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Linking Critical IT Skills to Industry Needs: A Study

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ABSTRACT

As the information technology profession continues to grow, educators are challenged to meet employer needs by maintaining the currency and relevance of IT education. This paper reports survey results of IT professionals from the Southwestern Pennsylvania regional technological corporate community. The research process addresses industry professionals' perceptions of what areas of study in IT are considered critical, useable, and of no importance in relation to the current workforce. Specific areas of computer-related areas of study, such as networks, databases, and software are derived through questionnaire responses. The results are then tabulated to identify the key areas of study considered critical to higher education curricular offerings in Information Technology related programs.

INTRODUCTION

The information technology (IT) profession has emerged as one of the most dynamic movements in United States workforce history and has rapidly become one of the leading segments of the U.S. economy. This expansion provides a challenging and ongoing undertaking for college/university educators who are responsible for preparing information technology professionals for the workforce. One way to meet this challenge is to collect and analyze data from industry professionals concerning IT areas of study and job skills. Once analyzed, the data may then be used to determine the relevancy and the adequacy of IT educational programs and courses.

A number of previous studies have surveyed employers to identify and evaluate the areas of study and skills that should be addressed in an IT curriculum. These studies have been useful in understanding how the needs of industry have changed over time; particularly with respect to technical skills. Hingorani and Sankar (1995) compared the prioritization of IT skills by graduating seniors versus those by industry professionals. Jiang, Udeh, and Ayajneh (1994) surveyed recruiters in reference to 13 different IT related job skills. Richards, Yellen, Kappelman, and Guynes (1998) asked IT managers to rate the importance of 19 business, people-related, and technical skills. Bailey and Mitchell (2000) focused their study on employers' perceptions of the importance of various "soft skills," while other researchers have analyzed the content of IT job advertisements in newspapers to determine the areas of study that are considered to be the most essential by employers (Maier, Clark, & Remington, 1995; Todd, McGee, & Gallupe, 1995; Modzelewski, 2001).

This study relates to, and captures, the expertise of professionals who are involved in the information technology field. A survey of these professionals was conducted from a representation of the Southwestern Pennsylvania regional technological corporate community to answer the following questions:

1. What areas of study in Information Technology are critical to workforce requirements, as assessed by field professionals?
2. What areas of study in Information Technology are usable to workforce requirements, as assessed by field professionals?
3. What areas of study in Information Technology are of no importance to workforce requirements, as assessed by field professionals?

4. How do the critical areas of study in Information Technology relate to the functional roles of Information Technology professionals?

ASSUMPTIONS

This study is predicated upon the following assumptions:

1. Those individuals surveyed are a representative sample of Information Technology practitioners in the Southwestern Pennsylvania corporate district.
2. The Information Technology professionals surveyed are currently using or have used the information technology skills in their functional role.
3. The individuals surveyed can identify their needs in relation to Areas of Study Competencies in Information Technology.
4. A survey of Information Technology professionals is crucial to the assessment and subsequent revision and enhancement of higher education programs, (i.e., such programs are to service the needs of students and working professionals).

RESEARCH APPROACH

The current study surveyed information technology (IT) professionals who are employed by over 1,600 organizations in the Southwestern Pennsylvania region. The list of IT professionals used in the study was provided by the Pittsburgh Technology Council (PTC), the Association of Information Technology Professionals (AITP), and Corporate Education Career Services partners with Robert Morris University.

The geographic region involved in the study included five counties in and around the Pittsburgh area: Allegheny, Washington, Butler, Beaver, and Westmoreland. CorpTech (a Massachusetts-based survey organization) placed the Pittsburgh region as one of the nation's top ten cities for software job growth and high-tech job growth (Creedy, 1995). In the survey of 40,000 technology companies nationwide, Pittsburgh ranked near Cleveland and Cincinnati; cities that are similar to Pittsburgh in size and economic growth. Atlanta ranked first in the CorpTech study (Creedy, 1995). Pittsburgh also ranks high in information technology due to considerable advances in the region's healthcare information systems. The University of Pittsburgh Medical Center has been ranked among America's 100 Most Wired Hospitals for the past six years (Guzzo, 2003; Landro, 2002). The regional sample in the current study was intended to provide insight into the demand for IT skills in and around the Pittsburgh area. However, the findings of the study may be generalized to other geographic regions that are similar to the Pittsburgh region, in terms of demographics, economics, and maturity of information technology.

