Multi-Dimensional Analysis on Korean IS Practitioners' Job Activities and Competency Requirements

Seokha Koh*

Abstract

Research results show (1) there are two dimensions characterizing Korean IS practitioners : 'project-operation' and 'product-orientation-strategic-orientation', (2) there are two distinctive and main career paths of Korean IS practitioners : generalists who support using information systems in the context of operation and specialists who are engaged in software development or improvement projects, and (3) Korean IS practitioners are experiencing serious and pervasive knowledge and skill deficiencies. Research results also provide clear evidence that Korean universities fail to provide eligible entry-level software developers and that the shortage of eligible entry-level software developers distorts both IS specialists' careers and knowledge and skill requirements for them.

Keywords : Information Systems, Job Activities, Knowledge and Skills, IS Practitioners, Education and Training

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* Professor of Department of MIS, Chungbuk National University, Tel : +82-43-261-2356, e-mail : shkoh@cbnu.ac.kr

1. Introduction

The context of IS (information systems) is an organization and its systems, and is differentiated from computer science of software engineering to the context of the work to be performed, the type of problems to be solved, the types of systems to be designed and managed [Glass, 1992; Couger et al., 1995]. According to this definition of IS, IS practitioners can be defined as persons whose main tasks are to develop information systems, to maintain them, or to help people to use them in an organization [Yen et al., 2001].

The joint committee from ACM (Association for Computing Machinery), DPMA (Data Processing Management Association), ICIS (International Conference of Information Systems) and AIS (Association of Information Systems) recommended "unified" undergraduate IS curriculum in 1995. The old paradigm of a single career path of programmer-analyst-project manager-IS manager, however, is being replaced by a new reality in which there are number of IS career paths [Lee et al., 1995; Moeller and Kerstetter, 1998; Ross et al., 1996; Trauth et al., 1993]. Given the variety of possible IS career paths, the 'unified' IS curriculum may be outdated from the start.

Koh et al. [2008] found that most Korean IS practitioners follow either of two distinct career paths of the 'generalist' or the 'specialist' too. Koh et al. [2008]'s finding suggests the necessity for Korean universities to provide distinctive IS curriculums focused on either of the career paths.

The graduate of an IS program should be equipped with both proper function in an entry-level position and basis for continued career growth [Couger et al., 1995]. The emphasis on human resource management and learning systems in the workplace is shifting from training to learning [Young and Lee, 1996]. Moreover, the average organization fails to provide adequate training for employees and the growth rate of training investments and practices is very low. [Bassie and Van Buren, 1999; Carnevale and Desrochers, 1999]. Schools should take learning in the workplace into explicit consideration to optimize their students' life-long learning process [Yen et al., 2001].

Learning is an indispensable component of any job in today's professional workplace, especially true for IS professionals [Yen et al., 2001]. Changes in the market, technology, and workplace reduce and may even eliminate the need for old skills and demand the development of new ones. Performance standard are becoming more complex and demanding requiring continuous skill development [Howard, 1995]. Some skills become necessary only at the later stage of one's career, and it may be not economical for him/her to acquire such skills in advance more than 10 years. For the skills necessary at the later stage of career, schools should not teach the very skills but only provide the basis for one to learn the skills after graduation.

Lee et al. [2001] found that USA IS practitioners, as their careers progress, (1) perform different activities (2) are required to have different skills, (3) do have different skills at different stages. Koh et al. [2008] found that the same conclusions hold for Korean IS 'specialists' where as those findings do not hold for Korean IS 'generalists'. This paper investigates what dimensions characterize Korean IS practitioners in different career paths and at different stages of career. This paper investigates how well Korean IS practitioners in different career paths and at different stages of career are equipped with necessary knowledge and skills in detail too.

2. Literature Survey

Koh et al. [2008] investigated Korean IS practitioners about (1) how much time they spend spent to do their activities, (2) how much IS knowledge is required to do the activities successfully, and (3) how proficient software/tool skills are required to do the activities successfully. <Table 1>, <Table 3>, <Table 4> show the results.

Koh et al. [2008] found that Korean IS practitioners can be classified into 'generalists' who spend their work time relatively evenly across various job activities and 'specialists' who spend their work time much more on some activities than on other activities (refer <Table 1>[1]). They found that generalists' tasks remain constant throughout their careers where as specialists' tasks change as their careers evolve. They classified, operationally, specialists further into 'junior specialists' (less than 3 work years), 'middle-level specialists' (4-10 work years), and 'senior specialists' (more than 11 work years). They found that the homogeneity in each group and heterogeneity among the groups are consistently maintained across all of the three aspects they had researched : the time spent to do their job activities, the general IS knowledge requirements, and the software/tool skill requirements.

