
# ASSESSING INFORMATION TECHNOLOGY EDUCATIONAL PATHWAYS THAT PROMOTE DEPLOYMENT AND USE OF RURAL BROADBAND:

# SECOND CURRICULUM ANALYSIS REPORT

**February 23, 2016**

**Jonathan Hollister** <jmh09k@my.fsu.edu>
Research Coordinator

**Charles R. McClure**, **Ph.D.** <cmcclure@lis.fsu.edu>
Director, Information Institute and Francis Eppes Professor

**Marcia A. Mardis, Ed.D.** <Marcia.mardis@cci.fsu.edu>
Associate Professor

**Chandrahasa Reddy Ambavarapu** <ca13@my.fsu.edu>
Research Associate

**Elizabeth Liebman** < el12f@my.fsu.edu>
Research Associate

**Laura I. Spears** <lib03@my.fsu.edu>
Research Associate

**Information Use Management & Policy Institute**
010 Louis Shores Building, 142 Collegiate Loop, P.O. Box 3062100, Tallahassee, FL 32306-2100
Telephone 850.645.5683 Fax 850.644.4522

## INTRODUCTION

The goals of the Information Institute's National Science Foundation Advanced Technological Education (NSF ATE) *Assessing Information Technology Educational Pathways That Promote Deployment and Use of Rural Broadband* study are to strengthen the employee pool of information technology (IT)/broadband staffing (including general IT, broadband, and network technicians); improve educational support related to broadband, telecommunications, and networks for future and current IT employees in non-metropolitan (non-metro) Northwest Florida; and understand how to transfer this competency to similar non-metro markets.[1]

Many studies have supported the important roles that community college programs can play in certification training and as a gateway to the four-year degree (Bailey, Jenkins & Leinback, 2005; Compton, Laanan, & Starobin, 2010; Laanan, Hardy, & Katsinas, 2006). IT degrees have demonstrated significant impact on an individual's earning capacity, with up to a 40% increase over a five-year period (Compton et al., 2010). In Florida, two- and four-year institutions have received high marks for student access, success, and cost effectiveness, with nationally competitive retention and completion rates (Board of Governors, State University System of Florida, 2011; 2015). However, these institutions have had less remarkable records in graduating students that are prepared to meet employer needs, as the wage earning and employment performance of Associate of Arts (AA) degree graduates barely surpasses that of high school graduates (US Chamber of Commerce, 2012).

The Information Institute project team shared findings from preliminary curricula analyses in our 2015 Annual Report for our NSF ATE Project, (April 14, 2015; *2015 Annual Report* hereafter).[2] These preliminary findings, along with the themes that arose from our employer and early career professional interviews and focus groups suggested that non-technical, or "soft," skills are not always included in technical education curriculum frameworks or guidelines despite these skills often being cited as critically important for early IT career professionals. The secondary analysis presented in this report took into account competencies described in the course descriptions, objectives, and/or knowledge, skills, abilities, and 'other' (KSAOs) listed on syllabi. The 'other' category includes soft skills. To accomplish this analysis, researchers created a meso-level codebook that combines competencies from both the United States Office of Personnel Management (2011) *Competencies Model for IT Program Management* and Florida Department of Education's (2013) *Career and Technical Education IT Framework*. This second curriculum analysis expands on the scope of the original to include an examination of the soft skills in addition to the technical skills offered by these curricula. Identifying both the soft and technical skills across these curricula will identify areas for improvement, enabling educators to better equip IT graduates with the skills needed by new IT professionals and requested by IT employers.

### Research Questions (RQs)

[1] Our NSF ATE Project website: http://ii.fsu.edu/Research/Projects/Assessing-Information-Technology-Educational-Pathways-that-Promote-Deployment-and-Use-of-Rural-Broadband-NSF

[2] Our 2015 Annual Report can also be found at the link in the above footnote.

While the overall NSF ATE project has five research questions, not all research questions are covered in every stage of the project. This report addresses parts of the following research question:

> RQ5. How can two-and four-year college IT/broadband program curricula be modified to best meet the specific needs of employers and IT/broadband employees in non-metro/metropolitan areas?

This report informs our understanding of the gaps in IT education by supplementing and expanding our previous data research findings.

## METHOD

The research team developed text-mining techniques to examine the relationship between relevant learning outcomes and the IT curricula syllabi from two colleges, Tallahassee Community College and Chipola College. The syllabi contents were matched to relevant learning outcome standards listed in a codebook derived from the *Competencies Model for IT Program Management* (OPM, 2011) and *Career and Technical Education IT Frameworks* (FL DOE, 2013). The combined codebook (include in Appendix A) includes 13 general competencies, such as soft skills like communication and self-management, and 14 technical competencies, including knowledge of operating systems, coding, and other related technical skills.

