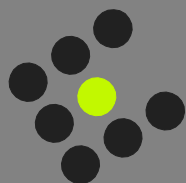


Information & Communications Technologies

Advancing Digital Literacy
in the Greater Sacramento Region



2011



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CENTERS OF EXCELLENCE
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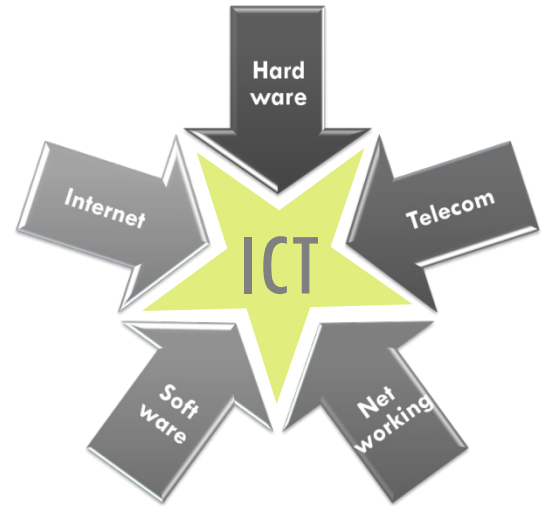
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Introduction

The Information and Communications Technologies (ICT) sector encompasses all rapidly emerging, evolving, and converging computer, software, networking, telecommunications, Internet, programming, and information systems technologies. ICT is a flexible framework for organizing these interdependent, inter-related and rapidly changing high-tech fields and their workforce, spanning firms of all sizes and industries.

The ICT framework is widely used outside the U.S., for example, by the United Nations, European Union, World Bank, and International Telecommunications Union. Even though ICT is not a widely used term in the U.S., it is a strategically important sector that is a major driver of the California economy.



To better understand the size and scope of the ICT sector in California, the Centers of Excellence developed a crosswalk that identifies primary and secondary ICT industries and occupations in the North American Industry Classification System (NAICS) and Standard Occupation Classification System (SOC), respectively. In addition, the COE conducted a survey to identify the core job functions of ICT in the greater Sacramento economy, including the identification of advanced and basic literacy competencies.¹

Building on the statewide research of ICT conducted by the Centers of Excellence, this report provides (1) an analysis of the size and scope of the ICT sector in the Sacramento Region and (2) profiles ICT digital literacy competencies required across all sectors.

ICT Industry Overview

Information and Communications Technologies is the convergence of computer networking and telecommunications. The ICT umbrella organizes budding technologies related to telecommunications, computing, networks, and other high-tech fields. ICT job functions impact all businesses, regardless of industry type or size of employment. However there are a core set of industries that engage primarily in ICT activities that can be used to define the sector.

Crosswalking the ICT job functions to traditional NAICS and SOC codes provides an opportunity to scope the size and importance of the ICT sector and related occupations in the California economy. There are five primary ICT industry groups as well as a secondary industry group that either produce or provide ICT products or services.

- **ICT Component Manufacturing** – This industry group comprises establishments primarily engaged in manufacturing computers, storage devices, terminals, telephone apparatus, broadband and wireless communications equipment, fiber optical cable, and other peripheral and telecommunication equipment.

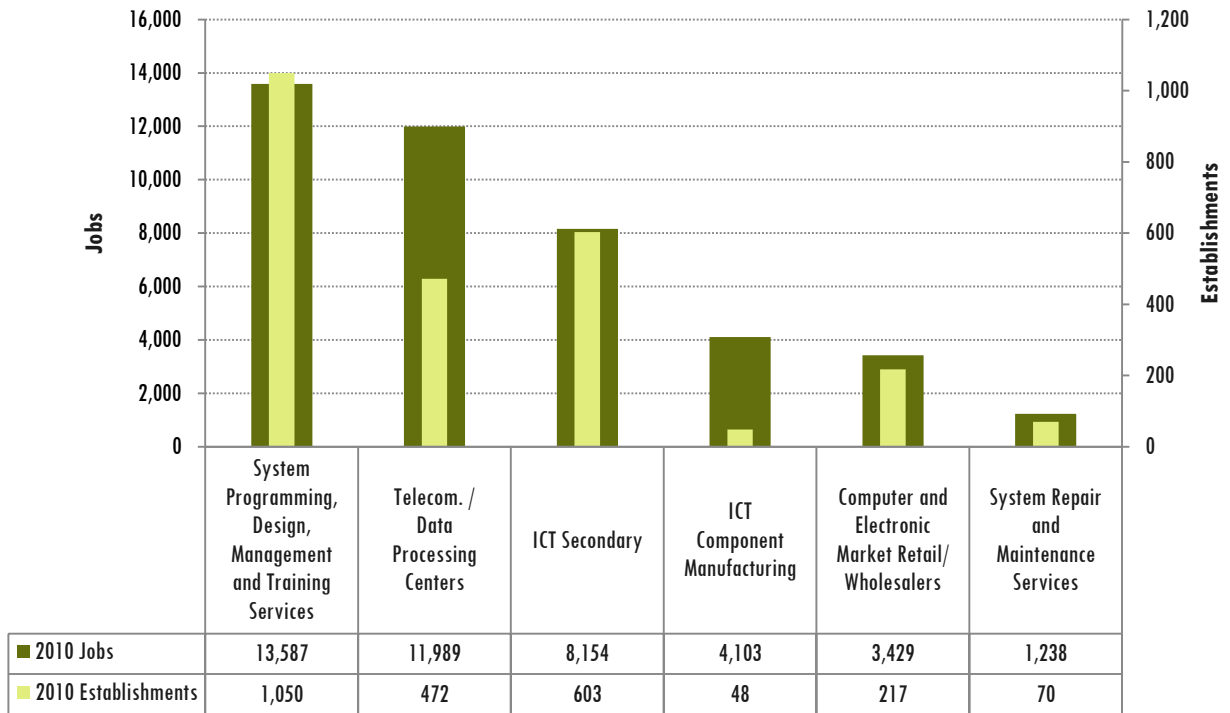
¹ Sacramento Region includes Sacramento, El Dorado, Placer, Yolo, Yuba and Sutter counties.

- **System Programming, Design, Management and Training Services** – This industry group comprises establishments primarily engaged in programming, planning and designing computer systems that integrate computer hardware, software, and communication technologies. This group also includes establishments that provide on-site management and operation of clients' computer systems and/or data processing facilities or training services.
- **System Repair and Maintenance Services** – This industry group comprises establishments primarily engaged in repairing and maintaining computers, office machines and telecommunications equipment.
- **Computer and Electronic Market Retail/Wholesalers** – This industry group comprises establishments primarily engaged in the merchant wholesale distribution and retail of computers, computer peripheral equipment, loaded computer boards, and/or computer software. These establishments are also engaged in retailing all types of merchandise using the Internet, internet auctioning, and business-to-business electronic markets.
- **Telecommunication/Data Processing Centers** – This industry group comprises establishments primarily engaged in operating and/or providing access to transmission facilities and infrastructure that they own and/or lease for the transmission of voice, data, text, sound, and video. This group also includes establishments that resell telecommunication services; provide specialized telecommunications services; provide data processing, hosting, and related services; and provide internet publishing and broadcasting.
- **ICT Secondary Industries** – This industry group includes all other establishments where some percentage of the companies is ICT related, but because of the classification scheme, it is impossible to determine the exact percentage directly related to ICT. A conservative estimate of 25% has been applied to assess the total number of direct jobs related to information and telecommunications technologies. Appendix C provides additional details about the industry and occupational crosswalks.

As measured by the NAICS crosswalk, the economic impact of the ICT sector in the Sacramento Region is significant. ICT represents a large number of businesses, a considerable share of private sector wages, and is a vital sector for employment in the region. This Industry Overview Section provides an analysis of secondary data sources on employment across all occupations at ICT-related firms.

