Aligning Expectation And Reality About IT Career Preparation: Perception Of Job Competencies By Students, New Professionals, And Employers

By

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Abstract

The skills that individuals need to compete in the knowledge economy place the emphasis on improving science, technology, engineering and mathematics (STEM) education in general and information technology (IT) education in particular. Understanding the underlying use of information and communication technologies (ICT) in all aspects of life sets the educational agenda that guides IT technician education and the future skill sets of IT workers. Prior research has focused on the value of undergraduate IT degrees but not enough is known about the impacts that IT education may have on student employment success and the labor market. This study examines current IT students' job competency expectations provided in IT college curricula, identifies the actual job competencies new IT professionals need, and describes the alignment between these competencies and the staffing needs reported by northwest Florida employer job postings. This paper presents preliminary findings of the four-year, National Science Foundation Advanced Technological Education (NSF ATE) project, *Assessing Information Technology Educational Pathways That Promote Deployment and Use of Rural Broadband* in which IT technician education is viewed from the perspective of the student and new professional in an effort to examine how IT workers meet the needs of employers.

Introduction

The skills that individuals need to compete in the knowledge economy place the emphasis on improving science, technology, engineering and mathematics (STEM) education in general and information technology (IT) education in particular. Understanding the underlying use of information and communication technologies (ICT) in all aspects of life precedes this challenge (Kozma, 2011) but sets the educational agenda that guides IT technician education and the future skill sets of IT workers. Prior research has focused on the value of undergraduate IT degrees but not enough is known about the impacts that IT education may have on student employment success and the labor market as reflected in employer perspectives expressed in job postings (Van Noy & Jacobs, 2012; Van Noy & Weiss, 2010).

Purpose and Significance of the Study

This paper presents preliminary findings of the four-year, National Science Foundation Advanced Technological Education (NSF ATE) project, *Assessing Information Technology Educational Pathways That Promote Deployment and Use of Rural Broadband*[1] in which IT technician education is viewed from the perspective of the student and new professional in an effort to examine how IT workers meet the needs of employers. The study is based on the research of northwest Florida communities and begins with views of undergraduate IT students from Tallahassee Community College (TCC), Chipola College (Chipola) and Florida State University (FSU) School of Information and then examines employer needs expressed in IT job postings.

IT employment is an enormous sector that spans numerous job titles and professional functions from systems administrator to applications developer, IT professionals are responsible for building and maintaining organizations' and communities technical infrastructure as well as the applications that are used within it. One obvious growth area in the implementation and maintenance of structures, systems, and applications that enable the use of the internet. However, as high speed Internet connectivity increasingly penetrates many areas of the United States, some areas of the country are excluded from the spread. Northwest Florida is just such an area with its mix of highly rural and non-rural communities that have erratic broadband presence. A key barrier to adding broadband connectivity in Northwest Florida is the availability of specialized IT technicians (McClure, Mandel, Alemanne, Saunders, Spears, & Bishop, 2011a; McClure, Mandel, Alemanne, Saunders, Spears, & Bishop, 2011b). With the clear impetus of the internet and a documented lack of skilled technicians to build, maintain, and manage organizational and community internet infrastructure in rural areas, more research must be done to determine the extent to which IT education meets the needs of employers in both rural and non-rural settings through several perspectives that include:

- Impacts based on such policy directives such as the Federal Communications Commission's (FCC) *National Broadband Plan (2010)* that spells out high-speed Internet deployment across America; or the more recent *Modernizing E-Rate* that realigns schools' and libraries' technology subsidies to direct the funding toward wireless capabilities at the nation's schools and libraries.
- Economic development initiatives, some of which have been implemented as a result of the Broadband Technology Opportunities Program;

[1] Study abstract available at the Information Institute website http://www.ii.fsu.edu/Research/Projects/Assessing-Information-Technology-Educational-Pathways-that-Promote-Deployment-and-Use-of-Rural-Broadband-NSF

- An examination of education curriculum standards that specifically guides the creation of IT programs at K-20 institutions; and
- The view of stakeholders in the education pipeline that include educators, students, IT professionals in the field, and the employers who need IT expertise in many roles in industry.

Research Questions

This study examines current IT students' job competency expectations, describes the actual job competencies new IT professionals need on the job, and identifies any gaps between these competencies and the staffing needs reported by northwest Florida employer job postings. This overarching purpose was achieved through the pursuit of three research questions:

RQ1: Are students' perceptions of IT job competencies misaligned with the employers' expectations for IT job competencies derived from job posting ads?

RQ2: Are new professionals perceptions of job competencies needed misaligned with the employers' expectations for job competencies derived from job posting ads?

RQ3: How are current students' perceptions of job competencies aligned/misaligned with new professionals' perceptions of job competencies needed?

This paper proposes that a fundamental examination of these various elements begins with this last point which includes a look at stakeholder perceptions of the IT competencies received in formal education, the competencies that are beneficial on the job, and the competencies being sought by employers as viewed through an analysis of IT job postings. While federal policy drives funding and state and district policies dictate implementation, another view of IT education effectiveness is in the ability of an educated IT professional to meet the needs of employers. In spite of federal funding and state and local mandates, ICT deployment is only as effective as the IT professionals who can facilitate its use.

Selected Related Literature

IT Diffusion in America

IT needs in rural communities. Forty-four percent of rural American households lack broadband capability and rural, low-income minority households' broadband adoption lags behind all other groups (NTIA, 2011). Low adoption rates in rural communities can be attributed in part to decreased availability of broadband service, expense of computers and Internet service, and a perceived lack of need for a household connection (Carnevale, Smith, Stone, Kotamraju, Steuernagel & Green, 2011). But if rural communities are going to capitalize on the benefits that broadband can bring for economic development, they will need more employees with advanced, diverse technology skills

Northwest Florida communities. Florida's Workforce Investment Act Annual Report for 2009-2010 identifies unique problems educating rural Floridians because of the nature of rural markets—they are low density, often at a distance from training and education facilities, and have minimal (or no) deployment of or access to broadband Internet. The report notes that "Rural Florida faces unique challenges, especially in meeting transportation and infrastructure needs" (Workforce Florida, 2011, p. 57).

The need to enhance the IT workforce in northwest Florida is supported by a significant body of research McClure, et al., 2011a; McClure, et al., 2011b) that assessed the Florida Rural Broadband Alliance, (FRBA) and the North Florida Broadband Authority (NFBA), funded by the Broadband Technology Opportunities Program (BTOP). The results of these studies suggest that key barriers to adding broadband connectivity or increasing existing connection speeds is the availability of specialized IT personnel.

The U.S. Chamber of Commerce *Leaders and Laggards Report Card* on public postsecondary education reported that Florida undergraduate institutions received high marks for student access, success, and cost effectiveness with higher retention and completion rates than the national average. However, in the *Report Card*'s area of "meeting employer needs," the Chamber reported the wage and employment levels of Florida employees with an Associate of Arts (AA) degree are barely surpasses that of a high school degree (USCC, 2012). These troubling findings suggest a misalignment between student preparation and employer needs. Little collaborative research has been done on the intersecting needs of IT educators, students, and employers concerning IT skills.

IT jobs in the American workplace. While up to thirty-million Americans are unemployed, underemployed or have given up looking for a job, employers report up to six million vacancies with another six million additional jobs disappearing to international markets or as the result of job obsolescence (Gordon, 2013). In addition to being one of the most difficult to fill jobs, 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).

According to the U.S. Bureau of Labor Statistics (BLS) (2011), computer systems design and related services industry will be in the top five largest-job-growth industries for 2008-2018, with the strongest growth in network systems and data communications analysis IT is projected to experience up to 18% employment growth for computer-related occupations from 2012 to 2022 including information security analysts (37%), computer systems analysts, computer and information research scientists, computer user support specialists, software developers and web developers (20 to 25%) and 15% or more growth for computer and information systems managers and computer hardware engineers. This compares to just an 11% growth for all occupations combined. A bachelor's degree in computer-related fields is the minimum degree required for most computer-related occupations, except for the position of web developers that typically requires only an associate degree (BLS, 2014). 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).

IT is a dynamic and pervasive phenomenon. With the rapid changes in IT and its evolution as an indispensable skill in many organizations, keeping abreast with new trends is crucial for IT educators. A number of researchers have reported that new graduates lack the skills necessary to prosper in today's IT environment (Fang, Lee, & Koh, 2005; Noll & Wilkins, 2002). IT wields a fundamental and pervasive presence in all jobs, underpinning both the American and the global economies as technology skills become a significant core business knowledge and become synthesized and integrated into the fundamental business processes of organizations (Lee, 2005).

Widening skills gap. Other studies reveal a widening gap between expected skill set 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). This is complicated by the studies of unprepared end-users who interact with technologies integrated into business processes (McClure, et al., 2011b; Yellen, 2005), resulting in a "widening gap between a growing demand for and an insufficient supply of workers" (Hawk, Kaiser, Goles, Bullen, Simon, Beath, Gallagher, & Frampton, 2012, p. 2).

The Challenge for Educators

Education policy in Florida. The National Broadband Plan (NBP), released by the FCC on March 17, 2010, is a roadmap for initiatives to stimulate economic growth, spur job creation and boost America's capabilities in education, health care, homeland security through increased availability and use of broadband. However, the sweeping and somewhat general nature of the NBP only begins to address the many challenges facing educators, students and employers as IT skills sets become fundamental "critical skills" (Downey, McMurtrey & Zeltmann, 2008). At the state level, many of these programs fall into the category of unfunded mandates: in 2012, the Florida Department of Education requested $390 million from the state legislature for the 2013-2014 school year to build the requisite infrastructure to support its digital education advances but state lawmakers only returned $76 million to fund school projects (O'Connor, 2013). The FCC's recent e-Rate modernization plan is not perceived by district education administrators to bring any relief, as subsidies for school and library internet connections that previously funded all connectivity will now only fund those with apparent needs for wireless connectivity. Schools that do not demonstrate a need for wireless will go without funding (O'Connor, 2014).

Finding federal directives funding digital education initiatives and extensive broadband infrastructure insufficient, Florida's state leadership has adopted a market-based approach to school reform in a paradigm shift that seeks to prepare students for the workforce rather than secondary school readiness (Zhao, 2013). This includes the most recent Florida Board of Governors $15 million dollar budget for Targeted Educational Attainment (TEAm) grants funded by the state legislature specifically targeting partnerships between educators and local industry. Grantees include university collaborations like the Florida IT Career (FITC) Pathways Alliance that combines the efforts of FSU, Florida Agricultural & Mechanical University (FAMU) along with community colleges and northwest Florida regional high schools.

These initiatives build on other Florida efforts such as the 2011 Digital Learning Now Act (DLNA) that mandates K- 12 digital learning delivery (FLDOE, 2012), the FloridaLearns STEM Scholars program (FL-STEM, n.d.) and the $10K Degree Challenge (FCS, 2014) issued to Florida colleges by Governor Rick Scott. These programs intend to develop partnerships with local community interests to advance the varied aspects of IT in education and the need for a digitally literate citizenry.

Curricula. Providing up-to-date curricula in a constantly changing policy environment that emphasizes the need for technology skills as 'essential skills' or 'critical skills', educators will be challenged to ensure that these skills are those that will advance students in the job market (Crews, 2004; Gordon, 2013; Hunt, et al., 2011). These skills are as dynamic as the innovative workplace needs they are designed to serve and this makes the integrity and value of an IT curriculum subject to constant scrutiny (Downey, McMurtrey & Zeltmann, 2008; especially as the behavioral skills, often termed 'soft skills' but named "General Competencies" in this study, are increasingly as critical as technical skills (Downey, McMurtrey & Zeltmann,

2008; Lee, 2005; Lee & Han, 2008). The change in emphasis from technical to general is a demonstrated cycle (Todd, McKeen and Gallupe, 1995).