The 13 course syllabi from TCC's Networking Services Technology program and 18 course syllabi from Chipola's Computer Information Technology program served as the units of analysis for this curriculum analysis. TCC and Chipola College selected syllabi from courses that represented their core IT program offerings. These course syllabi contained information about the curriculum content area emphasis and the course purposes as well as information about learning outcomes and expectations (Smith & Razzouk, 1993). Curriculum analyses often use syllabi as a preferred and primary data source (Corlu, 2013; Madson, Melchert, & Whipp, 2010; Willingham-Mclain, 2011).

From each syllabus, the research team selected text from course descriptions and student learning outcomes and, using natural language processing techniques, assigned relevant codes from the revised, meso-level codebook. A natural language processing technique for text mining the syllabi allowed us to more quickly examine a large number of documents with our combined codebook. We used a Python script to extract relevant sections from the syllabi, tokenize (fragmenting text into meaningful elements called *tokens*) the text, extract keywords, and identify keywords and patterns from the codebook.[3] We used six steps to extract keywords from each syllabus:

1. *Collect appropriate sections from the syllabus*: win32com.client[4] is a module from the PyWin32 package (Python for windows extension) and is used to automatically

[3] More information on Python: https://www.python.org/
[4] Python for Windows Extension: http://sourceforge.net/projects/pywin32/

extract these sections: course description, course objectives, and course outline/contents from the syllabi

2. *Run automatic text processing:* Various text processing modules defined in Python NLTK package[5] are used to process the text. "Tokenize" refers to a way to split the text into tokens. "*sent_tokenize"* is one of instances of "PunktSentenceTokenizer"[6] from the "*nltk.tokenize.punkt"* module. This identifies the punctuation and characters marking the end of and the beginning of a new sentence. Then each sentence is tokenized into "words" using "TreebankWordTokenizer"[7]
3. *Process keywords*: A list of unigrams (e.g. "User," "centered," "design" etc.), bigrams (e.g. "User centered," "centered design" etc.) and trigrams (e.g. "User centered design") are derived from the tokenized words
4. *Filter stop words*: Unigram tokens are then processed with a corpus of stop words.
5. *Run Stemming [8]and Lemmatization[9]:* The goal of both stemming and lemmatization is to reduce inflectional forms and sometimes derivationally related forms of a word to a common base form. The Natural Language Toolkit (NLTK) has a very powerful lemmatizer that makes use of WordNet,[10] and the common algorithm used for stemming is the Porter Stemming Algorithm[11]
6. *Map keywords*: The resulting words include processed course topics, course contents, technology related words, and supporting verbs. The resulting keywords are used as input for the keyword mapping program

The example below demonstrates the algorithm for keyword matching:

- **Input**: Course syllabi C $\{c_1, c_2, c_3, c_4, c_5, c_6 \ldots\ldots\ldots\ldots c_n\}$, where $c_1, c_2, c_3$ are individual course syllabi
- **Output***: Knowledge Units* associated with course $c_i$

1. For $c_i$ in C:
   1.1 input Standards
   1.1.1 For each 'keyword' in '$c_i$:
   1.1.1. 1 If 'keyword' in 'Learning Outcomes'
   Print '$c_i$, Standard'
   $c_i = c_{i+1}$ (Select next syllabus file)
   Go to step 1
2. Stop.

[5] Natural Language Toolkit: http://www.nltk.org/
[6] PunktSentenceTokenizer: http://www.nltk.org/api/nltk.tokenize.html
[7] TreebankWordTokenizer: http://www.nltk.org/api/nltk.tokenize.html
[8] Stemming: http://en.wikipedia.org/wiki/Stemming
[9] Lemmatization: http://en.wikipedia.org/wiki/Lemmatisation
[10] NLTK Stem Package: http://www.nltk.org/api/nltk.stem.html
[11] Porter Stemming Algorithm: An algorithm for suffix stripping, M.F. Porte

If the selected syllabi text included sufficient course content and technology keywords, we extracted the necessary keywords using the automated text mining above *r* automated text mining. We used manual text mining when content was sparse or highly irregular.
Once the syllabi were parsed, we examined the results using frequency analysis and comparison on means using a two-tailed t-test because we did not hypothesize that one curriculum would include more of a particular skill set than the other curriculum.

