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BUSINESS AS USUAL? IS JOB SKILL REQUIREMENTS DURING THE INTERNET ERA

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Abstract

The importance of matching IS workers' skills with the skills needs of organizations is often addressed within the academic and practitioner literature. This study analyzes the changes in job skill requirements in IS job advertisements in an attempt to identify the skills required by organizations in the Internet era. The analyses will be accomplished through the use of a methodology which was developed by Todd et al. in a study of IS job advertisements for the period of 1970 to 1990. In the Todd study, the authors found little difference in the skill requirements for IS personnel other than a small increase in technical skills for systems analyst advertisements. In the current study, initial findings are presented that indicate that although many skill requirements have remained stable as found by Todd et al., some skill requirements appear to have shifted in ways not expected before the study began.

Keywords: Information system jobs, job skills, IS skill requirements, job data analysis

Introduction

The Internet (specifically the Web) has re-defined the way business is done. What is the impact of this re-definition on IS job skill requirements? Have the skill requirements for programmers, system analysts, IS managers, and database administrators changed due to the use of the Internet for business purposes? To answer these questions, IS researchers need to investigate the skill portfolios for different IS job categories in various time periods.

As a starting point, this research attempts to examine the shifts, if any, in the information systems job skill requirements in the Internet era, by conducting a follow up on the Todd et al. (1995) study. In this paper, the Internet era implies the current time period in which the Internet is a very integral part of the business model. The introduction of the Internet has re-defined the way business is done, but has it re-defined the roles of the IS professionals? Therefore, specifically, the primary objective of this research is to compare IS job skill requirements in the Internet era with the skill requirements during 1970-1990 as reflected in IS job advertisements.

The rest of the paper is organized as follows. First, the Todd et al. (1995) study is briefly described. Second, the methodology for this study is presented. Third, the results of this study are compared with the findings in the Todd et al. study. Fourth, the limitations of this study are enumerated. Lastly, concluding comments are presented.

Background

Todd et al. (1995) conducted a study which analyzed the content of IS job advertisements from 1970 to 1990, for the positions of Programmer, Systems Analyst, and IS Manager. The primary objective of the Todd study was to assess whether there were changes in the mix of job skill requirements for the IS job positions within the time period under consideration. Broadly speaking, the changes were examined in light of three knowledge/skill (referred to as skills in the rest of the paper) categories namely: Technical, Business, and Systems.

Job ads were collected from four major newspapers (see Table 1), at an interval of five years. The three IS job types examined in this study include: Programmer, Systems Analyst, and IS Manager. The job ads were classified into one of the three skill categories using the classification scheme designed by the authors. The classification scheme was based on the ACM categories of computers, organizations, people/society, models, and systems. From these four categories the authors’ formulated a coding scheme that included the major classes of technical knowledge, which consisted of hardware and software skills; business knowledge, which consisted of function, management, and social skills; and systems knowledge, which consisted of problem solving and development methodology skills. Descriptions of the particular skills within each category are contained in Table 3 (See Appendix).

Three types of measures were used by Todd et al (1995) to analyze the content of the job ads: **Indicator data**, **average data**, and **percentage data**. The indicator data shows the proportion of ads that refer to each category (technical, business, and systems) at least once in the ad. The average data shows the average number of phrases per skill category in an ad. Lastly, the percentage data shows the proportion of number of phrases per category expressed as a percentage of the total number of relevant phrases per ad. The authors’ reported two findings of interest, one, that not much had changed in the IS job skills mix in relative terms from 1970 to 1990, and two, that surprisingly, systems analyst advertisements which mentioned technical skills more frequently over time, mentioned business skills less, which was in contrast to much of the thought within the IS field at the time of the study.

The Current Study

This study attempts to extend the study conducted by Todd et al. (1995). Therefore, in order to compare and contrast the findings of this study with that of Todd et al., it was imperative that the same data collection and analysis procedures were used. Except for some minor changes (discussed in the methodology section), the same coding scheme and data measures used in the Todd et al study were used in the current study.