Studies of IT Workforce Needs

Studies of IT workforce needs have frequently solicited feedback on competency requirements from three stakeholder groups: IT graduates, from which this study focuses on 'new professionals'; employers of IT workers, obtained using online job postings; 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.

IT graduates/new professionals. In a 2011 Organizational Systems and Research Association study of Organizational End-user Information Systems (OEIS) curriculum, Hunt, et al., found that recent graduates working in IT professions expressed that an understanding of the systems development life cycle (SDLC) was an essential component of an IT curriculum (2011). Graduates also perceived that experiential learning obtained in an internship experience was "of critical importance for information technology (IT) professionals (Hunt, et al., 2011, p. 1). To address the emphasis placed by the OEIS curriculum on graduates who can bridge a gap found between IT developers and "the typical computer end-user" (Hunt, et al., 2011, p. 5), the research team developed a Management, Technology and Communication (MTC) triad baseline model. This model focuses on systemic skills so students "know how to manage, communicate, and implement effective technological solutions in a global marketplace (p. 6). OEIS alumni rated the model using a Web-based instrument assessing the importance of learning outcomes based on a 5-point Likert-type scale. Alumni indicated that user needs, software, troubleshooting were most important topics and the use of internships the highest rated experience component in the curriculum.

Job postings. In an early study of 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. This look at the early years of computing in industry demonstrates an emphasis on the need for technical skills, with the frequency of stated technical requirements increasing dramatically over the study period. Requirements for managers of IT systems and for business and systems knowledge, the two non-technical categories, showed minimal change (1995). 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).

IT professionals/IT employers. 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). This paper describes the use of a federal labor agency competency classification (Office of Personnel Management) as a

criterion with which to analyze the competencies, expressed as skills, knowledge and abilities derived from job postings collected from 11 online sources available to employers posting in the rural northwest Florida region.

In a hybrid study, a list of information systems (IS) knowledge, programming, platforms/operating systems/applications, networking and database software, basic business knowledge and interpersonal/management skills were compiled into a survey sent to 380 companies who recruit all majors from a small Midwestern university (Noll and Wilkins, 2002). Respondents were asked to rate the future importance of the skills, based on a three-year time range, revealing five significant factors: business knowledge, advanced IS applications, user support, programming and systems planning. Researchers sent a companion survey with the same IS skill set to recent alumni of the IS program and the results confirmed the employer assessments, suggesting that the study's list may reflect an accurate view of the IS skills needed in the workplace (Noll and Wilkins, 2002).

In recruiting and selection of applicants for IT positions, employers indicated that in spite of the need for technical skills, an emphasis is placed on practical, experiential, project-oriented skills. In particular, mis-alignment occurs with project-oriented skills as students are often not educated in the skills to manage need for flexibility or revision of scope in project management Technical skills needed include software architecture with which students demonstrate the ability to synthesize the various and distinct skills provided in an IT program (Miller & Dettori, 2008).

Method

This study employs a mixed-method design to provide comprehensive data to answer the three research questions (Figure 1). By triangulating the quantitative job competency analysis and qualitative focus groups and interviews results, we attempt to examine alignment of current students, new professionals, and employers' expectations and reality of IT preparation in northwest Florida. These questions summarize preliminary findings of the larger NSF ATE research headed up by the authors and is based on unpublished results.

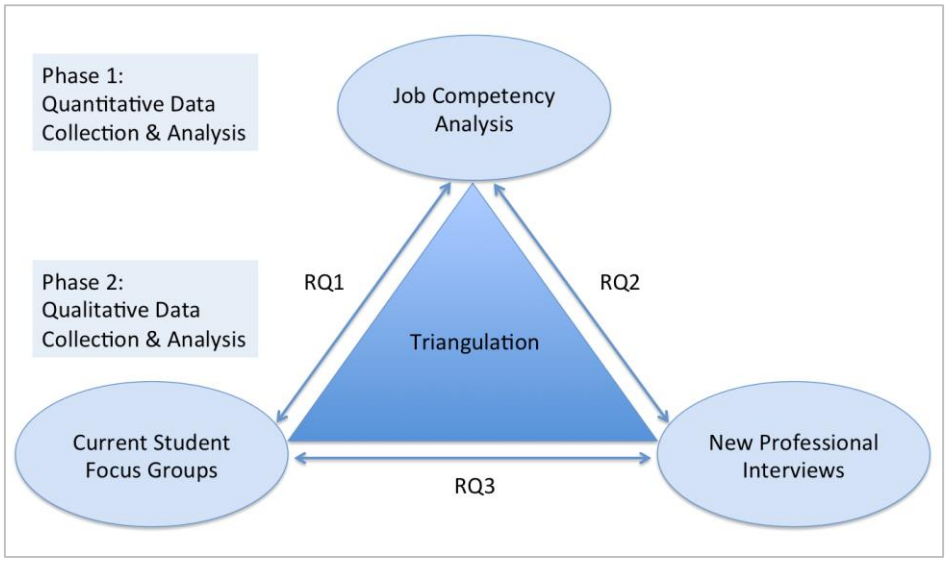

Figure 1. Overview of Research Design Model and Questions

This study examines current students' expectations of job competencies, new professionals' perception of job competencies needed, and employers' desired job competencies from job posting ads. We conducted job competency analyses from job posting ads, focus groups of current IT students, and semi-structured interviews with new IT professionals. Research proceeded in three phases:

Phase 1 – Job Competency Analysis

Data collection. During October, 2013, we collected a purposive sample of job posting ads (N=225) from 13 locations including 15 online and offline sources to obtain a non-representative sample of job announcements in the northwest Florida areas served by undergraduate institutions including TCC, Chipola, and FSU. We derived the set list of search terms for the job posting collection from the Florida Department of Education's Career and Technical Education (CTE) Program's *Information Technology Career Cluster Curriculum Frameworks*[2], which is one of eleven curriculum categories classified under the "Computers and Information Systems Managers" Standard Occupational Classification (SOC)[3]. The National Center for Education Statistics (NCES) provides 'crosswalks' which map Classification of Instructional Programs (CIP)'s titles to each occupational classification. The FL DOE then describes each program's resulting SOC-CIP mapping and describes the purpose of the curriculum assignments. These descriptions provide the initial set of search terms and include:

1. PC Support Technician
2. Help Desk Technician
3. Computer Repair Technician
4. Network Technician
5. Network Systems Technician
6. WAN/LAN Technician
7. Broadband Technician

We utilized these titles were as search terms because they are currently used by the FL DOE as part of their 2013-2014 Curriculum Framework for Information Technology. The FL DOE has recognized this CIP cluster as providing a coherent and rigorous set of academic standards that map to relevant technical knowledge required for career preparation in computer technology support positions. We only included titles if they referred to technician, specialist or analyst, each of which connotes a quantitative level of expertise in that particular area. Eliminated from the list were positions suggesting supervisory competency, as this is an examination of curricula that focus on early career employees; also removed were any reference to sales, marketing or human resource specialists. Other terms to be added will be broadband related, and specifically, the Society of Cable Telecommunications Engineers[4] is an association that provides technical education for this position, so we considered this a valid term. By using these search terms, we collected 225 job postings from both non-rural and rural areas of northwest Florida. The 225 job posting ads were saved in PDF format for the analysis.

Next, focus groups and semi-structured interviews with current IT students at the local 2 and 4 year colleges and universities and new IT professionals graduated from these affiliations

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[2] Florida Department of Education. (2013). *Curriculum Framework for Information Technology Career Cluster*. Available at http://www.fldoe.org/workforce/dwdframe/it_cluster_frame13.asp

[3] U.S. Department of Education. (2010) *Classification of Instructional Program's CIP Crosswalks*. Available at http://nces.ed.gov/ipeds/cipcode/resources.aspx?y=55

[4] http://www.scte.org/professional_development/BroadbandPremisesGuidebook/

were conducted to explore their perceptions and expectations of core IT job competencies based on their IT curricula/education and work experiences. We conducted two focus groups at TCC and Chipola in April, 2014. Five students from TCC (non-rural group) participated in a focus group for 80 minutes, and seven students from Chipola (rural group) joined a focus group for 65 minutes. We conducted individual semi-structured phone interviews with eight new professionals, each taking less than an hour, in August, 2014.

We compared results from focus groups and interviews with the desired job competencies from job posting ads (RQ1, RQ2). We then triangulated the analyses from both IT students' and new IT professionals' focus group interviews for further analysis and interpretation (RQ3).

Job competency analysis. We conducted job competency analyses from collected job posting ads to identify the core IT job competencies reflecting employers' needs and desires. Competencies are defined as a mixture of knowledge, skills, abilities, and/or characteristics associated with high performance on a job (Mirabile, 1997). Competencies—also referred to as KSA or KSAO—include a combination of motives, traits, self-concepts, attitudes or values, content knowledge or cognitive behavior skills; any individual characteristics that can be reliably measured or counted can differentiate superior from average performers (Spencer et al., 1994).

Therefore, we identified and coded job competencies from the job description texts in categories such as job duties, responsibilities, qualifications, knowledge, skills, abilities and *other* (KSAOs) from job posting ads. *Other* includes understandings, experiences, and familiarities. General summaries of job descriptions were excluded from the job competency analysis. We built the coding scheme and the codebook to annotate the core IT job competencies in terms of general, technical, and physical competencies.

Coding scheme and codebook. By analyzing the job description texts from the job posting ads, we attempted to examine the core IT job competencies desired by employers. The codebook for identifying the core IT job competencies was built based on the definitions of Competencies Model for IT Program Management (OPM, 2011). Considering that the focus of this study is on entry level IT jobs, higher-level competencies desired by senior positions were eliminated. The numbers of competencies for each category include 25 general competencies, 1 physical competency, and 33 technical competencies. We present an excerpt from the codebook in Table 2. The comprehensive full codebook including full descriptions and examples of competencies in each category are offered as Appendix A.

Table 1. An Excerpt from the Full IT Job Competency Codebook

Competencies	Codes	Definitions	Examples
Self-Management	G-SM	Sets well-defined and realistic personal goals for themselves; displays a high level of initiative, effort, and commitment towards completing assignments in a timely manner; works with minimal supervision; is motivated to achieve; demonstrates responsible behaviors; multi-tasking; remain positive and proactive;	Ability to work independently with minimum supervision; Ability to work efficiently and effectively in a fast-paced environment, under stress and within time constraints; Ability to manage multiple job tasks at one time;
Customer Service	G-CS	Works with clients and customers (that is, any individuals who use or receive the services or products that your work unit produces, including the general public, individuals who work in the agency, other agencies, or organizations outside the Government) to assess their needs, provide information or assistance, resolve their problems,	Ability to achieve successful outcomes in handling difficult situations and customers; Customer interaction skills;

		or satisfy their expectations; knows about available products and services; is committed to providing quality products and services	
Oral Communication	G-OC	Expresses information (for example, ideas or facts) to individuals or groups effectively, taking into account the audience and nature of the information (for example, technical, sensitive, controversial); makes clear and convincing oral presentations; listens to others, attends to nonverbal cues, and responds appropriately	Ability to clearly and concisely communicate technical information to non-technical users at all organizational levels; Group presentation skills; Effective listening skills; Ability to speak legibly and understand the English language;
Problem Solving	G-PS	Identifies problems; assess accuracy and relevance of information; uses sound judgment to generate and evaluate alternatives, and to make recommendations	Ability to problem solve and resolve problems creatively;
Infrastructure Design	T-ID	Knowledge of the architecture and typology of software, hardware, and networks, including LANS, WANS, and telecommunications systems, their components and associated protocols and standards, and how they operate and integrate with one another and with associated controlling software	Understanding of virtual infrastructure environments; Experience in network systems administration, network architecture, TCP/IP, LAN/WAN, routers and switches, Windows and Linux based server and client environments
Operations Support	T-OS	Knowledge of procedures to ensure production or delivery of products and services, including tools and mechanisms for distributing new or enhanced software	Ability to stay within the guidelines of Operations & Maintenance releases; Experience in implementing, day to day operations, architecture, troubleshooting, maintaining/ upgrading SW with Networking products LAN/ WAN, MPLS Support
Information Systems/ Network Security	T-ISNS	Knowledge of methods, tools, and procedures, including development of information security plans, to prevent information systems vulnerabilities, and provide or restore security of information systems and network services.	Understanding of virtual infrastructure environments; Experience in network systems administration, network architecture
Physical Capabilities	P-PC	Possessing physical capabilities to perform required tasks and assignments	Ability to carry tools and equipment including gaffs, ladders, tool belts; Ability to drive Company vehicles in a safe manner travel; Ability to use close vision, peripheral vision and adjust focus; Ability to perform work in elevated places (i.e., roofs and utility poles);

Characteristics of job description texts. A uniform structure or format of employer job description was not found in the job postings. While some employers provided a comprehensive list of duties, responsibilities, competencies and KSAOs, and qualifications, others rarely articulated the minimum list of their requirements in terms of competencies. For example, one job posting ad from a university provided an overwhelming list of competencies exceeding ten full pages while other job ads only offered a single paragraph of introductory description about

their company without a clear description of desired job competencies. Therefore, the employers' or job searching websites' idiosyncratic use of different formats and language resulted in frequent discrepancies and variations in the individual job posting ads in terms of formats, lengths, and contents of job description texts (e.g., the frequencies of and types of key terms and phrases used).