In all of the <Table 1>, <Table 3>, and <Table 4> the standard deviation increases in the order of generalists, junior specialists, middle-level specialists, and senior specialists. Data clearly show that senior specialists devote more work time into smaller number of activity categories, and hence feel stronger requirements in narrower areas of related knowledge and skills than any other groups. Specialists spend more time on smaller number of activity categories as their careers develop. On the other hand, generalists spend their work time evenly across various job activities and seldom feel especially strong requirements in any knowledge and skill area.

Lee at al. [1995] identified 21 job activities of IS personnel into seven categories; plan/

1) Koh and et al. [2008] used ordinary 5 point rating scales. To prevent 'leniency error' however, they standardized the data as follows : for each records, ① calculate the sum (S) of the response values, ② multiply N/S to the response values, where N is the number of items asked. <Table 1>, <Table 3>, and <Table 1> show the averages of standardized response values. The standardized value shows the relative magnitude of corresponding item : 1 means 'average', smaller than 1 means 'less than average', and bigger than 1 means 'more than average.' The error of leniency occurs when a respondent is either an 'easy rater' or a 'hard rater' and is very common to rating scales [Cooper and Schindler, 2003].

manage, analyze, develop, implement, support, integrate, and train/educate. Lee at al. [2001] (1) divided Lee et al. [1995]'s "analyze business problems and IS solutions" into "analyze business problems" and "design IS solutions to business problems." And, following Trauth et al. [1993], Lee at al. [2001] (2) added "develop data warehouse" to the "develop" category, and (3) added "learning" category, and included two activities : "learn new IS tech-

〈Table 1〉 Time Spent to Do Job Activities

Job Activities	Junior specialists	Mid-level specialists	Senior specialists	Generalists	Overall average
Manage/plan systems development/implementation	1.32	1.55	1.53	1.07	1.24
Learn new IS technologies	1.24	1.12	1.57	1.24	1.25
Manage/operate existing computing resources/procedures*	1.07	1.13	1.12	1.22	1.18
Learn knowledge other than new IS technologies	1.16	0.87	1.67	1.11	1.12
Support end-user developed systems	1.01	1.28	0.79	1.12	1.11
Manage/plan feasibility/approval process for new systems/technology	1.31	1.07	1.58	0.95	1.08
Develop in-house application programs	0.91	1.69	0.69	0.96	1.07
Analyze business problems	1.38	1.03	1.35	0.97	1.07
Support end-user computing	1.07	0.89	0.70	1.11	1.03
Develop application software - purchase/tailor	0.89	1.36	0.89	0.95	1.02
Develop DB/DW	0.83	1.26	0.68	1.01	1.01
Manage/plan corporate IS strategies/strategic applications/architecture	1.07	0.92	1.43	0.97	1.01
Analyze software packages-evaluation/selections*	1.10	0.95	0.99	1.02	1.01
Implement computer-supported business process	0.89	1.05	0.82	1.00	0.98
Train and educate end-users*	1.10	0.91	0.91	0.98	0.97
Integrate existing and new business applications	0.99	0.99	0.76	0.97	0.96
Design IS solutions to business problems	0.96	0.96	1.11	0.91	0.95
Implement system evaluation process	0.86	0.86	0.81	0.99	0.93
Support information access/security	0.84	0.67	0.63	1.03	0.90
Support hardware	0.86	0.62	0.58	1.01	0.88
Train and educate IS professional	0.88	0.69	1.23	0.82	0.84
Integrate networks	0.66	0.59	0.62	0.88	0.77
Integrate data types	0.60	0.54	0.53	0.71	0.64
Standard Deviation**	0.20	0.29	0.37	0.12	0.14
Non-standardized Overall Average***	2.27	2.33	2.36	2.57	2.47

Note) * For these items, no statistically significant (α = 0.1) difference among the groups was found.
** Standard deviation of the item values in the corresponding column.
*** Multiplying this value to the item values in the corresponding column, we get the ordinary averages of 5-point rating scale measurement.

〈Table 2〉 Classification and Importance of IS Abilities/Knowledge/Skills[2]

Authors	IS Abilities/Knowledge/Skills
ACM [1972]	People, models, systems, computers, organizations, society
Couger et al. [1995]	Communication, computer applications systems, information technology and tools, interpersonal relationships, management, problem solving, systems development methodologies, systems theory and concepts, professionalism
Koh [2006]	Personal trait/knowledge/skills (H), interpersonal knowledge/skills (H), organizational and societal knowledge/skills (L), IS technology knowledge/skills (M)
Lee et al. [1995]	business functional knowledge (H)*, interpersonal and management skills (H), technology management knowledge (M), Technical specialty knowledge (L),
Leitheiser [1992]	(developer skills) interpersonal (H), analysis and design (M), programming (M), business (M), environment (L), programming language (L), specific application (L),
	(specialist skills) database & data communication (1)*, software (2), hardware (3), advanced applications (4)
Nelson [1991]	Organizational knowledge, organizational skills, organizational skills, organizational unit, general IS knowledge, technical skills, IS product
Todd et al. [1995]	Hardware, software, business, management, social, problem solving, development methodology
Yen et al. [2001]	Personal trait/knowledge/skills (H), interpersonal knowledge/skills (H), organizational and societal knowledge/skills (M), IS technology knowledge/skills (L)
Young and Lee [1996]	Interpersonal skills (H), programming languages (M), development and management of applications (M), operating systems (M), network and communications (L), personal computer tools (L)