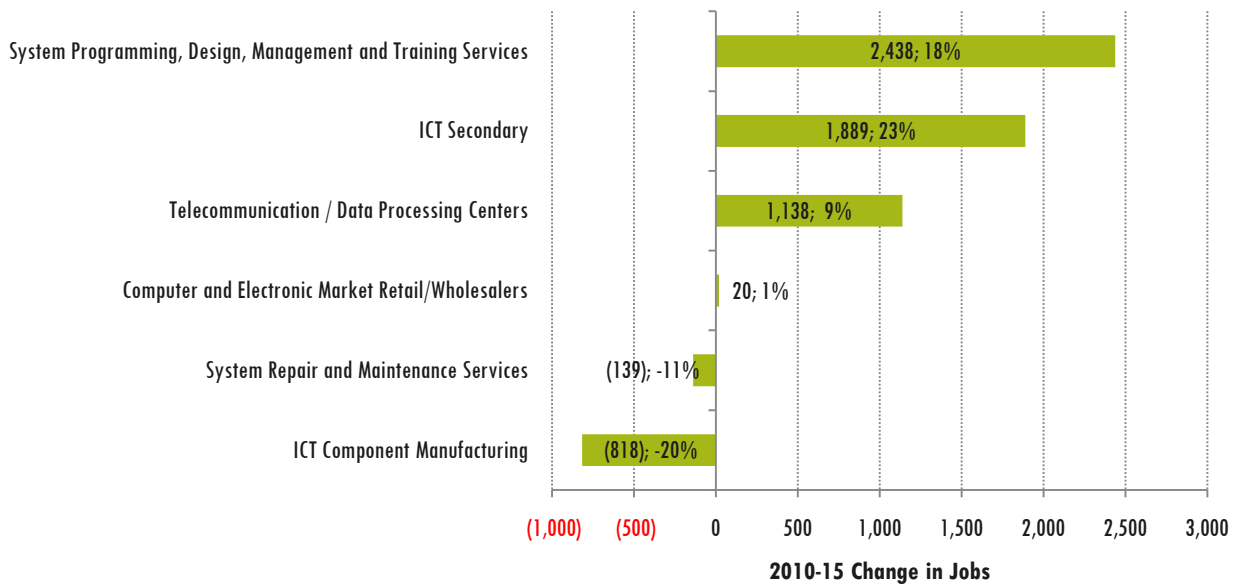
As shown in Exhibit 1, system programming, design, management and training services is the largest ICT industry group in the Sacramento Region with approximately 1,050 businesses and 13,600 jobs. Telecommunications/data processing centers is also a large industry group with 470 establishments and nearly 12,000 jobs.

Exhibit 1: ICT Jobs and Establishments in the Sacramento Region²



The ICT sector is expected to grow by 11 percent in the next five years, adding a total of 4,500 jobs. As shown in Exhibit 2, four of the six industry groups are expected to add jobs. However, system repair and maintenance services and ICT component manufacturing are both expected to decline, shedding as many as 960 jobs over the next five years.

Exhibit 2: ICT 5-Year Projected Change in Employment in the Sacramento Region



² EMSI Complete Employment - 4th Quarter 2010

Industry wages are reported in two categories: (1) wages, salaries and proprietors' earnings;³ and (2) supplements to wages and salaries, which includes employer contributions to employee pension and insurance funds [private and/or government] as well as employer contributions to government social insurance. The regional earnings per worker (EPW) includes wages, salaries, and proprietor earnings plus supplements. As shown in Table 1, ICT wages in every industry group are higher than the region's average wages across all industry sectors. ICT component manufacturing is the highest paid industry group, followed by system programming, design, management and training Services, and computer and electronic market retail/wholesalers.

Table 1: ICT Industry Wages in the Sacramento Region⁴

Description	Wages, Salaries, & Proprietor Earnings Per Worker	Supplements Per Worker	Regional Earnings Per Worker (EPW)
ICT Component Manufacturing	144,703	33,259	177,962
System Programming, Design, Management and Training Services	74,035	9,873	83,908
Computer and Electronic Market Retail/Wholesalers	65,754	10,447	76,201
Telecommunication / Data Processing Centers	62,207	13,373	75,580
ICT Secondary	64,186	9,240	73,426
System Repair and Maintenance Services	52,418	7,950	60,368
Employment across all industries	\$45,299	\$9,111	\$54,410

Occupational Overview

In the 21st century, nearly every company relies on ICT for its day-to-day operations. Therefore, it is not surprising that the majority of ICT employment occurs in non-ICT firms, or that ICT workers represent a significant piece of California's labor market. Unlike the employment figures presented in the industry overview, the data included in this section are not specific to any given industry group, but focus only on those employees that work directly with Information and Communications Technologies.

Primary ICT occupations are assumed to be 100 percent related to ICT employment, and include occupations such as database administrators, network systems analysts and computer programmers. Secondary ICT occupations are assumed to be partially involved in ICT employment activities, and include occupations such as technical writers and graphic designers. Appendix A provides the complete ICT occupational crosswalk.

As shown in Exhibit 3, there are about 64,160 ICT jobs in the Sacramento Region, 39,820 primary ICT positions and 24,340 secondary ICT positions. Over the next five years, Sacramento employers are projected to add approximately 6,690 new jobs and replace 6,800 existing ICT workers due to retirements and general separations.⁵ Primary ICT jobs

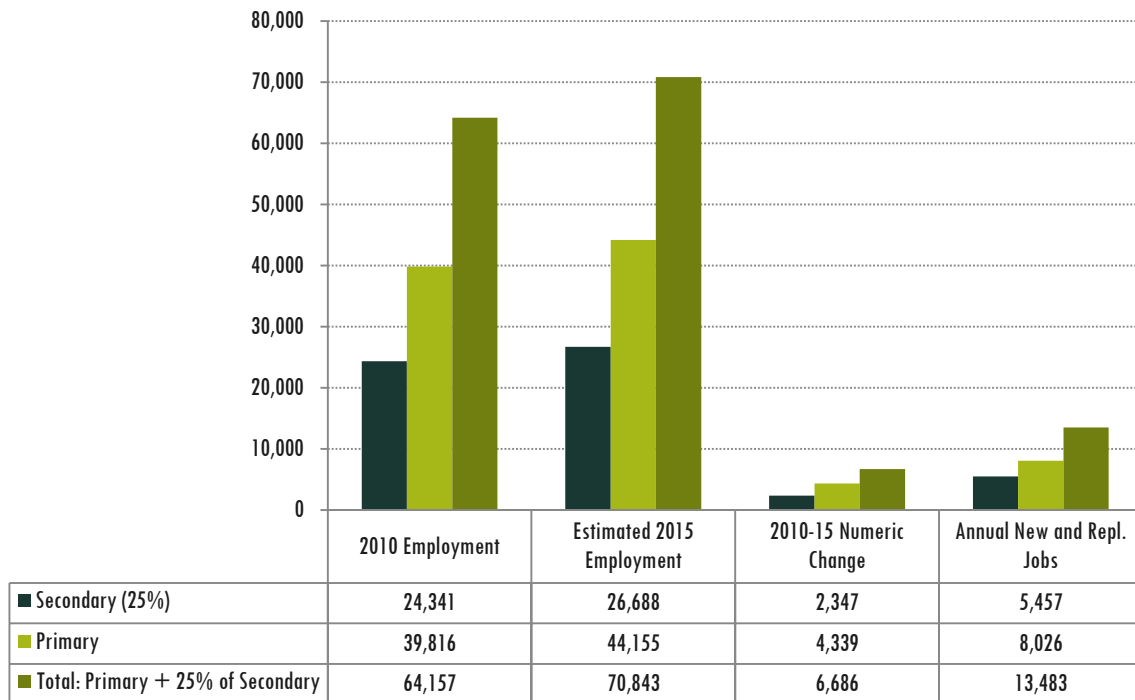
³ EMSI defines proprietors' earnings as "net-profit-less-loss" that is generally reported to the IRS on forms 1040 and 1065; because these can fluctuate wildly year-to-year, EMSI "smoothes" the data to reflect a typical year.

⁴ EMSI Complete Employment - 4th Quarter 2010.

⁵ General separations include turnover within the industry as well as those leaving for another type of position – i.e. changing careers.

provide above average wages with a median wage of \$31.70 per hour. Secondary ICT jobs provide median wages that are slightly below the regional average at \$17.50 per hour.⁶

Exhibit 3: ICT Occupation Employment in the Sacramento Region⁷

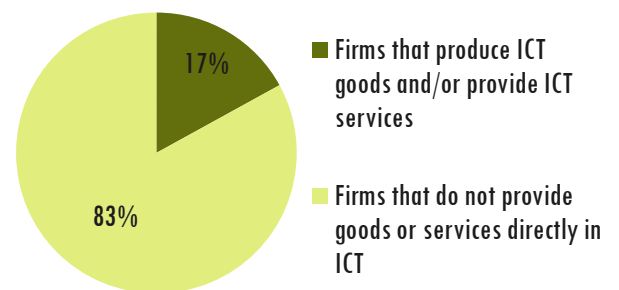


Primary Research on Employer Needs and Challenges

The Center of Excellence surveyed more than 150 employers in the Sacramento Region to obtain detailed information regarding their preferences, difficulties, requirements, and attitudes about ICT in the workplace. In addition, the COE conducted a web panel of 65 firms to identify the basic ICT digital literacy requirements for entry level workers. This section reviews the findings from the ICT survey and ICT web panel.

