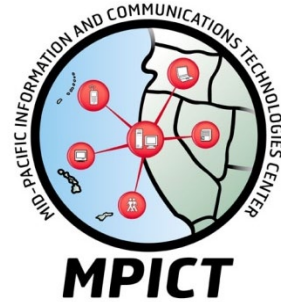




CENTERS OF EXCELLENCE
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2011 ENVIRONMENTAL SCAN

ICT

**INFORMATION & COMMUNICATIONS
TECHNOLOGIES**

in California

PHASE THREE: EDUCATIONAL PROGRAM INPUT

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Important Disclaimer

All representations included in this report have been produced from primary research and/or secondary review of publicly and/or privately available data and/or research reports. Efforts have been made to qualify and validate the accuracy of the data and the reported findings; however, neither the Centers of Excellence, COE host District, MPICT, nor California Community Colleges Chancellor's Office are responsible for applications or decisions made by recipient community colleges or their representatives, or others, based upon components or recommendations contained in this study.

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Executive Summary

In the information, knowledge and innovation economies of the 21st century, we increasingly depend on information and communications technologies (ICT) — as students, workers, organizations and society.

Information and Communications Technologies (ICT) is a superset term encompassing all rapidly emerging, evolving, and converging computer, software, networking, telecommunications, Internet, programming, and information systems technologies. ICT is a comprehensive framework for organizing these inter-related, interdependent and rapidly changing high-tech fields and industries — and the ICT workforce that spans organizations of all sizes, types and industries. The ICT term is widely used outside the U.S., for example, by the United Nations, European Union, World Bank, and International Telecommunications Union.

Aggregated ICT industry and employment sectors are bigger and more strategically important than we have historically recognized in the U.S. and in California.

- ICT industries include about 4% of companies, 6% of private sector revenues, 4% of workers and 12% of private sector wages in California, with much higher job growth and compensation expected than for most other industries or the nation as a whole.
- ICT Workforce occupations span and are strategically important to all industries and most organizations, which leverage ICT for productivity. ICT occupations throughout the economy employ more than a million people in California today, include about 1 in 20 private sector jobs in the U.S. and in California, with strong job growth expected and median ICT Workforce wages about twice the average in California. ICT occupations are California's 8th largest occupational cluster by job count, and employers are having difficulties hiring appropriately skilled ICT Workforce — even in this period of high unemployment.

Other nations and organizations using an aggregated ICT framework, rather than just its fragmented subsectors as we traditionally do in the U.S., more easily recognize the strategic importance of ICT and more readily devote significant strategic planning, public policy, educational planning and workforce development efforts into the sector. We need to do that in the U.S. and California also, to avoid further slipping in rankings of international competitiveness in ICT and economic performance. ICT sector investments and performance affect not only those in the ICT sector. ICT is an essential enabling infrastructure, technology and workforce. It enables all kinds of other productive efforts — for everyone, in every industry and most organizations.

This final part of a three-phase study of the ICT sector in California includes:

- Current information on ICT employment demand in California, using both Economic Modeling Specialists Inc. (EMSI) and real-time labor market information from Monster.com and Wanted.com.
- Detailed information on standard ICT related occupations as defined by the U.S. Department of Labor to inform and justify community college ICT-related programs.
- Preliminary findings from a study of ICT related program academic credentials at 48 of California's community colleges.
- Structure and tools for improved communication between education and business and industry about ICT and a consolidation of business and industry input from hundreds of conversations with employers and MPICT's Advisory Panel.
- Recommendations for additional work to better inform programs.

Widely circulated misinformation about ICT jobs, like “all the IT jobs went to China and India,” needs to be replaced with well-researched information. In addition to employing more than a million people in California today, EMSI estimates the creation of 30,000 new ICT Workforce jobs between 2011 and 2013 and more than 80,000 ICT Workforce job openings due to replacements, for a total of more than 110,000 new and replacement jobs in the period. Some ICT occupations are growing rapidly, and others

are experiencing negative employment growth or being subsumed by other roles. This report provides detailed data and information on standard occupational codes related to ICT.

Studying ICT Workforce demand using real time labor market analysis tools from Monster and Wanted shows big variations in job titles and descriptions advertised online. In practice, standard occupational codes are not really used. Apparently, employers are creating custom job titles and descriptions to meet special needs. While that makes sense, it creates chaotic expressions of ICT Workforce demand that are difficult for ICT Workforce development efforts to understand and respond to.

Studying community college ICT related programs and academic credentials reveals the lack of a coordinated, coherent system for providing ICT Workforce supply. There is little consistency in ICT related programs, degrees, certificates and courses across colleges. That creates confusion and difficulty for employers trying to understand knowledge and skill sets of workers coming from community colleges, and it dilutes the value of ICT educational credentials from California community colleges.

Community college CTE programs meet with business and industry representatives in local advisory groups to inform local ICT related programs. However, because computers and the Internet work the same throughout the state, there is the opportunity to create more consistency across college programs than the current process is providing.

Part of the problem is the rapid change and lack of common nomenclature, maps and academic standards in ICT. This report offers a systematic and plain language discussion of the ICT education and workforce landscape.

Employers should recognize the extraordinary diversity of the community college mission and student populations and work with community colleges to better inform and assist them. If we need a larger ICT Workforce with more knowledge and skills, there is no more cost effective way of pushing those knowledge and skills out into California communities than the California community college system.

California community colleges would be well-served implementing a strategic solution to validating Digital Literacy, or ICT User level competencies for all students, no matter what academic discipline or goal, and coordinating those solutions with public K-12 and 4-year university educational systems in California. Today, everyone needs a basic ability to work with these technologies and with information, which our education system can and should provide.

It would add value to all California community college ICT related academic credentials to have a process for better coordinating ICT programs and developing and updating a common and widely understood core that is part of all credentials and an alignment tool to improve articulation and transfer. Then, California community colleges could work to deliver more advanced and specialized courses and industry certifications system-wide through distance education technologies. A new California Community College (CCC) ICT Collaborative is being created to address these and other issues in a more coordinated and comprehensive way across the 112 campus CCC system.

Technical knowledge and skills are not enough for long-term success in the ICT Workforce. Employers also want people with a good basic education across standard educational disciplines; people with good character and soft, employability or workplace skills; people who understand how IT organizations work and who can work in those organizations; people who understand how businesses/organizations work and can work with their various departments, people, customers and suppliers; and people who will add value to their efforts, by solving problems, institutionalizing knowledge, creating efficiencies, making things work reliably, improving performance, helping others work with technologies to do what they do better, and helping management make better management decisions.

Introduction

Information and Communications Technologies (ICT)

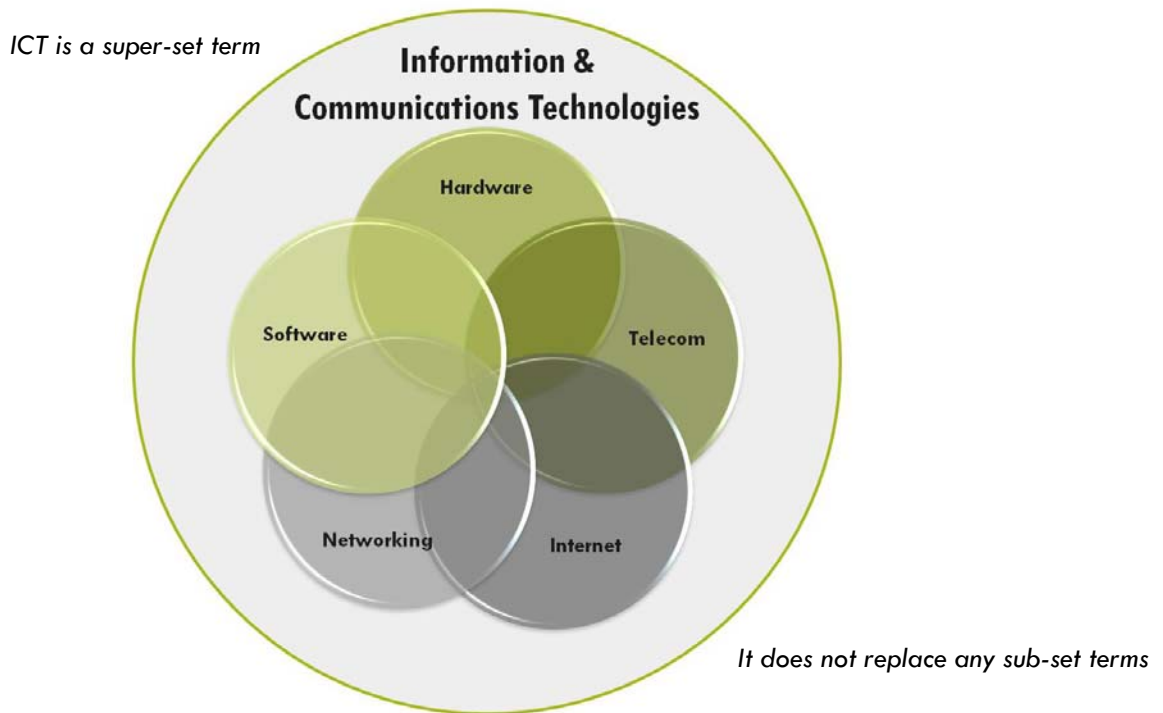
What is ICT?

Information and Communications Technologies (ICT) is a superset or umbrella term encompassing all computer, software, networking, telecommunications, Internet, programming and information systems technologies - rather than only thinking of each of these as separate and different things.

These rapidly emerging, evolving and converging technology, business and industry segments are inter-related and inter-dependent. Software does little without hardware. Hardware does more with software. Networking, telecommunications and the Internet are combinations and applications of hardware and software.

Use of the aggregate ICT term does not replace or eliminate other subset terms, but for some purposes, such as economic research, policy development, workforce development efforts and educational planning, it makes sense to look at all of these together as one cluster.

Figure 1: The ICT Term



Evolutionary consolidation of these technological, business, industry and employment domains has for years been called “convergence” in the U.S. At this point, for government and economic studies, for policy and educational system planning, most of the rest of the world considers these all one thing: Information and Communications Technologies, or ICT. The ICT term is used by the European Union, the International Telecommunications Union (ITU), the United Nations, the Organization for Economic Cooperation and Development (OECD), Australia, New Zealand and many other nations and organizations.

Why is ICT Important?

In the information, knowledge and innovation economies of the 21st century, we increasingly depend on ICT for commerce, efficiency, information, communication, services and function, at almost every level of society.

- **Students and their families** increasingly rely on ICT: to find and apply to schools and other educational programs; to communicate with teachers, family and friends; to find and register for classes; to get, complete and submit assignments; to interact with school systems; to check grades; to do research; to obtain and send transcripts; and increasingly even to read textbooks.
- **Workers** increasingly rely on ICT, in most organizations and in every industry: to find and apply for jobs; to interact with Human Resource and other employer systems; to communicate with customers, suppliers, supervisors and co-workers; and to do their work, whatever that work is.
- **All kinds of organizations** increasingly rely on ICT: for internal management; for organizational productivity and efficiency; for competitive advantage; to reduce costs and increase profitability; to find, sell and service customers; to find, contract and work with suppliers; to provide information and support for products and services; to help customers and clients find them; as part of new products and services; to communicate with stakeholders; for financial and regulatory reporting; for commerce; and generally to efficiently execute their missions.
- **Governments** increasingly rely on ICT: to share information with their citizens; to provide government services; and for all the other same reasons as other kinds of organizations.
- **Citizens** increasingly rely on ICT: to communicate with work, family and friends; to manage their personal lives, finances and property; to buy and sell goods and services; for entertainment; for information and education; to learn about government and government services; and generally to participate fully, efficiently and functionally in modern society.

Over the past 25 years or so, there has been a paradigm shift. Explosive emergence, growth and adoption of information and communications technologies have permeated most areas of modern life. We are now dependent on ICT, which enables and is applied in most dimensions of human endeavor. ICT is strategically important for all of us.¹

ICT Growing Pains

In spite of its prevalence, ICT is a chaotic and greatly misunderstood arena. ICT technologies have emerged, evolved, diverged and converged very rapidly, and they are very difficult to keep up with. Marketing spin and corporate and technical mergers, acquisitions and consolidations have resulted in an extraordinary diversity of technologies and terminology. Technical jargon is used widely, but poorly understood. There are important technical standards² but few educational standards related to ICT. Many schools do not teach ICT related subjects at all, and many people finished school and learned their workplace roles before the rise of ICT. As a result, the ICT arena is fragmented, noisy and confusing. It is to a large extent a wild west, free-market free-for-all. Even basic communication about ICT is impaired, because we lack and/or have not widely adopted common language and structure for the field.

Rationale for Using an ICT Framework in the U.S. and in California

Despite its size and importance - and perhaps due to the confusion surrounding its growing pains as a cluster, ICT has not received sufficient attention from policy makers and planners in the U.S. Current frameworks for study, developed by federal and state governments, do not consider the convergence of ICT into one technology, industry and employment cluster that can be researched effectively.³ This has resulted in fragmented reporting of ICT related information that does not accurately reflect the true breadth and depth of ICT, because it either includes its companies and workers with other sectors, or it reports on smaller components only (such as computers).⁴ As a result, industry and occupational research reporting in the U.S. does not draw as much attention to this strategic sector as research reporting abroad, which likely affects U.S. and California policy and planning. Strategically important ICT industry, infrastructure and employment do not get the level of attention in the U.S. that they do in many other countries, and that may lead to underinvestment in ICT or inadequately planned ICT policy or education.

Mid-Pacific ICT Center (MPICT)

The Mid-Pacific ICT Center (MPICT) was founded with a grant from the National Science Foundation Advanced Technological Education (ATE) program to raise awareness of the importance of ICT.

MPICT's mission is to coordinate, promote and improve the quality of ICT education, with an emphasis on 2-year colleges, in a region consisting of northern California, northern Nevada, southern Oregon, Hawaii and the Pacific Territories. Information on MPICT is available at www.mpict.org.

California Community Colleges' Economic and Workforce Development Program

Centers of Excellence

The Centers of Excellence (COE), in partnership with business and industry, deliver regional workforce research customized for community college decision making and resource development. This information has proven valuable to colleges in beginning, revising, or updating economic development and Career Technical Education (CTE) programs, strengthening grant applications, assisting in the accreditation process, and in supporting strategic planning efforts.

The Centers of Excellence Initiative is funded in part by the Chancellor's Office, California Community Colleges, Economic and Workforce Development program. The Centers aspire to be the premier source of regional economic and workforce information and insight for California's community colleges. Information about the Centers of Excellence is available at www.coecc.net.

Research Methodology

MPICT and COEs are collaborating on a three-phase study of ICT in California, to help inform decision making and planning for California Community College ICT education and workforce development efforts.

Phase One

In September 2009, this collaborative produced a Phase One overview report of ICT and how it is organized. Essentially, it introduced the use of an ICT framework in California at a high (50,000 feet) level and answered the question what is ICT and why should we study ICT for California and California Community Colleges. That report is available for download free at http://www.coecc.net/Environmental_Scans/ICT_scan_sw_09.pdf.

Phase Two

In July of 2010, the collaborative produced a Phase Two study focused on quantifying the size and scope of ICT in California. It basically answered the question, how big and important are ICT industries and employment in California?

Two versions of that report were produced: a comprehensive version available for download free at http://www.mpict.org/ict_study_phase2.html, and a more concise version targeted at California community college planners available for download free at http://www.coecc.net/Environmental_Scans/ICTed_sw_scan_10.pdf.

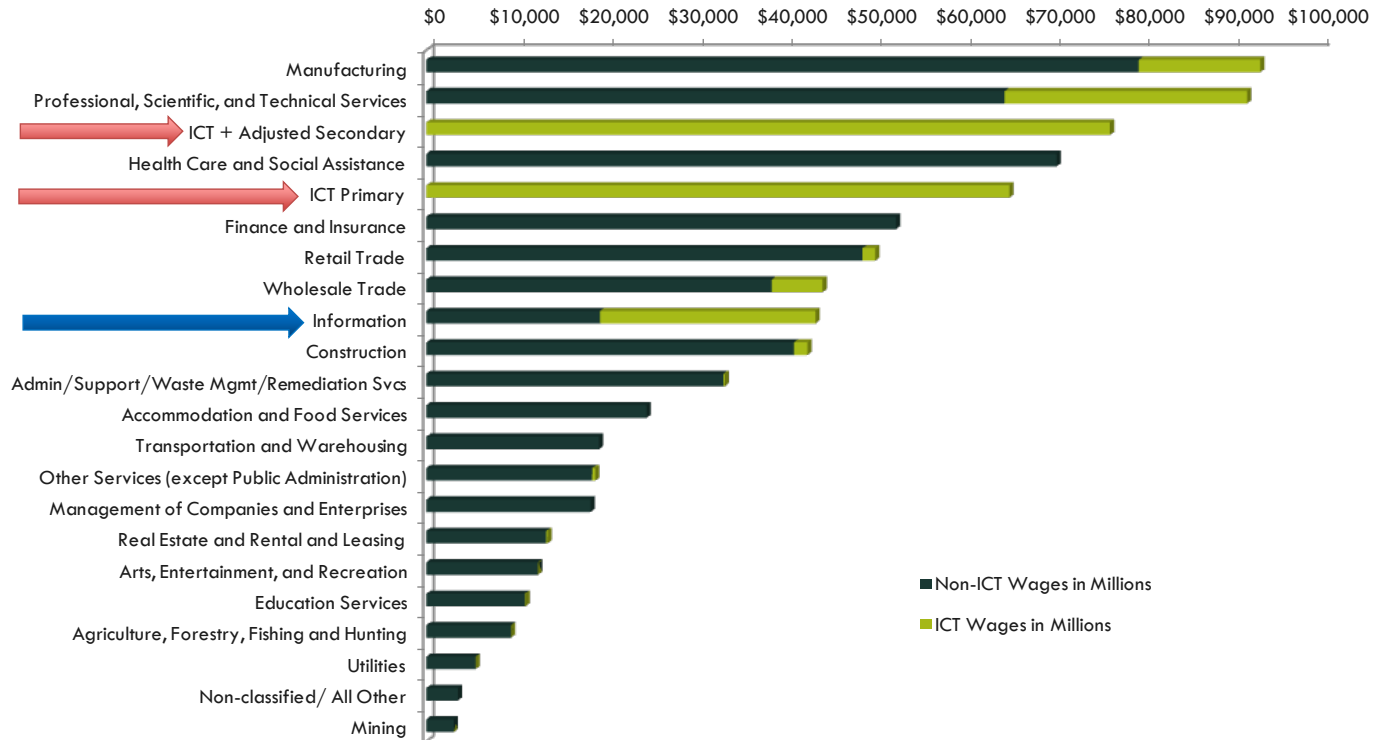
There were two major components of the Phase 2 research study: 1) secondary research and analysis mapping existing industry and employment data to an ICT framework, and 2) primary research on California companies' use of and opinions about ICT in their organizations.

Though most people intuitively know that ICT is an important driver of the state's economy, the data showed that ICT ranks in the top 10 industry sectors in California for sales revenue, wages, and employment. ICT is also a top-ten sector for its occupational employment counts and wages paid across most industry sectors in the state. Employers noted the current and growing strategic importance of ICT to the productivity of all types of organizations and the desire for more structure in ICT strategic planning, education, training and workforce development efforts.

These (20,000 feet) findings illustrate that by using the ICT framework to collect economic and labor market data, ICT is larger and more strategically important to California than previously realized.

The following graph of ICT industry wages is a good example. The closest existing category to ICT at a 2-digit NAICS code level is “Information,” ranked 7th among these industries. However, aggregated ICT would actually be 2nd among California industries by wages paid. The existing Information category includes industries like newspapers that are currently shedding jobs. This gives the false impression that ICT industries are not doing well in the state, when, in fact, they are experiencing strong employment growth.⁵ It is the existing categorization of industries that is misleading.

Figure 2: Industry Ranking of California Wages



California community colleges and other educator audiences should be aware of ICT employment’s high job counts, 1 in 20 private sector jobs; high compensation, twice the California median; rapid anticipated growth rates, in California and the U.S – and the fact that many of those jobs do not require baccalaureate degrees. They should also take note of the large percentage of employers with no opinion about whether California community colleges are doing a good job developing the ICT workforce, and that about half of all firms expressed that they would value a structure aligning ICT job requirements and educational credentials, as well as for a credential certifying ICT User, or digital literacy, competency.

The Phase 2 report highlighted that California community colleges and other educator audiences should be aware of ICT employment’s high job counts, 1 in 20 private sector jobs; high compensation, twice the California median; rapid anticipated growth rates, in California and the U.S – and the fact that many of those jobs do not require baccalaureate degrees. The report noted the large percentage of employers with no opinion about whether California community colleges are doing a good job developing the ICT workforce, and that about half of all firms expressed that they would value a structure aligning ICT job requirements and educational credentials, as well as for a credential certifying ICT User, or digital literacy, competency.

Phase 3

This Phase 3 study was originally envisioned as a detailed (ground level) report on ICT employment demand and ICT community college education workforce development supply organized around standardized ICT workforce occupational titles. From the Phase 1 report: “Phase 3 will focus on individual subsectors of ICT by geographic region, allowing for more in-depth occupation-specific research, including detailed wage information, employment growth projections, existing college program offerings, and recommendations to community colleges concerning new program development.”

The initial plan for Phase 3 was to provide a detailed, current mapping of the knowledge and skills requested of employers for their ICT workforce, like the basis for educational standards. A series of focus groups would inform the content of a series of statistically significant employer surveys. It would provide a detailed mapping of the knowledge and skills being developed for California community college academic credentials, and the report would provide a gap analysis identification process for better aligning employer demands with community college education supply.

As this study progressed, however, MPICT and COE determined, despite existing Standard Occupational Codes, ICT occupations are not standardized in practice. For the most part, employers create their job titles and job descriptions from scratch, customized to their specific needs and desires. An exploratory query of all unduplicated online Primary ICT job postings in a single market using information from Wanted.com, for example, showed 2,380 total job listings. Of those, there were 1,928 different job titles. Even jobs with the same job titles had different job descriptions and requirements. Compounding this problem, a study of ICT related academic credentials at 48 California community colleges showed 303 degrees offered with 263 different degree titles and 606 academic certificates offered with 522 different certificate titles. Even when they have the same title, each is different. It is a very fragmented and chaotic environment – for both employer demand and education supply.

Apparently, ICT is not organized and mature enough for the kind of supply-demand gap analysis intended — and which is possible in mature industries and disciplines with standard and well-defined occupations.

Community college ICT programs are informed by local business and industry advisory groups, as required by law for Career Technical Education programs. This requirement makes sense. Local employers should tell local programs what they want in their local employees. However, a computer works the same in Los Angeles as it does in San Francisco. The Internet works the same in Bakersfield as in Redding. Local employers are participating in advisory meetings and discussing what they have top of mind that moment. Local faculty members are presenting program plans based on whatever ideas they have, from whatever source. There should be more consistency across community college programs than this system is producing. This Phase 3 study provides more comprehensive input from business and industry than most programs are able to achieve from local advisory groups.

Considering these challenges, the vision for this Phase 3 report was modified, so the report now provides:

- Current information on ICT employment demand in California, using both EMSI and real-time labor market information from Monster.com and Wanted.com.
- Detailed information on standard ICT related occupations as defined by the U.S. Department of Labor to inform and justify community college ICT-related programs.
- Preliminary findings from a study of ICT related program academic credentials at California community colleges.
- Structure for input from business and industry and a consolidation of business and industry input from hundreds of conversations with employers and MPICT’s Advisory Panel.
- Recommendations for additional work to better inform programs, more in line with the original vision for Phase 3 at the beginning of this 3-phase study.

ICT Workforce Demand

There is strong and growing demand for a competent ICT Workforce in California.

Summary Phase 2 Study Findings

ICT Workforce Demand in California was the primary focus of the Phase 2 study. We encourage further review of that study. Key findings from that effort are summarized below.

ICT Industries Secondary Research

MPICT and COEs analyzed secondary data from the California Employment Development Department Labor Market Information Division (EDD), Economic Modeling Specialists, Inc. (EMSI), the Bureau of Labor Statistics (BLS), the U.S. Census Bureau, and InfoUSA. Neither the U.S. nor California aggregate industry and occupational classification data to a consolidated ICT framework. As a result, decision-makers studying this data do not easily recognize the size or importance of ICT in the U.S. or California economies. This Phase 2 report provided a crosswalk from existing U.S. industry North American Industry Classification System (NAICS) and employment SOC codes to an ICT framework, providing an opportunity to scope the size and importance of ICT industries and occupations in the California economy.

The ICT sector is a major industry cluster in California, accounting for:

- About 46,000 companies, 4% of all companies (1 in 28 companies), which ranks 12th among California industries by firm counts.
- Almost \$172 billion, or 6% of total California private sector revenues (1 in every \$17.50 in private sector revenues), which ranks 6th among California industries by revenues.
- About a million California workers, 4% of the total state workforce (1 in 17 jobs), which ranks 12th among California industries by employee counts.
- About \$76 billion, or 12% of private sector wages (\$1 of every \$8.61 in private sector wages), which ranks 2nd among California private industries by total wages paid. Wages per employee about twice the state average.
- Significant job growth approaching 20% for ICT industries from 2006 to 2016, outpacing the nation.

ICT Occupations Secondary Research

The ICT employment sector is a major occupational cluster in the United States and in California, across all geographies, industries and organization types and sizes, accounting for:

- In the U.S., about 7.6 million workers, 5% of all private sector jobs (1 in 20 jobs) in 2008
- U.S. employment growth of 14% between 2008-2018, representing over one million new positions and 275,000 annual new and replacement jobs.
- In California, about 1 million jobs, 5% of all jobs (1 in 20 jobs) in 2010.
- In California, projections of 12% employment growth, or 130,000 new jobs between 2006 and 2016. This represents 46,000 annual new and replacement jobs in California over the period.
- In California, the median ICT Workforce hourly wage is about twice the median wage for all jobs.
- In California, the 8th largest occupational cluster by job count.

Primary Research

In 2010, the Centers of Excellence conducted mixed-method data collection from over 600 California companies. The survey was large enough to be statistically significant, and diverse enough to represent ICT and non-ICT companies, the geographic diversity of California, single and multi-location companies and various company sizes. The following are highlights from that primary research.

Regarding ICT's Strategic Importance and Employment Growth:

- 88% of California firms providing ICT goods and/or services and 80% of California companies that do not provide ICT goods and/or services either agree or strongly agree that information and communications technologies are important to the productivity of their organizations.
- California firms anticipate 3.8% overall employment growth over the next 2 years. However, companies providing ICT goods and/or services expect 8.5% employment growth; those that do not expect overall employment to shrink by .4% over the next 2 years.

To simplify responses, "ICT Workforce" was defined as employees and contractors with more advanced ICT knowledge and skill sets who enable the productivity of "ICT Users" (which includes most employees, customers, suppliers and citizens today). Questions were asked regarding ICT Workforce job roles, because there is such disparity in ICT job titles, and because ICT Workforce roles are so frequently held by people with other workforce roles also.

Regarding simplified categories of ICT workforce roles:

- The following three, broad ICT workforce roles are important or very important (67-71%) to California companies, and were generally more important to tech companies, larger companies and Bay Area companies:
 - Roles supporting ICT end user devices, operating systems and applications, like desktop support, help desk, computer support specialists and computer repair (67% report important or very important).
 - Roles supporting Enterprise-wide and data center ICT systems, like phone, server, data storage, telecommunications and networking systems (67% report important or very important).
 - Roles supporting Internet, Intranet and other online or web based systems and services, such as web design and development, online commerce and webmaster (71% important/very important).
- Less universally important are the following three broad ICT workforce roles, which were primarily important to companies providing ICT goods and/or services, larger companies and Bay Area companies:
 - ICT management roles, such as system and business process design, vendor selection and management, and ICT strategic planning (58% report important or very important).
 - Hardware and software development roles, including hardware engineer, software engineer and programmer (51% report important or very important).
 - Roles supporting marketing and sales of ICT related products and services (40% report important or very important).
- 85% of companies require at least some employees to fill some of these ICT workforce roles, and for half of companies at least 25% of employees fill at least some of these described ICT roles.
- 74% of firms either agree or strongly agree that these roles and skill sets will grow in importance for their employees.

Regarding ICT Workforce Employment Growth:

- Overall, 36% of respondents expect to have more people, and only 2% expected fewer, employed in ICT-related job functions in 2 years.
- California companies anticipate 7% overall ICT workforce employment growth over the next two years, significantly higher than the 3.8% overall employment growth estimates.
- Companies providing ICT goods and/or services expect 11.2% growth in ICT workforce employment in the next two years, compared with overall employment growth expectations of 8.5%.
- Companies that do not provide ICT goods and/or services expect -.4% overall employment growth, but expect 3.7% growth in ICT workforce employment.

Regarding ICT Workforce Hiring and Recruitment:

- More than 50% of firms report difficulty recruiting employees with appropriate ICT workforce training. This finding is especially significant in light of a saturated general labor pool due to historically high rates of unemployment.
- Overall, more ICT workforce is hired from outside companies than developed and promoted from within them.
- For ICT workforce hiring, technical skills are most important; however, they are very closely followed by interpersonal communications skills, creative problem-solving skills and an ability to work with different groups or departments. It is frequently not enough to just have technical knowledge and skills to be hired as part of most companies' ICT workforce.
- Companies are very roughly about as likely as not to hire temporary employees, consultants and contractor to support ICT needs.

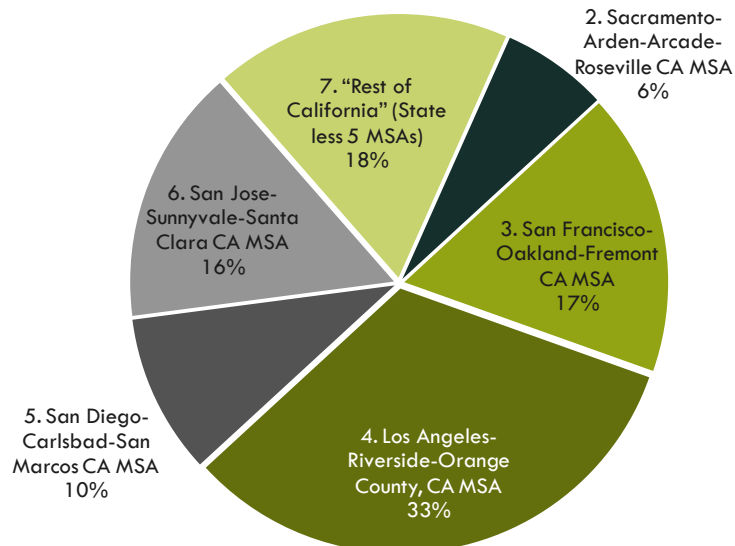
Regarding ICT Workforce Education and Training:

- Firms differ on the level of education that they require for their workforce. Non-ICT and smaller firms are less likely to require a bachelor degree for an ICT workforce role.
- More than half of California companies don't know or have no opinion about whether California community colleges are doing a good job developing the ICT workforce, suggesting an awareness problem. Of those with opinions, many more agree than disagree that California's community colleges are doing a good job in this regard, especially in larger companies.
- Approximately half of all firms and 58% of ICT firms indicated desire for a digital literacy, or ICT end-user knowledge and skills credential. Across geographies, for ICT and non-ICT companies, firms are 2 to 7 times more likely to value than not to value a credential certifying basic ICT user knowledge and skills (digital literacy).

2011 EMSI ICT Workforce Employment

This Phase Three study provides additional current labor market research based on Department of Labor Standard Occupational Codes (SOCs). A list of primary and secondary SOC codes related to ICT is included in Appendix A. As of the first quarter of 2011, the following pie chart and table show the estimated Primary ICT occupation employment in California.

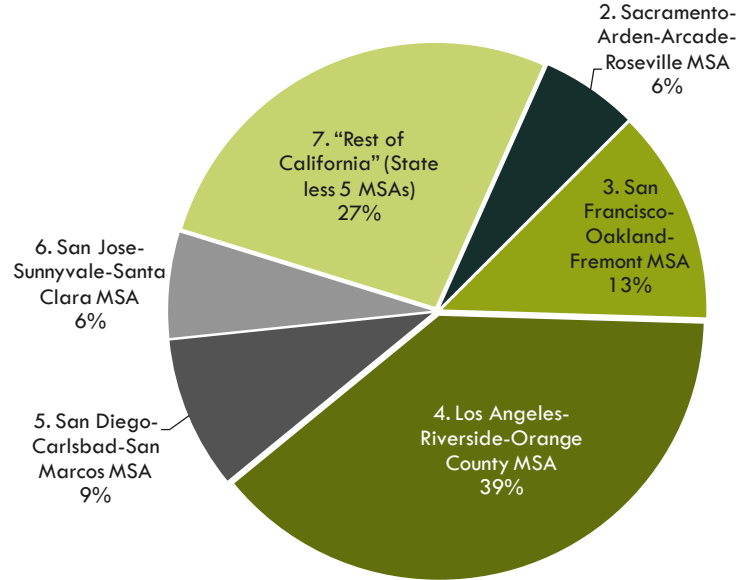
Figure 3: California Primary ICT Occupation Employment Q1 2011



SOC # and Title	1 State of California	2 Sacramento- Arden-Arcade- Roseville MSA	3 San Francisco- Oakland- Fremont MSA	4 LA-Riverside- Orange County MSA	5 San Diego- Carlsbad-San Marcos MSA	6 San Jose- Sunnyvale-Santa Clara MSA	7 "Rest of California" (State less 5 MSAs)
25-1021 Computer Science Teachers, Postsecondary	172,210	13,651	26,006	61,937	20,211	9,702	40,703
15-1031 Computer Software Engineers, Applications	85,988	3,479	19,706	21,461	8,103	24,978	8,261
15-1032 Computer Software Engineers, Systems Software	76,667	4,343	12,963	21,880	5,356	26,281	5,844
15-1051 Computer Systems Analyst	68,938	7,953	1,493	21,145	5,696	9,640	23,011
15-1041 Computer Support Specialists	63,825	3,340	11,544	22,796	7,142	7,355	11,648
15-1081 Network Systems and Data Communications Analysts	55,503	2,623	12,667	18,361	4,882	7,794	9,176
11-3021 Computer and Information Systems Managers	42,938	2,084	9,148	15,247	3,525	7,635	5,299
15-1021 Computer Programmers	42,248	2,215	9,412	14,049	4,223	5,807	6,542
15-1071 Network and Computer Systems Administrators	38,306	2,017	8,804	12,912	3,415	5,035	6,123
15-1099 Computer Specialists, All Other	34,396	3,007	8,382	10,535	4,183	3,902	4,387
49-2022 Telecommunications Equipment Installers and Repairers	27,384	2,269	5,014	10,428	2,560	1,925	5,188
49-9052 Telecommunications Line Installers and Repairers	20,991	993	2,004	8,353	1,967	1,203	6,471
43-2011 Switchboard Operators, Including Answering Service	17,796	833	2,200	7,474	1,660	699	4,930
17-2061 Computer Hardware Engineers	17,658	566	2,725	2,910	1,613	8,673	1,171
15-1061 Database Administrators	13,540	738	2,545	5,221	1,587	1,722	1,727
43-9011 Computer Operators	13,035	1,550	2,101	4,652	868	1,391	2,473
15-1011 Computer and Information Scientists, Research	5,175	72	1,036	901	862	1,546	758
43-2021 Telephone Operators	3,786	254	569	1,502	269	201	991
43-9031 Desktop Publishers	2,796	186	511	1,007	233	132	727
43-2099 Communications Equipment Operators, All Other	335	24	42	117	33	16	103
TOTALS	803,515	52,197	138,872	262,888	78,388	125,637	145,533

Using the Phase 2 study methodology, the following pie chart and table show the distribution of 25% of the Q1 2011 Secondary ICT occupation employment in California, because not all of those jobs can be attributed to ICT employment.

Figure 4: 25% of California Secondary ICT Occupation Employment Q1 2011

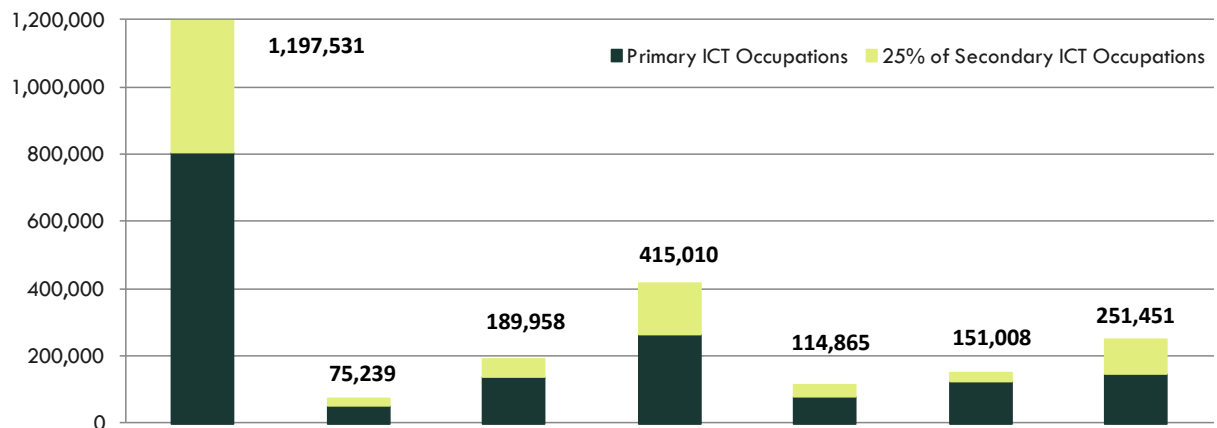


SOC # and Title	1 State of California	2 Sacramento- Arden-Arcade- Roseville MSA	3 San Francisco- Oakland- Fremont MSA	4 LA-Riverside- Orange County MSA	5 San Diego- Carlsbad-San Marcos MSA	6 San Jose- Sunnyvale-Santa Clara MSA	7 "Rest of California" (State less 5 MSAs)
41-2031 Retail Salespersons	123,913	7,054	15,493	44,336	11,851	6,434	38,746
41-1011 First Line Managers/ Supervisors of Retail Sales Workers	65,964	3,661	7,348	24,638	5,786	3,040	21,491
43-4051 Customer Service Representatives	49,325	3,415	6,283	21,442	4,415	2,553	11,216
43-1011 First Line Managers/ Supervisors of Office & Administrative Workers	45,697	3,793	5,910	18,057	3,840	2,335	11,763
41-1012 First Line Managers/ Supervisors of Non-Retail Sales Workers	33,379	1,790	4,340	13,666	3,015	1,654	8,914
41-3099 Sales Representatives, Services, All Other	21,506	1,077	3,437	9,167	2,197	1,479	4,150
27-1024 Graphic Designers	14,908	599	3,008	6,600	1,296	831	2,575
41-4011 Sales Reps, Wholesale & Manufacturing, Technical & Scientific Products	12,903	633	1,803	5,322	1,276	1,703	2,167
51-2022 Electrical & Electronic Equipment Assemblers	5,578	131	616	1,699	598	1,454	1,079
49-2011 Computer, Automated Teller, & Office Machine Repairers	5,178	306	907	1,828	488	506	1,144
17-3023 Electrical & Electronic Engineering Technicians & Technologists	4,882	122	553	1,444	725	1,047	992
17-2071 Electrical Engineers	4,512	265	509	1,411	437	1,194	696

SOC # and Title	1 State of California	2 Sacramento- Arden-Arcade- Roseville MSA	3 San Francisco- Oakland- Fremont MSA	4 LA-Riverside- Orange County MSA	5 San Diego- Carlsbad-San Marcos MSA	6 San Jose- Sunnyvale-Santa Clara MSA	7 "Rest of California" (State less 5 MSAs)
27-3042 Technical Writers	1,877	75	319	591	219	396	277
27-4099 Media & Communications Equipment Workers, All Other	1,439	20	158	993	128	28	113
49-2097 Electric Home Entertainment Equip. Installers & Repairers	1,438	70	196	575	96	63	439
51-9141 Semiconductor Processor	1,429	27	196	322	101	647	136
49-2021 Radio Mechanics	91	6	12	32	10	8	22
TOTALS	394,016	23,042	51,086	152,122	36,477	25,371	105,918

Combining Primary and 25% of Secondary ICT Occupations provides an estimate of over one million people in California currently employed in the ICT Workforce. (This does not count ICT Users, which includes most workers today.)

Figure 5: Aggregate Estimate of California ICT Workforce Employment Q1 2011



Employment Data Set	1 State of California	2 Sacramento- Arden-Arcade- Roseville MSA	3 San Francisco- Oakland- Fremont MSA	4 LA-Riverside- Orange County MSA	5 San Diego- Carlsbad-San Marcos MSA	6 San Jose- Sunnyvale-Santa Clara MSA	7 "Rest of California" (State less 5 MSAs)
Primary ICT Occupations	803,515	52,197	138,872	262,888	78,388	125,637	145,533
25% of Secondary ICT Occupations	394,016	23,042	51,086	152,122	36,477	25,371	105,918
TOTAL CALIFORNIA ICT WORKFORCE	1,197,531	75,239	189,958	415,010	114,865	151,008	251,451

EMSI ICT Workforce Job Growth Estimates

Primary ICT Occupations are anticipated to experience strong overall job growth in the period 2011 to 2013, and beyond. However, not all occupations are expected to grow. Following are tables of Primary and Secondary ICT Occupations ranked by expected job growth between 2011 and 2013. Overall, EMSI estimates there will be 30,000 new California ICT workforce jobs between 2011 and 2013.

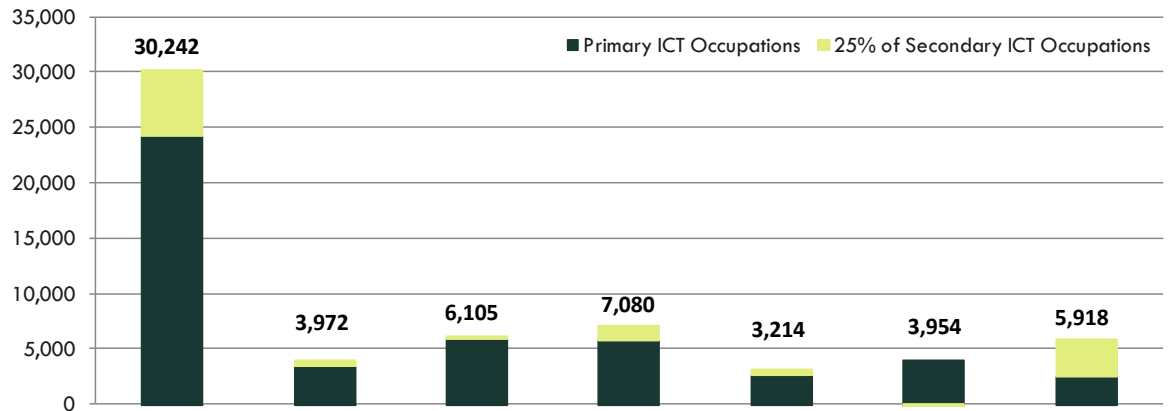
Figure 6: Estimated Primary ICT Occupation Job Growth 2011-2013

SOC # and Title	1 State of California	2 Sacramento- Arden-Arcade- Roseville MSA	3 San Francisco- Oakland- Fremont MSA	4 LA-Riverside- Orange County MSA	5 San Diego- Carlsbad-San Marcos MSA	6 San Jose- Sunnyvale-Santa Clara MSA	7 "Rest of California" (State less 5 MSAs)
25-1021 Computer Science Teachers, Postsecondary	6,392	407	840	2494	886	372	1,393
15-1031 Computer Software Engineers, Applications	4,485	2011	1348	881	398	1147	-1,300
15-1081 Network Systems and Data Communications Analysts	3,363	192	880	839	302	593	557
15-1032 Computer Software Engineers, Systems Software	3,099	168	752	754	193	933	299
15-1051 Computer Systems Analysts	2,308	293	662	441	183	332	397
15-1071 Network and Computer Systems Administrators	1,533	95	432	345	142	232	287
15-1041 Computer Support Specialists	1,437	75	382	235	154	223	368
11-3021 Computer and Information Systems Managers	1,087	67	318	215	93	212	182
15-1099 Computer Specialists, All Other	953	92	262	187	131	134	147
15-1061 Database Administrators	447	28	106	113	54	66	80
15-1011 Computer and Information Scientists, Research	239	4	60	36	41	58	40
15-1021 Computer Programmers	228	23	132	-76	10	37	102
49-9052 Telecommunications Line Installers and Repairers	81	32	-1	-21	81	-68	58
43-2099 Communications Equipment Operators, All Other	-4	0	-1	-3	0	-1	1
43-2021 Telephone Operators	-46	2	-15	-18	7	-25	3
43-9031 Desktop Publishers	-76	-4	-19	-30	-3	-1	-19
17-2061 Computer Hardware Engineers	-201	-20	-41	-22	-40	-87	9
43-9011 Computer Operators	-344	-46	-53	-172	-22	-13	-38
49-2022 Telecom Equipment Installers and Repairers	-390	13	-112	-248	85	-115	-13
43-2011 Switchboard Operators, Including Answering Service	-433	-10	-86	-220	-43	-32	-42
TOTALS	24,158	3,422	5,846	5,730	2,652	3,997	2,511

Figure 7: Estimated 25% of Secondary ICT Occupation Job Growth 2011-2013

SOC # and Title	1 State of California	2 Sacramento- Arden-Arcade- Roseville MSA	3 San Francisco- Oakland- Fremont MSA	4 LA-Riverside- Orange County MSA	5 San Diego- Carlsbad-San Marcos MSA	6 San Jose- Sunnyvale-Santa Clara MSA	7 "Rest of California" (State less 5 MSAs)
41-2031 Retail Salespersons	1,961	115	-41	303	162	-11	1,433
41-1012 First Line Managers/ Supervisors of Non-Retail Sales Workers	1,534	112	181	504	136	71	531
43-4051 Customer Service Representatives	1,318	121	101	416	113	71	498
43-1011 First Line Managers/ Supervisors of Office & Administrative Workers	968	110	53	274	89	20	423
27-1024 Graphic Designers	458	27	102	147	33	24	126
41-3099 Sales Representatives, Services, All Other	445	36	54	102	50	43	161
41-4011 Sales Reps, Wholesale & Manufacturing, Technical & Scientific Products	329	18	12	114	43	32	110
27-3042 Technical Writers	57	4	13	13	7	7	14
27-4099 Media & Communications Equipment Workers, All Other	38	1	6	22	4	2	4
49-2097 Electric Home Entertainment Equipment Installers & Repairers	5	0	0	-9	-1	-2	16
49-2021 Radio Mechanics	-2	0	0	-2	0	0	0
17-2071 Electrical Engineers	-63	9	-3	-20	4	-59	5
49-2011 Computer, Automated Teller, & Office Machine Repairers	-75	-4	-16	-66	1	2	8
17-3023 Electrical & Electronic Engineering Technicians & Technologists	-80	2	-10	-26	1	-56	9
51-9141 Semiconductor Processors	-92	0	-15	-17	-6	-48	-7
51-2022 Electrical & Electronic Equipment Assemblers	-317	-3	-37	-103	-29	-97	-48
41-1011 First Line Managers/ Supervisors of Retail Sales Workers	-401	4	-140	-304	-44	-41	124
TOTALS	6,084	550	259	1,350	562	-43	3,407

Figure 8: Aggregate Estimate of ICT Workforce Job Growth 2011-2013



Employment Data Set	1 State of California	2 Sacramento-Arden-Arcade-Roseville MSA	3 San Francisco-Oakland-Fremont MSA	4 LA-Riverside-Orange County MSA	5 San Diego-Carlsbad-San Marcos MSA	6 San Jose-Sunnyvale-Santa Clara MSA	7 "Rest of California" (State less 5 MSAs)
Primary ICT Occupations	24,158	3,422	5,846	5,730	2,652	3,997	2,511
25% of Secondary ICT Occupations	6,084	550	259	1,350	562	-43	3,407
TOTAL CALIFORNIA ICT WORKFORCE	30,242	3,972	6,105	7,080	3,214	3,954	5,918

EMSI ICT Workforce Job Opening Estimates

The previous Figures show net new jobs. Of course, there will also be jobs that open and are available for other reasons, such as replacing people who retire or move to other jobs. The following tables show EMSI estimates of more than 80,000 ICT Workforce job openings in the period 2011 to 2013, ranked by numbers of openings.