Note) * The number and letter in parentheses represents the rank of importance of the items of each category, with 1 the most important. H, M, and L in parentheses represent high, middle, and low importance, respectively. It means that, for example, the items in the category ranked as the first are generally rated more important than those of the category ranked as the second. Some items of the second-ranked category, however, may be rated more important than some items of the first-ranked category. It also doesn't mean necessarily that the skills of the first-ranked category as a whole is evaluate more important that those of the second-ranked category as a whole. The ranking is approximate for some authors.

nologies," and "learn knowledge other than new IS technologies," making 25 activities in total.

Koh et al. [2008], among the activities of Lee et al. [2001], (1) combined "develop DB" and "develop data warehouse" into "develop DB/DW", (2) combined "implement data management procedures" and "support existing portfolio of applications" combined into "manage/operate existing computing resources/procedures", and (3) substituted "implement new or change computer-supported business process" with "implement computer-supported business process'.

Ashenhurst [1972], reported the result of the research of ACM Curriculum Committee on Computer Education for Management, generating thirty seven skills and abilities that students in a graduate MIS program should expect to acquire and classified them into six categories : people, models, systems, computers, organizations, and society. Couger et al.

2) 'Knowledge', 'ability', and 'skill' will be used interchangeably when they are used without any constraint hereafter.

[1995] Lee et al. [1995], Nelson [1991], Todd et al. [1995], Yen et al. [2001], and Young and Lee [1996], provide other classifications of the abilities, knowledge, or skills which IS practitioners, therefore IS graduates too, must possess. <Table 1> shows various classification of traits IS practitioners must possess.

The IS technology differentiates IS personnel from other personnel in an organization. The literature, however, reports that IS practitioners generally regard 'general' knowledge/skills such as interpersonal skills and business knowledge more important than 'IS-related' knowledge/skills [Lee et al., 1995; Lei-

〈Table 3〉 General IS Knowledge Requirements

Knowledge/skills/ability of	Junior specialists	Mid-level specialists	Senior specialists	Generalists	Overall average
IS Technology					
Operating systems	1.10	1.08	1.02	1.14	1.11
Programming languages	0.97	1.34	0.88	1.06	1.09
DB/Data warehouse	0.92	1.24	0.98	1.08	1.08
Networking/communication/security*	1.02	1.02	1.05	1.09	1.07
Hardware	1.05	0.97	1.00	1.06	1.03
General commercial O/A packaged products	1.15	0.93	1.05	0.97	0.99
Business application programs	0.82	0.94	0.72	0.86	0.86
Behavioral/organizational issues about IS*	0.86	0.93	0.92	0.94	0.92
Systems development methodologies	0.87	1.00	0.90	0.88	0.91
IS technology trends	0.93	1.02	1.23	1.05	1.05
Visions about IT/IS for competitive advantage	0.86	0.98	1.29	1.02	1.02
2. Organization and Society					
Specific business function areas	0.93	0.86	0.64	0.86	0.85
Specific organizations	1.00	0.81	0.90	0.94	0.92
Specific industries	0.61	0.64	0.53	0.70	0.66
General business environment	0.90	0.66	0.89	0.81	0.80
3. Interpersonal Skills					
Interpersonal communication skills	1.18	1.19	1.23	1.11	1.14
Team-working	1.23	1.18	1.04	1.09	1.12
International communication*	1.01	0.91	1.03	0.93	0.94
4. Personal Traits					
Creative thinking	1.23	1.15	1.32	1.16	1.18
Critical thinking	1.22	1.08	1.19	1.15	1.15
Personal motivation*	1.13	1.09	1.20	1.11	1.11
Standard Deviation**	0.16	0.17	0.21	0.13	0.13
Non-standardized Overall Average***	3.15	3.39	3.02	3.35	3.32

Note) * For these items, no statistically significant (α = 0.1) difference among the groups was found.
** Standard deviation of the item values in the corresponding column.
*** Multiplying this value to the item values in the corresponding column, we get the ordinary averages of 5-point rating scale measurement.

theiser, 1992; Yen et al., 2001] This is true even for entry-level IS personnel [Young and Lee 1996]. A series of surveys repeatedly report that IS personnel generally show their knowledge deficiency most seriously in these important areas [Lee et al., 1995; Nelson, 1991; Todd et al., 1995; Trauth et al., 1993; Yen et al., 2001].

