2014 ENVIRONMENTAL SCAN

ICT

Information & Communication Technologies

Demand and Supply Issues and Opportunities

in the Greater San Francisco Bay Area

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A draft version of this report was released in March 2014. Thank you to all who provided feedback and input on that version, which led to this final report, released on July 10, 2014.

This document is largely intended as a reference, to draw from in efforts to improve ICT education and workforce development. It would be difficult to read, cover-to-cover. Skim it and focus on sections that are relevant to your perspective and efforts.

Contents

Executive Summary

21st century economies are increasingly driven by information and communication technologies (ICT).

In this report, Information and Communications Technologies (ICT) is used as a superset or umbrella term, encompassing all rapidly emerging, evolving, and converging computer, software, networking, telecommunications, Internet, programming, information systems and digital media technologies. ICT is a comprehensive framework for organizing these inter-related, interdependent, and rapidly changing technologies and high-tech fields - and for organizing the ICT workforce, which spans across organizations of all sizes - in all industries. The ICT term and framework are widely used outside the U.S., by institutions including the United Nations, European Union, World Bank, and International Telecommunications Union.

Until recently, this aggregated approach has not been often used in the U.S., leading ICT to receive less strategic attention from policy makers and planners. ICT is particularly important in the greater San Francisco Bay Area economy, as the data in this report shows.

ICT Industries

ICT industries, which create, market and deliver ICT related goods and services, are among the largest and most important industry clusters in the greater San Francisco Bay region. In 2012, they accounted for:

- 16,360 establishments, 8.7% of the total number of firms in the Bay Area.
- 411,335 employees, 10.2% of total industry employment in the SF Bay Area, > 1 in 10 jobs.
- Estimated 7.3% employment growth, 32,455 net new jobs, between 2012 and 2015,
- 17.2% of the overall employment growth expected for all industry employment in the Bay Area.
- >$230 billion in sales revenue, roughly 20% of total regional sales revenue for all industries.
- >$86.3 billion in earnings, nearly 23% of total regional earnings for all industries.

Multiplier effects expand the economic impact of this sector hugely. ICT industry encouragement and support should be a high, ongoing economic development priority in the San Francisco Bay Area.

ICT Occupations

However, ICT Workforce doesn't just work for ICT industry employers. ICT Workforce is now strategically essential to most organizations, across all industry sectors, because that ICT workforce enables increasing productivity from all workforce and many strategic efforts of all business functions. ICT Workforce demand in the Bay Area is large and growing. In 2012, ICT Workforce in the Bay Area accounted for:

- 333,229 people employed, 8.3% of all Bay Area employees (about 1 in 12 jobs)
- Median annual salaries of about $90,000

Between 2012 and 2015, ICT Occupations expect:

- 20,297 net job growth (6.1%)
- 21,178 total replacement jobs
- 43,054 total job openings (8.2% of all job openings)
- 14,354 average annual job openings

The many different standard occupations in the ICT Workforce cluster are hard for workforce systems to keep up with, because they emerge and evolve quickly, and because employers do not typically use standard or consistent job titles or requirements. Cybersecurity is a hot, current buzzword and employment need, but cybersecurity specialist occupations have not yet been formalized in occupational classification systems. ICT Workforce occupations are the best places for California community colleges to focus ICT related program and planning attention.

CCC ICT Education and Workforce Development Supply:

California community colleges (CCCs) are among the most efficient vehicles for cost-effectively pushing needed ICT knowledge and skills out into our society. The 28 colleges in the Bay Area Community College Consortium (BACCC) have rich ICT-related resources, faculty, curriculum and credentials. In 2010/11:

- 82 ICT related departments/programs
- 1,350 faculty teaching in those departments
- 140,000 for-credit and 16,000 non-credit ICT related enrollments
- 180 ICT related Associate Degrees
- 405 ICT related Academic Certificates
- 7,398 sections of 2,366 ICT related courses
- 17,784 full-time equivalent students of ICT
- Strong Vendor Neutral and Industry Academy Programs and Certification Test Preparation
- Service to all Bay Area geographic areas
- Affinity to local K-12 systems and schools
- Affinity to 4-year colleges and universities

University ICT Education Supply:

There are 10 public universities in the greater Bay Area. Nine have 32 ICT related departments with a wide variety of bachelor, master, doctoral and research opportunities. Generally, these are not well articulated with community colleges, especially in hands-on Career Technical Education pathways.

Regional Efforts to Improve ICT Education and Workforce Development

Historically, college offerings have been developed and delivered locally, with little regional coordination. However, today there is a new strategic emphasis and plan to bring those colleges together to better address ICT sector needs. The CCC "Doing What Matters for Jobs and the Economy" campaign includes one dedicated Statewide ICT Sector Navigator and two dedicated Bay Area region ICT Deputy Sector Navigator positions devoted to those efforts. These are exciting developments.

There are many ways the diverse stakeholders to a thriving ICT industry and employment sector in the greater Bay Area can join and work together to improve ICT economic and workforce development. The 4th section of this report includes many suggestions, but there are certainly many others. Appendices to this report provide detailed data to inform grant and project proposals and work.

21st century economies and workforce are different from 20th century economies and workforce. Let's wake up to and embrace these new realities, recognizing our strengths in the Bay Area around ICT, and organize ourselves and our efforts around making that work even better!

We need to be able to grow the ICT Workforce needed by Bay Area ICT industries and ICT Workforce employers here in the Bay Area, for the benefit of our local economies, communities and citizens, rather than import our ICT Workforce and risk driving our local citizens out of the Bay Area region. Let's get together and do that!

