USING ONLINE JOB POSTINGS TO ANALYZE DIFFERENCES IN SKILL REQUIREMENTS OF INFORMATION SECURITY CONSULTANTS: SOUTH KOREA VERSUS UNITED STATES

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Abstract

The disproportionate supply/demand ratio of information security consultant manpower is worsening yearly. It is necessary to analyze the specialized knowledge and skills required of information security consultants in their fulfilling job responsibilities, and to reflect the findings in developing and operating training programs. To identify the job requirements of information security consultants across industries, the present paper comparatively analyzed job descriptions posted on monster.com and jobkorea.co.kr sites. Based on the analysis results, the present study defined the job requirements and selected certain items of knowledge and skills valued across industries to help lay the foundation for training programs conducive to demand-oriented manpower cultivation.

Keywords: Information Security Consultant Manpower, Contents Analysis, Job Requirement, Knowledge and Skills

1 INTRODUCTION

Intruders leaking personal information and hackers targeting confidential information are becoming ever more intellectual and sophisticated. By contrast, the failure to supply information security professionals capable of taking proper defensive countermeasures throughout society in a timely manner increases potential threats. This imbalance between manpower supply and demand in the field of information security undermines the local information security industry, raising concerns over the likelihood of security incidents in wider society. According to the '2012 Information Security Manpower Supply and Demand Survey and Outlook' published by the KISA (Korea Internet and Security Agency), the disproportionate supply/demand ratio of security manpower is worsening yearly. By 2017 the shortage will amount to as many as 3,660 workers as foreseen by the report. Also, the KISA's '2012 Manpower Supply and Demand Survey per Information Security Job' report describes the status of manpower shortage in information security – 31% in information security consulting, 21% in R&D, 18% in strategic planning and 9.7% in emergency response in the order named – suggesting information security consultants are most in demand, calling for a responsive action. Against the backdrop of such extended imbalance between manpower supply and demand, oversupply as well as excessive demand is likely to arise, if any imprudent measures are taken to control the imbalance without grasping the exact state of qualifications and levels required by the government and industry of the manpower. Therefore, it is urgent to map out the training system fit for the rapidly changing demand from industry and to cultivate manpower accordingly in the field of information security, given the shifting trends of knowledge and skills and the expansive applications across industries. Thus, it is necessary to analyze the specialized knowledge and skills required of information security consultants in their fulfilling job responsibilities, and to reflect the findings in developing and operating training programs. In this context, the case in United States (US) accounting for over 75% of global market in information security is significantly worth investigating. In the US, cultivating and training manpower in information security is part of the country's information security policies, being regarded highly important. Hence, the present paper analyzed the data of recruitment ads for information security consultants posted on the US and Korean job sites. Collected job postings described fundamental competencies of information security consultants for carrying out their responsibilities, specifying the skills and knowledge required in the field. Based on the analysis results, the present study defined the job requirements required of information security consultants and selected certain items of knowledge and skills valued across industries to help lay the foundation for training programs conducive to demand-oriented manpower cultivation.

2 LITERATURE REVIEW

2.1 Analysis of skill requirements in job postings

Todd et al. (1995) researched on the shifting trends of the combinations of skill requirements in recruitment ads from the 1970s to 1990s, particularly in regard of programmers, analysts and information system managers. Debrah & Reid (1998) identified skills required of professionals equipped with internet-related specialized knowledge for their effective functioning within organizations. They reported Singaporean companies had difficulties recruiting internet specialists due to the short supply and high demand, but most job postings asked for degrees, certificates (96%) and experiences (92%), which could be explained by the arbitrary definitions of internet skills. Debrah & Reid (1998) identified internet skills by classifying relevant jobs in recruitment ads into TCP/IP and other internet business. Via content analysis and interviews, they identified 5 internet-related works and 6 internet job titles, and derived the titles of position, job descriptions and job specifications. Wade & Parent (2002) compared the effects of organizational skills and technical skills of web masters on their work performance, and suggested that the balance between the two skills would have positive effects on web-masters' work performance and that any disproportionate consideration of or indifference to either skills would undermine their outcomes. Gallivan et al. (2004) analyzed the trends of job skills required of IT professionals, foretelling future demands for jobs and skills. Choi (2008) examined the job postings for librarians to analyze the specific types and levels of

IT required, and found a range of IT knowledge and skills were required on account of differentiated segments including administration, operation, references and acquisition arrangement. Prabhakar et al. (2005) analyzed online job postings on Monster.com and classified job skills required of IT professionals into 3 groups, viz. Programming, Operating Systems and Database · ERP · E-commerce Server.

