



Information and Communications Technology Occupations in the Inland Empire

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Introduction

In today's world, Information and Communications Technologies (ICT) are integrated into nearly every industry and occupation. Technology has become increasingly more important to the daily activities of businesses of all types. It is estimated that IT spending will amount to \$3.7 trillion worldwide in 2013 and create millions of jobs by 2015.¹

A recent study defines **ICT as encompassing "all rapidly emerging, evolving, and converging computer, software, networking, telecommunications, Internet, programming, information systems and digital media technologies"**.² This same study points to the importance of understanding ICT as not only terminology but a framework for how work gets done. This is a key consideration to keep in mind when analyzing the ICT workforce.

How work gets done has changed significantly over the decades but has evolved at a much faster pace in recent years. Innovations in technology have notably created geographic regions with concentrations of ICT startup companies and talented young people. The genesis of these regions was Silicon Valley in northern California but the model has spread throughout the country and even around the globe as other major cities have adopted similar monikers, namely Silicon Alley in New York, Silicon Beach in Los Angeles, and even Silicon Savannah in Kenya.

Although not necessarily a hub of technological innovation, the Inland Empire (Riverside and San Bernardino counties) is a region that requires a technologically competent workforce. Aside from the use of ICT in offices, retail establishments, and hospitals, the proliferation of transportation and logistics operations have created a need for technologically savvy workers in high growth non-IT industries.

Methodology

On the workforce demand side, this study presents and analyzes labor market data for the ICT related occupations as identified by the Standard Occupational Codes (SOC). Occupations included in this study were selected from previous research conducted by the Mid-Pacific Information and Communications Technologies Center (MPICT) and validated by an advisory team for this study. Industries included in this study have been identified using the North American Industry Classification System (NAICS) and vetted by the advisory team as well. Occupation and industry data were obtained using the Economic Forecaster tool provided by Economic Modeling Specialists, Inc. (EMSI).

On the supply side, information on regional training programs was gathered from the California Community Colleges Chancellor's Office Data Mart system and the Integrated Postsecondary Education Data System (IPEDS). Programs were identified using the Taxonomy of Programs (TOP) coding system and the Classification of Instructional Programs (CIP) system.

For more information on the data sources utilized, please refer to Appendix A.

Industry Trends

Smart Business

Mobile computing has been incredibly popular for social media uses and personal interaction but ever more, businesses are realizing the cost effectiveness of mobile integration into traditional activities. One industry expert touts the benefits to businesses of using mobile technology saying "productivity is the

¹ Gartner. *Gartner Says Big Data Creates Big Jobs: 4.4 Million IT Jobs Globally to Support Big Data by 2015*.

² MPICT, Center of Excellence; *ICT Information & Communication Technologies: Foundational Competency Employment Demand in California*. Draft, March 18, 2013.

driver...two years from now, 20 percent of sales organizations will use tablets as their primary mobile platform for their field sales force”.³

This trend can be witnessed by visiting local retailers such as Nordstrom’s and Apple. In retail, more customer service transactions are expected to take place via smartphone or tablet and purchases made at locations through a store, not strictly at a counter. This movement translates to faster check-out and a paperless transaction as receipts are emailed to a customer via smartphone or tablet. Item stock can also be checked through a handheld electronic device, tying into a store’s warehouse system. A study conducted by the Industrial Technology Research Institute, *Global ICT Trends Emerging in 2013*, notes the tablet’s “supply of shopping, logistics, education, social media, entertainment, health counseling, and other service-oriented applications”.⁴

True Mobile Capability

Technology will continue to advance the day-to-day operations of not only the retail industry but some improbable industries like construction; transforming the traditional office to one that is mobile. For that sector of the labor force whose work is accomplished in the outdoors, technology needs are slightly different. Some of the unique issues affecting workers in fields like construction and forestry include the requirement of a product that is more durable to withstand weather and a harsh environment, and faster, more reliable connection/processors for products to last an entire work day and transmit data more efficiently. Products used specifically for these outdoor offices are termed “rugged technology” and electronics manufacturers are increasingly responding to the demand for these specialty items.⁵

The importance of true mobile capability for the future workforce is clear. Workers across all industries at all levels will require the ability to work on some form of computer to get the work done. This trend points to the necessity of integrating digital literacy into career technical education training in addition to academic programs.

Big Data Support

The traditional technical support occupation is also evolving and will require technical expertise in working with big data. An article on Information Week’s website posits that by the year 2015, 4.4 million IT jobs will be created to support big data. Support for big data however, will not look like traditional technical support. Instead of providing solutions to users over the telephone, technical support for big data comes in the form of workers who can manage large sets of data for businesses. These occupations will continue to exist in IT departments of all industries but will have the task of analyzing, visualizing, and translating data for the growth of the business.⁶

Along with big data, business operations are also becoming increasingly dependent on social media for improving competitiveness. While beneficial for sales, this medium brings with it the increased threat of breached security. IT departments will also need to be well trained in cyber security. In the future, it is likely that there will be increased demand for occupations like Pre-Crime Analysts.⁷

Industry Overview

While all industries implement ICT in their work to some extent, there are companies that specialize in developing and providing ICT products and services. These businesses have been identified by MPICT as high-technology or primary ICT industries. The following provides an overview of the labor market data for these primary ICT industries in the Inland Empire.

³ Gartner. *Gartner Says Big Data Creates Big Jobs: 4.4 Million IT Jobs Globally to Support Big Data by 2015*.

⁴ Industrial Technology Research Institute. *Global ICT Trends Emerging in 2013*.

⁵ Manufacturing Business Technology. *Here, There, Everywhere: Rugged Computers Enable True Workforce Mobility*.

⁶ Information Week. *Data Scientist Shortage: Split Role in Half*. December 12, 2012.

⁷ California Community Colleges’ Centers of Excellence. *Jobs of the Future: Crime Analysis to Pre-Crime Analysts*.

In 2012, ICT industries employed more than 17,000 workers across all occupations within the 2-county region. The largest industry employers were the Information (NAICS 51) and Professional, Scientific, and Technical Services (NAICS 54) sectors. Specifically, Custom Computer Programming Services (3,121 jobs), Wired Telecommunications Carriers (2,886 jobs in 2012), and Other Computer Related Services (2,443 jobs) accounted for the most jobs across all occupations. Wireless Telecommunications Carriers are projected to have the fastest job growth by the year 2015 – 82%.

The fast job growth in the Wireless Telecommunications Carriers industry could be related to the upward demand for more and faster connectivity from ICT users. A “smarter mobile infrastructure” will require not only more carriers to manage the large amounts of data traffic but equipment to build this infrastructure.⁸ This demand might also be driving the growth in Radio and television broadcasting and wireless communication equipment manufacturing (14% by 2015).

In the region, the next three years will see significant job loss in both the Satellite telecommunications and Computer terminal manufacturing industries, 70% and 67%, respectively. As increasingly more service providers offer wireless telecommunications, the decline in the Satellite telecommunications will likely continue.