Employers often listed the desired job competencies for the position as *desired or required behaviors* in sections that include job duties, responsibilities, qualifications, competencies, knowledge, skills, abilities and others (KSAOs; others refer to understanding, experiences, familiarities, and more). The general introduction or summary of job position, education requirements, and certifications were excluded from coding because they omitted specifically required job competencies. However, even though some job posting ads require the same job competencies, they did not use the uniformly agreed terms or phrases for describing those competencies.

In addition, some job description texts clearly distinguish general competencies from technical competencies in separate sentences, while in many cases multiple competencies were addressed together in combination by using consecutive semicolons. Therefore, coders attempted to break down the relevant job description texts into the different competency types described in the codebook by understanding the texts and contexts of the job description texts.

Examples of coding and inter-coder agreement. Identified IT job competencies were annotated in three categories: general, technical, and physical competencies. When suitable, multiple codes from general, technical, and physical competencies were assigned to a single sentence. For example,

> Job CL26: Applicant must be positive, enthusiastic, detailed, great communicator, efficient, thorough, willing to work extra hours as needed, and demonstrate a genuine desire to help clients.

Codes annotated from this job description text include eight general competencies. Self-management (G-SM) was coded from being positive and enthusiastic; attention to detail (G-AD) from being detailed and thorough; customer service (G-CS) from demonstrate a genuine desire to help clients; flexibility (G-F) from willing to work extra hours as needed. Since communication consists of multi-lateral actions including listening, speaking, writing, as well as reading, great communicator was assigned with multi codes of oral communication (G-OC), writing (G-W), reading comprehension (G-RC), and interpersonal skill (G-IS).

> Job I7: Ability to gather relevant information systematically, and identify needs and solve problems following the instruction.

Ability to gather relevant information systematically was coded as information management (T-IM); identify and solve problems following the instruction was coded as problem solving (G-PS), requirement analysis (T-RA), and reading comprehension (G-RC).

> Job DE8: This position includes Systems Analysis and Design, Application Software Development, Testing and Deployment, Application Software ongoing support, Monitoring and Troubleshooting and Project Management.

This job posting ad only offered limited information about the position without specific duties, responsibilities, qualification, and competencies. Based on this broad description of the position, operational supports (T-OS) was given for application software development and application software ongoing support; infrastructure design (T-ID) and configuration management (T-COM) for system analysis and design; system testing and evaluation (T-STE), planning and evaluation (G-PE) for testing and development; project management (T-PM), problem solving (G-PS), and requirement analysis (T-RA) for monitoring and troubleshooting and project management.

> Job TD5: Climbing and working on communications towers for the purpose of installing, replacing, and repairing antenna systems equipment; performs tower maintenance under close supervision.

Climbing and working on communication towers was coded as physical capabilities (P-PC); installing, replacing, and repairing antenna systems equipment, performs tower maintenance under close supervision was coded as infrastructure design (T-ID).

Five coders participated in five training sessions to understand and develop the coding scheme and codebook. The inter-coder agreements from two to five coders reached a minimum of 67% to the maximum of 87%. As the coders reached agreement on the definitions and examples of job competencies, higher inter-coder agreements were obtained. However, due to the overlap between the multiple similar competencies, variation in the levels of clarity and comprehensiveness in job description texts, and coders' different interpretation of the contexts, discrepancies of coding results were reasonably consolidated.

Phase 2 - Focus Groups and Interviews

Data collection. Descriptive data were collected from current students enrolled in undergraduate IT programs and newly hired IT professionals with three years or less post-graduate experience. Partner institutions for the NSF ATE study, Tallahassee Community College (TCC) and Chipola State College (Chipola), organized groups of current students for focus group interviews. We met with a group of seven non-metro college information technology (IT) program students at Chipola and a group of five metro college IT students at TCC during April 2014.

We conducted semi-structured interviews with graduate alumni working as IT professionals from TCC and Florida State University's School of Information (FSU) were contacted respectively for individual phone interviews. Many new professionals spoke with researchers from their current job locations—inside and outside Florida. The sample was solicited from the collaborating institutions of the NSF ATE project and these findings represent an ongoing four-year investigation of students enrolled in IT programs at all three sites and their experiences as new IT professionals.

Focus group participants. Generally, the students are young adults between 20-35 with at least two students being 40 or older. Two of the 13 participants are female. Many of the students have previous experience in some form of IT work, e.g., help desk, computer repair, or network maintenance. One has IT experience from his previous work in the military. Two participants are minorities. One has a BS degree in a different field and returned to school to increase employment opportunities.

Interview participants. Interview participants were primarily from TCC and FSU IT programs, having graduated within the previous 1-3 years. Of the eight interviews completed for this phase of the study, four of the participants were male. All of the new professionals are working in the IT field but while several attended secondary and some post-secondary school in rural areas, none of them are currently working in a rural area. Half of the respondents were dual-enrolled in college technical programs while finishing secondary school; two matriculated from TCC to FSU; and all eight possess a four-year Bachelor's diploma. Only three of the professionals have certifications, and two of these individuals earned these as a result of the employer's request. Six of the eight professionals participated in internships as part of their undergraduate program although not required by program guidelines.

The same general set of discussion questions directed conversations at both TCC and Chipola was used as a guide for the new professional interviews, although we allowed related topics to be brought into all of the conversations. All conversations were recorded and analyzed by multiple researchers for emergent themes, and for comparison between and among groups. Both the focus groups and the new professional interviews were summarized and categorized by descriptive coding based on the CHCOC codebook to categorize job competencies and compare to the job posting results.

Analysis

Descriptive Analysis

The number of unique job posting ads collected during October 2013 is 225. The descriptive statistics are from the 225 IT jobs obtained using 7 search terms (i.e., 7 different job categories), 13 locations, and 15 online and offline sources. Of the 225 jobs, 84.9% resulted from 4 search term categories: PC Support Technician (N=87, 38.7%), Network Technician (N=44, 19.6%), Computer Repair Technician (N=37, 16.4%), and Help Desk Technician (N=23, 10.2%). These 4 dominant search term categories are presented as blue-shaded sections in Table 1. Jobs for Network Systems Technician (N=16, 7.1%) and WAN/LAN Technician (N=14, 6.2%) occupy up to 13.3% of the total. Broadband Technicians are resulted in only 4 jobs (1.8%). Table 2 shows the number of jobs by locations (non-rural, rural, and other) and job search terms. *Other* refers to jobs with the unknown locations or multiple locations such as work from home.

Table 2. IT Jobs by Location and Job Search Terms

	Metro	Non-Metro	Other	Total
Broadband Technician	4 (1.8%)	0	0	4 (1.8%)
Computer Repair Technician	33 (14.7%)	3 (1.3%)	1 (0.4%)	37 (16.4%)
Help Desk Technician	19 (8.4%)	2 (0.9%)	2 (0.9%)	23 (10.2%)
Network Systems Technician	12 (5.3%)	4 (1.8%)	0	16 (7.1%)
Network Technician	40 (17.8%)	2 (0.9%)	2 (0.9%)	44 (19.6%)
PC Support Technician	82 (36.4%)	0	5 (2.2%)	87 (38.7%)
WAN/LAN Technician	10 (4.4%)	2 (0.9%)	2 (0.9%)	14 (6.2%)
Total	**200 (88.9%)**	**13 (5.8%)**	**12 (5.3%)**	**225 (100.0 %)**

Nine of 13 locations provided 225 jobs while four rural counties (Wakulla, Liberty, Calhoun, Washington) did not result in any job openings. Figure 2 shows the number of jobs (N=225) from the 9 locations. The five biggest job markets are: Out-of-state (74, 32.9%), followed by Leon (45, 20%), Pensacola (44, 19.6%), other Florida (30, 13.3%), and Panama City (22, 9.8%). Except for Dothan, AL, which provided 7 jobs, the counties of Gadsden, Jackson, and Holmes only provided one job each.

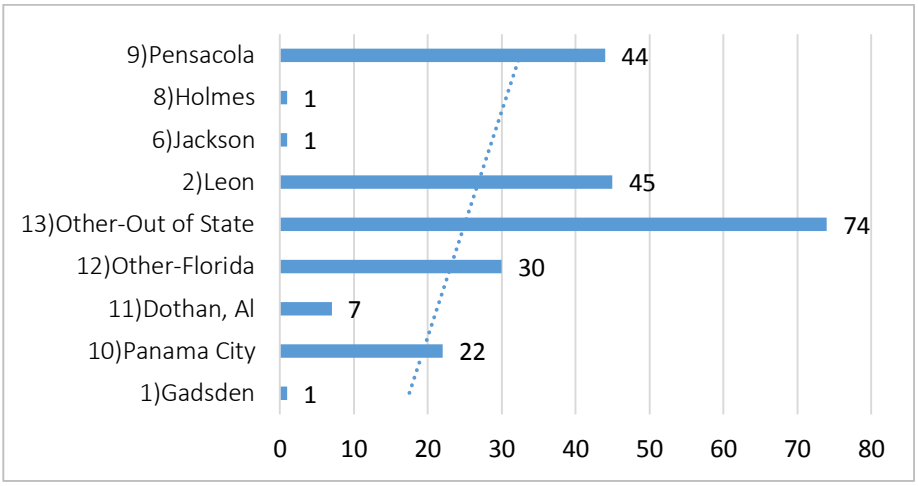

Figure 2. IT Jobs by Locations in northwest Florida

Figure 3 depicts the job breakdown in terms of locale.

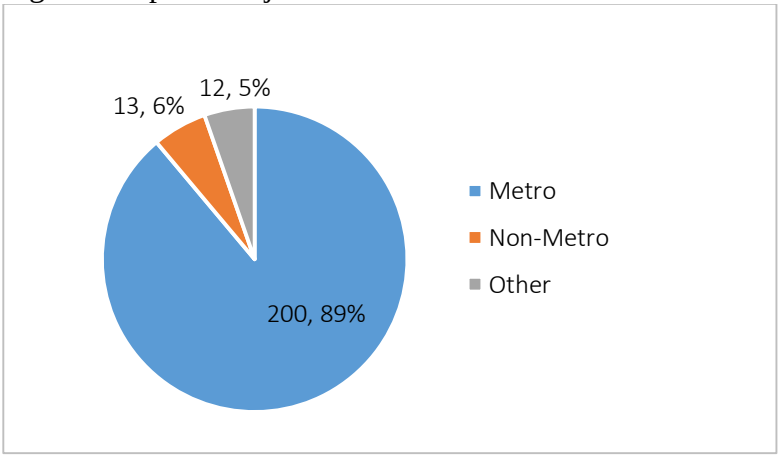

Figure 3. IT Jobs in Metro vs. Non-Metro Areas

As Figure 3 shows, 200 (88.9%) out of 225 jobs are classified as non-rural, 13 (5.8%) are classed as rural, and 12 (5.3%) are classed as Other (e.g., unknown and multiple locations such as work from home) in Figure 2.