As shown to the left, 17 percent of the firms that responded to the survey produce ICT goods and/or provide ICT services in the region. Eighty-three percent of the firms are not directly involved in providing ICT goods or services; rather, they are considered ICT user firms. These firms use information and telecommunication technologies to conduct their daily operations. Approximately 15 percent of the workers in both ICT user firms and ICT firms are required to have advanced ICT skills.

Exhibit 4: Survey Respondents by Type



⁶ The regional median wage for Sacramento workers across all industries is \$19.80 per hour. EMSI Complete Employment - 4th Quarter 2010.

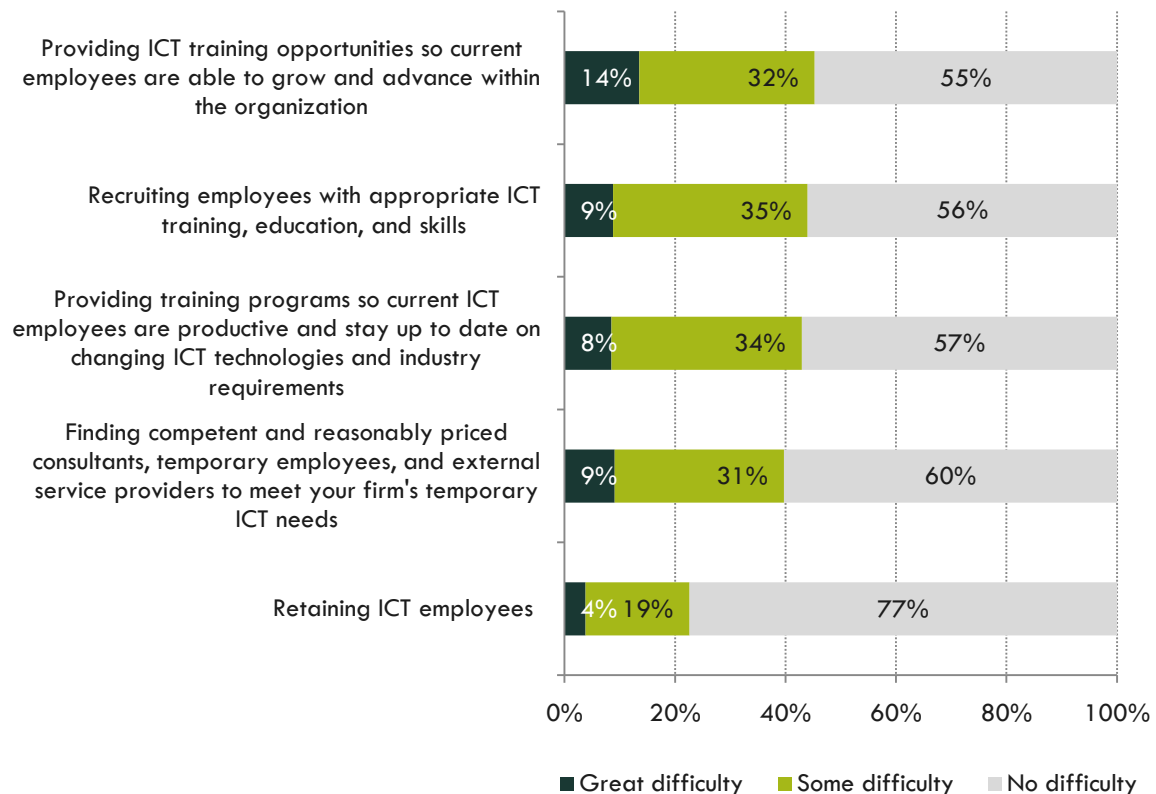
⁷ EMSI Complete Employment - 4th Quarter 2010.

Workplace Challenges & Opportunities

Over the next two years, 39 percent of the firms surveyed expect to add workers with ICT skills to their payroll, 57 percent expect to maintain the same number of ICT workers, and less than one percent plan to downsize their ICT staff.⁸ This equates to a two-year growth rate of 16 percent, which suggests that ICT is becoming increasingly important to the success of local businesses.

Exhibit 5 displays the level of difficulty these organizations currently face in recruiting, retaining, and training ICT employees. The respondents reported the highest level of difficulty providing ICT training opportunities so current employees are able to grow and advance within the organization, followed by recruiting ICT employees with the appropriate skills, and providing training to keep employees up-to-date on current technology. These findings indicate that ICT training is a significant issue in the workplace.

Exhibit 5: ICT Workplace Issues and Challenges



⁸ Three percent of the survey respondents declined to answer this question.

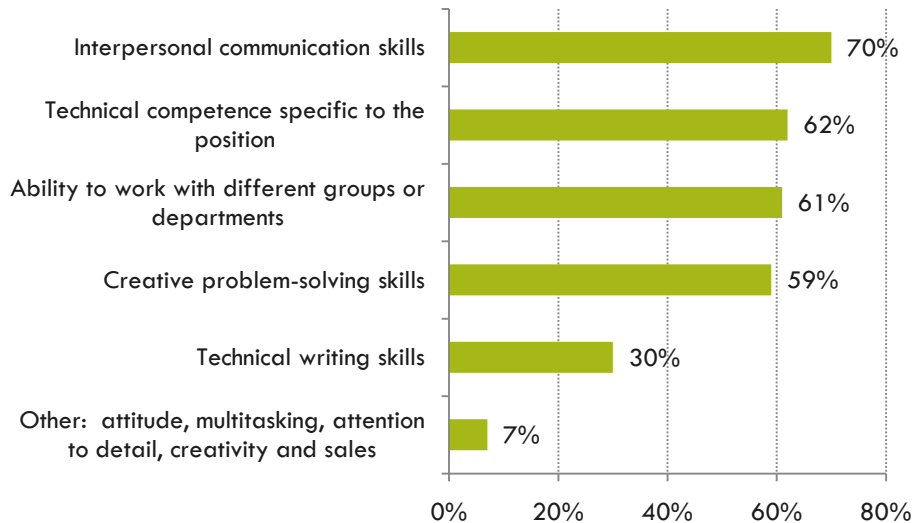
Skills, Education and Training Needs

Information and communications technologies are an integral facet of most business operations in the Sacramento Region. In fact, 85 percent of the respondents reported that information and communications technologies are important to the productivity of their organizations, and 75 percent reported that ICT skill sets will grow in importance for their employees.

Two-thirds of ICT workers are not required to have a bachelor's degree.

The following exhibit displays the most important skills employers require of candidates seeking an ICT position. The majority indicated that interpersonal communication skills, technical competence specific to position, ability to work with different groups or departments, and creative problem-solving skills are the most important skills for new hires. In addition, only about one-third of employers surveyed require their ICT workers to have a bachelor's degree.