Table 1 - Employment by ICT Industry (sorted by 2012 Jobs)

NAICS Code	Description	2012 Jobs	2015 Jobs	Change	% Change	2013 Earnings
541511	Custom Computer Programming Services	3,121	3,703	582	19%	\$54,509
517110	Wired Telecommunications Carriers	2,886	2,880	(6)	0%	\$73,294
541519	Other Computer Related Services	2,443	2,790	347	14%	\$102,082
541512	Computer Systems Design Services	1,348	1,369	21	2%	\$60,348
517210	Wireless Telecommunications Carriers (except Satellite)	1,114	2,029	915	82%	\$73,733
454111	Electronic Shopping	1,013	1,130	117	12%	\$44,258
517911	Telecommunications Resellers	771	582	(189)	(25%)	\$101,235
518210	Data Processing, Hosting, and Related Services	717	937	220	31%	\$85,763
811212	Computer and Office Machine Repair and Maintenance	630	734	104	17%	\$34,686
423430	Computer and Computer Peripheral Equipment and Software Merchant Wholesalers	605	559	(46)	(8%)	\$76,369
517410	Satellite Telecommunications	592	177	(415)	(70%)	\$88,575
443120	Computer and Software Stores	549	436	(113)	(21%)	\$51,758
334290	Other Communications Equipment Manufacturing	286	255	(31)	(11%)	\$74,099
519130	Internet Publishing and Broadcasting and Web Search Portals	217	249	32	15%	\$42,376
511210	Software Publishers	174	184	10	6%	\$82,715
541513	Computer Facilities Management Services	165	133	(32)	(19%)	\$55,993
454112	Electronic Auctions	163	179	16	10%	\$30,293
323115	Digital Printing	148	130	(18)	(12%)	\$51,379
811213	Communication Equipment Repair and Maintenance	130	138	8	6%	\$25,490
425110	Business to Business Electronic Markets	128	85	(43)	(34%)	\$63,329
334220	Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing	107	122	15	14%	\$51,882
334119	Other Computer Peripheral Equipment Manufacturing	73	75	2	3%	\$39,770
611420	Computer Training (Private)	68	41	(27)	(40%)	\$30,485

⁸ Telecomindiaonline.com. *Telecom Viewpoint: The hottest ICT trends in 2013.*

334210	Telephone Apparatus Manufacturing	54	23	(31)	(57%)	\$65,490
334113	Computer Terminal Manufacturing	48	16	(32)	(67%)	\$34,406
335921	Fiber Optic Cable Manufacturing	34	38	4	12%	\$111,993
334112	Computer Storage Device Manufacturing	29	19	(10)	(34%)	\$195,791
334611	Software Reproducing	18	14	(4)	(22%)	\$47,118
517919	All Other Telecommunications	17	<10	-	-	\$92,327
334111	Electronic Computer Manufacturing	11	<10	-	-	--
Total/Average for All Industries		17,659	19,027	1,368	8%	\$66,950

Source: EMSI Employment Data – 2013.3

Occupational Overview

This section provides detailed labor market information on occupations specific to the ICT sector. Occupations were chosen based on previous research conducted by MPICT and with input from the advisory group for this project. Although this study focuses on a small group of occupations, it is important to note that ICT skills requirements can be found across many occupations (other than those in the primary group).

In order to analyze the primary ICT occupations that were chosen for this study, the group of 30 occupations were organized into clusters based on the job duties and knowledge and skill areas. Six groups were created – Support/Technicians, Multimedia, Software & Database Specialists, Network, Hardware & Systems Specialists, Telecommunications, and Other Specialized IT occupations.

Cluster	Occupations Included
Support/Technicians	<ul style="list-style-type: none"> • Computer user support specialists • Computer operators
Multimedia	<ul style="list-style-type: none"> • Desktop publishers • Computer occupations, all other • Web administrators* • Video game designers* • Web developers • Multi-media artists and animators • Graphic designers
Software & Database specialists	<ul style="list-style-type: none"> • Database administrators • Computer programmers • Software developers, applications • Software developers, systems software • Information security analysts
Network, Hardware & Systems Specialists	<ul style="list-style-type: none"> • Computer network architects • Computer and information system managers • Network and computer systems administrators • Computer systems analysts • Computer network support specialists • Computer hardware engineers
Telecommunications	<ul style="list-style-type: none"> • Switchboard operators, including answering services • Telephone operators • Communications equipment operators, all other • Telecommunications line installers and repairers • Computer, automated teller, and office machine repairers • Telecommunications equipment installers and repairers, except line installers • Telecommunications engineering specialists*

Other Specialized IT	<ul style="list-style-type: none"> • Geographic Information Systems technician* • Informatics nurse specialists 	<ul style="list-style-type: none"> • Computer and information research specialists*
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*Labor market information not available

Due to the rapidly evolving nature of ICT occupations, traditional labor market information is not available for all 30 occupations selected. Therefore, the remainder of this study will analyze 25 occupations for which data are available.

The group of 25 ICT occupations accounted for 27,166 jobs in the Inland Empire in 2012, according to Economic Modeling Specialists, Inc. (EMSI) data, and is expected to add 1,528 jobs by the year 2015, a 6% growth rate.

Largest ICT Occupations

The largest ICT occupations, by number of 2012 jobs, are computer support specialists who accounted for 3,672 regional jobs. Graphic designers were the next largest occupation with 2,299 jobs followed by software developers, systems software who counted 2,209 jobs in the same year.

Among these occupations, the highest wage earners are software developers, systems software, with average hourly wages of \$55.13 in 2012. Network and computer systems administrators were the second highest earners in 2012 (\$42.35/hr.). The lowest paid ICT occupations, among the top ten largest occupations, are computer, automated teller, and office machine repairers (\$16.14/hr.) and graphic designers (\$19.30/hr.).

Table 2 - Top 10 Largest ICT Occupations (by 2012 jobs)

Occupation (SOC Code)	2012 Jobs	2015 Jobs	Change	% Change	Annual Openings	Avg. Hourly Earnings
Computer Support Specialists (15-1159)	3,672	3,913	241	7%	185	\$22.89
Graphic Designers (27-1024)	2,299	2,337	38	2%	76	\$19.30
Software Developers, Systems Software (15-1133)	2,209	2,439	230	10%	102	\$55.13
Telecommunications Line Installers and Repairers (49-9052)	1,873	1,763	(110)	(6%)	33	\$28.00
Computer Systems Analysts (15-1121)	1,831	2,012	181	10%	87	\$34.13
Network and Computer Systems Administrators (15-1142)	1,718	1,890	172	10%	88	\$42.35
Telecommunications Equipment Installers and Repairers, Except Line Installers (49-2022)	1,502	1,485	(17)	(1%)	40	\$24.50
Computer Programmers (15-1131)	1,405	1,487	82	6%	56	\$31.63
Computer, Automated Teller, and Office Machine Repairers (49-2011)	1,351	1,475	124	9%	80	\$16.14
Software Developers, Applications (15-1132)	1,345	1,553	208	15%	74	\$41.85

Source: EMSI Employment Data – 2013.3

Fastest Growing ICT Occupations

In the Inland Empire, some of the highest paid ICT occupations will also be the fastest growing, by percentage job growth, over the next three years. Information security analysts and software developers, applications will experience a 17% and 15% growth, respectively.