Koh [2006] (1) added "database/data warehouse" to Lee et al. [2001]'s list of IS knowledge/skills, (2) changed "packaged products", "networking/communication software/langua-

〈Table 4〉 Software/Tool Skill Requirements

Skills of	Junior specialists	Mid-level specialists	Senior specialists	Generalists	Overall average
PC operating systems*	1.39	1.25	1.35	1.33	1.32
Presentation tools	1.39	1.14	1.50	1.27	1.28
Client-server based DB tools	1.12	1.42	1.13	1.26	1.26
Word processing tools	1.38	1.10	1.39	1.21	1.23
DB query language	1.03	1.47	1.11	1.19	1.22
Spreadsheet tools	1.32	1.11	1.36	1.18	1.20
Internet/web-browser tools*	1.18	1.15	1.35	1.19	1.20
E-mail tools	1.19	1.06	1.26	1.09	1.11
Mark-up languages	1.09	1.19	0.98	1.07	1.09
Server/mainframe Operating systems*	0.99	1.03	0.96	1.11	1.06
e-Business software/tools*	1.02	1.09	1.08	1.04	1.05
Dynamic web-page development languages	0.89	1.18	0.73	1.05	1.03
Object-oriented languages	0.83	1.17	0.80	1.04	1.02
Software project management/configuration tools*	0.92	1.01	1.09	0.94	0.96
High-level procedural languages	0.84	1.07	0.80	0.92	0.93
PC-based DB tools	1.07	0.89	0.80	0.90	0.91
Graphic tools	1.13	0.64	1.11	0.85	0.87
Data warehouse/mart tools*	0.85	0.85	0.78	0.90	0.87
Software design/implementation CASE tools*	0.80	0.92	0.81	0.81	0.84
Modeling languages*	0.74	0.84	0.91	0.82	0.82
Communication software/protocols*	0.77	0.67	0.67	0.76	0.74
Statistics tools*	0.78	0.62	0.80	0.71	0.71
Expert systems/shells	0.63	0.62	0.61	0.75	0.69
Simulation/optimization tools	0.63	0.52	0.62	0.61	0.59
Standard Deviation**	0.23	0.25	0.27	0.20	0.21
Non-standardized Overall Average***	2.70	2.99	2.45	2.94	2.91

Note) * For these items, no statistically significant (α = 0.1) difference among the groups was found.
** Standard deviation of the item values in the corresponding column.
*** Multiplying this value to the item values in the corresponding column, we get the ordinary averages of 5-point rating scale measurement.

ges", "application programs", "implementation/operation/maintenance issues", "general environment", and "interpersonal behavior skills" to "general commercial O/A packaged products", "networking/communication/security software/languages", "business application programs", "behavioral/organizational issues about IS", "general business environment", and "team working", respectively and (3) deleted "teaching/training skills" from the list. Their empirical study on Korean IS practitioners shows that Korean IS practitioners regard interpersonal skills and personal traits the most important but regard IS technology more important than organizational and societal knowledge. The research also showed that Korean IS practitioners are experiencing knowledge deficiency severely on every item researched [Koh, 2006].

Yen et al. [2001] and Koh et al. [2004] researched how proficient software/tool skills are required for USA IS practitioners too. Yen et al [2003], using the identical scales, researched how proficient software/tool skills are required for Taiwanese IS practitioners. Modifying the scales used by the authors mentioned above, Koh [2006] and Koh et al. [2008] researched how proficient software/tool skills are required for Korean IS practitioners. The research results show that Korean IS practitioners are experiencing the most serious software/tool skill deficiency.

3. Dimensions Differentiating Korean IS Practitioners

The tables in <Table 5> show Euclidean distance among the columns in <Table 1>, <Table 3>, and <Table 4> respectively and the maps in <Figure 1> are the results of MDS[3] using the distance data respectively. <Table 5> and <Figure 1> show clearly that dominating and consistent gap exists between middle-level specialists and senior specialists. Middle-level specialists are busy "developing or tailoring application programs and DB/DW." They also spend relatively much time to "integrate existing and new business applications." So, they feel strong requirements for the IS knowledge of "programming languages", "DB/DW", and "systems development methodologies", and the software/tool skills in "DB query languages", "client-server based DB tools", "mark-up languages", "dynamic web-page development languages", "object-oriented languages", "high-level procedural languages", and "software design/implementation CASE tools." In short, middle-level specialists develop, tailor, integrate or implement software or systems in the context of a project already selected and approved. They spend much time to "manage/plan systems development/implementation" too. At the end of a project, they spend time to "implement computer-supported business process." Out of the context of projects, they "support end-user developed systems."

3) MDS (multidimensional scaling) develops a geometric picture or a spatial map of the locations of some objects relative to others. This map specifies how the objects differ: similar objects fall close together, and dissimilar objects are farther apart. It is best understood when limited to two or three dimensions that can be graphically displayed [Cooper and Schindler, 2003]. SPSS v.13 is used for data analysis.