Next, we analyzed job postings by source. The 225 job postings were collected from 11 sources in Figure 4.

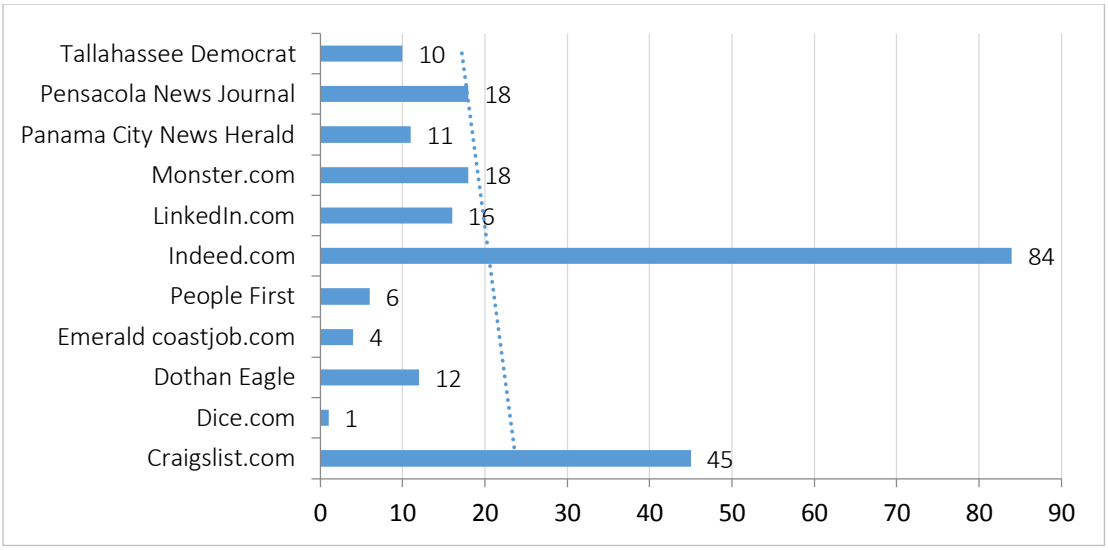

Figure 4. IT Jobs in northwest Florida by Source

As Figure 4 shows, 224 jobs resulted from online sources and one job was collected from an offline newspaper source (Tallahassee Democrat). The largest numbers of jobs (181, 80.4%) were returned by Indeed.com (84, 37.3%), followed by Craigslist.com (45, 20%), Monster.com (18, 8%), Pensacola News Journal (18, 8%), and Linked.com (16, 7.1%). Among the regional news sources, the metropolitan city level papers, Pensacola News Journal, Dothan Eagle, Panama City News Herald, and Tallahassee Democrat provided the most jobs, while the four county level newspapers did not offer any jobs during the data collection period: Chipley Paper, Jackson County Times, Gadsden County Times, and Wakulla Times. The linear trend line shows the five most fruitful Internet job sources in Northwest Florida.

Employers' Desired IT Job Competencies

In this study, the total of 213 jobs from non-rural (N=200) and rural areas (N=13) were used for the analysis: other jobs with unknown or multiple locations (N=12) were excluded. The number of jobs for seven different job search terms in both non-rural (N=200, 93.9%) and rural areas (N=13, 6.1%) are shown in Table 3. In non-rural areas, 117 jobs (81.7%) were retrieved for PC support technician, network technician, computer repair technician, and help desk technician. In rural areas, five job search terms resulted in 13 positions for network system technician, computer repair technician, help desk technician, network technician, and WAN/LAN technician. No jobs were found using the search terms of broadband technician, and PC support technician.

Table 3. IT Jobs by Non-rural and Rural Locations and Job Search Terms

	Metro	**Non-Metro**
Broadband Technician	4 (1.9%)	0
Computer Repair Technician	33 (15.5%)	3 (1.4%)
Help Desk Technician	19 (8.9%)	2 (0.9%)
Network Systems Technician	12 (5.6%)	4 (1.9%)
Network Technician	40 (18.8%)	2 (0.9%)
PC Support Technician	82 (38.5%)	0
WAN/LAN Technician	10 (4.7%)	2 (0.9%)
Total (N=213)	**200 (93.9%)**	**13 (6.1%)**

Job competencies were coded from the relevant job description texts according to the codebook adapted from Competencies Model for IT Program Management (OPM, 2011). The codebook consists of 25 general competencies, 1 physical competency, and 33 technical competencies. If one competency was written multiple times, occupying more portion of the job description texts in that job posting ad, the number of that code being presented was accumulated. The total number of accumulated codes assigned in 213 jobs was 4,993 including accumulated general competency codes of 2,233; physical competency codes of 188; and technical competency codes of 2,572. The total number of codes being calculated as unique code (without accumulation) was 2,530 with 1,333 general competency codes, 63 physical competency codes, and 1,134 technical competency codes (Table 4).

Table 4. Total and Average Numbers of Accumulated and Unique Codes

	Accumulated Codes	Ave. of Acc. Codes	Unique Codes	Ave. of Unique Codes
General Competency	2,233 (44.7%)	10.5	1,333 (52.7%)	6.3
Physical Competency	188 (3.8%)	0.9	63 (2.5%)	0.3
Technical Competency	2,572 (51.5%)	12.1	1,134 (44.8%)	5.3
Total	**4,993 (100%)**	**23.4**	**2,530 (100%)**	**11.9**

Table 4 shows that 2,530 unique competency codes were repetitively described in 213 job posting ads. Particularly, the number of technical competency codes resulted in more than half of the entire accumulated competency codes. However, of unique codes, general competency codes were more frequently identified (52.7%) than technical competency (44.8%). This demonstrates that the same technical competency codes often repetitively occurred (e.g., by giving detailed examples regarding one competency through multiple phrases), while unique general competency code types more frequently occurred (e.g., by listing up various types of unique competencies within a single phrase). Figure 5 shows the total number of accumulated and unique codes in 213 jobs.

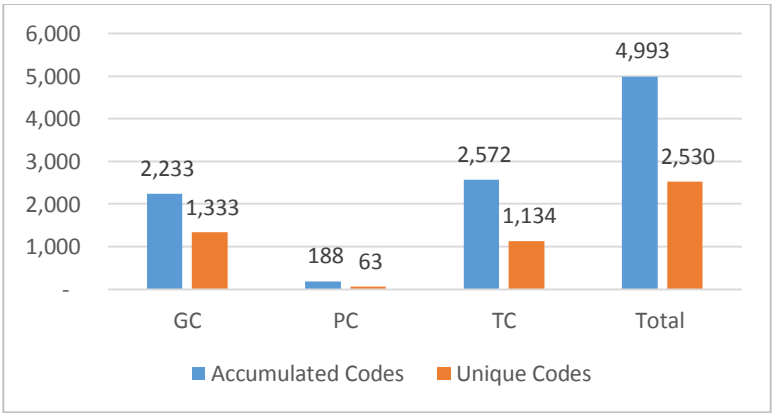

Figure 5. Total Numbers of Accumulated and Unique Codes in 213 Jobs

Figure 6 shows the average number of accumulated and unique codes per job. In average, 10.5 of general competency codes, 0.9 of physical competency code, and 12.1 of technical competency codes (a total of 23.4 competency codes) were repetitively occurred per job. However, in terms of unique job competency types, 6.3 general competency codes, 0.3 physical

competency code, and 5.3 technical competency codes (a total of 11.9 competency codes) were identified per job.

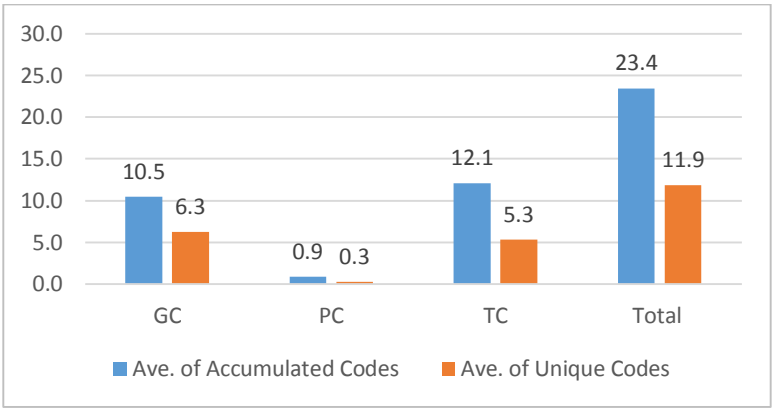

Figure 6. The Average Number of Accumulated and Unique Codes Per Job

General Competencies

Table 5 shows the types and numbers of 25 unique general competencies and the percentage of jobs including those unique codes. From the 213 jobs, the top 10 of unique competency types occupy 70.1% of the entire unique codes (934 out of 1,333). They include writing (G-W), customer service (G-CS), oral communication (G-OC), interpersonal skills (G-IS), reading comprehension (G-RC), problem solving (G-PS), self-management (G-SM), accountability (G-A), teaching others (G-TO), and flexibility (G-F). Writing (G-W) is found in 120 jobs (56.3%) out of 213 jobs, meaning one in two job posting ads asks applicants to have writing competency (G-W). Customer service (G-CS) is the second most frequently identified competency: 114 jobs (53.5%) out of 213 jobs include customer service competency as a required competency. Ten competencies in orange shades are the 10 most frequently desired general competencies.

Table 5. Number of Unique Code and Percentage of Jobs including Unique Code

	Number of Unique Code	Percentage of Jobs with the Unique Code
Writing (G-W)	120	56.3%
Customer Service (G-CS)	114	53.5%
Oral Communication (G-OC)	113	53.1%
Interpersonal Skills (G-IS)	97	45.5%
Reading Comprehension (G-RC)	93	43.7%
Problem Solving (G-PS)	92	43.2%
Self-Management (G-SM)	88	41.3%
Accountability (G-A)	77	36.2%
Teaching Others (G-TO)	70	32.9%
Flexibility (G-F)	70	32.9%
Teamwork/Collaboration (G-TC)	68	31.9%
Compliance (G-C)	55	25.8%
Influencing/Negotiating (G-IN)	51	23.9%
Reasoning (G-R)	47	22.1%
Planning and Evaluation (G-PE)	30	14.1%
Leadership (G-L)	29	13.6%
Learning (G-LE)	29	13.6%
Attention to Detail (G-AD)	18	8.5%

Managing Human Resources (G-MHR)	17	8.0%
Decision Making (G-DM)	14	6.6%
Integrity (G-I)	11	5.2%
External Awareness (G-EA)	9	4.2%
Creative Thinking (G-CT)	9	4.2%
Vision (G-V)	7	3.3%
Conflict Management (G-CM)	5	2.3%
Total	**1,333**	

Table 6 shows the numbers and types of accumulated code and percentage of the code repeated. The top 10 competency types occupy 75.6% of the entire accumulated codes (1,688 out of 2,233). They include customer service (G-CS), writing (G-W), self-management (G-SM), oral communication (G-OC), interpersonal skills (G-IS), problem solving (G-PS), reading comprehension (G-RC), accountability (G-A), teaching others (G-TO), and teamwork/collaboration (G-TC). Customer service (G-CS) is found 272 times from 114 jobs, meaning that customer service competency is repeated more than twice (238.6%) in a single job. Self-management (G-SM) is found 184 times (209.1%) from 88 jobs. 120 jobs require writing competency (G-W) for the position 223 times (185.8%). The ten competencies in blue shading are the 10 most frequently repeated general competencies.