Figure 9: Primary ICT Occupation Openings Estimates 2011-2013

SOC # and Title	1 State of California	2 Sacramento-Arden-Arcade-Roseville MSA	3 San Francisco-Oakland-Fremont MSA	4 LA-Riverside-Orange County MSA	5 San Diego-Carlsbad-San Marcos MSA	6 San Jose-Sunnyvale-Santa Clara MSA	7 "Rest of California" (State less 5 MSAs)
25-1021 Computer Science Teachers, Postsecondary	12,390	882	1,746	4,651	1,590	710	2,811
15-1031 Computer Software Engineers, Applications	5,940	270	1,679	1,242	543	1,567	639
15-1081 Network Systems and Data Communications Analysts	5,359	286	1,336	1,500	477	873	887
15-1051 Computer Systems Analysts	5,283	636	1,306	1,352	428	747	814
15-1041 Computer Support Specialists	4,986	260	1,029	1,497	550	630	1,020
15-1032 Computer Software Engineers, Systems Software	4,418	262	970	1,122	283	1,375	406
15-1071 Network and Computer Systems Administrators	2,811	162	725	775	256	400	493
11-3021.00 Computer and Information Systems Managers	2,487	134	615	710	208	460	360

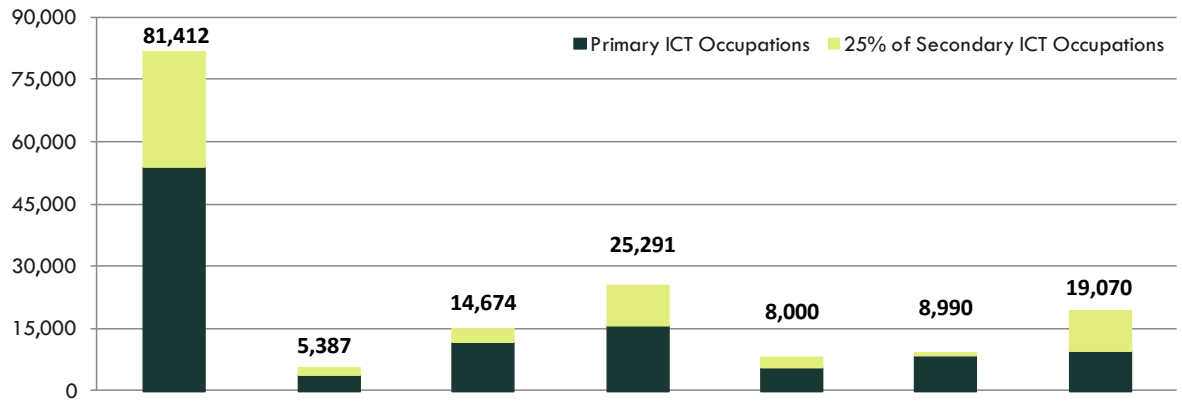
SOC # and Title	1 State of California	2 Sacramento- Arden-Arcade- Roseville MSA	3 San Francisco- Oakland- Fremont MSA	4 LA-Riverside- Orange County MSA	5 San Diego- Carlsbad-San Marcos MSA	6 San Jose- Sunnyvale-Santa Clara MSA	7 "Rest of California" (State less 5 MSAs)
15-1099.00 Computer Specialists, All Other	2,439	222	627	641	312	302	335
15-1021 Computer Programmers	1,961	107	521	529	169	255	380
49-2022 Telecommunications Equipment Installers & Repairers	1,153	104	188	366	174	70	251
17-2061 Computer Hardware Engineers	1,062	34	189	165	89	485	100
15-1061 Database Administrators	899	53	191	287	107	124	137
49-9052 Telecommunications Line Installers and Repairers	898	64	77	273	142	38	304
43-2011 Switchboard Operators, Including Answering Service	768	38	91	309	69	29	232
15-1011 Computer and Information Scientists, Research	462	7	105	75	78	124	73
43-9011 Computer Operators	307	36	47	105	20	32	67
43-2021 Telephone Operators	157	13	20	52	17	7	48
43-9031 Desktop Publishers	96	7	17	34	8	5	25
43-2099 Communications Equipment Operators, All Other	15	1	2	5	1	1	5
TOTALS	53,891	3,578	11,481	15,690	5,521	8,234	9,387

Figure 10: 25% of Secondary ICT Occupation Openings Estimates 2011-2013

SOC # and Title	1 State of California	2 Sacramento- Arden-Arcade- Roseville MSA	3 San Francisco- Oakland- Fremont MSA	4 LA-Riverside- Orange County MSA	5 San Diego- Carlsbad-San Marcos MSA	6 San Jose- Sunnyvale-Santa Clara MSA	7 "Rest of California" (State less 5 MSAs)
27-3042 Technical Writers	9,054	555	925	2,777	824	185	3,789
17-2071 Electrical Engineers	4,428	336	501	1,766	391	116	1,319
41-3099 Sales Representatives, Services, All Other	3,080	192	316	1,058	248	67	1,200
49-2021 Radio Mechanics	3,034	281	323	1,089	263	63	1,016
41-4011 Sales Reps, Wholesale & Manufacturing, Technical & Scientific Products	2,918	186	361	1,071	261	70	971
27-4099 Media and Communications Equipment Workers, All Other	1,512	89	225	557	158	58	426
43-4051 Customer Service Representatives	1,374	64	287	552	112	37	321
49-2097 Electric Home Entertainment Equipment Installers and Repairers	936	48	104	361	102	56	266
41-2031 Retail Salespersons	235	22	24	65	24	28	73
41-1012 First Line Managers/Supervisors of Non-Retail Sales Workers	206	7	21	55	29	20	76
49-2011 Computer, Automated Teller, and Office Machine	204	12	33	63	18	10	69

SOC # and Title	1 State of California	2 Sacramento- Arden-Arcade- Roseville MSA	3 San Francisco- Oakland- Fremont MSA	4 LA-Riverside- Orange County MSA	5 San Diego- Carlsbad-San Marcos MSA	6 San Jose- Sunnyvale-Santa Clara MSA	7 "Rest of California" (State less 5 MSAs)
Repairers							
51-2022 Electrical and Electronic Equipment Assemblers	181	6	20	53	19	23	62
43-1011 First Line Managers/Supervisors of Office and Administrative Workers	118	6	24	32	14	10	33
27-1024 Graphic Designers	109	2	14	71	11	2	11
51-9141 Semiconductor Processors	68	3	9	20	3	1	33
41-1011 First Line Managers/Supervisors of Retail Sales Workers	62	3	8	13	4	13	20
17-3023 Electrical and Electronic Engineering Technicians & Technologists	4	0	1	1	1	0	1
TOTALS	27,521	1,809	3,193	9,601	2,479	756	9,683

Figure 11: Total ICT Workforce Openings Estimates 2011-2013



Employment Data Set	1 State of California	2 Sacramento- Arden-Arcade- Roseville MSA	3 San Francisco- Oakland- Fremont MSA	4 LA-Riverside- Orange County MSA	5 San Diego- Carlsbad-San Marcos MSA	6 San Jose- Sunnyvale-Santa Clara MSA	7 "Rest of California" (State less 5 MSAs)
Primary ICT Occupations	53,891	3,578	11,481	15,690	5,521	8,234	9,387
25% of Secondary ICT Occupations	27,521	1,809	3,193	9,601	2,479	756	9,683
TOTAL CALIFORNIA ICT WORKFORCE	81,412	5,387	14,674	25,291	8,000	8,990	19,070

EMSI Median Hourly Wage Estimates

Many of these jobs pay well. The Phase 2 study showed that on average they pay about twice the median private sector wage in California. The following tables show EMSI 2010 median hourly wage estimates.

Figure 12: Primary ICT Occupation Median Hourly Wage Estimates, 2010

SOC # and Title	1 State of California	2 Sacramento- Arden-Arcade- Roseville MSA	3 San Francisco- Oakland- Fremont MSA	4 LA-Riverside- Orange County MSA	5 San Diego- Carlsbad-San Marcos MSA	6 San Jose- Sunnyvale-Santa Clara MSA	7 "Rest of California" (State less 5 MSAs)
11-3021 Computer and Information Systems Managers	\$57.07	\$47.63	\$60.69	\$55.50	\$50.88	\$71.72	N/A
17-2061 Computer Hardware Engineers	\$52.16	\$49.29	\$53.02	\$48.78	\$41.22	\$57.08	N/A
15-1011 Computer and Information Scientists, Research	\$51.74	\$41.03	\$50.06	\$50.64	\$48.50	\$62.06	N/A
15-1032 Computer Software Engineers, Systems Software	\$48.82	\$40.89	\$47.82	\$44.77	\$41.34	\$59.00	N/A
15-1031 Computer Software Engineers, Applications	\$45.65	\$36.90	\$47.44	\$41.10	\$40.49	\$54.65	N/A
25-1021 Computer Science Teachers, Postsecondary	\$44.95	\$38.86	\$46.34	\$44.05	\$46.32	\$43.83	N/A
15-1061 Database Administrators	\$35.69	\$33.09	\$42.55	\$38.18	\$29.60	\$42.07	N/A
15-1071 Network and Computer Systems Administrators	\$35.59	\$33.85	\$40.60	\$33.27	\$32.88	\$45.48	N/A
15-1099 Computer Specialists, All Other	\$35.38	\$31.52	\$40.19	\$34.09	\$36.73	\$44.48	N/A
15-1051 Computer Systems Analysts	\$34.98	\$36.45	\$38.60	\$33.90	\$32.93	\$40.09	N/A
15-1021 Computer Programmers	\$33.56	\$29.57	\$35.81	\$33.14	\$33.37	\$43.51	N/A
15-1081 Network Systems and Data Communications Analysts	\$29.12	\$25.30	\$33.16	\$28.04	\$26.99	\$39.38	N/A
49-2022 Telecommunications Equipment Installers and Repairers	\$26.38	\$26.91	\$27.84	\$25.75	\$26.97	\$28.00	N/A
49-9052 Telecommunications Line Installers and Repairers	\$24.01	\$24.75	\$26.65	\$23.48	\$23.12	\$26.40	N/A
15-1041 Computer Support Specialists	\$23.51	\$23.22	\$26.92	\$22.50	\$22.22	\$30.16	N/A
43-2099 Communications Equipment Operators, All Other	\$20.16	\$20.54	\$22.53	\$21.44	\$19.52	\$22.71	N/A
43-9011 Computer Operators	\$18.20	\$18.26	\$19.39	\$17.51	\$17.51	\$20.80	N/A
43-9031 Desktop Publishers	\$16.23	\$16.46	\$17.94	\$17.81	\$15.44	\$17.34	N/A
43-2021 Telephone Operators	\$15.51	\$15.70	\$17.57	\$15.84	\$13.24	\$17.72	N/A
43-2011 Switchboard Operators, Including Answering Service	\$12.88	\$13.06	\$15.85	\$12.82	\$12.32	\$14.84	N/A

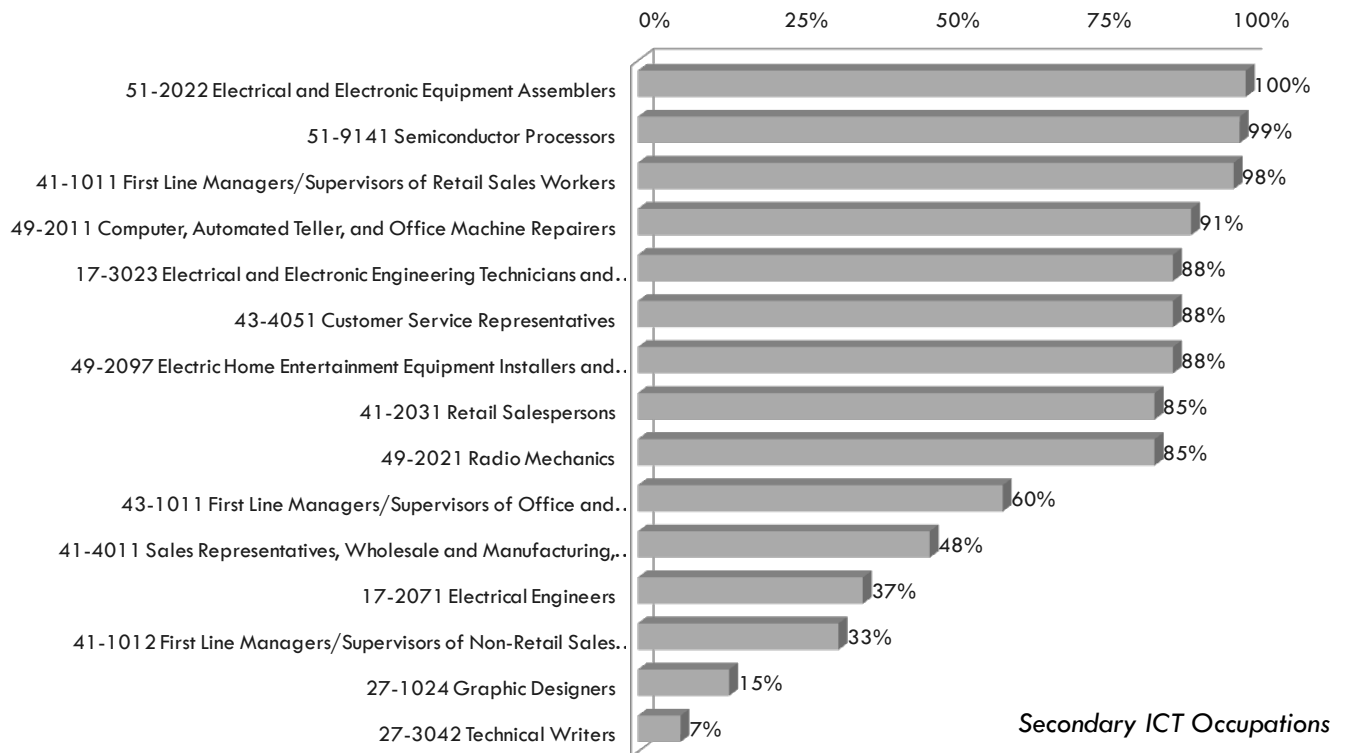
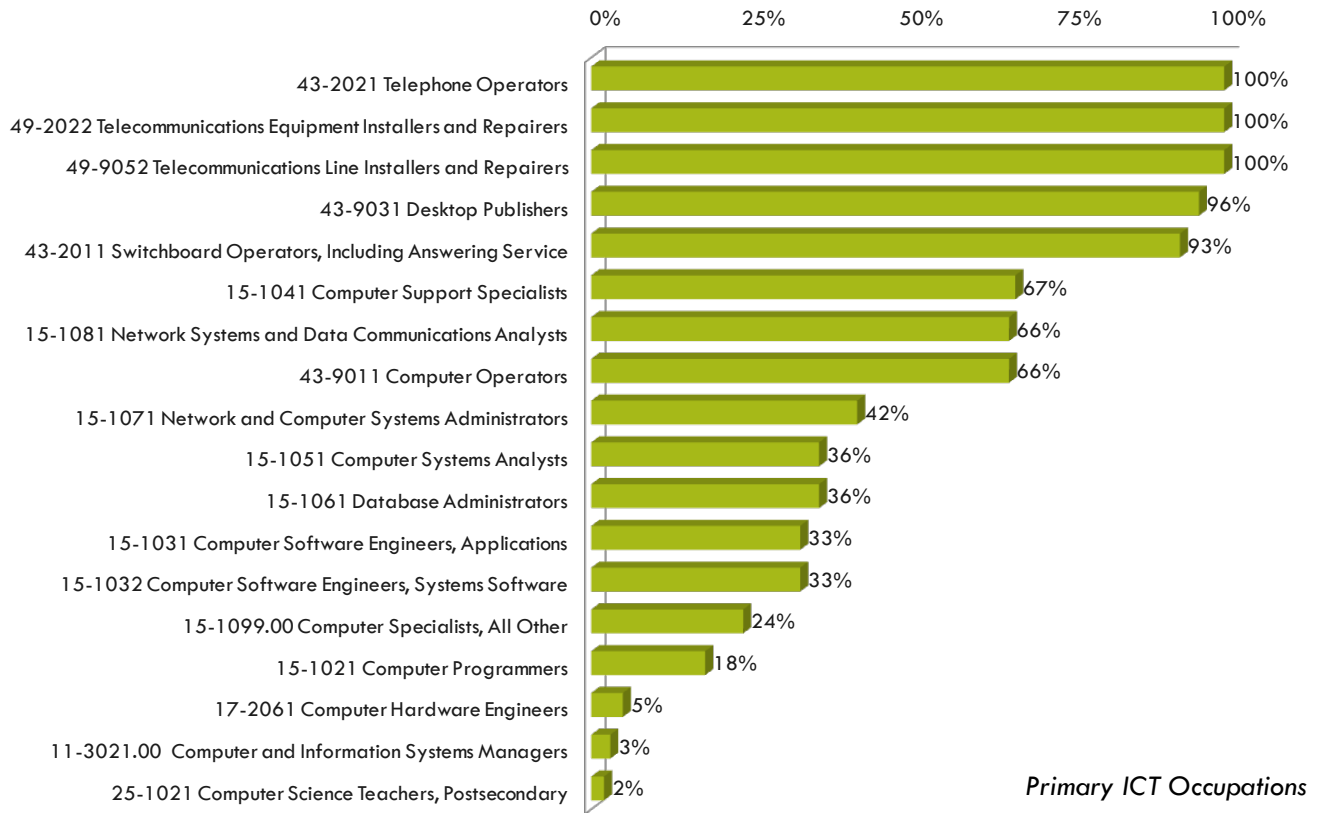
Figure 13: Secondary ICT Occupation Median Hourly Wage Estimates 2010

SOC # and Title	1 State of California	2 Sacramento- Arden-Arcade- Roseville MSA	3 San Francisco- Oakland- Fremont MSA	4 LA-Riverside- Orange County MSA	5 San Diego- Carlsbad-San Marcos MSA	6 San Jose- Sunnyvale-Santa Clara MSA	7 "Rest of California" (State less 5 MSAs)
17-2071 Electrical Engineers	\$44.08	\$46.81	\$44.86	\$41.37	\$43.06	\$49.93	N/A
41-4011 Sales Representatives, Wholesale & Manufacturing, Technical & Scientific Products	\$36.36	\$47.85	\$40.70	\$34.64	\$32.78	\$43.28	N/A
27-3042 Technical Writers	\$35.07	\$29.66	\$33.91	\$31.97	\$32.94	\$46.01	N/A
17-3023 Electrical and Electronic Engineering Technicians & Technologists	\$27.55	\$25.92	\$28.75	\$25.38	\$27.56	\$26.54	N/A
41-1012 First Line Managers/ Supervisors of Non-Retail Sales Workers	\$25.04	\$22.06	\$28.58	\$27.80	\$24.11	\$29.05	N/A
43-1011 First Line Managers/ Supervisors of Office and Administrative Workers	\$24.61	\$27.71	\$27.04	\$24.96	\$24.06	\$27.16	N/A
27-4099 Media & Communications Equipment Workers, All Other	\$23.88	\$24.61	\$23.63	\$24.99	\$23.25	\$22.57	N/A
41-3099 Sales Representatives, Services, All Other	\$23.86	\$21.82	\$27.26	\$23.34	\$24.94	\$29.24	N/A
49-2021 Radio Mechanics	\$20.63	\$21.84	\$24.76	\$20.83	\$20.45	\$24.44	N/A
27-1024 Graphic Designers	\$20.13	\$16.01	\$23.31	\$21.54	\$17.48	\$23.16	N/A
49-2097 Electric Home Entertainment Equipment Installers & Repairers	\$19.46	\$18.14	\$23.45	\$20.34	\$19.37	\$19.20	N/A
49-2011 Computer, Automated Teller, & Office Machine Repairers	\$18.51	\$18.29	\$20.21	\$19.20	\$16.65	\$20.80	N/A
41-1011 First Line Managers/ Supervisors of Retail Sales Workers	\$17.23	\$17.11	\$19.33	\$18.01	\$16.74	\$17.54	N/A
43-4051 Customer Service Representatives	\$16.78	\$16.80	\$18.25	\$16.56	\$16.86	\$20.21	N/A
51-9141 Semiconductor Processors	\$15.23	\$14.19	\$14.59	\$15.04	\$17.06	\$16.76	N/A
51-2022 Electrical & Electronic Equipment Assemblers	\$13.92	\$12.91	\$13.79	\$12.98	\$12.15	\$15.81	N/A
41-2031 Retail Salespersons	\$10.22	\$9.81	\$11.44	\$10.30	\$10.12	\$10.13	N/A

ICT Workforce Jobs for People with No More than Associate Degrees

Some of these jobs require bachelor or master degrees. However, the tables on the following page show the 2010 employment estimates for the percent of jobs in each occupation available to people with no more than associate level degrees.

Figure 14: Percent of ICT Occupation Jobs Available to People with 2 Year Degrees or Less



Online ICT Workforce Jobs Advertised Q1 2011

Wanted.com⁶ has a service that crawls the public Internet and aggregates all online job postings by job listing boards, recruiters and companies. The following table shows numbers of online postings in the first quarter of 2011 for Primary ICT Occupations, produced in collaboration with Monster.com⁷. Wanted.com estimates this captures 80-85% of all online job postings in the State. However, it does not de-duplicate single jobs with multiple listings. It also does not capture jobs that are not advertised online, but rather filled through networking and personal relationships, a significant and growing way people find jobs.

Figure 15: Wanted.com Total Online Primary ICT Occupation Job Postings Q1 2011

SOC # and Title	Data	1	2	3	4	5	6	7
		State of California	Sacramento-Arden-Arcade-Roseville MSA	San Francisco-Oakland-Fremont MSA	LA-Riverside-Orange County MSA	San Diego-Carlsbad-San Marcos MSA	San Jose-Sunnyvale-Santa Clara MSA	"Rest of California" (State less 5 MSAs)
15-1099 Computer Specialists, All Other	Total Job Postings	98,768	2,914	31,382	33,238	8,504	14,357	8,373
	# of Different Job Titles	29,538	1,111	10,642	10,623	2,788	5,701	3,574
15-1031 Computer Software Engineers, Applications	Total Job Postings	57,299	829	21,684	10,149	5,716	15,179	3,742
	# of Different Job Titles	17,225	342	7,491	3,324	1,514	5,750	1,416
15-1051 Computer Systems Analysts	Total Job Postings	36,039	1,861	10,716	12,444	3,889	3,722	3,407
	# of Different Job Titles	11,842	702	3,768	4,431	1,201	1,822	1,417
15-1071 Network & Computer Systems Administrators	Total Job Postings	25,008	955	7,276	6,992	2,945	3,522	3,318
	# of Different Job Titles	7,405	372	2,464	2,347	895	1,420	1,203
15-1041 Computer Support Specialists	Total Job Postings	24,625	1,440	5,578	8,198	3,188	1,747	4,474
	# of Different Job Titles	8,192	569	2,186	3,027	1,067	894	1,942
15-1021 Computer Programmers	Total Job Postings	15,565	629	4,528	5,350	1,573	1,842	1,643
	# of Different Job Titles	5,213	298	1,685	1,975	600	870	689
15-1032 Computer Software Engineers, Systems Software	Total Job Postings	15,062	401	2,629	2,529	2,044	6,714	745
	# of Different Job Titles	4,386	124	958	788	573	2,129	360
11-3021 Computer & Information Systems Managers	Total Job Postings	11,440	394	3,700	3,378	1,035	1,719	1,214
	# of Different Job Titles	4,227	165	1,690	1,371	311	892	486
15-1061 Database Administrators	Total Job Postings	8,731	483	2,681	2,798	877	1,009	883
	# of Different Job Titles	2,834	185	940	979	276	520	349
17-2061 Computer Hardware Engineers	Total Job Postings	5,941	166	771	829	902	3,015	258
	# of Different Job Titles	1,873	79	338	268	242	1,024	176
15-1081 Network Systems & Data Communications Analysts	Total Job Postings	4,242	280	1,178	1,213	370	707	494
	# of Different Job Titles	1,371	82	416	418	140	304	212
49-2022 Telecommunications Equipment Installers & Repairers	Total Job Postings	2,539	161	409	748	216	101	904
	# of Different Job Titles	855	80	158	321	90	48	376
15-1011 Computer & Information Scientists, Research	Total Job Postings	1,189	6	327	208	104	425	119
	# of Different Job Titles	528	4	193	95	39	198	54
43-2011 Switchboard Operators, Including Answering Service	Total Job Postings	607	18	75	199	76	37	202
	# of Different Job Titles	196	8	32	90	28	6	60
43-9011 Computer Operators	Total Job Postings	267	36	24	87	22	20	78
	# of Different Job Titles	118	9	17	46	14	6	42
25-1021 Computer Science Teachers, Postsecondary	Total Job Postings	244	8	37	87	33	18	61
	# of Different Job Titles	115	4	22	48	15	15	29
49-9052 Telecommunications Line Installers & Repairers	Total Job Postings	227	19	18	105	10	6	69
	# of Different Job Titles	126	8	11	61	9	6	48
43-2021 Telephone Operators	Total Job Postings	13	-	4	3	2	1	3
	# of Different Job Titles	7	-	3	2	1	1	3
43-9031 Desktop Publishers	Total Job Postings	118	6	26	37	17	13	19
	# of Different Job Titles	52	2	11	26	8	3	12
43-2099 Communications Equipment Operators, All Other	Total Job Postings	11	-	-	1	1	-	9
	# of Different Job Titles	3	-	-	1	1	-	2
TOTAL PRIMARY ICT SOC CODES	Total Job Postings	307,935	10,606	93,043	88,593	31,524	54,154	30,015
	# of Different Job Titles	96,106	4,144	33,025	30,241	9,812	21,609	12,450

In the preceding table (Figure 15), note the relationship between total job postings and numbers of different job titles. Using these numbers, roughly 1 in 3 Primary ICT Workforce jobs advertised online in California has a unique job title. De-duplicating the data would increase that ratio. It appears employers are using their own job titles and descriptions, which may or may not relate well to Standard Occupational Codes. These expressions of ICT Workforce demand are very difficult for ICT educators to understand, in order to educate and prepare an appropriate ICT Workforce. A more detailed list of Wanted.com findings is included as Appendix B.

ICT Occupation Descriptions

More detailed information is provided for each of the Primary and Secondary ICT Occupations as Appendix C. That information includes a description of the occupation and a summary of its prospects; EMSI employment, job growth, educational requirement, compensation and job opening estimates; summaries of educational and experience requirements in the first quarter of 2011 for all Monster.com online job postings in California; job title research for all online job postings on the public Internet aggregated by Wanted.com; and knowledge, skill and ability profiles from the O*NET[®] system.

Based on job growth estimates in the previous tables, and targeting those occupations that require less than a baccalaureate degree, it appears that Standard ICT Workforce Occupations with the best apparent prospects for community college program workforce development efforts are:

- 11-3021 Computer and Information Systems Managers
- 15-1021 Computer Programmers
- 15-1031 Computer Software Engineers, Applications
- 15-1032 Computer Software Engineers, Systems Software
- 15-1041 Computer Support Specialists
- 15-1051 Computer Systems Analysts
- 15-1061 Database Administrators
- 15-1071 Network and Computer Systems Administrators
- 15-1081 Network Systems and Data Communications Analysts
- 15-1099 Computer Specialists, All Other
- 17-2061 Computer Hardware Engineers
- 27-1024 Graphic Designers
- 27-3042 Technical Writers
- 27-4099 Media and Communications Equipment Workers, All Other
- 41-1012 First Line Managers/Supervisors of Non-Retail Sales Workers
- 41-2031 Retail Salespersons
- 41-3099 Sales Representatives, Services, All Other
- 41-4011 Sales Reps, Wholesale and Manufacturing, Technical and Scientific Products
- 43-1011 First Line Managers/Supervisors of Office and Administrative Workers
- 43-4051 Customer Service Representatives
- 49-2022 Telecommunications Equipment Installers & Repairers
- 49-2097 Electric Home Entertainment Equipment Installers and Repairers
- 49-9052 Telecommunications Line Installers and Repairers

ICT Workforce Data and Demand Issues

Studying ICT related employment data raises a number of issues, including:

- Existing occupational descriptions are not currently aggregated in the U.S. or California under a single ICT category, as is done in much of the rest of the world. This can lead to different conclusions here versus in other countries. Aggregated ICT is quickly recognized as a top employment category, while subcategories observed in the U.S. may not be.

- There is a lot of misinformation about ICT related employment. One frequently hears comments like: “All of the IT jobs have gone overseas.” Clearly, that is not true. Outsourcing has affected some categories of ICT employment, but not others. We need to produce accurate and reliable information and not rely on anecdotes.
- Occupational codes are hard to keep current in quickly changing ICT employment areas. Existing SOC codes and descriptions need updating to better reflect current conditions. For example, Radio Mechanics is an almost obsolete job category. “Computer Support Specialists” and “Computer Specialists – All Other” employ about 100,000 people in California and are expected to have 7,500 job openings in California in the next 2 years. It is difficult to know exactly what to teach students to enter the workforce in those roles with such vague titles and descriptions.
- Employers do not often use Standard Occupational Codes when creating job titles or descriptions. Rather, they identify their internal needs and create a job title and description to meet those needs. Those titles and descriptions are extremely varied, combining occupations and often crossing disciplines into competencies associated with other occupations and specific industry knowledge. That makes understanding aggregate workforce demand difficult. How do we know how much of what kind of workforce to develop in educational systems if one out of every three job titles is a unique job title?
- As ICT technologies and people’s abilities to work with them evolve, previously unique job titles are subsumed by Users and other occupations. Desktop publishing is an example. Previously, those skills were very specialized and more limited to dedicated workers. Increasingly, those skills are held by workers with other workforce roles. Reduced job demand for desktop publishers doesn’t mean people are doing less desktop publishing; rather, desktop publishing is being done by all kinds of people. ICT education still needs to develop those abilities in workers, but workers may not end up in an exclusively desktop publishing job role.
- Convergence is a workforce phenomenon, as well as a technology and operational phenomenon. ICT Workforce skills are frequently demanded of people with other primary roles in an organization. For example, an office manager may now be responsible for network, desktop and User support today as part of his or her job.
- Many jobs today are filled outside of more traditional online job postings. Social media like Linked-In are increasingly used for that purpose, and many jobs are filled through personal relationships and networking. Those jobs are not visible to online data mining technologies.⁹
- ICT Workforce demand appears very chaotic and fragmented.

ICT Workforce Demand Summary Conclusions

All of these issues notwithstanding, it is not possible to study aggregated ICT Workforce data without realizing that this is a very important employment sector that deserves significantly more strategic attention.

- The ICT Workforce employs more than a million people in California today.
- There are very strong growth prospects for ICT Workforce jobs in the future, in spite of the bad economy.
- Employers are having a hard time finding appropriately skilled ICT Workforce today, even in a period of very high unemployment.
- The ICT Workforce enables increased productivity of all kinds of other workers (i.e., users) – in every industry and most organizations in California.
- We need to do a better job as a society expressing and quantifying ICT workforce demand and responding to that demand with educational systems and workforce development efforts.

ICT Education Supply

Community College ICT Related Program Offerings

This Phase 3 study also looked at the offerings of California Community Colleges related to ICT.

Colleges: We studied the 48 of California's 112 community colleges currently in the MPICT Region.

Departments:

- In these 48 colleges 129 different academic departments offered ICT related programs.
- The number of different departments offering ICT related programs averaged 2.7 per college and ranged from 1 to 9.
- The 129 different departments offering ICT programs had 93 different names.
- The most common department name was Computer Information Systems (CIS) with 13 instances.

Degrees:

- The 129 departments offered 303 different associate level degrees related to ICT.
- The 303 associate degrees had 263 unique degree titles.
- The most commonly repeated ICT degree name was A.S. in Computer Science with 9 instances.
- Degrees per department ranged from 0 (Feather River College) to 27 (Sierra College).
- Academic credits required for a degree ranged from 18.5 (Fresno City College) to 58.5 (Ohlone College), averaging 29.3 units, excluding general education units.
- Associate degree options ranged from 2 (multiple) to 6 (City College of San Francisco).
- The content of each degree is generally significantly different from all others, with the exception of a few programs and credentials offered consistently across a community college district.

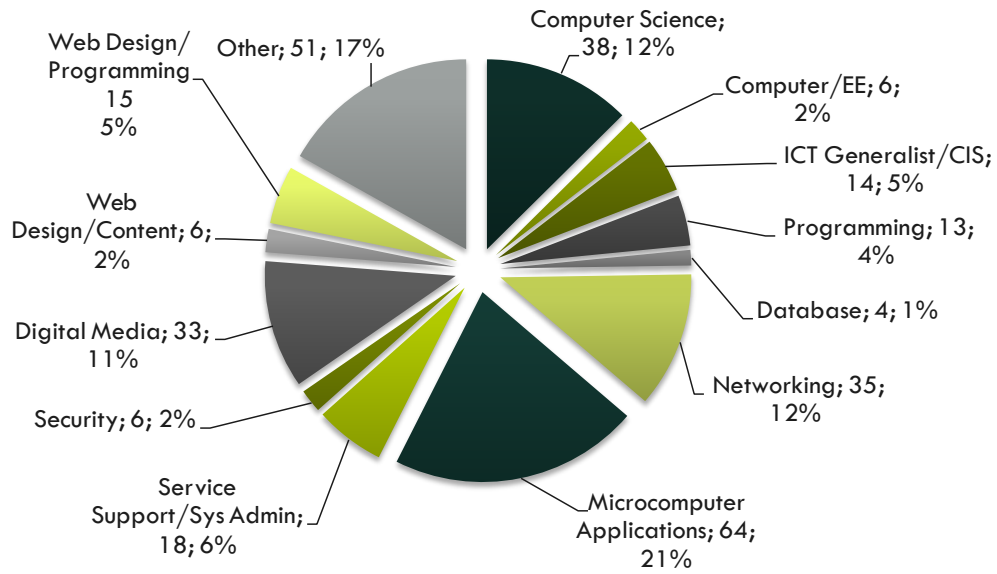
Academic Certificates:

- The 129 departments offered 606 academic certificates.
- The 606 certificates had 522 unique titles.
- The most commonly repeated certificate name was Administrative Assistant, with 7 instances.
- Certificates per college ranged from 0 (West Hills College) to 54 (Ohlone College)
- Academic units required per certificate ranged from 12.6 to 50.9 units, averaging 23.9 units, excluding general education units.
- Certificate options ranged from 2 to 15 per certificate.
- The content of each certificate is generally significantly different from all others, except for a few programs and credentials offered consistently across a community college district.

An immediate and obvious summary conclusion is that California Community College ICT Education and Workforce Development supply appears very chaotic and fragmented. The data from this study is included as Appendix D.

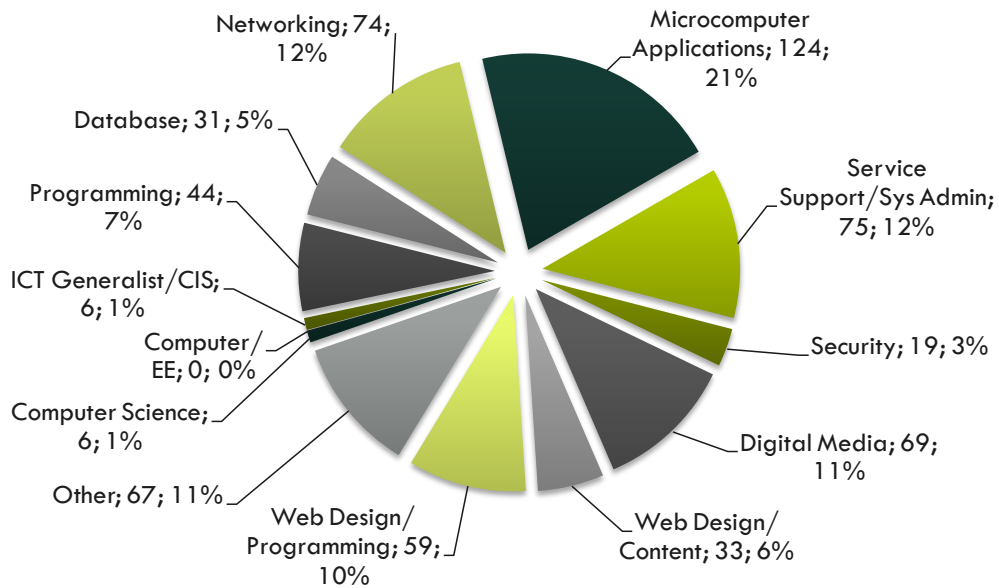
A team of community college professors in ICT related programs were asked to do an analysis of academic programs in ICT. They were asked to group academic program credentials by categories that seemed logical and consistent. They organized the 303 associate degrees as in the following graph and named the various academic content areas. *[Labels detail Content Area; Number of Degree Programs; and Percent of Total.]*

Figure 16: California Community MPICT Region ICT Related Degree Categories Q1 2011



They organized the 606 academic certificates as indicated in the following graph and named the various academic content areas. [Labels detail Content Area; Number of Certificate Programs; and Percent of Total.]

Figure 17: California Community MPICT Region ICT Categories: Total Certificates



The study team initially considered exploring courses required for academic credentials, but those also vary widely by title and have very large numbers. Interestingly, those consistencies that were observed across programs were related to two general areas:

- Programs that align to Association of Computing Machinery (ACM) academic standards.
- Other program offerings that align to vendor sponsored and vendor neutral academy programs and industry certificates, like the Cisco Networking Academy, CompTIA, Microsoft Academy, etc.

ICT Academic Standards

In discussions and focus groups with community college educators, MPICT has found that professors frequently react negatively to the term “academic standards,” perhaps with justification. Teachers also enjoy the freedom to create whatever ICT courses they want. Students will attend them, because they know intuitively that ICT is important, want to develop their ICT abilities, and that’s what’s available to them. However, that isn’t necessarily what best serves society, employers, students or workers.

How does an employer know what is taught in an ICT course, program and credential are, or how to evaluate them? We need an ICT academic system that fits together coherently. Teaching in K-12 systems should align to teaching in community college systems, and that should align to teaching in 4 year colleges and universities. It very frequently does not for ICT subjects. ICT teachers are quite comfortable with the idea of ICT technical standards. Without technical standards, technical systems do not work. The same is true for academic systems. We need ICT academic standards to create a functional and inter-operative ICT educational system. Unfortunately, those academic standards are generally either not adequately developed or not adequately adopted yet.

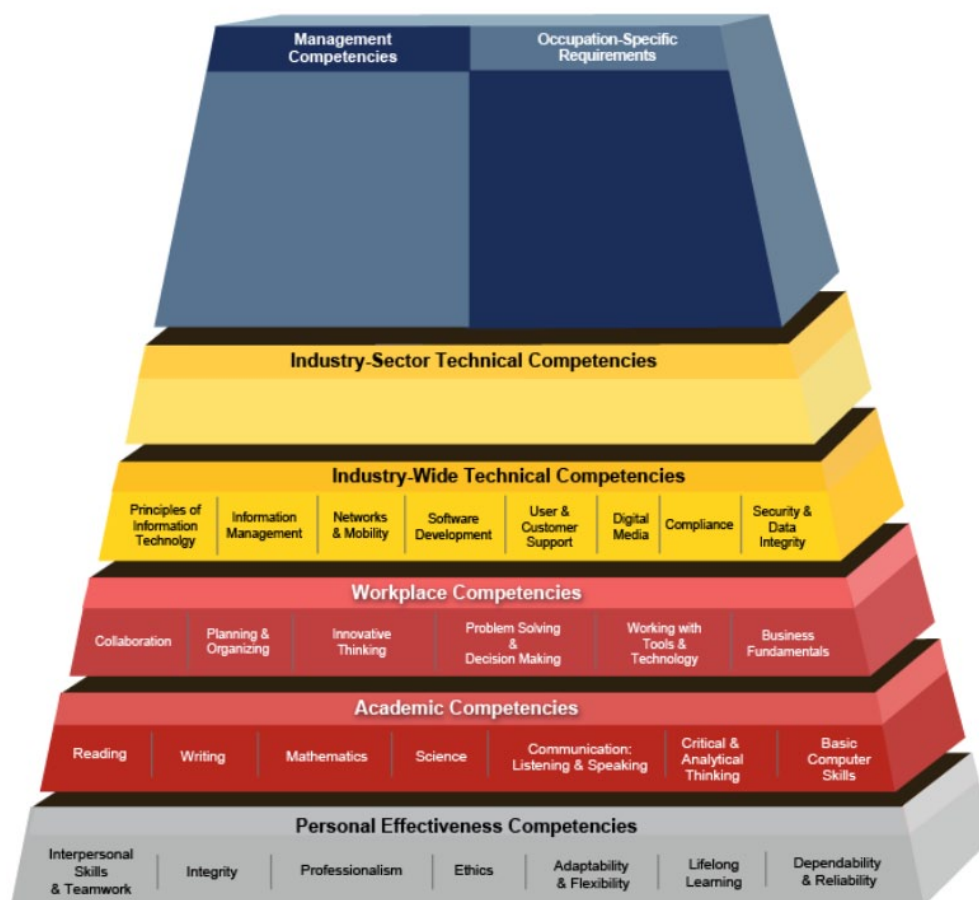
For California community college faculty willing to entertain ICT related academic standards, following are some places to look:

Association for Computing Machinery - With few exceptions, academic standards related to ICT are scarce. A major exception is the Association for Computing Machinery (ACM). In the past, ACM academic standard initiatives have focused primarily on traditional Computer Science, Computer Engineering, Software Engineering and Information Systems at 4 year colleges and universities, which develop people with deep knowledge and skills to advance the field. Some two-year colleges transfer programs that articulate and transfer students into those 4-year programs align to those standards, and those are the existing academic programs and pathways that are most coherent in ICT.

Applied ICT technology domains, which affect jobs in IT operations of all kinds of organizations, have received less focus. It is actually a major issue that there are so few baccalaureate degree options in IT or applied ICT technology domains, because employer human resource systems frequently screen applicants for bachelor degrees but are looking to hire the applied technology knowledge and skills that 4 year colleges and universities frequently do not address.

Recently, however, ACM has been working on standards related to Information Technology (IT) and recommendations for 2 year colleges, in part through its Special Interest Group on Information Technology (SIGITE). This is probably the most credible and widely adopted academic standard work for California community colleges to refer to. For more information on ACM ICT related academic standards, go to <http://www.acm.org/education/curricula-recommendations>.

ITAA/U.S. Department of Labor – A few years ago, the Information Technology Association of America (ITAA) and U.S. Department of Labor collaborated on an Information Technology Competency Model, available at <http://www.careeronestop.org/competencymodel/pyramid.aspx?it=Y>. (Since then, ITAA has been absorbed by TechAmerica (<http://www.techamerica.org/>)). That model is summarized graphically as:

Figure 18: Career One Stop IT Competency Model

Navigating through the interface with this model provides information on knowledge, skills and abilities for IT occupations in the O*NET system, which are the official ICT occupations used in this study. The model also allows customization by specific employers for training programs geared to their needs.

e-skills UK National Occupational Standards for IT & Telecomm – The United Kingdom information technology and telecommunications national occupational standards are an interesting 3rd leg on the ICT academic standards stool, because they are more focused on knowledge, skills and competencies associated with the IT operations of enterprises, rather than technical content areas. These dimensions are absolutely necessary for workplace success in real world IT and Telecom operations, and they are frequently inadequately addressed by community college ICT related programs. Learn more at <http://www.e-skills.com/standards-and-qualifications/national-occupational-standards-nos/>.

Industry and Vendor Neutral Academies and Certificates

The idea of basing academic, or even CTE programs on standards, curriculum and certificates developed by businesses, often as part of commercial training organizations, offends some academics and grant funders, who believe academics should be pure and free of corporate influences. However, academia also has tremendous difficulty keeping current with quickly changing ICT technologies and practices. MPICT views these industry academy programs as public-private partnership opportunities that can be win-win solutions for all parties involved. Academics need to work to adapt these programs to meet the specialized needs of academia (for example delivery in semester formats) and work with private sector partners to develop what they need for success.

Among the greatest values for students going through ICT related programs from these partnerships is the opportunity to acquire a credential verifying certain knowledge and skill sets that is widely known, recognized and understood by employers. Employers frequently use industry certifications as search terms or screens in hiring new employees. They want broader backgrounds, knowledge and skills that come from academic degree completions, but they also want to be able to verify specific knowledge and skill sets with industry certifications. Preparing students for both in a community college ICT related program provides better value to students in the ICT workforce. It also provides a structure around which to align programs and their articulation and transfer relationships.

A list of industry resources for ICT educators is available at http://www.mpict.org/ict_industry_resources.html. Well known examples include the Cisco Networking Academy, Microsoft IT Academy, and CompTIA.