〈Table 5〉 Dissimilarity between IS Practitioner Groups

(a) Time Spend to Do Job Activities

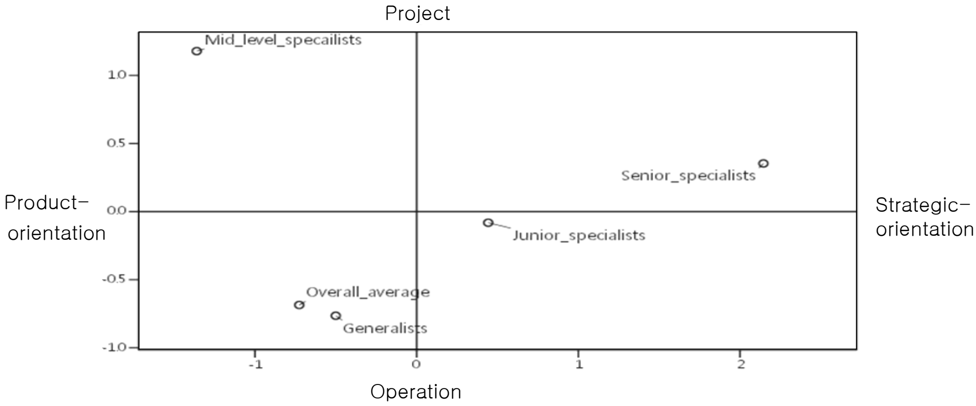
Rank	Group – Group	Euclidean Distance
1	Overall average – Generalists	0.72
2	Generalists – Junior specialists	0.79
3	Overall average – Junior specialists	1.03
4	Junior specialists – Senior specialists	1.12
5	Overall average – Middle-level specialists	1.22
6	Generalists – Middle-level specialists	1.27
7	Junior specialists – Middle-level specialists	1.30
8	Generalists – Senior specialists	1.62
9	Overall average – Senior specialists	1.69
10	Middle-level specialists – Senior specialists	1.93

(b) General IS Knowledge Requirements

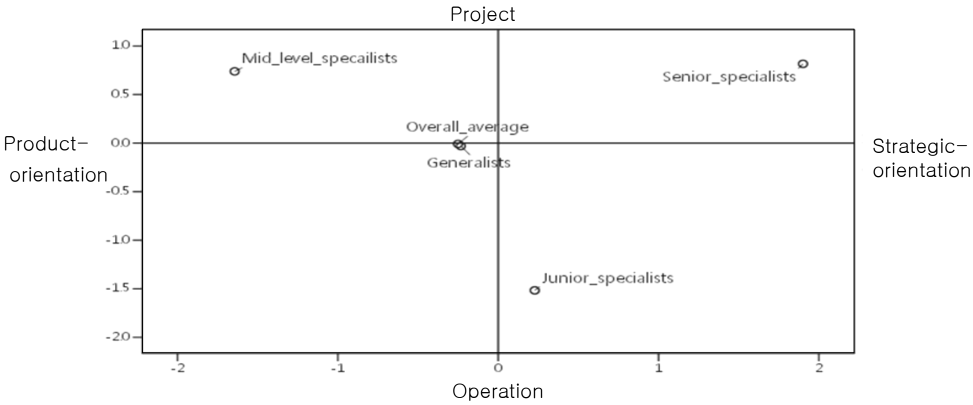
Rank	Group – Group	Euclidean Distance
1	Overall average – Generalists	0.29
2	Overall average – Middle-level specialists	0.45
3	Overall average – Junior specialists	0.45
4	Generalists – Junior specialists	0.46
5	Generalists – Middle-level specialists	0.52
6	Junior specialists – Middle-level specialists	0.76
7	Generalists – Senior specialists	0.82
8	Junior specialists – Senior specialists	0.86
9	Overall average – Senior specialists	0.88
10	Middle-level specialists – Senior specialists	1.16

(c) Software/Tool Skill Requirements

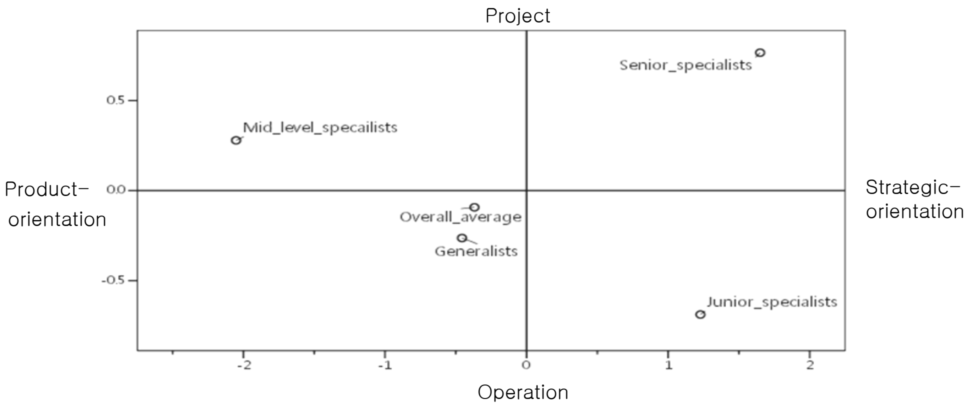
Rank	Group – Group	Euclidean Distance
1	Overall average – Generalists	0.12
2	Junior specialists – Senior specialists	0.50
3	Overall average – Middle-level specialists	0.55
4	Overall average – Junior specialists	0.55
5	Generalists – Middle-level specialists	0.58
6	Generalists – Junior specialists	0.59
7	Overall average – Senior specialists	0.69
8	Generalists – Senior specialists	0.75
9	Junior specialists – Middle-level specialists	1.06
10	Middle-level specialists – Senior specialists	1.16