A questionnaire was developed based on a literature review and input from the PTC, the AITP, and the Corporate Education Career Services partners. The questionnaire, accompanied with a cover letter, was mailed during the period of February through May 2004. Two other information-refining phases were developed. In the first, follow-up calls and on site visits with approximately half of the original respondents were made to enhance the validity and response nature of the survey

instrument. During this phase of the study, the researchers used more open-ended methods to ascertain original findings and, in a surprising number of cases, to visualize new conceptual skills beyond the original scope of the study for future research. As an example, one result of this probe was the introduction and definition of an IT attribute that was not originally conceived: Business Information Intelligence or Integrated IT Logic Processes. IT managers rated this as the most highly regarded and desirable ability that an IT professional could exhibit. A second phase of post questionnaire analysis included face-to-face lengthy IT management interviews with the original respondents was commissioned to the Crossroads Development Group (2004). This study, when released, will determine whether Robert Morris University students are gaining and mastering the surveyed skills in undergraduate and graduate courses, and the relative competency of the student in these skill areas in comparison to students from other higher educational institutions in Western Pennsylvania. Statistically, of the 135 questionnaires mailed, 91 (67 percent) were returned. The returns of ten respondents were unusable because the respondents devoted insufficient time to IT activities or reported ambiguous data. The unusable responses reduced the number of usable returns from 91 to 81 (89 percent). The 81 returns became the basis for the analysis of data and are referred to as "the sample" for this study. The number of unique organizations/corporations surveyed in this sample was 70. In a few cases, those corporations having large and diverse IT departments (with multiple supervisors and managers in various departments or divisions) provided more than one response per corporate entity.

The design of the questionnaire included the following three main parts:

- Part I, Personal and Corporate Profile – This section was used to collect data about the experience, corporate hierarchical level, IT service, degrees attained and current professional status of the respondents.
- Part II, Areas of Study – This section was used to collect data concerning curriculum.
- Part III, Competency Profile – This section was developed to elicit information concerning the development of competencies associated with Information Technology.

For the purpose of the present research, only portions of the data from Part I and Part II of the questionnaire were used. Thus, this paper initiates and defines the first phase of a comprehensive assessment of corporate and collegiate workforce attributes and relationships.

SAMPLE CHARACTERISTICS

The first part of the questionnaire was designed to collect information regarding the general characteristics of the study sample ($n = 81$). An analysis of each question is presented in terms of frequency of response. The total population for this study included professionals who are involved with Information Technology in business, industrial, governmental, and service organizations in Southwestern Pennsylvania. Table 1 is a breakdown of the demographic profile of the participating organizations and respondents. As indicated in the table, the two largest components of the sample were from the Education & Health Services Industry (23.5%) and Manufacturing (22.2%), followed by Financial Activities such as Banking and Insurance (18.5%). Various other industries represented include Information Services, Transportation, Utilities, Business Services, Government, Retail and Construction.

More than one-half of the individual respondents (55.6%) reported that they held a Master's Degree. The size of the respondents' employers ranged from five employees to 142,000 employees. The years of experience was more evenly distributed, with the highest percentage occurring between five and ten years (22.2%).

Table 1. Demographics of Sample

<i>Industry</i>	<i>Relative Frequency</i>
Education & Health Services	23.5%
Manufacturing	22.2%
Financial Activities	18.5%
Information Services	12.3%
Transportation and Utilities	8.6%
Professional and Business	3.7%
Government	2.5%
Wholesale & Retail Trade	1.2%
Construction	1.2%
Other	6.2%
<i>Company Size</i>	<i>Relative Frequency</i>
Less than 100	12.3%
101 to 1000	39.5%
1001 to 5000	24.7%
5001 to 10000	3.7%
Greater than 10000	19.8%
<i>Highest Education</i>	<i>Relative Frequency</i>
Some College	2.5%
Associate Degree	1.2%
Bachelor Degree	27.2%
Some Graduate Study	6.2%
Master's Degree	55.6%
Doctorate	7.4%
<i>Years Employed</i>	<i>Relative Frequency</i>
0 – 2 Years	13.6%
2 – 5 Years	19.8%
5 – 10 Years	22.2%
10 – 15 Years	14.8%
15 – 20 Years	19.8%
20 or More	9.9%

ANALYSIS OF DATA AND FINDINGS

Functional Role

Table 2 illustrates the Functional Roles of the study sample. As indicated in the table, IT Managers, Project Leaders, and Programmer Analysts comprised 60.5 percent of the sample. Database Administrators, Network Administrators, Systems Analysts, and Technical Support made up 25.9% of the sample and only two respondents indicated a Functional Role of Multi-Media/Graphics Designer. The *Other* category made up 11.1% of the sample and included roles such as Manager of Professional Services, Management Consultant, Teacher, and Safety Manager. All of the respondents within the *Other* category were included in the study because they did indicate time spent in the IT profession.