The increase in demand for software developers, applications and systems software, is indicative of the continued increase in technology use by both individuals and businesses. Cloud computing and multi-channel capabilities are only a couple examples of the types of technologies that will be requiring a

larger labor force in the coming years.⁹ Additionally, the anticipated need for more Information security analysts is reflective of the growing traffic on network systems and the increased need for security of the data collected and used.

Table 3 - Top 10 Fastest Growing ICT Occupations (by % change)

Occupation (SOC Code)	2012 Jobs	2015 Jobs	Change	% Change	Annual Openings	Avg. Hourly Earnings
Information Security Analysts (15-1122)	166	194	28	17%	11	\$39.80
Software Developers, Applications (15-1132)	1,345	1,553	208	15%	74	\$41.85
Database Administrators (15-1141)	599	665	66	11%	32	\$35.60
Software Developers, Systems Software (15-1133)	2,209	2,439	230	10%	102	\$55.13
Network and Computer Systems Administrators (15-1142)	1,718	1,890	172	10%	88	\$42.35
Computer Systems Analysts (15-1121)	1,831	2,012	181	10%	87	\$34.13
Web Developers (15-1134)	824	903	79	10%	37	\$21.58
Computer, Automated Teller, and Office Machine Repairers (49-2011)	1,351	1,475	124	9%	80	\$16.14
Computer and Information Systems Managers (11-3021)	1,256	1,363	107	9%	52	\$53.09
Computer Network Architects (15-1143)	565	610	45	8%	25	\$41.36

Source: EMSI Employment Data – 2013.3

Education Requirements

Typical education requirements, identified by the Bureau of Labor Statistics (BLS), are presented below for the 25 ICT occupations. Among this group of occupations, four necessitate community college level awards for employment. Fourteen of the 25 occupations (56%) require a Bachelor's degree for employment.

Although the Bureau of Labor Statistics (BLS) has determined that a Bachelor's degree is necessary for employment for the majority of these occupations, the panel of industry experts in attendance at the regional ICT Skills Panel event on August 19, 2013 noted that certifications, soft skills, and project management often are more desirable than a BA or BS. Specifically, experts spoke of the usefulness of [CompTIA](#) certifications. Industry recognized certificates are offered in many areas including networking, mobile app, security, A+ and more.

Education Requirement	Occupations
Short-term OJT	<ul style="list-style-type: none"> ▪ Communications Equipment Operators, all other ▪ Telephone Operators ▪ Switchboard Operators, including answering service
Moderate-term OJT	<ul style="list-style-type: none"> ▪ Computer Operators
Long-term OJT	<ul style="list-style-type: none"> ▪ Telecommunications Line Installers and Repairers
Postsecondary certificate	<ul style="list-style-type: none"> ▪ Telecommunications Equipment Installers and Repairers, except line installers ▪ Computer, Automated Teller, and Office Machine Repairers
Associate degree	<ul style="list-style-type: none"> ▪ Computer User Support Specialists ▪ Desktop Publishers ▪ Computer Network Support Specialists

⁹ NetSuiteBlog. *Five Trends That Will Dominate Software Spending in 2013*.

Bachelor's degree	<ul style="list-style-type: none"> ▪ Computer and information systems managers ▪ Computer hardware engineers ▪ Computer network architects ▪ Computer occupations, all other ▪ Computer programmers ▪ Computer systems analyst ▪ Database administrators ▪ Graphic designers 	<ul style="list-style-type: none"> ▪ Information security analysts ▪ Multimedia artists and animators ▪ Network and computer systems administrators ▪ Software developers, applications ▪ Software developers, systems software ▪ Web developers
Doctoral degree	<ul style="list-style-type: none"> ▪ Computer and Information Research Scientists 	

Occupational Wages

ICT occupations are relatively high paying jobs when compared to all other occupational areas. Figure 1 provides a comparison of average hourly wages for ICT occupations, by typical education requirement, to the average hourly wages of all occupations in the Inland Empire. Wages for nearly all ICT professionals are higher than the regional average wages for all occupations.

Figure 1 - ICT Average Hourly Wages Comparison (by education level)

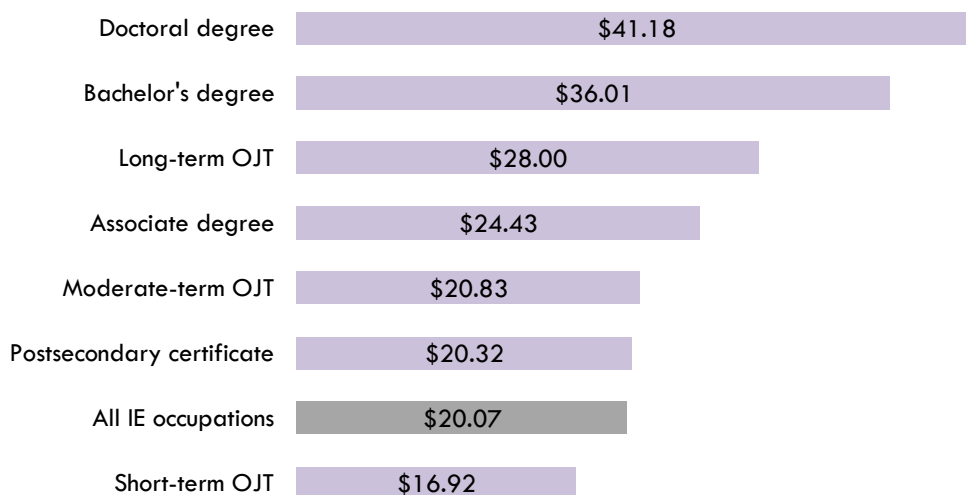


Table 4 summarizes labor market data for the 25 ICT occupations of study, by education level. The most job openings over the next three years will be for occupations that require a Bachelor's degree – 693 openings. In the region, Bachelor's degree level occupations also have the largest number of current jobs (15,735 in 2012). Occupations that require long-term on-the-job training will experience the largest job loss by 2015 (loss of 110 jobs).