(a) Time Spend to Do Job Activities



(b) General IS Knowledge Requirements.



(c) Software/Tool Skill Requirements

〈Figure 1〉 Multi-Dimensional Scaling : Results of 2 Dimensional Analysis

Becoming a senior personnel, an IS specialist abruptly abandon the job activities which he/she has done. Instead, he/she starts to "manage/plan corporate IS strategies, strategic applications, architecture" and to "manage/plan feasibility/approval process for new systems and technology." So, he/she feel strong requirement for IS knowledge of "visions about IT/IS for competitive advantage" and "IS technology trends" and spend much time to "learn knowledge about both new IS technologies and other than new IS technologies." He/he, however, still spend much time to "manage/plan systems development/implementation." He/she spend relatively much time to "design IS solutions to business problems."

<Figure 1> shows clearly that the relative position of generalists against middle-level specialists and senior specialists remains constant across all of the three aspects, and that middle-level specialists and senior specialists share something in common against generalists. The pair of key words discriminating middle-evel specialists and senior specialists against generalists seems to be 'project-operation.'[4] In the context of system development projects, middle-level specialists assume the responsibility for design, programming, and implementation of software and senior specialists assume the responsibility for selection and approval of projects. Both the groups share the responsibility for managing/planning the project approved.

Generalists spend most of the time to "learn new IS technologies" and to "manage/operate existing computing resources." They spend much time to "support end-user computing, information access and security, and hardware." They also spend relatively much time to "implement system evaluation process", "integrate networks and data types." Summing up, in the existing IS environment and infrastructure constructed through projects, generalists do the ongoing and repetitive, mainly supportive, job activities in context of operation.

Because generalists spend time relatively evenly across various activities, they need various IS knowledge and software/tool skills relatively evenly too. They, however, need the knowledge of "hardware", "operating systems", "networking/communication/security", "behavioral/organizational issues about IS" *, and "spe-

4) PMI [2004] classifies work organizations perform into "project" and "operation." As the work, they may overlap and share many characteristics such as (1) performed by people, (2) constrained by limited resources, and (3) planned, executed, and controlled. Projects and operations, however, differ in that "operations are ongoing and repetitive, while projects are temporary and unique."
A project may be defined as "a temporary endeavor undertaken to create a unique product, service, or result." The project processes are performed by the project team, and generally fall into one of two major categories : the "project management processes" and the "product-oriented processes" [PMI, 2004, p. 38]. The purpose of the project management processes is to initiate, plan, execute, monitor and control, and close a project. Product-oriented processes specify and create the project's product. Product-oriented processes vary by application area. Data clearly show the "product-orientation" of 'middle-level specialists.'
The authorization of project is typically done as a result of one or more strategic considerations such as market demand, an organizational need, a customer request, a technological advance, and a legal requirement [PMI, 2004, p. 7]. Data clearly show that 'senior professionals' are engaged in the selection and authorization of projects.

〈Table 6〉 General IS Knowledge Surplus/Deficiency of Korean IS Practitioners

Knowledge/skills/ability	Junior specialists	Mid-level specialists	Senior specialists	Generalists	Overall average
IS Technology					
Hardware	-0.44	-0.35	-0.42	-0.35	-0.37
General commercial O/A packaged products	-0.21	0.07	-0.28	0.01	-0.03
Operating systems	-0.35	-0.54	-0.29	-0.47	-0.45
Networking/communication/security*	-0.76	-0.70	-0.41	-0.62	-0.63
Business application programs	-0.65	-0.39	-0.12	-0.39	-0.40
Programming languages	-0.68	-0.59	-0.40	-0.52	-0.54
DB/Data warehouse	-0.82	-0.74	-0.42	-0.71	-0.70
Systems development methodologies	-0.71	-0.69	-0.32	-0.61	-0.61
Behavioral/organizational issues about IS*	-0.65	-0.61	-0.40	-0.60	-0.59
Visions about IT/IS for competitive advantage	-0.56	-1.00	-0.80	-0.76	-0.78
IS technology trends	-0.62	-0.93	-0.84	-0.78	-0.79
2. Organization and Society					
Specific business function areas	-0.68	-0.63	-0.20	-0.49	-0.52
Specific industries	-0.41	-0.43	-0.04	-0.26	-0.29
Specific organizations	-0.71	-0.44	-0.44	-0.53	-0.53
General business environment	-0.82	-0.31	-0.64	-0.40	-0.46
3. Interpersonal Skills					
Team-working	-0.65	-0.50	-0.52	-0.37	-0.44
Interpersonal communication skills	-0.88	-0.72	-0.56	-0.56	-0.63
International communication*	-1.03	-0.74	-0.72	-0.69	-0.75
4. Personal Traits					
Personal motivation*	-0.76	-0.54	-0.60	-0.46	-0.53
Creative thinking	-0.74	-0.74	-0.60	-0.66	-0.68
Critical thinking	-0.74	-0.43	-0.64	-0.71	-0.65
Overall Average**	-0.66	-0.57	-0.46	-0.52	-0.54