Areas of Study

Part II of the questionnaire solicited responses to determine the specific IT Areas of Study that professionals consider to be *critical*, *usable*, or of *no importance*. The seven Areas of Study included were:

1. Software Development
2. Network Administration (including Professional Certifications)
3. Web Development and Programming
4. Multimedia and Graphics
5. Office Software (Database Software as the major component)

Table 2. Functional Roles

Category	Absolute Frequency	Relative Frequency
IT Manager	24	29.6%
Project Leader	14	17.3%
Programmer/Analyst	11	13.6%
System Analyst	7	8.6%
Network Administrator	5	6.2%
Technical Support	5	6.2%
Database Administrator	4	4.9%
Multimedia/Graphics	2	2.5%
Designer		
Other	9	11.1%
Total	81	100.0%

6. Project Management

7. System Development Tools and Technology

Within each Area of Study, there were multiple selections. As an example, included under the category for Software Development were programming languages such as C++, Java, COBOL, Visual Basic, and other current software. Included under the Project Management category were Project Initiation, Project Planning, Project Execution, Project Control, and Project Closure.

These data were analyzed by calculating mean values for each Area of Study, based on the following scale: 0 = *no importance*; 1 = *usable*; and 2 = *critical*.

Table 3 provides a breakdown of the responses according to perceived values. The *critical* column arranges the Areas of Study from most critical to least critical.

A review of Table 3 reveals that the most critical Area of Study is Office Software (85.2%), which included word processing, spreadsheets, presentation graphics, and database. Project management was the next significant Area of Study reported as critical by over half (50.6%) of the responses. Network Administration was the third highest Area of Study (43.2%) to be reported as critical. Although Systems Development, Web Development and Software Development were not significantly critical, these areas of study were reported as significantly *usable*. According to the respondents, Multimedia/Graphics was the least critical Area of Study (63.0%).

Critical Areas of Study Related to Functional Roles

A further analysis of the data was conducted to compare critical Areas of Study by Functional Role. The results of this comparison are presented in Table 4.

A review of Table 4 reveals that Office Software was critical, regardless of Functional Role. In fact, all respondents who function as Database Administrators, Network Administrators, System Analysts, and Multimedia/Graphics designers specified a critical need for Web Develop-

Table 3. Comparison of Respondents' Perceived Importance of Areas of Study in IT

Area of Study	No Importance		Usable		Critical	
	n	%	n	%	n	%
Office Software	0.0	0.0	12.0	14.8	69.0	85.2
Project Management	9.0	11.1	31.0	38.3	41.0	50.6
Network Administration	10.0	12.3	36.0	44.4	35.0	43.2
Systems Development	25.0	30.9	47.0	58.0	9.0	11.1
Multimedia/Graphics	51.0	63.0	26.0	32.1	4.0	4.9
Web Development	28.0	34.6	50.0	61.7	3.0	3.7
Software Development	28.0	34.6	51.0	63.0	2.0	2.5

Table 4. Comparison of Critical Areas of Study by Functional Role

	Office Software	Project Mgmt.	Network Admin.	Systems Develop.	Web Develop.	Multimedia	Software Develop.
	%	%	%	%	%	%	%
Programmer/Analyst	90.9%	63.6%	54.5%	0.0%	0.0%	0.0%	0.0%
Project Leader	78.6%	35.7%	14.3%	7.1%	0.0%	0.0%	0.0%
IT Manager	87.5%	70.8%	62.5%	25.0%	8.3%	8.3%	8.3%
Database Administrator	100.0%	0.0%	50.0%	0.0%	0.0%	0.0%	0.0%
Network Administrator	100.0%	60.0%	60.0%	0.0%	0.0%	0.0%	0.0%
System Analyst	100.0%	42.9%	0.0%	0.0%	0.0%	0.0%	0.0%
Technical Support	100.0%	40.0%	100.0%	20.0%	0.0%	0.0%	0.0%
Multimedia/Graphics	100.0%	0.0%	50.0%	0.0%	0.0%	50.0%	0.0%
Other	44.4%	44.4%	11.1%	11.1%	11.1%	11.1%	0.0%

ment, Multimedia and Software development and Office Software. Web and Software development were critical only to IT Managers, whereas Multimedia was critical to IT Managers as well as Multimedia/Graphics Designers. There is no indication of a critical need for Project Management by Database Administrators or Multimedia/Graphics Designers. Also, Systems Analysts did not report a critical need for Network Administration Areas of Study.