Qualitative Observations of Community College ICT Program Research

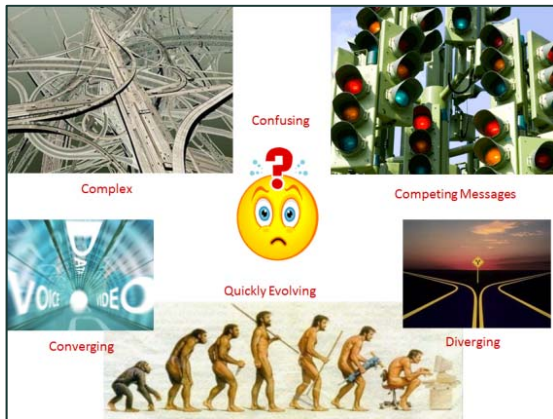
The study team also reported qualitative observations from the exercise of trying to find information on ICT related programs at California community colleges:

- There is an extreme variety of experiences in how community colleges present information on college websites. From the perspective of a student interested in “computer stuff,” it can be very confusing and frustrating to try to find appropriate information on ICT related programs through college websites. There were sites without a search function or a search function that did not lead directly to the degree or certificate. In about half the cases information was located in a PDF catalog, rather than html, which required downloading the file and searching within the PDF. Improving these experiences could improve program enrollments.
- There are big differences in how ICT related programs and credentials are described. Colleges use different naming conventions when describing very similar programs. This creates confusion.
- ICT related programs are often offered by departments that are not intuitive, such as "Natural Sciences" or "Art". In some cases, different departments offer ICT related courses almost as if they are competing with each other and without apparent coordination across departments.
- Generally, colleges often offer a variety of ICT related degrees and especially certificates but no real online or catalog guidance for how to choose among the offerings.
- The greatest program consistencies are in programs in Computer Science (CS) and Computer Information Systems (CIS).
- Some program math requirements (gateway Calculus) may be a barrier for many community college students, especially when Calculus is not needed in ICT Workforce roles that the programs are preparing students for.

Generally, California community colleges could help students with better and more consistent information.

Tools to Improve Communication about ICT and Input for ICT Education Programs

It is a legal requirement in California for community college Career Technical Education (CTE) programs to have business/industry advisory groups, to inform their activities. The following section of this report contains a series of communication tools developed by MPICT to improve interactions between people in those meetings - and between others interested in improving ICT education. It also includes input received by this study group through many dozens of interactions with business and industry people that may help community college educators in developing and improving their ICT related programs.



Market Confusion

Information and communications technologies have emerged, evolved and permeated society rapidly. In the U.S., where many ICT innovations have originated, that has been a free-market, free-for-all process. There have been many competing, proprietary technologies and terms in use, much of it technical jargon that is not widely understood. The technologies and their implementations are complex.

A recognized trend in ICT fields is “convergence.” Previously separate technologies are combined or consolidated. For example, what was once many separate devices is now one or few devices. A handheld smartphone today has the

functionality of a cellular telephone, a Personal Digital Assistant (PDA), a pager, a portable computer and a Global Positioning Satellite (GPS) device. What were once separate voice, video and data networks, with separate organizational support and infrastructure, is increasingly one multipurpose network. Separate software application functionality is increasingly combined into fewer applications. This megatrend is one of the reasons for aggregating all of the many ICT related technologies under the single superset ICT term. In the past, an organization may have had separate departments to handle telephone and voice systems, computer data systems and TV/video systems. Increasingly, one department manages all of those activities.

Another trend is divergence, in which what was once a single known technology area splits into multiple branches of technical development. For example, computer programming was once focused only on large, centralized computers. Now, computer programming specializes in large mainframe environments, smaller personal computers, handheld mobile devices, specialized computing systems for cars, machines and tools, and specialized networking equipment. Data storage systems were once physically connected in close proximity to computing devices. Now, Storage Area Networks (SANs), Network Attached Storage (NAS), iSCSI and other solutions exist as specialized data storage technologies.



Tower of Babel Effect

As a result of technical jargon, inconsistent use of terms, quickly emerging and evolving technologies, inconsistent ICT implementations, the rise and fall of technologies, corporate changes and rebranding, inconstant and often inadequate ICT education, and other causes, there is a lot of market confusion about information and communications technologies. There are few common maps of this technical domain, and, as a result, people have created their own mental maps of what ICT is, whatever they call it, and how to talk about it. Some people visibly retract when conversations about ICT are initiated, avoiding what have been frustrating and confusing conversations in the past. Often, ICT related conversations take place, with people using common terms, but each mean

(slightly) different things to different people or refer to different mental maps of the space. Conversation is taking place, but real communication is not, because the meaning sent and meaning received are different. MPICT refers to this issue as the “Tower of Babel Effect.” The lack of common nomenclature and structure for the ICT field leads to inefficient and ineffective communication about the field, which makes policy and educational planning difficult.

Conversations about ICT are often like the old parable of blindfolded people asked to describe an elephant. Each approaches and touches the elephant in a different place and describes something fundamentally different. A company CEO has a strategic view of ICT, often with little technical understanding, and one set of perspectives on what is important. A technician with a limited understanding and role with a specific technology has another view. An IT manager in one organization using one solution set has one viewpoint, and another manager using other solutions has another. Policymakers, administrators and others may have very little understanding of ICT but be expected to express authoritative opinions about it. Citizens and users vary widely in their understanding of ICT and what is important about it. Journalists have different understandings and viewpoints. Even ICT educators vary widely in what they think is important about the field or how to talk about it. A university computer science professor has a very different view from a community college IT career and technical education professor.

This Tower of Babel effect makes it hard to figure out this field through advisory meetings, reading articles, following corporate messaging, reading academic papers, attending conferences or any other method.



Confusion about ICT in Education

A Tower of Babel effect in discussions about “ICT in education” results from people having different concerns or focuses about what that means and what is important. Following are several different dimensions or focuses of conversation for ICT in education:

ICT to improve productivity, efficiency and operations for schools as enterprises

There has been phenomenal progress on the part of many businesses and industries in integrating information and communications technologies into their operations, creating efficiencies, improving productivity, and improving relationships with customers and suppliers. Many schools and school systems have not made great strides in implementing ICT to improve their operations. In conversations about ICT in education, many people are focused on this aspect.

How can schools and school systems integrate ICT into their organizational operations to make them more efficient? Discussions in this dimension include things like: computerized recordkeeping, administrative and reporting systems, systems for better communicating and sharing information with parents and students, ways to share resources between schools in a system, faculty development delivery solutions, connecting teachers to information sources, school websites, etc.

ICT to improve teaching and learning experiences for students

For many, ICT in education is about improving the way students learn and teachers teach – in all fields. Information and communications technologies can be used to provide multimedia learning resources, conduct research online, take video field trips, have remote guest speakers, take classes online, build community between students, write papers, do math, tie into vast information resources around the planet, present student work, connect students and teachers remotely, etc. How do we make better use of ICT to make all education more engaging, productive and modern, for teachers and students, in all subjects?

ICT as an essential set of knowledge and skills competencies everyone needs today

Another dimension of ICT in education is about helping students learn how to use ICT to be productive and efficient students, employees and citizens, no matter what their academic field or career pathway is, which industry or job they are pursuing, or where they live. Everybody needs to be a proficient user of ICT today. Those who are not are disadvantaged and on the deprived side of the “Digital Divide.” Those who are have an advantage which will serve them well in life, no matter what they do. This is an essential

modern requirement of education, and it needs to be addressed explicitly, comprehensively and competently. Too many children and citizens are being left behind in the Digital Age, and we need to competently impart needed ICT User knowledge and skills to everyone who goes through our educational systems. Terms used in this dimension of discussion include: “Digital Literacy,” “Computer Literacy,” “ICT Literacy,” and “Information Literacy.” Definitions of those terms vary. This has *enormous implications* for community college ICT education, because it is something for every student, in every subject. (See Appendix E for more on ICT Digital Literacy.)

ICT education and training for people wanting skills that allow them to enter the workforce

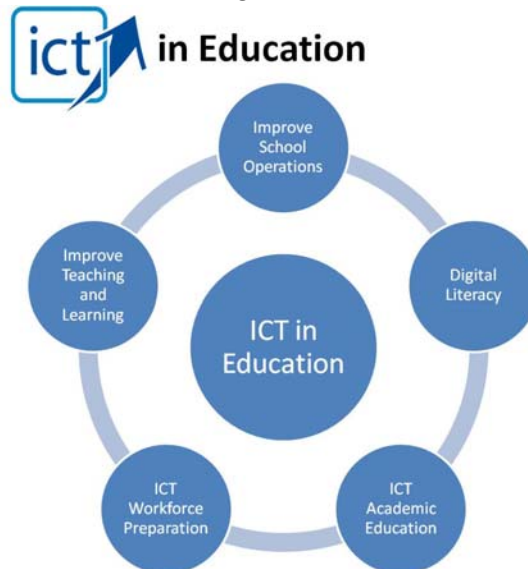
For some, ICT in education is about imparting ICT knowledge and skills that allow students to find ICT Workforce jobs. For a variety of reasons, many people are not interested in academic careers. They just want to go to work and support themselves and their families. There are good jobs that do not require baccalaureate degrees: supporting ICT Users, building websites and fixing ICT equipment. Whether the education program is Career Technical Education, “Tech Prep,” a trade school, or an apprenticeships, we need to help people acquire ICT knowledge and skills that allow them to support themselves and their families in those one in twenty jobs in ICT that do not require baccalaureate degrees. This is a K-12 educational issue and a community college educational issue, and those systems should fit together.

ICT education for those who will become scientists and engineers and advance ICT fields

For many, primarily in 4-year colleges and universities, ICT in education is about developing students in rigorous academic tracks that lead to ICT inventor, scientist and engineering workforce roles that will provide the innovations that drive our economy in the future. We need people with deep understanding of math and science principles and their applications who can become engineers, scientists, professors, and researchers in order to advance ICT fields in the future. These are often Computer Science or Computer Engineering people and organizations, like the Association for Computing Machinery (ACM). How do we attract early and serve throughout our educational systems the bright young people who will understand ICT deeply and keep advancing the frontiers of knowledge and ability in ICT?

It is important to be able to separate, or at least recognize, which of these dimensions is being talked about in discussions about ICT in education. Each of these dimensions is important and deserves attention, planning and resources. However, it is frequently difficult to separate these discussions, and productive efforts are confused and delayed by inefficiencies, because of different concerns competing for attention. We recommend that people involved in ICT in Education develop a common understanding of different dimensions of ICT in Education, to enable more productive engagement in improving ICT in Education.

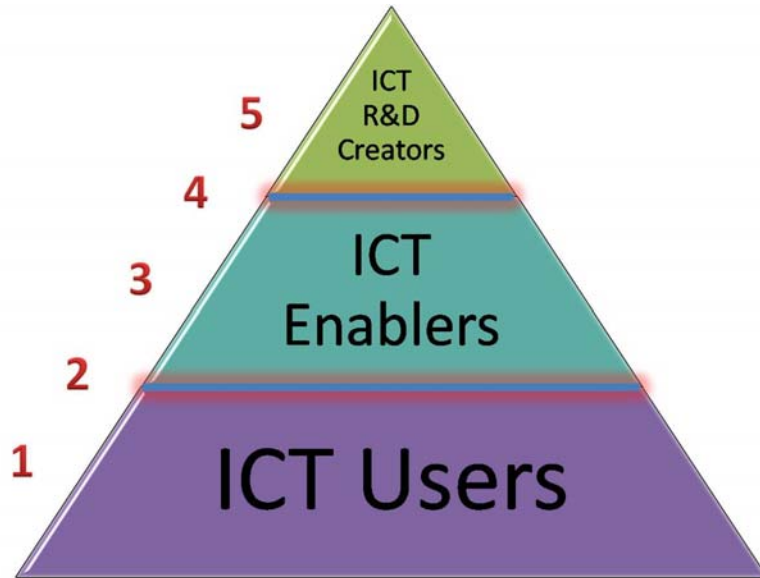
Figure 19:



ICT Pyramid (Depth and Breadth of ICT Knowledge and Skills):

Another simple tool developed by MPICT is for discussing depth and breadth of ICT knowledge and skills. This simple, 3-level pyramid is useful for being able to identify and agree on what depth or dimension of ICT knowledge and skills is being discussed and being sure everyone is talking about the same thing – using plain language that everyone can understand, even if they know nothing about the field.

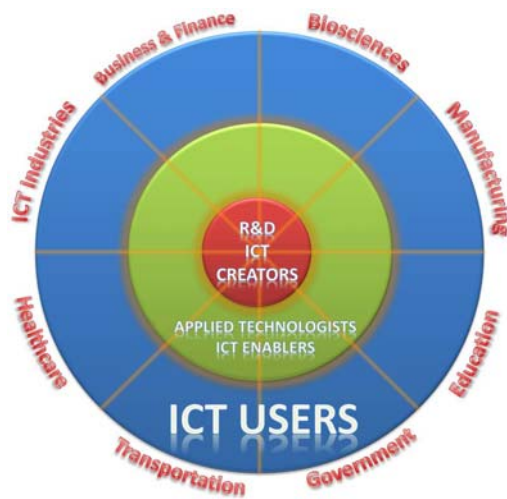
Figure 20: Basic ICT Pyramid



1. At the base of the pyramid is the largest group of people, those who use ICT in their schools, jobs and lives. These people can operate the common ICT devices, applications and systems they use in their lives (cell phones, computers, telephones, the Internet, email, voicemail, text messaging, word processing, spreadsheet and other common applications). In the knowledge, information and innovation economies we live in today, many people are advocating that everyone in our society should be a competent ICT User. They argue compellingly for Digital Literacy efforts to educate everyone to be a competent User. Any graduate of a public educational system should have as part of the value of their education credential (high school diploma or college degree or certificate) an assurance to employers and to them that they know what they need to know to be a successful user of common ICT systems and applications. (See Appendix E for more on Digital Literacy.) *This is potentially an enormous issue for community colleges, which would need to provide or validate this education for all of their students, and remediate the lack of these knowledge and skill sets for all kinds of people who did not get it when they were in high school.*
2. The fuzzy line between the first and second level of the pyramid represents entry level ICT workforce positions which support ICT Users. These are people who are competent ICT Users themselves, with good people skills, who help other Users understand and use ICT systems and solutions. In roles like Help Desk support, technician, call center representative and Computer Support Specialist, they help other users realize the benefits of ICT in their lives and jobs. In addition to technical knowledge, they also understand how technical support operations run and may have credentials from organizations like HDI (formerly Help Desk Institute). Community colleges serve students seeking these entry level ICT workforce positions. This is called Career Technical Education (CTE) in California.
3. The middle layer of the pyramid, “ICT Enablers,” is the dimension of applying mature ICT technologies in the real world. These are the core Information Technology (IT) operations of all kinds of enterprises. They deploy developed technologies as infrastructure to support the operations of their enterprises, which Users use. This is the applied technology domain. The ICT workforce at this level is applied technologists,

technicians, managers, operators, analysts, specialists, administrators... This is almost anybody employed by the IT operations of an organization, the ICT enabling operation of enterprises, which allows the benefits, efficiency and productivity of ICT to be realized in all other aspects of organizations and society. Community colleges serve students seeking these ICT workforce positions or trying to expand their knowledge and skills to grow in these positions, and those people include a vast range, from high school students to working professionals with graduate degrees. This is generally considered/called Career Technical Education (CTE) in California.

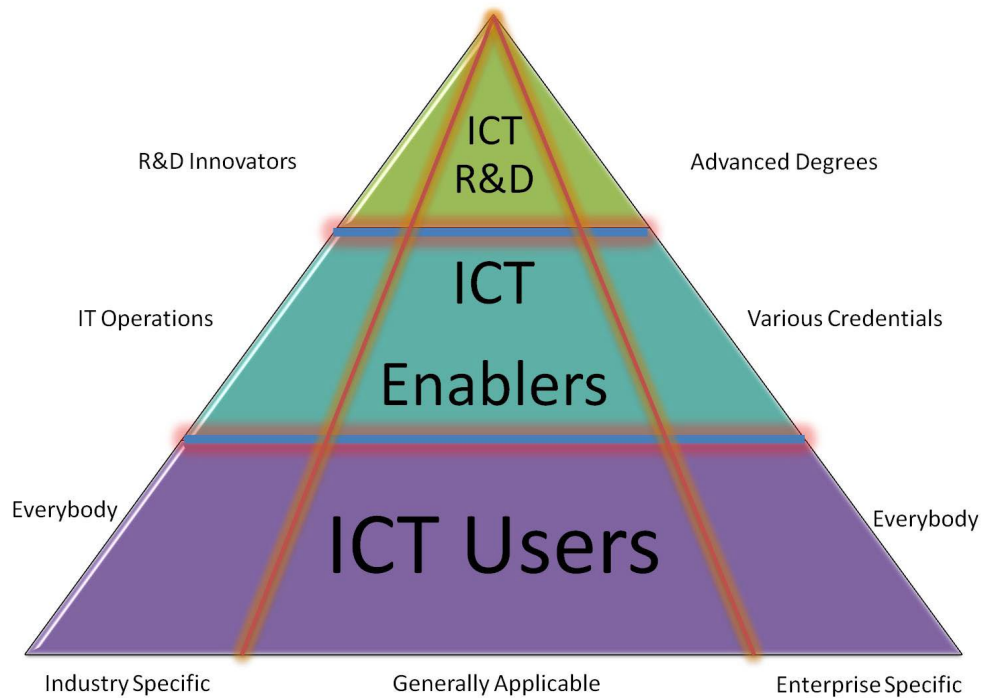
4. The fuzzy line between the middle and top layers of the pyramid represents the intersection of ICT research and development (R&D) and IT operations, enterprises, consumers and users. At this layer, representatives of ICT companies or business units interact with their consumer and enterprise customers, to buy and sell goods and services, to understand customer requirements and specifications, to do marketing, to design and install custom customer solutions. These are sales, marketing, engineering, management, and support roles that form the interaction between organizations that create and sell ICT goods and services and their customers, which are IT operations of enterprises or consumers. Community colleges prepare students for some of these roles. Often, technical knowledge is required to do technical sales, for example.
5. The top level of the pyramid, "ICT Creators," represents the innovators who develop ICT technologies, goods, services and businesses. These are scientists, engineers, business people and other inventors and adapters. They work in enterprise R&D organizations, in universities and in garages. They often have advanced academic degrees and experiences that include deep understanding of math, science and technologies. They are valued when they have knowledge of industry verticals and operations. These are the wizards who cook up ICT's magic and commercialize it for implementation and use by others. This is the traditional focus of 4-year college Computer Engineering and Computer Science programs and organizations like the Association of Computing Machinery (ACM). They argue correctly that the U.S. is not attracting an adequate number of students into ICT Creator academic and career pathways, and the U.S. and California economies will suffer if we are not able to continue to innovate and create new ICT technologies in the future. Community colleges primarily serve these needs through ICT academic transfer pathways.



ICT Industry Pie

The ICT Pyramid is not limited to just ICT industries, however. ICT permeates all industries. Where would a company like Charles Schwab or Fidelity Investments be without online trading systems and the Internet? The biotech industry would not exist, and we would never have mapped the human genome without ICT. Government operations and services are increasingly ICT enabled. Many manufacturing businesses have strong ICT integrations. Healthcare IT is not a new industry. It is about applying the benefits of ICT to the healthcare industry, so that it can realize some of the many efficiencies and cost reductions already experienced by other industries.

The ICT pyramid is more like a piece of the pie, but its dimensions apply in all industries, and all industries have their peculiarities and customizations of ICT.

Figure 21: Comprehensive ICT Pyramid

A modification of the ICT Pyramid picks up this industry dimension, and the customizations many individual enterprises create, especially very large ones. It contains all of the dimensions previously described, but it makes space for specialized implementations in an individual industry. For example, car mechanics diagnose car trouble with computers today, airline employees need to know online reservation systems, and nurses may now do charting on computers. There are specialized knowledge and skills in different industries related to operational environment, regulatory requirements, security considerations, safety requirements, custom industry-wide solutions (like stock market trading systems) and industry standards.

Similarly, some large enterprises have custom ICT hardware and software developed especially for them. It is important to be able to work with those systems if you are working for that employer. For example, government entities have large, proprietary systems. In all industries and some enterprises, there are all of the vertical dimensions of the pyramid, innovators to users.

Our experience is that diverse audiences pick up the simple distinctions in this Comprehensive ICT Pyramid communication tool quickly, and with a little coaching they can learn to identify which segment of this graphic they are focused on with their input, advice or proposals. That helps make communication more effective, especially between business/industry and education. It helps people with little understanding of ICT academic and career pathways better understand their basic breadth and depth, and it can help people counseling or advising potential students and workers about their options.

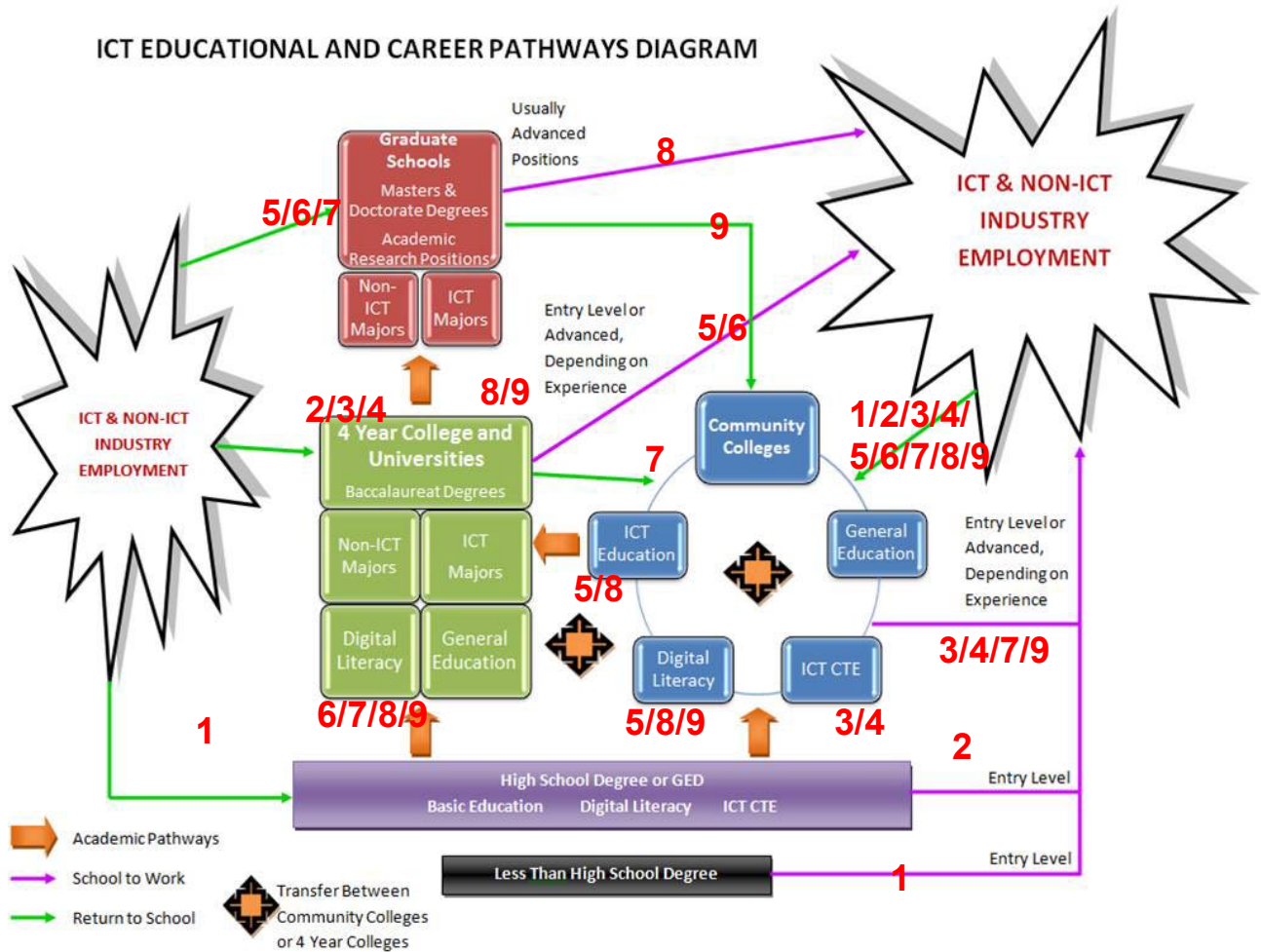
ICT Pathways

One of the findings in the Phase 2 study was that many employers do not understand the many diverse roles of community colleges and the extraordinarily diverse populations of students served by community colleges in ICT education.

MPICT has developed and is currently disseminating a high level ICT pathways map, which can aid in discussions of ICT education and career pathways.

This diagram is useful in discussions with business, industry, educators and counselors to talk about the very diverse roles of community colleges in ICT education and workforce development - and in discussions with teachers, counselors and education administrators about ICT education and career pathways.

Figure 22:



1. Some people drop out of high school and pick up ICT knowledge and skills on their own. If they're good, they can succeed. Employers want an ICT workforce that can add value to their enterprises. Some people can figure out how to do that on their own. Many find they need additional knowledge and skills to advance in their careers, though, or employers screen them out if they do not have a high school or college degree, and it is not always possible to come back to complete high school or college later. Many of these students end up at community college, and some go back to 4-year colleges and universities, following one of the pathways below.
2. Some people finish high school and go straight to work, without going to college. In some cases, high school Career Technical Education (CTE) programs help them acquire knowledge and skills they can use to get entry level jobs, but they frequently find they need additional knowledge and skills to advance. Many of these end up in community colleges, and some go back to 4-year colleges and universities, following one of the pathways below.
3. Some people go straight from high school to community college. Some of those seek CTE knowledge and skills that allow them to enter the workforce, and that works for them. They complete courses and perhaps get industry certifications that help them get a job.

Frequently, that was their goal. They never even intended to get an AS degree or academic certification, and they never intended to transfer to a 4-year school. They succeeded in community college, based on their goal of learning what they needed to get a job. However, community colleges have no systematic method for capturing successful student employment outcomes, and therefore this situation is typically not considered a success by educational systems, which primarily evaluate community colleges on transfer or academic degree or certificate completion. This should be fixed.

Often, however, they find they need additional knowledge and skills or academic credentials to advance in their careers. Many of these end up in back community colleges, and some go back to 4-year colleges and universities, following one of the pathways below.

4. Some people go straight from high school to community college, complete a community college ICT academic degree or certification and then get a job. That's a success for the community college and for the student with that as a goal. To keep up with changing ICT technologies and advance in their jobs, some return to community college for additional course work or certifications, or they find they need additional knowledge and skills or academic credentials to advance in their careers. Many of these end up in back community colleges, and some go back to 4-year colleges and universities, following one of the pathways below.
5. Some people go straight from high school to community college, take ICT and non-ICT related courses, transfer to 4-year colleges and universities and then get a job with an ICT workforce role. That's a success for the community college and the 4-year school. Some of these students end up returning to graduate school or community college for additional study to advance their careers.

However, most 4-year schools want and accept for credit mostly just general education or standards-based computer science courses. Many computer science and business programs will not accept community college IT courses. That is a major obstacle for technical students with ICT interests, because it is precisely those hands-on ICT courses that attract their interest and which they want to pursue in their careers. Businesses want the technical skills, but they frequently require a baccalaureate degree as a screening mechanism in the hiring process. This pathway is broken for IT subjects. It works pretty well for Computer Science programs.

6. Some students go straight from high school to a 4-year college or university. They get a baccalaureate degree in an ICT or non-ICT related discipline and find a job that includes an ICT workforce role. Some of these students will end up returning to graduate school or community college for additional study to advance their careers.
7. Some students go straight from high school to a 4-year college or university. They get a baccalaureate degree in a non-ICT academic field and discover that it is difficult to get a job in their field when they are done. They learn that ICT workforce skills are in high demand and take classes at a local community college to learn those skills. With a combination of baccalaureate degree and technical knowledge and skills, perhaps demonstrated with industry certification(s), they find meaningful employment that includes an ICT workforce role.

In some cases, even graduates from traditional theory-based Computer Science programs end up going through community college hands-on courses before they find a place in the workforce, because many jobs in IT roles in organizations demand those skills.

Completion of a community college academic credential is not their goal. When they get the ICT knowledge and skills they need and get a job, they meet their goal and succeed. However, they are frequently not counted as successes for community colleges by current academic completion or transfer evaluation metrics.

8. Some students who transfer from community colleges or go directly to 4 year colleges and universities go on to complete graduate degrees in ICT related fields. Many of them go on to work in ICT industry in R&D and other advanced roles.
9. Some students who transfer from community colleges or go directly to 4 year colleges and universities go on to complete graduate degrees in non-ICT related fields. Frequently, when they try to find jobs, however, they find that employers want ICT technical knowledge and skills that these schools do not provide – even for students in Computer Science programs. Many of these people go to community colleges with advanced degrees to get knowledge and skills they don't have but need for productive employment.

Completion of a community college academic credential is not their goal. When they get the ICT knowledge and skills they want, they meet their goal and succeed. However, they are not counted as successes for community colleges by current academic completion or transfer evaluation metrics.

10. It is not on the map, but people who go through any of these tracks may end up teaching ICT related subjects in K-12 schools, community colleges, 4-year colleges or universities. There are inconsistencies in the requirements for those teachers. Many have not worked, at least recently, in real world businesses and have difficulty knowing what current ICT workforce demands and realities are. There is a real need to provide ICT related teachers current, real world ICT employment experiences, so they can shape their courses, programs and instruction to meet current workplace demands.

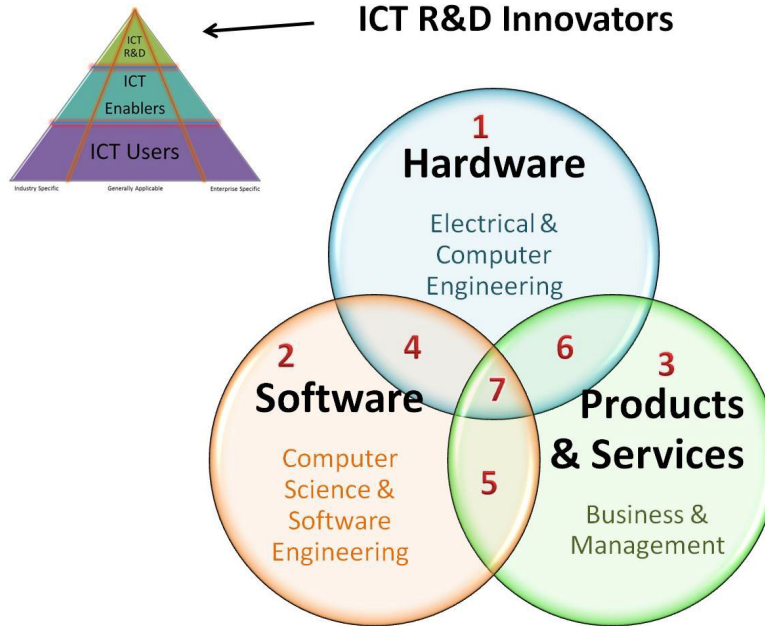
No matter their education or work background, many working or unemployed professionals come to community colleges to keep up with rapidly emerging and evolving ICT technologies. Their employer may not be willing to pay high price “boot camp” training fees charged by private training organizations, and they can't or won't pay those fees on their own, but they need those skills to advance. Again, completion of a community college academic credential is not their goal. When they get the ICT knowledge and skills they need and get a job or advance in their careers, they meet their goal and succeed. However, they are often not counted as successes for community colleges by current academic completion evaluation metrics. Anecdotally, as many as half of students in some ICT related programs are in this category.

The different student groups served by community college ICT related programs are extraordinarily diverse. That makes delivering appropriate educational experiences to everyone very challenging. However, the role of community colleges in developing the ICT workforce is extremely important strategically, because of the many different student groups they work with in ICT workforce development – and because they are extremely affordable. To benefit from the ICT workforce output provided by community colleges, business and industry would be well served to better recognize community colleges' strategic roles in ICT workforce development and find ways of collaborating with them and helping them find resources with which to do a better job developing the ICT workforce. There is currently no more cost-effective or ubiquitous way of pushing valuable ICT workforce knowledge and skills out into communities throughout California than the California community college system.

ICT Research and Development Innovation

In reality, ICT technology, business and, in some cases, industry emergence and development do not usually evolve to fit existing academic, economic or business structures. Rather, ICT innovation is generally a result of pure research and/or a combination of hardware, software and business knowledge and skills to solve a business problem or to meet a business opportunity. Entrepreneurs identify issues, problems and opportunities and assemble teams of people to solve those issues and problems. At a high level, this is a pretty simple idea. Technologies and businesses are created to solve problems and make money for their creators. Entrepreneurs seek opportunities to make contributions to the field and to make money.

Figure 23: ICT Innovation



For job seekers and career planners seeking ICT research and development workforce roles this simplified graphic can provide some assistance in increasing their value in the workforce.

1. **Hardware Research and Development Roles** involve a deep understanding of scientific principles, mathematics, engineering, materials, production processes and manufacturing. Advanced degrees in Electrical or Computer Engineering and Materials Science are often desired for these roles. Increasingly, to be successful these roles also require an understanding of software and business and an ability to work effectively in teams with other hardware, software and business experts.
2. **Software Research and Development Roles** involve a deep understanding of scientific principles, mathematics, software engineering, and computer science. Advanced degrees in Computer Science or Software Engineering are often desired for these roles. Increasingly, to be successful these roles also require an understanding of hardware and business and an ability to work effectively in teams with other hardware, software and business experts.
3. **Business, Marketing and Management Roles** involve a deep understanding of business, marketing, product development, management and organizational behavior. Advanced degrees in Business and Management are often desired for these roles. Increasingly, to be successful these roles also require an understanding of hardware and software and an ability to work effectively in teams with other hardware, software and business experts.

4. **Hardware and Software Expert Roles** involve deep understanding of both hardware and software. Generally, a person with knowledge and skills in both areas is more valuable and more highly compensated than a specialist in one area only.
5. **Software and Business Expert Roles** involve deep understanding of both software and business. Generally, a person with knowledge and skills in both areas is more valuable and more highly compensated than a specialist in one area only.
6. **Hardware and Business Expert Roles** involve deep understanding of both hardware and business. Generally, a person with knowledge and skills in both areas is more valuable and more highly compensated than a specialist in one area only.
7. **Hardware, Software and Business Expert Roles** involve deep understanding of hardware, software and business. Generally, a person with knowledge and skills in all of these areas is most valuable and highest compensated as part of an ICT innovation team.

Cross-disciplinary knowledge, skills and experience increase one's value in ICT innovation, research and development roles. Increasingly, deep knowledge and experience in one or more industry verticals also increases a person's workplace value. This is a focus of ICT employment demand with ICT companies in environments like Silicon Valley. (See "Silicon Valley in Transition: Economic and Workforce Implications in the Age of iPads, Android Apps, and the Social Web," July 2011, which can be downloaded free at: http://connect.one-stop.org/lmi/TechStudyFullReport_05.pdf.)

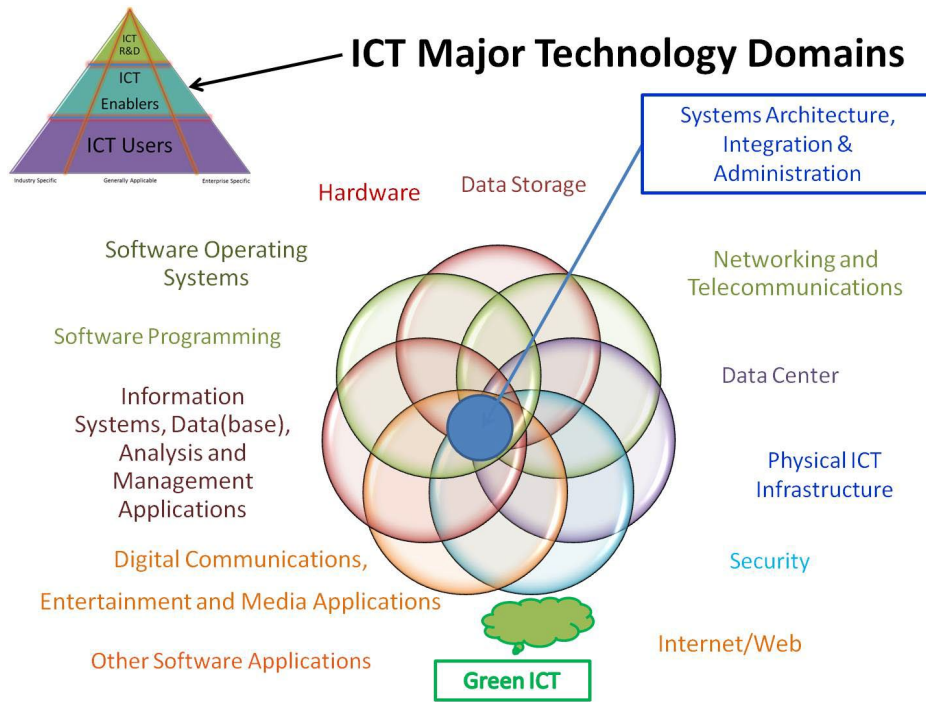
ICT Application and Implementation Categories

In reality, this innovation engine can create complexity and confusion, however, because it is sometimes hard to know where to fit a new technology, business or practice innovation with previous innovations. The innovation engine doesn't always worry about that. It just creates and sells solutions. It is in real world Information Technology (IT) organization operations and households that people and organizations have to figure out which solutions to buy and implement - and how to fit it all together into efficient and effective contributions to organizational and individual productivity.

Because many ICT innovations are relatively new, because there are inconsistencies in which innovations are adopted by various organizations, and because different IT operations are organized and function differently, there is a wide variety of demand for workforce knowledge and skills with existing ICT technologies and their implementations. There is also a lot of confused or conflicting input from business and industry about what they want in their IT workforce in terms of technical knowledge and skills. The noise level is high in these discussions.

Based on research and hundreds of conversations with business and industry, MPICT offers the following graphic (Figure 24) as a tool for discussing ICT technical knowledge and skills, not a definitive categorization of ICT technologies. This is an example of an ICT technical knowledge and skills constellation for a typical, larger IT operation.

Figure 24: ICT Major Applied Technology Domains



Again, there are a wide variety of language and categorization of IT technical knowledge and skill domains in use, but these are elements of many IT operations and elements to be addressed by ICT applied technology programs. Many of these domains overlap and are inter-related and inter-dependent, so there are not clear lines between them, and knowledge and skills with other domains is often necessary to be proficient in any given domain. These are dynamic systems that are difficult to freeze into a static picture, but when you take a snapshot you see elements like these:

- **Hardware:** ICT hardware is physical computing, communication and electronic devices used as part of ICT infrastructure and by users and ICT systems. These are things like mainframe, mini and personal computers, laptop computers, tablet computing devices, landline telephones, cellular telephones, telephone systems, PDAs, smart phones, routers, switches, servers, battery backup systems, data storage systems, printers, audio and audio conferencing systems, video and videoconferencing systems, RFID systems, point of sale devices, fax machines, scanners, copiers, projectors, displays, surge protectors, wireless access points, satellite dishes, entertainment systems, firewalls, various other appliances and peripherals, industry specific ICT devices and systems, and enterprise-specific ICT devices and systems – and their various components. Generally, in relation to hardware, employers want IT staff to help them
 - Evaluate hardware and component options and make optimal buying decisions
 - Manage hardware vendor, warranty and service relationships and projects
 - Receive, install, customize and configure hardware devices and keep track of them
 - Make hardware fit into and function as part of IT systems and document how
 - Monitor, update, upgrade and maintain hardware
 - Troubleshoot and repair hardware and hardware component problems
 - Train and support hardware users
 - Secure hardware against theft and unauthorized and inappropriate use
 - Operate hardware efficiently to minimize operating costs and waste
 - Manage any legal, health or ethical use issues related to hardware

- **Data Storage:** ICT data storage used to be closely tied to physical hardware. Data storage was integrated with the mainframe or PC. Today, data volume is growing exponentially, and enterprises have had to develop systems to remotely backup and store data, mirror data in real time across multiple locations, backup data offsite to secure against disasters in primary locations, integrate data from multiple locations into single, coherent systems and be able to restore data efficiently when necessary. This specialization is increasingly mission-critical. Data storage technologies include Storage Area Networks (SANs), Network Attached Storage (NAS), iSCSI RAID, and tape backup systems. Data storage specialists are in high demand and command high wages. Generally, in relation to data storage, employers want IT staff to help them:
 - Evaluate and make optimal data storage solution hardware, software and service options
 - Make optimal data storage solution buying decisions
 - Manage data storage vendor, warranty and service relationships and projects
 - Receive, install, customize and configure data storage solution systems
 - Keep records of data storage solution hardware and software implementations
 - Make data storage fit into and function as part of IT systems and document how
 - Monitor, update, upgrade and maintain data storage systems
 - Troubleshoot and repair data storage system and component problems
 - Train and support data storage system users
 - Secure data storage systems against theft and unauthorized and inappropriate use
 - Operate data storage systems efficiently to minimize operating costs and waste
 - Manage any legal, regulatory, health or ethical use issues related to data storage systems
 - Generally, they want to guarantee that their data is backed up, secured and available to them and them alone when they need it, even in cases of any kind of disaster

- **Data Networking and Telecommunications:** ICT data networking, video networking and telecommunications systems used to be largely separate technologies and operations in enterprises. Relatively recently, these domains have largely converged. People responsible for managing data networks are now commonly also responsible for managing voice and video networks. In fact, voice, data and video are now commonly transmitted across single purpose networks as data packets. There are a large variety of core, edge and user devices supported by voice, video and data networks, and they are provided by a large number of vendors, like Cisco Systems, Juniper Networks, Alcatel-Lucent, Dell, Hewlett Packard, Huawei and Avaya. To further complicate things, these networks include both wired and wireless components. These networks are now typically considered mission critical, and these ICT workforce roles are very important strategically. Generally, in relation to voice, video and data networking and telecommunications, employers want IT staff to help them:
 - Evaluate networking/telecom solution hardware, software and service options
 - Make optimal networking/telecom solution buying decisions
 - Manage networking/telecom vendor, warranty and service relationships and projects
 - Receive, install, customize and configure networking/telecom solution systems
 - Keep records of networking/telecom solution hardware and software implementations
 - Make networking/telecom fit into and function as part of IT systems and document how
 - Monitor, update, upgrade and maintain networking/telecom systems
 - Troubleshoot and repair networking/telecom system and component problems
 - Train and support networking/telecom system users
 - Secure networking/telecom systems against theft and unauthorized and inappropriate use
 - Operate networking/telecom systems efficiently to minimize operating costs and waste
 - Manage legal, regulatory, health or ethical issues related to networking/telecom systems
 - In general, they want a staff to implement network solutions that meet business needs, are available only to those selected, that perform well and are available all the time

- **Data Center:** Many years ago, ICT operations were centralized in computer rooms in large mainframe or mini computers, with “dumb” terminals at the edge that allowed users to interact with these centralized computing resources. Years ago, there was movement away from that model as part of the personal computer revolution. User computing devices at the edge got their own storage, processing, memory, display, networking and peripheral device resources, empowering users at the edge, who were more independent of centralized resources. Now, there is a new “cloud computing” model emerging, in which ICT resources are again largely centralized in data centers, and users interact with those resources using less expensive “thin client” and mobile devices. Throughout, there has been a demand for IT staff to operate data centers, where computer servers, backup and storage, network core, and security devices are centrally located and managed. Data center issues include computer server management, virtualization, core routing and switching, firewalls, intrusion detection systems, phone switches, VoIP “switches,” videoconferencing multipoint control units, backup power supplies and uninterrupted battery power systems, specialized heating and cooling systems, cable management solutions and efficient equipment racks. Data center operations are also increasingly mission critical for enterprises. Generally, in relation to data centers, employers want IT staff to help them:

 - Evaluate various data center hardware, software and component options
 - Make optimal data center equipment and service buying decisions
 - Manage data center vendor, warranty and service relationships and projects
 - Receive, install, customize and configure data center solutions and keep track of them
 - Make data center systems fit into and function as part of IT systems and document how
 - Monitor, update and maintain data center hardware and software
 - Troubleshoot and repair data center hardware, component, software and service issues
 - Train and support data center system users
 - Secure data center systems against theft and unauthorized and inappropriate use
 - Operate data centers efficiently to minimize operating costs and waste
 - Manage any legal, health or ethical use issues related to data center operations
 - Generally, they want IT to very cost effectively operate data centers that meet the mission critical needs of the enterprise and its users, perform well and work all the time.

