(4), spreadsheet tools(5).

The possessed technology/tools set which complete the bottom five rankings are the same as the bottom of required technology/skills set.

Obviously, software modeling languages, software project/configuration management tools, Expert System tools, tend to be less focused in today’s environment.

6 Data Comparisons

A comparative analysis between the required vs. possessed knowledge/skills and technology/skills set will be useful in identifying some additional insights from this survey. As shown in Table VII, VIII, it is interesting to notice the following findings:

- **Higher possessed mean compared with required mean.**

Table VII shows that all IS/IT practitioners required more Knowledge/Skills than they possessed

Table VII. Summary of Knowledge/skills : required vs. possessed

	Required		Possessed		Diff.
	Mean	Rank	Mean	Rank	PO-RE
Packaged products	3.25	13	3.21	2	-0.04
Knowledge of specific industries	2.23	21	1.92	21	-0.31
Hardware	3.37	11	3.02	9	-0.35
Knowledge of Application Program	2.86	19	2.44	16	-0.42
Operating system	3.62	6	3.18	3	-0.44
Interpersonal behavior skills	3.74	4	3.28	1	-0.46
Environment	2.71	20	2.22	20	-0.49
Knowledge of specific organizations	3.05	16	2.54	14	-0.51
Knowledge of specific functional areas	2.87	18	2.32	19	-0.55
Personal motivation and working independently	3.68	5	3.13	6	-0.55
Programming languages	3.61	7	3.05	8	-0.56
SDLC (Software Development Life Cycle) methodologies	3.02	17	2.43	17	-0.59
Implementation, operation, and maintenance issue	3.10	15	2.48	15	-0.62
Networking/communication/security software and languages	3.49	10	2.86	10	-0.63
Interpersonal communication skills	3.78	3	3.14	5	-0.64
Critical thinking	3.80	2	3.13	7	-0.67
Knowledge of Database and Data Warehouse	3.53	8	2.85	11	-0.68
Creative thinking	3.90	1	3.18	4	-0.72
Visions about IS/IT for competitive advantage	3.34	12	2.58	13	-0.76
International communication ability	3.16	14	2.37	18	-0.79
IS/IT technological trends	3.50	9	2.68	12	-0.82

■ *Higher required mean compared with possessed mean.*

The following knowledge/skills that have a higher required value than possessed mean value include: IS/IT technological trends, international communication ability, visions about IS/IT for competitive advantage, Creative thinking, knowledge of Database and Data warehouse.

These technology/skills data sets which fall into this group include internet/navigation browser, word processing tools, electronic mail tools.

■ *Higher required mean compared with possessed mean.*

Surprisingly enough, most of technology/skills, which belong to this category.

■ *Higher possessed mean compared with required mean.*

Table VIII. Summary of Technology/Skills : required vs. possessed

	Required		Possessed		Diff.
	Mean	Rank	Mean	Rank	PO-RE
Internet/navigation browser(Explorer, Navigator, etc)	3.41	6	3.49	2	0.08
Word processing tools (Ms word)	3.41	5	3.47	3	0.06
Electronic mail tools (outlook express, Lotus notes, etc.)	3.11	9	3.15	6	0.04
PC Operating systems (WIN98, WINXP, win2000, etc.)	3.72	1	3.64	1	-0.08
Spreadsheet tools (MS EXCEL, Lotus, etc.)	3.35	7	3.24	5	-0.11
PC based database tools (MS Access)	2.63	16	2.45	13	-0.18
Multimedia/graphic production tools (Photoshop, Flash, etc.)	2.46	19	2.25	16	-0.21
Presentation graphics tools (Powerpoint)	3.57	3	3.35	4	-0.22
Mark-up languages (HTML, XML, etc.)	3.15	8	2.91	9	-0.24
High level procedural languages (C, Pascal, Cobol, etc.)	2.72	15	2.44	14	-0.28
Simulation/optimization tools (Stella, Lingo, etc.)	1.77	24	1.42	24	-0.35
Expert systems/shells	2.03	23	1.63	22	-0.40
Dynamic web page production tools (JSP, ASP, PHP, etc)	3.03	11	2.63	10	-0.40
Telecommunication tools (WAP, Bluetooth, etc.)	2.16	21	1.75	21	-0.41
Statistics tools (SAS, SPSS, Minitab, etc.)	2.05	22	1.60	23	-0.45
Database Query languages (SQL)	3.49	4	3.02	7	-0.47
Server-mainframe operating system (Sun Solaris, AIX, Linux, etc.)	3.04	10	2.57	11	-0.47
CASE/structured programming tools (ER-win, together, etc)	2.48	18	2.01	18	-0.47
Object oriented programming languages (C++, JAVA, etc)	3.01	12	2.51	12	-0.50
Software modeling languages (UML)	2.43	20	1.89	20	-0.54
Data warehouse/mart tools	2.56	17	1.98	19	-0.58
e-business software tools (ERP, SCM, CRM, etc.)	2.99	13	2.37	15	-0.62
Software project/configuration management tools(MS project 2000)	2.77	14	2.14	17	-0.63
Client-server based database tools(MSSQL, Oracle, etc.)	3.61	2	2.98	8	-0.63