2.2 Knowledge and skills required of information security consultants

To derive specialized knowledge and skills required of information security consultants for their job performance, previous studies on knowledge and skills in the fields of information security and information systems were analyzed. Most prior studies classified the manpower into academia, industry or engineers and managers, and presented knowledge and skills necessary for the curriculum of information security. Jun et al. (2008) defined the information security specialists, and surveyed the employees in information security companies and other businesses on their perception of the extent of knowledge and skills required of 4 job groups. Cockcroft (2002) proposed and discussed risk management, disaster recovery, business continuity planning, security architecture, laws and security strategies intended for graduate courses. Logan (2002) linked information security-related knowledge and skills to undergraduate curriculums and proposed security management, security architecture and modelling, business continuity planning and laws. Irvine et al. (1998) asserted engineering majors should learn information security subjects, proposing 7 knowledge items and skills including cyber laws, communication skills and interpersonal relationships. Lee et al. (1995) categorized knowledge and skills required of IT personnel into four segments, viz. information technology, technical management, business and interpersonal relationships. Wright (1998) proposed 8 areas of security-related knowledge including cyber ethics and laws, information security measures and analysis of security vulnerabilities. Yen et al. (2003) proposed knowledge and skills required across industries such as appreciation of goals and strategies in management environment, maintaining close customer relations, word processing and presentation skills, interpersonal relationships and communication skills. Trauth et al. (1993) elucidated knowledge and skills required of information system specialists, and surveyed information system administrators, end-user managers, information system consultants and information system faculty. They presented such knowledge and skills as information system skills including database development and information security skills, and management skills including fulfilment and business environment analysis.

3 RESEARCH METHOD

The present paper comparatively analyzed the education, experiences, annual salaries and certificates required of information security consultants in the collected recruitment ads in both countries. Based on the public awareness of free non-membership-based recruitment sites in the US, www.monster.com was analyzed weekly for three months from May to August, 2014. Also, over the same period, South Korea's best job site www.jobkorea.co.kr with over 3 million members was analyzed. Search conditions such as full time worker, no limitations on workplace location/commuting distance were set. The keyword for search was Security Consultant. Such data items as position, career, company name, education, experience, job description, annual salary and certificate were collected. Searched data were reviewed to eliminate recurring or overlapping postings over the three months. In total, 110 and 212 data items of recruitment ads were collected on monster.com and jobkorea.co.kr respectively for the comparative analysis.

4 DATA ANALYSIS AND RESULTS

In view of educational requirements of information security consultants in the US and South Korea, the US and Korean companies proved to prefer applicants with bachelor's degrees and associate degrees, respectively. As for experiences, the US businesses called for specific number of years with over 30% of American companies intending to hire skilled workers with at least five years' experience, whereas around 45% of Korean job postings were looking for those with no more than

five years of experience, using ambiguous terms such as 'regardless of experience' or 'experienced preferred' without specifying the exact number of years of experience.

	Monster.com (US)		Jobkorea.co.kr (South Korea)	
	Frequency	Percentage	Frequency	Percentage
Master, MBA	4	3%	0	0%
Bachelor's Degree	57	52%	45	21%
Associate Degree	3	2%	112	53%
High School Diploma	10	9%	4	2%
Not Specified	36	32%	51	24%
Total	110	100%	212	100%

Table 1.   Comparison of Education Level

	Monster.com (US)		Jobkorea.co.kr (South Korea)	
	Frequency	Percentage	Frequency	Percentage
Regardless of Experience	0	0%	13	6%
Experienced Preferred	0	0%	17	8%
1~3 years	23	21%	42	20%
3~5 years	23	21%	52	25%
5~10 years	26	24%	16	7%
More than 10 years	8	7%	0	0%
N/A	30	27%	72	34%
Total	110	100%	212	100%

Table 2.   Comparison of Years of Experience

In light of annual salaries, 13% of Korean recruitment ads openly specified the amount of annual salaries, averaging $27,000. Most recruitment ads did not specify the annual salaries by saying 'as per internal rules'. 10% of American recruitment ads openly specified the amount of annual salaries, averaging $120,000. The difference in annual salaries between the two countries may be attributable to the tendency of the US companies to prefer skilled and experienced workers.