## CURRICULUM ANALYSIS RESULTS

The syllabi analysis revealed that the curricula of Chipola College's Computer Information Technology program and Tallahassee Community College's Networking Services Technology programs had much in common; in particular, they both have a heavy emphasis on technical skills, as Table 1 illustrates.

Table 1. Coverage of Skills Technical and Soft Skills across Each Curricula

| Skill (FL DOE/US OPM Code) | Chipola College (N=18) | TCC (N=13) |
|---|---|---|
| | Frequency (% out of 18 courses) | Frequency (% out of 13 courses) |
| **Technical Skills** | | |
| Compliance (T-C) | 4 (22.22) | 1 (7.69) |
| Configuration Management (T-COM) | 11 (61.11) | 11 (84.62) |
| Data Management (T-DM) | 2 (11.11) | 0 (0.00) |
| Information Management (T-IM) | 6 (33.33) | 5 (38.46) |
| Information Systems/Network Security (T-ISNS) | 11 (61.11) | 7 (53.85) |
| Infrastructure Design (T-ID) | 12 (66.67) | 9 (69.23) |
| IT Architecture (T-ITA) | 10 (55.56) | 9 (69.23) |
| IT Performance Assessment (T-ITPA) | 1 (5.56) | 0 (0.00) |
| Operations Support (T-OS) | 11 (61.11) | 12 (92.31) |
| Product Evaluation (T-PE) | 2 (11.11) | 2 (15.38) |
| Project Management (T-PM) | 1 (5.56) | 0 (0.00) |
| Systems Testing & Evaluation (T-STE) | 0 (0.00) | 0 (0.00) |
| Technology Awareness (T-TA) | 7 (38.89) | 9 (69.23) |
| Coding/Programming | 2 (11.11) | 0 (0.00) |
| **General (Soft) Skills** | | |
| Accountability (G-A) | 0 (0.00) | 0 (0.00) |
| Compliance (G-C) | 1 (5.56) | 0 (0.00) |
| Customer Service (G-CS) | 2 (11.11) | 0 (0.00) |
| Flexibility (G-F) | 0 (0.00) | 0 (0.00) |
| Interpersonal Skills (G-IS) | 1 (5.56) | 0 (0.00) |
| Learning (G-LE) | 0 (0.00) | 1 (7.69) |
| Oral Communication (G-OC) | 0 (0.00) | 0 (0.00) |
| Problem Solving (G-PS) | 1 (5.56) | 0 (0.00) |
| Reading Comprehension (G-RC) | 0 (0.00) | 0 (0.00) |
| Self-Management (G-SM) | 0 (0.00) | 0 (0.00) |

| | | |
|---|---|---|
| Teaching Others (G-TO) | 1 (5.56) | 0 (0.00) |
| Teamwork/Collaboration (G-TC) | 0 (0.00) | 0 (0.00) |
| Writing (G-W) | 2 (11.11) | 0 (0.00) |

The codes presented in Table 1, as well as Tables 2 and 3, are ordered alphabetically. Table 1 describes the coverage of technical and general skills across each curricula by counting the presence or absence of a particular skill as listed in the course objectives, descriptions, and/or KSAOs in the syllabus for each course. For example, 4 out of 18 courses in the Chipola College IT curriculum cover the knowledge and skills related to Technical Compliance (T-C). Conceptual and operational definitions and examples used in the combined OPM and FL DOE codebook can be found in Appendix A. This particular view offers an understanding of the where skills may overlap with one another and also demonstrates the cross applicability of skills across different courses covering different content areas. For example, Configuration Management (T-COM) is featured in 11 out 18 (61.11%) IT courses at Chipola College and 11 out of 13 (84.62%) IT courses at TCC. This suggests that Configuration Management is an important skill set that is useful in a variety of IT courses at both institutions. As Table 1 shows, Operations Support, Configuration Management, Infrastructure Design, IT Architecture, and Information Systems/Network Security were the most prevalent skills covered in the courses at each school. Operations Support is covered in some manner in 11 out of 18 (61.11%) of Chipola College courses and in 12 out of 13 (92.31%) of TCC courses. Technology Awareness is noted to be in 7 out of 18 (38.89%) of Chipola College courses and 9 out of 13 (69.29%) TCC courses.

In contrast, soft skills were largely absent in the syllabi across both curricula. As Table 2 shows, Chipola College covered writing and customer service in two of their courses (IT User Support and Desktop Support), while TCC did not have any soft skills in its courses. TCC covered learning (G-LE) in just one of its courses.

