

FITC Institute Final Report

Appendix F

Job Posting Analysis: Florida State University

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1. Introduction

One of the tasks of the FITC Assessment project is to determine how well graduates of certain technology-related programs are prepared to meet the needs of regional technology employers. Specifically, in order to determine whether the requirements for entry level full-time and internship positions are reflected in the FSU BS/IT curriculum, this portion of the analysis answers two research questions:

RQ1: What required competencies do technology employers identify in their job postings for entry-level technology-related positions?

RQ2: To what extent are the competencies specified in employer job postings related to the learning outcomes in the FSU BS/IT program?

In order to answer these questions, a job posting content analysis was conducted to identify employment requirements. Job posting content analysis is a popular method by which to discern necessary skills for workers, particularly in the IT fields (Debus & Lawley, 2009; Kim, Warga, & Moen; Smith & Ali, 2014). The competencies listed in the job postings were analyzed using the learning outcomes specified in the Association for Computer Machinery (ACM) and the Institute of Electrical and Electronics Engineers (IEEE) undergraduate IT curriculum guidelines (hereafter referred to as ACM/IEEE) and frequencies of each are reported in this phase of the study.

2. Selected Related Literature

The U.S. Chamber of Commerce reported that Florida's results in "meeting employer needs," is marked by a wage and employment level of Florida employees with an Associate of Arts (AA) degree that barely surpasses that of a high school degree (USCC, 2012). These

troubling findings suggest a misalignment between student preparation and employer needs. While up to thirty-million Americans are unemployed, underemployed or have given up looking for a job, IT workers have experienced one of the lowest jobless rates ranging from 2.1% to 7.4%, dating back to 2008 (National Science Board [NSB], 2010). Obtaining a four-year degree in the IT career field offers individuals opportunities in the field that is projected to be the fourth fastest growing by 2018 (Castellano & Sundell, 2010).

However, studies reveal a widening gap between skill set expected by employers and actual skill set of students (Tang, Lee and Koh, 2000/2001). Hunt et al., concluded that “the emerging information technologies are also requiring a new breed of IT professional - a person who understands the needs of the business as well as IT” (2011, p. 5); these competing priorities further complicate the efforts of IT educators to prepare students for careers, not simply for their entry-level job, in a field that is highly dynamic and places great emphasis on innovation (Downey, McMurtrey & Zeltmann, 2008).

Studies of IT Workforce Needs

Studies of IT workforce needs have frequently solicited feedback on competency requirements from three stakeholder groups: IT graduates or ‘early-career professionals’; employers of IT workers, obtained using online job postings and/or personal interviews; and IT curricula, a perspective that this study obtained in part from current IT students. Literature on prior studies addresses research in these three areas.

In an early study of the computing skills desired by employers of information systems (IS) professionals, Todd, McKeen and Gallupe conducted a content analysis of 20 years’ worth of job advertisements from four major newspapers from 1970-1990 resulting in findings that emphasized the need for technical skills, with the frequency of stated technical requirements increasing dramatically over the study period. Galup, Dattero and Quan’s 2004 analysis of job postings suggested a trend toward software design specifically focused on Web services was already eclipsing a need for programming or hardware knowledge.

A three year study by Lee and Han of 837 information systems (IS) job ads posted on Fortune 500 corporate analyzed the programmer/analyst skills requirements and concluded that candidates in these positions would be required to fulfill a diverse spectrum of roles including technical, business and programming roles and possess skills such as development, software and social skills; this study found less attention given to the more technically oriented network architecture, hardware and problem solving (2008).

In a study of new Management and Information systems (MIS) graduates, Downey, McMurtrey & Zeltmann identified the MIS skills 159 IT professionals from the mid-southern United States, desire and compared these to the critical skills provided in MIS curricula (2008). Downey, McMurtrey & Zeltmann concisely summarize that studies of critical skills vary based

on two factors: the stakeholders providing feedback and the criteria upon which the selection of critical skills are based (2008).

3. Method

This study employs a mixed method design to provide comprehensive data to answer the research questions. By triangulating the quantitative job competency analysis, FSU BS/T curriculum and employer interviews, we attempted to examine the competencies employers look for in entry-level technology-related positions. By examining IT curriculum, courses that cover these competencies were identified.