Methodology

Data Collection

The job ad sources included in both the Todd et al. and current study are listed in Table 1. The major differences among the sources for the two studies are that the current study includes the San Francisco Chronicle, which was added to represent a U.S. location other than the Northeast, the Washington Post which was included rather than the Wall Street Journal to eliminate a source whose distribution is global in nature and the addition of online job ad sources. Additionally, data from the two foreign papers were not collected due to the wide range of sources being utilized for the current study. Further, although Todd et al. acknowledged that there was no reason why geographic location would make a difference, it was determined that for this study a major paper should be selected that represented a U.S. location other than the Northeast to allow for the investigation of the possibility of geographic differences among the job advertisement data. Secondly, due to the extensive availability and use of online-resources during the Internet era, it was crucial to include job ads from online sources. The larger variety of sources used in the data collection were added in an attempt to increase the external validity of the study. An independent t-test indicates that there was no significant difference between the data obtained from the online and newspaper sources ($t=-1.670$, $p=0.139$).

Table 1. IS Job Advertisement Sources

Todd et al. (1995)	Current Study
New York Times	New York Times
Wall Street Journal	Washington Post
The Global and Mail	San Francisco Chronicle
The Toronto Star	Monster.com
	Hotjobs.com
	Headhunter.net

Two time periods, 1997 and 2001, were examined in the current study. The first time period, i.e., 1997 was selected through an examination of IS job data, in particular job data from the Bureau of Labor Statistics, which revealed that the year 1997 had one of the greatest percentage changes of IS job demand of any year in the 1990s (Bureau of Labor Statistics) and additionally, the

1997 data would reflect any Internet related changes in IS job requirements. The second time period, i.e., 2001 was selected because it offered the most recent job advertisement data, and would be representative of contemporary IS skills. The days of the month for which job data was collected was not perceived as a factor in establishing the validity of the study, and therefore, since Sunday issues routinely publish the greatest number of job advertisements in any given week, five ads from two Sundays each month per newspaper source, were selected. Internet ads were selected according to their availability on each website. Previous literature provides support for the use of both the use of ads from the Sunday edition and the use of Internet sources for job ad content analysis (Wade and Parent 2002).

In the Todd et al. study the job skills under investigation were for the IS positions of programmer, systems analyst, and IS manager. In addition to these positions, the database administrator position was examined in the current study. Because of the ubiquity of database technology within today's organizations, and the associated high demand for database personnel (Bureau of Labor Statistics 2001), the position of database administrator was included. A total of 100 advertisements were collected for the current study. The job type composition of the sample is as follows: 23% for system analysts, 29% for programmers, 29% for IS managers, and the remaining 19% for database administrators. 49% of the ads have a requirement for a college degree; of these, 6% require an Associate's degree, 86% require a Bachelor's degree, and 8% require a Master's degree. The sample size and job types for Todd et al and the current study are listed in Table 2.

Table 2. Sample Size and Job Type

1970 (Todd et al., 1995)		1990 (Todd et al., 1995)		1997 & 2001 (Current Study)	
Sample: 104		Sample: 330		Sample: 100	
Job Type:		Job Type:		Job Type:	
Programmers	46%	Programmers	52%	Programmers	29%
Analysts	26%	Analysts	26%	Analysts	23%
Managers	28%	Managers	22%	Managers	29%
				DB Administrator	19%

For the purposes of data coding, the data classification scheme developed by Todd et al. was used. As indicated in Table 3 (see appendix) some modifications were made to the classification scheme. The modifications are minor and do not sacrifice the data comparisons between the two studies. The categories were changed for reasons ranging from parsimony to frequency of skill mentions within the initial sample. For example, the descriptors of 2GL, 3GL, 4GL, and COBOL were combined into the one descriptor, "programming." This decision was made for reasons of parsimony and support from the prior literature, which further justified collapsing the descriptors into one category (Nakayama and Sutcliffe 2001). Other relevant changes include addition of the descriptor "budgetary" within the business management category, which was based on the frequency of mentions within the initial sample, the addition of "general problem solving" within the business social category, which was based on discussion by the authors who felt that general problem solving in a business context represented a different skill than general problem solving in a systems context, and the moving of "creative" from systems problem solving to the business social category, due also to discussion by the authors who felt that creative represented more of a personal trait than a skill as represented in the systems class. A comparison of the descriptors within each category and class between the current study and Todd et al. are presented in Table 3 (see appendix). The individual job advertisement data were coded by having two of the authors code the job advertisements individually. The number of skill mentions for the major classes was recorded and then compared. The inter coder reliability was found to be 0.96 across the major classes. This high level of agreement is attributable to the lengthy discussion between the authors that led to the formation and understanding of the categories.

