Using the Labor Market Information System to Inform Continuous Program Improvement Efforts

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Abstract

The federal government has recognized the need to coordinate efforts of key government agencies; educational providers; and private business to build a common approach to workforce and economic development. This approach to build a pipeline of an educated and skilled workforce is known as a demand-driven workforce development system. The enabling technology for the federal government's efforts is its labor market information system.

In order for STEM programs to meet the needs of the 21st Century workforce, we must understand the components of the nation's labor market information system (LMIS) so that we can fully participate in our regional and local workforce and economic development planning decisions. The LMIS collects, among other things, data from a myriad of sources on employment across occupations and industries, projections of high demand/high wage occupations for the next 10 years, occupations and industries likely to see declining demand, and the knowledge, skills, and abilities that are required in over 800 occupations. The presentation of this workforce research data is a far cry from the LMIS's predecessor, the Dictionary of Occupational Titles. Workforce information is now delivered over the internet; the data is repurposed to provide an online career management system for job seekers and job changers, and career planning information is provided directly to students and their parents. The same data is available to institutions of higher education, but few programs have taken advantage of it to inform their outreach and recruitment efforts nor their statements of program objectives and outcomes.

Introduction

Outcomes-based assessment is designed to ensure program quality and accountability through adherence to high standards, measurement of results, and participation in a continuous improvement process. Continuous program improvement is certainly a goal of the faculty and administrators responsible for STEM undergraduate academic programs, particularly in light of its inclusion as a general criteria in ABET's final version of the Computing Accreditation Commission's (CAC) accreditation documents for its three program's—information technology (IT), information systems (IS), and computer science (CS). For the CAC programs, as well as the other commissions, this "harmonized" document translates into (1) common ABET definitions across all ABET programs, (2) a revision of the CAC criteria that eliminates Standards statements, included General criteria numbered and named similarly to the other commissions, and (3) inclusion of specific program criteria for the IT, IS, and CS programs.[1] The sections of the common General Criteria for all three CAC programs are as follows:

- Criterion 1. Students
- Criterion 2. Program Educational Objectives
- Criterion 3. Program Outcomes (a-i)
- Criterion 4. Continuous Improvement
- Criterion 5. Curriculum
- Criterion 6. Faculty
- Criterion 7. Facilities
- Criterion 8. Support
- Criterion 9. Program Criteria (varies for each discipline)

The standalone General Criteria for Continuous Improvement (Criteria 4) demonstrates the importance that ABET places on the need for feedback systems to ensure that evaluation results translate into the improvement of the program. Feedback or "Closing the loop" strategies represent the continuous improvement processes necessary to move evaluation results from documented actions into program improvement. While much time and effort has been

expended on developing best practices for both assessment of student learning and educational objectives, the validity of the processes relies on "incorporating relevant data." One could not argue that the mountains of paper gathered together in conference rooms and turned over to evaluation teams is not impressive, but in "closing the loops" have we not relegated the outcomes and their related data sources to the equivalent of "teaching to the test." Willis and Mayo advocate a larger net for gathering data that informs future revisions of a program or that informs planning for a new program.[2] Their curriculum development model calls for an environmental scan of external data sources, particularly when analyses of job requirements/employer demands are made.

Gathering information from stakeholders like industry representatives, employers, or surveys of alumni, as is the usual case for continuous program improvement assessment, cannot provide the depth of detail that potentially could come from an analysis of the labor markets' supply and demand indicators. By using the data resources of the Federal-State Cooperative Labor Market Statistical System, known collectively for this paper as the labor market information system (LMIS), to inform their continuous program improvement efforts, STEM programs could include a relevant layer of information sources to aid in the identification, design, and alignment of program outcomes and objectives with economic demands and needs of the state and region.

This paper reflects one STEM program's use of the LMIS to inform its program planning and revision efforts. An environmental scan for program planning/revision purposes was conducted to collect labor market demand and supply indicators based on an industry-sector analysis and an occupational analysis using the data sources available in the LMIS. The results of the two analyses will be described and how the labor market demand and supply indicators were collected. Of interest to the broader STEM community are the planning, design, alignment, and revision decisions that could inform their own continuous program improvement.