Table 6. Number of Accumulated Codes and Percentage of Codes Repeated

	Number of Accumulated Code	**Percentage of the Code Repeated**
Customer Service (G-CS)	272	238.6%
Writing (G-W)	223	185.8%
Self-Management (G-SM)	184	209.1%
Oral Communication (G-OC)	184	162.8%
Interpersonal Skills (G-IS)	165	170.1%
Problem Solving (G-PS)	159	172.8%
Reading Comprehension (G-RC)	147	158.1%
Accountability (G-A)	127	164.9%
Teaching Others (G-TO)	122	174.3%
Teamwork/Collaboration (G-TC)	105	154.4%
Flexibility (G-F)	86	122.9%
Influencing/Negotiating (G-IN)	75	23.9%
Compliance (G-C)	70	23.9%
Reasoning (G-R)	63	22.1%
Planning and Evaluation (G-PE)	53	14.1%
Leadership (G-L)	41	13.6%
Learning (G-LE)	39	13.6%
Attention to Detail (G-AD)	26	8.5%
Managing Human Resources (G-MHR)	26	8.0%
Decision Making (G-DM)	17	6.6%
Integrity (G-I)	12	5.2%
External Awareness (G-EA)	12	4.2%
Creative Thinking (G-CT)	10	4.2%
Vision (G-V)	9	3.3%
Conflict Management (G-CM)	6	2.3%
Total	**2,233**	

The top 10 general competencies from both the accumulated and unique code lists include nine common competencies and two competencies from each list. Writing (G-W),

customer service (G-CS), oral communication (G-OC), interpersonal skills (G-IS), reading comprehension (G-RC), problem solving (G-PS), self-management (G-SM), accountability (G-A) are shared in both list; Teaching others (G-TO) and flexibility (G-F) are displayed from each list.

Technical Competencies

Table 7 shows the types and numbers of 33 unique technical competencies and the percentage of jobs producing those unique codes. From the 213 jobs, the top 10 unique technical competency types occupy 73.5% of the entire unique codes (834 out of 1,134). They include operational support (T-OS), technology awareness (T-TA), configuration management (T-COM), infrastructure design (T-ID), information management (T-IM), compliance (T-C), system testing and evaluation (T-STE), data management (T-DM), information technology architecture (T-ITA), information technology performance assessment (T-ITPA). Operational support (T-OS) is found in 116 jobs (77.9%) out of 213 jobs, meaning three in four job posting ads ask applicants to have the operational support (T-OS) competency. Technology awareness (T-TA) and configuration management (T-COM) are the second most frequently identified competencies: 116 jobs (54.5%) out of 213 jobs reveal these competencies as desired. The ten competencies in orange shading are the 10 most frequently desired general competencies.

Table 7. Number of Unique Code and Percentage of Jobs including Unique Code

	Number of Unique Code	Percentage of Jobs with the Unique Code
Operational Support (T-OS)	166	77.9%
Technology Awareness (T-TA)	116	54.5%
Configuration Management (T-COM)	116	54.5%
Infrastructure Design (T-ID)	94	44.1%
Information Management (T-IM)	89	41.8%
Compliance (T-C)	53	24.9%
System Testing and Evaluation (T-STE)	53	24.9%
Data Management (T-DM)	51	23.9%
Information Technology Architecture (T-ITA)	50	23.5%
Information Technology Performance Assessment (T-ITPA)	46	21.6%
Information Systems/Network Security (T-ISNS)	45	21.1%
Product Evaluation (T-PE)	42	19.7%
Information Resources Strategy and Planning (T-IRSP)	36	16.9%
Requirements Analysis (T-RA)	26	12.2%
Information Assurance (T-IA)	25	11.7%
Project Management (T-PM)	24	11.3%
Quality Assurance (T-QA)	18	8.5%
Information Technology Program Management (T-ITPM)	16	7.5%
Change Management (T-CM)	12	5.6%
Systems Life Cycle (T-SLC)	10	4.7%
Financial Analysis (T-FA)	7	3.3%
Stakeholder Management (T-SM)	6	2.8%
Financial Management (T-FM)	5	2.3%
Cost-Benefit Analysis (T-CBA)	5	2.3%
Accessibility (T-A)	4	1.9%
System Engineering (T-SE)	4	1.9%
Information Systems Security Certification (T-ISSC)	3	1.4%
Enterprise Architecture (T-EA)	3	1.4%
Contracting/Procurement (T-CP)	3	1.4%
Risk Management (T-RM)	2	0.9%
Business Process Reengineering (T-BPR)	2	0.9%

Acquisition Strategy (T-AS)	1	0.5%
Capital Planning and Investment Assessment (T-CPIA)	1	0.5%
Total	**1,134**	

Table 8 displays the numbers and types of accumulated codes and percentage of repeated codes. The top 10 competency types account for 82.9% of the entire accumulated codes (2,131 out of 2,572). They include operational support (T-OS), infrastructure design (T-ID), technology awareness (T-TA), configuration management (T-COM), information management (T-IM), system testing and evaluation (T-STE), information systems/network security (T-ISNS), data management (T-DM), information technology architecture (T-ITA), information technology performance assessment (T-ITPA) and compliance (T-C). Operational support (T-OS) is found 658 times from 166 jobs, meaning that operational support is mentioned almost four times more (396.4%) in a single job. Infrastructure design (T-ID) is found 296 times (314.9%) from 94 jobs. 116 jobs ask applicant to have technical awareness (G-TA) 294 times (253.4%) and configuration management (T-COM) 228 times respectively (196.6%). The ten competencies in blue shading are the 10 most frequently repeated technical competencies.

Table 8. Number of Accumulated Codes and Percentage of Codes Repeated

	Number of Accumulated Code	**Percentage of the Code Repeated**
Operational Support (T-OS)	658	396.4%
Infrastructure Design (T-ID)	296	314.9%
Technology Awareness (T-TA)	294	253.4%
Configuration Management (T-COM)	228	196.6%
Information Management (T-IM)	168	188.8%
System Testing and Evaluation (T-STE)	126	237.7%
Information Systems/Network Security (T-ISNS)	106	235.6%
Data Management (T-DM)	93	182.4%
Information Technology Architecture (T-ITA)	92	184.0%
Compliance (T-C)	70	132.1%
Information Technology Performance Assessment (T-ITPA)	64	139.1%
Product Evaluation (T-PE)	64	152.4%
Information Resources Strategy and Planning (T-IRSP)	49	136.1%
Requirements Analysis (T-RA)	49	188.5%
Project Management (T-PM)	39	162.5%
Information Assurance (T-IA)	35	140.0%
Information Technology Program Management (T-ITPM)	27	168.8%
Quality Assurance (T-QA)	26	144.4%
Change Management (T-CM)	16	133.3%
Systems Life Cycle (T-SLC)	14	140.0%
Financial Management (T-FM)	9	180.0%
Financial Analysis (T-FA)	7	100.0%
Stakeholder Management (T-SM)	6	100.0%
Accessibility (T-A)	6	150.0%
Cost-Benefit Analysis (T-CBA)	5	100.0%
System Engineering (T-SE)	5	125.0%
Information Systems Security Certification (T-ISSC)	5	166.7%
Enterprise Architecture (T-EA)	4	133.3%
Risk Management (T-RM)	4	200.0%
Contracting/Procurement (T-CP)	3	100.0%
Business Process Reengineering (T-BPR)	2	100.0%
Acquisition Strategy (T-AS)	1	100.0%
Capital Planning and Investment Assessment (T-CPIA)	1	100.0%

Total	**2,572**

The top 10 technical competencies from both the accumulated and unique code lists include nine competencies in common and two competencies from each list. Operational support (T-OS), technology awareness (T-TA), configuration management (T-COM), infrastructure design (T-ID), information management (T-IM), compliance (T-C), system testing and evaluation (T-STE), data management (T-DM), information technology architecture (T-ITA) are shared by both lists; Information technology performance assessment (T-ITPA) and information systems/network security (T-ISNS) are displayed from each list.

Physical Competency

From 213 jobs, physical capabilities (P-PC) is found from 63 jobs, meaning that three out of ten jobs include this physical capability as a required competency. Physical capabilities (P-PC) is identified 188 times from 63 jobs (298.4%). Even though only three in ten jobs list physical competency, it is repeated three times when that job posting ad stresses it (Table 9).

Table 9. Number and Percentage of Unique and Accumulated Code

	Number of Unique Code	Percentage of Jobs with the Unique Code	Number of Accumulated Code	Percentage of the Code Repeated
Physical Capabilities (P-PC)	63	29.6%	188	298.4%

Focus Group and Interview Analysis

Descriptive coding. This section presents current students' perceptions of IT job competencies that they will need to be employed in the IT field, followed by the new professionals' perceptions of the job competencies they actually need to be successful based on an assessment of their current career experiences. We derived these competencies from the conversations using descriptive coding "which summarizes the primary topic of the excerpt" (Saldana, 2009, p. 3) taken from recordings of the discussions and interviews, and are based on the definitions provided by the OPM competency model (2011). These are organized by the categories of technical, and general competencies; no physical competencies were reported in either the focus groups or the interviews.

Based on the 'topic of the excerpts', the key salient codes that emerge will answer the research questions, along with a narrative description of how this manifests as described by the student or new professional. Thus, we coded the instances of the competency with the general and technical competency codes; we then assessed these for relative frequency and intensity; we used quantitative assessment of the coding to highlight the most evident competencies and do not suggest a measure of significance.

Competency ranking. We ranked the competencies by frequency within each conversation, with a low frequency equivalent to 1-2 instances; medium frequency equal to 3-4 instances; and a high frequency equal to five instances or greater. Multiple competencies could emerge from an excerpt of a response to one question, such as this example of an IT director discussing some of his work habits when asked to describe challenges and opportunities:

> "I now try to [educate and train people] (G-TO) that I work with when they [ask for help] (G-CS, G-TC). I like to [take a hands-on approach] (G-IS) [to show people how to do things] (G-TO). Rather than [solve all the problems] (G-PS, T-OS) myself, [I show others] (G-L, G-TO) how to [troubleshoot for themselves] (G-PS)."

The high frequency competencies are qualitatively characterized using the rich details of the on-the-job examples provided by the participants. While these competencies are listed separately, the characterizations are often compilations of multiple competencies.

RQ1: Current Students Perception of IT Job Competencies

General and Technical Competency

High frequency. The top rated general competencies that current students perceive to be most important include self-management (G-SM) and learning (G-LE), both of which were mentioned with multiple descriptions of continuing self-education and obtaining increasing credentials and technical skills sets through certifications and 'apprenticeships.' Four technical competencies were identified as high frequency including technology awareness (T-TA), operations support (T-OS), infrastructure design (T-ID), and configuration management (T-COM) (see Appendix I for the complete description of each).

The emphasis placed on certifications by current students indicate their acknowledgment of three competencies: self-management (G-SM), those in which the codebook describes as one who is "motivated to achieve" and "displays a high level of initiative, effort and commitment" (OPM, 2011, n.p.); learning (G-LE), expressed by "research, acquire, update and apply new and relevant knowledge and skills quickly" (OPM, 2011 n.p.); and the technical competency of technology awareness (T-TA), "knowledge of developments and new applications of information technology" (OPM, 2011, n.p.).