Data Analysis

The data are summarized using the same three measures that were used by Todd et al. namely the indicator data, the average data, and the percentage data. The data is analyzed and compared with the Todd et al. data at a macro level (i.e., the technical, business, and system level). Due to the modest number of ads in the sample, the micro level analysis (i.e., using the descriptors within the three main categories) was avoided. The indicator data was computed by dividing the total number of ads referring to a category at least once by the total number of ads per job type. The average data was calculated by dividing the frequency of skills referring to each category by the total number of ads per job type. The percentage data was computed by dividing the number of skills for a particular skill category (i.e., technical, business, or system) by the number of relevant phrases.

Results

The findings are presented and compared using the broad level skill classification of technical, business, and systems. A summary of data using the three measures described before, along with the Todd et al. data summary is presented in Tables 4 – 6.

Programmers

The indicator data for programmers are presented in Table 4. On average, in the Internet era, technical skills appear at least once about 97 percent of the time in an ad as opposed to 92 and 96 percent in 1970 and 1990 respectively. The technical skill requirements appear to be relatively stable over the three time periods. On average, in the Internet era, business skills appear at least once about 69 percent of the time in an ad as opposed to 28 and 60 percent in 1970 and 1990 respectively. The 9 percent increase on average in business skill requirements since the 1990s is relatively smaller than the 32 percent shift that occurred from 1970 to 1990. On average, in the Internet era, system skills appear at least once about 59 percent of the time in an ad as opposed to 54 and 68 percent in 1970 and 1990 respectively. The percentage of ads with at least one reference to systems skills, which appear to have increased from 1970 to 1990 appear to have decreased in the Internet era.

The average data for programmers are show in Table 5. On average, the frequency of technical, business, and system skills per ad has not changed since the 1990s. However, there was a shift in skill frequency per ad from 1970 to 1990 for all three categories. The percentage data, shown in Table 6, indicate that there is a small shift in the composition of the programmer ads. In the Internet era, on average 64 percent of an ad is composed of technical skills, 17 percent is composed of business skills, and 18 percent is composed of system skills. There is an emphasis on technical skills and a decline in the system skill requirements during the Internet era as compared to 1990

System Analysts

The indicator data for system analyst ads are presented in Table 4. On average, in the Internet era, technical skills appear at least once about 83 percent of the time in an ad as opposed to 37 and 77 percent in 1970 and 1990 respectively. On average, in the Internet era, business skills appear at least once about 83 percent of the time in an ad as opposed to 74 and 70 percent in 1970 and 1990 respectively. On average, in the Internet era, system skills appear at least once about 87 percent of the time in an ad as opposed to 74 and 77 percent in 1970 and 1990 respectively. Over time, the skill requirements for system analyst appear to have increased for all three categories, with a substantial jump in the business and system skills references in the Internet era as compared to 1990 (technical skill went up by 6%, business skill went up by 13% and system skill went up by 10%).

The average data for system analysts are show in Table 5. On average, the frequency of technical skills, business, and system skills per ad has not changed since the 1990s. The percentage data, shown in Table 6, indicate that there is a shift in the composition of the system analyst ads. In the Internet era, on average 41 percent of an ad is composed of technical skills (13% in 1970 and 43% in 1990), 34 percent is composed of business skills (34% in 1970 and 24% in 1990), and 25 percent is composed of system skills (53% in 1970 and 33% in 1990). There is a steady decline in the frequency of system skill requirements over time. There is an increase in the business skill requirements since 1990 (a 10 % increase).

IS Managers

The indicator data for IS Managers are presented in Table 4. On average, in the Internet era, technical skills appear at least once about 86 percent of the time in an ad as opposed to 52 and 65 percent in 1970 and 1990 respectively. On average, in the Internet era, business skills appear at least once about 93 percent of the time in an ad as opposed to 86 and 92 percent in 1970 and 1990 respectively. On average, in the Internet era, system skills appear at least once about 55 percent of the time in an ad as opposed to 79 and 80 percent in 1970 and 1990 respectively. The technical skill requirements for IS managers appear to increase substantially since 1990 (up by 21%). There is a significant drop (down by 25%) in the mentions of the system skills since 1990. There is not a significant shift in the business skill requirements since 1990.