Exhibit 6: Principal Skill Requirements for ICT Occupations



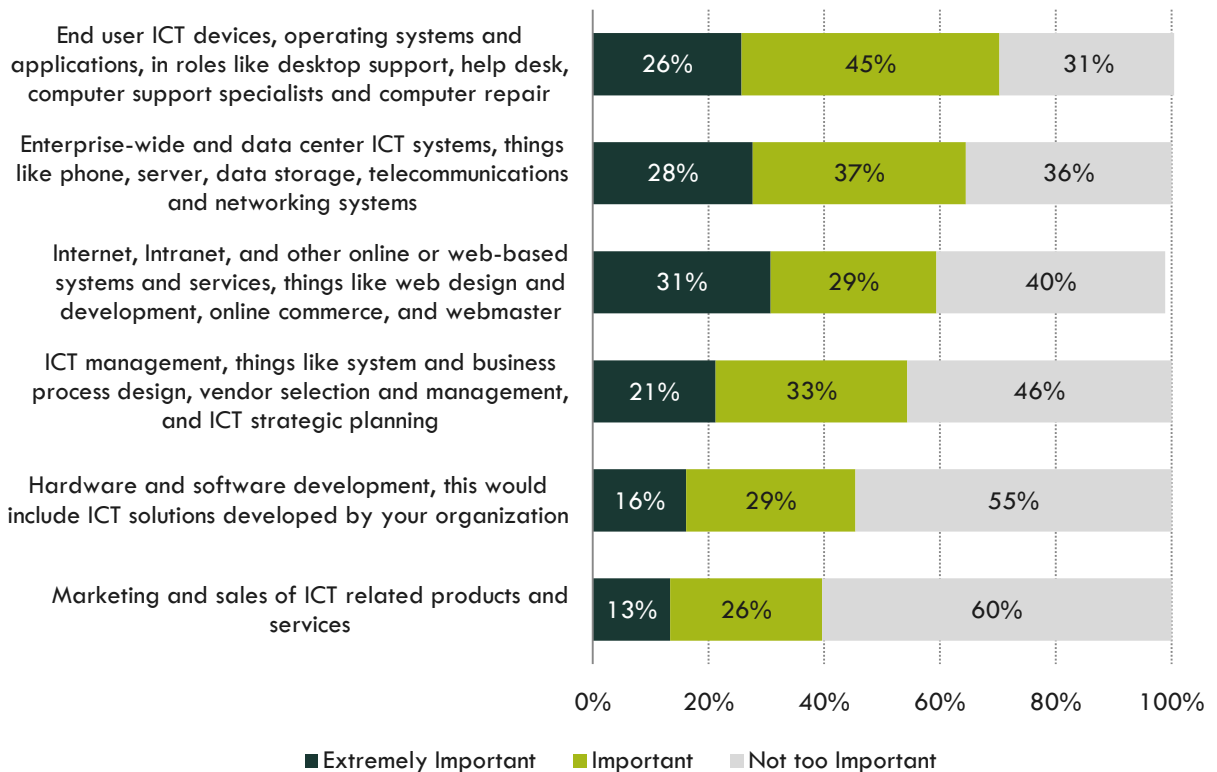
Employers were also asked to comment on the current status of ICT training and education in the region.

- Sixty percent reported that their organization would value a credential certifying basic ICT user knowledge and skills, also known as digital literacy.
- Fifty-seven percent indicated that their organization would value statewide ICT standards that align employer needs with education and training programs.

Advanced ICT Job Function Requirements

Advanced ICT workers deploy, manage, and enable ICT infrastructure and systems and support their users. Based on this definition, respondents were asked to rank the level of importance for six advanced ICT job functions. As shown below, 71 percent of employers ranked the ability to enable and support end user ICT devices, operating systems and applications as important or extremely important. Two-thirds of the employers ranked the ability to enable and support enterprise-wide and data center ICT systems, such as phone, server, data storage, telecommunications and networking systems, as important or extremely important. These job functions are critical to improving an organization’s productivity in today’s digital environment.

Exhibit 7: Top Job Functions of Advanced ICT Workers



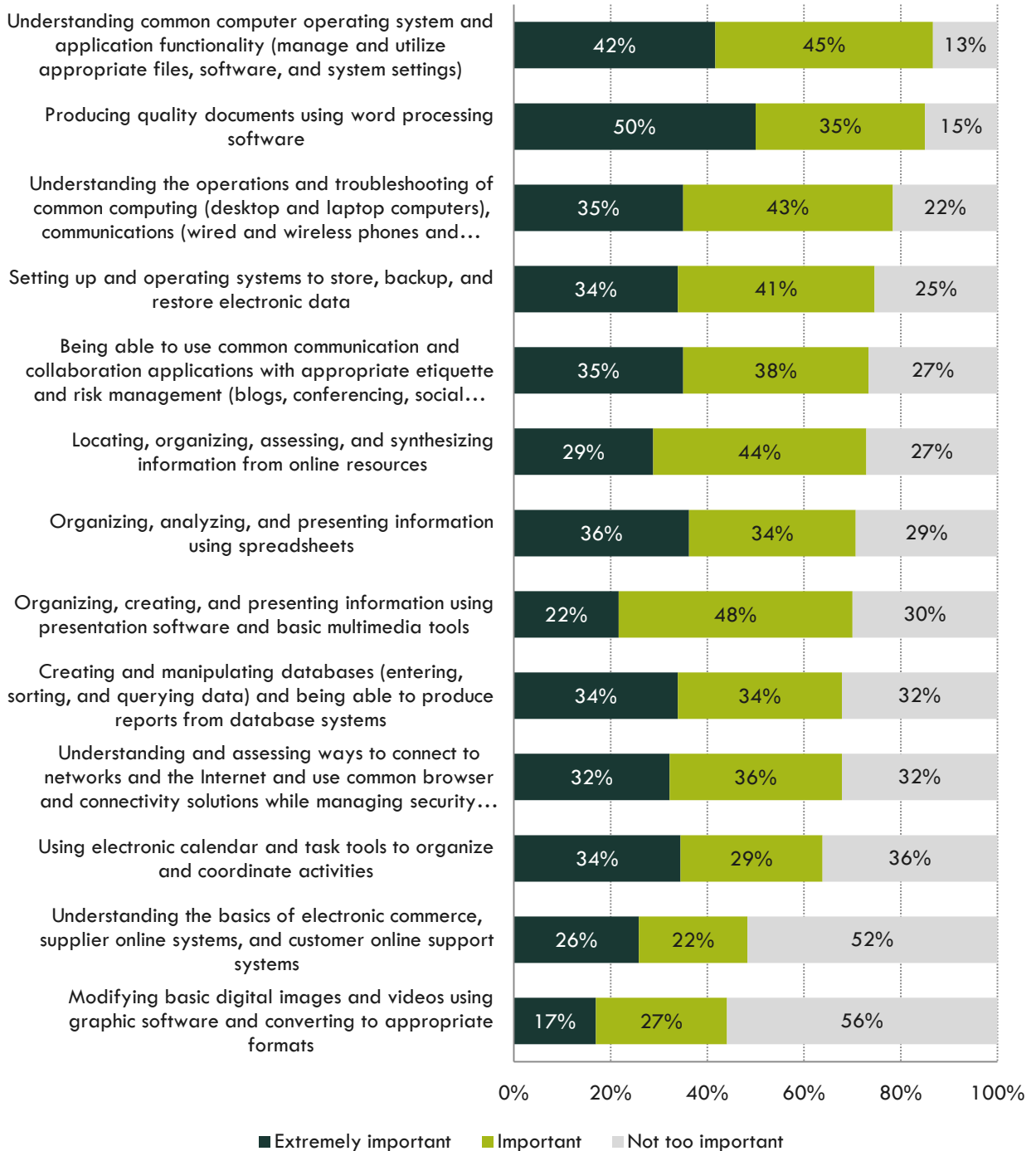
Basic ICT Literacy Requirements

In addition to the employer survey, the COE conducted a web panel of local firms on basic ICT digital literacy requirements. Of the 65 human resource professionals and small business owners that participated in the web panel, 15 percent produce ICT goods and/or provide ICT services in the region and 85 percent are not directly involved in providing ICT goods or services. The latter group consists of ICT users, in that these businesses use information and communication technologies to conduct their day-to-day activities.

ICT digital literacy competencies are required by most businesses, including those that provide or produce ICT services and those that use ICT to perform daily operations. As shown in Exhibit 8, the majority of the web panel respondents ranked 11 of the 13 basic ICT digital literacy requirements as important or very important. Employers ranked understanding

common computer operating system and application functionality (87%) as the most important, followed by producing quality documents using word processing software (85%), and understanding the operations and troubleshooting of common computing, communications, and peripheral devices (78%).

Exhibit 8: Basic ICT Digital Literacy Requirements



The following exhibit displays the Basic Elements of Digital Literacy developed by the California ICT Digital Literacy Leadership Council. Based on existing literature and a critical review by the Leadership Council, the Basic Elements provides a basis for understanding the ICT skills required for assessment, certification and career planning. Employers were asked if they agreed or disagreed with the Basic Elements:

- Half reported that the Basic Elements adequately captures the ICT user level competencies they seek in their employees;
- Sixteen percent reported that the specific technical competencies identified in Exhibit 8 more adequately capture ICT user competencies, and;
- One-third reported that a mixture of the technical competencies from Exhibit 8 and the Basic Elements listed below is ideal.

These findings suggest that the ability to perform ICT job functions is important to employers in the Sacramento Region; yet there is some disagreement on the best way to define the elements of digital literacy. Regardless, two-thirds of the web panel respondents said that applicants with an ICT digital literacy certificate would have a competitive advantage during the hiring process. Forty percent of the respondents said they would encourage their current employees to complete an ICT digital literacy certificate training program.