The Federal-State Cooperative Labor Market Statistical System

The U.S. Department of Labor Bureau of Labor Statistics (BLS), the U.S. Department of Commerce Census Bureau, the partnering state labor market information units, and the Department of Education's National Center for Education Statistics (NCES) are primarily responsible for collecting and reporting data on the nation's labor market and workforce developments. The Federal-State Cooperative Labor Market Statistical System (known collectively as LMIS) is one of the most advanced statistical information systems in the world. NCES conducts surveys and collects information from our nation's schools and universities. Through a combination of establishment surveys, household surveys, and administrative records, the BLS, Census Bureau, and the U.S. Department of Labor's Employment and Training Administration (ETA) produce timely, reliable, and accessible information about national, state, regional, and local labor markets and changing conditions over time. America's Labor Market Information System (ALMIS) with guidance from ETA has facilitated the development of One-Stop Career Centers and the Occupational Information Network (O*NET)--systems to provide job seekers (like our students), employers (like our advisory board members), and workforce professionals (like faculty and administrators) easier access to workforce and labor market information. STEM programs could benefit greatly from the data resources and analysis tools provided by this information-rich network. [3]

North American Industrial Classification System (NAICS)

To identify regional and labor market demand indicators, an industry-sector analysis must be conducted and should be based upon the North American Industrial Classification System (NAICS), an industrial coding system adopted by the U.S. Department of Labor Bureau of Labor Statistics. An industry refers to a productive sector of the economy.[4] As its name implies, this system will be used by Canada and Mexico, also. NAICS groups establishments into industries based on the products or services produced by the establishments. From 2 to 6 digits are used to identify the industrial classification of a business.

The NAICS categorizes the economy into 20 major sectors (5 goods producing categories and 15 services producing) including 1,170 industries. The BLS NAICS page can be accessed at http://www.bls.gov/bls/naics.htm . Table 1 lists the two-digit 2007 NAICS with the Goods-producing industries separated from the Service-providing industries. Both the engineering services industries and the computer related industries that are of importance to most STEM programs are located in the super-sector "Professional and Business Services," and more specifically, "Sector 54 Professional, Scientific, And Technical-Services."

Table 1. NAICS Major Industry Sectors with Aggregation Titles

Goods-Producing
- Natural resources and mining
  - Sector 11 (Agriculture, forestry, fishing and hunting)
  - Sector 21 (Mining)
- Construction
  - Sector 23 (Construction)
- Manufacturing
  - Sector 31-33 (Manufacturing)

Service-Providing
- Trade, transportation, and utilities
  - Sector 42 (Wholesale trade)
  - Sector 44-45 (Retail trade)
  - Sector 48-49 (Transportation and warehousing)
  - Sector 22 (Utilities)
- Information
  - Sector 51 (Information)
- Financial activities
  - Sector 52 (Finance and insurance)
  - Sector 53 (Real estate and rental and leasing)
- *Professional and business services*
  - *Sector 54 (Professional, scientific, and technical services)*
  - Sector 55 (Management of companies and enterprises)
  - Sector 56 (Administrative and support and waste Management and remediation services)
- Education and health services
  - Sector 61 (Education services)
  - Sector 62 (Health care and social assistance)
- Leisure and hospitality
  - Sector 71 (Arts, entertainment, and recreation)
  - Sector 72 (Accommodation and food services)
- Other services
  - Sector 81 (Other services, except public administration)
- Public administration
  - Sector 92 (Public administration)
- Unclassified
  - Sector 99 (Unclassified)

Labor Market Demand Indicators

The goal of local and regional economic planners is to have high growth, high demand industries employing workers in high growth, high wage occupations. The LMIS enables the identification of industries or clusters of industries and occupations that meet the operationalized criteria for industries and occupations. The 28 Texas Workforce Development Areas have restrictions on which industries and occupations in those industries meet the eligibility criteria to receive training funds. Since the goal of this project was for to use the LMIS for informational purposes, there was no need to meet the high growth, high demand criteria.