Table 2 compares the mean frequency for each code across the curricula, the average number of times the skill set was mentioned per syllabi. This view helps to understand the relative emphasis or importance of each skill set.

Table 2. Average Emphasis of IT Skills in Each Syllabus and Comparison of Means

| **Skill (FL DOE/US OPM Code)** | **Chipola College (n=18)** | | **TCC (n=13)** | | **Two-Tailed t-Test (Unequal Variances Assumed)** | | |
|---|---|---|---|---|---|---|---|
| **Technical Skills** | *M* | *SD* | *M* | *SD* | *t* | d*f* | Sig. (2-tailed) |
| Coding/Programming | 0.44 | 1.65 | 0.00 | 0.00 | 1.1408 | 17 | 0.270 |
| Compliance (T-C) | 0.33 | 0.69 | 0.08 | 0.28 | 1.432 | 24 | 0.165 |
| Configuration Management (T-COM) | 3.50 | 5.07 | 2.85 | 2.94 | 0.4521 | 28 | 0.655 |
| Data Management (T-DM) | 0.11 | 0.32 | 0.00 | 0.00 | 1.4577 | 17 | 0.163 |
| Information Management (T-IM) | 0.61 | 1.04 | 0.38 | 0.51 | 0.8035 | 26 | 0.429 |
| Information Systems/Network Security (T-ISNS) | 3.44 | 5.87 | 2.00 | 4.58 | 0.7686 | 29 | 0.448 |
| Infrastructure Design (T-ID) | 1.72 | 1.90 | 3.31 | 3.15 | -1.616 | 18 | 0.124 |
| IT Architecture (T-ITA) | 1.28 | 1.93 | 2.92 | 2.90 | -1.78 | 20 | 0.090 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| IT Performance Assessment (T-ITPA) | 0.06 | 0.24 | 0.00 | 0.00 | 1.00 | 17 | 0.331 |
| Operations Support (T-OS) | 1.61 | 2.33 | 3.00 | 2.31 | -1.646 | 26 | 0.112 |
| Product Evaluation (T-PE) | 0.11 | 0.32 | 0.38 | 1.12 | -0.854 | 13 | 0.408 |
| Project Management (T-PM) | 0.94 | 4.01 | 0.00 | 0.00 | 1.00 | 17 | 0.331 |
| Systems Testing & Evaluation (T-STE) | 0.00 | 0.00 | 0.00 | 0.00 | n/a | n/a | n/a |
| Technology Awareness (T-TA) | 1.33 | 2.22 | 2.15 | 1.91 | -1.102 | 28 | 0.280 |
| **General (Soft) Skills** | | | | | | | |
| Accountability (G-A) | 0.00 | 0.00 | 0.00 | 0.00 | n/a | n/a | n/a |
| Compliance (G-C) | 0.06 | 0.24 | 0.00 | 0.00 | 1.00 | 17 | 0.331 |
| Customer Service (G-CS) | 0.33 | 1.19 | 0.00 | 0.00 | 1.1902 | 17 | 0.250 |
| Flexibility (G-F) | 0.00 | 0.00 | 0.00 | 0.00 | n/a | n/a | n/a |
| Interpersonal Skills (G-IS) | 0.06 | 0.24 | 0.00 | 0.00 | 1.00 | 17 | 0.331 |
| Learning (G-LE) | 0.00 | 0.00 | 0.08 | 0.28 | -1 | 12 | 0.337 |
| Oral Communication (G-OC) | 0.00 | 0.00 | 0.00 | 0.00 | n/a | n/a | n/a |
| Problem Solving (G-PS) | 0.06 | 0.24 | 0.00 | 0.00 | 1.00 | 17 | 0.331 |
| Reading Comprehension (G-RC) | 0.00 | 0.00 | 0.00 | 0.00 | n/a | n/a | n/a |
| Self -Management (G-SM) | 0.00 | 0.00 | 0.00 | 0.00 | n/a | n/a | n/a |
| Teaching Others (G-TO) | 0.06 | 0.24 | 0.00 | 0.00 | 1.00 | 17 | 0.331 |
| Teamwork/Collaboration (G-TC) | 0.00 | 0.00 | 0.00 | 0.00 | n/a | n/a | n/a |
| Writing (G-W) | 0.11 | 0.32 | 0.00 | 0.00 | 1.4577 | 17 | 0.163 |

As Table 2 depicts, Operations Support, Technology Awareness, Configuration Management, Infrastructure Design, IT Architecture, and Information Systems/Network Security skills sets were most frequent in the syllabi, ranging from a mean of 1.28 to 3.5 mentions per syllabus.