Exhibit 9: Basic Elements of Digital Literacy⁹

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 timelines 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.

⁹ Digital Literacy Pathways in California, ICT Leadership Council Action Plan Report, January 2010

Conclusion and Recommendations

In the information and knowledge 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. With this increased dependence and rapidly evolving technology, organizations require all their workers to possess ICT skills. This study documented the demand for both advanced and basic ICT skills in the workplace. Some of the key findings include:

- 85 percent of the survey respondents reported that information and communications technologies are important to the productivity of their organizations.
- 75 percent reported that ICT skill sets will grow in importance for their employees.
- 66 percent of the respondents said that applicants with an ICT digital literacy certificate would have a competitive advantage during the hiring process.
- 39 percent of the firms surveyed expect to add workers with ICT skills to their payroll over the next 2 years.

The survey findings also identified the advanced and basic job functions required in the workplace. Advanced ICT workers are expected to perform tasks such as enabling end user ICT devices and operating systems and supporting enterprise-wide ICT data centers and systems. ICT users are not required to perform high level ICT functions, but they do need to have a basic set of ICT competencies.

Eleven basic ICT digital literacy competencies were identified as important or very important to employers in the region. These ICT competencies may be used as a foundation for developing an ICT digital literacy certificate to prepare job seekers with limited ICT skills for entry level jobs. Alternatively, the ICT competencies could be integrated into existing training programs that prepare for basic office technology. Appendix B provides a list of existing training programs that teach advanced and basic IT skills that could be adapted to incorporate ICT competencies.

In addition, ICT skills should be incorporated into K-12 education programs. While many K-12 institutions incorporate technology into their curriculum, it's important that educators are provided with the tools and learning prompts that will keep their curriculum up-to-date. Information and communication technologies are changing at such a rapid rate, that it is important to continuously monitor the new applications and related industry training needs. High priority should be given to supporting the K-12 education system with ICT learning tools that will prepare students to successfully transition to college or into the global workplace.

Appendix A: Industry and Occupational Crosswalks

Despite the limitations of available industry and occupational data currently collected in the United States, general trends and patterns become evident upon their review. Classification systems allow for standardization of data, however, as previously noted, neither the United States nor California have organized or aggregated industry or job classification data to an ICT framework. As a result, decision-makers studying this data cannot easily recognize the size or importance of ICT in the U.S. or California economies. This report maps existing U.S. NAICS and SOC codes to ICT, providing an opportunity to scope the size and importance of ICT industries and occupations in the California economy.

The first step in developing a U.S./California definition of ICT was to identify all of the potential industries (using existing NAICS codes) that are related to ICT. The next step was to further delineate the industry list into two categories to differentiate those that are only partially ICT related. The first category, labeled “Primary Industries,” includes those industries where 100% of the firms are directly involved with producing ICT goods or services. The second category, “Secondary Industries,” includes those where some percentage of the companies is ICT related, but because of the classification scheme, it is impossible to determine the percentage directly related to ICT.

This process was then repeated for occupations (using existing SOC codes), again delineating those occupational codes in which every worker therein is engaged in ICT functions (“Primary Occupations”) and those where only some portion of the workers work in ICT (“Secondary Occupations”). These initial crosswalk drafts were then reviewed by an advisory group comprised of experts from industry, academia, nonprofit organizations, and government. This group includes human resource professionals, labor market analysts, college administrators and faculty, and small business owners.

These sets of NAICS and SOC codes were then used to query existing employment datasets. Because it is not possible to know how much of secondary NAICS industries and secondary SOC occupations are attributable to ICT, a conservative estimate of 25% of secondary industries and occupations were added to primary industry and occupation findings to arrive at the total estimates. This conservative estimate was also validated with the MP ICT industry advisory group.

The following pages display the industry and occupational crosswalks resulting from the validation process.

ICT Primary and Secondary NAICS Mapping

For purposes of this study, Secondary ICT NAICS codes are assumed to be partially involved in ICT industry activities or significantly dependent on ICT industries. It is not possible at this time to know to what extent; therefore, this study conservatively attributes only 25% of Secondary ICT NAICS economic activity to ICT.

PRIMARY: These are industries directly involved in the manufacture of Information and Communications Technologies (ICT) related equipment, peripherals or software, delivering network or telecommunications services, providing exclusively Internet or web-based services or doing exclusively Internet or web based commerce, providing computer system related services, or providing computer or communications equipment or software repair, maintenance or management services.		
NAICS	Industry	Description
323115	Digital Printing	This U.S. industry comprises establishments primarily engaged in printing graphical materials using digital printing equipment. Establishments known as digital printers typically provide sophisticated prepress services including using scanners to input images and computers to manipulate and format the graphic images prior to printing.
334111	Electronic Computer Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing and/or assembling electronic computers, such as mainframes, personal computers, workstations, laptops, and computer servers. Computers can be analog, digital, or hybrid. Digital computers, the most common type, are devices that do all of the following: (1) store the processing program or programs and the data immediately necessary for the execution of the program; (2) can be freely programmed in accordance with the requirements of the user; (3) perform arithmetical computations specified by the user; and (4) execute, without human intervention, a processing program that requires the computer to modify its execution by logical decision during the processing run. Analog computers are capable of simulating mathematical models and contain at least analog, control, and programming elements. The manufacture of computers includes the assembly or integration of processors, coprocessors, memory, storage, and input/output devices into a user-programmable final product.
334112	Computer Storage Device Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing computer storage devices that allow the storage and retrieval of data from a phase change, magnetic, optical, or magnetic/optical media. Examples of products made by these establishments are CD-ROM drives, floppy disk drives, hard disk drives, and tape storage and backup units.
334113	Computer Terminal Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing computer terminals. Computer terminals are input/output devices that connect with a central computer for processing.
334119	Other Computer Peripheral Equipment Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing computer peripheral equipment (except storage devices and computer terminals).
334210	Telephone Apparatus Manufacturing	This industry comprises establishments primarily engaged in manufacturing wire telephone and data communications equipment. These products may be standalone or board-level components of a larger system. Examples of products made by these establishments are central office switching equipment, cordless telephones (except cellular), PBX equipment, telephones, telephone answering machines, LAN modems, multi-user modems, and other data communications equipment, such as bridges, routers, and gateways.
334220	Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing	This industry comprises establishments primarily engaged in manufacturing radio and television broadcast and wireless communications equipment. Examples of products made by these establishments are: transmitting and receiving antennas, cable television equipment, GPS equipment, pagers, cellular phones, mobile communications equipment, and radio and television studio and broadcasting equipment.

PRIMARY: These are industries directly involved in the manufacture of Information and Communications Technologies (ICT) related equipment, peripherals or software, delivering network or telecommunications services, providing exclusively Internet or web-based services or doing exclusively Internet or web based commerce, providing computer system related services, or providing computer or communications equipment or software repair, maintenance or management services.

NAICS	Industry	Description
334290	Other Communications Equipment Manufacturing	This industry comprises establishments primarily engaged in manufacturing communications equipment (except telephone apparatus, and radio and television broadcast, and wireless communications equipment).
334611	Software Reproducing	This U.S. industry comprises establishments primarily engaged in mass reproducing computer software. These establishments do not generally develop any software. They mass reproduce data and programs on magnetic or optical media, such as CD-ROMs, diskettes, tapes, or cartridges. This industry includes establishments that mass reproduce game cartridges.
335921	Fiber Optic Cable Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing insulated fiber-optic cable from purchased fiber-optic strand.
423430	Computer and Computer Peripheral Equipment and Software Merchant Wholesalers	This industry comprises establishments primarily engaged in the merchant wholesale distribution of computers, computer peripheral equipment, loaded computer boards, and/or computer software.
425110	Business to Business Electronic Markets	This industry comprises business-to-business electronic markets bringing together buyers and sellers of goods using the Internet or other electronic means and generally receiving a commission or fee for the service. Business-to-business electronic markets for durable and nondurable goods are included in this industry.
443120	Computer and Software Stores	This industry comprises establishments primarily engaged in retailing new computers, computer peripherals, and prepackaged computer software without retailing other consumer-type electronic products or office equipment, office furniture, and office supplies; or retailing these new products in combination with repair and support services.
454111	Electronic Shopping	This U.S. Industry comprises establishments engaged in retailing all types of merchandise using the Internet.
454112	Electronic Auctions	This U.S. Industry comprises establishments engaged in providing sites for and facilitating consumer-to-consumer or business-to-consumer trade in new and used goods, on an auction basis, using the Internet. Establishments in this industry provide the electronic location for retail auctions, but do not take title to the goods being sold.
511210	Software Publishers	This industry comprises establishments primarily engaged in computer software publishing or publishing and reproduction. Establishments in this industry carry out operations necessary for producing and distributing computer software, such as designing, providing documentation, assisting in installation, and providing support services to software purchasers. These establishments may design, develop, and publish, or publish only.
517110	Wired Telecommunications Carriers	This industry comprises establishments primarily engaged in operating and/or providing access to transmission facilities and infrastructure that they own and/or lease for the transmission of voice, data, text, sound, and video using wired telecommunications networks. Transmission facilities may be based on a single technology or a combination of technologies. Establishments in this industry use the wired telecommunications network facilities that they operate to provide a variety of services, such as wired telephony services, including VoIP services; wired (cable) audio and video programming distribution; and wired broadband Internet services. By exception, establishments providing satellite television distribution services using facilities and infrastructure that they operate are included in this industry.