To continue with the industry-sector analysis, we first studied the national level analysis of the industry employment for the time period currently available to provide comparison data for the regional data. Every two years, the BLS publishes their industry employment projections for the next decade. The national level results of their detailed industry employment and output projects from 2006-2016 indicated that **employment growth** in the professional and business services sector is projected to increase more than in any other sector in the economy over the next decade.[5] Business demand for consultants (Management, scientific, and technical consulting services sector, 5416), sophisticated computer networks (Computer systems design and related services sector), and a variety of employment services to address complex business issues (employment services sector, 5413) will account for most

of the overall sector's growth. The Information sector (51) is projected to experience **output growth** faster than any other sector in the economy. Software publishing (5112) is expected to be the third-fastest growing industry in terms of output and among those with the fastest employment growth. Table 2 shows the employment growth numbers for these four sectors.

Table 2. National Employment data for selected sectors.

2002 NAICS	Industry description	Sector	Thousands of jobs		Change	Average annual rate of change
			2006	2016	2006–16	2006–16
5416	Management, scientific, and technical consulting services	Professional and business services	920.9	1,638.70	717.8	5.9
5415	Computer systems design and related services	Professional and business services	1,278.20	1,767.60	489.4	3.3
5413	Employment services	Professional and business services	3,656.6	4,348.1	691.5	1.5
5112	Software publishers	Information	243.4	321.3	77.9	2.8

The *Career Guide to Industries, 2008-09 Edition,* published by the BLS is available online at http://www.bls.gov/oco/cg/home.htm and describes topics of interest about working in a specific industry such as the nature of the industry, working conditions, employment information, occupations in the industry, training and advancement, employment outlook, and earnings.[6] One of the interesting pieces of information in the discussion of the Computer Systems Design and Related Services industry was that 78% of the establishments in this industry employed fewer than five workers in 2006, but that the majority of the jobs were found in businesses that employed 50 or more workers. Another excellent national level resource is *Industries at a Glance* (IAG) available at http://www.bls.gov/iag/home.htm . For over 100 industries, IAG provides fairly thorough statistical snapshots of links to resources for each industry.

After gathering background information from national LMIS sources, we turned our attention to state data covering industry demand. The subsectors in these two industries (541 and 511) were next used to analyze the current employment situation for the major industries in the region as well as the projected employment, the changes in industry trends for current and projected job openings due to growth and replacement factors, and the number of employers and contact information for businesses in these industries. This part of the industry-sector analysis produced a set of key industry sectors (by four-digit NAICS codes) that offers the greatest employment demand (current indicator) and the best growth prospects (projection indicator).

The State Labor Market and Career Resources division of the Texas Workforce Commission has created many online tools for workforce professionals to use in helping citizens make decisions either for job placement or to establish a business in the state. To provide information on high demand industries, the Industrial Evaluation module was developed. It is a part of a larger application called the Standardized Occupational Components for Research and Analysis of Trends in Employment System (SOCRATES).[7]To run the industrial evaluation application, one needs to know the name of the geographical region to be analyzed and the 4-digit industry code of the industry of most interest. Our program supports computer-related industries so the industry chosen for analysis was Computer System Design and Related Services—5415.The geographical region of interest will also need to be chosen. Weights are assigned to the 10 industry employment variables (current and projected growth), the calculations are run for every 3-digit NAICS industry operating in the chosen region, and then a summary quotient of every variable for each industry is calculated and ranked from 1 to n. The lower the rank, the higher the industry is rated as a high growth, high demand industry. The results include a ranking of the following employment variables:

- Local Employment Change
- Local Employment
- Local Industry Location Quotients
- Local Industry Average Weekly Wage/font

- Local Short Term Employment Projections Absolute Change
- Local Short Term Employment Projections Percent Change
- Local Long Term Employment Projections 2014
- Local Long Term Employment Projections Change 2004-2014
- Local Long Term Employment Projections Percent Change 2004-2014
- National Projected Employment in 2014