While the means may seem noticeably different between the curricula of Chipola College and TCC, the results of the two-tailed t-tests shown in Table 2 suggest that these mean differences were not statistically significant ($\alpha$=.05), thus confirming that the curricula were indeed quite similar. Given the small sample size, large standard deviations, and the existing similarity of the content in each program, these results were not unexpected.

Table 3 depicts the IT skills emphasis as determined by the total number of skills mentioned in both the TCC and Chipola curricula and overall.

Table 3. Emphasis Gauged by IT Skills Coding Totals Across Curricula

| **Skill (FL DOE/US OPM Code)** | **Chipola College** | **TCC** | **Overall Percentage** | |
|---|---|---|---|---|
| | Skill Count | Skill Count | Skill Totals | % of 514 Codes |
| Coding/Programming | 8 | 0 | 8 | 1.56% |
| Compliance (T-C) | 6 | 1 | 7 | 1.36% |
| Configuration Management (T-COM) | 63 | 37 | 100 | 19.46% |
| Data Management (T-DM) | 2 | 0 | 2 | 0.39% |
| Information Management (T-IM) | 11 | 5 | 16 | 3.11% |

| | | | | |
|---|---|---|---|---|
| Information Systems/Network Security (T-ISNS) | 62 | 26 | 88 | 17.12% |
| Infrastructure Design (T-ID) | 31 | 43 | 74 | 14.40% |
| IT Architecture (T-ITA) | 23 | 38 | 61 | 11.87% |
| IT Performance Assessment (T-ITPA) | 1 | 0 | 1 | 0.19% |
| Operations Support (T-OS) | 29 | 39 | 68 | 13.23% |
| Product Evaluation (T-PE) | 2 | 5 | 7 | 1.36% |
| Project Management (T-PM) | 17 | 0 | 17 | 3.31% |
| Systems Testing & Evaluation (T-STE) | 0 | 0 | 0 | 0.00% |
| Technology Awareness (T-TA) | 24 | 28 | 52 | 10.12% |
| **Technical Skills Total** | **279** | **222** | **501** | **97.47%** |
| Accountability (G-A) | 0 | 0 | 0 | 0.00% |
| Compliance (G-C) | 1 | 0 | 1 | 0.19% |
| Customer Service (G-CS) | 6 | 0 | 6 | 1.17% |
| Flexibility (G-F) | 0 | 0 | 0 | 0.00% |
| Interpersonal Skills (G-IS) | 1 | 0 | 1 | 0.19% |
| Learning (G-LE) | 0 | 1 | 1 | 0.19% |
| Oral Communication (G-OC) | 0 | 0 | 0 | 0.00% |
| Problem Solving (G-PS) | 1 | 0 | 1 | 0.19% |
| Reading Comprehension (G-RC) | 0 | 0 | 0 | 0.00% |
| Self-Management (G-SM) | 0 | 0 | 0 | 0.00% |
| Teaching Others (G-TO) | 1 | 0 | 1 | 0.19% |
| Teamwork/Collaboration (G-TC) | 0 | 0 | 0 | 0.00% |
| Writing (G-W) | 2 | 0 | 2 | 0.39% |
| **General (Soft) Skills Total** | **12** | **1** | **13** | **2.53%** |

As Table 3 shows, Configuration Management accounts for 19.46% (100 out of 514) of the skills coded. Along with Configuration Management, Information Systems/Network Security (17.12%), Infrastructure Design (14.40%), Operations Support (13.23%), IT Architecture (11.87%), and Technology Awareness (10.12%) were the most prevalent skill sets in both curricula. However, some technical skills received much less coverage. For example, Information Management, Systems Testing & Evaluation, Data Management, IT Performance Assessment, Product Evaluation, and Project Management represented at most only 3.31% of course content. Out of the general skills, only Customer Service managed to garner over 1% coverage at 1.17%. Many of the other general skills are not covered.

Grouping technical and general/soft/employability skills together, technical skills account for 97.47% (501 out of the 514) of the codes applied to the syllabi with general skills accounting for just 2.53%. These results demonstrate a massive disparity between technical and general skills taught in the curricula at Chipola College and TCC. The implications of these findings will be discussed below.