cific industries" and the specialties in "server/mainframe operating systems", "data warehouse/mart tools", and "expert systems/shells"[5] more than the other groups.

Junior specialists devote their most time into "analyze business problems", "manage/plan feasibility/approval process for new systems/technology", and "manage/plan corporate IS strategies, strategic applications, architecture" along with other specialists. They spend much time to "manage/operate existing computing resources/procedures" and to "support end user computing" along with generalists too. Junior

5) For the items marked with *, no statistically significant (α = 0.1) difference among the groups was found.

<Table 7> Software/Tool Skill Surplus/Deficiency of Korean IS Practitioners

Software/Tools	Junior specialists	Mid-level specialists	Senior specialists	Generalists	Overall average
Software project management/configuration tools	-0.79	-0.72	-0.52	-0.63	-0.66
e-Business software/tools	-0.79	-0.57	-0.48	-0.62	-0.62
Client-server based DB tools	-0.91	-0.46	-0.48	-0.63	-0.62
Data warehouse/mart tools	-0.74	-0.67	-0.32	-0.59	-0.60
Modeling languages	-0.30	-0.70	-0.36	-0.61	-0.57
Object-oriented languages	-0.33	-0.48	-0.20	-0.60	-0.51
Software design/implementation CASE tools	-0.41	-0.67	-0.04	-0.53	-0.49
DB query language	-0.71	-0.31	-0.16	-0.53	-0.47
Server/mainframe Operating systems*	-0.74	-0.39	-0.36	-0.45	-0.47
Statistics tools	-0.50	-0.39	-0.32	-0.48	-0.45
Dynamic web-page development languages	-0.38	-0.22	-0.20	-0.54	-0.43
Communication software/protocols	-0.57	-0.56	-0.04	-0.41	-0.43
Expert systems/shells	-0.35	-0.43	-0.20	-0.44	-0.40
Simulation/optimization tools	-0.45	-0.35	-0.20	-0.39	-0.37
High-level procedural languages	-0.35	-0.26	0.00	-0.33	-0.29
Mark-up languages	-0.27	-0.22	-0.36	-0.27	-0.27
Presentation tools	-0.18	-0.07	-0.24	-0.25	-0.21
PC-based DB tools	-0.26	-0.02	-0.32	-0.21	-0.19
Graphic tools	-0.18	-0.17	-0.44	-0.15	-0.18
Spreadsheet tools	-0.24	-0.04	-0.12	-0.13	-0.12
PC operating systems*	-0.26	0.00	-0.28	-0.06	-0.09
E-mail tools	-0.09	-0.09	-0.40	0.14	0.02
Internet/web-browser tools*	0.27	0.09	-0.48	0.03	0.03
Word processing tools	0.06	0.04	0.04	0.05	0.05
Overall Average	-0.39	-0.32	-0.27	-0.36	-0.35

specialists' main task seems to assist other IS practitioners and they position in the middle of other groups in <Figure 1> (a) Time Spend to Do Job Activities. So they need "team working" skill the most among the four groups. They spend much time to "learn new IS technologies and other knowledge" too. It is notable that junior specialists need organizational and societal knowledge more than any other groups.

4. Knowledge and Skill Deficiency of Korean IS Practitioners

<Table 6> and <Table 7> show well how serious and pervasive knowledge and skill deficiency Korean IS practitioners are experiencing.[6] Especially, junior specialists report

6) Koh [2006] measured both the knowledge/skill level required for and the knowledge/skill level possessed by Korean IS practitioners using 5 point

the most serious deficiency in most areas of both general IS knowledge (16 areas out of 21 areas) and software/tool skills (11 areas out of 24 areas).