- **Physical ICT Infrastructure:** To function as a system, ICT components have to be connected somehow. In addition to the hardware, software, data center, and application systems, IT operations also need solutions for data center and data closet physical spaces, with specialized heating, ventilation and cooling systems, copper and fiber optic cabling systems, conduit systems for those cables, racks for equipment, structured cabling systems for the data centers and data closets, cross-connect facilities for voice lines, secure mounting systems for wireless devices, building security systems, building control systems, camera mounting systems and other physical infrastructure. Some of the activities around implementing this infrastructure are outsourced to electricians and outside specialists, but IT staff still need to understand this physical infrastructure and be able to work with others to put it in place. Generally, in relation to physical ICT infrastructure, employers want IT staff to help them:

 - Evaluate various physical ICT infrastructure options
 - Make optimal physical ICT infrastructure and service buying decisions
 - Manage and document physical ICT infrastructure and vendor relationships and projects
 - Make physical ICT infrastructure systems fit into and function as part of IT systems
 - Monitor, update and maintain physical ICT infrastructure
 - Troubleshoot and repair physical ICT infrastructure problems
 - Train and support physical ICT infrastructure system users
 - Secure physical ICT infrastructure against theft and unauthorized and inappropriate use
 - Operate physical ICT infrastructure efficiently to minimize operating costs and waste
 - Manage any legal, health or ethical use issues related to physical ICT infrastructure

- **Software Operating Systems (OS):** Most ICT hardware systems have some kind of computer software that enables its custom operation. There are many, including many flavors of Microsoft Windows, Apple OS, Unix, Linux, Cisco IOS, JunOS, Blackberry, Android and JavaOS. Generally, IT employers want an IT workforce that will:
 - Evaluate software operating system options and make optimal buying decisions
 - Manage operating system vendor, warranty and service relationships and projects
 - Receive, install, customize and configure software OSs and keep track of them
 - Make operating systems fit into and function as part of IT systems and document how
 - Monitor, update and maintain OSs for critical systems and all users
 - Troubleshoot and repair OS problems
 - Train and support OS users
 - Secure OS against theft and unauthorized and inappropriate use
 - Operate OS efficiently to minimize operating costs and waste
 - Manage any legal, licensing, health or ethical use issues related to OS

- **Software Engineering and Programming:** In addition to pre-packaged, third-party software, many IT operations need custom computer programming, ranging from customization, script and macro programming within existing applications and operating systems, add-on applications to integrate with existing 3rd party applications and operating systems, web programming, and custom, standalone, start from scratch applications. When creating and selling ICT products and services are a part of the employer's business, that is even more likely. There are many common programming languages (like various flavors of C, Java, Javascript, Perl, Python, and Cobol), tools (like object oriented programming solutions, algorithms, compilers, data structures, and logic diagrams) and practices (like process oriented programming, functional programming, declarative programming and computational thinking). Fortunately, this ICT domain is strongly established, has academic standards and strong support. Community colleges would do well to follow standards, curriculum and assessments developed with the Association for Computing Machinery (ACM).¹⁰ Generally, IT employers want an IT software engineering and programming workforce that can:
 - Work with others to understand and document application requirements and specifications
 - Design and validate program structure and logic
 - Design, test and validate appropriate user interfaces
 - Select and use appropriate development environments and tools
 - Acquire and manage rights to appropriate development environments and tools
 - Work in teams to develop necessary application code
 - Compile, run, test, evaluate, problem solve and fix applications under development
 - Test, validate and improve applications based on user feedback
 - Integrate new applications with other IT systems
 - Document software and its implementations well
 - Train and support users of the applications
 - Troubleshoot and repair application problems
 - Solicit feedback and new requirements to iteratively improve applications
 - Secure software against theft and unauthorized and inappropriate use
 - Design and develop software efficiently to minimize operating costs and waste
 - Manage any legal, licensing, health or ethical use issues related to new software

- **Information Systems, Data(base), Analysis and Management Applications:** Variations of categorizations of ICT applications are many. However, there is some consensus around a category of people who support database systems and their various querying, reporting, analysis, management and information systems. Most enterprises use third party database solutions, such as Oracle DBMS, IBM

DB2, Microsoft Access, SQL Server, Sybase and open source MySQL, often with customization and add-on programming. In this category are systems designed around database functionality, like Enterprise Resource Management (ERM), Human Resources Management (HRM), Management Information Systems (MIS), Customer Relationship Management (CRM), Facilities Management, Financial Management and Accounting Systems. Probably also in this category are spreadsheet analysis programs and add-ons. Again, fortunately, the database portion of this ICT domain is strongly established, has academic standards and strong support. Community colleges would do well to follow standards, curriculum and assessments developed with the Association for Computing Machinery (ACM).¹¹ For other proprietary add-on systems, it is probably best to seek standards, training materials and support from vendor training organizations. Generally, IT employers want a database/information analysis and management workforce that can:

- Work with others to understand and document database requirements and specifications
 - Design and validate appropriate database structures and logic
 - Design, test and validate appropriate user interfaces, querying and reporting functionality
 - Select and use appropriate database and information system environments and tools
 - Manage database/info system vendor and custom programmer relationships and projects
 - Acquire and manage rights to appropriate database/info system environments and tools
 - Select, acquire and implement appropriate hardware and software systems on which database and information system solutions operate
 - Create, run, test, evaluate, problem solve and fix databases so they work as intended
 - Test, validate and improve database/info systems based on user feedback
 - Integrate database/information solutions with other IT systems
 - Document database/information systems and their implementations and uses well
 - Train and support users of the databases and information systems
 - Troubleshoot and repair database and information system problems
 - Manage ongoing database/info system software updates
 - Solicit feedback and new requirements to iteratively improve database/info systems
 - Secure database/info systems against theft and unauthorized and inappropriate use
 - Design/develop database/info systems efficiently to minimize operating costs and waste
 - Manage any legal, licensing, health or ethical use issues related to database/info systems
- **Digital Communications, Entertainment and Media Applications:** This broad category of ICT applications includes communication tools like word processing, page layout, presentation software, websites, games, media players, audio conferencing, email, instant messaging, mobile device applications, video conferencing, online collaboration tools, video editing, music players, photo management and editing, video production, social media and other tools for communicating with written and spoken words and still and moving graphics. The ICT component is the technical implementations of these systems and applications. They interact with design and creative components to create, share and manage effective single- and multi-media communications. There are a wide variety of vendors, solutions, standards and practices with regard to these applications. Generally, employers seek in their IT workforce for roles supporting these applications things like:
 - Evaluate software application options and make optimal buying decisions
 - Manage application vendor, warranty and services relationships and projects
 - Receive, install, customize and configure software and keep track of it
 - Make applications fit into and function as part of IT systems and document how
 - Monitor, update and maintain applications
 - Troubleshoot and repair application problems
 - Train and support application users
 - Secure applications against theft and unauthorized and inappropriate use

- Operate applications efficiently to minimize operating costs and waste
- Manage any legal, licensing, health or ethical use issues related to applications
- **Other Software Applications:** This catchall category of ICT applications includes applications not listed elsewhere, like project management tools, engineering design tools, drafting tools, industry specific applications, and enterprise specific applications. There are a wide variety of vendors, solutions, standards and practices with regard to these applications. Generally, employers seek in their IT workforce for roles supporting these applications things like:
 - Evaluate software application options and make optimal buying decisions
 - Manage application vendor, warranty and services relationships and projects
 - Receive, install, customize and configure software and keep track of it
 - Make applications fit into and function as part of IT systems and document how
 - Monitor, update and maintain applications and troubleshoot and repair problems
 - Train and support application users
 - Secure applications against theft and unauthorized and inappropriate use
 - Operate applications efficiently to minimize operating costs and waste
 - Manage any legal, licensing, health or ethical use issues related to applications
- **Internet/Web:** The Internet and World Wide Web (www) are a network of networks, along with their many users, uses, interfaces, information and applications. Internet, intranet and www growth has been and will continue to be explosively and transformationally phenomenal. This category is a combination of networking, IT, programming, database and other IT skills, but it is now considered so mission critical that it is typically considered separately. Activities in this arena include website design and development, web application design and development, web communication tools, database application integration, tracking and analytics, audio and video presentation and collaboration, social media and many other things. There are a wide variety of vendors, solutions, standards and practices with regard to these applications. Generally, employers seek in their IT workforce for roles supporting the Internet and Web things like:
 - Evaluate web application and services options and make optimal buying decisions
 - Manage web application and vendor, warranty and services relationships and projects
 - Receive, install, customize and configure web software and services and keep track of it
 - Make web systems and services fit into and function as part of IT systems
 - Document web systems and services
 - Monitor, update and maintain web systems and services
 - Troubleshoot and repair web system and service problems
 - Train and support web system and service users
 - Secure web systems and services against theft and unauthorized and inappropriate use
 - Operate web systems and services efficiently to minimize operating costs and waste and maximize performance
 - Manage legal, licensing, health or ethical use issues related to web systems and services
- **Security:** ICT security is a mindset that ideally pervades the ICT workforce in all of its many roles and efforts and all ICT system users anywhere. It is important to develop, use and manage ICT hardware, operating systems, applications, networks, storage, physical infrastructure, databases, information systems and the Internet with a strong security consciousness and awareness. In many industries, data security is mandated, and there are big penalties for breaches. Incidences of data theft and malicious attacks on ICT systems are all too frequently in the news, and many more incidences go unreported. As ICT systems permeate further into our lives and enterprises, ICT security becomes ever more important. ICT security is so important now that there are many ICT security specialization roles. Activities in this arena include user authentication systems, firewalls, intrusion detection systems, biometric control systems, software assurance, software patching, antivirus, malware detection and

removal, password protection, video surveillance, and encryption. There are a wide variety of vendors, solutions, and practices with regard to ICT security. Generally, employers seek in their IT workforce for roles supporting ICT security things like:

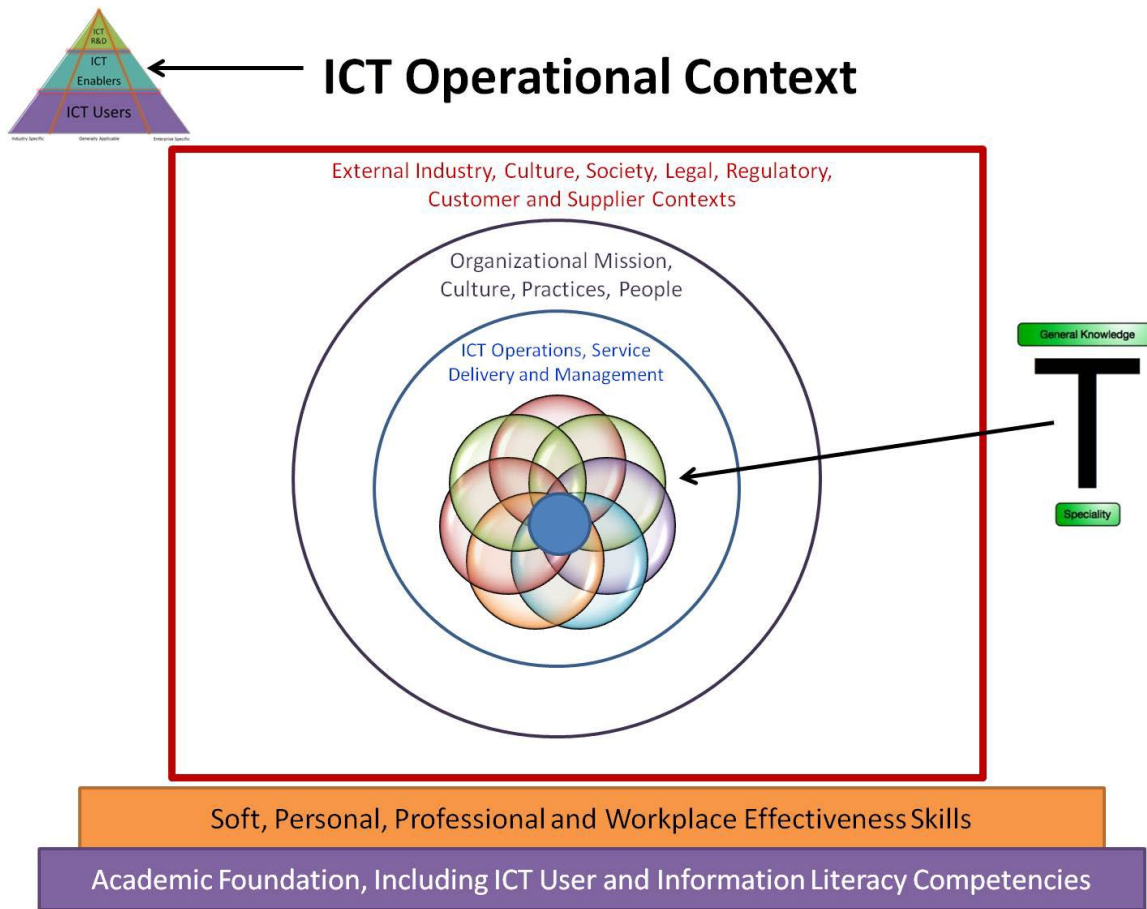
- Evaluate ICT security hardware, application and services options
 - Make optimal ICT security hardware, application and services buying decisions
 - Manage ICT security hardware, application and services vendor relationships and projects
 - Receive, install, customize and configure ICT security hardware, application and services
 - Make ICT security solutions fit into and function as part of IT systems
 - Document ICT security solutions
 - Monitor, update and maintain ICT security solutions
 - Troubleshoot and repair ICT security solution problems
 - Train and support ICT security solution users
 - Operate ICT security solutions efficiently to minimize operating costs and waste and maximize performance
 - Manage legal, regulatory, licensing, or ethical use issues related to ICT security solutions
- **Green ICT:** ICT operations are estimated to currently account for 2-3% of global greenhouse gas emissions. As ICT continues to grow, that percentage could also be expected to grow, unless we do something about it. Green ICT is a set of values and principles and a mindset that should apply to every dimension of ICT workforce and user activity. How can we do what we're doing more efficiently, so that it is less wasteful, costly and harmful to the environment? Additionally, ICT is strategically integrated into many plans to improve the efficiency and reduce the environmental harm of other kinds of human endeavor. For example, smart grids are the integration of ICT system sensors, controls and intelligence to make electrical distribution systems more efficient and less costly and wasteful; smart buildings are plans to integrate ICT system sensors, controls and intelligence to make home and commercial building systems more efficient and less costly and wasteful; smart transportation is about integrating ICT system sensors, controls and intelligence to make transportation systems more efficient and less costly and wasteful. There are key ICT workforce roles in all of these endeavors, and every ICT educational program should integrate Green ICT values and mindset into all of their courses. This is important to everyone. Generally, employers seek in their IT workforce for roles supporting Green ICT things like:
 - A strong set of values about the importance of reducing environmental harm
 - A problem solving mentality with regard to optimizing ICT systems to reduce costs and environmental harm
 - A willingness to find and advocate for efficient solutions
 - A willingness to teach others about the importance of Green ICT and how they can be more efficient and reduce their environmental impact from ICT
 - An ability to operate ICT systems efficiently to minimize operating costs and waste and maximize performance
- **Systems Architecture, Integration, Administration and Management:** It is not enough to have people who can competently cover each of the ICT technical domains listed above. To function as a whole, and to achieve synergistic efficiencies beyond the sum of its parts, it is also necessary to design, architect and implement all of the various pieces of an IT operation into a functional and efficient overall system. This is the role of system architects, with various titles. What are all of the different pieces? How can they fit together? How can they fit together optimally? How does that serve organizational priorities and goals? How can new pieces be integrated into this consolidated system efficiently? How can the various players in this IT organization team and all of the various users in the enterprise be coordinated and orchestrated into a functional whole? These higher level functions are critical. It is unlikely community colleges will be directly preparing students for these roles. However, it is important for community college students to understand what this role is and how to work with people in this role.

ICT Operational Contexts

In reality, in the applied technology domains where ICT Enablers work to establish the infrastructure and services that support ICT Users and all kinds of organizations and enterprises, technology does not exist in isolation. ICT technologies are applied in operational contexts, with organizational goals in mind. To be effective in that environment, employers are seeking an ICT workforce with technical knowledge and skills, but technical knowledge and skills are frequently not enough. Employers are also seeking in their ICT workforce broader and non-technical knowledge and skills.

The following graphic may assist in conversations with business and industry representatives about what they are seeking in their ICT workforce. Following the graphic is a summary of the kinds of inputs MPICT has received from its many interactions with business and industry representatives in this context.

Figure 25: ICT Operational Contexts



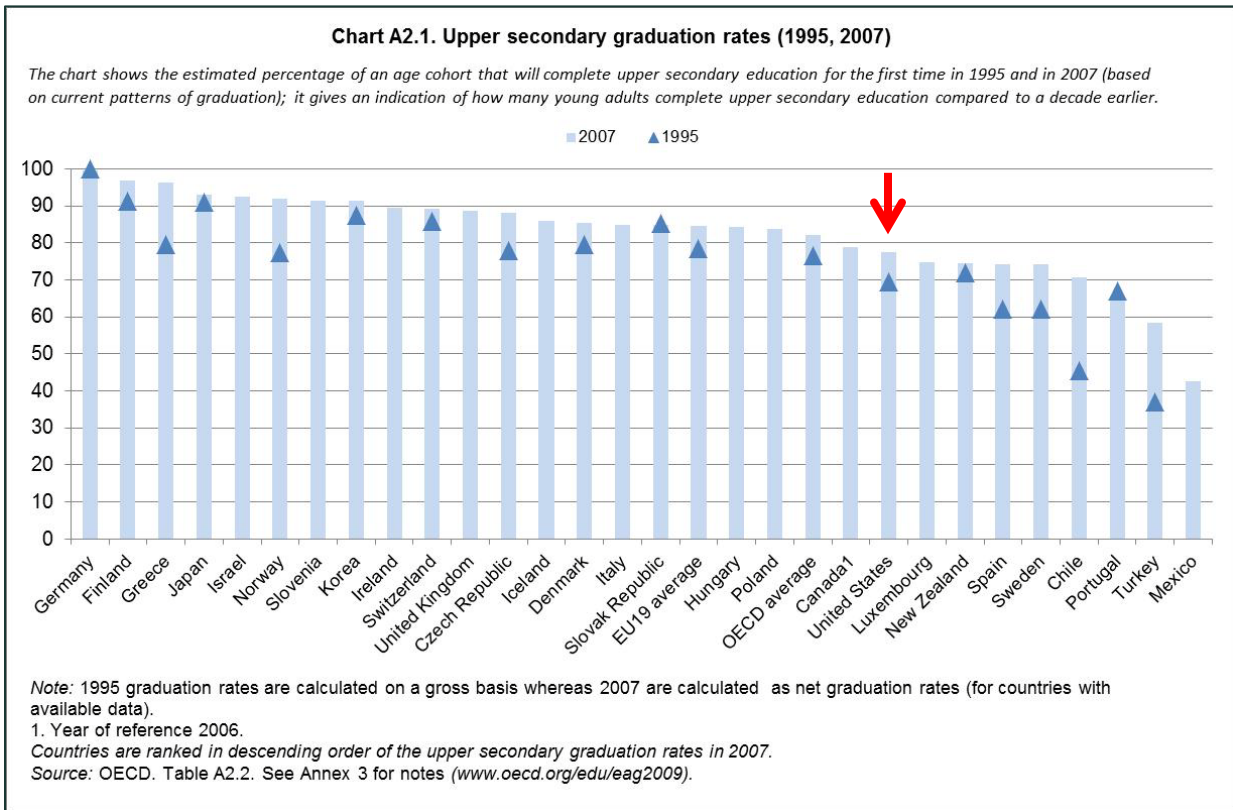
Academic Foundation, Including ICT User and Information Literacy Competencies: Employers very frequently express that they are seeking in their entire workforce, not just their ICT Workforce, a strong academic foundation. They want employees with knowledge and skills in mathematics, English language, American and world history, government, science, other languages, and other disciplines. They want people who have learned to think and reason, do research, understand what they read, write well, speak well and socialize with others.

Many employers express frustration with what they perceive to be deteriorating education backgrounds of workers in California, deteriorating performance of California’s public educational systems, and deteriorating government performance in funding, supporting and improving California’s public

educational systems. California ranks between 46th and 48th in cost adjusted per pupil spending on public K-12 education.¹² According to a recent Public Policy Institute of California report: “California ranks 40th among the 50 states in college attendance rates;” “California ranked 43rd among states in the ratio of bachelor’s degrees awarded in 2006 to high school diplomas awarded five years earlier;” and “If current trends persist, California will have one million fewer college graduates than it needs in 2025.”¹³

At the same time, U.S. educational system performance is dropping relative to other countries. As of 2007, the U.S. was 20th among OECD nations in upper secondary graduation rates, below the average for Organisation for Economic Co-operation and Development (OECD) members, and below the Slovak Republic, Hungary and Poland.¹⁴

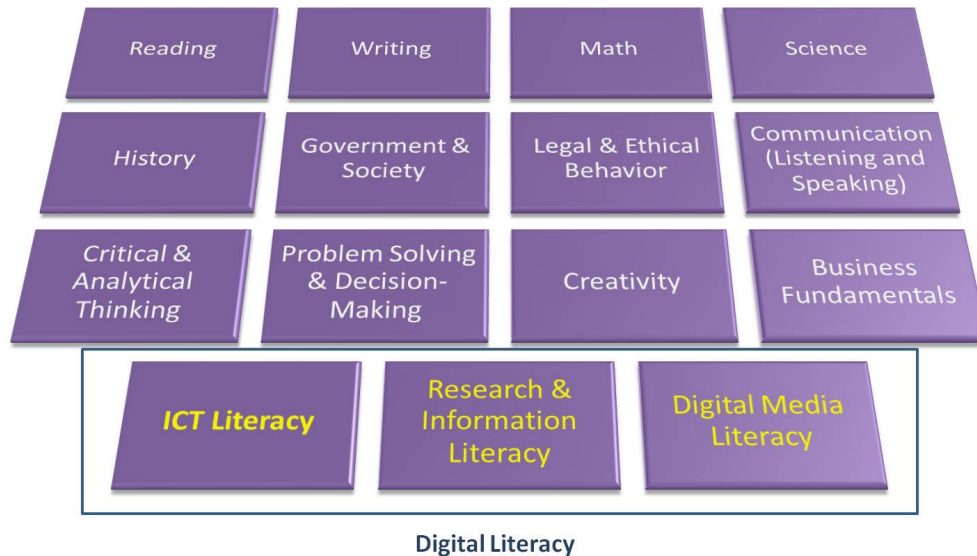
Figure 26: OECD 2007 Upper Secondary Graduation Rates



Improving public education routinely ranks among the highest priorities of California citizens in public opinion polls. Yet, California routinely does not improve its public education. How can we as citizens and as businesses prosper in increasingly global information, knowledge and innovation economies of the 21st century if our population and workforce are inadequately educated? The problem is even more severe in Science, Technology, Engineering and Math (STEM) education.

This is an entire genre of conversations and issues that employers care deeply about. They are serious with their concerns and demands around high quality basic education. They are also serious in their threats to locate businesses and jobs overseas where they can find an adequately educated workforce, if necessary. We have to do something about this. But, it is important to be able to segment these discussions from other discussions about the quality of ICT specific education and workforce demands.

For that reason, the following graphic separates Academic Foundation as a base level of demands for their ICT workforce. To facilitate discussions on the topic of Academic Foundation, MPICT recommends using something like the following graphic as a discussion tool.

Figure 27: Academic Foundation

What are the various components of an academic foundation that are expected of all, or at least for the ICT workforce? These placeholders can facilitate productive conversations.

Digital Literacy: Note that the bottom three elements of this graphic relate to digital literacy, or ICT User competencies, the base of the ICT Pyramid. Employers increasingly want everyone in society, but especially their workforce, to understand and be able to use basic ICT computing, communications and information technologies; to be able to do research and be information literate; and to be able to create, interpret and work with an increasing variety of digital media. This is a demand of basic education. Every student should emerge from K-12 educational systems with these literacies, and higher education should be prepared to remediate and deliver these competencies in their systems also. See Appendix E for more.

Soft, Personal, Professional and Workplace Effectiveness Skills: This second foundational level of ICT Workforce demand from employers cannot be overemphasized. It has come up, with various names, in virtually every one of hundreds of conversations with business and industry representatives about their ICT Workforce demand. It was also strongly represented in the results of Phase 2 of this study. It is not enough to have technical knowledge and skills. ICT Workforce members need to be able to function effectively in society, organizational environments, work groups and systems. They need problem solving, teamwork and communication skills. They need to be able to plan and organize. They need to be able to show up on time or call if they're going to be late. They need reasonable expectations of their compensation and career growth. They need to be able to seek out information needed to get their jobs done. They need to be culturally and personally sensitive. They need to take charge of their own ongoing learning and personal and professional growth. They need to be flexible and show entrepreneurial spirit.

Again, this is a whole genre of opinions, issues and discussions, and the following graphic can help facilitate discussions about this domain.

Figure 28: Soft, Personal, Professional and Workplace Effectiveness Skills

People call these skills different things: soft skills, personal effectiveness skills, professional skills, or workplace effectiveness skills. What is unique about this skill domain is that it is not a knowledge domain. These are not subjects in school. These are things people learn from doing real things in the real world, with real responsibilities and real interactions with real people and real organizations. Employers are complaining that their workers do not have enough real world experiences to have developed these real world skills. You learn how to function effectively in the real world by engaging in real world activities. People are entering the workforce today without these experiences or skills, and it is a big problem for employers.

This is a big challenge to educators, and many educators are threatened by this challenge and do not know how to respond to it. Since when is it a teacher's job to teach someone how to function in the workplace? Teachers teach academic knowledge content. In the past, students got these kinds of real world skills outside of school – working in the summer and after school, from parents, through church, community and extracurricular activities. Teachers didn't have to teach this, because students got it elsewhere. For whatever reason, too many students are not getting this elsewhere now, and employers are pushing educators to help with the problem.

The tricky part for ICT educators is that this is not a new content area to be taught; it is a challenge to pedagogical practice. It is not a matter of what to teach; it is a matter of how to teach. The challenge is to integrate experiential learning experiences into academic experiences. Experiential learning techniques are things like: Problem/Case-Based Learning, Internships, Project-Based Learning, Mentoring, Service Learning, Job Shadowing, Apprenticeships and Jobs. Industry and business are very, very clearly challenging ICT educators to rise to this challenge.

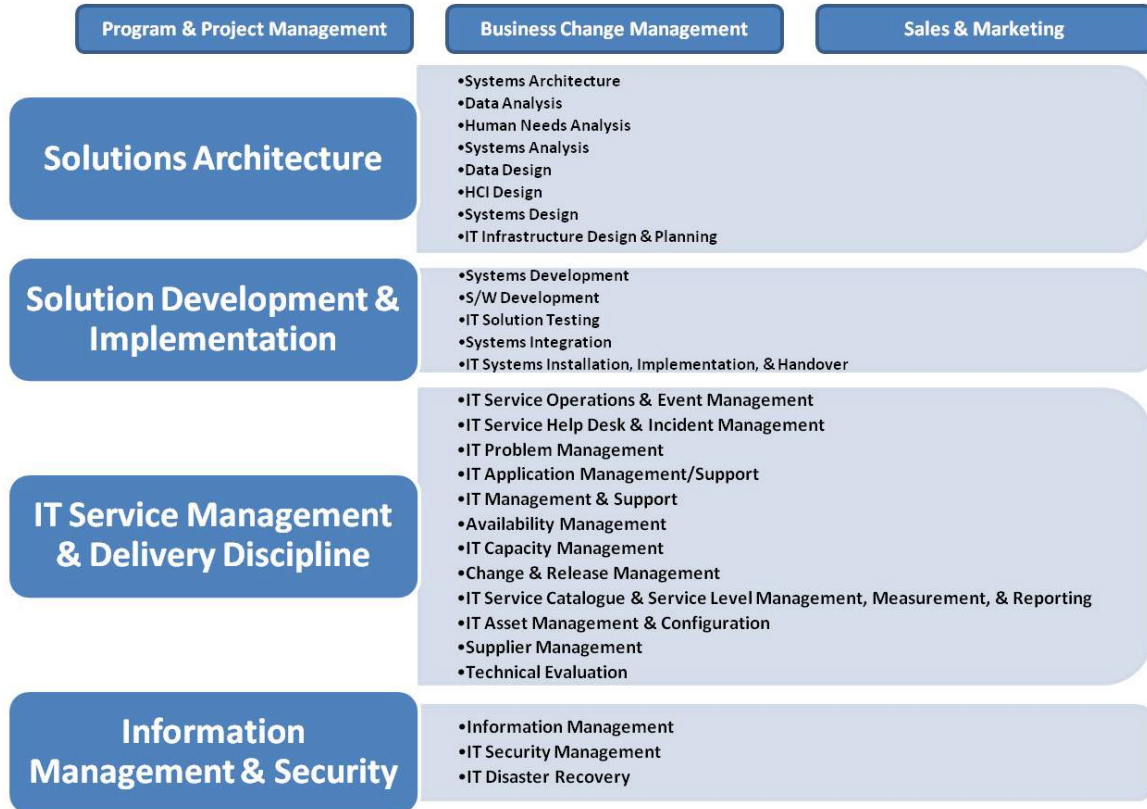
ICT Operations, Service Delivery and Management: For the most part, the ICT Workforce operates within some kind of organization or enterprise devoted to providing ICT infrastructure, deploying ICT technologies and delivering ICT services to enable ICT User and organizational effectiveness. These are typically called Information Technology (IT) Departments in the U.S., but there are a variety of other names, and sub-departments, such as Management Information Systems, Information Systems, Business Systems, Telecommunications, and Technology.

To be an attractive and effective member of the ICT Workforce, it is important to have ICT technical knowledge and skills. It is also important to understand IT operations. How are IT operations organized? What roles do people play in these organizations? What services do IT organizations provide? How are

those services provided and managed? What systems are used to track, manage, monitor and maintain IT systems and operations? How do IT organizations make decisions? How do they accomplish their goals and meet their responsibilities? How do they set their goals? How do IT operational teams work together to get things done? ICT Workforce employers are challenging ICT educators to impart at least some of these knowledge, skill and practice capabilities to students in preparing them for the ICT Workforce.

These kinds of knowledge and skills are summarized in the following graphic from National Occupational Standards developed for Information Technology and Telecommunications jobs in the United Kingdom. ¹⁵

Figure 29: UK National Occupational Standards (NOS) for IT and Telecomm



T-Shaped ICT Workforce: To be effective as part of the ICT workforce, employers want a broad set of ICT technical knowledge and skills, and they also want specialized, in depth knowledge and skills with specific ICT technologies. IBM advocates what it calls T-Shaped Professionals. The horizontal bar of the “T” represents broad based knowledge and skills – technical, soft, organizational and entrepreneurial. To be successful, ICT Workforce members need a broad set of knowledge and skills. The vertical bar of the “T” represents deeper, more specialized knowledge and skills in a specific technical area, a unique value add. This communication tool is in wide use, and it is a useful way of talking about ICT Workforce demand.

Organizational Mission, Practices Culture and People: Employers want an ICT Workforce that understands what an organization does and how to add value to those efforts. As an employer succinctly put it: “Add value, or die.” That requires understanding organizational culture and behavior. It requires a willingness to learn about other activities of the organization. It requires knowing how organizations and their various technical and non-technical systems work. This is a “big picture” understanding of the larger organization and how it works. Who are the other people in an organization, what are their roles, what do they care about and how can ICT technologies help them be more effective? What do the other departments of an organization do, how do they do it, and how can ICT technologies be applied to help them be more

effective? How can ICT technologies be simplified or better explained to less technical people in the organization? How do we explain technologies and their benefits to business decision-makers?

External Industry, Culture, Society, Legal, Regulatory, Customer and Supplier Contexts: No organization or enterprise exists in isolation. All operate in larger contexts, and all interact with a wide variety of stakeholders, communities and interested parties. To be an attractive and effective member of the ICT Workforce it is important to understand the industry in which you will be operating. It is important to understand and be able to function in the society and culture in which you live and work. It is important to understand legal and regulatory environments and requirements in which you operate. It is important to understand who your customers, suppliers and clients are, what they care about and want, how they interact with your organization and how information and communications technologies can be most effectively engaged in improving those relationships and interactions.

Summary Advice to Community College ICT Programs

Succinctly, employers generally want in their ICT workforce:

- People with a good basic education across standard educational disciplines, including Digital Literacy or common ICT User knowledge and skills
- People with good character and soft, employability or workplace skills, who fit in and add value
- People with a broad technical understanding of ICT, ideally with a “common core” across community colleges, so employers know that all community college ICT program graduates have at least a defined common set of knowledge and skills validated with an academic credential
- People with specialized technical knowledge and skills that give them a unique value-add to technical teams, ideally certified with standard industry certifications
- People who understand how IT organizations work and who can work in those organizations
- People who understand how businesses/organizations work and can work with their various departments, people, customers and suppliers
- Good citizens who understand how society works and can manage their lives and operate in larger social contexts
- People who will add value to their business efforts, by solving problems, institutionalizing knowledge, creating efficiencies, making things work reliably, improving performance, helping others work with technologies to do what they do better, and helping management make better management decisions.

Regarding diversity of specialized program offerings, employers’ opinions differ. Having wildly different academic degrees and certificates across the California community college system dilutes the value of those credentials, because employers generally have no real idea about what a graduate with one of those credentials knows and can do. That is a problem. A common ICT core across the California Community College (CCC) system that is widely understood would help with that problem and improve the value of all CCC ICT academic credentials.

However, when employers have a problem or need for someone in their ICT workforce, real-time LMI data demonstrates that they often make up job titles and job descriptions to fit that need. Hopefully, the CCC system is producing potential employees with all of the common knowledge and skills desired – and at least some with the specialized knowledge and skills needed. Across the CCC system, employers would hope that at least some college in the State is producing people with the specialized knowledge and skills needed. Having different community colleges with different advanced and specialized ICT educational offerings adds value to the overall ICT Workforce and to the CCC contribution to developing that workforce – especially if those specialized course and industry certification preparation offerings are available to students across the State through distance education technologies.

Recommendations for Additional Study

Hopefully, this report, and the presentations and activities that follow it, will advance the dialogue concerning ICT and ICT education in California. This dialogue should lead to significant improvements in California community college ICT workforce development efforts, improved understanding of ICT by a variety of stakeholders, and increased attention to ICT strategic issues by policymakers and planners. There are significant additional opportunities to leverage ICT for economic growth and efficiencies throughout the California economy.

Future Labor Market Research Needed

The traditional labor market information (LMI) research approach is apparently not adequately keeping pace with fast changing ICT environments. This approach attempts to determine demand for workers using Standard Occupational Codes, or SOCs, and the North American Industry Classification System, or NAICS. Our research to date, however, indicates that ICT job titles and descriptions (frequently created by employers in an ad-hoc manner, bundling various ICT and non-ICT knowledge and skill sets) are often not readily mapped to specific SOC codes, so gathering LMI on specific ICT jobs at a regional level is problematic. The knowledge, skills and functions of various ICT Workforce roles are not standardized, so occupational classification systems do not provide adequate insight into the real needs of employers. This makes the demand side of the ICT workforce equation difficult to understand.

Responding to inconsistent expressions of ICT Workforce demand, community college ICT related programs are also often created in an ad-hoc manner by educators, producing inconsistent and poorly understood program offerings. This means the supply-side of the workforce equation is hard to understand.

In essence, the findings in this report illustrate the disconnect between education supply and employers' needs. It is easy to understand how this disconnect has occurred in the fast paced, ever changing environment of the ICT sector. Nevertheless, colleges and ICT industries/employers don't appear to understand each other very well, with each creating ad-hoc job titles or education program titles that are not standardized, and as this report shows, are confusing to those who have an interest in mapping ICT workforce supply and demand.

In addition, community college education programs are required to demonstrate labor market demand in order to create new programs and the public workforce system must also demonstrate demand for training program approval. When real world jobs do not align well to SOCs, however, the traditional labor market information system is either inadequate or misleading. Similarly, colleges and Workforce Investment Boards are evaluated on their success in placing students and trainees into jobs based on SOC codes that are not aligned with employer job titles. It is even possible that if this disconnect grows between employers and training providers, then many of the training programs that are offered may not provide ICT workers with the skills that employers need, and many programs that are necessary could never be approved.

Finally, there is a knowledge and skill migration phenomenon that misinforms educational programs. Skills that were previously specialized ICT occupations migrate to knowledge and skills available to ICT Users in other job roles. For example, Desktop Publishing was once a vision that motivated ICT Creators to develop desktop publishing applications and capabilities – and which nobody else had access to. Once those applications and capabilities were created and sold, they became widely deployed, but only specialists understood and were able to use those tools effectively. Today, desktop publishing capabilities are widely available, and Users do desktop publishing in many different job roles. LMI creates the appearance that Desktop Publishing is no longer in demand, and therefore academic programs to develop desktop publishing knowledge and skills are not needed – when, in fact, more people need to know how to do desktop publishing now than ever. The current BLS and O*NET frameworks cannot adequately reflect this reality, nor properly identify the importance of desktop publishing in the workplace. A new set of accountability standards must be developed so that the training provided can be properly assessed outside of the SOC-employment frameworks currently in use.

The findings in this report call for a new direction and approach for future work on ICT workforce issues. MPICT and COE suggest a change in the way community colleges and other interested stakeholders think about the ICT Workforce. Such an approach would focus on identifying and quantifying employer demand for specific ICT knowledge and skill sets and mapping those to Student Learning Outcomes (SLOs). Community college educators could then design ICT course, program and credential offerings around those SLOs in a more coordinated and organized way. Those SLOs would provide a framework for improved articulation, transfer and communication between ICT education programs – and for communicating the value of those offerings with employers. Employers could also use those desired knowledge and skill sets to better describe roles they are looking to fill with their custom job titles and descriptions.

For example, MPICT and the COE could initiate study of the knowledge and skills needed in ICT domains (e.g. Networking) at 3 levels:

- a) Knowledge and skills needed by Users
- b) Knowledge and skills needed by Enablers
- c) Knowledge and skills needed by Research and Development workers

Once this is accomplished, these ICT knowledge and skill sets could then be mapped to SLOs colleges could use in developing curriculum for courses, certificates and degrees that include that domain (Networking).

This student learning outcome information could serve as a basis for digital literacy/ICT User education standards and a common ICT education core for California community colleges — and for clearly communicating what graduates know and can do. MPICT would help to get adoption of such a common core by community colleges throughout the State. This would provide value to California community college ICT academic credentials by providing a more widely known set of minimum ICT Workforce knowledge and skills produced by all programs.

This approach is consistent with an increased focus on Student Learning Outcomes in the California Community College system.

Additional issues and opportunities for further study and effort include:

- Identifying standards for Digital Literacy or ICT User competencies, adopting assessments for validating those competencies, and working to address Digital Literacy comprehensively through the State, in coordination with K-12 and other higher educational systems.
- Developing a distributed ICT education capacity in California, to better justify and make widely available more advanced and specialized ICT courses and certifications throughout the State using distance learning technologies.
- Engaging with employers, businesses and industry more efficiently and effectively as a 112 campus collective community college system, with more opportunities for impact and better motivations for engagement.
- Studying and reporting on efforts abroad to improve ICT education, for example:
 - The European Credit Transfer and Accumulation System (ECTS)¹⁶, which aims to improve articulation and transfer of academic programs and efforts across school systems and nations within the European Union.
 - The European Credit system for Vocational Education and Training (ECVET)¹⁷, which aims to ease articulation and transfer of credits across not only different school systems, but also different countries in the European Union.
 - Adopting Standards and Specifications for Educational Content (ASPECT)¹⁸, an effort in the European Union to discover, learn from, adopt and adapt best practices to improve how ICT can improve teaching, learning and student outcomes in education in Europe.

- The European Pedagogical ICT License (EPICT),¹⁹ introducing a European quality standard for the continued professional development of teachers in the pedagogical integration of information, media and communication technologies (ICT) in education.
- Working to update U.S. Standard Occupational Codes for quickly changing ICT fields.
- Developing abilities to track community college student job placements and count those outcomes, and other outcomes in which students meet their goals, as successes for CTE programs.
- Developing baccalaureate in ICT/IT options, so hands-on ICT technical students have a functional transfer pathway to jobs that screen for bachelor degrees but want hands-on technical skills.
- Working with California K-12 systems to attract and serve students with interests in ICT early, to develop pipelines for digitally literate workforce members and citizens in all fields; to develop pipelines for a competent ICT Enabler Workforce, enabling productivity in all kinds of enterprises; and to develop pipelines for Computer Science, Computer Engineering, Electrical Engineering and other advanced academic degree pathways, so that we can continue to advance the economy with innovation in ICT fields.
- Working to develop and spread simple and common nomenclature and understanding of ICT, to demystify and improve engagement with ICT.
- Improving understanding of the phenomenon by which knowledge and skill sets migrate from R&D Creator roles, to widely deployed but specialized ICT technician roles, to everyday Users, as in the Desktop Publishing example.
- Working to improve ICT in Education in other dimensions detailed in this report, to improve overall education system performance.

California Community College Response to ICT Strategic Issues

In a very positive recent development, the California Community College Chancellor's office has recognized the many important strategic challenges of the ICT sector and the need for focused education responses to them by creating a new California Community College ICT Collaborative.

This new ICT Collaborative, funded as a CTE initiative, will endeavor to develop better coordinated and more comprehensive ICT Workforce development efforts across the entire 112 campus California Community College system.

This report will be used to inform and engage stakeholders in those efforts.

Conclusion

In the information, knowledge and innovation economies of the 21st century, all kinds of organizations and individuals increasingly depend on computer, information and communications technologies for productivity, efficiency, connectivity and growth.

The U.S. still has a mostly fragmented view of the technology, industry and occupational clusters related to these rapidly emerging, evolving and converging fields. Much of the rest of the world collects and analyzes data for one large, umbrella cluster, a superset term capturing all of these inter-related and interdependent fields: Information and Communications Technologies (ICT).

In doing so, other countries typically see ICT technologies, industries, and occupations higher up on their lists, and therefore may be more likely to have implemented strategic public and educational plans and

policies to advance ICT. The effectiveness of those efforts may be contributing to the ongoing slide of the U.S. in various international ICT and economic performance rankings.

Studying industry and employment in California using the ICT framework clearly shows that ICT is strategically very important in California.

ICT industries include about 4% of companies, 6% of private sector revenues, 4% of workers and 12% of private sector wages in California, with much higher job growth and compensation expected than for most other industries or the nation as a whole.

ICT Workforce occupations span and are strategically important to all industries, which leverage ICT for productivity. ICT occupations throughout the economy, in all industries and most organizations, employ more than a million people in California today, include about 1 in 20 private sector jobs in the U.S. and in California, will have more than 100,000 California job postings by 2013, and pay about twice the median wages in California. ICT occupations are California's 8th largest occupational cluster by job count.

Employers across California industries and geographies overwhelmingly acknowledge the current and growing strategic importance of ICT to their organizations, and there is strong (and unmet) ICT Workforce demand even in this difficult economy.

There are strong ICT job and career prospects for people with advanced training and degrees and for applied technologists without advanced degrees. Employers are struggling to find adequately trained employees, even in this period of high unemployment, and a significant number report difficulty in training their ICT workforce in California.

Employer ICT Workforce demand is expressed chaotically, with employers essentially making up job titles and descriptions to fit their needs of the moment. While this is understandable, it makes it very difficult to comprehensively understand that workforce demand and develop ICT Workforce development efforts to meet those needs.

Employers would be well served to recognize the extraordinary diversity of the community college mission and student population and work with community colleges to better inform and assist them. If we need a larger ICT Workforce with more knowledge and skills, there is no more cost effective way of pushing those knowledge and skills out into California communities than the California community college system. It costs about \$100 for a California community college course. It often costs \$2,500 for a commercial training program with similar content.

Community colleges and their ICT-related programs need to do a better job of raising their visibility with employers and coordinating their ICT-related program offerings and credentials. There is significant support from California companies for a common framework or set of standards mapping ICT workforce needs and jobs to education and training credentials, for a common ICT education core, and for a credential certifying basic ICT User, or Digital Literacy competency in California.

California community college ICT education offerings vary significantly from college to college, lacking a standard framework and consistency, thus creating confusion and diluting the value of all community college ICT academic credentials in California. More coherence in these offerings is needed.

California community colleges would be well-served to implement a strategic solution to validating Digital Literacy, or ICT User level competencies for all students, no matter what academic discipline or goal, and coordinating those solutions with public K-12 and 4-year college and university educational systems in California. Today, everyone needs a basic ability to work with these technologies and with information, and our educational system should provide that.

The ICT arena is confusing. We need to develop common and plain language ways of communicating about ICT and better navigating the chaos of this space. This will help everyone.

Intuitively, most people think of California, especially the San Francisco Bay Area and Silicon Valley, as a global leader in ICT. California policymakers, investors and education planners should use the information in this series of reports to develop and implement strategic plans to improve ICT infrastructure, adoption, industries, employment and education — to build on California’s strengths and stay competitive in the global community. Information and communications technologies are empowering and enabling for all kinds of individuals and organizations. Implementing high quality ICT strategic and educational plans should lead to increased economic performance and higher employment in the state, across all industries and economic strata. It should also help to stem the nation’s decline in global rankings of important measures of ICT competitiveness.

It would add value to all California community college ICT related academic credentials to better coordinate ICT programs and have a common and widely understood core that is part of all credentials. With that, California community colleges can add additional value to ICT educational offerings by making available more advanced and specialized courses and industry certifications to students throughout the system using distance education technologies.

Technical knowledge and skills are not enough for long-term success in the ICT Workforce. Employers also want people with a good basic education across standard educational disciplines; people with good character and soft, employability or workplace skills, who fit in and add value; people who understand how IT organizations work and who can work in those organizations; people who understand how businesses/organizations work and can work with their various departments, people, customers and suppliers; and people who will add value to their efforts, by solving problems, institutionalizing knowledge, creating efficiencies, making things work reliably, improving performance, helping others work with technologies to do what they do better, and helping management make better management decisions.

There are plenty of opportunities for valuable additional work to further understand and demystify the ICT space and better develop systems to deliver the ICT Workforce we need for ongoing prosperity and economic growth.

These are strategic issues that have broad implications for California as a society, for all of its many industries and enterprises, and for its citizens, students, workers and families.

Encouragingly, a new California Community College ICT Collaborative has been created to begin to address these many issues in a more coordinated and comprehensive manner across all 112 California Community College campuses.

Appendices

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A: ICT Primary and Secondary SOC Mapping

For purposes of this study, Primary ICT SOC codes are assumed to be 100% counted as ICT-related employment. Secondary ICT SOC codes are assumed to be partially involved in ICT employment activities. It is not possible at this time to know to what extent; therefore, this study conservatively attributes only 25% of Secondary ICT SOC employment activity to ICT.