## Study Limitations

The variety of formatting styles and content guidelines of the syllabi required extensive mapping and data transformation in order to assess the similarity of learning outcomes and corresponding codes across both programs. While the automated text mining process is designed to map root forms of the keywords to the codebook, some keyword forms may result in inappropriate matches. Similarly, it is also possible that the lemmatization techniques impact the semantics of the original text.[12] Finally, it is clear that given the unit of analysis is a course syllabus, a comprehensive view of the curriculum is needed to include all elements of classroom content delivery. Since this analysis focused on the syllabi from the IT programs of each respective institutions, it is possible that the soft skills are a more prominent in other parts of the curriculum, such as the general education requirements or prerequisites. However, given the importance of these soft skills as noted by new professionals and IT employers as seen in our *Preliminary Report of New Professional Interviews* as well as in our *Preliminary Report of IT Employer Interviews,* including these skills within the IT classroom could help students understand, develop, and apply them within the IT context before beginning their careers.

The study is limited by the use of a codebook that has received limited confirmation and peer review from outside our research team and the context of this project. However, the FL DOE program learning outcomes which made up a portion of the codebook were examined by the research team and validated by two external IT experts. Similarly, a team of 5 researchers worked to test and validate the combined FL DOE and OPM codebook.[13] The program learning outcomes comprise two levels of specificity: a macro level that serves as categories and a micro level that includes extensive task details. Both the macro categories and micro level task details were analyzed for relevant key terms to be used as the basis for the codebook; these key terms form the basis of the codebook text mining algorithm.

Given the differences in codebooks used in the first curriculum analysis as opposed to that as reported in the *Annual Report,* a direct comparison between the curricula is not possible. However, the resultant themes from each analysis are discussed in the following section.

## DISCUSSION

The 2014-2015 academic year curriculum analysis reported in the *2015 Annual Report* suggests that the curricula of Chipola College and TCC were substantially different in focus. In the previous *Annual Report* using the different codebooks, we concluded that Chipola College's curriculum centered on Networking Hardware, Windows Applications, Windows-based Client

[12] Lemmatization is a method of combining different versions or conjugations of a particular word into one category to aid in analysis. For example, jump, jumping, jumped, jumps, and to jump would all get sorted into the same category. More information: http://en.wikipedia.org/wiki/Lemmatisation

[13] This process is detailed in another paper: Lee, J., Spears, L., Ambavarapu, C., Ma, J., Hollister, J., Mardis, M.A., & McClure, C.R. (2014).*Aligning Expectations and Reality about IT/Broadband Education: Perceptions of Job Competencies by Students, New Professionals and Employers.* Paper presented at the 42nd Research Conference on Communication, Information, and Internet Policy (2014 TPRC), George Mason University, Arlington, VA, September 12-14, 2014. Available at http://ssrn.com/abstract=2485678

and Network Computer Systems, Desktop Applications and Micro-computing Operating System using the original codebook. Additionally, TCC's desired learning outcomes emphasized Networked Environment, Computer Software, Network Hardware, Network Software, Internetworking and Network Administration and Management Activities. Using the original codebooks in the first curriculum analysis, TCC's curriculum focused on networking related activities, while Chipola focused more on operations support and related skill sets. As seen above, the skill categories present in the codebooks used in the first curriculum analysis in the *Annual Report* do not align with the skills categories or codes in the updated and combined codebook (Appendix A) used in this second curriculum analysis. As such, a direct comparison between both curriculum analyses would not be valid. However, the curriculum analysis was re-done in 2016 in an effort to capture any curriculum updates stemming from statewide framework changes and national IT workplace trends as well as to re-examine the curricula to explore the coverage and inclusion of soft skills, which were identified as highly desirable by both new professionals and IT employers.

As the results of this 2015-2016 academic year analysis suggest, there is now no significant difference between the curricula offered by Chipola College's Computer Information Technology Program and TCC's Networking Services Technology programs. The results indicated that graduates from Chipola College and TCC are prepared mainly in the technical skill areas of Configuration Management, Information Systems/Network Security, Infrastructure Design, Operations Support, IT Architecture, and Technology Awareness. However, the curricula from both schools lack emphasis in some technical skill areas, such as Compliance, Project Management, Coding/Programming, Product Evaluation, Systems Testing and Evaluation, Information Management, IT Performance Assessment, and Data Management.

Each institution's curriculum focus is heavily skewed towards the technical skills rather than general, soft, or employability skills. Given the U.S. Chamber of Commerce's (2012) findings, graduates from these and similar programs may be failing to meet the needs of employers because they did not complete coursework that emphasized general, soft, or employability skills. Preliminary findings from the employer and early career professionals suggest that it is these soft skills, such as problem solving, self-management, and interpersonal communication skills, which are more useful for new professionals and sought after by employers. Information on the perspectives of new professionals and IT employers can be found in the *Preliminary Report of New Professional Interviews* and *Preliminary Report of IT Employer Interviews*, respectively.