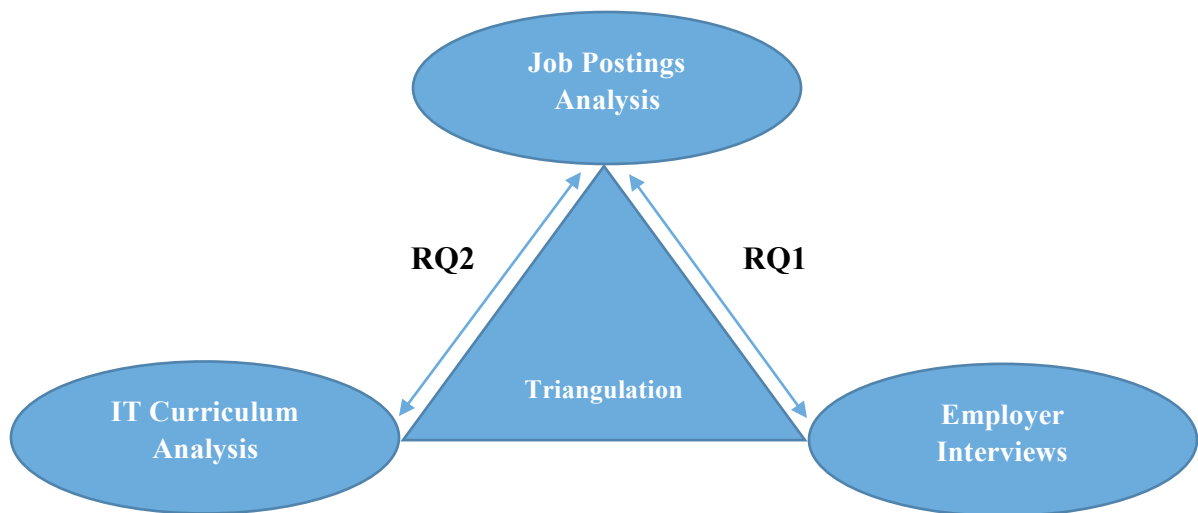


Figure1: Overview of Job postings analysis model and questions

3.1 Data Collection

In order to determine the skill and knowledge requirements conveyed by employers, job postings provided by the FSU Career Center were analyzed. This study investigates which competencies are important for employees functioning in IT roles using a sample of job postings that were categorized based on job function. The results were divided into technical competencies and general competencies using the ACM/IEEE 2008 IT curriculum framework.

The FSU Career Center provided a total of 134 job postings placed by employers between July 1, 2014 and December 15, 2014 for this study. Postings that required work experience and other managerial level job postings were eliminated from analysis, since this analysis focused on analyzing entry level positions. The 134 job postings were categorized into 10 different occupational categories based on the U.S. Bureau of Labor Statistics Computer and Information Technology Occupations.¹

1. Computer and Information Research Scientists
2. Computer Network Architects

¹ <http://www.bls.gov/ooh/computer-and-information-technology/home.htm>

3. Computer Programmers
4. Computer Support Specialists
5. Computer Systems Analysts
6. Database Administrators
7. Information Security Analysts
8. Network and Computer Systems Administrators
9. Software Developers
10. Web Developers

After initial data cleansing (eliminating duplicates, the posts which required 5+ years' experience, and managerial level postings), the 134 job posts were grouped into respective computer and information technology occupations.

Table 1: Occupations and number of jobs considered for analysis

Occupation	Number of Jobs
Computer and Information Research Scientists	1
Computer Network Architects	3
Computer Programmers	20
Computer Support Specialists	12
Computer Systems Analysts	16
Database Administrators	8
Information Security Analysts	3
Network and Computer Systems Administrators	4
Software Developers	49
Web Developers	11
Others	7
Total	134

3.2 Competency Analysis Using Codebook

The primary goal of this analysis is to examine the most important technical and non-technical competencies from the sample job postings. For this purpose, we customized a codebook from the ACM/IEEE IT 2008 curriculum guidelines to annotate the core IT job competencies in terms of general and technical competencies. This codebook is based on the knowledge units and topics/contents presented in ACM/IEEE IT 2008 IT undergraduate curriculum. The codebook includes 13 technical competencies and 10 general competencies. The codebook used for this analysis can be found in FITC Report Appendix A.