Primary:	These are occupations directly involved in the development, manufacture, sales, implementation, maintenance, monitoring or support of ICT equipment, peripherals, software,		
SOC	Occupation	Description	Sample Job Titles
15-1051	Computer Systems Analysts	Analyze science, engineering, business, and all other data processing problems for application to electronic data processing systems. Analyze user requirements, procedures, and problems to automate or improve existing systems and review computer system capabilities, workflow, and scheduling limitations. May analyze or recommend commercially available software. May supervise computer programmers.	Systems Analyst, Programmer Analyst, Business Systems Analyst, Computer Systems Analyst, Computer Systems Consultant, Computer Analyst, Information Systems Analyst (ISA), Applications Analyst, Business Analyst, Systems Engineer
15-1061	Database Administrators	Coordinate changes to computer databases, test and implement the database applying knowledge of database management systems. May plan, coordinate, and implement security measures to safeguard computer databases.	Database Administrator (DBA), Database Analyst, Database Administration Manager, Database Coordinator, Database Programmer, Information Systems Manager, Management Information Systems Director (MIS Director), Programmer Analyst, Systems Manager
15-1071	Network and Computer Systems Administrators	Install, configure, and support an organization's local area network (LAN), wide area network (WAN), and Internet system or a segment of a network system. Maintain network hardware and software. Monitor network to ensure network availability to all system users and perform necessary maintenance to support network availability. May supervise other network support and client server specialists and plan, coordinate, and implement network security measures.	Systems Administrator, Network Administrator, Network Engineer, Information Technology Specialist (IT Specialist), Local Area Network Administrator (LAN Administrator), Information Technology Manager (IT Manager), Information Technology Director (IT Director), Systems Engineer, Network Manager, Network Specialist
15-1081	Network Systems and Data Communications Analysts	Analyze, design, test, and evaluate network systems, such as local area networks (LAN), wide area networks (WAN), Internet, intranet, and other data communications systems. Perform network modeling, analysis, and planning. Research and recommend network and data communications hardware and software. Includes telecommunications specialists who deal with the interfacing of computer and communications equipment. May supervise computer programmers.	Network Analyst, Network Engineer, Systems Engineer, Systems Administrator, Systems Analyst, Network Specialist, Network Technician, System Programmer, Telecommunications Manager, Systems Specialist
15-1099	Computer Specialists, All Other	All computer specialists not listed separately.	SEE GROUPING BELOW
17-2061	Computer Hardware Engineers	Design core features of video games. Specify innovative game and role-play mechanics, story lines, and character biographies. Create and maintain design documentation. Guide and collaborate with production staff to produce games as designed.	N/A
25-1021	Computer Science Teachers, Postsecondary	Implement and administer enterprise-wide document management procedures for the capture, storage, retrieval, sharing, and destruction of electronic records and documents.	N/A
43-2011	Switchboard Operators, Including Answering Service	Operate telephone business systems equipment or switchboards to relay incoming, outgoing, and interoffice calls. May supply information to callers and record messages.	Switchboard Operator, PBX Operator (Private Branch Exchange Operator), Administrative Assistant, Operator, CBX Operator, Communication Specialist, Dispatcher, Telecommunications Operator, Office Assistant, Telecommunications Clerk

Primary:	These are occupations directly involved in the development, manufacture, sales, implementation, maintenance, monitoring or support of ICT equipment, peripherals, software,		
SOC	Occupation	Description	Sample Job Titles
43-2021	Telephone Operators	Provide information by accessing alphabetical and geographical directories. Assist customers with special billing requests, such as charges to a third party and credits or refunds for incorrectly dialed numbers or bad connections. May handle emergency calls and assist children or people with physical disabilities to make telephone calls.	Operator, Directory Assistance Operator, Telephone Operator, Customer Service Assistant, Information Specialist, Long Distance Operator (LD Operator), Telecommunications Operator, Toll Operator, 411 Directory Assistance Operator, Live Source Operator
43-2099	Communications Equipment Operators, All Other	All communications equipment operators not listed separately.	N/A
43-9011	Computer Operators	Monitor and control electronic computer and peripheral electronic data processing equipment to process business, scientific, engineering, and other data according to operating instructions. May enter commands at a computer terminal and set controls on computer and peripheral devices. Monitor and respond to operating and error messages.	Computer Operator, Operations and Maintenance Technician, Computer Specialist, Information Technology Specialist, Software Technician, Systems Operator, Computer Console Operator, Computer Technician
43-9031	Desktop Publishers	Format typescript and graphic elements using computer software to produce publication-ready material.	Computer Typesetter, Art Director, Electronic Console Display Operator, Graphic Artist, Mac Operator, Production Manager, Desktop Publishing Specialist, Electronic Imager, Advertising Associate, Creative Director
49-2022	Telecommunications Equipment Installers and Repairers	Set-up, rearrange, or remove switching and dialing equipment used in central offices. Service or repair telephones and other communication equipment on customers' property. May install equipment in new locations or install wiring and telephone jacks in buildings under construction.	Central Office Technician, Install / Repair Technician, Service Technician, Installer, Telecommunications Technician, Customer Service Technician (CST), Combination Technician, Field Technician, Communications Technician, Outside Plant Technician
49-9052	Telecommunications Line Installers and Repairers	String and repair telephone and television cable, including fiber optics and other equipment for transmitting messages or television programming.	Combination Technician, Service Technician, Installation and Repair Technician (I & R Technician), Cable Splicer, Cable Technician, Installer, Outside Plant Technician, Construction Technician, Construction Worker, Lineman

Secondary: These are occupations directly involved in the development, manufacture, sales, implementation, maintenance, monitoring or support of ICT equipment, peripherals, software, services, or systems.			
SOC	Occupation	Description	Sample Job Titles
17-2071	Electrical Engineers	Design, develop, test, or supervise the manufacturing and installation of electrical equipment, components, or systems for commercial, industrial, military, or scientific use.	Electrical Engineer, Electrical Design Engineer, Project Engineer, Electrical Controls Engineer, Test Engineer, Hardware Design Engineer, Broadcast Engineer, Circuits Engineer, Electrical and Instrument Maintenance Supervisor (E and I Maintenance Supervisor), Electrical Project En
17-3023	Electrical and Electronic Engineering Technicians and Technologists	Apply electrical and electronic theory and related knowledge, usually under the direction of engineering staff, to design, build, repair, calibrate, and modify electrical components, circuitry, controls, and machinery for subsequent evaluation and use by engineering staff in making engineering design decisions.	SEE GROUPING BELOW
27-1024	Graphic Designers	Design or create graphics to meet a client's specific commercial or promotional needs, such as packaging, displays, or logos. May use a variety of mediums to achieve artistic or decorative effects.	
27-3042	Technical Writers	Write technical materials, such as equipment manuals, appendices, or operating and maintenance instructions. May assist in layout work.	Technical Writer, Information Developer, Documentation Specialist, Documentation Designer, Engineering Writer, Technical Communicator
27-4099	Media and Communications Equipment Workers, All Other	All media and communication equipment workers not listed separately.	N/A
41-1011	First Line Managers/Supervisors of Retail Sales Workers	Directly supervise sales workers in a retail establishment or department. Duties may include management functions, such as purchasing, budgeting, accounting, and personnel work, in addition to supervisory duties.	Manager, Store Manager, Assistant Manager, Department Manager, Shift Manager, Meat Department Manager, Assistant Store Manager, Office Manager, Bakery Manager, Deli Manager
41-1012	First Line Managers/Supervisors of Non-Retail Sales Workers	Directly supervise and coordinate activities of sales workers other than retail sales workers. May perform duties, such as budgeting, accounting, and personnel work, in addition to supervisory duties.	Sales Manager, District Sales Manager, Branch Manager, Sales Supervisor, Area Sales Manager, Inside Sales Manager, Outside Sales Manager, Sales Activity Manager, Sales Leader, Sales Team Manager
41-2031	Retail Salespersons	Sell merchandise, such as furniture, motor vehicles, appliances, or apparel in a retail establishment.	Sales Associate, Sales Consultant, Sales Clerk, Sales Person, Customer Assistant, Clerk, Sales Representative, Design Consultant, Salesman, Bridal Consultant
41-3099	Sales Representatives, Services, All Other	All services sales representatives not listed separately.	N/A
41-4011	Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	Sell goods for wholesalers or manufacturers where technical or scientific knowledge is required in such areas as biology, engineering, chemistry, and electronics, normally obtained from at least 2 years of post-secondary education.	Sales Representative, Account Manager, Sales Manager, Inside Sales Representative, Account Development Manager, Account Executive, Channel Sales Director, Marketing Representative, Sales Director, Distribution Sales Manage

Secondary: These are occupations directly involved in the development, manufacture, sales, implementation, maintenance, monitoring or support of ICT equipment, peripherals, software, services, or systems.			
SOC	Occupation	Description	Sample Job Titles
43-1011	First Line Managers/Supervisors of Office and Administrative Workers	Supervise and coordinate the activities of clerical and administrative support workers.	Office Manager, Team Leader, Customer Service Manager, Customer Service Supervisor, Office Supervisor, Accounting Manager, Director, Office Coordinator, Accounts Payable Supervisor, Administrative Supervisor
43-4051	Customer Service Representatives	Interact with customers to provide information in response to inquiries about products and services and to handle and resolve complaints.	Customer Service Representative, Account Manager, Client Services Representative, Account Representative, Customer Service Specialist, Customer Service Agent, Member Services Representative, Hub Associate, Account Service Representative, Call Center Representative
49-2011	Computer, Automated Teller, and Office Machine Repairers	Repair, maintain, or install computers, word processing systems, automated teller machines, and electronic office machines, such as duplicating and fax machines.	Computer Technician, Field Service Engineer, Service Technician, Field Engineer, Computer Repair Technician, Customer Service Engineer, Field Service Technician, Computer Consultant, Copier Technician, Electronics Technician
49-2021	Radio Mechanics	Test or repair mobile or stationary radio transmitting and receiving equipment and two-way radio communications systems used in ship-to-shore communications and found in service and emergency vehicles.	Electronics Technician, Radio Technician, Field Technician, Radio Frequency Technician, Two-Way Radio Technician, Field Service Technician, Radio Repairman
49-2097	Electric Home Entertainment Equipment Installers and Repairers	Repair, adjust, or install audio or television receivers, stereo systems, camcorders, video systems, or other electronic home entertainment equipment.	Electronic Technician, Home Theater Installer, Field Service Technician, Satellite Installer, Television Analyzer, Installer, Service Technician, Television Repairman, Field Service Representative, Low Voltage Electrician
51-2022	Electrical and Electronic Equipment Assemblers	Assemble or modify electrical or electronic equipment, such as computers, test equipment telemetering systems, electric motors, and batteries.	Assembler, Assembly Worker, Production Worker, Electronic Assembler, Factory Assembler, Factory Worker, Armature Assembler, Breaker Units Assembler, Final Motor Assembler, Gear Assembler
51-9141	Semiconductor Processors	Perform any or all of the following functions in the manufacture of electronic semiconductors: load semiconductor material into furnace; saw formed ingots into segments; load individual segment into crystal growing chamber and monitor controls; locate crystal axis in ingot using x-ray equipment and saw ingots into wafers; clean, polish, and load wafers into series of special purpose furnaces, chemical baths, and equipment used to form circuitry and change conductive properties.	Wafer Fabrication Operator, Fabrication Operator, Process Technician, Diffusion Operator, Engineering Technician, Manufacturing Technician, Device Processing Engineer, Manufacture Specialist, Metalorganic Chemical Vapor Deposition Engineer (MOCVD Engineer), Probe Operator

B: WANTED.COM Aggregation of Online Job Listings - 1st Quarter 2011

Q1 2011/ SOC Title	Data	1. State of California	2. Sacramento- Arden-Arcade- Roseville CA MSA	3. San Francisco- Oakland-Fremont CA MSA	4. Los Angeles-Long Beach-Santa Ana, CA MSA	5. San Diego- Carlsbad-San Marcos CA MSA	6. San Jose- Sunnyvale-Santa Clara CA MSA	7. "Rest of California" (State minus the 5 MSAs)
15-1011 Computer and Information Scientists, Research								
Total Job Postings		1,189	5	327	208	104	425	119
# of Different Job Titles		528	3	193	95	39	198	54
	Top Job Title #1 Name	Research Scientist	Computer Scientist/Engineer	Data Scientist	Scientist, Staff II Spice Modeling	Scientist	Research Scientist	PRINCIPAL SCIENTIST- 6973110106
	Count	40	3	9	23	17	18	13
	Top Job Title #2 Name	Scientist	GEEK SQUAD Deputy of Counter Intelligence – Computer Tech Supervisor	Staff Scientist, Bioinformatics	Computational Linguist	Evaluation/Research Specialist	Principal Research Scientist (CCD PMT Optical Sensor)	Anti-Piracy Researcher
	Count	24	1	7	17	6	11	12
	Top Job Title #3 Name	Scientist, Staff II Spice Modeling	GEEK SQUAD Deputy of Counter Intelligence – Computer Tech Supervisor	An hour of user research for \$50	Senior Information Researcher	Analytical Modeling Staff Scientist	HP Labs - Researcher - Web Mining Research	Senior Scientist, Technical Transfer (1 of 3)
	Count	23	1	6	11	5	9	7
	Top Job Title #4 Name	Computational Linguist	N/A	Research or Staff Scientist/Engineer - Lighting Systems & Controls	Research Scientist	Neuroanatomic Imaging Research Assoc	HP Labs-Researcher, Nanoscale Devices	PRINCIPAL SCIENTIST
	Count	21	N/A	6	11	4	8	7
	Top Job Title #5 Name	Data Scientist	N/A	Researcher, Senior - Ads Platform	Computer Researching & Acquisition Coordinating	Data Scientist	HP Labs-Researcher, (PL))	COMPUTER SCIENTIST IV / 1112
	Count	20	N/A	6	10	4	8	6
	Top Job Title #6 Name	Computer Scientist	N/A	Data Mining/Analytics Intern	Research Scientist- Academic	Chief Scientist	Data Scientist	Computers & Information Technology Opportunities
	Count	19	N/A	5	5	4	7	5

Q1 2011 / SOC Title	Data	1. State of California	2. Sacramento-Arden-Arcade-Roseville CA MSA	3. San Francisco-Oakland-Fremont CA MSA	4. Los Angeles-Long Beach-Santa Ana, CA MSA	5. San Diego-Carlsbad-San Marcos CA MSA	6. San Jose-Sunnyvale-Santa Clara CA MSA	7. "Rest of California" (State minus the 5 MSAs)
	Top Job Title #7 Name	Senior Information Researcher	N/A	Advanced Light Source Postdoctoral Fellowship	Associate Scientist/Scientist, Systems Development /Integration	Senior Discharge Chamber Scientist	Tech Yahoo, Research Eng, Principal	Computer Scientist
	Count	15	N/A	5	4	4	7	5
	Top Job Title #8 Name	Anti-Piracy Researcher	N/A	Computational Science Postdoctoral Fellow	New Mobile Forms and Experiences Researcher	Research Scientist	HP Labs-Researcher: Social Computing	Research Scientist IV
	Count	14	N/A	5	4	4	7	4
	Top Job Title #9 Name	PRINCIPAL SCIENTIST-6973110106	N/A	Research Scientist / Systems Engineer	Computer Scientist	Senior Scientist	RESEARCH SCIENTISTS	MANTECA-Geek Squad Deputy of Counter Intelligence - Computer Tech Supervisor
	Count	13	N/A	5	4	4	7	3
	Top Job Title #10 Name	Computers & Information Technology Opportunities	N/A	Researcher	Post - Doctral Research Fellow	Sr. Scientist	Principal Research scientist - UV Optical Metrology	Computational Scientist (ACE)
	Count	11	N/A	5	3	3	6	3

15-1021 Computer Programmers

Total Job Postings		15,565	629	4,528	5,350	1,573	1,842	1,643
# of Different Job Titles		5,213	298	1,685	1,975	600	870	689
	Top Job Title #1 Name	Software Developer	Application Developer	Developer	Programmer	Oracle Developer	Software Developer	Software Developer
	Count	391	30	94	121	35	152	73
	Top Job Title #2 Name	Programmer	Developer	Software Developer	Application Developer	Programmer, EDI	C++ Developer	Programming
	Count	195	20	80	91	31	33	36
	Top Job Title #3 Name	Application Developer	Cache Developer	Cognos Developer	Programming	SQL Developer	Perl Programmer	Cognos Planning Developer.
	Count	194	15	69	84	26	23	29
	Top Job Title #4 Name	Developer	Sr. Programmer	iPhone Developer	Software Programmer/ Developer	Android Developer	Android software developer	SAS Programmer (SB)
	Count	158	14	61	74	22	23	25

Q1 2011 / SOC Title	Data	1. State of California	2. Sacramento-Arden-Arcade-Roseville CA MSA	3. San Francisco-Oakland-Fremont CA MSA	4. Los Angeles-Long Beach-Santa Ana, CA MSA	5. San Diego-Carlsbad-San Marcos CA MSA	6. San Jose-Sunnyvale-Santa Clara CA MSA	7. "Rest of California" (State minus the 5 MSAs)
Top Job Title #5 Name Count	Programming	JCAPS Developer	SAS Programmer	SQL Developer	Software Developer	API Technical Writer	Programmer	131 12 55 71 22 20 25
Top Job Title #6 Name Count	SQL Developer	Android Developer - Mobile Applications Developer	Sas Developer	Software Developer	Senior PS3 Programmer	Python Developer, Social Game Developer	C Programmer / Engineer / Developer	121 10 42 58 21 20 22
Top Job Title #7 Name Count	iPhone Developer	Olap Developer	Application Developer	iPad Developer	GIS Developer	Windows Developer - C/C++, security	C# Developer	110 10 37 38 15 19 21
Top Job Title #8 Name Count	Cognos Developer	SQL Database Developer	Mobile Developer	ETL Developer	APP DEV CONSULTANT- SAN DIEGO	Senior Developer	Application Developer	108 8 37 37 15 18 17
Top Job Title #9 Name Count	Android Developer	Senior Programmer	Android Developer	iPhone Developer	Senior GIS Developer	Perl Developer	Mobile Developer CA #178	92 7 36 31 14 17 16
Top Job Title #10 Name Count	SAS Programmer	Svc Info Developer IV	Python Developer	Cognos Developer	\$100,000-\$120,000 salary - Software Developer	Nuance Developer - Telecommunications Industry	ETL Developer	91 6 30 30 14 13 15

15-1031 Computer Software Engineers, Applications

Total Job Postings	57,299	829	21,684	10,149	5,716	15,179	3,742	
# of Different Job Titles	17,225	342	7,491	3,324	1,514	5,750	1,416	
Top Job Title #1 Name Count	Software Engineer	Software Engineer	Software Engineer	Software Engineer	Software Engineer	Software Engineer	Software Engineer	2,261 78 665 536 243 551 188
Top Job Title #2 Name Count	Senior Software Engineer	Senior Software Engineer	Senior Software Engineer	Senior Software Engineer	Senior Software Engineer	Senior Software Engineer	Senior Software Engineer	1,348 24 527 191 131 351 124
Top Job Title #3 Name Count	Sr. Software Engineer	Engr Program Mgr II	Sr. Software Engineer	Sr. Software Engineer	Sr. Software Engineer	Sr. Software Engineer	.Net Software Engineer (Contractor)	525 22 168 85 67 179 68

Q1 2011 / SOC Title	Data	1. State of California	2. Sacramento-Arden-Arcade-Roseville CA MSA	3. San Francisco-Oakland-Fremont CA MSA	4. Los Angeles-Long Beach-Santa Ana, CA MSA	5. San Diego-Carlsbad-San Marcos CA MSA	6. San Jose-Sunnyvale-Santa Clara CA MSA	7. "Rest of California" (State minus the 5 MSAs)
Top Job Title #4 Name	Principal Software Engineer	ALLDATA - Lead Software Engineer	Principal Software Engineer	Applications Engineer	Software Engineer/Java Developer	Software Engineer 2	SR SOFTWARE ENGINEER, JAVA	
Count	250	15	118	56	48	98	50	
Top Job Title #5 Name	Applications Engineer	UNIX ENGINEER - BUILD ENGINEER	Java Engineer	Database Engineer	Software Engineer - Intern (Temporary)	Principal Software Engineer	Sr Software Engineer, Grid Computing	
Count	248	15	80	41	48	84	44	
Top Job Title #6 Name	Sr Software Engineer	Software Design Engineer	User Experience Designer	Sr. Software Development Engineer	Applications Engineer	Applications Engineer	Sr Software Engineer	
Count	186	15	79	39	45	57	44	
Top Job Title #7 Name	Java Software Engineer	User Experience Designer	Java Software Engineer	Application Engineer	Software Engineering Company Is HIRING!	Staff Software Engineer	Sr Software Engineer (Contractor)	
Count	149	14	66	38	34	54	39	
Top Job Title #8 Name	Software Development Engineer	Software Engineer II JAVA	Senior Java Engineer	Tibco Support	Data Warehouse Architect	Java Software Engineer	Software Engineer, Consumer Tools (Contractor)	
Count	144	13	60	35	33	48	38	
Top Job Title #9 Name	Staff Software Engineer	Software Designer V	Applications Engineer	Senior Software Systems Engineer (IT)	Software Engineer li	Sr Software Engineer	Sr JavaScript Engineer	
Count	140	13	58	35	33	48	37	
Top Job Title #10 Name	User Experience Designer	Application Engineer	Yelp! Software Engineer: Web, Backend, Search, Ads, and Mobile	Senior Engineer C++ with Linux.	Engineer, Sr Staff - Software Applications Eng (Android/Bluetooth)	Field Applications Engineer, Principal	Sr Software Engineer, Java (Contractor)	
Count	139	10	51	34	33	43	37	

15-1032 Computer Software Engineers, Systems Software

Total Job Postings	15,062	401	2,629	2,529	2,044	6,714	745
# of Different Job Titles	4,386	124	958	788	573	2,129	360
Top Job Title #1 Name	Embedded Software Engineer	Software/Firmware Internship-532966	Software Engineer	Systems Engineer	Embedded Software Engineer	Engineer, Sr Staff - Software Development	Senior Software Engineer
Count	237	33	47	54	79	148	26

Q1 2011 / SOC Title	Data	1. State of California	2. Sacramento-Arden-Arcade-Roseville CA MSA	3. San Francisco-Oakland-Fremont CA MSA	4. Los Angeles-Long Beach-Santa Ana, CA MSA	5. San Diego-Carlsbad-San Marcos CA MSA	6. San Jose-Sunnyvale-Santa Clara CA MSA	7. "Rest of California" (State minus the 5 MSAs)
Top Job Title #2 Name	Software Engineer	Systems/Software Engr V	Mobile Device Engineer	Engineer, Principal - Software Systems	Engineer, Sr Staff - Software Systems	Software Engineer	Senior Software Engineer - Embedded...	
Count	229	28	40	43	70	111	21	
Top Job Title #3 Name	Senior Software Engineer	Embedded Software Engineer	Systems Engineer	Embedded Software Engineer	Engineer, Staff I - Software Development	Senior Software Engineer	Systems Engineer	
Count	198	13	38	42	52	103	20	
Top Job Title #4 Name	Systems Engineer	Firmware Engineer Embedded Software Developer Ethernet USB	Product Support Engineer	Firmware Engineer	Firmware Engineer	Engineer, Principal - Systems Design	Software Engineer	
Count	181	12	37	36	46	83	18	
Top Job Title #5 Name	Firmware Engineer	Firmware Development Engineer	Senior Software Engineer	Engineer, Principal - Firmware	Systems Engineer	Embedded Software Engineer	Embedded Software Engineer	
Count	156	11	36	34	34	72	15	
Top Job Title #6 Name	Engineer, Sr Staff - Software Development	R&D Embedded SW Engineer	Senior Software Engineer - Embedded - Real-time Mission Critical	Engineer, Principal - Software Systems GPS Algorithms/Software	Engineer, Sr Staff - Firmware Integration	Engineer, Principal - Software Development	Lead Infomart Developer	
Count	148	11	31	34	29	69	12	
Top Job Title #7 Name	Engineer, Sr Staff - Software Systems	Systems Software Engr V	Staff Software Engineer	Engineer, Sr Staff - Software Development (GPS)	Engineer, Sr Staff - Systems Design	Engineer, Principal - Software Systems	Windows Principal Software Engineer	
Count	115	10	27	31	29	64	11	
Top Job Title #8 Name	Engineer, Principal - Software Systems	Sr. Embedded Firmware Development Engineer	Senior Software Engineer Embedded Real time Mission Critical	DVT Engineer	Engineer, Principal Systems Design (Wireless Personal Area Networking)	Staff Engineer	Senior Software Engineer - Embedded - Audio - DSP - TI - ARM	
Count	108	10	22	29	27	61	10	
Top Job Title #9 Name	Engineer, Principal - Systems Design	Systems/Software Engr VI	Systems/Software Engr VI	Engineer, Sr Staff - Software Systems	Software Engineer	System Software Engineer	Information Assurance Engineer	
Count	89	10	22	26	26	56	10	

Q1 2011 / SOC Title	Data	1. State of California	2. Sacramento-Arden-Arcade-Roseville CA MSA	3. San Francisco-Oakland-Fremont CA MSA	4. Los Angeles-Long Beach-Santa Ana, CA MSA	5. San Diego-Carlsbad-San Marcos CA MSA	6. San Jose-Sunnyvale-Santa Clara CA MSA	7. "Rest of California" (State minus the 5 MSAs)
	Top Job Title #10 Name	Staff Software Engineer	Embedded SW Programmer/RTOS	Staff Engineer, Software	Software Engineer	Engineer, Sr Staff - Test (Embedded Software / Device Drivers)	Firmware Engineers	
	Count	84	9	20	23	25	52	10

15-1041 Computer Support Specialists

Total Job Postings		24,625	1,440	5,578	8,198	3,188	1,747	4,474
# of Different Job Titles		8,192	569	2,186	3,027	1,067	894	1,942
	Top Job Title #1 Name	Call Center Support	Help Desk L1	Technical Support	Call Center Support	AT&T IDC Technical Specialist	Desktop Support	Call Center Support
	Count	310	24	61	138	41	25	118
	Top Job Title #2 Name	Desktop Support	Clinical Applications Analyst RN 3 (ClinDoc/Orders) EPIC Clinical Informatics	Desktop Support Specialist	COMPUTER	Technical Support Representative	Data Support Specialist (SAP ECC)	COMPUTER
	Count	229	23	46	103	39	24	74
	Top Job Title #3 Name	COMPUTER	Call Center Support	Desktop Support	Technical Support Specialist	ITO Svc Delivery Rep IV	Lead Helpdesk Specialist (Contractor)	Client Support Spclst I Job
	Count	187	22	43	88	36	24	64
	Top Job Title #4 Name	Technical Support Specialist	Support Service Specialist	Technical Support Specialist	Desktop Support	Account Administration Representative	Technical Support Engineer	Desktop Support
	Count	183	20	40	77	36	20	49
	Top Job Title #5 Name	Technical Support	Help Desk Associate/Technical Support Analyst	Field Service Technician, A+ Certified	Tech Support Analyst I Job	Archaeological Technician	Technical Support Specialist	HelpDesk Specialist
	Count	171	19	38	62	32	18	40
	Top Job Title #6 Name	Technical Support Representative	Desktop Support Technician	Customer Support Specialist	Help Desk Analyst	Help Desk Specialist	Field Technical Specialist	Desktop Support Technician
	Count	115	14	34	59	31	17	31
	Top Job Title #7 Name	Technical Support Analyst	IS EHR Trainer 2 (ClinDoc/Orders) - Application Services, EPIC Training	Sr Cust Tech Consultant	Technical Support Analyst	Field Installation Specialist	Technical Support	Desktop Support Specialist
	Count	104	14	30	58	30	15	31

Q1 2011 / SOC Title	Data	1. State of California	2. Sacramento-Arden-Arcade-Roseville CA MSA	3. San Francisco-Oakland-Fremont CA MSA	4. Los Angeles-Long Beach-Santa Ana, CA MSA	5. San Diego-Carlsbad-San Marcos CA MSA	6. San Jose-Sunnyvale-Santa Clara CA MSA	7. "Rest of California" (State minus the 5 MSAs)
Top Job Title #8 Name	Desktop Support Specialist	Japanese Email Support	Technical Support 3	IT Support Technician	POS Technical Support Specialist (Food Service Industry)	IT Support Lead	Support Service Specialist	
Count	103	13	30	54	26	13	31	
Top Job Title #9 Name	Help Desk Analyst	Application Support Analyst (ASA)	Desktop Support Analyst	Technical Support	Desktop Support	Helpdesk Specialist (Contractor)	Operations Specialist (Level II)	
Count	103	13	30	45	24	11	26	
Top Job Title #10 Name	PC Technician	Clinical Applications Analyst RN3 - EPIC ClinDoc- Application Services/Support	Professional Services Consultant	Helpdesk Analyst	Implementation Manager/Client Support	Technical Lead - ITIL Certified	Helpdesk Support Specialist	
Count	95	12	29	35	24	11	24	

15-1051 Computer Systems Analysts

Total Job Postings	36,039	1,861	10,716	12,444	3,889	3,722	3,407
# of Different Job Titles	11,842	702	3,768	4,431	1,201	1,822	1,417
Top Job Title #1 Name	Business Systems Analyst	Business Analyst	Business Systems Analyst	Business Systems Analyst	Sr. Systems Analyst	Business Analyst	Business Systems Analyst
Count	883	73	290	357	124	75	71
Top Job Title #2 Name	Business Analyst	Applications Analyst 3 (ClinDoc / Orders) - EPIC Clinical Informatics	Business Analyst	Business Analyst	Business Systems Analyst	Business Systems Analyst	Senior Business Analyst
Count	607	55	174	196	85	63	58
Top Job Title #3 Name	Systems Analyst	Systems Analyst	Data Analyst	Systems Analyst	Business Analyst	Member Technical Staff	Nursing, Health Informatic Specialist
Count	343	35	136	142	53	43	54
Top Job Title #4 Name	Data Analyst	Programmer Analyst	Sr Business Appl Coord	Project Analyst	Sr. Business Systems Analyst	Programmer Analyst	Specialist IS Bus Sys Analyst
Count	313	34	101	103	50	35	54
Top Job Title #5 Name	Programmer Analyst	Business Applications Analyst	Senior Business Systems Analyst	Data Analyst	Systems Analyst	Staff Project Manager	Programmer Analyst
Count	263	27	71	87	49	28	44

Q1 2011 / SOC Title	Data	1. State of California	2. Sacramento-Arden-Arcade-Roseville CA MSA	3. San Francisco-Oakland-Fremont CA MSA	4. Los Angeles-Long Beach-Santa Ana, CA MSA	5. San Diego-Carlsbad-San Marcos CA MSA	6. San Jose-Sunnyvale-Santa Clara CA MSA	7. "Rest of California" (State minus the 5 MSAs)
Top Job Title #6 Name	Senior Business Analyst	HL7 ANALYST	BA/QA/BA-Healthcare/SAP/Financials.	Senior Business Analyst	Mailing Data Analyst	Database Analyst-Registration & Process Improvement	Systems Analyst	
Count	199	23	66	69	44	26	44	
Top Job Title #7 Name	Project Analyst	Senior Programmer/Analyst	Data Consultant	Programmer Analyst	Programmer/Analyst	Systems Analyst	Data Analyst	
Count	174	18	63	68	40	25	44	
Top Job Title #8 Name	SR. BUSINESS ANALYST	Business Systems Analyst	Programmer Analyst	Senior Business Systems Analyst	Experienced Business Analyst	Database Analyst-Business Services	Senior Programmer Analyst Job	
Count	160	17	54	67	39	23	38	
Top Job Title #9 Name	Senior Business Systems Analyst	Senior Business Analyst	Systems Analyst	HRIS Analyst	Senior Sharepoint Consultant	Data Analyst	Business Analyst	
Count	154	16	48	66	37	23	36	
Top Job Title #10 Name	Sr. Systems Analyst	EPIC Business Analyst- Orders RN	SAP-FICO, SD, HR and Project System...	SR. BUSINESS ANALYST	SR. BUSINESS ANALYST	BODI Developer (Business Objects Data Integrator)	Customer Information Management Analyst	
Count	152	15	47	64	30	21	25	

15-1061 Database Administrators

Total Job Postings	8,731	483	2,681	2,798	877	1,009	883
# of Different Job Titles	2,834	185	940	979	276	520	349
Top Job Title #1 Name	Database Administrator	Database Administrator	Database Administrator	Database Administrator	Database Administrator	Oracle DBA	Sr Database Developer (Contractor)
Count	394	39	124	87	77	45	84
Top Job Title #2 Name	Oracle DBA	SQL Server Dba	Oracle DBA	Oracle DBA	Database Administrator II	Database Administrator	Database Administrator
Count	268	24	96	79	31	30	37
Top Job Title #3 Name	MySQL DBA	Oracle DBA	MySQL DBA	SQL Dba	SQL Server Dba	Senior Oracle DBA For Internet Services	Database Developer
Count	117	13	82	63	21	16	21
Top Job Title #4 Name	SQL Dba	Data Architect	Teradata Dba	Sr. DBA	Database Developer	Oracle Database Administrator 2	Oracle DBA
Count	114	13	43	45	19	13	20

Q1 2011 / SOC Title	Data	1. State of California	2. Sacramento-Arden-Arcade-Roseville CA MSA	3. San Francisco-Oakland-Fremont CA MSA	4. Los Angeles-Long Beach-Santa Ana, CA MSA	5. San Diego-Carlsbad-San Marcos CA MSA	6. San Jose-Sunnyvale-Santa Clara CA MSA	7. "Rest of California" (State minus the 5 MSAs)
Top Job Title #5 Name Count	SQL Server Db 103	Sr. MySQL DBA 12	Database Administrator – Project Mgr 35	Cognos Administrator 44	Senior Database Administrator 19	Sql Db Developer 13	Oracle Technologies Consultant I Job 20	
Top Job Title #6 Name Count	Database Developer 100	Sr. SQL Server DBA 12	Senior Database Administrator 34	Production Database Administrator 35	Oracle DBA 15	Senior Database Administrator 12	Sr Database Developer (Contractor) 12	
Top Job Title #7 Name Count	Sr Database Developer (Contractor) 84	SQL DBA/Analyst 11	Oracle Database Administrator 32	SQL Database Administrator 31	Configuration Management/Data Management Administrator 15	Oracle Apps Db 11	Sr Database Developer (Contractor) - Job #: 3345 12	
Top Job Title #8 Name Count	Senior Database Administrator 79	Senior Database Administrator - (Sacramento, CA) 11	Informatica Administrator 27	Senior Oracle Db 28	Database Analyst/Administrator 14	Senior Oracle Applications Db 11	Application DBA 11	
Top Job Title #9 Name Count	Oracle Database Administrator 68	Assoc Provider Sys Info Admin Job 10	Database Analyst 26	SQL Server Db 26	Oracle Data Warehouse Architect 13	Database Developer 10	Sr SQL Server Production DBA Sr SQL DBA Database Administrator 11	
Top Job Title #10 Name Count	Senior Oracle Db 62	Oracle Consultant 10	SQL Server Db 24	Sr. Database Administrator 26	SQL Db 13	Microsoft SQL Database Administrator 10	BUSINESS SUPPORT ADMINISTRATOR 11	

15-1071 Network and Computer Systems Administrators

Total Job Postings	25,008	955	7,276	6,992	2,945	3,522	3,318
# of Different Job Titles	7,405	372	2,464	2,347	895	1,420	1,203
Top Job Title #1 Name Count	Systems Administrator 705	Systems Administrator 43	Network Engineer 169	Systems Administrator 250	Network Engineer 88	Systems Administrator 100	Information Technology Specialist (Information Security) 136
Top Job Title #2 Name Count	Network Engineer 519	Network Engineer 27	Systems Administrator 142	System Administrator 145	Systems Administrator 82	Network Engineer 60	Systems Administrator 88

Q1 2011 / SOC Title	Data	1. State of California	2. Sacramento-Arden-Arcade-Roseville CA MSA	3. San Francisco-Oakland-Fremont CA MSA	4. Los Angeles-Long Beach-Santa Ana, CA MSA	5. San Diego-Carlsbad-San Marcos CA MSA	6. San Jose-Sunnyvale-Santa Clara CA MSA	7. "Rest of California" (State minus the 5 MSAs)
Top Job Title #3 Name Count	System Administrator 387	Systems Admin 23	System Administrator 133	Network Engineer 124	Systems Engineer 35	Technical Support Engineer 51	Network Administrator 66	
Top Job Title #4 Name Count	Network Administrator 289	Technician-Systems 22	Network Security Engineer 79	Network Administrator 120	Network Administrator 33	Senior Network Engineer 41	System Administrator 60	
Top Job Title #5 Name Count	Systems Engineer 217	Websphere Administrator 18	Technical Support Engineer 70	Systems Engineer 100	Sr. Network Engineer 29	Senior Unix Systems Engineer 40	Network Engineer 51	
Top Job Title #6 Name Count	Sr. Network Engineer 191	Network Administrator 16	Unix Systems Administrator 67	LINUX ADMINISTRATOR 53	Sr Lead Systems Engineer 26	Sr. Network Engineer 37	Vmware Job Training By Senior Vmware Architect 35	
Top Job Title #7 Name Count	Senior Network Engineer 178	WebLogic Administrator 15	Sr. Network Engineer 66	Network Security Engineer 51	Systems Administrator with DOORS Experience 24	Linux Systems Administrator 32	Sr CRM Solutions Specialist 34	
Top Job Title #8 Name Count	Network Security Engineer 159	Security Project Manager 14	Senior Network Engineer 58	Senior Network Engineer 50	Senior Systems Administrator 23	Senior Systems Administrator 30	Unix Systems Administrator 29	
Top Job Title #9 Name Count	Senior Systems Administrator 156	Network Administrator 14	Senior Systems Administrator 55	Sr. Network Engineer 48	IT Manager 19	Systems Engineer 27	Telecommunication Engineer-Commercial 28	
Top Job Title #10 Name Count	Unix Systems Administrator 155	Support Engineer 14	Linux Systems Administrator 53	Senior Systems Engineer 39	Sr. Systems Administrator 19	Sr. Systems Administrator 27	Information Assurance Engineer 27	

15-1081 Network Systems and Data Communications Analysts

Total Job Postings	4,242	280	1,178	1,213	370	707	494
# of Different Job Titles	1,371	82	416	418	140	304	212
Top Job Title #1 Name Count	Network Engineer 311	Sr. Network Architect 29	Network Engineer 80	Network Engineer 84	Network Engineer 35	Network Engineer 56	Network Architect (Contractor) 35
Top Job Title #2 Name Count	Sr. Network Engineer 156	Network Engineer 26	Sr. Network Engineer 49	Sr. Network Engineer 44	Network Architect 35	Sr. Network Engineer 33	Network Engineer 30

Q1 2011 / SOC Title	Data	1. State of California	2. Sacramento-Arden-Arcade-Roseville CA MSA	3. San Francisco-Oakland-Fremont CA MSA	4. Los Angeles-Long Beach-Santa Ana, CA MSA	5. San Diego-Carlsbad-San Marcos CA MSA	6. San Jose-Sunnyvale-Santa Clara CA MSA	7. "Rest of California" (State minus the 5 MSAs)
Top Job Title #3 Name Count	Senior Network Engineer 101	Sr. Network Engineer, Internet Services 22	Senior Network Engineer 43	Strategic Solutions Consultant 32	Engineer Field 2/Payload Controller 15	6474 : Network Engineer, Sr Staff 22	SENIOR VIRTUALIZATION ARCHITECT 27	
Top Job Title #4 Name Count	Network Architect 76	Sr. Network Engineer 22	Engineer 27	Senior Network Engineer 30	Engineer Field 3/Payload Controller 11	Sr. Network Engineer, LAN,WAN, Cisco, protocols, Optical Switch 18	Intern Undergrad Infrastructure Planning & Delivery 16	
Top Job Title #5 Name Count	Sr. Network Architect 39	VolP Technology Lead Analyst 16	Technical Communications Lead 17	SoC Platform Architect, Communications, Baseband, MIPS, ARM, UWB 25	SR IT Network Engineer (4805) 9	Senior Network Engineer 16	Infrastructure Cabling Engineer 12	
Top Job Title #6 Name Count	Data Analyst 39	Sr. Voice Engineer 9	Network and Security Engineer 15	Intern Undergrad Network Services 25	Engineer Interconnect-Software-Reporting-Analyst II - 8	Jr UC Engineer 13	Cisco Unified/Visual Communications... 11	
Top Job Title #7 Name Count	Network Architect (Contractor) 35	Networking Program Manager (VOIP Phones/Telephony) 9	VOICE/DATA SPECIALIST 14	Sr Network Engineer-Commercial 17	MTS 2 - H/W 7	Sr. Network Engineer, LAN, WAN, Cisc... 11	Data Analyst 9	
Top Job Title #8 Name Count	Strategic Solutions Consultant 32	Network Engineering Technical Development Program (NETDP) Student Interns 8	Consultant Prof Svcs 3 APP 13	Network Cost Systems 16	Field Engineer Network 4 7	Intern - software (WLAN) 10	Intern Undergrad Infrastructure Pla... 8	
Top Job Title #9 Name Count	Network Analyst 30	Sr. Engineer - Network Architect 6	Cisco Voice Engineer 13	Network Architect 15	Email Communication Specialist 6	Juniper Network Engineer 9	Network Design Engineer 7	
Top Job Title #10 Name Count	Engineer 29	Network Architect Engineer 5	Network Modeler - Mountain View 13	Cisco UCS Implementation Expert 14	Sr. Voice Systems Engineer 5	Intern 8	Voice Network Engineer 6	

Q1 2011 / SOC Title	Data	1. State of California	2. Sacramento-Arden-Arcade-Roseville CA MSA	3. San Francisco-Oakland-Fremont CA MSA	4. Los Angeles-Long Beach-Santa Ana, CA MSA	5. San Diego-Carlsbad-San Marcos CA MSA	6. San Jose-Sunnyvale-Santa Clara CA MSA	7. "Rest of California" (State minus the 5 MSAs)
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15-1099 Computer Specialists, All Other

Total Job Postings		98,768	2,914	31,382	33,238	8,504	14,357	8,373
# of Different Job Titles		29,538	1,111	10,642	10,623	2,788	5,701	3,574
	Top Job Title #1 Name	Project Manager	Project Manager	Project Manager	Project Manager	Project Manager	Project Manager	Project Manager
	Count	2,247	107	777	779	128	243	213
	Top Job Title #2 Name	Web Developer	JAVA Developer	Web Developer	Web Developer	IT Project Manager	Web Developer	Web Developer
	Count	1,489	64	529	498	81	197	134
	Top Job Title #3 Name	JAVA Developer	Web Developer	JAVA Developer	JAVA Developer	Web Developer	JAVA Developer	Lead Software Quality Assurance Engineer
	Count	1,246	52	468	413	79	194	88
	Top Job Title #4 Name	.Net Developer	Sr. Voice Engineer	Project Coordinator	.Net Developer	.Net Developer	Engineer, Staff II - Software Quality Assurance	Software Quality Assurance Manager
	Count	691	40	186	359	77	135	77
	Top Job Title #5 Name	IT Project Manager	QA Test Automation	IT Project Manager	Web Designer	Web Application Developer	Software QA Engineer	IT Project Manager
	Count	575	35	179	269	63	99	77
	Top Job Title #6 Name	Project Coordinator	IT Project Manager	PHP Developer	PHP Developer	Project Coordinator	Intern (Software Development or Test)	.Net Developer
	Count	571	30	156	263	63	96	73
	Top Job Title #7 Name	Web Designer	.Net Developer	QA Engineer	Quality Assuran	JAVA Developer	Intern	Intern, Consumer Web
	Count	537	28	155	225	62	66	62
	Top Job Title #8 Name	PHP Developer	Test Engineer	.Net Developer	Project Coordinator	Sr. Web Developer	QA Engineer	Information Systems
	Count	516	27	139	203	62	62	62
	Top Job Title #9 Name	QA Engineer	.NET Developer (Web Developer)	Web Designer	IT Project Manager	Web Designer	Program Manager	Project Coordinator
	Count	430	23	136	167	52	58	62
	Top Job Title #10 Name	Technical Project Manager	Project Coordinator	Senior Project Manager	QA Engineer	CSS/HTML/Web Design Guru Needed	Senior Java Developer	Software Engineer, Test
	Count	306	23	126	157	48	57	58

Q1 2011 / SOC Title	Data	1. State of California	2. Sacramento-Arden-Arcade-Roseville CA MSA	3. San Francisco-Oakland-Fremont CA MSA	4. Los Angeles-Long Beach-Santa Ana, CA MSA	5. San Diego-Carlsbad-San Marcos CA MSA	6. San Jose-Sunnyvale-Santa Clara CA MSA	7. "Rest of California" (State minus the 5 MSAs)
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17-2061 Computer Hardware Engineers

Total Job Postings		5,941	166	771	829	902	3,015	258
# of Different Job Titles		1,873	79	338	268	242	1,024	176
Top Job Title #1 Name	Hardware Engineer	Memory Subsystem Design Engineer	Hardware Engineer	Engineer, Principal - Hardware Development	Engineer, Sr Staff - Firmware	Intern	Design Engineer	
Count	99	16	20	63	45	72	10	
Top Job Title #2 Name	Intern	Firmware Engineer	Hardware Test Engineer, cooling systems	Engineer, Sr Staff - IC Design Verification	Manager, Test Engineering	Hardware Engineer	Electrical/Firmware Engineer	
Count	72	11	19	37	39	53	7	
Top Job Title #3 Name	Engineer, Principal - Hardware Development	Design Engineer	ENGINEER, HARDWARE	Engineer, Sr Staff - CAD Design	Intern - Cellular Baseband DVT	Sr Staff IC Design / Verification Engineer	Systems Engineer 2 - Equipment Design Engineer	
Count	63	8	16	28	34	39	7	
Top Job Title #4 Name	Senior Hardware Engineer	Electronics FPGA Designer	Senior Hardware Engineer	Engineer, Sr Staff - IC Design	Engineer, Staff II - Firmware	Engineer, Sr Staff, Hardware Systems Test	Senior Hardware Engineer / FPGA	
Count	59	7	15	20	27	38	5	
Top Job Title #5 Name	Test Engineer	Engineer 2	Hardware Manager - Lead Hardware Engineer - Mobile Devices - HW	Installation Team Lead - Los Angeles, CA	Engineer, Sr Principal - Systems Design	Senior Hardware Engineer	H-1 System/Test Engineer - SE3-1399	
Count	54	7	13	15	24	36	5	
Top Job Title #6 Name	Engineer, Sr Staff - Firmware	Validation Engineer	MCU Development Engineer	Product Development, Vehicle Validation Performance Engineer	Hardware Integration Engineer	Engineer, Principal-Hi-speed Bus Test Development	Interdisciplinary Engineer	
Count	46	7	11	15	24	33	4	
Top Job Title #7 Name	Engineer, Sr Staff - IC Design	Validation Engineer USB3	FPGA Firmware Engineer	Principle Engineer Hardware Systems Architecture, Video, Board	Engineer, Staff I - Firmware	Test Engineer	Test System Engineer	
Count	46	7	10	15	16	32	4	
Top Job Title #8 Name	Sr Staff IC Design / Verification Engineer	Manager - Electrical Hardware Engineering	EMC Test Engineer - Mountain View	Sr Staff - IC Design/Verification Engineer	Sr. IC Test Development Engineer	Firmware and Electrical Systems Test Engineer	Systems Senior Engineer	
Count	45	5	9	14	15	30	4	