Table 4 - ICT Occupational Employment by Education Level

Education Level	Occupation	2012 Jobs	Change through 2015	Openings (new+replacement jobs)	Avg. Hourly Wages
Short-term OJT	Switchboard Operators	1,280	(67)	24	\$12.51
	Telephone Operators	198	(17)	6	\$16.40
	Communications Equipment Operators, including answering service	28	0	1	\$21.86

	Total/Average for Short-term OJT	1,506	(84)	31	\$16.92
Moderate-term OJT	Computer Operators	469	11	10	\$20.83
	Total/Average for Moderate-term OJT	469	11	10	\$20.83
Long-term OJT	Telecommunications Line Installers and Repairers	1,873	(110)	33	\$28.00
	Total/Average for Long-term OJT	1,873	(110)	33	\$28.00
Postsecondary certificate	Telecommunications Equipment Installers and Repairers, except Line Installers	1,502	(17)	40	\$24.50
	Computer, Automated Teller, and Office Machine Repairers	1,351	124	80	\$16.14
	Total/Average for Postsecondary certificate	2,853	107	120	\$20.32
Associate degree	Computer Support Specialists	3,672	241	185	\$22.89
	Computer Network Support Specialists	844	63	45	\$28.50
	Desktop Publishers	100	(6)	2	\$21.89
	Total/Average for Associate degree	4,616	298	232	\$24.43
Bachelor's degree	Graphic Designers	2,299	38	76	\$19.30
	Software Developers, Systems Software	2,209	230	102	\$55.13
	Computer Systems Analysts	1,831	181	87	\$34.13
	Network and Computer Systems Administrators	1,718	172	88	\$42.35
	Computer Programmers	1,405	82	56	\$31.63
	Software Developers, Applications	1,345	208	74	\$41.85
	Computer and Information Systems Managers	1,256	107	52	\$53.09
	Web Developers	824	79	37	\$21.58
	Computer Occupations, All Other	815	23	25	\$33.29
	Database Administrators	599	66	32	\$35.60
	Computer Network Architects	565	45	25	\$41.36
	Multimedia Artists and Animators	427	29	15	\$13.27
	Computer Hardware Engineers	276	13	13	\$41.82
	Information Security Analysts	166	28	11	\$39.80
	Total/Average for Bachelor's degree	15,735	1,301	693	\$36.01
Doctoral degree	Computer and Information Research Scientists	114	5	4	\$41.18
	Total/Average for Doctoral degree	114	5	4	\$41.18
	Total/Average for all education levels	27,166	1,528	1,123	\$30.36

Source: EMSI Employment Data – 2013.3

Education and Training

In order to quantify the available education and training for ICT occupations in the region, an inventory of relevant programs from two-year and four-year institutions was taken. Relevant programs were identified by Taxonomy of Programs (TOP) code and related Classification of Instructional Programs (CIP) code. Programs included in this inventory are:

TOP Code	CIP Code	TOP Title
051400	520401	Office Technology/Office Computer Applications
061400	100303	Digital Media

061410	100304	Multimedia
061420	100304	Electronic Game Design
061430	110801	Website Design and Development
061440	100304	Animation
061450	100303	Desktop Publishing
061460	110803	Computer Graphics and Digital Imagery
070100	110101	Information Technology, General
070200	110103	Computer Information System
070210	110601	Software Applications
070600	110701	Computer Science (Transfer)
070710	110201	Computer Programming
070720	110802	Database Design and Administration
070730	110501	Computer Systems Analysis
070800	111003	Computer Infrastructure and Support
070810	110901	Computer Networking
070900	111004	World Wide Web Administration
079900	119999	Other Information Technology
093430	141004	Telecommunications Technology
220610	450799	Geographic Information Systems

Regional Occupational Centers and Programs

Early introduction to ICT is provided by Regional Occupational Centers and Programs (ROCPs). Local K-12 districts provide education and training in various ICT related areas such as Computer Information Systems (CIS), multimedia, and hardware related topics. Computer repair, 3D computer animation, Computer network management, and website design are offered by three of the four ROCPs in the Inland Empire. San Bernardino County ROP has the most ICT offerings in the region, covering 16 topic areas. Riverside County ROP offers 14 different programs, Colton Redlands Yucaipa ROP provides 12, followed by Baldy View with seven courses.

As useful as ROP education is for early career introduction and training, an educational challenge discussed at the ICT Skills Panel event was the impending cut of funding to state ROP programs in the near future.

One available service disclosed at the ICT Skills Panel event is an online soft skills training [program](#) developed by Group 1 Production.¹⁰ This program is currently being utilized by San Bernardino County school districts and is available for use by other education institutions and workforce development organizations.

Table 5 - ICT courses/programs offered by ROPs in the Inland Empire

Course/ROCP	Baldy View	Colton-Redlands Yucaipa	Riverside	San Bernardino
3D Computer Animation				
Advanced PC Repair (Computer Hardware/Electrical/Networking Engineering)				
CIS Information Technology				
CIS Microsoft Tools Level 1				
Cisco Internetworking Level 1 & 2 (Information Technology)				
Computer Business Application				

¹⁰ www.interactivevt.net

Computer Network Management				
Computer Repair				
Computer Security				
Computer Software Lab				
Creative Digital Media				
Desktop Publishing and Printing (Graphic Arts Technology)				
Digital Design				
Digital Imaging				
Foundations of Information Technology				
Fundamental Web Page Design (Media Support/Services)				
Geographic Information Systems Fundamentals (Information Support/Services)				
Graphic Communication				
Graphics Technology				
Health Information Technician				
IC3 Internet and Computing Core				
Interactive Media Design				
Introduction to Computers				
Introduction to Game Design				
Introduction to Visual Basic Programming (Programming & Systems Development)				
Medical Billing & Coding				
Microsoft Office				
Multi-Media and Entertainment				
Office Operations & Technology Phase 2				
Office Support Procedures (Keyboarding)				
PC Repair and Maintenance (Computer Hardware/Electrical/Network Engineering)				
TV/Video Digital Media				
Web Site Design				

Two-year Schools

Community College

Community colleges in the region offer many education and training programs that prepare students for careers in ICT. Computer information systems is the most commonly offered program in the region, with nine area community colleges awarding degrees and certificates in the field. Other widely available programs include computer programming, multimedia, other information technology, and office technology/office computer applications.

Education and training provided through community college certificate and degree programs offer students a background in industry recognized skills and abilities. Industry experts confirmed that students who complete a program at a community college often have the appropriate amount of expertise to make them a desirable candidate in the labor market.¹¹

¹¹ Comments from industry experts in attendance at the Inland Empire ICT Skills Panel Event held on 08/19/13.

Table 6 - Community College ICT Programs in the Inland Empire

C=Certificate AA/AS=Associate degree

Program/College	Barstow	Chaffey	Copper Mountain	Crafton Hills	Desert	Moreno Valley	Mt San Jacinto	Norco	Palo Verde	Riverside	San Bernardino	Victor Valley
Animation		C		C					C			
Computer Graphics & Digital Imagery		AA,C		C	AA,C				C			
Computer Information Systems	AS,C	AS,C	AA,C	AS,C	AA,C		AS,C		AS,C		AA,C	AS
Computer Networking		C					C					
Computer Programming						AS,C	C	AS,C		AS,C	C	C
Computer Science (transfer)					AA							
Database Design & Administration										C		
Digital Media										AS,C		
Geographic Information Science							AS,C					
Information Technology, General									C	C		C
Multimedia		AA,C				AS,C	AS,C	AS,C		AS,C	C	
Other Information Technology				C		C		C	C	C	C	
Office Technology/Office Computer Applications	C	AS,C					AS,C		AS,C		C	AS,C
Software Applications						AS,C		C	C	AS,C		C
Telecommunications Technology										C	AS,C	
Website Design & Development		AA,C										
World Wide Web Administration				C			C					C

Proprietary/Technical Colleges

Some ICT related programs are also provided by area proprietary/technical schools. However, most of these programs award a Bachelor’s degree as opposed to the Associate degree conferred by community colleges.