As part of the qualification, relevant specialty certificates were required in 63 out of 110 (57%) postings on Monster.com. Notably, job postings specifying specialty certificates were calling for more than 3 certificates. 43 types of specialty certificates were mentioned more than once in recruitment ads for information security consultants. 4 certificates were mentioned more than 10 times: CISA (Certified Information Systems Auditor), CISM (Certified Information Security Manager), CISSP (Certified Information Systems Security Professional) and GIAC (Global Information Assurance Certification). In South Korea, 76 out of 212 (36%) job postings for information security consultants on Jobkorea.co.kr called for relevant specialty certificates. 20 types of certificates were mentioned more than once in recruitment ads for security consultants. 4 certificates were mentioned more than 10 times: CISA, CISSP, EIP (Engineer Information Processing) and EIS (Engineer Information Security). Table 3 below lists the top 4 certificates mentioned more than 10 times. In brief, CISSP and CISA proved to be most sought out in both the US and Korean industries.

Top4 Certifications		Monster.com (US)
		Total
1	CISSP	54
2	CISA	26
3	CISM	15
4	GIAC	12

Top4 Certifications		Jobkorea.co.kr (South Korea)
		Total
1	CISSP	46
2	CISA	39
3	EIP	33
4	EIS	26

Table 3.   Comparison of Top 4 Certifications

Table 4 shows the findings concerning job skills description, which came down to 7 groups (i.e., programming, network, operating system, information security management, technical security, application security and non-technical skills).

	Group (Code)	Job Skills (Monster.com)	Job Skills (Jobkorea.co.kr)
1	Programming (SW)	C, C++, C#, .Net, Objective C, Java, Javascript, Ajax, PHP, Python, Html5, CSS3, Perl, JQuery, JSP	S/W Development, Android Application, Java, Spring, JQuery, Html5, CSS, PHP, Javascript, C, C++
2	Network (NW)	IDS, Router, Firewall, VPN, IPS, Network Protocols, DDoS, LAN/WAN, Wireless Security, TCP/IP, SSL	IDS, IPS, Firewall, DDoS, VPN, SSL, Wireless Security, Router, Switch, Snort, APT, UTM, TMS, ESM
3	Operating System (OS)	Unix, Windows, Linux, Mac	Unix, Windows, Linux, Secure OS
4	Information Security Management (ISM)	Risk Management, Security Strategy, ISO27001, COBIT, NIST SP 800-53, PCI DSS, Security Operation, Physical Security, Compliance, Security Architecture, Project Management, Audit, Privacy Policy, Disaster Recovery Plan, PIA (Privacy Impact Assessment), Security Awareness	Security Policy, ISMS (Information Security Management System), PIMS (Personal Information Management System), ISO27001, PIA, Business Process Analysis, Security Architecture, Security Education, Physical Security, Compliance, Audit, Project Management, Risk Management
5	Technical Security (TS)	Vulnerability Tools, Antivirus Tools, Forensic Tools, Penetration Testing	Vulnerability Diagnosis, Penetration Testing, Malware Analysis, Forensic, Reverse Engineering
6	Application Security (APP)	Application Firewall, Oracle, SQL Server, PKI, Web Application Security, Cryptography, Email & Messaging Security, Data Loss Protection	DBMS, Oracle, DB2, Encryption, PKI, MS-SQL
7	Non-Technical Skills (NTS)	Microsoft Office (Word, PPT, Excel), Communication	Marketing, Technical Sales, Customer Service & Management, Communication, Teamwork, Reasoning (competence in solving problem), Presentation, Writing Skill

Table 4.   Comparison of Group (Knowledge and Skills)

In the frequency analysis of group-specific knowledge and skills, Information Security Management (ISM) and Network (NW) groups showed the highest percentage in both countries. This finding seems ascribable to the conditions in Korean information security industry. According to the '2013 Local Information Security Industry Survey' published by the KISIA (Korean Information Security Industry Association), in terms of the sales of each category in Korean information security industry, network security as part of information security products and security consulting as part of information security services recorded relatively high sales. Among the groups, the non-technical skills (NTS) group showed the most significant differences in knowledge and skills. In contrast to the US, Korean recruitment ads required technical sales and marketing-related knowledge and skills including customer support of information security consultants, which indicated consulting was mixed with technical sales. This issue may result from the substantial reliance of corporate sales on information security products including network, system, encryption/authentication and physical security items in Korean industry.