Q1 2011 / SOC Title	Data	1. State of California	2. Sacramento-Arden-Arcade-Roseville CA MSA	3. San Francisco-Oakland-Fremont CA MSA	4. Los Angeles-Long Beach-Santa Ana, CA MSA	5. San Diego-Carlsbad-San Marcos CA MSA	6. San Jose-Sunnyvale-Santa Clara CA MSA	7. "Rest of California" (State minus the 5 MSAs)
Top Job Title #9 Name	Firmware Engineer	Electrical/Hdwr Engineer V	Hardware Manager	Engineer, Sr Staff - Product Applications (Hardware/Touch)	System Integration & Test Manager- Mgr Engineering 2	SSD Architect -	Hardware Engineering Manager	
Count	39	4	9	13	15	28	4	
Top Job Title #10 Name	Firmware and Electrical Systems Test Engineer	Network Test Engineer	Firmware and Electrical Systems Test Engineer	Principal Digital Hardware Engineer	Hardware Engineer	Design Verification Principal Engineer - Sunnyvale	Senior Hardware Engineer	
Count	39	3	9	12	13	27	4	

25-1021 Computer Science Teachers, Postsecondary

Total Job Postings	244	8	37	87	33	18	61
# of Different Job Titles	115	4	22	48	15	15	29
Top Job Title #1 Name	Computer Science Instructor	ASIC College Intern	Adjunct Computer Networking Instructor	Computer Science Instructor	Adjunct Computer Networking Instructor	Computer Science & Information Technology (CSIT) FT instructor	Computer Science Instructor
Count	33	3	5	11	8	3	18
Top Job Title #2 Name	Adjunct Computer Networking Instructor	Computer Applications Instructor /Teacher	need a Java teacher	Adjunct Computer Networking Instructor	Adjunct Instructors - Programming and Networking	Summer Intern in Stream Computing Department	Adjunct Computer Networking Instructor
Count	25	2	4	7	4	2	5
Top Job Title #3 Name	Adjunct Computer Networking Instructor	Assistant Professor	Computer Science Instructor	Computer Instructor	Computer Networking Instructor	Programming Instructor	Computer Information Systems Part Time Pool
Count	10	2	4	5	4	1	4
Top Job Title #4 Name	Computer Instructor	CIS Educator	Teach Computer Programming or Video Game Design to Campers!	Experienced Computer Instructors	Assistant Professor - WGD, GSP	Computer Science or Computer Information Systems Asst. Professor	Adjunct Computer Networking Instructor
Count	6	1	3	4	2	1	4
Top Job Title #5 Name	Computer Information Systems Part Time Pool	N/A	Adjunct Faculty - Networking	Computer Teacher - Armenian	COMPUTER PROGRAMMING INSTRUCTORS	Faculty Instructor-- Multiple Disciplines	NETWORKING INSTRUCTOR WANTED
Count	4	N/A	3	4	2	1	2
Top Job Title #6 Name	need a Java teacher	N/A	computer programming trainer	Adjunct Faculty - IT & Networking	Assistant Professor - CIS/Programming	Lecturer or Sr. Lecturer	Asst. Professor- College of Engineering Information Sciences
Count	4	N/A	2	4	2	1	2

Q1 2011 / SOC Title	Data	1. State of California	2. Sacramento-Arden-Arcade-Roseville CA MSA	3. San Francisco-Oakland-Fremont CA MSA	4. Los Angeles-Long Beach-Santa Ana, CA MSA	5. San Diego-Carlsbad-San Marcos CA MSA	6. San Jose-Sunnyvale-Santa Clara CA MSA	7. "Rest of California" (State minus the 5 MSAs)
Top Job Title #7 Name	Experienced Computer Instructors	N/A	Computer Science or Computer Information Systems Asst. Professor	Adjunct Faculty - Computer Networking	Assistant Professors	PART-TIME FACULTY OPENINGS IN ENGINEERING	Computer Instructor Intern	
Count	4	N/A	1	3	2	1	2	
Top Job Title #8 Name	Computer Teacher - Armenian	N/A	Faculty Instructor-- Multiple Disciplines	Instructional Computing Intermediat...	Teacher Operations Coordinator	Faculty Instructor-- Multiple Openings	Bilingual Computer Instructor	
Count	4	N/A	1	3	2	1	2	
Top Job Title #9 Name	Adjunct Faculty - IT & Networking	N/A	Computer Science Instructor	Adjunct Faculty - Networking/Programming/Electronics	Computer Software Teacher	COMPUTER SCIENCE & INFORMATION TE...	Computer Instructor's Wanted	
Count	4	N/A	1	3	1	1	2	
Top Job Title #10 Name	Adjunct Instructors - Programming and Networking	N/A	PART-TIME FACULTY OPENINGS IN ENGINEERING	Computer Science Students Wanted	Computer Teacher Part time	Research Intern - Science & Technology	COLLEGE COMPUTER GEEK NEEDED	
Count	4	N/A	1	2	1	1	1	

43-2011 Switchboard Operators, Including Answering Service

Total Job Postings	607	16	75	199	76	37	202
# of Different Job Titles	196	7	32	90	28	6	60
Top Job Title #1 Name	PBX Operator	COMMUNICATION OPERATOR Grade (On Call #3)	COMMUNICATION OPERATOR, Grade 125 (223)	Telephone Operator	Call Center Operator	PBX Operator-Sunnyvale	PBX Operator
Count	47	6	7	17	10	15	23
Top Job Title #2 Name	Telephone Operator	PBX Operator	Operator	PBX Operator	Part-Time Landline Operator	AOI Operator	CBX Operator-4712 Stoddard*
Count	28	5	6	16	9	12	23
Top Job Title #3 Name	CBX Operator-4712 Stoddard*	Operational Service Support 1 - Telephone Operator	Multi-Line Phone Operator - Veterinary Hospital	Communications Operator	Switchboard Operator I (San Diego, CA)-	Security Command Center Operator	SGMF-CBX Operator-4712 Stoddard*
Count	23	1	6	12	7	4	19
Top Job Title #4 Name	Operator	Communications Operator	Telephone Operator- PM	Telephone Operator, Per Diem	PBX Operator - PM Shift	PBX - Telephone Operator - PT	CBX Operator-Stoddard
Count	22	1	5	8	5	3	13
Top Job Title #5 Name	SGMF-CBX Operator-4712 Stoddard*	COMMUNICATION OPERATOR Grade	SMT OPERATORS	Answering service operator	Receptionist/Switchboard Operator	Test Operator	PBX Message Cntr Opt
Count	19	1	4	7	4	2	11

Q1 2011 / SOC Title	Data	1. State of California	2. Sacramento-Arden-Arcade-Roseville CA MSA	3. San Francisco-Oakland-Fremont CA MSA	4. Los Angeles-Long Beach-Santa Ana, CA MSA	5. San Diego-Carlsbad-San Marcos CA MSA	6. San Jose-Sunnyvale-Santa Clara CA MSA	7. "Rest of California" (State minus the 5 MSAs)
Top Job Title #6 Name	Communications Operator	PBX Operator - FT TMP	Telephone Operator- PM - SF Marriott	Operator	Ideal Services Agent (PBX Operator)	Telephone Operator	Operator	
Count	15	1	4	6	4	1	10	
Top Job Title #7 Name	PBX Operator-Sunnyvale	Answering service operator	PBX Operator - Temporary PT/On-Call Holiday Inn	CMM Operator	P.B.X. Operator	N/A	Telephone Operator	
Count	15	1	4	6	3	N/A	8	
Top Job Title #8 Name	Answering service operator	N/A	Hosted PBX / 8x8 expert	Switchboard Operator	Telephone Attendant - Overnight Shift	N/A	Communication Operator, Grade 125	
Count	14	N/A	4	4	3	N/A	8	
Top Job Title #9 Name	CBX Operator-4712 Stoddard	N/A	Operator, Telephone Services Assistant (Bilingual a Plus)	Part-time Call Center Operators	Lead PBX Answering Service Operator	N/A	Switchboard Operator	
Count	13	N/A	4	4	3	N/A	5	
Top Job Title #10 Name	Switchboard Operator	N/A	Communication Operator, Grade 125	PBX - Telephone Operator	PBX Operator	N/A	Communications Operator (PT)-PBX	
Count	12	N/A	4	4	3	N/A	4	

43-2021 Telephone Operators

Total Job Postings	10	N/A	3	2	2	1	2
# of Different Job Titles	6	N/A	2	1	1	1	2
Top Job Title #1 Name	Telephone Operators	N/A	Assistance with iPhone needed	La Academia Latino Americana sollicita Telefonistas	Telephone Operators	Assistance with E bay	Local Operator
Count	2	N/A	2	2	2	1	1
Top Job Title #2 Name	Assistance with E bay	N/A	Assistance with E bay	N/A	N/A	N/A	Central Utility Operator
Count	2	N/A	1	N/A	N/A	N/A	1
Top Job Title #3 Name	Assistance with iPhone needed	N/A	N/A	N/A	N/A	N/A	N/A
Count	2	N/A	N/A	N/A	N/A	N/A	N/A
Top Job Title #4 Name	La Academia Latino Americana sollicita Telefonistas	N/A	N/A	N/A	N/A	N/A	N/A
Count	2	N/A	N/A	N/A	N/A	N/A	N/A
Top Job Title #5 Name	Local Operator	N/A	N/A	N/A	N/A	N/A	N/A
Count	1	N/A	N/A	N/A	N/A	N/A	N/A

Q1 2011 / SOC Title	Data	1. State of California	2. Sacramento-Arden-Arcade-Roseville CA MSA	3. San Francisco-Oakland-Fremont CA MSA	4. Los Angeles-Long Beach-Santa Ana, CA MSA	5. San Diego-Carlsbad-San Marcos CA MSA	6. San Jose-Sunnyvale-Santa Clara CA MSA	7. "Rest of California" (State minus the 5 MSAs)
	Top Job Title #6 Name	Central Utility Operator	N/A	N/A	N/A	N/A	N/A	N/A
	Count	1	N/A	N/A	N/A	N/A	N/A	N/A
	Top Job Title #7 Name	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Count	N/A	N/A	N/A	N/A	N/A	N/A	N/A

43-2099 Communications Equipment Operators, All Other

Total Job Postings		11	N/A	N/A	1	1	N/A	9
# of Different Job Titles		3	N/A	N/A	1	1	N/A	2
	Top Job Title #1 Name	Communications Operator	N/A	N/A	Communications Equipment Operators	Talented Communicator with Ambition	N/A	Communications Operator
	Count	6	N/A	N/A	1	1	N/A	6
	Top Job Title #2 Name	Talented Communicator with Ambition	N/A	N/A	N/A	N/A	N/A	Talented Communicator with Ambition
	Count	4	N/A	N/A	N/A	N/A	N/A	3
	Top Job Title #3 Name	Communications Equipment Operators	N/A	N/A	N/A	N/A	N/A	N/A
	Count	1	N/A	N/A	N/A	N/A	N/A	N/A

43-9011 Computer Operators

Total Job Postings		267	36	24	87	22	20	78
# of Different Job Titles		118	9	17	46	14	6	42
	Top Job Title #1 Name	Senior Computer Batch Operator	Senior Computer Batch Operator	Footprint Operators for SF!!	ISeries Operator	COMPUTER OPERATOR III	CNN Operator	COMPUTER OPERATOR III
	Count	19	19	4	6	3	8	8
	Top Job Title #2 Name	COMPUTER OPERATOR III	Batch Operator	Print Operator	AS/400 Computer Operator	PT Lead Computer Tape Operator	Process Operator #150T	Computer Operator
	Count	11	7	2	6	3	4	7
	Top Job Title #3 Name	Computer Operator	our company need computer repair operator	Print/Graphics/Computer Repair	Advertising - DATA PROCESSOR-	Printroom Operator	DES Operator	Computer Operator
	Count	9	3	2	4	2	4	2 5
	Top Job Title #4 Name	Printroom Operator	Download Operator	Data Processor	Print Operator (3rd Shift)	Computer Operator	Data Processor	Printroom Operator
	Count	8	2	2	4	2	2	4

Q1 2011 / SOC Title	Data	1. State of California	2. Sacramento-Arden-Arcade-Roseville CA MSA	3. San Francisco-Oakland-Fremont CA MSA	4. Los Angeles-Long Beach-Santa Ana, CA MSA	5. San Diego-Carlsbad-San Marcos CA MSA	6. San Jose-Sunnyvale-Santa Clara CA MSA	7. "Rest of California" (State minus the 5 MSAs)
Top Job Title #5 Name Count	CNN Operator 8	M7 Transaction Generator Operator 1	IT Computer Operator, Part-Time 2	Encoding Operator 4	Business Data Operator 2	Scan Operator 1	Full-Time Computer Print Operator 3	
Top Job Title #6 Name Count	Batch Operator 7	Operator, Computer 1	Computer Operator - 3rd Shift 1	Security Control Center Console Operator 4	Computer Print Operator with File Management Skills 1	Process Operator #150T (Temp Position) 1	Operator 3	
Top Job Title #7 Name Count	ISeries Operator 6	Computer Operator Sr Spec 1	CHB/UPA Operator 1	PREPRESS COMPUTER OPERATOR 4	Computer Classroom Operator 1	N/A N/A	Computer input/Warehouse 2	
Top Job Title #8 Name Count	AS/400 Computer Operator 6	Computer Operations 1	Process Operator #150T 1	Information Processing Operator 3	3 years exp as a Pharmacy Computer Processor 1	N/A N/A	Computer Clerk 2	
Top Job Title #9 Name Count	Process Operator #150T 5	Digital/Prepress Operators 1	On-Call Digital Print/Media Operator 1	Batch Operator (Night Shift) 3	Computer Operator (PA 11713) 1	N/A N/A	COMPUTER OPERATOR I / 1126 2	
Top Job Title #10 Name Count	Computer Operator 2 5	N/A N/A	Production Operator - S&G 1	Printroom Operator 2	Third Shift Computer Operator 1	N/A N/A	DATA PROCESSING 2	

43-9031 Desktop Publishers

Total Job Postings	118	6	26	37	16	13	19
# of Different Job Titles	52	2	11	26	7	3	12
Top Job Title #1 Name Count	Prepress-Digital 17	Digital Prepress Opportunity 4	Prepress-Digital 6	Desktop Publishing Spec2 (3379876) 3	Desktop Publisher 6	Prepress-Digital 10	Publisher 4
Top Job Title #2 Name Count	Desktop Publisher 11	Proofreader Microsoft Publisher expert 2	Desktop Publishing Spec2 (3454950) 5	Typesetter/Pre-Press Assistant 2	Write, design, publish: in-house, online trade magazine 4	Desktop Publisher 2	Desktop Publisher 2
Top Job Title #3 Name Count	Desktop Publishing Spec2 (3454950) 5	N/A N/A	PAGINATION COORDINATOR 4	DESK TOP PUBLISHING 2	freelance graphic designer for magazine 2	Digital Publishing SDK Engineer 1	Experienced Photoshop Person Needed!! 2
Top Job Title #4 Name Count	PAGINATION COORDINATOR 4	N/A N/A	Quark Xpress Wizard wanted 2	Unique Magazine Publishing Internship 2	Desktop Publishing Expert 1	N/A N/A	Digital Print Specialist 2

Q1 2011 / SOC Title	Data	1. State of California	2. Sacramento-Arden-Arcade-Roseville CA MSA	3. San Francisco-Oakland-Fremont CA MSA	4. Los Angeles-Long Beach-Santa Ana, CA MSA	5. San Diego-Carlsbad-San Marcos CA MSA	6. San Jose-Sunnyvale-Santa Clara CA MSA	7. "Rest of California" (State minus the 5 MSAs)
Top Job Title #5 Name	Write, design, publish: in-house, online trade magazine	N/A	Desktop publishing position at copy/print store	Tri-Fold Brochure on Publisher	Production Typesetter	N/A	Freelance Desktop Publisher Position	
Count	4	N/A	2	2	1	N/A	2	
Top Job Title #6 Name	Publisher	N/A	Copy Central has an opening for a Desktop Publisher	Administration Deals/Sub Publishing	Photoshop Illustrator Mechanic	N/A	Church Bulletin Publisher	
Count	4	N/A	2	2	1	N/A	1	
Top Job Title #7 Name	Digital Prepress Opportunity	N/A	Multilingual Publishing Specialist	Digital file-prep tech wanted	Desktop Publisher - Temp to Perm	N/A	Freelance Desktop Publishing Position	
Count	4	N/A	1	2	1	N/A	1	
Top Job Title #8 Name	Freelance Desktop Publisher Position	N/A	Desktop Publisher	Freelance Desktop Publisher Position	N/A	N/A	Periscope Magazine	
Count	4	N/A	1	2	N/A	N/A	1	
Top Job Title #9 Name	Desktop Publishing Spec2 (3379876)	N/A	Digital Imager	Digital and Offset Prepress Person	N/A	N/A	DIGITAL COLOR SPECIALIST	
Count	3	N/A	1	2	N/A	N/A	1	
Top Job Title #10 Name	Quark Xpress Wizard wanted	N/A	DESKTOP PUBLISHING SPEC2	14 Publisher File Templates	N/A	N/A	Publisher Assistance Needed	
Count	2	N/A	1	2	N/A	N/A	1	

49-2022 Telecommunications Equipment Installers and Repairers

Total Job Postings	2,539	161	409	748	216	101	904
# of Different Job Titles	855	80	158	321	90	48	376
Top Job Title #1 Name	Wireless Technician CWA-MOB	Cable tech	AT&T Premises Technician	Wireless Technician CWA-MOB	Tower Technicians San Diego, CA	Cable Technician - Comcast Contractor	Wireless Technician CWA-MOB
Count	85	12	21	28	18	15	48
Top Job Title #2 Name	Cable Modem and Phone Installers	AT&T Premises Technician	Field Service Telecommunications Tech	Tower Technicians - Los Angeles, CA	RF Microwave Technician	AT&T Premises Technician	AT&T Premises Technician
Count	31	10	15	18	18	11	20
Top Job Title #3 Name	WEST - AT&T TEMP Splicing Technicia...	Wireless Technician CWA-MOB	Immediate Openings for Cable TV Installers	Cable Modem and Phone Installers	Foreman Rigger San Diego, CA	Satellite TV Installer/ Technician	Foreman, Rigger - Bay Area
Count	26	9	14	18	18	4	18
Top Job Title #4 Name	Satellite TV Installer/ Technician	Technical Field Service Technician	Retention Specialists, Equipment Recovery Specialists, & Disconnect	Foreman, Riggers-Los Angeles	AT&T Premises Technician	Cable-Retention/Disconnect Technician	Tower Technicians - Bay Area, CA
Count	23	8	13	18	9	4	17

Q1 2011 / SOC Title	Data	1. State of California	2. Sacramento-Arden-Arcade-Roseville CA MSA	3. San Francisco-Oakland-Fremont CA MSA	4. Los Angeles-Long Beach-Santa Ana, CA MSA	5. San Diego-Carlsbad-San Marcos CA MSA	6. San Jose-Sunnyvale-Santa Clara CA MSA	7. "Rest of California" (State minus the 5 MSAs)
Top Job Title #5 Name Count	Telecommunications Technician 22	Technician-Sacramento/Fresno/Fairfield locations 6	RBS Cell Site Technician 11	Equipment Installer 16	DirecTV Installers 6	Cable 4	Tower Technicians - Sacramento, CA 17	
Top Job Title #6 Name Count	AT&T Premises Technician 21	Satellite TV Installer / Technician 6	AT&T Premises Technician 10	RF Cable Technician 16	Nortel Meridian 1 / CS1000 PBX Technician 6	Telecommunications Technician 4	Forman Rigger - Sacramento CA 17	
Top Job Title #7 Name Count	Commercial Cable Tech 21	Branch Mechanic 5	Field Service Telecommunications Technician 10	AT&T Premises Technician 11	Telephone Technician 5	WEST - AT&T TEMP Splicing Technician 4	WEST - AT&T TEMP Splicing Technicia... 16	
Top Job Title #8 Name Count	Satellite TV Installer / Technician 21	WEST - AT&T TEMP Splicing Technician 5	Telecommunications Technician 9	Central Office Technician III 11	Tower Technicians Seattle, WA 5	Assembly Equipment Repair tech 3	Rf Technician 15	
Top Job Title #9 Name Count	Cable Technician - Comcast Contractor 20	Central Office Technician III 5	Certified Tower Climbers / Antenna Installers 8	Field Technicians (City of Industry) 10	WEST - AT&T TEMP Splicing Technician 4	Satellite TV Installer / Technician 3	Commercial Cable Tech 14	
Top Job Title #10 Name Count	AT&T Premises Technician 20	SALES & SERVICE TECHNICIAN - TRAINEE 4	Installer (Oakland, CA) - 8 positions available 8	HIRING EXPERIENCED DIRECTV INSTALLERS 9	Part Time Job in Office 4	AT&T Premises Technician 3	Cable Modem and Phone Installers 13	

49-9052 Telecommunications Line Installers and Repairers

Total Job Postings	220	19	13	105	8	6	67
# of Different Job Titles	124	8	9	61	7	6	47
Top Job Title #1 Name Count	Line Lead 14	Line Technician Assistant 11	Teleco Lineman 3	Line Lead 14	CABLE TV/DATA/PHONE 2	Fiber Optic Technician 1	Cable Installer 6
Top Job Title #2 Name Count	CABLE TV/DATA/PHONE 13	Cable tech 2	FILED SERVICE TELECOMMUNICATIONS TECHNICIAN 2	CABLE TV/DATA/PHONE 11	WEST - AT&T TEMP Splicing Technician 1	WEST - AT - T TEMP Splicing Technician 1	CABLE TV INSTALLERS 5
Top Job Title #3 Name Count	Line Technician Assistant 11	WEST - AT - T TEMP Splicing Technician 1	TELECOMMUNICATIONS INSTALLERS 2	Cable Modem and Phone Installers 6	Telecommunications Technician 1	extend phone line to suite 1	CABLE TV INSTALLERS 4

Q1 2011 / SOC Title	Data	1. State of California	2. Sacramento-Arden-Arcade-Roseville CA MSA	3. San Francisco-Oakland-Fremont CA MSA	4. Los Angeles-Long Beach-Santa Ana, CA MSA	5. San Diego-Carlsbad-San Marcos CA MSA	6. San Jose-Sunnyvale-Santa Clara CA MSA	7. "Rest of California" (State minus the 5 MSAs)
Top Job Title #4 Name Count	Cable Installer 6	Cable Wrangler PA 1	Fiber Optic Technician 1	Drupal install 4	WEST - AT&T TEMP Splicing Technician - 1	WEST - AT&T TEMP Splicing Technician 1	CABLE & PHONE INSTALLERS 3	
Top Job Title #5 Name Count	Cable Modem and Phone Installers 6	WEST - AT&T TEMP Splicing Technician 1	extend phone line to suite 1	Lead Cable Technician 3	Apprentice Assistant Lineman 1	CABLE INSTALLERS NEEDED 1	CABLE AND PHONE INSTALLERS Hiring 3	
Top Job Title #6 Name Count	CABLE TV INSTALLERS 5	Telecommunications Technician 1	Telecommunications Level 2 Installation Technician 1	Cable Tv Installer 2	OST: Looking for Cable Techs I-III and Cable Pullers! 1	WEST - AT&T TEMP Splicing Technician 1	Cabling This Saturday 2	
Top Job Title #7 Name Count	CABLE TV INSTALLERS 4	CABLE INSTALLATION 1	WEST - AT - T TEMP Splicing Technician 1	Phone Line Reinstall/Repair 2	WEST - AT - T TEMP Splicing Technician 1	N/A N/A	CABLE AND PHONE INST 2	
Top Job Title #8 Name Count	Drupal install 4	WEST - AT&T TEMP Splicing Technician - 1	WEST - AT&T TEMP Splicing Technician 1	WEST - AT&T TEMP Splicing Technician 2	N/A N/A	N/A N/A	CABLE INSTALLERS NEEDED 2	
Top Job Title #9 Name Count	N/A N/A	N/A N/A	N/A N/A	Line Technician 2	N/A N/A	N/A N/A	CABLE TV INSTALLERS 2	
Top Job Title #10 Name Count	N/A N/A	N/A N/A	N/A N/A	need TV/Cable wires run 2	N/A N/A	N/A N/A	N/A N/A	

Data is aggregated via Wanted for all online job postings crawled from the public Internet. Data represents an estimated 80-85% of all online job postings in the state.

C: ICT Occupation Descriptions

Primary ICT Occupations

- [11-3021 Computer and Information Systems Managers](#)
- [15-1011 Computer and Information Scientists, Research](#)
- [15-1021 Computer Programmers](#)
- [15-1031 Computer Software Engineers, Applications](#)
- [15-1032 Computer Software Engineers, Systems Software](#)
- [15-1041 Computer Support Specialists](#)
- [15-1051 Computer Systems Analyst](#)
- [15-1061 Database Administrators](#)
- [15-1071 Network and Computer Systems Administrators](#)
- [15-1081 Network Systems and Data Communications Analysts](#)
- [15-1099 Computer Specialists, All Other](#)
- [17-2061 Computer Hardware Engineers](#)
- [25-1021 Computer Science Teachers, Postsecondary](#)
- [43-2011 Switchboard Operators, Including Answering Service](#)
- [43-2021 Telephone Operators](#)
- [43-2099 Communications Equipment Operators, All Other](#)
- [43-9011 Computer Operators](#)
- [43-9031 Desktop Publishers](#)
- [49-2022 Telecommunications Equipment Installers and Repairers](#)
- [49-9052 Telecommunications Line Installers and Repairers](#)

Secondary ICT Occupations

- [17-2071 Electrical Engineers](#)
- [17-3023 Electrical and Electronic Engineering Technicians and Technologists](#)
- [27-1024 Graphic Designers](#)
- [27-3042 Technical Writers](#)
- [27-4099 Media and Communications Equipment Workers, All Other](#)
- [41-1011 First Line Managers/Supervisors of Retail Sales Workers](#)
- [41-1012 First Line Managers/Supervisors of Non-Retail Sales Workers](#)
- [41-2031 Retail Salespersons](#)
- [41-3099 Sales Representatives, Services, All Other](#)
- [41-4011 Sales Reps, Wholesale and Manufacturing, Technical & Scientific Products](#)
- [43-1011 First Line Managers/Supervisors of Office and Administrative Workers](#)
- [43-4051 Customer Service Representatives](#)
- [49-2011 Computer, Automated Teller, and Office Machine Repairers](#)
- [49-2021 Radio Mechanics](#)
- [49-2097 Electric Home Entertainment Equipment Installers and Repairers](#)
- [51-2022 Electrical and Electronic Equipment Assemblers](#)
- [51-9141 Semiconductor Processor](#)

Individual occupational reports are available online at

http://www.mpict.org/ict_employment_section/2011_California_ICT_Workforce_Occupation_Descriptions.

D: California MPICT Region ICT Related Academic Degrees and Certificates

ICT RELATED ACADEMIC DEGREES & CERTIFICATES FOR CALIFORNIA COMMUNITY COLLEGES IN THE MPICT REGION					
College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
1 American River College	Sacramento	Computer Science & Information Technology	A.S. in Computer Science		36
2 American River College	Sacramento	Computer Science & Information Technology	A.S. in CIS Computer Networking Management	-	33
3 American River College	Sacramento	Computer Science & Information Technology	-	CIS: Networking Management	30.5
4 American River College	Sacramento	Computer Science & Information Technology	A.S. in CIS Computer Programming	-	34
5 American River College	Sacramento	Computer Science & Information Technology	A.S. in CIS Computer Database Management	-	39.5
6 American River College	Sacramento	Computer Science & Information Technology	-	CIS: Database Management	24
7 American River College	Sacramento	Computer Science & Information Technology	A.S. in CIS Microcomputer Applications	-	40
8 American River College	Sacramento	Computer Science & Information Technology	-	CIS: Microcomputer Applications	26
9 American River College	Sacramento	Computer Science & Information Technology	A.S. in CIS PC Support Management	-	31
10 American River College	Sacramento	Computer Science & Information Technology	-	CIS: PC Support	25
11 American River College	Sacramento	Computer Science & Information Technology	-	CIS: Computer Programming	35
12 American River College	Sacramento	Computer Science & Information Technology	A.S. in Information Systems Security	-	33
13 American River College	Sacramento	Computer Science & Information Technology	-	Computer Information Security Essentials	23
14 American River College	Sacramento	Computer Science & Information Technology	-	Information Systems Security	12
15 American River College	Sacramento	Computer Science & Information Technology	-	Network Administration Essentials-Windows	12
16 American River College	Sacramento	Computer Science & Information Technology	A.A. Technical Communications	-	44
17 American River College	Sacramento	Computer Science & Information Technology	-	Technical Communications	22
18 American River College	Sacramento	Computer Science & Information Technology	-	Web Developer	25
19 American River College	Sacramento	Computer Science & Information Technology	-	Web Publishing	19
20 Berkeley City College	Berkeley	Computer Information Systems	A.S. in Applied Microcomputer Information Systems		27.25
21 Berkeley City College	Berkeley	Computer Information Systems	-	Applied Microcomputer Information Systems	27.25
22 Berkeley City College	Berkeley	Computer Information Systems	A.S. in Web Programming	-	41
23 Berkeley City College	Berkeley	Computer Information Systems	-	Web Programming	41
24 Berkeley City College	Berkeley	Business	A.A. in Office Technologies	-	35
25 Berkeley City College	Berkeley	Business	-	Office Technologies	35
26 Berkeley City College	Berkeley	Multimedia Arts	A.A. in Multimedia Arts w/emphasis: Animation		48

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
27	Berkeley City College	Berkeley	Multimedia Arts	A.A. in Multimedia Arts w/emphasis: Digital Imaging	-	43
28	Berkeley City College	Berkeley	Multimedia Arts	A.A. in Multimedia Arts w/emphasis: Digital Video Arts	-	45
29	Berkeley City College	Berkeley	Multimedia Arts	-	Digital Video Arts	45
30	Berkeley City College	Berkeley	Multimedia Arts	A.A. in Multimedia Arts w/emphasis: Web Design & Production	-	45
31	Berkeley City College	Berkeley	Multimedia Arts	A.A. in Multimedia Arts w/emphasis: Writing for Multimedia	-	46
32	Butte College	Oroville	Center For Information Technology & Computer Science	-	CompTIA A+	6
33	Butte College	Oroville	Center For Information Technology & Computer Science	-	CompTIA Security+	9
34	Butte College	Oroville	Center For Information Technology & Computer Science	-	CCNA (Cisco Certified Network Associate)	12
35	Butte College	Oroville	Business Computer Information Systems	A.S. in Computer Applications	-	30
36	Butte College	Oroville	Business Computer Information Systems		Computer Applications	17.5
37	Butte College	Oroville	Business Computer Information Systems	A.S. in Legal Office Administration		33
38	Butte College	Oroville	Business Computer Information Systems		Legal Office Administration	33
39	Butte College	Oroville	Business Computer Information Systems	A.S. in Medical Office Administration		34
40	Butte College	Oroville	Business Computer Information Systems		Medical Office Administration	34
41	Butte College	Oroville	Computer Science Drafting & Engineering	A.S. in Computer Engineering		55
42	Butte College	Oroville	Computer Science Drafting & Engineering	A.S. in Electrical & Electronic Engineering	-	53
43	Butte College	Oroville	Computer Science Drafting & Engineering	A.S. in Computer Science		38
44	Butte College	Oroville	Computer Science Drafting & Engineering	A.S. in Computer Information Systems		32
45	Butte College	Oroville	Computer Science Drafting & Engineering	-	Computer Technology	36
46	Butte College	Oroville	Computer Science Drafting & Engineering	-	Cisco Network Administration	36
47	Butte College	Oroville	Computer Science Drafting & Engineering	-	Microsoft Server Administration	36
48	Cabrillo College	Aptos	Natural & Applied Sciences Division	A.S. in Computer Networking and System Administration		25
49	Cabrillo College	Aptos	Natural & Applied Sciences Division	-	Computer Networking and System Administration	25
50	Cabrillo College	Aptos	Natural & Applied Sciences Division	-	A+ Preparation	15
51	Cabrillo College	Aptos	Natural & Applied Sciences Division	-	CCNA (Cisco Certified Network Associate)	12
52	Cabrillo College	Aptos	Natural & Applied Sciences Division	-	CCNP (Cisco Certified Network Professional)	16
53	Cabrillo College	Aptos	Natural & Applied Sciences Division	-	UNIX/LINUX System Administration	15

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
54	Cabrillo College	Aptos	Natural & Applied Sciences Division		MCP (Microsoft System Administration)	11
55	Cabrillo College	Aptos	Natural & Applied Sciences Division	A.S. in Computer Support Specialist		39
56	Cabrillo College	Aptos	Natural & Applied Sciences Division	-	Computer Support Specialist	32
57	Cabrillo College	Aptos	Natural & Applied Sciences Division	A.S. in Computer Science	-	<u>39</u>
58	Cabrillo College	Aptos	Natural & Applied Sciences Division	A.A. in Computer Science	-	<u>30</u>
59	Cabrillo College	Aptos	Natural & Applied Sciences Division	-	C++ Programming	24.5
60	Cabrillo College	Aptos	Natural & Applied Sciences Division	-	Java Programming	24.5
61	Cabrillo College	Aptos	Natural & Applied Sciences Division	-	Programming	35
62	Cabrillo College	Aptos	Natural & Applied Sciences Division	-	Web Programming	28
63	Cabrillo College	Aptos	Natural & Applied Sciences Division	-	Game Programming (Certif. of Completion)	12
64	Cabrillo College	Aptos	Natural & Applied Sciences Division	-	Web Programming (Certif of Completion)	15
65	Cabrillo College	Aptos	Computer Applications and Business Technology	A.S. Computer Business Application		39
66	Cabrillo College	Aptos	Computer Applications and Business Technology	-	Computer Business Application	27.75
67	Cabrillo College	Aptos	Computer Applications and Business Technology	-	Administrative Support	25.75
68	Cabrillo College	Aptos	Computer Applications and Business Technology	-	Computer for the Office (Certif. of Completion)	4
69	Cabrillo College	Aptos	Computer Applications and Business Technology	-	Professional Computer Applications (Certif. of completion)	13.5
70	Cañada College	Redwood City	Science and Technology	A.S. in Computer Information Science		33
71	Cañada College	Redwood City	Business, Workforce and Athletics	A.S. in Administrative Assistant		30
72	Cañada College	Redwood City	Business, Workforce and Athletics	A.S. in Administrative Support Assistant		23.5
73	Cañada College	Redwood City	Business, Workforce and Athletics	-	General Office	15
74	Cañada College	Redwood City	Business, Workforce and Athletics	-	Administrative Assistant	30
75	Cañada College	Redwood City	Business, Workforce and Athletics	-	Administrative Support Assistant	23.5
76	Chabot College	Hayward	Applied Technology and Business Division	A.S. in Administrative Assistant	-	25.5
77	Chabot College	Hayward	Applied Technology and Business Division	A.S. in Computer Application Systems Software Specialist	-	25.5
78	Chabot College	Hayward	Applied Technology and Business Division	-	Administrative Assistant	20.5
79	Chabot College	Hayward	Applied Technology and Business Division	-	Office Technology	20.5
80	Chabot College	Hayward	Applied Technology and Business Division	-	Software Specialist	25
81	Chabot College	Hayward	Applied Technology and Business Division	-	Business Graphics (Certif. of completion)	17
82	Chabot College	Hayward	Applied Technology and Business Division	-	Office Technology (Certif. of completion)	10

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
83	Chabot College	Hayward	Computer Science Department	A.A. /A.S in Computer Science (General & Emphasis on Math)	-	32
84	Chabot College	Hayward	Cisco Networking Academy	-	CCNA (CISCO Certified Network Associate)	12
85	City College of S.F.	San Francisco	CNIT	A.S. in CNIT /Cust. Tech Supp. Option		34
86	City College of S.F.	San Francisco	CNIT	A.S. in CNIT /Internet & Web Devel. Option	-	33
87	City College of S.F.	San Francisco	CNIT	A.S. in CNIT /Network Security Option	-	33
88	City College of S.F.	San Francisco	CNIT	A.S. in CNIT /Wireless Networks Option	-	34
89	City College of S.F.	San Francisco	CNIT	A.S. in CNIT /CISCO Networking Option	-	33
90	City College of S.F.	San Francisco	CNIT	A.S. in CNIT /Microsoft Windows Option	-	33
91	City College of S.F.	San Francisco	CNIT	-	Computer Technical Supp.	25
92	City College of S.F.	San Francisco	CNIT	-	Computer Technician	14
93	City College of S.F.	San Francisco	CNIT	-	E-Commerce Systems Devl.	15
94	City College of S.F.	San Francisco	CNIT	-	Fundamentals of Networking	15
95	City College of S.F.	San Francisco	CNIT	-	Fundamentals of Tech. Supp.	13
96	City College of S.F.	San Francisco	CNIT	-	Network Security	15
97	City College of S.F.	San Francisco	CNIT	-	Routing & Switching (Cisco)	21
98	City College of S.F.	San Francisco	CNIT	-	Web Site Devel. Techniques	15
99	City College of S.F.	San Francisco	CNIT	-	Windows Networking	12
100	City College of S.F.	San Francisco	CNIT	-	Wireless Networking	12
101	City College of S.F.	San Francisco	Computer Science	Computer Science/ Transfer Track	-	31
102	City College of S.F.	San Francisco	Computer Science	Computer & Information Science/ Transfer	-	20
103	City College of S.F.	San Francisco	Computer Science	-	Computer Programming: C++	17
104	City College of S.F.	San Francisco	Computer Science	-	Computer Programming: (Java)	15.5
105	City College of S.F.	San Francisco	Computer Science	-	Computer Programming: Visual Basic.Net	18
106	City College of S.F.	San Francisco	Computer Science	-	Computer Skills for Scientists	8
107	City College of S.F.	San Francisco	Computer Science	-	Database Programming/Oracle	12
108	City College of S.F.	San Francisco	Computer Science	-	Database Programming: My SQL/Open Source	12
109	City College of S.F.	San Francisco	Computer Science	-	Database Programming/ Microsoft	13
110	City College of S.F.	San Francisco	Computer Science	-	Lamp Fundamentals	14
111	City College of S.F.	San Francisco	Computer Science	-	Lamp Administration	14
112	City College of S.F.	San Francisco	Computer Science	-	Unix/Linux Administration	17

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
113	City College of S.F.	San Francisco	Multimedia Studies	-	Animation	40
114	City College of S.F.	San Francisco	Multimedia Studies		Rich Media Productions	42
115	City College of S.F.	San Francisco	Multimedia Studies	-	Performance Arts	38.5
116	City College of S.F.	San Francisco	Multimedia Studies	-	Programming	38.5
117	City College of S.F.	San Francisco	Multimedia Studies		Web Design & Graphics	40
118	City College of S.F.	San Francisco	Multimedia Studies	-	Web Production (Fast Track)	23.5
119	City College of S.F.	San Francisco	Multimedia Studies	-	Web Programming (Fast Track)	24
120	City College of S.F.	San Francisco	Multimedia Studies	-	Flash Design & Development	17
121	City College of S.F.	San Francisco	Multimedia Studies	-	Web Design w/Dreamweaver Certificate	12
122	City College of S.F.	San Francisco	Business	A.S. in Administrative Support	-	39
123	City College of S.F.	San Francisco	Business		Administrative Support	39
124	City College of S.F.	San Francisco	Broadcast Media Arts		Digital Radio	17
125	City College of S.F.	San Francisco	Broadcast Media Arts		Live Sound	16
126	City College of S.F.	San Francisco	Broadcast Media Arts		Sound Design	14
127	City College of S.F.	San Francisco	Broadcast Media Arts		Sound Recording	15
128	City College of S.F.	San Francisco	Broadcast Media Arts		Video Production & Editing	17
129	College of Alameda	Alameda	Computer Information Systems	A.A. in Computer Information Systems		25
130	College of Alameda	Alameda	Computer Information Systems		Computer Information Systems	25
131	College of Alameda	Alameda	Computer Information Systems		Computer Applications (Certif. of Completion)	6
132	College of Alameda	Alameda	Computer Information Systems	-	Desktop Support Technician (Certif. of Completion)	17
133	College of Alameda	Alameda	Computer Information Systems	-	Network Administration	16
134	College of Alameda	Alameda	Computer Information Systems		Programming (Certif. of Completion)	17
135	College of Alameda	Alameda	Computer Information Systems	-	Web Publishing (Certif. of Completion)	10
136	College of Marin	Kentfield	Business & Information Systems	A.S. in Computer Information Systems	-	24
137	College of Marin	Kentfield	Business & Information Systems		Desktop Network Specialty	26
138	College of Marin	Kentfield	Business & Information Systems		Desktop Publishing Specialty	24.5
139	College of Marin	Kentfield	Business & Information Systems		Microcomputer Manager Specialty	24
140	College of Marin	Kentfield	Business & Information Systems	-	Microcomputer Programmer Specialty	23.5
141	College of Marin	Kentfield	Business & Information Systems		Print Production (Certif. of Completion)	17
142	College of Marin	Kentfield	Business & Information Systems		Web Programming (Certif. of Completion)	15.5

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
143	College of Marin	Kentfield	Business & Information Systems		A+	7.5
144	College of Marin	Kentfield	Business & Information Systems		Microsoft Office Database Specialist	6.5
145	College of Marin	Kentfield	Business & Information Systems		Microsoft Office Specialist	9
146	College of Marin	Kentfield	Physical Science	A.S. in Computer Science	Network Security	44
147	College of Marin	Kentfield	Career Education	A.S. in Multimedia Studies		44
148	College of Marin	Kentfield	Career Education		Multimedia Studies	18.5
149	College of Marin	Kentfield	Career Education		Sound & Video Design Specialty	28.5
150	College of Marin	Kentfield	Career Education		Video Design Specialty	28.5
151	College of Marin	Kentfield	Career Education		Multimedia 3D Skills Certificate	9
152	College of Marin	Kentfield	Career Education		Multimedia Foundation Skills Certificate	9
153	College of Marin	Kentfield	Career Education		Multimedia Print Design Skills Certificate	12
154	College of Marin	Kentfield	Career Education		Multimedia Video Production Skills Certificate	9
155	College of Marin	Kentfield	Career Education		Web Authoring Skills Certificate	9
156	College of San Mateo	San Mateo	Computer & Information Science Dept.	A.S. in Computer & Information Science		31
157	College of San Mateo	San Mateo	Computer & Information Science Dept.	A.S. in Computer & Network Forensics		33
158	College of San Mateo	San Mateo	Computer & Information Science Dept.	A.S. in Computer Science Applications & Development		32.5
159	College of San Mateo	San Mateo	Computer & Information Science Dept.	A.S. in Computer Support Specialist (Opt. 1 Network Support)		29.5
160	College of San Mateo	San Mateo	Computer & Information Science Dept.		Computer & Network Forensics	33
161	College of San Mateo	San Mateo	Computer & Information Science Dept.		Computer Science Applications & Development	32.5
162	College of San Mateo	San Mateo	Computer & Information Science Dept.		Computer Support Specialist (Opt. 1 Network Support)	29.5
163	College of San Mateo	San Mateo	Computer & Information Science Dept.		C++ Programming (Certif. of Completion)	8
164	College of San Mateo	San Mateo	Computer & Information Science Dept.		CIS Network Security Specialist (Certif. of Completion)	9
165	College of San Mateo	San Mateo	Computer & Information Science Dept.		Computer Forensics (Certif. of Completion)	15
166	College of San Mateo	San Mateo	Computer & Information Science Dept.		Internet Programming (Certif of Completion)	15.5
167	College of San Mateo	San Mateo	Computer & Information Science Dept.		Java Programming (Certif. of Completion)	8
168	College of San Mateo	San Mateo	Digital Media	A.A. in Web Design		30
169	College of San Mateo	San Mateo	Digital Media	A.A. in Digital Video		28.5
170	College of San Mateo	San Mateo	Digital Media	A.A. in Digital Audio		25.5
171	College of San Mateo	San Mateo	Digital Media		Web Design	30

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
172	College of San Mateo	San Mateo	Digital Media		Digital Video	28.5
173	College of San Mateo	San Mateo	Digital Media		Digital Audio	25.5
174	College of San Mateo	San Mateo	Digital Media		Web Design (Certif. of Completion)	12
175	College of San Mateo	San Mateo	Digital Media		Digital Video (Certif of Completion)	12
176	College of San Mateo	San Mateo	Business	A.A. in Business Information Processing (Option 1/Microcomputer Office Asst.		23.75
177	College of San Mateo	San Mateo	Business	A.A. in Business Information Processing (Option 2/Microcomputer Database & Spreadsheet Functions)		22
178	College of San Mateo	San Mateo	Business		Business Information Processing (Option 1/Microcomputer Office Asst.	24
179	College of San Mateo	San Mateo	Business		Business Information Processing (Option 2/Microcomputer Database & Spreadsheet Functions	24
180	College of San Mateo	San Mateo	Business		Office Assistant I (Certif. of Completion)	8.75
181	College of San Mateo	San Mateo	Business		Office Assistant II (Certif. of Completion)	11
182	College of the Redwoods	Eureka	Digital Media	A.S. in Digital Media		47.5
183	College of the Redwoods	Eureka	Digital Media		Digital Media	34
184	College of the Redwoods	Eureka	Information Sciences	A.S. in Networking		42
185	College of the Redwoods	Eureka	Information Sciences	-	Networking	31
186	College of the Redwoods	Eureka	Information Sciences	-	Network Technician (Certif. of Completion)	12
187	College of the Redwoods	Eureka	Information Sciences	A.S. in Office Professional		42
188	College of the Redwoods	Eureka	Information Sciences	A.S. in Computer Support Specialist		40
189	College of Sequoias	Visalia	Business Division	A.S. in Computer & Information Systems	-	30
190	College of Sequoias	Visalia	Business Division	-	Computer & Information Systems	30
191	College of Sequoias	Visalia	Business Division	A.S. in Computer Applications	-	30
192	College of Sequoias	Visalia	Business Division		Computer Applications	30
193	College of Sequoias	Visalia	Business Division	-	Computer Web Technician	30
194	College of Sequoias	Visalia	Business Division		Word Processing	44
195	College of Siskiyou	Weed	Computer Science	A.S. in Computer Science		30
196	College of Siskiyou	Weed	Computer Science		PC Network/Hardware/Software	20
197	College of Siskiyou	Weed	Computer Science	-	Web Design	14
198	College of Siskiyou	Weed	Computer Science	-	Programming	16
199	College of Siskiyou	Weed	Computer Science	-	Game Design	15