Table 7 - Proprietary/Technical ICT Programs in the Inland Empire

TC=Technical Certificate TB=Technical Bachelor’s degree
 TA= Technical Associate degree

Program/College	ITT Technical Institute-Corona	ITT Technical Institute-San Bernardino	Kaplan College	The Art Institute of CA-Argosy University	Westwood College
Animation, Interactive Technology, Video Graphics, Special Effects		TB			TB
Computer & Information Systems Security/Information Assurance	TB	TB			TB
Computer Graphics				TB	
Computer Support Specialists			TC		
Computer Systems Networking and Telecommunications	TA	TA			TA
Health Information/Medical Records Technology/Technician		TA			TA

Information Technology			TA		
Web Page, Digital/Multimedia and Information Resources Design				TB	

Universities

There are a limited number of 4-year programs in the region that train for occupations in the ICT field. Among the public and private Inland Empire universities, there are seven related programs. The University of California Riverside is the only area 4-year institution to offer a doctorate degree, in the field of computer science.

Table 8 - 4-year ICT Programs in the Inland Empire

B=Bachelor's degree D=Doctoral degree					
M= Master's degree					
College/Program	California Baptist University	CSU-San Bernardino	La Sierra University	UC Riverside	University of Redlands
Computer and Information Sciences, General					B
Computer Science		B, M	B	B, M, D	
Desktop Publishing/Digital Imaging Design	B				
Information Technology	B	B			

Gap Analysis

In order to understand the supply and demand for the ICT labor market in the Inland Empire, education program completions (supply) were compared to the number of occupational job openings (demand). Supply and demand analysis for each of the six occupational clusters is contained in this section.¹²

Support/Technical Cluster

Support/technical occupation group has lower entry requirements for employment and pay lower wages compared to other ICT clusters. However, the number of jobs available on the labor market is quite significant. The two identified support/technician occupations accounted for more than 4,141 jobs in 2012. Programs that prepare for these occupations conferred 1,932 awards in the same year. The large majority of completions counted toward these occupations were awarded by ROP programs. ROP courses can offer sufficient training for entry-level occupations by providing foundational knowledge that can be later built on in post-secondary institutions.

Currently there is one technical/proprietary school that offers a program in Computer Support which awarded 4 certificates to students in 2012. Training and education through Information Technology and Software Applications programs can also prepare the workforce for jobs in this field. Table 9 provides employment and education data for the technician/support occupations included in this study.

Even though the number of students completing related programs is significantly larger than the anticipated demand for new entrants, it should be noted that many of the students who completed ROP programs will continue on with the education rather than obtain employment.

¹² Note that completions from "Other Information Technology" programs are not included in the gap analysis because of insufficient information about the program and course content.

Table 9 - Support/Technician Occupational Employment and Education

Occupation	Education level	2012 Jobs	Annual Openings	2012 Completions	Over/(Under) Supply
Computer Operators (43-9011)	Moderate-term OJT	469	10	1,712	1,702
Computer User Support Specialists (15-1151)	Associate degree	3,672	185	283	98
Total		4,141	195	1,932	1,737

According to aggregated job postings data, more than half of job advertisements from area employers indicate that a high school education, or equivalent, is the most commonly preferred education requirement for these occupations. Some examples of job titles include:

- Geek Squad Agent
- Computer Operator
- Easy Technology Associate
- Systems Technician
- Help Desk Analyst
- Help Desk Support
- Taff Analyst

Multimedia/Digital Media Cluster

Multimedia occupations consist of those who develop, design, and maintain websites, video games, graphics, and other types of multi-media. The development of technology has created the need to formalize new occupations in this cluster that will require new education and training programs. Among the occupations in this cluster, the region prepares more students for jobs as graphic designers and multi-media artists and animators. Largely, these programs are being completed at technical/proprietary schools.

A true analysis of the supply and demand in this cluster is impeded by the evolving nature of multimedia occupations. Traditional labor market data is not yet available for emerging occupations, such as video game designers and web administrators. The data for these occupations and others are currently being collected under Standard Occupational Code 15-1199 computer occupations, all other.

Available data show some oversupply for multi-media artists and animators of 34 workers and for desktop publishers occupations (21 workers). Employment and education statistics for all occupations in the cluster are presented in Table 10.

Table 10 - Multimedia Occupational Employment and Education

Occupation	Education level	2012 Jobs	Annual Openings	2012 Completions	Over/(Under) Supply
Desktop Publishers (43-9031)	Associate degree	100	2	23	21
Computer Occupations, all other (15-1199)	Bachelor's degree	815	25	2	(23)
Video game designers (15-1199.11)	Bachelor's degree	N/A	N/A		
Web administrators (15-1199.03)	Bachelor's degree				

Occupation	Education level	2012 Jobs	Annual Openings	2012 Completions	Over/(Under) Supply
Web Developers (15-1134)	Bachelor's degree	824	37	10	(27)
Multi-media artists and animators (27-1014)	Bachelor's degree	427	15	49	34
Graphic Designers (27-1024)	Bachelor's degree	2,299	76	80	4
Total		4,465	155	164	9

Employers in the Inland Empire posted **197** advertisements for web developer jobs in 2012. Among them, Environmental Systems Research Institute (ESRI), California Baptist University, and CGI Group had the most job openings. Certifications required for web developer positions, according to online job descriptions, were Security +, Network+, various Microsoft certifications, Certified Customer Service Specialist (CSS), and Casino Gaming License.

Software & Database Specialists Cluster

Software and database specialists work as developers of software or applications, provide security support services, database support services, and develop programming for computers. As a group, these occupations accounted for 5,724 jobs in 2012. Regional employers are projected to have 275 job openings (new and replacement jobs) for these workers annually, while regional education institutions only graduate about 50 students in relevant programs. This creates the training gap (undersupply) for these professionals in the regional labor market.

According to the Bureau of Labor Statistics, all occupations in this cluster require a Bachelor's degree to be eligible for employment. However, industry employers claim that practical knowledge and applicable skills are often more valuable than the 4-year degree.

The largest need in the region is for programs that prepare students for jobs as computer programmers, and software developers (both applications and systems software). In 2012, community colleges awarded 36 certificates in computer programming. The largest need within this cluster is for training and education to prepare software developers, with an apparent undersupply of 172 workers (see Table 11 for details).

Table 11 – Software & Database Specialists Occupational Employment and Education

Occupation	Education level	2012 Jobs	Annual Openings	2012 Completions	Over/(Under) Supply
Database administrators (15-1141)	Bachelor's degree	599	32	5	(27)
Computer Programmers (15-1131)	Bachelor's degree	1,405	56	36	(20)
Software developers, applications (15-1132)	Bachelor's degree	1,345	74	4	(172)
Software developers, systems software (15-1133)	Bachelor's degree	2,209	102		
Information security analysts (15-1122)	Bachelor's degree	166	11	7	(4)
Total		5,724	275	52	(223)

There were **1,592** job advertisements posted online for this cluster of occupations in 2012. The most postings were for software developers, applications (903) followed by computer programmers (302), database administrators (212), information security analysts (110), and software developers, systems

software (65). It should be noted that job postings for software developers, systems software mostly required a high school diploma, not a bachelor's degree, for employment – 68% of job ads.