PRIMARY: These are industries directly involved in the manufacture of Information and Communications Technologies (ICT) related equipment, peripherals or software, delivering network or telecommunications services, providing exclusively Internet or web-based services or doing exclusively Internet or web based commerce, providing computer system related services, or providing computer or communications equipment or software repair, maintenance or management services.

NAICS	Industry	Description
517210	Wireless Telecommunications Carriers (except Satellite)	This industry comprises establishments engaged in operating and maintaining switching and transmission facilities to provide communications via the airwaves. Establishments in this industry have spectrum licenses and provide services using that spectrum, such as cellular phone services, paging services, wireless Internet access, and wireless video services.
517410	Satellite Telecommunications	This industry comprises establishments primarily engaged in providing telecommunications services to other establishments in the telecommunications and broadcasting industries by forwarding and receiving communications signals via a system of satellites or reselling satellite telecommunications.
517911	Telecommunications Resellers	This U.S. industry comprises establishments engaged in purchasing access and network capacity from owners and operators of telecommunications networks and reselling wired and wireless telecommunications services (except satellite) to businesses and households. Establishments in this industry resell telecommunications; they do not operate transmission facilities and infrastructure. Mobile virtual network operators (MVNOs) are included in this industry.
517919	All Other Telecommunications	This U.S. industry comprises establishments primarily engaged in providing specialized telecommunications services, such as satellite tracking, communications telemetry, and radar station operation. This industry also includes establishments primarily engaged in providing satellite terminal stations and associated facilities connected with one or more terrestrial systems and capable of transmitting telecommunications to, and receiving telecommunications from, satellite systems. Establishments providing Internet services or voice over Internet protocol (VoIP) services via client-supplied telecommunications connections are also included in this industry.
518210	Data Processing, Hosting, and Related Services	This industry comprises establishments primarily engaged in providing infrastructure for hosting or data processing services. These establishments may provide specialized hosting activities, such as web hosting, streaming services or application hosting; provide application service provisioning; or may provide general time-share mainframe facilities to clients. Data processing establishments provide complete processing and specialized reports from data supplied by clients or provide automated data processing and data entry services.
519130	Internet Publishing and Broadcasting and Web Search Portals	This industry comprises establishments primarily engaged in 1) publishing and/or broadcasting content on the Internet exclusively or 2) operating Web sites that use a search engine to generate and maintain extensive databases of Internet addresses and content in an easily searchable format (and known as Web search portals). The publishing and broadcasting establishments in this industry do not provide traditional (non-Internet) versions of the content that they publish or broadcast. They provide textual, audio, and/or video content of general or specific interest on the Internet exclusively. Establishments known as Web search portals often provide additional Internet services, such as e-mail, connections to other web sites, auctions, news, and other limited content, and serve as a home base for Internet users.

PRIMARY: These are industries directly involved in the manufacture of Information and Communications Technologies (ICT) related equipment, peripherals or software, delivering network or telecommunications services, providing exclusively Internet or web-based services or doing exclusively Internet or web based commerce, providing computer system related services, or providing computer or communications equipment or software repair, maintenance or management services.

NAICS	Industry	Description
541511	Custom Computer Programming Services	This U.S. industry comprises establishments primarily engaged in writing, modifying, testing, and supporting software to meet the needs of a particular customer.
541512	Computer Systems Design Services	This U.S. industry comprises establishments primarily engaged in planning and designing computer systems that integrate computer hardware, software, and communication technologies. The hardware and software components of the system may be provided by this establishment or company as part of integrated services or may be provided by third parties or vendors. These establishments often install the system and train and support users of the system.
541513	Computer Facilities Management Services	This U.S. industry comprises establishments primarily engaged in providing on-site management and operation of clients computer systems and/or data processing facilities. Establishments providing computer systems or data processing facilities support services are included in this industry.
541519	Other Computer Related Services	This U.S. industry comprises establishments primarily engaged in providing computer related services (except custom programming, systems integration design, and facilities management services). Establishments providing computer disaster recovery services or software installation services are included in this industry.
611420	Computer Training	This industry comprises establishments primarily engaged in conducting computer training (except computer repair), such as computer programming, software packages, computerized business systems, computer electronics technology, computer operations, and local area network management. Instruction may be provided in diverse settings, such as the establishments or client's training facilities, educational institutions, the workplace, or the home, and through diverse means, such as correspondence, television, the Internet, or other electronic and distance-learning methods. The training provided by these establishments may include the use of simulators and simulation methods.
811212	Computer and Office Machine Repair and Maintenance	This U.S. industry comprises establishments primarily engaged in repairing and maintaining computers and office machines without retailing new computers and office machines, such as photocopying machines; computer terminals, storage devices, and printers; and CD-ROM drives.
811213	Communication Equipment Repair and Maintenance	This U.S. industry comprises establishments primarily engaged in repairing and maintaining communications equipment without retailing new communication equipment, such as telephones, fax machines, communications transmission equipment, and two-way radios.

SECONDARY: These are industries non-exclusively or indirectly involved in the manufacture of ICT related equipment, peripherals, components or software, delivering network or telecommunications services, providing exclusively Internet or web-based services or doing exclusively Internet or web based commerce, providing computer system related services, or providing computer or communications equipment or software repair, maintenance or management services.

NAICS	Industry	Description
238211	Electrical Contractors and Other Wiring Installation Contractors (res)	This industry comprises establishments primarily engaged in installing and servicing electrical wiring and equipment. Contractors included in this industry may include both the parts and labor when performing work. These contractors may perform new work, additions, alterations, maintenance, and repairs.
238212	Electrical Contractors and Other Wiring Installation Contractors (non-residential)	
237130	Power and Communication Line and Related Structures Construction	This industry comprises establishments primarily engaged in the construction of power lines and towers, power plants, and radio, television, and telecommunications transmitting/receiving towers. The work performed may include new work, reconstruction, rehabilitation, and repairs. Specialty trade contractors are included in this group if they are engaged in activities primarily related to power and communication line and related structures construction. All structures (including buildings) that are integral parts of power and communication networks (e.g., transmitting towers, substations, and power plants) are included.
325992	Photographic Film, Paper, Plate, and Chemical Manufacturing (printer toner, etc.)	This U.S. industry comprises establishments primarily engaged in manufacturing sensitized film, sensitized paper, sensitized cloth, sensitized plates, toners (i.e., for photocopiers, laser printers, and similar electrostatic printing devices), toner cartridges, and photographic chemicals.
331422	Copper Wire (Except Mechanical) Drawing	This U.S. industry comprises establishments primarily engaged in drawing or drawing and insulating communication and energy wire and cable from purchased copper or in integrated secondary smelting and wire drawing plants.
331491	Nonferrous Metal (except Copper and Aluminum) Rolling, Drawing, and Extruding	This U.S. industry comprises establishments primarily engaged in (1) rolling, drawing, or extruding shapes (e.g., bar, plate, sheet, strip, tube) from purchased nonferrous metals and/or (2) recovering nonferrous metals from scrap and rolling, drawing, and/or extruding shapes (e.g., bar, plate, sheet, strip, tube) in integrated mills.
333295	Semiconductor Machinery Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing wafer processing equipment, semiconductor assembly and packaging equipment, and other semiconductor making machinery.
334412	Bare Printed Circuit Board Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing bare (i.e., rigid or flexible) printed circuit boards without mounted electronic components. These establishments print, perforate, plate, screen, etch, or photoprint interconnecting pathways for electric current on laminates.
334413	Semiconductor and Related Device Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing semiconductors and related solid state devices. Examples of products made by these establishments are integrated circuits, memory chips, microprocessors, diodes, transistors, solar cells and other optoelectronic devices.
334418	Printed Circuit Assembly (Electronic Assembly) Manufacturing	This U.S. industry comprises establishments primarily engaged in loading components onto printed circuit boards or who manufacture and ship loaded printed circuit boards. Also known as printed circuit assemblies, electronics assemblies, or modules, these products are printed circuit boards that have some or all of the semiconductor and electronic components inserted or mounted and are inputs to a wide variety of electronic systems and devices.