The three remaining technical competencies of operations support (T-OS), infrastructure design (T-ID) and configuration management (T-COM) were all related to the discussion of certifications and to the awareness of the rural focus group participants that they would be called upon to be a "jack of all trades", especially those who might work in small companies or rural settings. The participants relayed experiences of ensuring "production or delivery of products and services" (operations support competency) in help desk training and experience; being expected to know "the architecture and typology of software, hardware and networks" (infrastructure design competency) by assisting a wide variety of clients; and, the configuration management competency, "planning or managing the implementation, update, or integration of information systems" (OPM, n.p.), reflected in a limited understanding of the need for support of newly deployed broadband technology in the rural areas in which many of the focus group participants live.

Average or low frequency competencies. Other general competencies that emerged from the focus groups with lesser frequency include accountability (G-A), external awareness (G-EA), flexibility (G-F), integrity (G-I), leadership (G-L), oral communications (G-OC) and teamwork/collaboration (G-TC). Three additional technical competencies were identified as information assurance (T-IA), information systems security certification (T-ISSC), and information systems/network security (T-ISNS). In all, the focus groups discussions identified 16 competencies, broken down into nine general competencies and seven technical competencies, with the two general competencies of learning (G-LE) and self-management (G-SM) distinguished by frequency in both groups and with greater numbers of examples shared by participants for each.

These competencies were reflected in the focus groups of current students from colleges in northwest Florida and represent the perceptions of students who have limited work and IT experience as professionals. The importance of professional certifications in the minds of the

students cannot be over-stated and it was the overwhelming focus on this topic in which the competencies listed as findings were expressed.

Comparison with Job Competency Analysis

Current students perceive self-management (G-SM) and learning (G-LE) as core competencies along with accountability (G-A), flexibility (G-F), oral communication (G-OC), and teamwork/collaboration (G-TC), which are shared by job competency results in common. However, the employers' strong emphases on writing (G-W), customer service (G-CS), interpersonal skills (G-IS), reading comprehension (G-RC), and problem solving (G-PS) are not identified from current students' perception. The top four technical competencies from job postings - operations support (T-OS), technology awareness (T-TA), infrastructure design (T-ID), and configuration management (T-COM) - are valued similarly by current students.

RQ2: New Professionals Perception of IT Job Competencies

This section describes the perceptions of new IT professional obtained during semi-structured interviews, in which the interview guide was based on both the focus group discussion guide and the feedback obtained.

General Competencies

High frequency. The top general competency identified is self-management (G-SM), which includes the control of one's own behavior in an effort to set and achieve goals, multi-task, work without supervision, complete assignments on time, and essentially "demonstrate responsible behavior" (OPM, 2011, n.p.). All of the respondents indicated the need for this competency, half with great frequency. The respondents described being able to independently learn skills on the job from peers and mentors and take advantage of on-the-job training sessions; and, being able to use basic Web searches to create productive research in which new professionals are able to self-develop and maintain technical skills currency – overwhelmingly, respondents reported that they relied heavily on accessing online information in the form of community forums and tutorials to discover new knowledge and maintain the currency of their formal education.

Other general competencies exhibited high frequency rankings including interpersonal skills (G-IS) and learning (G-LE). Interpersonal skills are those in which one "shows understanding, friendliness, courtesy, tact, empathy" and sensitivity to cultural and social differences. This was often described by new professionals as the ability to work with diverse groups. In the IT work environment, the IT professional is working with and supporting the needs of a wide variety of individuals, often many who have more unrelated work experience and little or no technical skills; this includes those who may be older than the IT professional, requiring an adjustment for the new professional to be able to work well with others, including those with limited technical skills and vernacular. Learning to work in groups mirrors the work world of diverse co-workers and competing priorities. With the focus on collaborative work flows, this competency involves knowing several technical languages, how each component fits into the larger environment, and how to get results in spite of the lack of consistent contribution from each group member (Davenport, 2013). This example also demonstrates that multiple competencies are combined by new professionals on the job, as the lower ranked competency, teamwork/collaboration (G-TC) is evident in this excerpt as well.

The learning (G-LE) competency is described often and is another high intensity competency that is manifested in a new professional's daily tasks and is often accompanied by several other competencies. Learning (G-LE) is described by one participant as he recounted

learning to effectively synthesize and leverage email, telephone and face to face communications as critical; The participant also learned to use the email client, MS Outlook, a popular business communication platform more effectively rather than the more social-oriented web-based email platforms.

Average frequency. The next level of competencies is topped by the diverse complement of communication skills of oral communication (G-OC), reading comprehension (G-RC), and writing (G-W) competencies that rank in the second level of frequency. Other competencies with average frequency include leadership skills (G-L) and teamwork/collaboration (G-TC) which are described by participants when expected to organize projects and people, consult with others, and prioritize projects to meet team goals; and, problem solving (G-PS) which participants describe as figuring out problems for others, especially in a Help Desk position in which troubleshooting malfunctioning computers is frequent. The competency of accountability (G-A) is also described with average frequency and is noted by new professionals as one of the challenges of transitioning from student to work life.

Low frequency. Competencies that were reported by new professionals with low frequency include creative thinking (G-CT), customer service (G-CS), flexibility (G-F), influence/negotiation (G-IN), managing human resources (G-MHR), planning and evaluation (G-PE), reasoning (G-R) and vision (G-V).

Technical Competencies

The technical competencies did not result in any medium frequency competencies so the finding are split between just the two categories of high and low frequency.

High frequency. The technical competencies observed with high frequency are headed by technology awareness (T-TA), which appeared in every respondent's interview with high or average frequency. Each participant described the need to acquire knowledge of unfamiliar applications or problems, confronting new or different hardware and software and being required to understand all types of operating systems. One participant stated "employers want to know that I am versed in the product *they* use, which my coursework could not fully prepare me for." Other high frequency competencies are infrastructure design (T-ID) and operations support (T-OS), both of which are observed together, especially as respondents discuss the importance of understanding networks, database programs and their interaction with applications and programming.

Low frequency. The low frequency competencies include infrastructure architecture (T-IA), information management (T-IM), project management (T-PM), and stakeholder management (T-SM). One excerpt from an IT consultant for a financial company that characterizes these competencies describes how he needed to understand how all these component parts, web server, application server, and databases work together to serve the diverse needs of his clients and that competency in each is required.

Other competencies. Competencies that emerged from the data that did not fall into specific categories include experience with broadband deployment, as described by one participant who observed that IT healthcare technicians required the ability to identify healthcare worker resistance to new applications provided as the result of new technology afforded by higher bandwidth and better quality broadband was observed as a necessary skill during an internship.

Comparison with Job Competency Analysis

New professionals' perceptions of core job competencies better align with job competency analysis than does those of current students. They identified self-management (G-

SM), interpersonal skill (G-IS), and learning (G-LE), along with oral communication (G-OC), reading comprehension (G-RC), writing (G-W), teamwork/collaboration (G-TC), problem solving (G-PS), and accountability (G-A). They also mention creative thinking (G-CT), customer service (G-CS), and flexibility (G-F). New professionals' perception of core job competencies matches well with the top ten technical competencies than that of current students. The top three technical competencies - technology awareness (T-TA), infrastructure design (T-ID), and operational support (T-OS) – are also considered core competencies by both new professionals and employers.

RQ3: Comparisons between Current Students' and New Professionals' Perception of IT Job Competencies

Current Students' Perceptions

Current students' perceptions reflect overall higher rankings for technical competencies than general competencies, with four competencies ranking with high frequency including technology awareness (T-TA), configuration management (T-COM), infrastructure design (T-ID), and operations support (T-OS). Three other technical competencies were also noted, infrastructure architecture (T-IA), information systems security certification (T-ISSC), and information systems/network security (T-ISNS) with low frequency.

Current students highly ranked two general competencies, learning (G-LE) and self-management (G-SM); seven other general competencies were ranked with low frequency including accountability (G-A), external awareness (G-EA), flexibility (G-F), integrity (G-I), leadership (G-L), oral communication (G-OC) and teaching others (G-TO). Perceptions of current students as revealed in the focus groups ranked a total of 16 unique competencies out of a total of 59 unique competencies possible with the OPM codebook. In addition, current students perception of communication skill—related to writing (G-W), oral communication (G-OC), reading comprehension (G-RC), and interpersonal skill (G-IS)—and customer service (G-CS) were not identified.

New Professionals' Perceptions

Overall, new professionals' perception of core job competencies matches well with the job competencies analysis drawn from job posting ads. New professionals ranked a total of 36 unique competencies, 24 general and 12 technical. The three highly ranked technical competencies include technology awareness (T-TA), infrastructure design (T-ID), and operations support (T-OS); one technical competency ranked as average frequency, stakeholder management (T-SM); and eight technical competencies ranked with low frequency, infrastructure architecture (T-IA), compliance (T-C), information management (T-IM), information technology program management (T-ITPM), product evaluation (T-PE), project management (T-PM), quality assurance (T-QA), and requirements analysis (T-RA).

Of the 25 unique general competencies, three were highly ranked including self-management (G-SM), learning (G-LE) and interpersonal skills (G-IS); seven were ranked average including accountability (G-A), oral communication (G-OC), problem solving (G-PS), reading comprehension (G-RC), writing (G-W), leadership (G-L) and teamwork/collaboration (G-TC); and 14 competencies were ranked with low frequency including creative thinking (G-CT), influence/negotiation (G-IN), planning/evaluation (G-PE), and vision (G-V), among others.

Current Students Comparison with New Professionals

Comparative analysis demonstrates both the similarities and differences between current students' and new professionals' perceptions of desired job competencies. Both current students

and new professionals identify the core technical competencies of operational support (T-OS), infrastructure design (T-ID), and technology awareness (T-TA), which align well with the job posting competency analysis. Current students particularly spoke with greater frequency about the technical competencies they anticipate needing, with multiple comments about the urgency and value of obtaining technical skills by obtaining professional certifications. New professionals, however, cited experiences in internships as being the single most important course activity that provided experience-using competencies learned.

New professionals show a wider spectrum of desired general competencies that are far more diverse: new professionals list 18 general competencies and current students mention 9 general competencies. Current students particularly pin point two general competencies, self-management (G-SM) and learning (G-LE), with high frequency. These along with four other competencies, accountability (G-A), flexibility (G-F), oral communication (G-OC), and teamwork/collaboration (G-TC), align with the job posting competency analysis. However, new professionals' perceptions of the desired general competencies align with nine of the most frequently desired technical competencies from the job postings.

Discussion

Self-management & Learning by Current Students and New Professionals

A competency that was expressed with high frequency by current students and new professional are self-management (G-SM) and learning (G-LE): individuals must come into the job with the awareness that their skills are general and applications that are contextual require the ability to find answers on their own, practice and education themselves and gain a certain proficiency in order to continue to independently and successfully perform as the IT technician on the job. While current students stressed their focus on and value of certifications as a primary means of acquiring those competencies, many of the new professionals expressed that they felt that taking advantage of both curricular and extra-curricular activities in their IT programs rather than certifications, offered them the chance to increase skills, contacts, experience and therefore job opportunities.

However, the job posting competency analysis reveals that the need for self-management and learning is relatively low. The reason why learning is considered relatively less desired can be further studied from interviewing employers or hiring managers who create the job descriptions regarding competencies.

Customer Service & Communication by Employers

Both current students and new professionals do not perceive customer service (G-CS) as a core competency while job posting ads consistently emphasize customer service. In addition, the importance of communication related competencies—writing (G-W), oral communication (G-OC), reading comprehension (G-RC), and interpersonal skill (G-IS)—are not highly identified by current students. New professionals, however, are aware of the value of good communication skills at work. They recommended that current students increase communication and interpersonal skills by engaging with various team projects in class and other activities such as student organizations/services outside class. One new professional even stressed this by saying "communication cannot be taught, it only can be developed by experiences with others over a long period of time." Customer service greatly relates with communicating with users and clients, identifying their needs, and troubleshooting the issues. Therefore, customer service and communication skills identified as misalignment between employers and current and future employees need to be resolved. IT programs may better encourage students to get more

internship and work experiences and provide the right connections and opportunities to do so. Employers of all types benefit from a more-ready workforce as information technology permeates economic, social, cultural and political processes (Davenport, 2013, Hawk, et al., 2012) and could be motivated to participate in and provide opportunities for experiential learning for both educators and students.