3.3 Characteristics of Job Postings and Extracting Desired Competencies

The job postings collected lacked standard formatting, and some postings provided incomplete details. For example, four job postings provided incomplete and unusual information without specifying any technical or general competencies. Such postings were excluded from this analysis. The general introduction or summary of job position, education requirements, location, and contact information were also removed from all the postings.

Sections of interest such as roles, responsibilities, and duties were mined using regular expression patterns. The mined text was further refined to extract specific technologies and general skills using the concept of *tokenization*. Tokenization is an act of breaking up sentences into segments such as words, keywords, and other elements called tokens. These tokens can be individual words or phrases. In the process of tokenization, some characters like punctuation marks are discarded. Unigrams (one word) and bigrams (two words) were extracted from the postings. Bigrams were extracted from text in order to identify certain words like “problem solving” or “interpersonal skills,” which would otherwise make no sense if single words were considered. This way, all technology skills and general competency skills were mapped to the specific competencies in the ACM/IEEE codebook and their frequencies were calculated, in turn mapping it to appropriate course in IT curriculum.

Python programming language was employed in the entire process to remove duplicate files, search required sections, conduct spell checking and tokenization, and to extract skills by removing stop words.

4. Findings

Results are divided into two sections: a) technical and general competencies required of new IT professionals; and b) how these skills map to the learning outcomes of the FSU BS in IT program derived using the same ACM/IEEE codebook identities.

4.1 Technical and general competencies

To test which skills were most frequently requested by employers, we examined skills from job postings for different job functions. Table 2 provides various job functions and statistical information on frequency of technical and general competencies identified in job postings.

Table 2: Technical and general competencies identified from different job functions and the list of courses the job posting requirements.

Job Function	Technical Competencies (Frequency)	General Competencies (Frequency)	Mapped to courses in FSU BS in IT program
Computer and Information Research Scientists	SIA(1) SA(1) PF(1) IPT(1)	SP-TW(1)	<ol style="list-style-type: none"> 1. Research & Data Analysis for Information Professionals(LIS 3201) 2. Information Architecture (LIS 3793) 3. Information Technology Project (LIS 4910) 4. IT Leadership(LIS 4480) 5. Information Systems & Services(LIS 3706) 6. Information Technology Project (LIS 4910) 7. Extensible Enterprise Solutions (LIS 4369) 8. Website Development with PHP(LIS 4368) 9. Extensible Enterprise Solutions (LIS 4369)
Computer	SIA(8)	SP-COM(6)	<ol style="list-style-type: none"> 1. Advanced Database Management(LIS