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
200	College of Siskiyous	Weed	Business		E-Business	16
201	Columbia Community	Sonora	Computer Science	A.S. Computer Science	-	17
202	Columbia Community	Sonora	Computer Science	-	Computer Science	41.5
203	Columbia Community	Sonora	Computer Science	A.S. Applied Computer Studies(Bus. Emphasis)	-	30
204	Columbia Community	Sonora	Computer Science	-	Applied Computer Studies(Bus. Emphasis)	31.5
205	Columbia Community	Sonora	Computer Science	A.S. Geographic Information Systems	-	31.5
206	Columbia Community	Sonora	Computer Science	-	Geographic Information Systems	35.5
207	Columbia Community	Sonora	Computer Science	-	Digital Graphic Arts	41.5
208	Columbia Community	Sonora	Computer Science	-	Multimedia Web Design	17
209	Columbia Community	Sonora	Computer Science	-	Website Development	16.5
210	Columbia Community	Sonora	Computer Science	-	Network Support Technician	15.75
211	Columbia Community	Sonora	Computer Science	-	Computer Support Technician	17
212	Columbia Community	Sonora	Computer Science	-	Management Information Systems	17
213	Contra Costa College	San Pablo	Computer & Related Electronics	A.S. Degree in Computer Science		32
214	Contra Costa College	San Pablo	Business Office Technology	A.S. Degree Administrative Assistant		31
215	Contra Costa College	San Pablo	Business Office Technology	-	Administrative Assistant	31
216	Contra Costa College	San Pablo	Business Office Technology		General Office	20
217	Contra Costa College	San Pablo	Computer & Communications Technology	A.S. Degree in Network Technology		19
218	Contra Costa College	San Pablo	Computer & Communications Technology		Network Technology	19
219	Contra Costa College	San Pablo	Computer Information Systems	A.S. Degree in Computer Operations		23.75
220	Contra Costa College	San Pablo	Computer Information Systems	-	Computer Operations	23.75
221	Cosumnes River	Sacramento	Business & Family Science	A.S. in Computer Science	-	22
222	Cosumnes River	Sacramento	Business & Family Science	A.S. in Computer Info Science: Server Admin		<u>31.5</u>
223	Cosumnes River	Sacramento	Business & Family Science	A.S. in Computer Info Science: Enterprise Admin.	-	31.5
224	Cosumnes River	Sacramento	Business & Family Science	A.S. in Computer Info Science: Info. Sys. Security	-	37.5
225	Cosumnes River	Sacramento	Business & Family Science	A.S. in Management Information Systems	-	47.5
226	Cosumnes River	Sacramento	Business & Family Science	-	CIS - Programming in C/C++	47
227	Cosumnes River	Sacramento	Business & Family Science	-	CIS - Internet Programming	34
228	Cosumnes River	Sacramento	Business & Family Science	-	Desktop Publishing	27
229	Cosumnes River	Sacramento	Business & Family Science	-	CIS- Network Helpdesk Technician	26

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
230	Cosumnes River	Sacramento	Business & Family Science	-	CIS- Server Administrator	17
231	Cosumnes River	Sacramento	Business & Family Science	-	CIS- Enterprise Administrator	22.5
232	Cosumnes River	Sacramento	Business & Family Science	-	CIS-Database Analyst-SQL	28.5
233	Cosumnes River	Sacramento	Business & Family Science	-	CIS- Computer Programmer-SQL	14
234	Cosumnes River	Sacramento	Business & Family Science	-	CIS-Relational Database Administration	20
235	Cosumnes River	Sacramento	Business & Family Science	-	CIS-Database Design	20
236	Cosumnes River	Sacramento	Business & Family Science	-	CIS-Software Development using Visual Basic.Net	16
237	Cosumnes River	Sacramento	Business & Family Science	-	CIS-Software Development using Java	17
238	Cosumnes River	Sacramento	Business & Family Science	-	CIS-Web Publishing	16
239	Cosumnes River	Sacramento	Business & Family Science	-	CIS-Web Programming	15
240	Cosumnes River	Sacramento	Business & Family Science	-	CIS- Information Systems Security	30
241	Cosumnes River	Sacramento	Business & Family Science	-	CIS- Linux Systems Administor	22
242	Cosumnes River	Sacramento	Business & Family Science	-	MIS- Information Processing	15.5
243	Cosumnes River	Sacramento	Business & Family Science	-	MIS-Application Technician	20.5
244	Cosumnes River	Sacramento	Business & Family Science	-	MIS-Application Analyst	26.5
245	Cosumnes River	Sacramento	Business & Family Science	-	MIS-Application Manager	33
246	Cosumnes River	Sacramento	Business & Family Science	-	MIS-E-Business Infrastructure	44
247	Cuesta College	San Luis Obispo	Business Education	A.A. in Computer Applications/Office Administration	-	15
248	Cuesta College	San Luis Obispo	Business Education		Administrative Assistant	41.5
249	Cuesta College	San Luis Obispo	Business Education	-	Computer Office Support & Maintenance Specialist	30
250	Cuesta College	San Luis Obispo	Business Education	-	Office Professional	25
251	Cuesta College	San Luis Obispo	Business Education	-	Word Processing	25.5
252	Cuesta College	San Luis Obispo	Business Education		Desktop Publishing	28
253	Cuesta College	San Luis Obispo	Business Education		Computer Applications	13.5
254	Cuesta College	San Luis Obispo	Business Education	A.S. in Computer Info Sys/Programming	-	16
255	Cuesta College	San Luis Obispo	Business Education		Internet Applications Developer	44
256	Cuesta College	San Luis Obispo	Business Education	A.S. Computer Science	-	17
257	Cuesta College	San Luis Obispo	Business Education	A.S. in Management Information Systems	-	34
258	Cuesta College	San Luis Obispo	Business Education	A.S. in Visual Basic/Database Administration	-	36

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
259	Cuesta College	San Luis Obispo	Engineering & Technology	A.S. in Computer Networking & Technology	-	38
260	Cuesta College	San Luis Obispo	Engineering & Technology		Computer & Network Maintenance	45
261	Cuesta College	San Luis Obispo	Engineering & Technology	A.S. in Computer Network Administration	-	18
262	Cuesta College	San Luis Obispo	Engineering & Technology		Computer Networking Specialist	40
263	Cuesta College	San Luis Obispo	Engineering & Technology		Computer Repair	29
264	DeAnza College	Cupertino	Computer Information Systems	A.A. in Business Programming		10
265	DeAnza College	Cupertino	Computer Information Systems		Business Programming-Advanced	46.25
266	DeAnza College	Cupertino	Computer Information Systems	A.A. in System Programming		46.25
267	DeAnza College	Cupertino	Computer Information Systems	-	System Programming	41.25
268	DeAnza College	Cupertino	Computer Information Systems	A.A.in Network Programming		41.25
269	DeAnza College	Cupertino	Computer Information Systems		Network Programming	42
270	DeAnza College	Cupertino	Computer Information Systems	A.A. in System Support Services	-	42
271	DeAnza College	Cupertino	Computer Information Systems	-	System Support Services	44.5
272	DeAnza College	Cupertino	Computer Information Systems	A.A. Network Administration		44.5
273	DeAnza College	Cupertino	Computer Information Systems	-	Network Administration	40.75
274	DeAnza College	Cupertino	Computer Information Systems	A.A. in Enterprise Security Professional		40.75
275	DeAnza College	Cupertino	Computer Information Systems		Enterprise Security Professional	41
276	DeAnza College	Cupertino	Computer Information Systems		Programming in C	25.5
277	DeAnza College	Cupertino	Computer Information Systems		Programming in Java	18
278	DeAnza College	Cupertino	Computer Information Systems		Programming in Perl	22.5
279	DeAnza College	Cupertino	Computer Information Systems		Visual Basic Programming	22.5
280	DeAnza College	Cupertino	Computer Information Systems		Unix/Linux Operating System	18
281	DeAnza College	Cupertino	Computer Information Systems		Database Design for Developers (Oracle)	22.5
282	DeAnza College	Cupertino	Computer Information Systems		Web Development	25.5
283	DeAnza College	Cupertino	Computer Information Systems	-	Help Desk	21.5
284	DeAnza College	Cupertino	Computer Information Systems	-	Network Administration	22.75
285	DeAnza College	Cupertino	Computer Information Systems	-	Network Administration- Advanced	20.25
286	DeAnza College	Cupertino	Computer Information Systems	-	Network Basics	40.75
287	DeAnza College	Cupertino	Computer Information Systems		Computer Crime Investigation (Forensics) & Security	18.5
288	DeAnza College	Cupertino	Computer Information Systems		Home/Small Business Computer Security	26

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
289	DeAnza College	Cupertino	Computer Information Systems		Enterprise Security Professional	14.75
290	DeAnza College	Cupertino	Computer Information Systems		Systems Programming-Advanced	41
291	DeAnza College	Cupertino	Computer Applications & Office Sys.	-	Web Development	41.25
292	DeAnza College	Cupertino	Computer Applications & Office Sys.	A.A. Administrative Asst/Office Technology		20.5
293	DeAnza College	Cupertino	Computer Applications & Office Sys.	-	Administrative Asst./Office Technology	33.5
294	DeAnza College	Cupertino	Computer Applications & Office Sys.		Administrative Asst./Office Technology (Advanced)	20.5
295	DeAnza College	Cupertino	Computer Applications & Office Sys.		Administrative Asst./Office Technology	20.5
296	Diablo Valley College	Pleasant Hill	Computer Information Systems	A.S. Degree in Computer Information Systems		8.5
297	Diablo Valley College	Pleasant Hill	Computer Information Systems		Computer Information Systems-Core(P)	12
298	Diablo Valley College	Pleasant Hill	Computer Information Systems		Computer Information Systems-Database Management	22
299	Diablo Valley College	Pleasant Hill	Computer Information Systems		Computer Information Systems-Project Management	22
300	Diablo Valley College	Pleasant Hill	Computer Information Systems		Computer Information Systems-Web Graphics	21.5
301	Diablo Valley College	Pleasant Hill	Computer Information Systems		Computer Information Systems-Web Technology	22.5
302	Diablo Valley College	Pleasant Hill	Computer Information Systems		Computer Information Systems-Database Management (Certif. of Comp.)	18
303	Diablo Valley College	Pleasant Hill	Computer Information Systems		Computer Information Systems-Project Management (Certif. of Comp.)	18
304	Diablo Valley College	Pleasant Hill	Computer Information Systems		Computer Information Systems-Web Graphics (Certif. of Completion)	18
305	Diablo Valley College	Pleasant Hill	Computer Information Systems		Computer Information Systems-Web Technology (Certif of Completion)	18
306	Diablo Valley College	Pleasant Hill	Math & Computer Science	A.S. Degree in Microsoft System Administrator		33
307	Diablo Valley College	Pleasant Hill	Math & Computer Science		Microsoft System Administrator	33
308	Diablo Valley College	Pleasant Hill	Math & Computer Science	A.S. Degree in Computer Science (Pending approval 2011-2012)		P/A
309	Diablo Valley College	Pleasant Hill	Math & Computer Science		Microcomputer Software Support (Pending approval 2011-2012)	P/A
310	Diablo Valley College	Pleasant Hill	Physical Science & Engineering	A.S. Degree in Computer Technical Support		27
311	Diablo Valley College	Pleasant Hill	Physical Science & Engineering		Computer Technical Support	27
312	Diablo Valley College	Pleasant Hill	Physical Science & Engineering		Computer Technical Support (Certif. of Completion)	14
313	Diablo Valley College	Pleasant Hill	Applied & Fine Arts	A.A. Degree in Art Digital Media		33.5
314	Diablo Valley College	Pleasant Hill	Applied & Fine Arts		Art Digital Media	33.5

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
315	Diablo Valley College	Pleasant Hill	Applied & Fine Arts	-	Art Digital Media (Certif. of Completion)	15
316	Evergreen Valley College	San Jose	Computer and Information Technology	A.S. in Computer Information & Technology		30
317	Evergreen Valley College	San Jose	Business Information Systems	A.S. in General Business		35.75
318	Evergreen Valley College	San Jose	Business Information Systems		General Business	30.75
319	Evergreen Valley College	San Jose	Business Information Systems	A.S. in Information Processing Specialist		29.25
320	Evergreen Valley College	San Jose	Business Information Systems	-	Information Processing Specialist	27.25
321	Evergreen Valley College	San Jose	Business Information Systems		Digital Media Design Specialist	33
322	Evergreen Valley College	San Jose	Business Information Systems		Accounting Specialist	33
323	Evergreen Valley College	San Jose	Business Information Systems		Bookkeeping Assistant	11.75
324	Evergreen Valley College	San Jose	Business Information Systems		Business Systems Assistant	8.75
325	Evergreen Valley College	San Jose	Business Information Systems		Computer Systems Assistant	10.75
326	Evergreen Valley College	San Jose	Business Information Systems		Computer Applications Specialist	10
327	Evergreen Valley College	San Jose	Business Information Systems	-	Information Processing Specialist	11.5
328	Feather River College	Quincy	Administrative Office Management		Legal Office Assistant	12.25
329	Feather River College	Quincy	Administrative Office Management		Medical Office Assistant	15
330	Feather River College	Quincy	Administrative Office Management		Personal Computer Office Suite Applications	15
331	Feather River College	Quincy	Administrative Office Management	-	Office Career & Technology	8
332	Folsom Lake College	Folsom	Computer Information Systems	A.S. in Computer Science		32.5
333	Folsom Lake College	Folsom	Computer Information Systems		Programming	35
334	Folsom Lake College	Folsom	Computer Information Systems		Windows Programming	21
335	Folsom Lake College	Folsom	Computer Information Systems		Computer Programmer-SQL	18
336	Folsom Lake College	Folsom	Computer Information Systems		Programming	14
337	Folsom Lake College	Folsom	Computer Information Systems		Database Ladder Level 1 / Database Analyst-SQL	21
338	Folsom Lake College	Folsom	Computer Information Systems		Database Ladder Level 2 / Computer Programmer-SQL	14
339	Folsom Lake College	Folsom	Computer Information Systems		Database Ladder Level 3 / Relational Database Administration	20
340	Folsom Lake College	Folsom	Computer Information Systems		Web Developer	20
341	Folsom Lake College	Folsom	Computer Information Systems		Web Publishing	21
342	Folsom Lake College	Folsom	Computer Information Systems		MIS Ladder Level 1 / Application Data Entry	16
343	Folsom Lake College	Folsom	Computer Information Systems		MIS Ladder Level 2 / Information Processing	11

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
344	Folsom Lake College	Folsom	Computer Information Systems		MIS Ladder Level 3/ Application Technician	17
345	Folsom Lake College	Folsom	Business Technology		Business Office Assistant	22
346	Folsom Lake College	Folsom	Business Technology		Business/Office Technician	14
347	Foothill College	Los Altos Hills	Business Technology	A.S. in Business Technology: Help Desk Technical Support		17
348	Foothill College	Los Altos Hills	Business Technology		Business Technology: Help Desk Technical Support	39
349	Foothill College	Los Altos Hills	Business Technology		Help Desk Technical Support Level I (Career Certificate)	24.5
350	Foothill College	Los Altos Hills	Business Technology		Help Desk Technical Support Level II Certificate of Achievement (A+)	19
351	Foothill College	Los Altos Hills	Business Technology	-	A+ Preparation Skills Certificate	29
352	Foothill College	Los Altos Hills	Computers, Technology & Information Systems	A.S. in Computer Science (Transfer)		10
353	Foothill College	Los Altos Hills	Computers, Technology & Information Systems	A.S. in Computer Software Development		54
354	Foothill College	Los Altos Hills	Computers, Technology & Information Systems		Computer Software Development	45
355	Foothill College	Los Altos Hills	Computers, Technology & Information Systems	A.S. in Database Management		30
356	Foothill College	Los Altos Hills	Computers, Technology & Information Systems		Oracle Database Administration (Certificate of Achievement)	40
357	Foothill College	Los Altos Hills	Computers, Technology & Information Systems		Oracle Database Developer (Certificate of Achievement)	40
358	Foothill College	Los Altos Hills	Computers, Technology & Information Systems		Oracle Database Administration Skills Certificate	15
359	Foothill College	Los Altos Hills	Computers, Technology & Information Systems		Oracle Database Developer Skills Certificate	15
360	Foothill College	Los Altos Hills	Computers, Technology & Information Systems		Open Source Database Certificate of Proficiency	20
361	Foothill College	Los Altos Hills	Computers, Technology & Information Systems		M/S IT Professional (MCITP) Database Administration Skills Certificate	20
362	Foothill College	Los Altos Hills	Computers, Technology & Information Systems	A.S. in Enterprise Networking		15
363	Foothill College	Los Altos Hills	Computers, Technology & Information Systems		MCITP Server Administrator Certificate of Achievement	55
364	Foothill College	Los Altos Hills	Computers, Technology & Information Systems		MCITP Enterprise Administrator Certificate of Proficiency	25
365	Foothill College	Los Altos Hills	Computers, Technology & Information Systems		Network Security Certificate of Proficiency	25
366	Foothill College	Los Altos Hills	Computers, Technology & Information Systems		Cisco Academy CCNA Certificate of Proficiency	25
367	Foothill College	Los Altos Hills	Computers, Technology & Information Systems		Cisco Academy CCNP Certificate of Proficiency	20
368	Foothill College	Los Altos Hills	Computers, Technology & Information Systems		Wireless Networking Certificate of Proficiency	15
369	Foothill College	Los Altos Hills	Computers, Technology & Information Systems	A.S. in Informatics		20

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
370	Foothill College	Los Altos Hills	Computers, Technology & Information Systems		Informatics	66
371	Foothill College	Los Altos Hills	Computers, Technology & Information Systems		Informatics	33
372	Foothill College	Los Altos Hills	Computers, Technology & Information Systems	A/S in Interactive and Multimedia Technologies		9
373	Foothill College	Los Altos Hills	Computers, Technology & Information Systems		Interactive and Multimedia Technologies	50
374	Foothill College	Los Altos Hills	Computers, Technology & Information Systems		Interactive and Multimedia Technologies (Skills Cert)	50
375	Foothill College	Los Altos Hills	Computers, Technology & Information Systems		Web Based Multimedia (Skills Cert)	23
376	Foothill College	Los Altos Hills	Computers, Technology & Information Systems	A.S. in Internet Technology/Electronic Business		20
377	Foothill College	Los Altos Hills	Computers, Technology & Information Systems	A.S. in Internet Technology/Web Programming		42
378	Foothill College	Los Altos Hills	Computers, Technology & Information Systems	A.S. in Internet Technology/Web Administration		40
379	Foothill College	Los Altos Hills	Computers, Technology & Information Systems	-	AJAX Certificate of Proficiency	35
380	Foothill College	Los Altos Hills	Computers, Technology & Information Systems	-	Web Publishing/Dreamweaver	35
381	Foothill College	Los Altos Hills	Computers, Technology & Information Systems	-	Web Development	24
382	Foothill College	Los Altos Hills	Computers, Technology & Information Systems		Electronic Business (Skills Cert)	24
383	Foothill College	Los Altos Hills	Computers, Technology & Information Systems		Web Development (Skills Cert)	27
384	Foothill College	Los Altos Hills	Computers, Technology & Information Systems	-	Web-Based Multimedia (Skills Cert)	20
385	Fresno City College	Fresno	The Computer Information Technology and Decision Sciences	A.S. in Computer Information Systems		19
386	Fresno City College	Fresno	The Computer Information Technology and Decision Sciences		Information Security I	39
387	Fresno City College	Fresno	The Computer Information Technology and Decision Sciences		Information Security II	12
388	Fresno City College	Fresno	The Computer Information Technology and Decision Sciences	A.S. in Microcomputer Software Specialist		9
389	Fresno City College	Fresno	The Computer Information Technology and Decision Sciences		Microcomputer Software Specialist	33
390	Fresno City College	Fresno	The Computer Information Technology and Decision Sciences	A.S. in Networking/Computer Technician		33
391	Fresno City College	Fresno	The Computer Information Technology and Decision Sciences		Networking/Computer Technician	23
392	Fresno City College	Fresno	The Computer Information Technology and Decision Sciences		Preparation in Microsoft Office	23
393	Fresno City College	Fresno	The Computer Information Technology and Decision Sciences		Systems Support Specialist	17
394	Fresno City College	Fresno	The Computer Information Technology and Decision Sciences	A.S. Web Developer		13
395	Fresno City College	Fresno	The Computer Information Technology and Decision Sciences		Web Developer	38

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
396	Fresno City College	Fresno	The Computer Information Technology and Decision Sciences	-	Web Page Development	38
397	Gavilan College	Gilroy	Computer Science & Information Systems Department	A.S. in Business Computer Applications		9
398	Gavilan College	Gilroy	Computer Science & Information Systems Department	A.S. in Computer Networking		21
399	Gavilan College	Gilroy	Computer Science & Information Systems Department	A.S. in Computer Programming		24
400	Gavilan College	Gilroy	Computer Science & Information Systems Department	A.S. in Programming for the Internet		21.5
401	Gavilan College	Gilroy	Computer Science & Information Systems Department	A.S. in Scientific Programming		19.5
402	Gavilan College	Gilroy	Computer Science & Information Systems Department	A.S. in UNIX Operating System		26.5
403	Gavilan College	Gilroy	Computer Science & Information Systems Department		Business Computer Applications	23.5
404	Gavilan College	Gilroy	Computer Science & Information Systems Department		Computer Networking	21
405	Gavilan College	Gilroy	Computer Science & Information Systems Department		Computer Programming	24
406	Gavilan College	Gilroy	Computer Science & Information Systems Department		Programming for the Internet	21.5
407	Gavilan College	Gilroy	Computer Science & Information Systems Department		Scientific Programming	19.5
408	Gavilan College	Gilroy	Computer Science & Information Systems Department		UNIX Operating System	26.5
409	Gavilan College	Gilroy	Computer Science & Information Systems Department		Computer Hardware	23.5
410	Gavilan College	Gilroy	Computer Graphics & Design	A.S. in Advanced Technical Computer Graphics		8
411	Gavilan College	Gilroy	Computer Graphics & Design		Advanced Technical Computer Graphics	19
412	Gavilan College	Gilroy	Computer Graphics & Design	A.S. in Computer Graphics in Environmental Design		19
413	Gavilan College	Gilroy	Computer Graphics & Design		Computer Graphics in Environmental Design	18
414	Gavilan College	Gilroy	Computer Graphics & Design	A.S. in Desktop Publishing and Graphics		18
415	Gavilan College	Gilroy	Computer Graphics & Design		Desktop Publishing and Graphics	18
416	Gavilan College	Gilroy	Digital Media	A.A. in Digital Art & Imaging		18
417	Gavilan College	Gilroy	Digital Media		Digital Art & Imaging	27
418	Gavilan College	Gilroy	Digital Media	A.A. in Digital Audio.Video		27
419	Gavilan College	Gilroy	Digital Media		Digital Audio.Video	27
420	Gavilan College	Gilroy	Digital Media	A.A. Interactive Media & Authoring		27

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
421	Gavilan College	Gilroy	Digital Media		Interactive Media & Authoring	27
422	Gavilan College	Gilroy	Digital Media		Digital Imaging Graphics Production Specialist	27
423	Gavilan College	Gilroy	Digital Media		Digital Print Production Specialist	17
424	Gavilan College	Gilroy	Digital Media		Digital Video Editor Specialist	15.5
425	Gavilan College	Gilroy	Digital Media	-	Web Page Production Specialist	13.5
426	Hartnell College	Salinas	Computer Information & Sciences	A.A. in Computer Information & Sciences-Digital & Web Design Option		17
427	Hartnell College	Salinas	Computer Information & Sciences	-	Computer Information & Sciences-Digital & Web Design Option	42
428	Hartnell College	Salinas	Computer Information & Sciences	A.A. in Computer Information & Sciences-Computer Science Option		38
429	Hartnell College	Salinas	Computer Information & Sciences	A.S. in PC & Network Support Specialist		39
430	Hartnell College	Salinas	Computer Information & Sciences		PC & Network Support Specialist	39
431	Hartnell College	Salinas	Digital Arts		Digital Arts	39
432	Hartnell College	Salinas	Digital Arts	A.S. in Digital Arts-Animation Specialist		24
433	Hartnell College	Salinas	Digital Arts	-	Digital Arts-Animation Specialist	33
434	Lake Tahoe Community College	South Lake Tahoe	Computer & Information Science	A.A. Web Development		24
435	Lake Tahoe Community College	South Lake Tahoe	Computer & Information Science		Web Development	30
436	Lake Tahoe Community College	South Lake Tahoe	Computer & Information Science	-	Computer Applications/Office Technology	30
437	Laney College	Oakland	Computer Information Systems	A.S. in Computer Programming		37
438	Laney College	Oakland	Computer Information Systems	A.S. in Computer Programming Information Specialist (pending approval)		51.5
439	Laney College	Oakland	Computer Information Systems	A.S. in Computer System/Software Security & Encryption (pending approval)		47
440	Laney College	Oakland	Computer Information Systems	A.S. in Game Development & Programming (pending approval)		54
441	Laney College	Oakland	Computer Information Systems	A.S. in Internet Development & Programming (pending approval)		51.5
442	Laney College	Oakland	Computer Information Systems	-	Computer Programming	50.5
443	Laney College	Oakland	Computer Information Systems	-	Computer Programming Information Specialist (pending approval)	51.5
444	Laney College	Oakland	Computer Information Systems	-	Computer System/Software Security & Encryption (pending approval)	47
445	Laney College	Oakland	Computer Information Systems	-	Game Development & Programming (pending approval)	54

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
446	Laney College	Oakland	Computer Information Systems	-	Internet Development & Programming (pending approval)	51.5
447	Laney College	Oakland	Business	A.S. in Business Information System		50.5
448	Las Positas College	Livermore	Computer Information Systems	A.A. in Computer Information Systems	-	43
449	Las Positas College	Livermore	Computer Information Systems	-	Computer Network Technician	32
450	Las Positas College	Livermore	Computer Information Systems	-	CISCO CCNA	12
451	Las Positas College	Livermore	Computer Information Systems	-	CISCO CCNP	20
452	Las Positas College	Livermore	Computer Information Systems		Computer Network Administration (Microsoft)	36
453	Las Positas College	Livermore	Computer Information Systems	A.S. in Computer Science		17
454	Las Positas College	Livermore	Computer Information Systems	-	Computer Applications Software	37
455	Las Positas College	Livermore	Computer Information Systems	A.S. in Computer Programming for the Web	-	36
456	Las Positas College	Livermore	Computer Information Systems		Computer Programming for the Web	34.5
457	Las Positas College	Livermore	Computer Information Systems	A.S. in Internetworking Technology & Cisco Administration		34.5
458	Las Positas College	Livermore	Computer Information Systems	A.S. in Computer Programming		34
459	Las Positas College	Livermore	Computer Information Systems	-	Computer Programming	34
461	Los Medanos College	Pittsburg	Computer Science	A.S. in Computer Networking & Security (Appr. 12/10, new program-no link)		31.5
462	Los Medanos College	Pittsburg	Computer Science		Computer Networking & Security (Appr. 12/10, new program- no link)	31.5
463	Los Medanos College	Pittsburg	Computer Science		Computer Networking & Security - Certif of Comp. (Apprv. 12/10, no link)	16
464	Los Medanos College	Pittsburg	Computer Science	A.S. in Computer Support Specialist (Appr. 3/17/11, new program-no link)		33
465	Los Medanos College	Pittsburg	Computer Science		Computer Support Specialist (Appr. 3/17/11, new program-no link)	33
466	Los Medanos College	Pittsburg	Computer Science		Computer Support Specialist (Appr. 3/17/11, new program-no link)	16.5
467	Los Medanos College	Pittsburg	Computer Science	A.S in Computer Science (Appr. 3/17/11, new program-no link)		33
468	Los Medanos College	Pittsburg	Computer Science		Foundation - Level 1	16
469	Los Medanos College	Pittsburg	Computer Science		Foundation - Level 2	11
470	Los Medanos College	Pittsburg	Computer Science	-	A+, Computer Programming, Gaming, Internet Web Design, or Computer Applications (Certif. of Achievement)	15
471	Mendocino College	Mendocino	Computer Science	A.S. In Computer & Information Sciences		36
472	Mendocino College	Mendocino	Computer Science	A.S. in Computer & Information Applications		24

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
473	Mendocino College	Mendocino	Computer Science		Computer Applications: Office Environment	24
474	Mendocino College	Mendocino	Computer Science		Computer Applications: Graphics Presentation	24
475	Mendocino College	Mendocino	Computer Science		Computer Applications: Networking	24
476	Mendocino College	Mendocino	Computer Science		Computer Applications: Web Page Design	23
477	Mendocino College	Mendocino	Business Office Technology	A.S. in Business Office Technology: Admin. Assistant		24
478	Mendocino College	Mendocino	Business Office Technology		Business Office Technology: Medical Billing Coding Specialist	35
479	Mendocino College	Mendocino	Business Office Technology		Business Office Technology: General	35
480	Mendocino College	Mendocino	Business Administration	Business Administration	-	10
481	Mendocino College	Mendocino	Business Administration	Business Management	-	22
482	Mendocino College	Mendocino	Business Administration	Business Accounting	-	21
483	Mendocino College	Mendocino	Business Administration	-	Business: Accounting	21
484	Mendocino College	Mendocino	Business Administration	-	Business: Management	21
485	Merced College	Merced	Computer Studies Department	Computer Science		37
486	Merced College	Merced	Computer Studies Department	Management Information Systems		31
487	Merced College	Merced	Business	General Business		37.75
488	Merced College	Merced	Business		General Business	37
489	Merced College	Merced	Electronics Technology	Computer and Networking Technology	-	43
490	Merced College	Merced	Electronics Technology	Electrical Technology	-	31
491	Merced College	Merced	Electronics Technology	Electronics Technician	-	36.5
492	Merced College	Merced	Electronics Technology	Industrial Electronics Technology	-	41
493	Merced College	Merced	Electronics Technology	Instrumentation and Process Control Technology	-	40.5
494	Merced College	Merced	Electronics Technology		Computer and Networking Technology	43
495	Merced College	Merced	Electronics Technology		Electrical Technology	42
496	Merced College	Merced	Electronics Technology		Electronics Technician	30
497	Merced College	Merced	Electronics Technology		Industrial Electronics Technology	35.5
498	Merced College	Merced	Electronics Technology		Instrumentation and Process Control Technology	40
499	Merced College	Merced	Electronics Technology		Cisco Networking Academy	41.5
500	Merced College	Merced	Administrative Office Management	Administrative Medical Office Professional	-	32
501	Merced College	Merced	Administrative Office Management	Administrative Office Professional	-	26
502	Merced College	Merced	Administrative Office Management		Administrative Medical Office Professional	32

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
503	Merced College	Merced	Administrative Office Management	-	Administrative Office Professional	26
504	Merced College	Merced	Engineering	Engineering (A.A.)	-	20
505	Merced College	Merced	Engineering	Engineering (A.S.)	-	27
506	Merced College	Merced	Engineering	Engineering Technology (A.S.)		42
507	Merritt College	Oakland	Computer Information Systems		Internet Programming	14
508	Merritt College	Oakland	Computer Information Systems		PC Applications Help Desk Specialist	17
509	Merritt College	Oakland	Computer Information Systems		Web Page Authoring	14
510	Merritt College	Oakland	Computer Information Systems		Web Publishing	10
511	Merritt College	Oakland	Business	Administrative Office Assistant		39
512	Merritt College	Oakland	Business	Administrative Assistant		27.5
513	Merritt College	Oakland	Business		Administrative Assistant	27.5
514	Merritt College	Oakland	Business	Business Information Processing		25
515	Merritt College	Oakland	Business		Business Information Processing	25
516	Merritt College	Oakland	Business	Accounting		21
517	Merritt College	Oakland	Business		Accounting	18
518	Merritt College	Oakland	Business	Business Administration		21
519	Merritt College	Oakland	Business		Legal Office Assistant	17
520	Merritt College	Oakland	Business	-	Office Administrator	17
521	Mission College	Santa Clara	Computer Network Electronics Technology	Computer Electronics Technology		17
522	Mission College	Santa Clara	Computer Information Systems	Computer Information Systems		41
523	Mission College	Santa Clara	Computer Information Systems		Computer Information Systems	31
524	Mission College	Santa Clara	Computer Information Systems		C/C++/Unix Programming(Level I)	31
525	Mission College	Santa Clara	Computer Information Systems		C/C++/Unix Programming(Level II)	17
526	Mission College	Santa Clara	Computer Information Systems		Unix Systems Administration (Level 1)	15
527	Mission College	Santa Clara	Computer Information Systems		Unix Systems Administration (Level 2)	17
528	Mission College	Santa Clara	Computer Information Systems		PC Systems Administration (Level 1)	17
529	Mission College	Santa Clara	Computer Information Systems		Java Programming	16
530	Mission College	Santa Clara	Computer Information Technology		Cisco Certified Network Administration (CCNA)	17
531	Mission College	Santa Clara	Computer Information Technology		Cisco Certified Network Professional (CCNP)	27
532	Mission College	Santa Clara	Computer Information Technology		Certified Network Engineer (CNE)	12

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
533	Mission College	Santa Clara	Computer Information Technology		Microsoft Certified Systems Engineer (MCSE)	31
534	Mission College	Santa Clara	Computer Information Technology		Microsoft Certified Database Administration (MCDBA)	34
535	Mission College	Santa Clara	Computer Information Technology		Oracle Database Administration (DBA)	26
536	Mission College	Santa Clara	Computer Applications		Computer Applications - Level II	25
537	Mission College	Santa Clara	Computer Applications		Help Desk Specialist	16
538	Mission College	Santa Clara	Computer Applications		Microsoft Office	16
539	Mission College	Santa Clara	Computer Applications	Office Administration		17.5
540	Mission College	Santa Clara	Computer Applications		Office Administration	41
541	Mission College	Santa Clara	Computer Applications	Office Information Systems		23
542	Mission College	Santa Clara	Computer Applications		Office Information Systems	32.5
543	Mission College	Santa Clara	Computer Applications		Office Support Specialist	26.5
544	Mission College	Santa Clara	Computer Applications		Oracle Developer/DBA	8
545	Mission College	Santa Clara	Computer Applications		Oracle Developer	16
546	Mission College	Santa Clara	Computer Applications		Professional Internet Skills	12
547	Mission College	Santa Clara	Graphic and Multimedia Design		E-Commerce	8
548	Mission College	Santa Clara	Graphic and Multimedia Design		Digital Illustration	28
549	Mission College	Santa Clara	Graphic and Multimedia Design		Creative Arts Entrepreneurship	17
550	Mission College	Santa Clara	Graphic and Multimedia Design	Graphic Design		16
551	Mission College	Santa Clara	Graphic and Multimedia Design		Graphic Design	33
552	Mission College	Santa Clara	Graphic and Multimedia Design		Multimedia	33
553	Mission College	Santa Clara	Graphic and Multimedia Design		Web Graphic Design	25
554	Mission College	Santa Clara	Graphic and Multimedia Design	-	Webmaster	24
555	Modesto Junior College	Modesto	Computer Science	Computer Science (A.A.)		25
556	Modesto Junior College	Modesto	Computer Science	Computer Science (A.S.) in Information Systems		20
557	Modesto Junior College	Modesto	Computer Science	Computer Science (A.S.) in Networking		30
558	Modesto Junior College	Modesto	Computer Science	Computer Science (A.S.) in Programming		30
559	Modesto Junior College	Modesto	Computer Science		Computer Programming Specialist	30
560	Modesto Junior College	Modesto	Business Administration		Accounting Clerk	16
561	Modesto Junior College	Modesto	Business Administration		Accounting	14.5
562	Modesto Junior College	Modesto	Business Administration	Accounting (A.A.)	-	24

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
563	Modesto Junior College	Modesto	Business Administration	Accounting (A.S.)	-	20
564	Modesto Junior College	Modesto	Business Administration	Bookkeeping (A.A.)	-	30
565	Modesto Junior College	Modesto	Business Administration	Bookkeeping (A.S.)	-	22
566	Modesto Junior College	Modesto	Business Administration		Bookkeeping	30
567	Modesto Junior College	Modesto	Business Administration	Business Administration (A.A.)	-	25
568	Modesto Junior College	Modesto	Business Administration	Business Administration (A.S.)	-	20
569	Modesto Junior College	Modesto	Business Administration	Clerical (A.A.)	-	30
570	Modesto Junior College	Modesto	Business Administration	Clerical (A.S.)	-	20
571	Modesto Junior College	Modesto	Business Administration		Clerical	30
572	Modesto Junior College	Modesto	Business Administration		Computer Applications Specialist	30
573	Modesto Junior College	Modesto	Computer Graphics		Computer Graphics Applications	18
574	Modesto Junior College	Modesto	Computer Graphics	Computer Graphics Applications		39
575	Modesto Junior College	Modesto	Business Administration	Computer Information Systems (A.A.)		39
576	Modesto Junior College	Modesto	Computer Science		Computer Network Administration	21
577	Modesto Junior College	Modesto	Business Administration		Computer Network Technician	15
578	Modesto Junior College	Modesto	Office Administration		Office Administration	17
579	Modesto Junior College	Modesto	Office Administration	Office Administration (A.A.)		32
580	Modesto Junior College	Modesto	Office Administration	Office Administration (A.S.)		20
581	Modesto Junior College	Modesto	Office Administration		Office Computer Applications	30
582	Modesto Junior College	Modesto	Office Administration		Office Support	18
583	Modesto Junior College	Modesto	Office Administration		Records Management/Data Entry Specialist	18
584	Modesto Junior College	Modesto	Office Administration	-	Word Processing	16
585	Monterey Peninsula College	Monterey	Computer Science and Information Systems	Computer Science and Information Systems (A.A.)		32
586	Monterey Peninsula College	Monterey	Computer Science and Information Systems	Computer Networking (A.S.)		18
587	Monterey Peninsula College	Monterey	Computer Science and Information Systems		Computer Networking	30
588	Monterey Peninsula College	Monterey	Computer Science and Information Systems	Computer Software Application, Business Technology Focus		29
589	Monterey Peninsula College	Monterey	Computer Science and Information Systems		Computer Software Application, Business Technology Focus	30
590	Monterey Peninsula College	Monterey	Computer Science and Information Systems	Computer Software Application, Internet Technology Focus		30

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
591	Monterey Peninsula College	Monterey	Computer Science and Information Systems		Computer Software Application, Internet Technology Focus	30
592	Monterey Peninsula College	Monterey	Business	Office Technology		30
593	Monterey Peninsula College	Monterey	Business		Office Technology	32
594	Monterey Peninsula College	Monterey	Business	Secretarial	-	23
595	Monterey Peninsula College	Monterey	Business		Secretarial	27
596	Monterey Peninsula College	Monterey	Business	Accounting	-	18
597	Monterey Peninsula College	Monterey	Business		Accounting	33
598	Monterey Peninsula College	Monterey	Medical Assisting	Medical Office Administration	-	21
599	Monterey Peninsula College	Monterey	Medical Assisting		Medical Office Administration	28
600	Monterey Peninsula College	Monterey	Medical Assisting	Medical Office Procedures	-	28
601	Monterey Peninsula College	Monterey	Medical Assisting	-	Medical Office Procedures	19
602	Napa Valley College	Napa	Digital Art and Design	Graphic Design, Transfer Emphasis		19
603	Napa Valley College	Napa	Digital Art and Design	Graphic Design, Graphic Design Emphasis		21
604	Napa Valley College	Napa	Business and Computer Studies	Business (A.S.), concentration in Accounting		34
605	Napa Valley College	Napa	Business and Computer Studies		Bookkeeping	31
606	Napa Valley College	Napa	Business and Computer Studies	Business (A.S.), concentration in Business Administration		31
607	Napa Valley College	Napa	Business and Computer Studies	Business (A.S.), concentration in Computer Studies		30
608	Napa Valley College	Napa	Business and Computer Studies		Microcomputer Applications Specialist	30
609	Napa Valley College	Napa	Business and Computer Studies		Management Information Systems	27
610	Napa Valley College	Napa	Business and Computer Studies		Computer Networking Technology	48
611	Napa Valley College	Napa	Business and Computer Studies	Business (A.S.), concentration in Office Administration		15
612	Napa Valley College	Napa	Business and Computer Studies	-	Office Assistant Studies	30
613	Napa Valley College	Napa	Business and Computer Studies	-	Business Software	30
614	Napa Valley College	Napa	Digital Design Graphics Technology	Digital Design Graphics Technology	-	6
615	Napa Valley College	Napa	Digital Design Graphics Technology	-	Digital Design Graphics Technology	48

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
616	Ohlone College	Fremont	Computers, Networks, and Emerging Technology	CISCO CERTIFIED NETWORK PROFESSIONAL (NETWORK+, CCNA, CCNP)	NETWORK+, CCNA, CCNP	48
617	Ohlone College	Fremont	Computers, Networks, and Emerging Technology	CISCO CERTIFIED NETWORK PROFESSIONAL (NETWORK+, CCNA, CCNP)	NETWORK+, CCNA, CCNP	42
618	Ohlone College	Fremont	Computers, Networks, and Emerging Technology	DESKTOP SUPPORT TECHNICIAN (A+, NETWORK+, MCP)	A+, NETWORK+, MCP	36
619	Ohlone College	Fremont	Computers, Networks, and Emerging Technology	DESKTOP SUPPORT TECHNICIAN (A+, NETWORK+, MCP)	A+, NETWORK+, MCP	31
620	Ohlone College	Fremont	Computers, Networks, and Emerging Technology	MICROSOFT SYSTEMS ENGINEER (NETWORK+, MCP, MCSE)	NETWORK+, MCP, MCSE	25
621	Ohlone College	Fremont	Computers, Networks, and Emerging Technology	MICROSOFT SYSTEMS ENGINEER (NETWORK+, MCP, MCSE)	NETWORK+, MCP, MCSE	33
622	Ohlone College	Fremont	Computers, Networks, and Emerging Technology	NETWORK ADMINISTRATOR (NETWORK+, MCP OR UNIX, CCNA)	NETWORK+, MCP OR UNIX, CCNA	27
623	Ohlone College	Fremont	Computers, Networks, and Emerging Technology	NETWORK ADMINISTRATOR (NETWORK+, MCP OR UNIX, CCNA)	NETWORK+, MCP OR UNIX, CCNA	38
624	Ohlone College	Fremont	Computers, Networks, and Emerging Technology	TECHNICAL SUPPORT SPECIALIST (A+, NETWORK+, MCP)	A+, NETWORK+, MCP	32
625	Ohlone College	Fremont	Computers, Networks, and Emerging Technology	TECHNICAL SUPPORT SPECIALIST (A+, NETWORK+, MCP)	A+, NETWORK+, MCP	32
626	Ohlone College	Fremont	Computers, Networks, and Emerging Technology	UNIX/LINUX SYSTEMS ADMINISTRATOR		26
627	Ohlone College	Fremont	Computers, Networks, and Emerging Technology	UNIX/LINUX SYSTEMS ADMINISTRATOR	-	31
628	Ohlone College	Fremont	Computers, Networks, and Emerging Technology	Natural Science (A.A.), Mathematics and Technology Emphasis	-	31
629	Ohlone College	Fremont	Computers, Networks, and Emerging Technology	-	CISCO CERTIFIED NETWORK ASSOCIATE	20
630	Ohlone College	Fremont	Computers, Networks, and Emerging Technology	-	COMPUTER AND INFORMATION LITERACY	8
631	Ohlone College	Fremont	Computers, Networks, and Emerging Technology	-	DATABASE ADMINISTRATION	12
632	Ohlone College	Fremont	Computers, Networks, and Emerging Technology	-	DESKTOP SUPPORT TECHNICIAN	12
633	Ohlone College	Fremont	Computers, Networks, and Emerging Technology	-	LINUX+	10
634	Ohlone College	Fremont	Computers, Networks, and Emerging Technology	-	LINUX/UNIX ADMINISTRATION	8
635	Ohlone College	Fremont	Computers, Networks, and Emerging Technology	-	MICROSOFT CERTIFIED SYSTEMS ADMINISTRATOR (MCSA)	15
636	Ohlone College	Fremont	Computers, Networks, and Emerging Technology	-	MICROSOFT CERTIFIED SYSTEMS ENGINEER (MCSE)	8
637	Ohlone College	Fremont	Computers, Networks, and Emerging Technology	-	NETWORK TECHNICIAN	12

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
638	Ohlone College	Fremont	Computers, Networks, and Emerging Technology	-	WEB INFRASTRUCTURE	12
639	Ohlone College	Fremont	Computer Science	-	WEB DESIGN	15
640	Ohlone College	Fremont	Computer Science	-	WEB DELIVERY	13
641	Ohlone College	Fremont	Computer Science	-	WEB CONTENT	16
642	Ohlone College	Fremont	Computer Science	-	OFFICE SUPPORT	16
643	Ohlone College	Fremont	Computer Science	-	OFFICE COMPUTER APPLICATIONS	8
644	Ohlone College	Fremont	Computer Science	-	JAVA DEVELOPER	9
645	Ohlone College	Fremont	Computer Science	-	INTERNET APPLICATIONS DEVELOPMENT	15
646	Ohlone College	Fremont	Computer Science	-	COMPUTER APPLICATIONS IN BIOTECHNOLOGY	7
647	Ohlone College	Fremont	Computer Science	-	COMPUTER PROGRAMMING	12
648	Ohlone College	Fremont	Computer Science	-	DATA COMMUNICATIONS AND WEB PROGRAMMING	16
649	Ohlone College	Fremont	Computer Science	Computer Engineering	-	11
650	Ohlone College	Fremont	Computer Science	Computer Science (A.S.)	-	53
651	Ohlone College	Fremont	Computer Science	Computer Studies (A.A.), Computer Programming (Software Development)	-	42
652	Ohlone College	Fremont	Computer Science		Computer Studies (A.A.), Computer Programming (Software Development)	27
653	Ohlone College	Fremont	Computer Science	Computer Studies (A.A.), Computer Programming (Internet/Web Programming)	-	27
654	Ohlone College	Fremont	Computer Science		Computer Studies (A.A.), Computer Programming (Internet/Web Programming)	31
655	Ohlone College	Fremont	Multimedia	-	3D MODELING AND ANIMATION	31
656	Ohlone College	Fremont	Multimedia	Multimedia		12
657	Ohlone College	Fremont	Multimedia	-	Multimedia	29
658	Ohlone College	Fremont	Multimedia	-	VIDEO GAME DEVELOPMENT	17
659	Ohlone College	Fremont	Graphic Arts	-	Digital Art	17
660	Ohlone College	Fremont	Graphic Arts	GRAPHIC ARTS/COMPUTER GRAPHICS		12
661	Ohlone College	Fremont	Graphic Arts	-	GRAPHIC ARTS/COMPUTER GRAPHICS	35
662	Ohlone College	Fremont	Art	-	Multimedia	34
663	Ohlone College	Fremont	Network Technology and Systems Administration	-	A+	14
664	Ohlone College	Fremont	Network Technology and Systems Administration	-	CCENT	31