There is a significant discrepancy between the estimated annual openings for occupational jobs and employer job postings. Job advertisements in 2012 outnumbered traditional labor market job openings by more than 1,000, reflecting either an unmet demand due to an unqualified workforce or employer need being underestimated.

Network & Hardware Specialists Cluster

The cluster of network, hardware & systems specialists is comprised mainly of occupations that require a Bachelor's degree for employment. In the region, there are two bachelor's degree level programs with the focus on computer Infrastructure and Support and Computer Information Systems. These programs prepare students for jobs as computer network architects and computer and information systems managers.

Industry experts observed at the Inland Empire ICT Skills Panel that a four-year education provides students with sufficient theory in this field but the graduates are lacking training in applied skills. Applied skills and soft skills are what are most needed to make a candidate attractive to employers, according to experts.

Overall, this group of occupations displays a potential oversupply of 161 trained workers. The largest oversupply is for network and computer systems administrators followed by computer network support specialists. The largest undersupply is for qualified computer systems analysts. Table 12 provides complete occupational employment and education data for this cluster of occupations.

Table 12 - Network, Hardware & Systems Specialists

Occupation	Education level	2012 Jobs	Annual Openings	2012 Completions	Over/(Under) Supply
Computer Network Architects (15-1143)	Bachelor's degree	565	25	75	50
Computer and information system managers (11-3021)	Bachelor's degree	1,256	52	121	69
Network and computer system administrators (15-1142)	Bachelor's degree	1,718	88	162	74
Computer system analysts (15-1121)	Bachelor's degree	1,831	87	-	(87)
Computer network support specialists (15-1152)	Associate degree	844	45	113	68
Computer Hardware Engineers (17-2061)	Bachelor's degree	276	13	-	(13)
Total		6,490	310	471	161

In 2012, employers in the Inland Empire advertised more than **1,114** jobs for the occupations in this cluster. The largest demand was for computer systems analysts (557 advertisements) and network and computer systems administrators (364 advertisements). In this cluster, employer job ads again significantly exceed job openings for occupations.

Telecommunications Cluster

Telecommunications incorporate occupations that operate or install telecommunications or communications equipment. Some examples of telecommunications include radio and television broadcasting, cable and

satellite, mobile and wired telephones, and the internet. The majority of these occupations require minimal to no formal education.

In some areas, ROPs can provide sufficient training for students to enter positions that only require some level of on-the-job training. However, there are no applicable ROP programs related to the Telecommunications cluster of occupations. In fact, the region only counts one Associate degree completion in a related program for the 2011-12 academic year.

A comparison of job openings to program completions displays an apparent undersupply of a qualified workforce for this cluster but since the majority of these occupations only require on-the-job training, the actual undersupply is relatively small. Table 13 provides complete occupational employment and education detail.

Table 13 - Telecommunications Occupational Employment and Education

Occupation	Education level	2012 Jobs	Annual Openings	2012 Completions	Over/(Under) Supply
Switchboard Operators, Including Answering Services (43-2011)	Short-term on-the-job training	1,280	1	-	(1)
Telephone Operators (43-2021)	Short-term on-the-job training	198	6	-	(6)
Communications Equipment Operators, All Other (43-2099)	Short-term on-the-job training	28	1	-	(1)
Telecommunications Line Installers and Repairers (49-9052)	Long-term OJT	1,873	33	-	(33)
Computer, Automated Teller, and Office Machine Repairers (49-2011)	Postsecondary certificate	1,351	80	-	(80)
Telecommunications Equipment Installers and Repairers, Except Line Installers (49-2022)	Postsecondary certificate	1,502	40	1	(39)
Telecommunications Engineering specialists (15-1143.01)	Bachelor's degree	N/A	N/A	-	-
Total		6,232	161	-	(160)

Employers who hire for telecommunications occupations placed ads for **358** jobs in 2012. Computer, automated teller, and office machine repairers were the most in demand occupation (179 job postings) followed by telecommunications equipment installers and repairers, except line installers (62 postings). Some of the skills desired by employers, as outlined in job advertisements, include repair, PC support, printers, technical support, computer hardware/hardware knowledge, help desk support, hardware and software installation, and network hardware/software maintenance.

Other Specialized IT

The cluster of Specialized IT occupations contains occupations that have a specific application of their IT skills and knowledge. In this cluster, labor market information is not available for two of the three occupations however the region does offer educational programs for training in both Geographic Information Systems and Health Information Technology. Education completions and the limited available labor market data is provided in Table 14.

Table 14 - Other Specialized IT Occupational Employment and Education

Occupation	Education level	2012 Jobs	Annual Openings	2012 Completions	Over/(Under) Supply
Geographic information systems technician (15-1199.05)	Bachelor's degree	N/A	N/A	12	N/A
Informatics Nurse Specialists (15-1121.01)	Bachelor's degree	N/A	N/A	27	N/A
Computer and information research scientists (15-1111)	Doctoral degree	114	4	13	9
Total		114	4	52	21

In place of unavailable labor market data for emerging occupations, online job advertisements from employers demonstrate demand. In the region, there were 27 openings for Computer and information research scientists, 8 job postings for Geographic Information Systems (GIS) Analysts, and 7 openings for Clinical Informatics Specialists (Informatics Nurse Specialists) in 2012.

Conclusions & Recommendations

Information and Communications Technology is an important sector for economic growth and provides good paying employment opportunities for students at varying levels of training and education. The sector is unique in that it combines various technologies, with ICT being an umbrella term that includes several sub terms. The multi-faceted nature of this sector makes it challenging to fully capture all industries and occupations that it is comprised of. However, previous work by the Mid Pacific Information and Communications Technology (MPICT) center has provided a solid foundation for this work.

Using previously established industries and occupations, this study sought to provide the landscape for ICT in the Inland Empire. Following are some of the key findings and recommendations for education institutions in the region.

Key findings include:

- In the region, the 30 identified industries accounted for 17,659 jobs in 2012 and are expected to have 8% job growth over the next three years. In 2012, the average annual wages paid to industry employees were \$66,950.
- Occupations that have been identified as being primarily ICT focused accounted for 27,166 jobs in 2012 in the Inland Empire. Employment for these 25 occupations will increase by 6% by the year 2015. Job openings, new plus replacement jobs, will sum 3,369 over the same time period.
- In comparison to all occupations in the Inland Empire, those that have a primary ICT focus pay considerably higher average hourly wages.
- The majority of programs that train for employment in ICT related jobs are offered either through ROP or community colleges.
- Industry experts revealed that for most occupations, a two-year education provides sufficient skills and practical knowledge of desired qualifications.
- The matching of available training and education programs to labor market demand is made difficult by the evolving nature of the industry and the inconsistency in program structure. However, based on the data available it appears there is a high demand in the regional labor market for software developers, web developers, and computer systems analysts. Area education institutions are lacking sufficient completions in programs that prepare for these positions. In other areas where oversupply is demonstrated, employer job postings reflect a larger need thus requiring a closer look at seeming market saturation.