Network Architects	NET(4) SA(3) IM(2) PF(2)	SP-PS(5) SP-SM(5) SP-TW(2) SP-FL(2) SP-BF(3)	3781) 2. Extensible Enterprise Solutions (LIS 4369) 3. Information Architecture (LIS 3793) 4. Information Organization & Communication(LIS 3784) 5. Information Systems & Services(LIS 3706) 6. Information Technology Project (LIS 4910) 7. IT Leadership(LIS 4480) 8. Managing Networks & Telecommunications(LIS 4482) 9. Network Administration(LIS 4488) 10. Research & Data Analysis for Information Professionals(LIS 3201)
Computer Programmers	PF(30) SIA(22) SA(11) IM(8) WS(6) NET(5) IPT(4) HCI(4) PT(1) MS(2)	SP-BF(14) SP-TW(5) SP-CUS(6) SP-SM(4) SP-COM(4) SP-IS(3) SP-PS(2) SP-FL(2)	1. Advanced Database Management(LIS 3781) 2. Digital Graphic Design(DIG 3118) 3. Extensible Enterprise Solutions (LIS 4369) 4. Information Architecture (LIS 3793) 5. Information Organization & Communication(LIS 3784) 6. Information Systems & Services(LIS 3706) 7. Information Technology Project (LIS 4910) 8. IT Leadership(LIS 4480) 9. Managing Networks & Telecommunications(LIS 4482) 10. Network Administration(LIS 4488) 11. Research & Data Analysis for Information Professionals(LIS 3201) 12. User Experience Design(LIS 4351) 13. Website Development with PHP(LIS 4368)
Computer Support Specialists	NET(19) SA(7) SIA(7) PF(3) PT(2) NET(1) IPT(1) WS(1)	SP-CUS(7) SP-COM(4) SP-PS(3) SP-FL(1) SP-IS(1) SP-SM(1)	1. Website Development with PHP(LIS 4368) 2. Research & Data Analysis for Information Professionals(LIS 3201) 3. Network Administration(LIS 4488) 4. Managing Networks & Telecommunications(LIS 4482) 5. IT Leadership(LIS 4480) 6. Information Technology Project (LIS 4910) 7. Information Systems & Services(LIS 3706) 8. Information Architecture (LIS 3793) 9. Extensible Enterprise Solutions (LIS 4369) 10. Digital Graphic Design(DIG 3118)
Computer Systems Analysts	SIA(27) SA(10) IM(6) PF(4) HCI(1) NET(1) PT(1)	SP-BF(19) SP-TW(10) SP-CUS(9) SP-COM(6) SP-FL(6) SP-IS(2) SP-SM(2) SP-CUS(2)	1. Advanced Database Management(LIS 3781) 2. Extensible Enterprise Solutions (LIS 4369) 3. Information Architecture (LIS 3793) 4. Information Organization & Communication(LIS 3784) 5. Information Systems & Services(LIS 3706) 6. Information Technology Project (LIS 4910) 7. IT Leadership(LIS 4480)

			8. Managing Networks & Telecommunications(LIS 4482)
			9. Network Administration(LIS 4488)
			10. Research & Data Analysis for Information Professionals(LIS 3201)
			11. User Experience Design(LIS 4351)
Database Administrators	IM(21) SIA(13) SA(6) PF(5) IPT(1) HCI(1)	SP-BF(5) SP-SM(3) SP-FL(3) SP-CUS(2) SP-COM(2) SP-TW(1)	1. Advanced Database Management(LIS 3781) 2. Extensible Enterprise Solutions (LIS 4369) 3. Information Architecture (LIS 3793) 4. Information Organization &Communication(LIS 3784) 5. Information Systems & Services(LIS 3706) 6. Information Technology Project (LIS 4910) 7. IT Leadership(LIS 4480) 8. Research & Data Analysis for Information Professionals(LIS 3201) 9. User Experience Design(LIS 4351) 10. Website Development with PHP(LIS 4368)
Information Security Analysts	IAS(18) SA(6) SIA(5) PF(4) NET(3) MATHS(2) HCI(1) IM(1) PT(1)	SP-BF(3) SP-FL(2) SP-IS(2) SP-PS(2) SP-COM(1) SP-SM(1) SP-TW(1) SP-A(1)	1. Research & Data Analysis for Information Professionals(LIS 3201) 2. Information Architecture (LIS 3793) 3. Information Systems & Services(LIS 3706) 4. Information Technology Project (LIS 4910) 5. Information Organization &Communication(LIS 3784) 6. Advanced Database Management(LIS 3781) 7. Managing Networks & Telecommunications(LIS 4482) 8. Network Administration(LIS 4488) 9. User Experience Design(LIS 4351) 10. Digital Graphic Design(DIG 3118) 11. Website Development with PHP(LIS 4368) 12. Extensible Enterprise Solutions (LIS 4369) 13. Information Systems & Services(LIS 3706)
Network and Computer Systems Administrators	NET(29) SA(13) SIA(6) IAS(3) IM(2) PT(2) IPT(1)	SP-BF(8) SP-SM(7) SP-FL(4) SP-TW(4) SP-COM(2) SP-CUS(1) SP-PS(1)	1. Advanced Database Management(LIS 3781) 2. Extensible Enterprise Solutions (LIS 4369) 3. Information Architecture (LIS 3793) 4. Information Organization &Communication(LIS 3784) 5. Information Systems & Services(LIS 3706) 6. Information Technology Project (LIS 4910) 7. IT Leadership(LIS 4480) 8. Managing Networks & Telecommunications(LIS 4482) 9. Network Administration(LIS 4488) 10. Research & Data Analysis for Information Professionals(LIS 3201) 11. Website Development with PHP(LIS 4368)