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
665	Ohlone College	Fremont	Network Technology and Systems Administration	-	CCNA	4
666	Ohlone College	Fremont	Network Technology and Systems Administration	-	CCNP	12
667	Ohlone College	Fremont	Network Technology and Systems Administration	-	CompTIA Linux+	12
668	Ohlone College	Fremont	Network Technology and Systems Administration	-	MCDST	10
669	Ohlone College	Fremont	Network Technology and Systems Administration	-	MCSA	10
670	Ohlone College	Fremont	Network Technology and Systems Administration	-	MCSE	8
671	Ohlone College	Fremont	Network Technology and Systems Administration	-	Oracle OCP-DBA	14
672	Ohlone College	Fremont	Network Technology and Systems Administration	-	Security+	16
673	Ohlone College	Fremont	Network Technology and Systems Administration	-	UNIX/Linux Open Source Training	12
674	Ohlone College	Fremont	Network Technology and Systems Administration	-	IP Telephony and VOIP Training	19
675	Ohlone College	Fremont	Network Technology and Systems Administration	-	Wireless LANs	12
676	Ohlone College	Fremont	Computer Applications & Occupational Technology	Administrative Assistant	-	12
677	Ohlone College	Fremont	Computer Applications & Occupational Technology		Administrative Assistant	34
678	Ohlone College	Fremont	Computer Applications & Occupational Technology	Administrative Assistant with Supervisory Focus		18
679	Ohlone College	Fremont	Computer Applications & Occupational Technology		Administrative Assistant with Supervisory Focus	36
680	Ohlone College	Fremont	Business Administration	Accounting	Administrative Assistant with Supervisory Focus	24
681	Porterville College	Porterville	Information Systems	Information Systems		48
682	Porterville College	Porterville	Office Technology	Office Technology		20
683	Porterville College	Porterville	Office Technology	-	Office Technology	24
684	Porterville College	Porterville	Accounting	-	Accounting Paraprofessional	24
685	Porterville College	Porterville	Art	-	Technical Illustration: Art Graphics	24
686	San Jose City College	San Jose	Math & Science Division	A.A. in Computer Science		25
687	San Jose City College	San Jose	Computer Applications	A.S. in Computer Applications		31
688	San Jose City College	San Jose	Computer Applications		Computer Applications-Level 2	36
689	San Jose City College	San Jose	Computer Applications		Computer Applications-Level 3	20

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
690	San Jose City College	San Jose	Computer Information Systems	A.S. Computer Programming	-	36
691	San Jose City College	San Jose	Computer Information Systems		Level 2 (Certif. of Achievement)	36
692	San Jose City College	San Jose	Computer Information Systems		Level 3 (Certif. of Achievement)	18
693	San Jose City College	San Jose	Computer Information Systems		M/S.NET Application Development	30
694	San Jose City College	San Jose	Computer Information Systems		MCSE	22
695	San Jose City College	San Jose	Computer Information Systems		MCSA	21
696	San Jose City College	San Jose	Computer Information Systems		UNIX Networks	18
697	San Jose City College	San Jose	Computer Information Systems		CISCO CCNA	20
698	San Jose City College	San Jose	Computer Information Systems		CISCO Networks Security	18
699	San Jose City College	San Jose	Computer Information Systems		CISCO Wireless LANs	18
700	San Jose City College	San Jose	Computer Information Systems		CISCO CCNP	18
701	San Jose City College	San Jose	Computer Information Systems		Network Security	30
702	San Jose City College	San Jose	Computer Information Systems	A/S in CIS General Networking		12
703	San Jose City College	San Jose	Computer Information Systems		General Networking	35
704	San Jose City College	San Jose	Computer Information Systems		Web Developer-Level 2 (Certif. of Achievement)	15
705	San Jose City College	San Jose	Computer Information Systems		Web Developer-Level 3	18
706	San Jose City College	San Jose	Media Arts		Web Interactive Design/Level 1	36
707	San Jose City College	San Jose	Media Arts		Web Interactive Design/Level 2	15
708	San Jose City College	San Jose	Media Arts		Web Interactive Design/Level 3	27
709	San Jose City College	San Jose	Media Arts	A.S. in Media Arts	-	36
710	San Jose City College	San Jose	Media Arts		Media Arts-Level 1	36
711	San Jose City College	San Jose	Media Arts		Media Arts-Certificate of Specialization-Level 1	15
712	San Jose City College	San Jose	Media Arts	-	Media Arts- Level 3	27
713	Santa Rosa Jr. College	Santa Rosa	Business Administration	Paralegal Studies		36
714	Santa Rosa Jr. College	Santa Rosa	Computer Studies	Computer Science (A.S)		29
715	Santa Rosa Jr. College	Santa Rosa	Computer Studies	Graphic Design Major (A.A)		35
716	Santa Rosa Jr. College	Santa Rosa	Computer Studies	-	Graphic Design	43.5
717	Santa Rosa Jr. College	Santa Rosa	Computer Studies	-	Interactive Media Design	43.5
718	Santa Rosa Jr. College	Santa Rosa	Agriculture and Natural Resources	Environmental Horticulture: Garden Design Major (AS)		35

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
719	Santa Rosa Jr. College	Santa Rosa	Agriculture and Natural Resources	Environmental Horticulture: Garden Design with CAD Skills Major (AS)		28.5
720	Santa Rosa Jr. College	Santa Rosa	Geography	Geospatial Technology		32.5
721	Santa Rosa Jr. College	Santa Rosa	Health Science	Medical Assisting: Administrative		44.5
722	Santa Rosa Jr. College	Santa Rosa	Health Science	Medical Assisting: Administrative and Clinical		29.5
723	Santa Rosa Jr. College	Santa Rosa	Health Science	Medical Assisting: Clinical		49
724	Santa Rosa Jr. College	Santa Rosa	Health Science	Medical Assisting: Coding and Reimbursement		39
725	Santa Rosa Jr. College	Santa Rosa	Agriculture and Natural Resources		Environmental Horticulture: Garden Design Certificate of Achievement	32
726	Santa Rosa Jr. College	Santa Rosa	Agriculture and Natural Resources		Environmental Horticulture: Garden Design with CAD Skills Certificate of Achievement	28.5
727	Santa Rosa Jr. College	Santa Rosa	Applied Technology		Residential Architecture Skills Certificate	31.5
728	Santa Rosa Jr. College	Santa Rosa	Business Administration		Account Clerk Skills	17.5
729	Santa Rosa Jr. College	Santa Rosa	Business Administration		Administrative Assistant Certificate of Achievement	13.3
730	Santa Rosa Jr. College	Santa Rosa	Business Administration		Administrative Support 1 Skills	43
731	Santa Rosa Jr. College	Santa Rosa	Business Administration		Administrative Support 2 Certificate of Achievement	12.3
732	Santa Rosa Jr. College	Santa Rosa	Business Administration		Legal Office Support Skills Certificate	23.3
733	Santa Rosa Jr. College	Santa Rosa	Business Administration		Legal Secretary Certificate of Achievement	17.5
734	Santa Rosa Jr. College	Santa Rosa	Business Administration		Bookkeeper Certificate of Achievement	49.5
735	Santa Rosa Jr. College	Santa Rosa	Business Administration		Bookkeeper Assistant Certificate of Achievement	47
736	Santa Rosa Jr. College	Santa Rosa	Business Administration		Client Services Specialist Certificate of Achievement	25.3
737	Santa Rosa Jr. College	Santa Rosa	Business Administration		Office Assistant Skills Certificate	27
738	Santa Rosa Jr. College	Santa Rosa	Business Administration		Payroll Skills Certificate	15.5
739	Santa Rosa Jr. College	Santa Rosa	Business Administration		Supervisory Management Certificate of Achievement	12
740	Santa Rosa Jr. College	Santa Rosa	Business Administration		Virtual Assistant: Administrative Support Skills Certificate	28.5
741	Santa Rosa Jr. College	Santa Rosa	Business Administration		Virtual Assistant: Bookkeeping Skills Certificate	17.5
742	Santa Rosa Jr. College	Santa Rosa	Business Administration		Virtual Assistant: Promotional/Marketing Skills Certificate	17.5
743	Santa Rosa Jr. College	Santa Rosa	Computer Studies		Adobe Applications Specialist Skills	17.5
744	Santa Rosa Jr. College	Santa Rosa	Computer Studies		Adobe Certification Training in Illustrator Skills	16.5
745	Santa Rosa Jr. College	Santa Rosa	Computer Studies		Adobe Certification Training in InDesign Skills	6

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
746	Santa Rosa Jr. College	Santa Rosa	Computer Studies		Adobe Certification Training in Photoshop Skills	10
747	Santa Rosa Jr. College	Santa Rosa	Computer Studies		CIS Information Technology: Cisco Certification Training in CCNA Skills	13
748	Santa Rosa Jr. College	Santa Rosa	Computer Studies		CIS Information Technology: IT Essentials Certification Training in A+ Skills	17
749	Santa Rosa Jr. College	Santa Rosa	Computer Studies		Computer Help Desk Skills Certificate	10
750	Santa Rosa Jr. College	Santa Rosa	Computer Studies		Dreamweaver Web Content Developer Certificate of Achievement	17
751	Santa Rosa Jr. College	Santa Rosa	Computer Studies		General Multimedia Skills Certificate	16
752	Santa Rosa Jr. College	Santa Rosa	Computer Studies		Geospatial Technology Certificate of Achievement	16.5
753	Santa Rosa Jr. College	Santa Rosa	Computer Studies		Graphic Design Certificate of Achievement	44.5
754	Santa Rosa Jr. College	Santa Rosa	Computer Studies		Graphic Design Production Fundamentals Skills Certificate	43.5
755	Santa Rosa Jr. College	Santa Rosa	Computer Studies		HTML Web Content Developer Skills Certificate	16
756	Santa Rosa Jr. College	Santa Rosa	Computer Studies		Interactive Media Design Certificate of Achievement	10
757	Santa Rosa Jr. College	Santa Rosa	Computer Studies		Web Graphic Production Certificate of Achievement	35
758	Santa Rosa Jr. College	Santa Rosa	Computer Studies		Web Project Management Certificate of Achievement	17.5
759	Santa Rosa Jr. College	Santa Rosa	Computer Studies		Web Site Development: ASP Programmer Certificate of Achievement	16
760	Santa Rosa Jr. College	Santa Rosa	Computer Studies		Web Site Development: Java Programmer Certificate of Achievement	34
761	Santa Rosa Jr. College	Santa Rosa	Computer Studies		Web Site Development: JavaScript Programmer Certificate of Achievement	31.5
762	Santa Rosa Jr. College	Santa Rosa	Computer Studies		Web Site Development: PHP Programmer Certificate of Achievement	30
763	Santa Rosa Jr. College	Santa Rosa	Computer Studies		Web Site Development: Web Graphic Designer Certificate of Achievement	31.5
764	Santa Rosa Jr. College	Santa Rosa	Computer Studies		Microsoft Office Specialist Skills Certificate	29
765	Santa Rosa Jr. College	Santa Rosa	Computer Studies		Personal Computer Specialist Certificate of Achievement	15.5
766	Santa Rosa Jr. College	Santa Rosa	Health Science		Medical Assisting: Administrative Certificate of Achievement	33.5
767	Santa Rosa Jr. College	Santa Rosa	Health Science		Medical Assisting: Administrative and Clinical Certificate of Achievement	38.5
768	Santa Rosa Jr. College	Santa Rosa	Health Science		Medical Assisting: Clinical Certificate of Achievement	48
769	Santa Rosa Jr. College	Santa Rosa	Health Science		Medical Assisting: Coding and Reimbursement Certificate of Achievement	38

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
770	Shasta College	Redding	Business Technology		Accounting Clerk/Bookkeeper	31
771	Shasta College	Redding	Business Technology		Engineering Technology	28.5
772	Shasta College	Redding	Business Technology		Administrative Office Assistant Certificate	41
773	Shasta College	Redding	Business Technology		Administrative Office Professional Certificate	15
774	Shasta College	Redding	Business Technology		Health Information Management Certificate	32
775	Shasta College	Redding	Business Technology		Virtual Assistant Certificate	34
776	Shasta College	Redding	Computer Information Services		COMPUTER AIDED DRAFTING (CAD) TECHNOLOGY	17.5
777	Shasta College	Redding	Computer Information Services		Computer Networking Certificate – CCNA Option	41
778	Shasta College	Redding	Computer Information Services		Computer Networking Certificate – CCNP Option	31
779	Shasta College	Redding	Computer Information Services		Cisco Networking Certificate	31
780	Shasta College	Redding	Computer Information Services		Web Design Certificate	16
781	Shasta College	Redding	Computer Information Services		Computer Maintenance CERTIFICATE	16
782	Shasta College	Redding	Science, Language and Mathematics		Geographic Information System	14
783	Shasta College	Redding	Business Technology	Business Administration - Accounting Concentration	-	13
784	Shasta College	Redding	Business Technology	Computer Aided Drafting (CAD) Technology		37.5
785	Shasta College	Redding	Business Technology	Computer and Information Systems - Computer Networking Concentration CCNA Option		41
786	Shasta College	Redding	Business Technology	Computer and Information Systems - Computer Networking Concentration CCNP Option		42
787	Shasta College	Redding	Business Technology	Computer and Information Systems - Business Information Systems Concentration		42
788	Shasta College	Redding	Business Technology	Legal Assistant		48.5
789	Shasta College	Redding	Business Technology	Office Administration - Administrative Office Professional		43
790	Shasta College	Redding	Business Technology	Office Administration - Health Information Management		43
791	Sierra College	Rocklin	Business Technology	Graphic Design Concentration		34
792	Sierra College	Rocklin	Business Technology	Illustration Concentration	-	24
793	Sierra College	Rocklin	Business Technology	Multimedia Concentration	-	32
794	Sierra College	Rocklin	Business Technology	-	Graphic Design Concentration	32
795	Sierra College	Rocklin	Business Technology	-	Illustration Concentration	32
796	Sierra College	Rocklin	Business Technology	-	Multimedia Concentration	24

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
797	Sierra College	Rocklin	Business Technology	Accounting		24
798	Sierra College	Rocklin	Business Technology		Accounting	21
799	Sierra College	Rocklin	Business Technology	Administration Professional		21.5
800	Sierra College	Rocklin	Business Technology		Administration Professional	21
801	Sierra College	Rocklin	Business Technology	Business Administration		21
802	Sierra College	Rocklin	Business Technology	Business Entrepreneurship	-	21.5
803	Sierra College	Rocklin	Business Technology	General Business		23
804	Sierra College	Rocklin	Business Technology	-	General Business	23
805	Sierra College	Rocklin	Business Technology	Risk Management and Insurance		24
806	Sierra College	Rocklin	Liberal Arts	Arts		33
807	Sierra College	Rocklin	Communication Studies	Graphic Design Concentration		27
808	Sierra College	Rocklin	Communication Studies	Multimedia Concentration		26.5
809	Sierra College	Rocklin	Computer Information Systems	Administrative Technical Support		28
810	Sierra College	Rocklin	Computer Information Systems	-	Administrative Technical Support	27.5
811	Sierra College	Rocklin	Computer Information Systems	Computer Information Systems - Computer Application Concentration		27.5
812	Sierra College	Rocklin	Computer Information Systems		Computer Information Systems - Computer Application Concentration	20
813	Sierra College	Rocklin	Computer Information Systems	Computer Information Systems - Computer Service Technologist Concentration		20
814	Sierra College	Rocklin	Computer Information Systems		Computer Information Systems - Computer Service Technologist Concentration	19.5
815	Sierra College	Rocklin	Computer Information Systems	Computer Information Systems - Computer Support Concentration		19.5
816	Sierra College	Rocklin	Computer Information Systems		Computer Information Systems - Computer Support Concentration	21.5
817	Sierra College	Rocklin	Computer Information Systems	Computer Information Systems - Internet Concentration		21.5
818	Sierra College	Rocklin	Computer Information Systems		Computer Information Systems - Internet Concentration	21.5
819	Sierra College	Rocklin	Computer Information Systems	Computer Information Systems - Networking Concentration		21.5
820	Sierra College	Rocklin	Computer Information Systems	-	Computer Information Systems - Networking Concentration	24
821	Sierra College	Rocklin	Virtual Office Professional Program	Virtual Office Professional - Administrative Concentration		24
822	Sierra College	Rocklin	Virtual Office Professional Program		Virtual Office Professional - Administrative Concentration	29

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
823	Sierra College	Rocklin	Virtual Office Professional Program	Virtual Office Professional - Technical Support Concentration		29
824	Sierra College	Rocklin	Virtual Office Professional Program		Virtual Office Professional - Technical Support Concentration	29
825	Sierra College	Rocklin	Virtual Office Professional Program	Virtual Office Professional - Web Management Concentration		29
826	Sierra College	Rocklin	Virtual Office Professional Program		Virtual Office Professional - Web Management Concentration	29
827	Sierra College	Rocklin	Virtual Office Professional Program		Computer Essentials	29
828	Sierra College	Rocklin	Virtual Office Professional Program		PC Care	15
829	Sierra College	Rocklin	Virtual Office Professional Program		Microsoft Office Specialist - Core Level	13
830	Sierra College	Rocklin	Virtual Office Professional Program		Microsoft Office Specialist - Expert Level	10
831	Sierra College	Rocklin	Virtual Office Professional Program		Online Business	15
832	Sierra College	Rocklin	Virtual Office Professional Program		Web Page Editor	12
833	Sierra College	Rocklin	Virtual Office Professional Program		Web Site Production	13
834	Sierra College	Rocklin	Computer Science	Computer Science		13
835	Sierra College	Rocklin	Computer Science	Computer Science - Management Information Systems Concentration	-	27
836	Sierra College	Rocklin	Computer Science		Embedded Systems Concentration	27
837	Sierra College	Rocklin	Computer Science		Web Programming Concentration	20
838	Sierra College	Rocklin	Mathematics	Mathematics		21
839	Sierra College	Rocklin	Computer Integrated Electronics	Mechatronic Technology		23
840	Sierra College	Rocklin	Computer Integrated Electronics		Mechatronic Technology	24
841	Sierra College	Rocklin	Real Estate	Real Estate		24
842	Sierra College	Rocklin	Real Estate		Real Estate	21
843	Sierra College	Rocklin	Real Estate	Recreation Management	-	21
844	Skyline College	San Bruno	Business	Accounting		21
845	Skyline College	San Bruno	Business	-	Accounting	22.25
846	Skyline College	San Bruno	Business	-	Accounting Computer Specialist	22.25
847	Skyline College	San Bruno	Business	Business Administration (A.S)	-	10.25
848	Skyline College	San Bruno	Business		Business Administration	33.5
849	Skyline College	San Bruno	Business	Administrative Assistant	-	30.5
850	Skyline College	San Bruno	Business	-	Administrative Assistant	24
851	Skyline College	San Bruno	Business	Business Information Systems	-	24

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
852	Skyline College	San Bruno	Business		Business Information Systems	28
853	Skyline College	San Bruno	Business	Computer Information Specialist	-	28
854	Skyline College	San Bruno	Business	-	Computer Information Specialist	18
855	Skyline College	San Bruno	Business		General Supervision	18
856	Skyline College	San Bruno	Business	Legal Administrative Assistant	-	23.25
857	Skyline College	San Bruno	Business		Legal Administrative Assistant	26
858	Skyline College	San Bruno	Business		Medical Billing and Coding	26
859	Skyline College	San Bruno	Business		Medical Office Assistant	17
860	Skyline College	San Bruno	Business	Medical Transcriptionist	-	13
861	Skyline College	San Bruno	Business		Medical Transcriptionist	24
862	Skyline College	San Bruno	Business	Office Assistant	-	24
863	Skyline College	San Bruno	Business		Office Assistant	18
864	Skyline College	San Bruno	Business	Office Information Systems	-	18
865	Skyline College	San Bruno	Business		Office Information Systems	34
866	Skyline College	San Bruno	Business	Web Developer	-	34
867	Skyline College	San Bruno	Business		Web Developer	18.5
868	Skyline College	San Bruno	Science Mathematics & Technology	Mathematics	-	18.5
869	Skyline College	San Bruno	Telecommunications Wireless Networking Technology	-	Basic Networking	24
870	Skyline College	San Bruno	Telecommunications Wireless Networking Technology	-	Linux/Unix	12
871	Skyline College	San Bruno	Telecommunications Wireless Networking Technology	Network Engineering	-	7.5
872	Skyline College	San Bruno	Telecommunications Wireless Networking Technology	-	Network Engineering	33
873	Skyline College	San Bruno	Telecommunications Wireless Networking Technology	-	PC Configuration and Repairs	33
874	Skyline College	San Bruno	Telecommunications Wireless Networking Technology	-	Wiring and Installation	7
875	Solano College	Fairfield	Business, Computer Science & Career Technical Education	A.S. in Computer Programming	-	12
876	Solano College	Fairfield	Business, Computer Science & Career Technical Education		Computer Programming	33
877	Solano College	Fairfield	Business, Computer Science & Career Technical Education	A.S. In Microcomputer Applications		33
878	Solano College	Fairfield	Business, Computer Science & Career Technical Education		Computer Applications	30

	College	City	Department	Associate Degree/Option	Academic Certificate/Option	# of Units
879	Solano College	Fairfield	Business, Computer Science & Career Technical Education	A.S. in Web Development & Administration		30
880	Solano College	Fairfield	Business, Computer Science & Career Technical Education	-	Web Development & Administration	33
881	West Hills College	Coalinga	Computer Information Systems	A.S. in Computer Information Systems		33
882	West Valley College	Saratoga	Computer and Information Systems	A.S. in Computer Information Systems - Business Applications	-	18
883	West Valley College	Saratoga	Computer and Information Systems	A.S. in Computer Information Systems - Computer Science	-	49
884	West Valley College	Saratoga	Computer and Information Systems	-	Business Applications	44
885	West Valley College	Saratoga	Computer and Information Systems	-	Computer Science	40
886	West Valley College	Saratoga	Digital Media/Internet Services	A.A. in Digital Media Design and Production	-	37.5
887	West Valley College	Saratoga	Digital Media/Internet Services	-	Digital Media Design and Production	37
888	West Valley College	Saratoga	Digital Media/Internet Services	A.A. in Digital Publishing	-	17
889	West Valley College	Saratoga	Digital Media/Internet Services	-	Digital Publishing	36
890	West Valley College	Saratoga	Digital Media/Internet Services	A.A. in Web Design and Production - Design Emphasis	-	17
891	West Valley College	Saratoga	Digital Media/Internet Services	-	Web Design	36
892	West Valley College	Saratoga	Digital Media/Internet Services	A.A. in Web Design and Production - Production Emphasis	-	17
893	West Valley College	Saratoga	Digital Media/Internet Services	-	Web Production	36
894	West Valley College	Saratoga	Digital Media/Internet Services	-	Web Development	17
895	West Valley College	Saratoga	Computer Applications	A.S. in Computer Applicatons	-	17
896	West Valley College	Saratoga	Computer Applications	-	Computer Applicatons	38
897	West Hills College	Coalinga	Office Management and Technology	A.S. in Office Management and Technology		38
898	Yuba CC District	Marysville	Computer Science	A.S. in Computer Science		27.5

E: ICT User/Digital Literacy



In the information, knowledge and innovation economies of the 21st century, we increasingly depend on information and communications technologies (ICT). In the past 25 years, there has been a paradigm shift. Computer, communications, information and networking technologies have emerged, evolved, converged and permeated modern society. They have created profound transformations in the ways we do things, interact, and manage many aspects of modern life.

Students increasingly rely on ICT:

- To communicate with teachers
- To find and apply for schools
- To interact with school services
- To do research and schoolwork
- To present and demonstrate work
- To inform family members
- To build community with other students



Workers increasingly rely on ICT:

- To find and apply for jobs
- To prepare and present resumes and demonstrations of prior work
- To interact with employer HR and other systems
- To do their jobs, in all industries, most companies and most jobs
- To communicate with customers, suppliers and other business partners
- To collaborate and work with others



Enterprises increasingly rely on ICT:

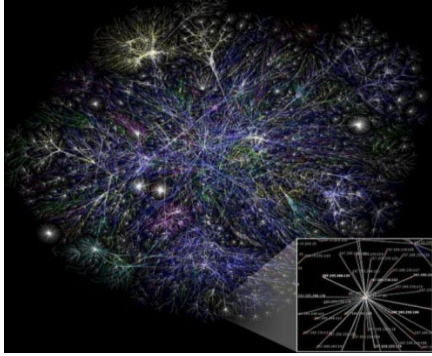
- To find and communicate with employees, customers and suppliers
- To create efficient business practices
- To manage operations
- To generate efficiencies and productivity that allow them to compete
- For regulatory compliance and reporting
- To serve and support customers



Citizens increasingly rely on ICT:

- To find, buy and sell goods and services
- For entertainment
- To find and access government services
- To manage relationships with family, friends and communities
- For support related to all kinds of products, services and systems





Directly and indirectly, ICT is important to all of us, and we all need to know how to work with common computing and communications devices, their common operating systems and applications, and the networks and systems that connect them and us.

People who have access to and can make productive use of ICT systems have critical tools for success in the modern world. Those who do not are disadvantaged. The separation of “Digital Haves” and “Digital Have-Nots” is referred to as the “Digital Divide,” and as a society we have a responsibility and a self interest in eliminating the Digital Divide, so our society and all within it can prosper.

California is working to address this very important issue. May 22, 2009, Governor Arnold Schwarzenegger signed Executive Order S-06-09, which endeavors to establish “Digital Literacy” as a goal for all California citizens. In the same way we all need to be able to read and write, do math, and understand basic science, history and government function, we also need to be able to work with ICT to be functional and self-sufficient members of 21st century society.

This effort has defined Digital Literacy as “a lifelong learning process of capacity building for using digital technology, communications tools, and/or networks in creating, accessing, analyzing, managing, integrating, evaluating, and communicating information in order to function in a knowledge based economy and society.”

There is widespread, high-level agreement in California on this definition and the importance of Digital Literacy, and there are many efforts around the globe to address this issue in modern societies.

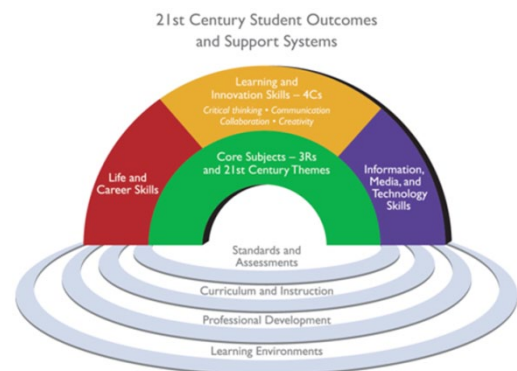
At the operational level, it gets more confusing. ICT moves quickly, and it is difficult to keep up with the changes. Language within the field is technical, chaotic and inconsistent. There are many different perspectives and values related to ICT and its use.



The [Partnership for 21st Century Skills](#), a cooperative [working group](#) representing many stakeholders, ICT companies and employers, has the mission: “To serve as a catalyst to position 21st century readiness at the center of US K12 education by building collaborative partnerships among education, business, community and government leaders.”

In its “Framework for 21st Century Learning” it has identified “21st Century Student Outcomes” (represented by the rainbow), the skills, knowledge and expertise students should master to succeed in work and life in the 21st century. Among those are 3 under “Information, Media and Technology Skills,” essentially Digital Literacy:

- Information Literacy (Information and)
- Media Literacy (Communications)
- ICT Literacy (Technologies)



Information Literacy:

Of these, there is the most consensus and established work around Information Literacy, thanks to long, concerted efforts, primarily by library-based initiatives, which have created and integrated K-12 academic standards in California. The elements of Information Literacy in California are:

Elements	Definitions	Competencies
Access	Knowing about and knowing how to collect and/or retrieve information	Search, find, and retrieve information in digital environments.
Manage	Applying an existing organizational or classification scheme.	Conduct a rudimentary and preliminary organization of accessed information for retrieval and future application.
Integrate	Interpreting and representing information - summarizing, comparing, and contrasting.	Interpret and represent information by using ICT tools to synthesize, summarize, compare, and contrast information from multiple sources.
Evaluate	Making judgments about the quality, relevance, usefulness, or efficiency of information.	Judge the currency, appropriateness, and adequacy of information and information sources for a specific purpose (including determining authority, bias, and timeliness of materials).
Create	Generating information by adapting, applying, designing, inventing, or authoring information.	Adapt, apply, design, or invent information in ICT environments (to describe an event, express an opinion, or support a basic argument, viewpoint or position).
Communicate	Communicating information persuasively to meet needs of various audiences through use of an appropriate medium.	Communicate, adapt, and present information properly in its context (audience, media) in ICT environments and for a peer audience.

(The only commonly used element of Information Literacy not included is “Define.” Many Information Literacy process descriptions start with the importance of a clear and appropriate statement of the problem, research question or issue for which information is sought.)

These Information Literacy elements have been integrated into [California K-12 educational standards for Information Literacy](#)²⁰.

They are traditionally embedded into the instruction of many different subjects, which require research paper and project work. These higher level skills are traditionally assessed by higher level evaluation by teachers, who grade student research papers and projects and provide thoughtful feedback on how students are addressing and can improve their thinking and work in these different areas. By the time a student finishes high school, he or she will have had many research paper and project experiences, supported and evaluated by librarians and teachers in many disciplines. (ETS is reintroducing the [iSkills](#) assessment for ICT/Information Literacy. [Project Sails](#) is another.)

Information Literacy addresses the highlighted portion of California’s Digital Literacy definition:

“a lifelong learning process of capacity building for using digital technology, communications tools, and/or networks in **creating, accessing, analyzing, managing, integrating, evaluating, and communicating information** in order to function in a knowledge based economy and society.”

Unfortunately, the California Digital Literacy effort has so far adopted only these Information Literacy elements into its Digital Literacy plans.

These higher level research and critical thinking skills now require ICT Literacy and Digital Media Literacy skills, because information sources are increasingly accessed through ICT systems, and the ways people work with, analyze and communicate information are increasingly through ICT systems. However, there is much less agreement, much less standardization and much less implementation of ICT Literacy and Digital Media Literacy in education today.

ICT Literacy:

ICT Literacy addresses the following highlighted portion of California’s Digital Literacy definition

“a lifelong learning process of capacity building for **using digital technology**, communications tools, **and/or networks** in creating, accessing, analyzing, managing, integrating, evaluating, and communicating information in order to function in a knowledge based economy and society.”

To be information literate, to be digitally literate, one needs a basic understanding and ability to work with information and communications technologies. One needs to understand and be able to work with common computing and communications devices, operating systems and applications. One needs to understand, be able to access and use the public Internet and other networked systems. One needs to know how to use ICT safely and productively.

There are currently no adopted academic standards for ICT Literacy in California, and there is much inconsistency in the availability of ICT systems and instruction in their use in California schools.



**EUROPEAN COMPUTER DRIVING LICENCE /
INTERNATIONAL COMPUTER DRIVING LICENCE**

Globally, the most widely adopted assessment for ICT Literacy is the vendor neutral [International Computer Driving License](#) (known as the European Computer Driving License in Europe). “The mission of (nonprofit) ICDL US is to enable the proficient use of Information and Communication Technology (ICT) that empowers individuals, organisations and society, through the development, promotion, and delivery of a quality certification program. ICDL US also promotes the development and investment in digital literacy at state, national and international level. To date, over 9 million candidates have enrolled in ICDL programs.” ICDL/ECDL is delivered in 148 countries and 41 languages worldwide.

ICDL curriculum and assessments are for computer and common computer application basics, and a certification is available for students who pass the ICDL test.



Another common ICT Literacy assessment is [Certiport’s IC3](#) (Internet and Computing Core Certification), which covers computing fundamentals, key computer applications and Internet living.



A third common ICT Literacy curriculum and assessment in the U.S. is [College Board's College-Level Examination Program® \(CLEP\) in Information Systems & Computer Applications](#). However, this is probably more advanced than expectations for a K-12 system graduate or every citizen.

The Mid-Pacific ICT (MPICT) Center summarizes ICT Literacy skills as:

<p>ICT Hardware</p>	<ul style="list-style-type: none"> •What are common ICT computing, communications and peripheral devices , what are their common components, and how do they work? •What are they used for and by whom? •How are they acquired, set up, configured, maintained, managed, upgraded and customized? •What are ethical uses and unethical abuses of them?
<p>Software: ICT Operating Systems</p>	<ul style="list-style-type: none"> •How do users interface and interact with common ICT devices? •How do hardware and software work together? •What are the major common features of operating systems and how do they work? •How do you organize, secure, manage and backup data and information in these systems? •How do you acquire, install, set up, customize, maintain, manage, secure and troubleshoot operating systems?
<p>Software: ICT Applications</p>	<ul style="list-style-type: none"> •What are different types and general concepts relating to application software categories? •What are common application functions and how do they work? •How do you use common applications effectively (wordprocessing, spreadsheet, presentation, email, web browser, search engine, database, social media, audio, digital image, digital video, voice, collaboration, etc.)? •How do you evaluate, acquire, install, set up, customize, maintain, manage, secure and troubleshoot common software applications? •What are appropriate and ethical uses and unethical abuses of software applications?
<p>Networking and Telecommunications</p>	<ul style="list-style-type: none"> •How does communication take place using ICT devices and software? •What are common networking and telecommunications solutions and services? •How do you evaluate, acquire, install, set up, customize, maintain, manage, secure and troubleshoot common networking and telecommunications solutions and services? •What are appropriate /ethical uses & unethical abuses of networking & telecom solutions/services?
<p>ICT and Society</p>	<ul style="list-style-type: none"> •What is the history of ICT and its impact on society? •Why and how do people, organizations and governments use ICT and what are they able to accomplish with ICT? •What are major components of ICT industry? •What are major opportunities and requirements for ICT employment? •What are social opportunities and risks associated with ICT?

California needs to settle on a definition and assessments for elements of ICT Literacy, as it has done for Information Literacy. By the time a student graduates high school, what do they all need to know and be able to do with ICT technologies. California also needs to develop and adopt K-12 academic standards for ICT Literacy, as it has done with Information Literacy. At each grade level, what should a student know and be able to do with ICT technologies? We need a clear answer to these questions.



Digital Media Literacy

Today, communications increasingly take place through digital media. Documents are prepared via word processing and page layout applications. ICT systems are used to project digital slides for presentations. Videoconferencing is increasingly accessible and important. Online collaboration systems are used in education and work environments. Email is an important way to communicate. Social media applications have experienced explosive growth, and they are being used by enterprises as well as individuals.

People can record music on home computer systems more powerful than anything used by the Beatles. Digital cameras record still and moving images, which can be integrated by everyday users into movies and all kinds of media. Modern telephones are digital communication devices. Users can broadcast audio and video over the Internet. Many digital media are accessible through mobile devices. Digital music and video are managed on computer systems. Television and radio are digital media. Computer gaming is digital media.

We need to help students understand, critically evaluate and make productive use of digital media. Many of these digital media are not addressed in ICT Literacy or Information Literacy definitions, standards and assessments. Digital Media Literacy addresses the following highlighted portion of California's Digital Literacy definition:

“a lifelong learning process of capacity building for **using** digital technology, **communications tools**, and/or networks in creating, accessing, analyzing, managing, integrating, evaluating, and communicating information in order to function in a knowledge based economy and society.”

The National Association for Media Literacy provides the following definitions:

- Media - all electronic or digital means and print or artistic visuals used to transmit messages.
- Literacy - the ability to encode and decode symbols and to synthesize and analyze messages.
- Media literacy - the ability to encode and decode the symbols transmitted via media and the ability to synthesize, analyze and produce mediated messages.
- Media education - the study of media, including 'hands on' experiences and media production.
- Media literacy education - the educational field dedicated to teaching the skills associated with media literacy.

The Partnership for 21st Century Skills calls out the following aspects of Digital Media Literacy:

Analyze Media

- Understand both how and why media messages are constructed, and for what purposes
- Examine how individuals interpret messages differently, how values and points of view are included or excluded, and how media can influence beliefs and behaviors
- Apply a fundamental understanding of the ethical/legal issues surrounding the access and use of media

Create Media Products

- Understand and utilize the most appropriate media creation tools, characteristics and conventions
- Understand and effectively utilize the most appropriate expressions and interpretations in diverse, multi-cultural environments

What are the Digital Media Literacy knowledge and skill sets we expect of digitally literate citizens, and what are the Digital Media Literacy knowledge and skill sets we expect of students at each K-12 grade level? California needs to develop a clear answer to these questions.

Related Issues:

- **ICT Infrastructure in Communities:** Many communities do not have high speed access to the Internet – at all. Many families cannot afford or have not chosen to acquire ICT infrastructure for their homes. As a society, we need to address that aspect of the Digital Divide if we are going to achieve the benefits of a digitally literate population.
- **ICT Infrastructure for Schools:** Many K-12 schools in California have inadequate ICT infrastructure to teach or give students access to modern computing and communications devices, systems and services. If students do not have access to ICT infrastructure at home, we should at least provide equal and fair access to ICT infrastructure for students in schools.
- **Teacher Professional Development in ICT:** If we are going to expect teachers to impart digital literacy knowledge and skills to students, we have to teach them how to do so. Many teachers are not digitally literate themselves, and their aversion to ICT technologies is communicated to students.
- **ICT Career Exploration:** ICT provides 1 in 20 jobs in the U.S. and in California today; these jobs pay twice the median in California; and they have much better than average growth prospects. We need to expose students to ICT related education and career pathways starting in middle schools. We also need to explicitly attract to Engineering and Computer Science fields students who will drive ICT innovation in the future.



California Digital Literacy Synthesis and Public Relations:

California's Digital Literacy effort has begun very important work on a critical 21st century social and education issue. It has created a statement of need and a definition of Digital Literacy that are easily understood and generate widespread agreement with a large variety of stakeholders.

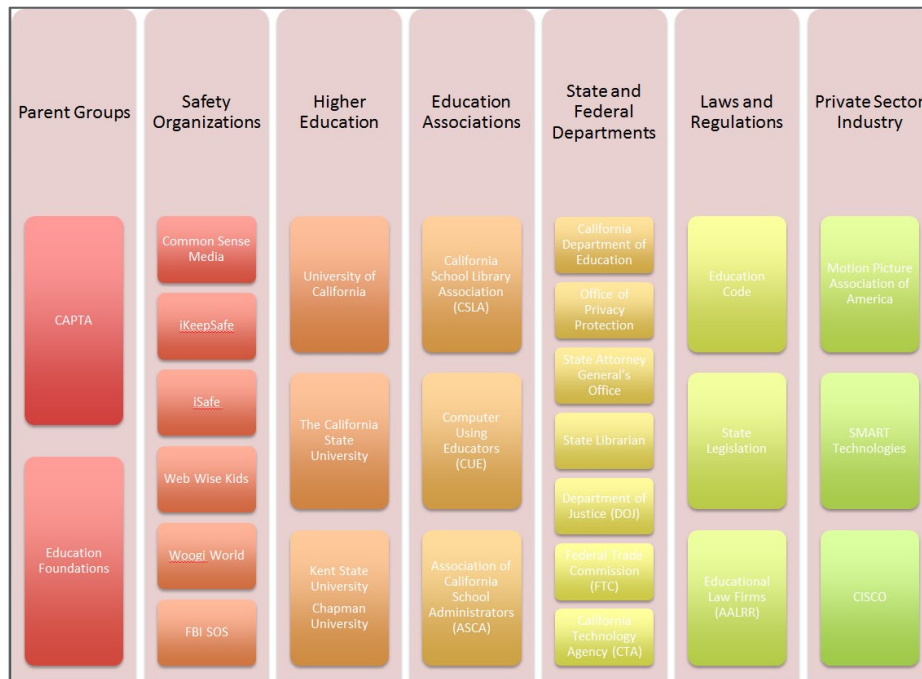
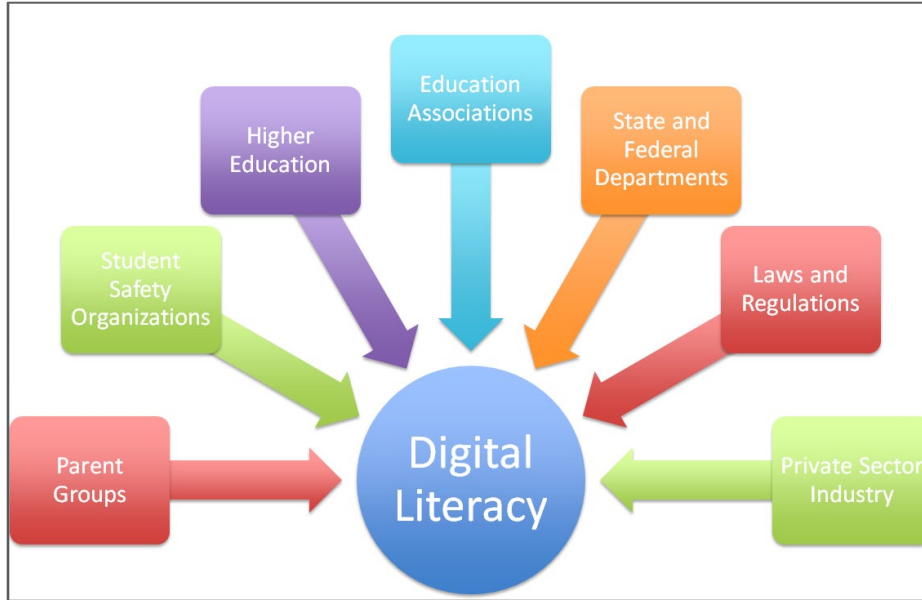
It has a great foundation to build on with the library based efforts to create Information Literacy standards and integrate them into teaching and learning in K-12 education in the state. It now needs to:

- Come up with standard elements for ICT Literacy and for Digital Media Literacy, or a combination of those two. We need standard terms and structure.
- Come up with K-12 academic standards for those elements at different grade levels.
- Settle on a method for assessing student performance against those standards.

California's Digital Literacy effort has begun a public relations campaign to publicize the importance of Digital Literacy. That effort includes videos from many reputable people. It now wants to expand on that campaign, to get the word out to the general public and various stakeholder groups. What is that message and what is its purpose? Current high level expressions of support for the importance of addressing Digital Literacy and overcoming the Digital Divide are not controversial. But that's where this whole effort started. What is it that we are announcing or asking people to do that is the focus of a public relations campaign?

Ideally, we would announce the high level definition of digital literacy we have; high level elements of digital literacy for ICT Literacy, Digital Media Literacy and Information Literacy in plain language that everyone would understand; and provide a rationale for why they are important. We would announce the implementation of standard definitions and K-12 academic standards for ICT Literacy, Digital Media Literacy and Information Literacy and help students, teachers, families and citizens feel good about implementing them. We would encourage citizens no longer in K-12 systems to get Digital Literacy knowledge and skills through remediation, community colleges, self study and community based organizations. We would paint a picture of digitally literate 21st century success and prosperity.

We should be able to get the support of many organizations and enterprises in that public relations effort, because we share a common interest in the outcomes of Digital Literacy and a digitally literate society for all. Partnership for 21st Century Skills, for one, would be a great channel for finding support for such a public relations campaign through its many well-funded members and contacts. Other organizations that this effort could/should coordinate with might include²¹:



Another PR campaign purpose could be to put public pressure on policymakers and educational system administrators and planners to create and implement standards for Digital Literacy, based on shared understanding of the importance of Digital Literacy which is not yet addressed in K-12.

California community colleges should engage in this extremely important issue.

Endnotes

- ¹ See generally, Breshnahan, Timothy F., et al., Information Technology, Workplace Organization, and the Demand for Skilled Labor: Firm-level Evidence, 2000.
- ² <http://archive.ifla.org/ll/standard.htm>
- ³ See <http://www.census.gov/eos/www/naics/>.
- ⁴ See NAICS 51, available at <http://www.census.gov/>. See also O*NET Online, available at <http://www.onetonline.org/find/career?c=3&g=Go>.
- ⁵ EMSI Complete Employment, Q2 2011
- ⁶ WANTED provides real-time business intelligence for the talent marketplace. Clients in the staffing, HR, RPO, media, and government sectors use WANTED Analytics™ to find sales leads, analyze employment trends, gather competitive intelligence, forecast economic conditions, and source hard-to-fill positions. The company began collecting detailed Hiring Demand data in June 2005, and currently maintains a database of more than 600 million unique job listings. WANTED is also the exclusive data provider for The Conference Board's Help-Wanted Online Data Series™, the monthly economic indicator of Hiring Demand in the United States. www.wanted.com
- ⁷ Monster Government Solutions is the premier global provider of real-time labor intelligence (RLI) and advisory services to government, education, economic development and labor-focused research organizations. Monster's RLI provides the demand and supply side data, analysis and insights to drive decisions related to both strategic and tactical workforce, economic, and educational development. Our RLI services utilize Monster's vast data resources, large, experienced internal analyst team and extensive partner network to deliver highly actionable research solutions. Our solutions utilize Monster's vast databases of talent supply and demand. <http://about-monster.com/content/who-we-are>
- ⁸ <http://www.onetonline.org/>
- ⁹ Social Media Trends with Silicon Valley Employers, NOVA Workforce Investment Board, 2011.
- ¹⁰ <http://www.acm.org/education/>
- ¹¹ Ibid
- ¹² http://www.air.org/files/CA_Fiscal_Crisis_Report_Draft_Final_May_19.pdf, page 1
- ¹³ Closing the Gap: Meeting California's Need for College Graduates, Hans Johnson and Ria Sengupta with contributions from Patrick Murphy, Public Policy Institute of California, April 2009, www.ppic.org/main/publication.asp?i=835
- ¹⁴ http://www.oecd.org/document/24/0,3746,en_2649_39263238_43586328_1_1_1_1,00.html
- ¹⁵ <http://www.e-skills.com/standards-and-qualifications/national-occupational-standards-nos/>
- ¹⁶ http://ec.europa.eu/education/lifelong-learning-policy/doc48_en.htm
- ¹⁷ http://ec.europa.eu/education/lifelong-learning-policy/doc50_en.htm
- ¹⁸ <http://aspect-project.org/node/2>
- ¹⁹ <http://www.epict.org/>
- ²⁰ <http://www.cde.ca.gov/ci/cr/lb/documents/stndrdsgrdwintro.doc>
- ²¹ Graphics produced by Glen Warren of the California School Library Association