It is notable that junior specialists are experiencing knowledge deficiency more seriously than middle-level specialists even in the areas of "programming languages", "DB/data warehouse", "systems development methodologies", "object-oriented languages", "high-level procedural languages", "dynamic web-page development languages", "mark-up languages", "client-server based DB tools", "software project management/configuration tools" which are required the most for middle-level practitioner. The knowledge and skill deficiency of junior specialists in these areas is so severe to prevent them from being assigned to software developing activities. Instead, they are assigned to less error-critical activities.

Evidence clearly shows that without an extensive learning of 2 or 3 years in the workplace, entry-level IS practitioners can not be allowed to assume the responsibility of developing software. If Korean universities provide eligible entry-level software developers that they can be assigned to software development projects without an extensive period of learning, then they will presumably take over much responsibility of development activities which middle-level specialists currently do, especially programming, to allow middle-level specialists to engage in projects management processes or strategic processes more. As the result, in <Figure 1>(a) Time Spend to Do Job Activities, junior specialists will move in upper-left direction to replace the current position of middle-level specialists and middle-level specialists move right to the middle of current positions of middle-level specialists and senior specialists. Knowledge/skill requirements for junior specialists and middle-level specialists will be changed accordingly. The MDS diagrams regarding IS knowledge and software/tools skills will change very similar as that regarding job activities.

How could a Korean IS specialist be 'a specialist' at all, without developing his/her specialty consistently and continuously? Data show the greatest gap lying between middle level specialists and senior specialists across all of the three aspects researched. This result is very striking because specialists are generally supposed to develop their specialty continuously and consistently throughout their careers. They abruptly abandon the activities before they get enough competencies for the activities they are doing and set out new activities they know even less. If Korean universities provide enough number of eligible software developers then, we believe, Korean IS specialists will be able to develop their careers smoothly and gradually and all these anomalies will disappear.

Data show clearly that schools fail to foster their students' fundamental personal and interpersonal skills too. Korean universities fail

rating scales. Subtracting the level required from the level possessed, he calculated the knowledge surplus or deficiency for each area of knowledge and skills. The positive value denotes knowledge surplus and the negative value denotes knowledge deficiency. The data used in this paper is essentially the same in Koh [2006] and Koh et al. [2008].

to provide their students both the knowledge to function properly in an entry-level position and the basis for continued career growth. We believe the failure of Korean universities to produce eligible software developers is one of the main causes of the distortion Korean industries are suffering.

5. Conclusion

Research results clearly show that there are two dimensions characterizing Korean IS practitioners : 'project (creating and changing IS) - operation (supporting the use of IS)' and 'product-orientation (constructing IS)-strategic-orientation (selecting and approving IS projects).' Generalists spend their work time evenly across various job activities and need various IS knowledge and skills evenly. They, however, spend more time to support the use of existing information systems and resources in the context of operation than specialists do.

Middle-level specialists devote especially much time to construct and maintain information systems in the context of projects. So, they need the knowledge and skills regarding "programming languages", "DB/data warehouse", "systems development methodologies" more than any other groups. Senior specialists devote especially much time to select and approve IS projects in the level of strategic process. So, they need knowledge regarding "IS technology trends" and "visions about IT/IS for competitive advantages." Middle-level specialists and senior specialists share the responsibility for "managing/planning the project approved" together.

Research results show that there are two main and distinctive career paths for Korean IS practitioners : generalists as operators and specialists as developers. Junior specialists seem to assist generalists as well as other specialists. Junior specialists, however, are quite different from 'junior generalists' in the aspects of the time spent to do their job activities, the general IS knowledge requirements, and the software/tool skills requirements. Generalists remain homogeneous across all of the three aspects researched, regardless of their work years. The very existence of two main and distinctive career paths suggests the necessity for Korean universities to provide distinctive IS curriculums focused on either of the career paths.

Data show that Korean IS practitioners are experiencing serious and pervasive knowledge and skill deficiencies. Especially, junior specialists reported the most serious knowledge and skill deficiencies in the most areas of both general IS knowledge and software/tool skills. This result provides clear evidence that Korean universities fail to provide eligible entry-level software developers. Without an extensive learning of 2 or 3 years in workplace, entry-level IS practitioners can not be allowed to assume the responsibility of developing software.

We believe that the shortage of eligible entry-level software developers distorts both IS specialists' careers and IS knowledge and skill requirements for them. It will be of great value to find the real IS knowledge and skill demands for Korean IS practitioners. Only upon the finding, the IS curriculum of Korean universities could be rebuilt properly.

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Author Profile

Seokha Koh

Seokha Koh is a professor of the Department of Management Information Systems at Chungbuk National University. He received a Ph.D. and Master of Management Science form the Korea Advanced Institute of Science and Technology. His research interests include software project management, software quality, business process modeling, object-oriented software development methodology, and IS education. Professor Koh is active in research, he has published several articles which have appeared in Information and Management, International Journal of Information Management, Journal of Global Information Management, Operation Research Letters, Journal of Optimization and Applications, Telecommunication Systems, Journal of Computer Information Systems, and Industrial Management and Data Systems among others