Specific Breakdown of the Most Critical Areas of study

A final analysis was conducted to examine the specific components included within the three most critical areas of study: 1) Office Software, 2) Project Management, and 3) Network Administration. This analysis is presented in Table 5.

In the Office Software Area of Study, over 80 percent indicated a critical need for Word Processing (84.0%), Spreadsheets (87.7%), and Database (80%). Presentation graphics was reported as the least critical of the Office Software area; however, 61.7 percent of the respondents regarded Presentation Graphics as critical.

Table 5. Breakdown of the Critical Areas of Study

Areas of Study	No Importance		Usable		Critical	
	n	%	n	%	n	%
<u>Office Software</u>						
Spreadsheets	2	2.5	8	9.9	71	87.7
Word Processing	1	1.2	12	14.8	68	84.0
Database	5	6.2	11	13.6	65	80.2
Presentation Graphics	2	2.5	29	35.8	50	61.7
<u>Project Management</u>						
Project Planning	7	8.6	27	33.3	47	58.0
Project Execution	9	11.1	27	33.3	45	55.6
Project Control	9	11.1	30	37.0	42	51.9
Project Initiation	7	8.6	39	48.1	35	43.2
Project Closure	9	11.1	39	48.1	33	40.7
<u>Network Administration</u>						
LAN Administration	13	16.0	18	22.2	50	61.7
Network Security	14	17.3	22	27.2	45	55.5
Network Tech. (N+)	24	29.6	31	38.3	26	32.1

Project management (58.0%), Project Execution (55.6%) and Project Control (51.9%) were the components found to be most critical under the Project Management category. Though, less than half of the respondents indicated a response of critical for Project Control (43.2%) and Project Closure (40.7 %). Almost half of the respondents, however, indicated Project Control and Project Closure to be usable.

Within the third critical Area of Study area, Network Administration, more than half of the respondents indicated a response of critical for LAN Administration (61.7 %) and Network Security (55.5%). The Network Technology Manager (N+) area (which leads to certification) was reported as *critical* for only 32.1 percent of the respondents and of *no importance* for 29.6 percent of the respondents.

SUMMARY AND RECOMMENDATIONS

Seven categories in the Areas Of Study relate directly to core information systems courses required in both ABET-CAC accredited information systems degree programs offered by the Computer Information and Systems Department of Robert Morris University. The university was granted the accolade by the Accreditation Board for Engineering and Technology of the Computing Accreditation Commission for both degrees of the B.S. in Information Systems Management and the B.S. in Information Sciences. Each of these degree programs share a common design that is tightly coupled to AITP's IS-2002 model curriculum (IS 2002 Model, 2002). The results of previous surveys, conducted by the CIS Department, indicated that corporate information technology managers recognized the importance of not only Office Software but also Project Management as potential Areas of Study that would be of major value to corporations. The very high percentages displayed in the Network Administration Area of Study were unexpected in that they were marked increases from the results of previous departmental assessment devices. Further, within the Network Administration area, the Network Technology Manager (N+) role (which leads to certification) was not as critical as LAN Administration and Network Security.

In fact, although not reported in this survey, the respondents were asked to indicate whether they had obtained a professional certificate. Only 17 of the 81 respondents reported that they currently held a professional certificate. Of the 17 certifications, only ten were within IT.

In summary, the present research revealed Office Software, Project Management, and Network Administration as the Areas of Study that were regarded as the most critical to employers. Within the Office Software category, Word Processing, Spreadsheet, and Database skills were regarded as more critical than other business software skills. Within the Project Management category, Project Management, Project Execution, and Project Control were regarded as more critical than other project management-related skills. Finally, within the Network Administration category, LAN Administration and Network Security were regarded as more critical than other network-related activities.

In an effort to best prepare graduates and to best serve IT-related employers, colleges and universities should underscore those areas of study that are regarded as critical by employers. Based on the findings of the present research, colleges and universities should emphasize Office Software, Project Management, and Network Administration within their IT curricula. More specifically, colleges and universities

should place particular emphasis on the aforementioned skills in each area of study category. Further, colleges and universities should continue to partner with industry in order to recognize those skills that are most essential in the workplace. In short, the most responsive and receptive IT degree programs will be the programs that best prepare graduates for the IT workforce of today and tomorrow.

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