Software Developers	SIA(78)	SP-TW(24)	1. Advanced Database Management(LIS 3781)
	SA(52)	SP-COM(21)	2. Digital Graphic Design(DIG 3118)
	PF(38)	SP-SM(19)	3. Extensible Enterprise Solutions (LIS 4369)
	IM(27)	SP-BF(18)	4. Information Architecture (LIS 3793)
	IPT(24)	SP-CUS(16)	5. Information Organization & Communication(LIS 3784)
	WS(18)	SP-FL(13)	6. Information Systems & Services(LIS 3706)
	PT(14)	SP-PS(10)	7. Information Technology Project (LIS 4910)
	HCI(11)	SP-BF(9)	8. IT Leadership(LIS 4480)
	IAS(4)	SP-	9. Managing Networks & Telecommunications(LIS 4482)
	NET(4)	CREATIVE(3)	10. Network Administration(LIS 4488)
	CS-AL(3)	SP-IS(1)	11. Research & Data Analysis for Information Professionals(LIS 3201)
			12. User Experience Design(LIS 4351)
			13. Website Development with PHP(LIS 4368)

The technical competencies identified were combined from all job positions to rank the most frequently occurring technical competencies. It was observed that SIA (System Integration and Architecture) related skills occurred most frequently in job postings and ranked #1 with a frequency 167. According to the ACM/IEEE 2008 IT undergraduate curriculum, “One of the roles of the IT professional is to design and build systems and integrate them into an organization. System Integration and Architecture area develops the skills to gather requirements, then source, evaluate and integrate components into a single system, and finally validate the system. It also covers the fundamentals of project management and the interplay between IT applications and organizational processes” (p. 113).

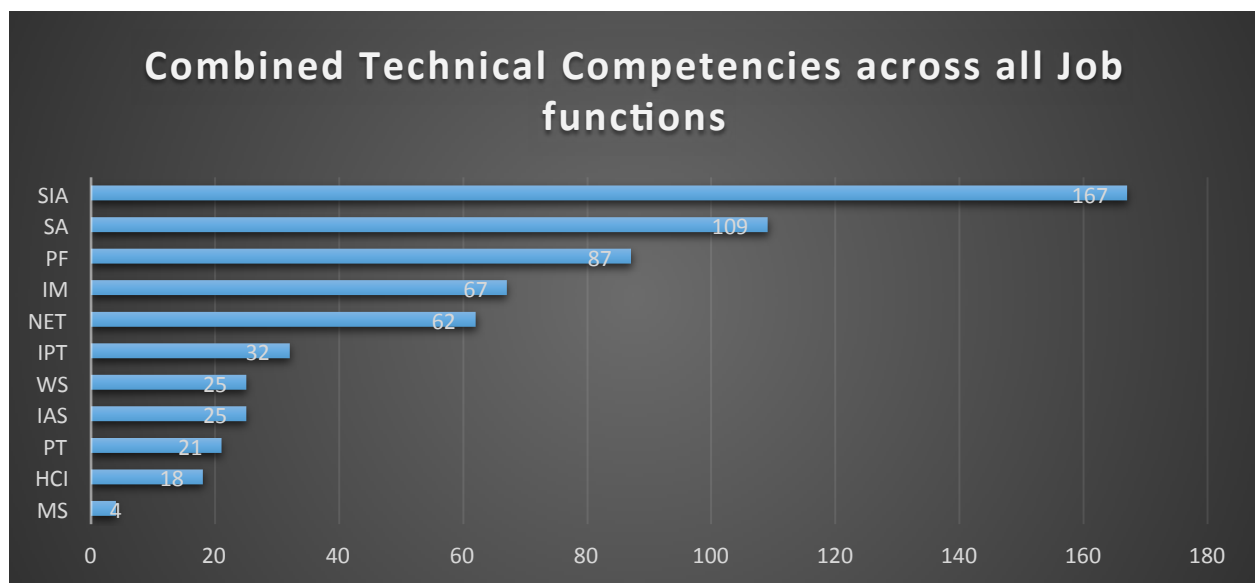


Figure 1: Technical competency skills in all job postings.