The 4-digit level NAICS industries were then ranked as a percentage of the 3-digit level NAICS total. Computer Systems Design and Related Services, 5415, was ranked third with 14% of the 541 sector total and Management and Technical Consulting Services, was ranked fourth with 12% of the 541 sector total (see Table 3 below). Software Publishers, 5112, had 34% of the total Publishing industries for the Information sector, but its short-term change rate for employment growth was slightly negative, meaning that it had a slight decrease in employment over the most recent two-year period. The software publishing industry is not a large part of the regional economy; certainly not like it is in the central Texas area. Since there is a fairly close correlation between the regional and national employment outcomes, we decided to continue to study the software publishing industry for this project (the results are not shown in this paper). Table 3 shows the percent change from 2005 to 2007. [Note: The data for this stage of

Table 3. Industry Current and Projected Employment

			Current Employment			
			1st Quarter			% Chg
NAICS Code	NAICS Title	% of 3 digit NAICS	2005	2006	2007	2005-2007
5413	Employment Services	34	53028	56566	59878	12.92
5411	Legal Services	15	24501	24221	23879	-2.54
5415	Computer Systems Design and Rel Services	14	21719	22283	23763	9.41
5416	Management & Technical Consulting Svc	12	16493	19109	19869	20.47
5412	Accounting and Bookkeeping Services	12	17238	18940	20339	17.99
5419	Other Professional & Technical Services	7	10420	10617	11613	11.45
5417	Scientific Research and Development Svc	4	6273	6334	9172	46.21
5418	Advertising and Related Services	3	4182	4245	4535	8.44
5414	Specialized Design Services	1	1964	1972	1991	1.37
541	**Professional and Technical Services**	**100**	**155818**	**164446**	**175039**	**12.34**

the analysis had to be split because of the width of the table so the Projections columns are shown below the Current Employment columns. We were just interested in the Industry 5415 for the project, but the current employment figures are only 25% of the projected. The Actual Change column in the Projected part of the tablebelow is the difference between the base year (2004) and the projected year (2014). If the Actual Change in the Computer Systems Design and Related Services Industry amount is divided by 10, then we theoretically could anticipate growth or openings (demand) of 905 jobs in this industry per year in this region for 10 years.

Table 3 Continued.

		2004-2014 Projections			
NAICS Code	**NAICS Title**	**Base Year**	**Proj Year**	**Actual Change**	**Percent Change**
5413	Employment Services	50800	61300	10500	20.65
5411	Legal Services	24650	29350	4700	19.02
5415	Computer Systems Design and Rel Services	22850	31900	9050	39.47
5416	Management & Technical Consulting Svc	15750	25250	9500	60.49
5412	Accounting and Bookkeeping Services	14750	19850	5100	34.79
5419	Other Professional & Technical Services	10500	13750	3250	30.99
5417	Scientific Research and Development Svc	6350	7200	850	13.42
5418	Advertising and Related Services	4200	4750	550	13.43
5414	Specialized Design Services	1950	2500	550	28.76
541	**Professional and Technical Services**	**151850**	**195900**	**44050**	**29.04**

Labor Market Supply Indicators

The next step in the environmental scan process is to conduct an occupational analysis of the industries of interest to determine the occupations or jobs that make up each local industries. Results from the annual Occupational Employment Statistics (OES) survey, which asks employers to list the occupations present in their organization, the number of employees in each occupation, and the wage range paid to those employees, provides the relative concentration of an occupation within a particular industry.[8] An industry-occupation matrix results, with industries in columns and occupations in rows and is based on the estimated staffing pattern of jobs needed to staff one business multiplied by the number of businesses in that one industry in the region.

Occupations are classified using the Standard Occupational Classification (SOC) system.[9] (available on the Internet at http://www.bls.gov/soc/home.htm). An occupation can be considered a particular job title or skill. An occupation is part of a grouping of jobs with common characteristics. This grouping might also be called a Job Family. The SOC uses a six-digit hierarchical classification system that categorizes more than 800 individual occupations into 23 major groups. Most of the professional computer-related occupations fall within the Computer and Mathematical Occupations.