## CONCLUSION & NEXT STEPS

In this report, we presented the findings of a second analysis of the IT curriculum in programs at Chipola College and TCC. Using text-mining and natural language processing, the researchers explored the extent to which learning outcomes expressed on course syllabi matched to the technical and general skills included on both the *Competencies Model for IT Program Management* (OPM, 2011) and *Career and Technical Education IT Frameworks* (FL DOE, 2013). The above analysis revealed that the Chipola College and TCC technology programs were quite similar. Consistent with themes that have emerged from other data analysis conducted in

this project, the curriculum analysis presented here suggests that soft skills content such as written and oral communication, interpersonal skills, customer service, self-management, and professional learning are lacking in technology curricula in the two programs under study. Given the importance of these skills to employment outcomes, earnings potential, and economic input, developers of these information technology programs may wish to consider including additional coursework or revise current coursework to emphasize soft skills within the context of IT work.

This finding, however, is just one factor of advanced technological education in Northwest Florida where changes might be made. In response to RQ 5, in which we inquired how two-and four-year college IT program curricula can be modified to best meet the specific needs of employers and IT employees, the findings of this report complement the findings of the results of the researchers' interviews with rural Northwest Florida employers. In their interviews, employers expressed that they expected their new employees to have and valued employees' abilities to apply soft skills; to this end, IT professional preparation programs are well positioned as natural sites for students to gain these skills.

To appropriately augment and enhance IT curricula, it is important to consider all of the stakeholders involved in IT education. Moving forward, a symposium that brings together employers, students, new professionals, educators, and policy makers could provide an excellent opportunity for these stakeholders to (1) discuss ways to improve IT education, (2) build partnerships that could streamline potential student-to-career pathways, (3) share knowledge and best practices, and (4) establish contacts and networks for these stakeholders to better work together in the future for improved IT education.

## REFERENCES

Bailey, T., Jenkins, D., & Leinback, T. (2005). *Community College Low-Income and Minority Student Completion Study: Descriptive statistics from the 1992 high school cohort*. New York, NY: Columbia University, Teachers College, Community College Research Center. Retrieved from CCRC website: http://ccrc.tc.columbia.edu/Publication.asp?uid=206

Board of Governors, State University System of Florida. (2011). *State University System Graduation and Retention Rates Are Nationally Competitive.* Retrieved from http://www.flbog.edu/pressroom/_doc/InfoBrief_Graduation_Rates_2011-09.pdf

Board of Governors, State University System of Florida. (2015). 2013-14 *System Accountability Report*. Retrieved from http://www.flbog.edu/about/_doc/budget/ar_2013-14/2013_14_System_Accountability_Report_Summary_REVISED_FINAL.pdf

Compton, J. I., Laanan, F. S., & Starobin, S. S. (2010). Career and technical education as pathways: Factors influencing postcollege earnings of selected career clusters, *Journal of Education for Students Placed at Risk, 15*(1-2), 93-113. doi: 10.1010/10824661003635044

Corlu, M. S. (2013). Insights into STEM Education Praxis: An Assessment Scheme for Course Syllabi. *Educational Sciences: Theory and Practice*, *13*(4), 2477-2485.

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

Laanan, F. S., Hardy, D. & Katsinas, S .G. (2006). Documenting and assessing the role of community colleges in developing human capital. *Community College Journal of Research and Practice, 30*(10), 855-869. doi: 10.1080/10668920600901830

Madson, M., Melchert, T., & Whipp, J. (2010). Assessing student exposure to and use of computer technologies through an examination of course syllabi. Assessment & Evaluation in Higher Education, 29(5), 549-561. doi: 10.1080/02602930410001689135

Office of Personnel Management [OPM]. (2011). *Competency model for IT program management. Chief Human Capital Officers Council*. Retrieved from http://www.chcoc.gov

Smith, M. F., & Razzouk, N. Y. (1993). Improving classroom communication: The case of the course syllabus. *Journal of Education for Business*, *68*(4), 215-221.

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

Willingham-McLain, L. (2011). Using a University-wide Syllabus Study to Examine Learning Outcomes and Assessment. *The Journal of Faculty Development*, *25*(1), 43-53.