Figure 1 sorts the technical competencies in descending order. The five top ranked competencies from job postings were SIA, SA, PF, IM and NET with frequencies 167(27%), 109(17.7%), 87(14.1%), 67(10.8%), and 62(10%) respectively.

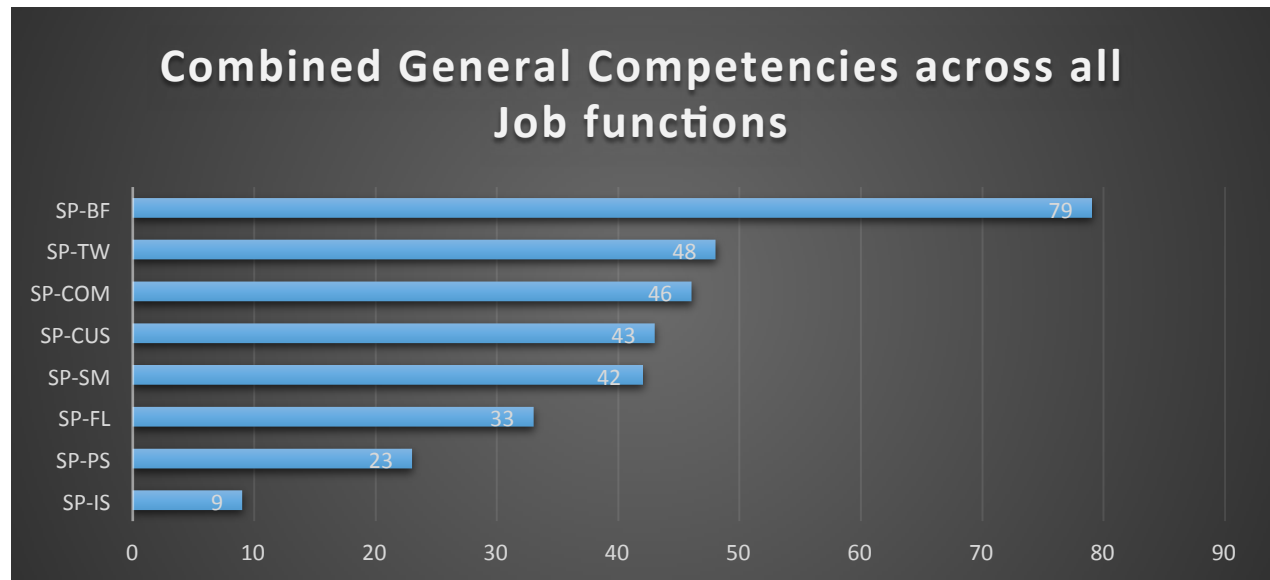


Figure 2: General competency skills in all job postings.

Figure 2 indicates the frequency of general competency skills in all job postings. These are sorted in descending order. The top ranked 5 competencies from job postings were SP-BF Business Fundamentals, SP-TW Team Work, SP-COM Communication Skills, SP-CUS Customer Skills, and SM - Self Management with frequencies 79(24.4%), 48(14.86%), 46 (14.24%), 43(13.31%) and 42(13%) respectively.

4. Discussion

4.1 Findings Discussion

This portion of the FITC Assessment project answered two research questions:

- What are the technical and general competencies that job postings identify for entry level technology-related positions?
- To what extent do the competencies specified in employer job postings related to the learning outcomes in the FSU BS in IT program?

In order to answer these questions, 134 (N=134) job postings collected from the FSU Career Center, and FSU IT undergraduate curriculum syllabi were analyzed. It was determined that SIA, SA, PF, IM and NET were the top 5 most frequently emerging technical competencies from job postings, and the top 5 most frequently emerging general competencies identified from job postings were SP-BF, SP-TW, SP-COM, SP-CUS and SP-SM. Employer interviews were a part of the FITC Assessment, wherein employers mentioned that these general competency skills

were important. Software Developers, Computer Systems Analyst, and Computer Programmers were the three job categories where this trend was identified.