Table 4 lists the 23 major SOC job families.

Table 4. Standard Occupational Classification (SOC) System

Major Group	Title
11-0000	Management Occupations
13-0000	Business and Financial Operations Occupations
15-0000	Computer and Mathematical Occupations
17-0000	Architecture and Engineering Occupations
19-0000	Life, Physical, and Social Science Occupations
21-0000	Community and Social Services Occupations
23-0000	Legal Occupations
25-0000	Education, Training, and Library Occupations
27-0000	Arts, Design, Entertainment, Sports, and Media Occupations
29-0000	Healthcare Practitioners and Technical Occupations
31-0000	Healthcare Support Occupations
33-0000	Protective Service Occupations
35-0000	Food Preparation and Serving Related Occupations
37-0000	Building and Grounds Cleaning and Maintenance Occupations
39-0000	Personal Care and Service Occupations
41-0000	Sales and Related Occupations
43-0000	Office and Administrative Support Occupations
45-0000	Farming, Fishing, and Forestry Occupations
47-0000	Construction and Extraction Occupations
49-0000	Installation, Maintenance, and Repair Occupations
51-0000	Production Occupations
53-0000	Transportation and Material Moving Occupations
55-0000	Military Specific Occupations

To view the national OES occupational employment and wage estimates for any industry, go to the National Industry-Specific Occupational Employment and Wage Estimates website http://www.bls.gov/oes/current/oessrci.htm. For instance, at the national level, the *occupations* classified in the Computer and Mathematical Sciences broad group make up over half (54.73%) of the total employees for an average business in the Computer Systems Design and Related Services *industry* http://www.bls.gov/oes/current/naics4_541500.htm. By comparison, Table 5 lists just the top ten occupations used in the State's staffing pattern for the same industry, with a total of about 50% for the six 15.xxxx occupations.

Table 5. State Staffing Pattern for NAICS 5415--Computer Systems Design and Related Services

SOC	Title	Percent Employment
15-1021	Computer Programmers	15.83
15-1031	Computer Software Engineers, Applications	11.93
15-1051	Computer Systems Analysts	8.01
15-1032	Computer Software Engineers, Systems Software	6.22
15-1041	Computer Support Specialists	4.77
11-1021	General and Operations Managers	3.79
13-1111	Management Analysts	2.8
43-4051	Customer Service Representatives	2.73
15-1071	Network and Computer Systems Administrators	2.71
43-6011	Executive Secretaries and Administrative Assistants	2.5

The *Occupational Outlook Handbook* (OOH) is a valuable source of career planning information for job seekers, incumbent workers, and workforce professionals. For specific occupations, it provides background on the training and education needed, earnings, expected job prospects, what workers do on the job, and working conditions. [10] It is updated every two years with content from the Employment Projections program. Tables 6 and 7 provide interesting

pieces of information about the occupation of Computer Systems Analyst from the OOH. Table 6 shows the five industries that employ the most computer systems analysts nationally and the annual median earnings for the employees hired as analysts.

Table 6. Industries with Highest Levels of Employment for Computer Systems Analysts

NAICS Code	Industry	Annual Median Earnings
423400	Professional and commercial equipment and supplies merchant wholesalers	$81,080
541500	Computer systems design and related services	$71,680
551100	Management of companies and enterprises	$71,090
524100	Insurance carriers	$69,990
929200	State government	$61,340

Table 7, and Table 6 for that matter, both provide some additional clues from the OOH for students who want to know which businesses hire computer systems analysts. [11]

Table 7. Top paying industries for computer systems analysts.