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NAICS	Industry	Description
334419	Other Electronic Component Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing electronic components (except electron tubes; bare printed circuit boards; semiconductors and related devices; electronic capacitors; electronic resistors; coils, transformers and other inductors; connectors; and loaded printed circuit boards).
334612	Prerecorded Compact Disc (except Software), Tape, and Record Reproducing	This U.S. industry comprises establishments primarily engaged in mass reproducing audio and video material on magnetic or optical media. Examples of products mass reproduced by these establishments are prerecorded audio compact discs, audio and video cassettes, and digital video discs (DVDs).
334613	Magnetic and Optical Recording Media Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing magnetic and optical recording media, such as blank magnetic tape, blank diskettes, blank optical discs, hard drive media, and blank magnetic tape cassettes.
335929	Other Communication and Energy Wire Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing insulated wire and cable of nonferrous metals from purchased wire.
335931	Current-Carrying Wiring Device Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing current-carrying wiring devices.
335999	All Other Miscellaneous Electrical Equipment and Component Manufacturing	This U.S. industry comprises establishments primarily engaged in manufacturing industrial and commercial electric apparatus and other equipment (except lighting equipment, household appliances, transformers, motors, generators, switchgear, relays, industrial controls, batteries, communication and energy wire and cable, wiring devices, and carbon and graphite products). This industry includes power converters (i.e., AC to DC and DC to AC), power supplies, surge suppressors, and similar equipment for industrial-type and consumer-type equipment.
423610	Electrical Apparatus and Equipment, Wiring Supplies, and Related Equipment Merchant Wholesalers	This industry comprises establishments primarily engaged in the merchant wholesale distribution of electrical construction materials; wiring supplies; electric light fixtures; light bulbs; and/or electrical power equipment for the generation, transmission, distribution, or control of electric energy.
423690	Other Electronic Parts and Equipment Merchant Wholesalers	This industry comprises establishments primarily engaged in the merchant wholesale distribution of electronic parts and equipment (except electrical apparatus and equipment, wiring supplies, and construction materials; electrical and electronic appliances; and television and radio sets).
454113	Mail-Order Houses	This U.S. industry comprises establishments primarily engaged in retailing all types of merchandise using mail catalogs or television to generate clients and display merchandise. Included in this industry are establishments primarily engaged in retailing from catalog showrooms of mail-order houses as well as establishments providing a combination of Internet and mail-order sales.
515111	Radio Networks	This U.S. industry comprises establishments primarily engaged in assembling and transmitting aural programming to their affiliates or subscribers via over-the-air broadcasts, cable, or satellite. The programming covers a wide variety of material, such as news services, religious programming, weather, sports, or music.

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NAICS	Industry	Description
515210	Cable and Other Subscription Programming	This industry comprises establishments primarily engaged in operating studios and facilities for the broadcasting of programs on a subscription or fee basis. The broadcast programming is typically narrowcast in nature (e.g., limited format, such as news, sports, education, or youth-oriented). These establishments produce programming in their own facilities or acquire programming from external sources. The programming material is usually delivered to a third party, such as cable systems or direct-to-home satellite systems, for transmission to viewers.
532420	Office Machinery and Equipment Rental and Leasing	This industry comprises establishments primarily engaged in renting or leasing office machinery and equipment, such as computers, office furniture, duplicating machines (i.e., copiers), or facsimile machines.
532490	Other Commercial and Industrial Machinery and Equipment Rental and Leasing	This industry comprises establishments primarily engaged in renting or leasing nonconsumer-type machinery and equipment (except heavy construction, transportation, mining, and forestry machinery and equipment without operators; and office machinery and equipment). Establishments in this industry rent or lease products, such as manufacturing equipment; metalworking, telecommunications, motion picture, or theatrical machinery and equipment; institutional (i.e., public building) furniture, such as furniture for schools, theaters, or buildings; or agricultural equipment without operators.
541430	Graphic Design Services	This industry comprises establishments primarily engaged in planning, designing, and managing the production of visual communication in order to convey specific messages or concepts, clarify complex information, or project visual identities. These services can include the design of printed materials, packaging, advertising, signage systems, and corporate identification (logos). This industry also includes commercial artists engaged exclusively in generating drawings and illustrations requiring technical accuracy or interpretative skills.
541611	Administrative Management and General Management Consulting Services	This U.S. industry comprises establishments primarily engaged in providing operating advice and assistance to businesses and other organizations on administrative management issues, such as financial planning and budgeting, equity and asset management, records management, office planning, strategic and organizational planning, site selection, new business startup, and business process improvement. This industry also includes establishments of general management consultants that provide a full range of administrative; human resource; marketing; process, physical distribution, and logistics; or other management consulting services to clients.
541618	Other Management Consulting Services	This U.S. industry comprises establishments primarily engaged in providing management consulting services (except administrative and general management consulting; human resources consulting; marketing consulting; or process, physical distribution, and logistics consulting). Establishments providing telecommunications or utilities management consulting services are included in this industry.
541690	Other Scientific and Technical Consulting Services	This industry comprises establishments primarily engaged in providing advice and assistance to businesses and other organizations on scientific and technical issues (except environmental).
541712	Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology)	This U.S. industry comprises establishments primarily engaged in conducting research and experimental development (except biotechnology research and experimental development) in the physical, engineering, and life sciences, such as agriculture, electronics, environmental, biology, botany, computers, chemistry, food, fisheries, forests, geology, health, mathematics, medicine, oceanography, pharmacy, physics, veterinary and other allied subjects.

SECONDARY: These are industries non-exclusively or indirectly involved in the manufacture of ICT related equipment, peripherals, components or software, delivering network or telecommunications services, providing exclusively Internet or web-based services or doing exclusively Internet or web based commerce, providing computer system related services, or providing computer or communications equipment or software repair, maintenance or management services.

NAICS	Industry	Description
541910	Marketing Research and Public Opinion Polling	This industry comprises establishments primarily engaged in systematically gathering, recording, tabulating, and presenting marketing and public opinion data.
561431	Private Mail Centers	This U.S. industry comprises (1) establishments primarily engaged in providing mailbox rental and other postal and mailing (except direct mail advertising) services or (2) establishments engaged in providing these mailing services along with one or more other office support services, such as facsimile services, word processing services, on-site PC rental services, and office product sales.
561439	Other Business Service Centers (including Copy Shops)	This U.S. industry comprises (1) establishments generally known as copy centers or shops primarily engaged in providing photocopying, duplicating, blueprinting, and other document copying services, without also providing printing services (e.g., offset printing, quick printing, digital printing, prepress services) and (2) establishments (except private mail centers) engaged in providing a range of office support services (except printing services), such as document copying services, facsimile services, word processing services, on-site PC rental services, and office product sales.
926130	Regulation and Administration of Communications, Electric, Gas, and Other Utilities	This industry comprises government establishments primarily engaged in the administration, regulation, licensing and inspection of utilities, such as communications, electric power (including fossil, nuclear, solar, water, and wind), gas and water supply, and sewerage.