In order to gain refined skills and expertise, many IT professionals choose to pursue a certification. Based on the findings of 134 job postings analysis and employer interviews, a list of certifications employers post in job ads was identified. Database related certifications (Oracle certifications), programming language certifications (Java, VB .NET), network/security certifications (CCNP, CCNA, etc.), and project management certifications like CAPM (Certified Associate in Project Management) and PMP (Project Management Professional) were among the most frequently emerging certifications from both job postings and employer interviews. Certification analysis was conducted as a part of FITC Assessment, and selected certification contents were mapped with FSU IT and FAMU IT programs. The FSU IT program covers the certification requirements identified in job postings and employer interviews.

4.2 Limitations

Limitations include the inconsistent and sometimes incomplete nature of the job postings. Further, postings often describe ideal situations that can be altered by the reality of job logistics, and job site resource limitations. Since this is a convenience sample, using 134 unique job postings from the FSU Career Resource Center, there is no generalizability of the results, therefore ranking technical and general workplace competencies may change based on discipline, and job function. This analysis of job postings can only suggest the important competencies for different job functions.

An additional limitation is that this is a fairly homogenous sample of job postings: 49 of 134(36.5%) of the job positions were intended for Software Developer positions, resulting in the largest percentage of job postings, biasing the technical competencies identified. The literature on job posting creation indicates a great diversity in the process, often one that does not include the operational supervisors of the job in question but is quite often completed by a human resource agent who is not completely familiar with a job's required expertise. Further, in technology fields, studies suggest that employers rely on the use of industry certifications to indicate desired technical competencies that may not accurately state requirements or preferences for a position, especially for entry-level jobs.

5. Conclusion.

References

- Castellano, M., & Sundell, K. (2010). Rigorous tests of student outcomes in CTE programs of study. National Research Center for Career and Technical Education. 1-2. Available at http://136.165.122.102/UserFiles/File/OnePagers/New_Current_Summaries/Rigorous_Tests_Year_4.pdf
- Debuse, J. and Lawley, M. (2009). Desirable ICT graduate attributes: theory vs. practice. *Journal of Information Systems Education*, 20(3), pp. 313-323. Retrieved from <http://jise.org>
- Downey, J. P., McMurtrey, M. E., & Zeltmann, S. M. (2008). Mapping the MIS Curriculum Based on Critical Skills of New Graduates: An Empirical Examination of IT Professionals. *Journal of Information Systems Education*, 19(3), 351–364.
- Galup, S. D., Dattero, R., & Quan, J. J. (2004). The demand for information technology knowledge and skills: an exploratory investigation, *Journal of International Technology and Information Management*, 3(4), 253-261
- Hunt, C. S., Crews, T. B., Feather-Gannon, S., Hunt, D., & Smith, L. B. (2011). Perceptions and validation of key Information Technology Competencies from an IT alumni viewpoint: Another stakeholder in the curriculum design process. *Review of Business Information Systems*, 15(2),
- Kim, J., Warga, E., Moen, W. E. (2013). Competencies required for digital curation: An analysis of job advertisements. *The International Journal of Digital Curation* 8(1), 66-83. <http://dx.doi.org/10.2218/ijdc.v8i1.242>
- Lee, C. K., & Han, H. (2008). Analysis of skills requirement for entry-level programmer/analysts in Fortune 500 corporations. *Journal of Information Systems Education*, 19(1), 17
- National Science Board (NSB). 2010. Science and Engineering Indicators 2010. Arlington, VA: National Science Foundation (NSB 10-01)
- Smith, D. and Ali, A. (2014). Analyzing computer programming job trend using web data mining. *Issues in Informing Science and Information Technology*, 11, pp. 203-214. Retrieved from <http://iisit.org>
- Tang, H., Lee, S., & Koh, S. (2000/2001). Educational gaps as perceived by IS educators: A survey of knowledge and skill requirements. *Journal of Computer Information Systems*, 41(2), 76-84.
- Todd, P. A., McKeen, J. D., & Gallupe, R. B. (1995). The evolution of IS job skills: A content analysis of IS job advertisements from 1970 to 1990. *MIS Quarterly*, 19(1), 1–27. doi:10.2307/249709

U. S. Chamber of Commerce [USCC]. (2012). Leaders and laggards: A state-by-state report card on public postsecondary education. Retrieved from <http://icw.uschamber.com/reportcard/>