NAICS Code	Industry	Annual mean wage
334100	Computer and Peripheral Equipment Manufacturing	$86,900
541700	Scientific Research and Development Services	$85,390
423100	Professional and Commercial Equipment and Supplies Merchant Wholesalers	$82,890
523100	Securities and Commodity Contracts Intermediation and Brokerage	$81,980
516100	Internet Publishing and Broadcasting	$81,390

Analyzing the Gap

The final step in this phase of the external environmental scan is to compare the numbers for employer job openings (demand) in an occupation with the numbers of graduates or incumbent workers in the region's supply of an occupation. Once again, the Labor Market and Career Information professionals developed an interactive online tool that creates both tables, and we only need two pieces of information: the 4-digit NAICS industry code and the regional name. The Labor Availability Estimator tool creates both labor demand and labor supply indicators.[12]

Figure 1 shows a partial table for the unmet employer demand for various occupations in the Computer Systems Design and Related Services industry. This table only uses Projected data. The absolute difference or job growth for Computer Systems Analysts is 3,793; the Growth column shows 379 which is 1/10 of the absolute value; the replacement amount is 73 which is the projected number of people who quit, retire, or die and need to be replaced. So the total openings (employer demand) is 452 (379 + 73). The hourly pay rate is $34.55.

Figure 0. Labor Market Demand Indicators

NAICS 5415 Computer Systems Design and Rel Services
Labor Market Information for Gulf Coast region

		Employment			Change		Openings			
SOC	Title	% of Ind.	2004	2014	Abs.	Pct.	Growth	Repl.	Total	Wages
15-1021	Computer Programmers	15.83	8,709	9,324	615	7.10	61	50	111	$38.65
15-1031	Computer Software Engineers, Applications	11.93	6,539	9,929	3,390	51.80	339	36	375	$42.16
15-1051	Computer Systems Analysts	8.01	10,288	14,081	3,793	36.90	379	73	452	$34.55
15-1032	Computer Software Engineers, Systems Software	6.22	6,650	9,179	2,529	38.00	252	36	288	$42.08

Figure 2 shows the partial list of occupations in the Computer Systems Design and Related Services industry, but this time the columns of data deal with "actual" or real numbers of TWC applicants with credentials for the job they applied for, real numbers of recent graduates from programs designed to educate workers for the specified occupation they applied for, and real numbers of workers who are currently employed in related occupations. The data values in any of the three columns of labor supply estimates—TWC Appl. Transcripts, Recent Grads, or Related Employment—is greater than the employer demand total in Figure 1. What's wrong with this picture?

Figure 0. Labor Market Supply Indicators.

NAICS 5415 Computer Systems Design and Rel Services
Labor supply estimates for Gulf Coast region

Show LMI

SOC	Title	% Ind. Emp.	2004 Emp.	TWC Appl. Trans.	Recent Grads	Related Emp.	Total Available
15-1021	Computer Programmers	15.83	8,709	2,628	1,803	15,739	28,879
15-1031	Computer Software Engineers, Applications	11.93	6,539	1,525	549	25,352	33,965
15-1051	Computer Systems Analysts	8.01	10,288	2,725	2,036	12,007	27,056
15-1032	Computer Software Engineers, Systems Software	6.22	6,650	1,096	638	25,241	33,625

This paper describes the beginning phase of an environmental scan for informing program planning or revision by faculty and administrators in a STEM undergraduate program. In the process of conducting the environmental scan to this point, over 60 new data points were brought together for review. Where could you use these data sources to inform the planning, design, alignment, and revision of a current program versus a proposed new program? How could these data sources be matched with CAC's a – i or program outcomes from the other commissions?

Connecting Program Planning to Economic Development via Labor Market Information

The two data sources below crosswalk SOC codes to CIP codes to program inventories. How could these data sources inform a program's efforts to recruit high school students?

CIP Code	Program
11	COMPUTER AND INFORMATION SCIENCES AND SUPPORT SERVICES
11.0101.00	COMPUTER SCIENCE
11.0401.00	COMPUTER SCIENCES-BUSINESS
11.0501.00	COMPUTER SCIENCES-SYSTEMS
11.1003.00	TECHNOLOGY PROJECT MANAGEMENT-INFORMATION SYSTEMS SECURITY

15-1051 Computer Systems Analysts

11.0101 Computer and Information Sciences, General
11.0103 Information Technology
11.0501 Computer Systems Analyst/Analysis
11.1004 Web/Multimedia Management and Webmaster (NEW)

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