# APPENDIX A – OPM & FL DOE COMBINED CODEBOOK

| Technical Competencies | Abbr. | Conceptual Definition | Operational Definition/Examples |
|---|---|---|---|
| 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; |
| 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; Mobile technology (software, hardware, etc.); Cloud computing; |
| 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; Cloud computing; |
| 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.; |
| 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; |
| 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; |
| 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; |
| 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; Mobile technology (software, hardware, etc.) |

| | | | |
|---|---|---|---|
| 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 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; |
| 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); |

| | | | |
|---|---|---|---|
| Coding/Programming | C/P | Programming Fundamentals<br>Programming is a foundational skill for all computing disciplines. This knowledge area develops skills and concepts that are essential to good programming practice and problem solving. It covers fundamental programming concepts, event-driven programming, object-oriented programming, basic data structures, and algorithmic processes.<br>a. Fundamental Data Structures<br>b. Fundamental Programming Constructs<br>c. Object-Oriented Programming<br>d. Algorithms and Problem-Solving<br>e. Event-Driven Programming<br><br>Integrative Programming and Technologies<br>Organizations typically use many disparate technologies that need to communicate and work with each other. A key component to the discipline of Information Technology is the integration of applications and systems. This knowledge area examines the various types of programming languages and their appropriate use. It also addresses the use of scripting languages, architectures, application programming interfaces and programming practices to facilitate the management, integration and security of the systems that support an organization.<br>f. Intersystems communications<br>g. Data mapping and Exchange<br>h. Integrative Coding<br>i. Scripting Technologies<br>j. Software Security Practices<br>k. Miscellaneous Issues<br>l. Overview of Programming Languages | 1a. Write programs that use each of the following data structures: arrays, records, strings, linked lists, stacks, and queues<br>2a. Choose the appropriate data structure for modeling a given problem<br>3a. Utilize primitive data types and built-in data structures.<br>4a. Describe common applications for each data structure in the topic list.<br>5a. Describe a simple hash function.<br><br>6b. Modify and expand short programs that use standard conditional and iterative control structures and functions<br>7b. Apply the techniques of structured (functional) decomposition to break a program into smaller pieces<br>8b. Analyze and explain the behavior of simple programs involving the fundamental programming constructs covered by this unit.<br>9b. Design, implement, test, and debug a program that uses each of the following fundamental programming constructs: basic computation, simple I/O, standard conditional and iterative structures, and the definition of functions.<br>10b. Choose appropriate conditional and iteration constructs for a given programming task.<br>11b. Describe the mechanics of parameter passing and the issues associated with scoping.<br>12b. Describe the concept of recursion and give examples of its use.<br>13b. Implement and trace the execution stack of a simple recursive function.<br><br>1c. Discuss and identify the concepts of encapsulation, abstraction, inheritance, and polymorphism<br>2c. Describe the relationship between an object and its |

| | | | |
|---|---|---|---|
| | | | corresponding class<br>3c. Compare and contrast the notions of overloading and overriding methods in an object-oriented language<br>4c. Design, implement, test, and debug simple programs in an object-oriented programming language.<br>5c. Describe how the class mechanism supports encapsulation and information hiding.<br>6c. Design, implement, and test the implementation of "is-a" relationships among objects using a class hierarchy and inheritance.<br>7c. Utilize iterators to access the elements of a container.<br>8c. Describe how constructors and destructors relate to the life of an object.<br>9c. Describe the relationship between an object and its corresponding class.<br><br>1d. Use a programming language to implement, test, and debug algorithms for solving simple problems<br>2d. Discuss the importance of algorithms in the problem-solving process<br>3d. Create algorithms for solving simple problems<br>4d. Identify the necessary properties of good algorithms.<br>5d. Apply effective debugging strategies. |
| **General Competencies** | **Abbr.** | **Conceptual Definition** | **Operational Definition/Examples** |
| 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; |

| | | | |
|---|---|---|---|
| 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; |
| 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; |
| 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; |
| 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; |
| 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; |

| | | | |
|---|---|---|---|
| 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 positive, proactive; professionalism | 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; |
| 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; Professional ethical issues and responsibility | Ability to work unsupervised, responsively, and or independently; |
| 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; |
| 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; be patient to ambiguity (e.g., process and tasks, etc.) |
| 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; |

| | | | |
|---|---|---|---|
| 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; Intellectual property (e.g., copy rights, patents, and trade secrets); Legal issues in Computing, E.U. Data protection act, HIPPA, FERPA acts, Gramm-Leach-Bailey Act and privacy related acts and issues; |
| 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; |