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
11-3021	Computer and Information Systems Managers	Plan, direct, or coordinate activities in such fields as electronic data processing, information systems, systems analysis, and computer programming.	Information Technology Manager (IT Manager), Information Technology Director (IT Director), Information Systems Director (IS Director), Data Processing Manager, MIS Director (Management Information Systems Director), Information Systems Manager (IS Manager), Information Systems Supervisor (IS Supervisor), Computing Services Director, Director of Application Development, Technical Services Manager
15-1011	Computer and Information Scientists, Research	Conduct research into fundamental computer and information science as theorists, designers, or inventors. Solve or develop solutions to problems in the field of computer hardware and software.	Computer Scientist, Control System Computer Scientist, Scientific Programmer Analyst
15-1021	Computer Programmers	Convert project specifications and statements of problems and procedures to detailed logical flow charts for coding into computer language. Develop and write computer programs to store, locate, and retrieve specific documents, data, and information. May program web sites.	Programmer Analyst, Programmer, Analyst Programmer, Computer Programmer, Software Developer, Applications Developer, Computer Programmer Analyst, Internet Programmer, Java Developer, Web Programmer
15-1031	Computer Software Engineers, Applications	Develop, create, and modify general computer applications software or specialized utility programs. Analyze user needs and develop software solutions. Design software or customize software for client use with the aim of optimizing operational efficiency. May analyze and design databases within an application area, working individually or coordinating database development as part of a team.	Software Engineer, Application Integration Engineer, Programmer Analyst, Software Development Engineer, Computer Consultant, Software Architect, Software Developer, Technical Consultant, Applications Developer, Business Systems Analyst
15-1032	Computer Software Engineers, Systems Software	Research, design, develop, and test operating systems-level software, compilers, and network distribution software for medical, industrial, military, communications, aerospace, business, scientific, and general computing applications. Set operational specifications and formulate and analyze software requirements. Apply principles and techniques of computer science, engineering, and mathematical analysis.	Software Engineer, Software Developer, Systems Engineer, Network Engineer, Developer, Publishing Systems Analyst, Application Developer, Averaged HEND (High-Energy Neutron Data) Data Product Lead (AHD Product Lead), Business Systems Analyst, Computer Consultant
15-1041	Computer Support Specialists	Provide technical assistance to computer system users. Answer questions or resolve computer problems for clients in person, via telephone or from remote location. May provide assistance concerning the use of computer hardware and software, including printing, installation, word processing, electronic mail, and operating systems.	Information Technology Specialist (IT Specialist), Support Specialist, Computer Technician, Computer Support Specialist, Help Desk Analyst, Technical Support Specialist, Network Support Specialist, Electronic Data Processing Auditor (EDP Auditor), Network Technician, Computer Specialist

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

Appendix B: Basic and Advanced IT Training Programs

The community colleges in the Sacramento Region offer a range of instructional programs that support the information and communication technology sector. The following programs are grouped in two categories: basic and advanced IT training programs. Basic IT training programs train students to perform basic IT job functions, which likely incorporate many of the basic ICT competencies required by employers. The advanced IT training programs focus on various aspects of ICT such as networking, telecommunications and programming. This list was compiled with the aid of the California Community College Chancellor's Office searchable program database, which may be found at the following website: https://misweb.cccco.edu/webproginv/prod/topcodelist_n.cfm.

Basic IT Training Programs in the Sacramento Region

College	Program Name	Degree
American River College	Administrative Assistant	AA / Certificate
	Office Administration	Certificate
	Office Administration	AA
	Office Careers: Fast Track	Certificate
	Office Technology	Certificate
	Technical Communications	AA / Certificate
Cosumnes River College	Office Technician	Certificate
	Business: Administrative Assistant	AA
	Office Assistant	Certificate
Folsom Lake College	Business: Administrative Assistant	AA
	Office Technician	Certificate
Sacramento City College	Office Admin: Capstone Office Simulation Internship- Level D	AS / Certificate
	Clerical General Office (Level A)	Certificate
	Business Operations and Management Technology (Level C)	Certificate
	CIS: Word Processing Technician, Level 3	Certificate
Sierra College	Administrative Professional	AA / AS / Certificate
	Virtual Office Professional: Administrative	AA / AS
	CIS: Administrative Technical Support	AA / AS / Certificate
	Virtual Office Professional: Administrative	Certificate
	Virtual Office Professional: Web Management	AA / AS / Certificate
	Virtual Office Professional: Technical Support	AA / AS / Certificate
Woodland Community College	Administrative Assistant	AS / Certificate
	Word Processing	AS / Certificate
	Business Computer Applications	AS / Certificate
Yuba College	Word Processing	AS / Certificate
	Business Computer Applications	AS / Certificate
	Administrative Assistant	AS / Certificate

Advanced IT Training Programs in the Sacramento Region

College	Program Name	Degree
American River College	CIS: Computer Networking Management	AS / Certificate
	CIS: Computer Programming	A
	CIS: Database Management	AS / Certificate
	CIS: Microcomputer Applications	AA / Certificate
	CIS: PC Support	Certificate
	CIS: PC Support Management	AS
	CIS: Programming	Certificate
	Computer Science	AS
	Information Systems Security	AS / Certificate
	Telecommunication Specialist	Certificate
	Web Developer	Certificate
	Web Publishing	Certificate
	Art New Media	AA
	Art New Media: Graphic Design	Certificate
	Art New Media: Web Design	Certificate
Cosumnes River College	Desktop Publishing	Certificate
	Management Information Systems	AS
	MIS: Application Manager	Certificate
	MIS: Application Analyst	Certificate
	MIS: Application Technician	Certificate
	MIS: Information Processing	Certificate
	Computer Programming	AS
	Computer Programmer: SQL	Certificate
	CIS: Internet Programming	Certificate
	Programming in "C/C++"	Certificate
	Web Programming	Certificate
	Relational Database Administration	Certificate
	Computer Information Science Security	AS / Certificate
	CIS: Network Systems Administrator	AS / Certificate
CIS: Network Systems Engineer	AS / Certificate	
Folsom Lake College	Computer Science	AS
	Web Developer	Certificate
	Windows Programming	Certificate
	Programming	Certificate
	Computer Programmer: SQL	Certificate
	Relational Database Administration	Certificate
	MIS: Information Processing	Certificate
	MIS: Application Technician	Certificate
Sacramento City College	Graphic Communication	AS / Certificate
	Web Design	Certificate
	Web Developer	AS / Certificate
	Management Information Systems	AS / Certificate

College	Program Name	Degree	
	Computer Science	AS / Certificate	
	Programming	Certificate	
	Data Base Management	Certificate	
	Computer Information Science : Information Systems Security	AS / Certificate	
	Network Design	AS / Certificate	
	Network Administration	AS / Certificate	
	Microcomputer Technician	AS	
	PC Support	Certificate	
	Microcomputer Technician	Certificate	
	Webmaster, Level 1	Certificate	
	Webmaster, Level 2	Certificate	
	Telecommunications Technician	AS / Certificate	
	Information Processing	AS / Certificate	
	CIS: Information Processing Technician, Level 3	Certificate	
	Sierra College	Applied Art & Design: Multimedia	AA / AS / Certificate
Communication Studies: Multimedia		AA / AS	
CIS: Internet		AA / AS / Certificate	
Computer Science: Management Information Systems		AA / AS	
CIS: Computer Applications		AA / AS / Certificate	
Computer Science: Programming Object Oriented		Certificate	
Computer Science: Web Programming		AA / AS	
Computer Science		AA / AS	
Computer Science: Programming Visual Basic		Certificate	
Computer Science: Web Programming		Certificate	
Computer Service Technology: Computer Service Technologist		AA / AS / Certificate	
Computer Service Technology: Microsoft Systems Engineer		Certificate	
Computer Service Technology: Networking		AA / AS / Certificate	
Computer Service Technology: Microsoft Systems Administrator		Certificate	
CIS: Computer Support		AA / AS / Certificate	
Computer Science: Web Server Administration		AA / AS / Certificate	
Computer Science: Embedded Systems		AA / AS / Certificate	
Yuba College		Computer Science	AS / Certificate
		Information Technologies	AS / Certificate

Appendix C: About the Center of Excellence

The Center of Excellence (COE), in partnership with business and industry, delivers regional workforce research customized for community college and workforce system decision making and resource development. The Northern California COE is one of five regional Centers of Excellence supported by the Chancellor's Office of the California Community Colleges and is tasked with conducting environmental scanning, partnership development and technical assistance activities.

The COE's research team represents expertise in labor market analysis, labor-management partnership projects, project management, and primary research. COE staff are experienced researchers with a focus on research design, partnership development, educational and training program mapping, and identifying skill sets for emerging occupations as well as key skill sets and geospatial analysis.

The COE maintains strategic alliances with research organizations whose relationships and technical expertise enhance COE's research efforts. These alliances enable COE to access information from over 80 public databases through the use of EMSI economic modeling software, GIS technology via the use of a customized geo-mapping software that ties industry codes (NAICS) to a private business database of over 1 million business records. The COE maintains robust partnerships with industry associations that assist in validating research findings, ensuring that the most recent industry and labor market conditions are captured.

COE studies are used to inform policy discussions, industry-wide legislative efforts, and regional workforce development strategies, as well as guide program and resource development efforts by the California Community Colleges. These reports can be accessed at www.coecc.net.