Based on research finding and the skill panel discussion, education institutions are recommended to:

- Introduce digital literacy skills in courses across disciplines. Increasingly, students entering the workforce are going to be expected to have some basic understanding of technological applications
- Integrate practical soft skills training into existing courses. Overwhelmingly, industry experts expressed the lack of “real world” skills in students who are seeking employment in their companies.
- Connect with local industry representatives to establish opportunities for internships as on-the-job experience is highly sought after in the labor market for ICT.
- Standardize program offerings across community colleges in the region. A more cohesive offering of programs will not only provide students with better information to make informed decisions but can also help determine where training gaps exist.

- Create articulation agreements between ROP, community college, and four-year institutions. Regional educators stressed a strong desire to have these agreements in place.

References

California Community Colleges' Centers of Excellence and Path2Careers. *Jobs of the Future: Crime Analysis to Pre-Crime Analysts*.

Gartner. *Gartner Says Big Data Creates Big Jobs: 4.4 Million IT Jobs Globally to Support Big Data by 2015*. Accessed on 07/11/13 at <http://www.gartner.com/newsroom/id/2207915>.

Huffington Post. *Techie's Dilemma: Silicon Valley vs. New York*. 02/22/13. Accessed on 07/15/13 at http://www.huffingtonpost.com/ben-cole/new-york-startups_b_2681804.html

Industrial Technology Research Institute. *Global ICT Trends Emerging in 2013*. Accessed on 07/15/13 at http://www.itri.org.tw/eng/econtent/news/news02_01.aspx?sid=13

Information Week. *Data Scientist Shortage: Split Role in Half*. December 12, 2012. Accessed on 07/11/13 at <http://www.informationweek.com/big-data/news/big-data-analytics/data-scientist-shortage-split-role-in-h/240144215>

KPMG. *Mobilizing Innovation: The changing landscape of disruptive technologies*. Accessed on 07/15/13 at <http://www.kpmg.com/Global/en/IssuesAndInsights/ArticlesPublications/technology-innovation-survey/Documents/mobilizing-innovation-august-2012.pdf>

Manufacturing Business Technology. *Here, There, Everywhere: Rugged Computers Enable True Workforce Mobility*. Accessed on 07/15/13 at <http://www.mbtmag.com/articles/2013/04/here-there-everywhere-rugged-computers-enable-true-workforce-mobility>

NetSuiteBlog. *Five Trends That Will Dominate Software Spending in 2013*. Accessed on 07/16/13 at <http://www.netsuiteblogs.com/blog/2013/07/five-trends-that-will-dominate-software-spending-in-2013.html>.

Telecomindiaonline.com. *Telecom Viewpoint: The hottest ICT trends in 2013*. Accessed on 07/11/13 at http://www.telecomindiaonline.com/the-hottest-ict-trends-in-2013.html?goback=%2Egde_63456_member_195846896.

Appendix A – How to use this report

This report is designed to provide current labor market information to:

- Understand the factors impacting information and communications technology occupations and their effect on the workforce in the Inland Empire, and;
- Provide information on information and communications technology education and training programs in the region

The information in this report has been validated by industry professionals and community colleges and includes a listing of programs being offered by colleges to address workforce needs. In some instances, the labor market information and industry validation will suggest that colleges might not want to begin or add programs, thereby avoiding needless replication and low enrollments.

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.

More information about the Centers of Excellence is available at www.coecc.net.

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, nor California Community Colleges Chancellor's Office are responsible for applications or decisions made by recipient community colleges or their representatives based upon components or recommendations contained in this study.

Explanation of Data Sources

Industry Data

In order to capture a complete picture of industry employment, EMSI basically combines covered employment data from Quarterly Census of Employment and Wages (QCEW) produced by the Department of Labor with total employment data in Regional Economic Information System (REIS) published by the Bureau of Economic Analysis (BEA), augmented with County Business Patterns (CBP) and Nonemployer Statistics (NES) published by the U.S. Census Bureau. Projections are based on the latest available EMSI industry data, 15-year past local trends in each industry, growth rates in statewide and (where available) sub-state area industry projections published by individual state agencies, and (in part) growth rates in national projections from the Bureau of Labor Statistics.

Occupation Data

Organizing regional employment information by occupation provides a workforce-oriented view of the regional economy. EMSI's occupation data are based on EMSI's industry data and regional staffing patterns taken from the Occupational Employment Statistics program (U.S. Bureau of Labor Statistics). Wage information is partially derived from the American Community Survey.

Real Time Labor Market Data

Burning Glass Labor Insight data services provides data collected from numerous online job posting websites, job boards, and employer boards to present real-time information on job postings by region. Data collected and presented here may not be free of duplicate job postings and is not a proven source for estimating total employment, projecting demand, or education and training preferences.

Education Program Data

Community college education programs were extracted from the California Community Colleges Chancellor's Office Inventory of Approved Programs. This inventory lists credit degrees and certificates offered by California community colleges which are approved by the Chancellors office. California Community Colleges approved programs are identified by the Taxonomy of Programs (TOP), a system of nomenclature for designating programs in the California Community Colleges system. The complete TOP manual can be viewed on the Chancellor's office website at

http://www.cccco.edu/Portals/4/TopTax6_rev0909.pdf

Program and completion data for 4 year education institutions and technical/proprietary institutions was compiled using the Integrated Postsecondary Education Data System (IPEDS). IPEDS gathers information from every college, university, and technical and vocational institution that participates in the federal student financial aid programs. The Higher Education Act of 1965, as amended, requires that institutions that participate in federal student aid programs report data on enrollments, program completions, graduation rates, faculty and staff, finances, institutional prices, and student financial aid.

Appendix B – Labor Market Data for All ICT Occupations (by SOC code)