Perception/Interpretation of Competencies

Three different stakeholders may have different perceptions or interpretations of competencies. While students expressed that what educational competencies provide in lieu of experience, can be gained by obtaining professional certifications. However, new professionals overwhelmingly expressed that competencies in lieu of experience are more valuable if obtained from internships or previous work experiences. We observed consistently that the current students knew that they must have demonstrable skill sets and certifications provide a commonly accepted industry standard and provide an edge over other entry-level candidates to those who know exactly what technical skills they want to use on the job. New professionals, however, expressed that during the hiring process, employers were not interested in certifications for entry-level employees and would pay for those they might need in the future; for new professionals, experience gained through internships, work experience, and other activities far outweighed the concern for certifications. Internships were credited with providing multiple competencies including self-management, communication, problem solving, interpersonal skills, teamwork/collaboration, and operations support, among others. Further, internships eased the student to work life transition as the academic pipeline is developed into a career pathway.

Sharing the Same Vernacular

Employers express their needs in many different formats including competencies, duties, responsibilities, qualification, and KSAOs, and others. However, neither unified structure of job postings nor the clear vernacular addressing job competencies was found. Discrepancy of language and format easily lead applicants, educators, and even employers' perceptions to confusion and disagreement. As this study suggests a need to reach consensus among different stakeholder perceptions and expectations, educators, employers and IT workers need to better communicate and reach consensus so that they use the same, comprehensive, and unified language and terms in an effort to collaboratively pursue the same goal.

Further research can employ text mining techniques to identify the different patterns of language use from curricular and job postings as well as interview educators, students, IT workers, and employers to synchronize different stakeholders' perception and expectation into mutually shared job competency standards.

Future Research

Creation of the job posting. Implications of this phase of the NSF ATE study indicate that future employer interviews planned for the northwest Florida industry and businesses can focus on the process of IT employee recruiting, specifically on the creation of the job posting descriptions for IT positions. In related NSF ATE faculty interviews, comments about the idiosyncratic language used in job advertisements, specifically that employers tend to include unreasonable numbers and types of technology skills in a single ad that prevent job seekers from distinguishing an accurate picture of the job available. While it is not expected that employers can be indoctrinated into greater uniformity in job postings but this research could influence professional recruiters and job referral websites to provide better guidance and/or structure for job advertisement placement.

Also, understanding the value of internships and professional certifications from the employer perspective is indicated and will be incorporated into future phases of the NSF ATE study.

Limitations

This study attempts to align the different stakeholders' expectation of and the reality of the IT job competencies by using both quantitative and qualitative data. However, this study has some limitations. We collected job posting ads from the limited number of online and offline sources for one month (October, 2013) in northwest Florida; we also administered a small number of focus groups and interviews from two local 2-year community colleges and one 4-year university. Our sample for this study was not representative of the entire population of IT employers' job posting ads, current students in IT programs, and new IT professionals in Northwest Florida.

As a result, the results of this study cannot be generalized for this Northwest Florida nor for any other area of the United States. However, this study attempts to align perceptions and reality of IT job competencies from different stakeholder groups as well as to provide insights into developing and enhancing the current IT programs and educating a more competitive IT work force for the local IT industry. The result of this study provides valuable indicators of what modifications the different sectors/stakeholder groups need to adopt to bridge the gap between their perceptions of IT job competency standards. As a part of the larger NSF-ATE research, we plan to improve and refine the research approach to be conducted in the third year of the project by interviewing both employers in industry and educators at multiple levels of IT programs to assess IT curricula standards and applications that better align IT education with the careers employers have to offer.

Conclusion

Misalignment of IT Job Expectations and Reality

The three stakeholders represented in this study, current IT students, new IT professionals and employers of IT workers, similarly identify the value of selected technical competencies. They consider foundational infrastructure design, operations support, and technology awareness as core competencies for entry level IT workforce. However, each of stakeholders' expectations of general competencies demonstrates discrepancy. While industry highly emphasizes customer service and communication skills and new professionals fairly recognize and utilize them, current students do not distinguish the necessity and values of those skills. It may results from lack of the curriculum or absence of on-going communication between industry and education.

Further research must examine how industry and education better communicate each other to decrease the gap between expectation and reality, build strong IT workforce, and to keep it abreast of ever changing technology and user needs.

Emphasis on Connecting People to Technologies

A key finding is that core competencies are highly related to all people-friendly characteristics and social behaviors. IT professionals need to constantly facilitate the needs of users with technology. Given that IT professionals must be equipped with both technical and general competencies to serve diverse spectrum of roles (Lee & Han, 2008), both education and industry need to constantly provide IT professionals with opportunities for re-educating and enhancing their competencies. As America faces the labor shortfall challenges and swiftly changing technology demands, alignment of workforce needs with education objectives may more suitably satisfy the growth opportunities facing those who will be fashioning a career pathway from the competencies provided as the result of academic curricula infused with

experiential learning. Federal and state policy could direct funding into programs like the NSF ATE funded program, AIM Careerlink[5], that provides a comprehensive career pathway database that provides job search strategies that connect employers, educators and students with up-to-date, step-by-step guidance that takes a career interest and turns it into a practical pathway.

This paper presents one phase of the four-year study conducted for the NSF ATE project, *Assessing Information Technology Educational Pathways That Promote Deployment and Use of Rural Broadband* that is examining alignment between IT education and IT employers. Various stakeholders have participated that include current IT students, new IT professionals that recently graduated from the programs in this study, and IT employers located in the northwest Florida region. The initial impetus for the study was to focus on rural communities that have newly deployed Broadband connectivity, in an attempt to understand the rich details of challenges and enablers to people using technology. Studies show that without adequate broadband, people are unable to truly integrate available technology into their lives (Kozma, 2011; Spears & Mardis, in press). However, there are other resources required to facilitate the full benefits afforded by technology, and a well-trained and innovative workforce are fundamental.

[5] Find AIM Careerlink at http://aimforbrilliance.org/blog/

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Appendix A.

Competencies Model for IT Program Management

Competencies	Codes	Definitions	Examples
Accountability	G-A	Holds self and others answerable for measurable high-quality, timely, and cost-effective results. Determines objectives, sets priorities, and delegates work. Accepts responsibility for mistakes	Ability to work unsupervised, responsively, and or independently;
Attention to Detail	G-AD	Is thorough when performing work and conscientious about attending to detail	Ability to demonstrate attention to detail; Ability to be detail-oriented;
Compliance	G-C	Knowledge of procedures for assessing, evaluating, and monitoring programs or projects for compliance (e.g. ability to read and comply with Federal or state laws) regulations, and guidance	Ability to follow precise direction; Ability to follow written and oral instructions; Ability to read, understand, and comply with the department's policies, procedures, methods, and practices; Ability to read and apply Florida Statute; Maintain confidentiality;
Conflict Management	G-CM	Manages and resolves conflicts, grievances, confrontations, or disagreements in a constructive manner to minimize negative personal impact	
Customer Service	G-CS	Works with clients and customers (that is, any individuals who use or receive the services or products that your work unit produces, including the general public, individuals who work in the agency, other agencies, or organizations outside the Government) to assess their needs, provide information or assistance, resolve their problems, or satisfy their expectations; knows about available products and services; is committed to providing quality products and services	Ability to achieve successful outcomes in handling difficult situations and customers; Ability to demonstrate excellent customer service skills; Customer interaction skills; Experience in a customer service environment; General hospitality;

Creative Thinking	G-CT	Uses imagination to develop new insights into situations and applies innovative solutions to problems; designs new methods where established methods and procedures are inapplicable, unavailable or inefficient	Ability to be creative;
Decision Making	G-DM	Makes sound, well-informed, and objective decisions; perceives the impact and implications of decisions; commits to action, even in uncertain situations, to accomplish organizational goals; causes change	Ability to make decisions; Ability to make quick decision;
External Awareness	G-EA	Ability to stay abreast of IT related laws, trends, policies and emerging technologies	Ability to stay abreast of, current security related laws, trends, and emerging technologies;
Flexibility	G-F	Is open to change and new information; adapts behavior or work methods in response to new information, changing conditions, or unexpected obstacles; effectively deals with ambiguity	Ability to be flexible and resourceful; Ability to work a flexible schedule; Ability to work scheduled and/or unscheduled overtime and callouts; Ability to take on-call duties;
Integrity	G-I	Contributes to maintaining the honesty and fairness of the organization; displays high standards of ethical conduct and understands the impact of violating these standards on an organization, self, and others; is trustworthy	Work ethics;
Influencing/Negotiating	G-IN	Persuades others to accept recommendations, cooperate, or change their behavior; works with others towards an agreement; negotiates to find mutually acceptable solutions	Ability to influence decisions;
Interpersonal Skills	G-IS	Shows understanding, friendliness, courtesy, tact, empathy, concern, and politeness to others; may include effectively dealing with individuals who are difficult, hostile, or distressed; relates well to people from varied backgrounds and different situations; is sensitive to cultural diversity, race, gender, disabilities, and other individual differences	Strong interpersonal skills; Personal Skills; People Skills; Ability to build and maintain relationships with clients, colleagues, and co-workers; Ability to interact professionally with a diverse group;

Leadership	G-L	Influences, motivates, mentors, guides, and challenges others; adapts leadership styles to a variety of situations	Strong leadership; Leadership skills to mentor and provide guidance to less experienced;
Learning	G-LE	Ability to research, acquire, update, and apply new and relevant knowledge and skills quickly; uses training, feedback, or other opportunities for self-learning and development;	Ability to quickly master new subjects and new technical concepts quickly; Ability to research information; Ability to learn and retain knowledge; Technical research and study skills;
Managing Human Resources	G-MHR	Plans, distributes, coordinates, and monitor work assignments of others; evaluates work performance and provides feedback to others on their performance; ensure that staff are appropriately selected, utilized, and developed, and that they are treated in a fair and equitable manner	Ability to allocate available resources as necessary; Ability to manage and track projects; Ability to work with management; Supervisory Skills;
Oral Communication	G-OC	Expresses information (for example, ideas or facts) to individuals or groups effectively, taking into account the audience and nature of the information (for example, technical, sensitive, controversial); makes clear and convincing oral presentations; listens to others, attends to nonverbal cues, and responds appropriately	Ability to clearly and concisely communicate technical information to non-technical users at all organizational levels; Group presentation skills; Effective listening skills; Ability to speak legibly and understand the English language;
Planning and Evaluating	G-PE	Organizes work, sets priorities, and determines resource requirements; determines short- or long-term goals and strategies to achieve them; coordinates with other organizations or parts of the organization to accomplish goals; monitors progress and evaluates outcomes;	Candidates must be skilled at organizing, prioritizing, and managing multiple concurrent tasks with little to no supervision; Organization, prioritization and project coordination skills; Ability to maintain multiple priorities in a fast paced environment; Ability to plan, organize, manage and track projects; Experience working remotely, but cooperatively with HQ;
Problem Solving	G-PS	Identifies problems; assess accuracy and relevance of information; uses sound judgment to generate and evaluate alternatives, and to make recommendations	Ability to identify and resolve complex network problems; Ability to problem solve and resolve problems creatively; The ability to respond to crises objectively;