As the most significant group with parallel trends of knowledge and skills in both countries, the Information Security Management group was analyzed in terms of the relationship between education, experience and the number of certificates. In the US, the minimum educational requirements for qualification proved to be higher than those in South Korea, with more sophisticated experience requirements leading to more certificate requirements. In South Korea, most employers wanted applicants with associate degree and bachelor's degrees as well as security-related experience and certificates.

Group	Education Level	Years of Experience	Monster.com (US)		Jobkorea.co.kr (South Korea)	
			Certification	Frequency	Certification	Frequency
Information Security Management (ISM)	Master, MBA	N/A	2	2	0	0
		7~10	3	3	0	0
	Bachelor's Degree	N/A	0	1	1	2
		1~2	2	4	1	1
		2~5	2	5	10	11
		5~7	3	6	1	2
		7+	0	0	0	1
	Associate Degree	N/A	0	0	11	15
		10+	0	0	0	0
	High school Diploma	N/A	0	4	0	0
		2~5	1	2	0	0
		10+	0	0	0	0
N/A			8	14	6	12
Total			21	41	30	44

Table 5.   Group-specific Education and Experience Requirements

5   CONCLUSION

To identify the job requirements of information security consultants across industries, the present paper comparatively analyzed job descriptions posted on local and overseas job sites. In short, in the US, the job titles relevant to information security consulting were specified in line with such fields as network, application, system and vulnerability, each of which required applicants to have relevant experience, education, skills and certificates. In South Korea, the requirements proved to be simply sub-divided into managerial and technical parts, and mixed with those for technical sales and marketing associated with information security products. In contrast to the US, the non-technical skills (NTS) group was seen frequently in South Korea, which indicates applicants should be fitted with the knowledge underlying not only information security consulting but also seamless business performance with clients and organizational members. Based on the analysis findings, in order to successfully cultivate talent pools of local information security consultants, it is necessary to design and operate training programs conducive to developing fundamental competencies and skills encompassing presentation, word processing, problem solving, interpersonal relations and communication skills as well as the job requirements per group defined here. This study has limitations in that it takes time and efforts to collect information from recruitment ads and organize data for more accurate analysis results. To address such limitations, the present study designed and implemented a web crawler collecting job postings. Table 6 shows the specifics of the web crawler developed here.