The average data for IS managers are show in Table 5. On average, the frequency of technical and business skills per ad have not changed since the 1990s. However, there is a decline (by 1.2 skill) in the frequency of system skill mentions per ad since 1990. The percentage data, shown in Table 6, indicate that there is a shift in the composition of the IS manager ads. In the

Table 5. Average Data (average number of skill per category)

		1970 (Todd et al, 1995)	1990 (Todd et al, 1995)	1997 & 2001 (Current Study)
Programmers	Technical	2.2	4.3	4.5
	Business	0.5	1.3	1.2
	System	1	1.3	1.3
/ / / / /				
System Analysts	Technical	0.9	3.5	3
	Business	1.5	1.9	2.5
	System	1.7	1.9	1.9
/ / / / /				
IS Managers	Technical	1	2	2.2
	Business	2	3	3.1
	System	2	2	0.8
/ / / / /				
DB Administrators	Technical	Not Examined	Not Examined	4.9
	Business	Not Examined	Not Examined	1.1
	System	Not Examined	Not Examined	1.6

Table 6. Percentage Data (percentage of skills per category)

		1970 (Todd et al, 1995)	1990 (Todd et al, 1995)	1997 & 2001 (Current Study)
Programmers	Technical	68	61	64
	Business	9	19	17
	System	23	21	18
/ / / / /				
System Analysts	Technical	13	43	41
	Business	34	24	34
	System	53	33	25
/ / / / /				
IS Managers	Technical	20	29	36
	Business	40	42	51
	System	40	29	13
/ / / / /				
DB Administrators	Technical	Not Examined	Not Examined	65
	Business	Not Examined	Not Examined	14
	System	Not Examined	Not Examined	21
	Analyst			

Limitations and Future Research

The two major limitations of this study are the use of job ads to examine the skill requisite of IS personnel and the sample size used. With regards to the former, job ads are used as a recruitment tool and thus reflect to a certain degree the nature of skills desired in potential IS personnel (Todd, et al. 1995; Wade and Parent 2002; Walsh, et al. 1975). However, future research should

capture the perspectives of the different stakeholders (such as practitioners and academicians) and compare their perspectives with the perspectives reflected in IS job advertisements.

Conclusion

The importance of matching IS workers' skills with the skills needs of organizations is often addressed within the academic and practitioner literature. Many other studies assessing IS skills have appeared in the literature as well (Berry 1998; Freeman 1998; Lee et al. 1995; Litecky 1994; Litecky 1996; Nelson 1991; Niederman et al. 1991; Todd et al. 1995; Trauth et al. 1993; Wagner 1997). The analysis of job advertisement data represents one way to study the mix of IS skills. The results presented here are based upon initial analysis and data collection and serve only as an indication of the results that may be expected from further data collection and analysis efforts.

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Appendix Study Comparison

Todd et al. 1995		Current Study	
Technical		Technical	
Hardware	Mainframe Mini Desktop Other	Hardware	Mainframe Mini Desktop Network Other
Software	2GL 3GL 4GL COBOL Database Case Operating systems Packages Other	Software	Programming Database Case Operating systems Packages Enterprise software Other
Business		Business	
Business	Industry specific Function specific Other	Business	Industry specific Function specific Other
Management	General management Leadership skills Organization skills Project management Planning Monitor and control Training Other	Management	General management Leadership skills Organization skills Project management Planning Monitor and control Training Budgetary Other
Social	Communication skills Independent/motivated Interpersonal skills	Social	Communication skills Interpersonal skills Independent Motivated Multitasking General problem solving Creative Other
Systems		Systems	
Problem Solving	Quantitative/logical General problem solving Technical expertise Creative/innovative Other	Problem Solving	Quantitative/logical Systems problem solving Technical expertise Innovative Other
Development Methodology	Analysis Design Programming Implementation Operations/maintenance General development General technology Other	Development Methodology	Analysis Design Programming Implementation Operations/maintenance General development Other