Reasoning	G-R	Identifies rules, principles, or relationships that explain facts, data, or other information; analyzes information and makes correct inferences or draws accurate conclusions; Critical thinking; Analytical thinking; Judgment skills;	Ability to succinctly synthesize data into information; Reasoning Ability; Critical thinking; Analytical skills; Ability to process information logically;
Reading Comprehension	G-RC	Understands and interprets written material, including technical material, rules, regulations, instructions, reports, charts, graphs, or tables; applies what is learned from written material to specific situations	Ability to read and interpret documents such as safety rules, operating and maintenance instructions, and procedure manuals;
Self-Management	G-SM	Sets well-defined and realistic personal goals for themselves; displays a high level of initiative, effort, and commitment towards completing assignments in a timely manner; works with minimal supervision; is motivated to achieve; demonstrates responsible behavior; Multi-tasking; Time-management; Stress management; Remain postive, proactive;	Ability to work independently with minimum supervision; Ability to work efficiently and effectively in a fast-paced environment, under stress and within time constraints; Stay focused; Ability to manage time and work responsibly without supervision; Ability to manage multiple job tasks at one time; Ability to work independently, self–starter with good time management skills; Ability to work efficiently and effectively in a fast-paced environment, under stress and within time constraints;
Teamwork/Collaboration	G-TC	Encourages and facilitates cooperation, pride, trust, and group identity; fosters commitment and team spirit; works with others to achieve goals	Ability to demonstrate team building and collaboration; Team building experience; Ability to work in a team environment; Experience managing teams;
Teaching Others	G-TO	Helps others learn through formal or informal methods; identifies training needs; provides constructive feedback; coaches others on how to perform tasks;	Ability to train and instruct effectively;

Vision	G-V	Understands the organization's mission, goals, and objectives and how to make a contribution; takes a long-term view and recognizes opportunities to help the organization accomplish its objectives or move toward the vision	Understanding of the organization's goals and objectives;
Writing	G-W	Recognizes or uses correct English grammar, punctuation, and spelling; communicates information (for example, facts, ideas, or messages) in a succinct and organized manner; produces written information, which may include technical material, that is appropriate for the intended audience; Ability to document procedures, policies and infrastructure in a detailed manner;	Excellent written communication skills; Ability to use basic grammar and sentence structure in English; Ability to write legibly and understand the English language; Ability to document procedures, policies and infrastructure in a detailed manner; Ability to type 30 to 40 words per minute;
Technical Competencies	**Codes**	**Definitions**	**Examples**
Accessibility	T-A	Knowledge of tools, equipment, and technologies used to help individuals with disabilities use computer equipment and software.	
Acquisition Strategy	T-AS	Knowledge of the principles and methods for developing an integrated acquisition management plan that describes the business, technical, and support strategies, including the relationship between the acquisition phases, work efforts, and key program events (for example, decision points, contract awards, test activities).	
Business Process Reengineering	T-BPR	Knowledge of methods, metrics, tools, and techniques of Business Process Reengineering.	
Compliance	T-C	Knowledge of procedures for assessing, evaluating, and monitoring programs or projects for compliance with Federal laws, regulations, and guidance.	Experience supporting DHS, Federal Civil, Intelligence and/or DoD Customers;
Cost-Benefit Analysis	T-CBA	Knowledge of the principles and methods of cost-benefit analysis, including the time value of money, present value concepts, and quantifying tangible and intangible benefits.	

Change Management	T-CM	Knowledge of change management principles strategies, and techniques required for effectively planning, implementing, and evaluating change in the organization.	Ability to prioritize and dynamically re-task response and recovery actions as situations change; Ability to conduct short range and long range project planning studies; Understanding Change Management requirements; Ability to adapt to change;
Configuration Management	T-COM	Knowledge of the principles and methods for planning or managing the implementation, update, or integration of information systems components	Experience with client/server software integrations in the image centric healthcare information; Experienced in the installation, integration and testing of HDX family of CODECs;
Contracting/Procurement	T-CP	Knowledge of various types of contracts, techniques for contracting or procurement, and contract negotiation and administration.	
Capital Planning and Investment Assessment	T-CPIA	Knowledge of the principles and methods of capital investment analysis or business case analysis, including return on investment analysis (ROI).	
Data Management	T-DM	Knowledge of the principles, procedures, and tools of data management, such as modeling techniques, data backup, data recovery, data dictionaries, data warehousing, data mining, data disposal, and data standardization processes.	Experience administering SQL or Oracle 11G or Sybase databases; Knowledge of Windows Server/Exchange, Storage Area Networks, Backup utilities; Experience in computer evidence seizure, computer forensic analysis, and data recovery;
Enterprise Architecture	T-EA	Knowledge of principles, concepts, and methods of enterprise architecture to align information technology (IT) strategy, plans, and systems with the mission, goals, structure, and processes of the organization.	Service Oriented Architecture and related enterprise design patterns, distributed system design, server load balancing, business, continuity, cloud deployment, client and server virtualization technologies;
Financial Analysis	T-FA	Knowledge of the principles, methods, and techniques of financial analysis, forecasting, and modeling to interpret quantitative and qualitative data; includes data modeling, earned value management, and evaluating key financial indicators, trends, and historical data.	
Financial Management	T-FM	Prepares, justifies, and/or administers the budget for program areas; plans, administers, and monitors expenditures to ensure cost-effective support of programs	Understanding of financial audit support;

		and policies; assesses financial condition of an organization.	
Information Assurance	T-IA	Knowledge of methods and procedures to protect information systems and data by ensuring their availability, authentication, confidentiality, and integrity.	Experience in the fields of communications and information assurance in an operational environment;
Infrastructure Design	T-ID	Knowledge of the architecture and typology of software, hardware, and networks, including LANS, WANS, and telecommunications systems, their components and associated protocols and standards, and how they operate and integrate with one another and with associated controlling software.	Understanding of virtual infrastructure environments; Experience in network systems administration, network architecture, TCP/IP,LAN/WAN, routers and switches, Windows and Linux based server and client environments;
Information Management	T-IM	Identifies a need for and knows where or how to gather information; organizes and maintains information or information management systems.	Ability to drive requirements gathering using effective elicitation and documentation techniques; Ability to set up and maintain computer hardware, networks and systems; Ability to accurately maintain records, logs, reports, work orders, etc.;
Information Resources Strategy and Planning	T-IRSP	Knowledge of the principles, methods, and techniques of information technology (IT) assessment, planning, management, monitoring, and evaluation, such as IT baseline assessment, interagency functional analysis, contingency planning, and disaster recovery.	Ability to work on multiple tasks setting priorities and allocating available resources as necessary;
Information Systems/Network Security	T-ISNS	Knowledge of methods, tools, and procedures, including development of information security plans, to prevent information systems vulnerabilities, and provide or restore security of information systems and network services.	Experience with network intrusion detection and response operations (Protect, Defend, Respond and Sustain methodology); Knowledge of and skills relevant to information & network security, access and authentication, physical location security, data integrity, and business recovery;

Information Systems Security Certification	T-ISSC	Knowledge of the principles, methods, and tools for evaluating information systems security features against a set of specified security requirements. Includes developing certification and accreditation plans and procedures, documenting deficiencies, reporting corrective actions, and recommending changes to improve the security of information systems.	Experience with system security including the management of Certificates, WSE, NTFS, Bitlocker, and Share level Permissions;
Information Technology Architecture	T-ITA	Knowledge of architectural methodologies used in the design and development of information systems, including the physical structure of a system's internal operations and interactions with other systems.	Experience in MEDITECH hardware infrastructure experience; Understanding of virtual infrastructure environments; Experience in network systems administration, network architecture, TCP/IP,LAN/WAN, routers and switches, Windows and Linux based server and client environments
Information Technology Performance Assessment	T-ITPA	Knowledge of the principles, methods, and tools (for example, surveys, system performance measures) to assess the effectiveness and practicality of information technology systems.	Understanding of basic debugging techniques such as analysis of dump files, tracing, performance tuning, and monitoring;
Information Technology Program Management	T-ITPM	Knowledge of the principles, methods, and tools for the coordinated management of an IT program to include providing oversight of multiple IT projects, integrating dependent schedules and deliverables, and related activities (for example, benefits management, life cycle management, program governance).	Business knowledge to support the property and Information Technology department objectives; Experience in information technology development; Knowledge of systems development life cycle methodologies;

Operations Support	T-OS	Knowledge of procedures to ensure production or delivery of products and services, including tools and mechanisms for distributing new or enhanced software.	Ability to stay within the guidelines of Operations & Maintenance releases; Experience in implementing, day to day operations, architecture, troubleshooting, maintaining/ upgrading SW with Networking products LAN/ WAN, MPLS Support;
Product Evaluation	T-PE	Knowledge of methods for researching and analyzing external products to determine their potential for meeting organizational standards and business needs.	Perform advanced level evaluation, installation, maintenance and repair functions for department multi-function automated computer and computer related hardware; Provide technical leadership including evaluation of technology to determine infrastructure direction, project planning and coordination, and technical assistance to other staff;
Project Management	T-PM	Knowledge of the principles, methods, or tools for developing, scheduling, coordinating, and managing projects and resources, including monitoring and inspecting costs, work, and contractor performance.	Knowledge of project management practices and will be required; Experience in administration, technology and/or project management is required; Experience in project management and managing with multiple projects.(PMP preferred);
Quality Assurance	T-QA	Knowledge of the principles, methods, and tools of quality assurance and quality control used to ensure a product fulfills functional requirements and standards.	Experience managing a quality assurance team, including SDETs and technical testers; Software development experience in the healthcare industry, especially hospital informatics, RISAs a Quality Assurance (QA);
Requirements Analysis	T-RA	Knowledge of the principles and methods to identify, analyze, specify, design, and manage functional and infrastructure requirements; includes translating functional equirements into technical requirements used for logical design or presenting alternative technologies or approaches.	Knowledge of and demonstrated ability to apply computer technology to customer requirements for networked products and systems solutions; Experience with business and technical requirements analysis, business process modeling/mapping, and data modeling

Risk Management	T-RM	Knowledge of methods and tools used for risk assessment and mitigation, including assessment of failures and their consequences.	Identify technology risks and help evaluate the efficiency and effectiveness of the information technology environment; Strong knowledge of technology controls, internal auditing standards, internal controls and risk assessment; Solid strategic thinking approach with business risk awareness and appropriate judgment desired
Systems Engineering	T-SE	Knowledge of the practice of integrating multiple disciplines into a team as part of a structured development process throughout a system's life cycle.	Planning, implementing, installing, supporting, integrating, other hardware and software along with security measures in the multi-platform server environment, specifically AIX, and other services provided by the work unit; Experience with cloud integration;
Systems Life Cycle	T-SLC	Knowledge of systems life cycle management concepts used to plan, develop, implement, operate, and maintain information systems.	Knowledge of systems development life cycle methodologies;
Stakeholder Management	T-SM	Knowledge of the concepts, practices, and techniques used to identify, engage, influence, and monitor relationships with individuals and groups connected to a work effort; including those actively involved, those who exert influence over the process and its results, and those who have a vested interest in the outcome (positive or negative).	
Systems Testing and Evaluation	T-STE	Knowledge of principles, methods, and tools for analyzing and developing systems testing and evaluation procedures and technical characteristics of IT systems, including identifying critical operational issues.	Ability to use scripting languages to automate testing tasks (Visual Basic or VBA preferred); Familiarity with agile software development and exploratory testing; Experience with automated testing tools such as TestPartner, SilkTest, or Quick Test Pro, demonstrated experience independently creating test;

Technology Awareness	T-TA	Knowledge of developments and new applications of information technology (hardware, software, telecommunications), emerging technologies and their applications to business processes, and applications and implementation of information systems to meet organizational requirements.	Knowledge of current and emerging Network and Open Systems environments; Create whitepapers and briefings to highlight emerging computer security trends to U.S. Army leadership and technical personnel; Familiarity with emerging WAN protocols; Ability to stay abreast of, current security related laws, trends, and emerging technologies;

Source: United States Office of Personnel Management, 2011.