7 Conclusions

The results of the statistical analysis did indicate that there are educational gaps between some IS/IT knowledge and skills. IS/IT educators need to revise their IS/IT curriculum to take care of deficiencies in the following areas:

Knowledge/Skills :

- IS/IT technical trends
- international communication ability
- visions about IS/IT for competitive advantage
- Knowledge of database & warehouse
- Critical thinking

Technology/skills

- Client-Server based DB tools & warehouse mart tools
- Software project/configuration Management tools

- E-Business softwares

- Object Oriented Program languages & modeling Languages

However, some of the identified critical deficiencies, such as personal motivation and working independently, creative thinking, and critical thinking, are difficult to teach.

Reference

- [1] Ashenurst, R.R., "Curriculum recommendations for graduate professional programs in information systems", *Communications of the ACM*, Vol. 15 No. 5, pp. 364-84, 1972.
- [2] Barley, S.R. and Orr, J.E., *Between Craft and Science: Technical Work in US Settings*, ILR Press, Ithaca, NY, 1997.
- [3] Burk, k., Corporate IS Staffing, *PC Week 101*, 28, 66, 1998.
- [4] Couger, J.D., Davis, G.B., Dologite, D.G., Feinstein, D.L., Gorgone, J.T., Jenkins, A.M., Kasper, G.M., Little, J.C., Longenecker, H.E. Jr, and Valacich, J.S., "IS'95:

guidelines for undergraduate IS curriculum", *MIS Quarterly*, Vol. 9 No. 3, pp. 341-59, September 1995.

[5] Koh, S., lee, S., Yen, D., Havelka, D." The relationship between information technology professional's Skill Requirements and Career Stage in the E-Commerce Era: An Empirical Study", *Journal of Global information management*, Idea Group Publisher 12(1), pp. 68~82, March 2004.

[6] Koh, S., lee, S., Yen, D., Chen, H., "Differences in Perception of IS Knowledge and Skills between Academia and Industry : Findings from Taiwan", *INTERNATIONAL JOURNAL OF INFORMATION MANAGEMENT, ELSEVIER SCI LTD*, 23(6), December 2003.

[7] Koh, S., lee, S., Yen, D., Chen, H., "Perception Gaps between IS Academicians and IS Practitioners: An Exploratory Study", *INFORMATIONS & MANAGEMENT, ELSEVIER SCIENCE B.V.*, 40(1), October 2002.

[8] Koh, S., lee, S., Yen, D., Havelka, D., "Evolution of IS Professionals' Competency: An Exploratory Study", *JOURNAL OF COMPUTER INFORMATION SYSTEMS, INTERNATIONAL ASSOCIATION FOR COMPUTER INFORMATION SYSTEMS*, 41 (4), June 2001.

[9] Koh, S., lee, S., Chen, H., "Educational Gaps as Perceived by IS Educators: A Survey of Knowledge and Skill Requirements", *THE JOURNAL OF COMPUTER INFORMATION SYSTEMS, INTERNATIONAL ASSOCIATION FOR COMPUTER INFORMATION SYSTEMS*, 41(2), March 2001.

[10] Koh, S., Yen D., lee, S., "Critical knowledge/skills sets required by industries: an empirical analysis", *INDUSTRIAL MANAGEMENT & DATA SYSTEMS, MCB UNIVERSITY PRESS*, 101(8&9), January 2001.

[11] Lee, D.M.S., Trauth, E.M. and Farwell, D., "Critical skills and knowledge requirement of IS professionals: a joint academic/industry investigation", *MIS Quarterly*, Vol. 19 No. 3, pp. 313-40, September 1995.

[12] Leitheiser, R.L., "MIS skills for the 1990s: a survey of MIS managers' perceptions", *Journal of Management Information Systems*, Vol. 9 No. 1, Summer, pp. 69-91, 1992.

[13] Nelson, R.R., "Educational needs as perceived by IS and end-user personnel: a survey of knowledge and skill requirements", *MIS Quarterly*, Vol. 15 No. 4, pp. 503-25, December 1991.

[14] Todd, P.A.,McKeen, J.D. and Gallupe, R.B., "The evolution of IS job skills: a content analysis of IS job advertisements from 1970 to 1990", *MIS Quarterly*, Vol. 19 No. 1, pp. 1-27, March 1995.

[15] Trauth, E.M., Farwell, D.W. and Lee, D., "The IS expectation gap: industry expectation versus academic preparation", *MIS Quarterly*, Vol. 17 No. 3, pp. 293-303, September 1993.

[16] Young, D. and Lee, S., " The relative importance of technical and interpersonal skills for new information systems personnel" , *Journal of Computer Information Systems*, Summer, pp. 66-71, 1996.