SOC	Description	2012 Jobs	2015 Jobs	Change	% Change	3-year openings	2013 Annual Openings	Avg. Hourly Earnings
11-3021	Computer and Information Systems Managers	1,256	1,363	107	9%	156	52	\$53.09
15-1111	Computer and Information Research Scientists	114	119	5	4%	12	4	\$41.18
15-1121	Computer Systems Analysts	1,831	2,012	181	10%	261	87	\$34.13
15-1122	Information Security Analysts	166	194	28	17%	33	11	\$39.80
15-1131	Computer Programmers	1,405	1,487	82	6%	168	56	\$31.63
15-1132	Software Developers, Applications	1,345	1,553	208	15%	222	74	\$41.85
15-1133	Software Developers, Systems Software	2,209	2,439	230	10%	306	102	\$55.13
15-1134	Web Developers	824	903	79	10%	111	37	\$21.58
15-1141	Database Administrators	599	665	66	11%	96	32	\$35.60
15-1142	Network and Computer Systems Administrators	1,718	1,890	172	10%	264	88	\$42.35
15-1143	Computer Network Architects	565	610	45	8%	75	25	\$41.36
15-1151	Computer User Support Specialists	3,672	3,913	241	7%	555	185	\$22.89
15-1152	Computer Network Support Specialists	844	907	63	7%	135	45	\$28.50
15-1199	Computer Occupations, All Other	815	838	23	3%	75	25	\$33.29
17-2061	Computer Hardware Engineers	276	289	13	5%	39	13	\$41.82
27-1014	Multimedia Artists and Animators	427	456	29	7%	45	15	\$13.27
27-1024	Graphic Designers	2,299	2,337	38	2%	228	76	\$19.30
43-2011	Switchboard Operators, Including Answering Service	1,280	1,213	(67)	(5%)	72	24	\$12.51
43-2021	Telephone Operators	198	181	(17)	(9%)	18	6	\$16.40
43-2099	Communications Equipment Operators, All Other	28	28	0	0%	3	1	\$21.86
43-9011	Computer Operators	469	480	11	2%	30	10	\$20.83
43-9031	Desktop Publishers	100	94	(6)	(6%)	6	2	\$21.89
49-2011	Computer, Automated Teller, and Office Machine Repairers	1,351	1,475	124	9%	240	80	\$16.14
49-2022	Telecommunications Equipment Installers and Repairers, Except Line Installers	1,502	1,485	(17)	(1%)	120	40	\$24.50
49-9052	Telecommunications Line Installers and Repairers	1,873	1,763	(110)	(6%)	99	33	\$28.00
	Total	27,166	28,694	1,528	6%		1,123	\$30.36

Appendix C – Occupation and Program Completions by Cluster

Statistics provided in the following tables include the following:

2012 Completions: Data collected include the number of awards (degrees and certificates) completed in the 2011-2012 academic year at Riverside and San Bernardino County ROPs, California Community Colleges, area technical/proprietary schools, and universities.

Total Completions: The number of total completions includes **only** degree and certificate completions from the 2011-12 academic year at California Community Colleges, area technical/proprietary schools, and universities.

Annual Openings: The number of annual openings from the period from 2012-2015 represents both new and replacement jobs for each occupation.

Over/ (Under) Supply: The over/under supply figure represents either a surplus or shortage of student completions for each occupation. A surplus is represented by a whole number and a shortage is represented by a whole number within parentheses.

Award Level: The following legend provides a description of the award levels used in the gap tables in the Award Level column.

ROP=ROP/ROCP program completion	AS/AA=2 year community college Associate degree
C=2 year community college certificate	TA=Technical/proprietary school Associate degree
TC=Technical/proprietary school certificate	BA/BS=Bachelor's degree
MA/MS=Master's degree	D=Doctoral degree

Support/Technical

Occupation	TOP Program Names	Award Level	2012 Completions	Total Completions	Annual Openings	Over/(Under) Supply
Computer Operators (43-9011)	Information Technology, General	ROP	1,649	63	10	(53)
	Office Technology/Office Computer Applications	C	34			
		AS/AA	29			
Computer User Support Specialists (15-1151)	Computer Support	ROP	212	71	185	114
		TC	4			
	Information Technology, General	C	49			
	Software Applications	C	7			
		AS/AA	11			
Total			1,995	134	195	61

Multimedia

Occupation	TOP Program Names	Award Level	2012 Completions	Total Completions	Annual Openings	Over/(Under) Supply
Desktop Publishers (43-9031)	Desktop Publishing	ROP	319	23	2	21
	Multimedia	C	23			
Computer Occupations, all other (15-1199)	World Wide Web Administration	ROP	414	2	25	(23)
Video game designers (15-1199.11)		C	2			
Web administrators (15-1199.03)						
Web Developers (15-1134)	Website Design and Development	ROP	425	10	37	(27)
		AS/AA	1			
		BA/BS	9			
Multi-media artists and animators (27-1014)	Multimedia	AS/AA	17	49	15	34
		BA/BS	30			
	Animation	ROP	143			
		C	2			
Graphic Designers (27-1024)	Computer Graphics and Digital Imagery	ROP	599	80	76	4
		C	15			
		AS/AA	4			
		BA/BS	31			
	Digital Media	ROP	424			
		BA/BS	30			
Total			2,169	164	155	9

Software & Database Specialists

Occupation	TOP Program Names	Award Level	2012 Completions	Total Completions	Annual Openings	Over/(Under) Supply
Database administrators (15-1141)	Database Design and Administration	C	5	5	32	(27)
Computer Programmers (15-1131)	Computer Programming	ROP	41	36	56	(20)
		C	27			
		AS/AA	9			
Software developers, applications (15-1132)	Computer Science (transfer)	AS/AA	4	4	74	(172)
Software developers, systems software (15-1133)					102	
Information security analysts (15-1122)	Information Technology, General	BA/BS	7	7	11	(4)
Total			93	52	275	(223)

Network, Hardware & Systems Specialists

Occupation	TOP Program Names	Award Level	2012 Completions	Total Completions	Annual Openings	Over/(Under) Supply
Computer Network Architects (15-1143)	Computer Infrastructure and Support	BA/BS	20	75	25	50
	Computer Networking	C	55			
Computer and information system managers (11-3021)	Computer Information Systems	BA/BS	22	121	52	69
	Computer Science (transfer)	BA/BS	60			
		MA/MS	39			
Network and computer system administrators (15-1142)	Computer Information Systems	C	22	144	88	56
		A	68			
		TA	18			
	Computer Networking	C	54			
Computer system analysts (15-1121)		-	-	-	87	(87)
Computer network support specialists (15-1152)	Computer Networking	AA/AS	113	113	45	68
Computer Hardware Engineers (17-2061)		-	-	-	13	(13)
Total			471	378	310	143

Telecommunications

Occupation	TOP Program Names	Award Level	2012 Completions	Total Completions	Annual Openings	Over/(Under) Supply
Switchboard Operators, Incl. Answering Svcs. (43-2011)	-	-	-	-	24	-
Telephone Operators (43-2021)	-	-	-	-	6	-
Communications Equipment Operators, All Other (43-2099)	-	-	-	-	1	-
Telecom Line Installers and Repairers (49-9052)	-	-	-	-	33	-
Computer, Automated Teller, and Office Machine Repairers (49-2011)	-	-	-	-	80	-
Telecom Equipment Installers & Repairers, Except Line Installers (49-2022)	Telecommunications Technology	AA/AS	1	1	40	(39)
Telecom Engineering specialists (15-1143.01)	-	-	-	-	N/A	-
Total			1	1	184	

Other Specialized IT

Occupation	TOP Program Names	Award Level	2012 Completions	Total Completions	Annual Openings	Over/(Under) Supply
Geographic information systems technician (15-1199.05)	Geographic Information Science	C	8	12	N/A	N/A
		A	4			
Informatics Nurse Specialists (15-1121.01)	Health Information Technology	TA	27	27	N/A	N/A
Computer and information research scientists (15-1111)	Computer Science (transfer)	D	13	13	4	9
Total			52	52	4	9