Delphi XE6 was used to develop the web crawler application for Windows. To retain and manage the data in database, Apache and MySQL were installed on a Cent OS 6.5 server. The web crawler operates in the following steps. First, URLs of job sites of interest and search keywords are set up. Second, URLs of list pages of search results and those of the pages describing each recruitment ad are collected and stored in the database. Both URLs are collected here to avoid any overlapping URLs. Third, job requirements on the pages describing recruitment ads are parsed and thus 11 requirement items are saved in the DB. Once the requirements are stored in the DB, the field in the DB table where URLs are stored is updated from 0 to 1, so that the data for a field marked as 1 will not be collected again. Fourth, collected DB files can easily be transformed into CSV or MS Excel files with HeidSQL tool for analysis. Currently, revising and debugging is underway with the completed beta version applicable to Jobkorea.co.kr chosen as the test site. In near future, another web crawler will be developed, and customized for a different job site. Future studies will draw on the web crawler for analysing a broader spectrum of data sets, and establish specific skill and knowledge components needed for fostering and training information security consultants by standardizing (coding) such skill and knowledge items for each group.
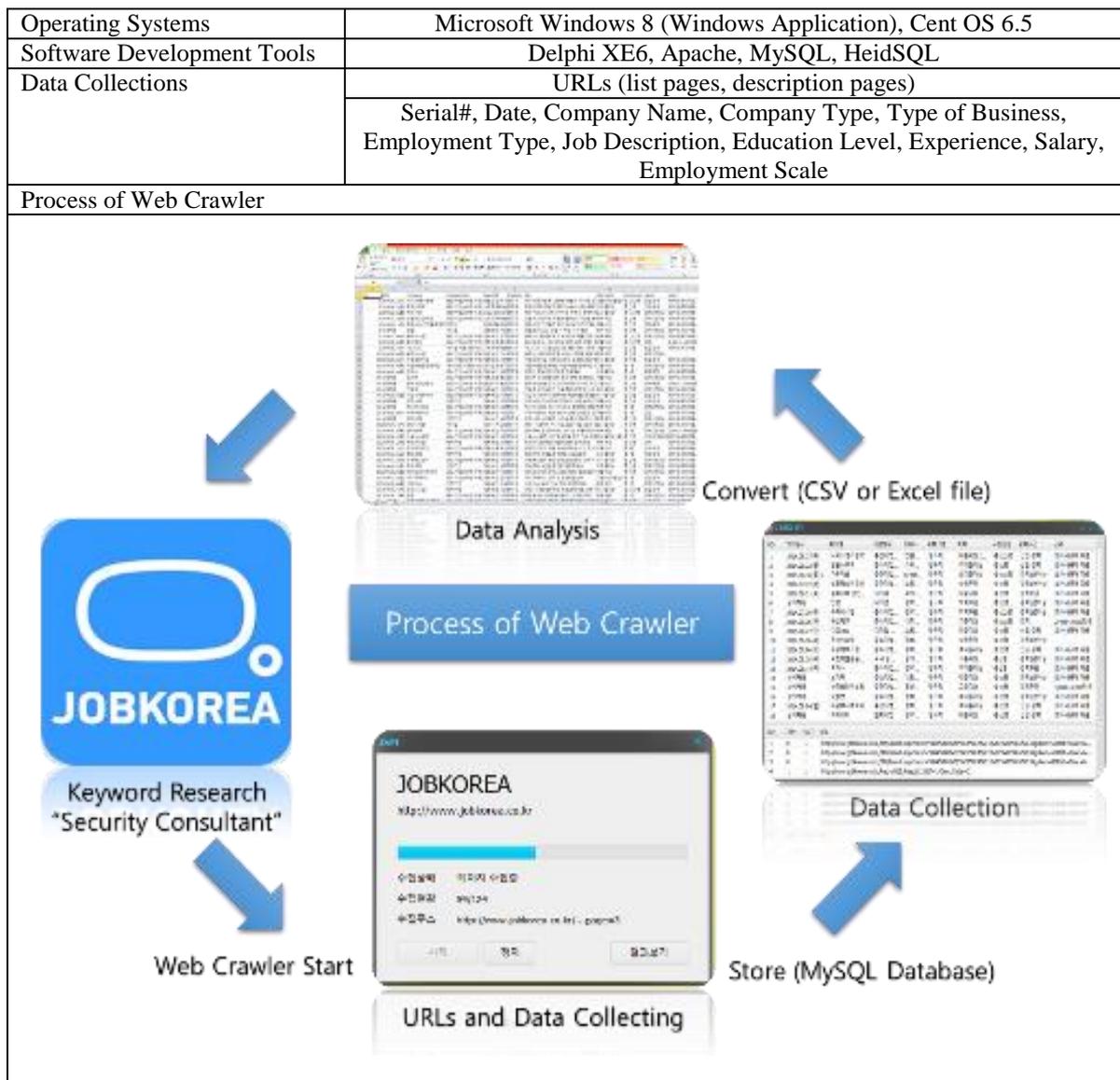
Operating Systems	Microsoft Windows 8 (Windows Application), Cent OS 6.5
Software Development Tools	Delphi XE6, Apache, MySQL, HeidSQL
Data Collections	URLs (list pages, description pages)
	Serial#, Date, Company Name, Company Type, Type of Business, Employment Type, Job Description, Education Level, Experience, Salary, Employment Scale
Process of Web Crawler	

Table 6.   Description of Web Crawler

Acknowledgement

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