Introduction

Information and Communication Technologies (ICT)

Information and Communications Technologies (ICT) encompasses all rapidly emerging, evolving, and converging computer, software, networking, telecommunications, Internet, programming, information systems and digital media technologies. It is an umbrella or superset term that includes many different competing subset terminologies. ICT is a comprehensive framework for organizing these inter-related, interdependent, and rapidly changing technologies and high-tech fields - and for organizing the ICT workforce, which spans across organizations of all sizes - in all industries. The ICT term and framework are widely used outside the U.S., by institutions including the United Nations, European Union, World Bank, International Telecommunications Union, and others. ICT is recognized in many global economies as a strategically important industry and employment sector that is a major driver of economic growth.

Despite its size and importance, until recently, ICT has not received sufficient attention from policy makers and planners in the U.S. Current frameworks for study, developed by federal and state governments, do not consider the convergence of ICT technologies, industries and employment into one cluster that can be researched effectively. This has resulted in fragmented reporting of ICT related information that does not accurately reflect the true breadth and depth of ICT, because it either includes its companies and workers with other sectors, or it reports on smaller components only (such as computers). As a result, industry and occupational research reporting in the U.S. does not draw as much attention to this strategic sector as research reporting abroad, which likely leads to U.S. policy and planning not paying adequate strategic attention to this very important 21st century industry and employment sector.

MPICT advocates use of ICT as a term and framework in the U.S. and in California. A very practical reason to adopt ICT, rather than IT (Information Technology), which is widely used in the U.S., is that ICT is more searchable on the internet and in other information systems. Searching "IT" produces every article in the English language, while searching ICT returns more focused and relevant results.

The paradigm shift from 20th century economies dominated by manufacturing, transportation and energy to 21st century information, knowledge and innovation economies includes many rapid changes that are difficult to adjust to. All industries are affected. Increasingly, ICT expertise is required by workforce at every level. ICT workforce is in high demand, and half of California employers report difficulty finding appropriately skilled ICT Workforce, even in the recent period of high unemployment.[1] This report is one in a series analyzing ICT industry and employment sectors in California, California Community College ICT related programs and credentials, and what California can do to improve our performance in relation to ICT industry growth, ICT employment in all industries and resulting economic impacts.

California Community Colleges

The primary audience for this report is educators and administrators in the California Community College (CCC) system and their strategic partners and stakeholders:

- The largest higher educational system in the U.S., 3M students attending 112 colleges annually.
- One in four community college students in the U.S. attends a CCC.
- CCCs have the highest attendance rate of any U.S. community college system.
- CCCs enroll one in three Californians aged 18 – 24.
- Over 80% of CCC students work already.
- CCCs transfer 60% of California State University system graduates.
- CCCs transfer 30% of University of California system graduates.
- Every $1 invested in CCC education returns $3 to the California economy.
- CCCs prepare people for the workforce, in addition to preparing students for transfer.[2]

[1] http://www.mpict.org/ict_study_phase2.html

[2] http://www.foundationccc.org/AbouttheColleges/FactsandFigures/tabid/636/Default.aspx

However, this report also includes valuable information for other CCC stakeholders, California legislators and public officials, the California Department of Education and K-12 system interests, California State University and University of California interests, California citizens, the U.S. Department of Labor, the California Employment Development Department (EDD), community based organizations, and others.

Study Collaborators

Based in San Francisco, the **Mid-Pacific ICT Center** (mpict.org) is a National Science Foundation (NSF) Advanced Technological Education (ATE) funded effort to coordinate, promote and improve ICT education, with an emphasis on 2-year colleges, in California, Nevada, Hawaii and the Pacific Territories.

The **Bay Area Community College Consortium** (BACCC.net) is comprised of 28 colleges and 10 Economic and Workforce Development Initiatives in Regions 3 (Bay) and 4 (Interior Bay). Funded by the Carl D. Perkins Vocational and Technical Education Act of 1998, the BACCC supports activities and projects that meet the four objectives of the Act:

- Improving the Academic skills of vocational and technical education students;
- Strengthening connections between secondary and postsecondary education;
- Preparing individuals for occupations in demand that pay family-supporting wages; and
- Investing in effective, high quality programs.

The BACCC serves as a regional framework to enhance the coordination of regional programs; to increase collaboration on regional priorities; and to serve as a link between colleges Career Technical Education programs, Economic and Workforce Development Initiatives, and the Chancellor's Office.

The California Community College (CCC) Economic and Workforce Development (EWD) **Centers of Excellence** (COE) partner with business and industry to deliver regional workforce research customized for community college decision making and resource development, funded in part by the Chancellor's Office, California Community Colleges, Economic and Workforce Development Program.

California Community College (CCC) ICT Sector Navigator and **Bay Region Deputy Sector Navigator** are recently created roles as part of the "Doing What Matters for Jobs and the Economy" campaign by the CCC State Chancellor's Office.

History of this Project

Over recent years, MPICT and Centers of Excellence have partnered on a series of research reports[3] illuminating the size and importance of ICT industry and employment in California and CCC system offerings related to ICT. Those and other efforts in the State have improved understanding of the strategic importance of ICT to California economic development and employment growth.

The CCC State Chancellor's office is underway with a strategic reorganization in its economic and workforce development and career technical education functions characterized as "Doing What Matters for Jobs and the Economy."[4] As part of that effort, each of the ten CCC Regional Consortia was asked to vote on which strategic sectors have the greatest and most immediate economic and workforce development opportunities in their region. ICT/Digital Media received the 2nd highest overall votes in the State, behind Healthcare[5]. That contributed to a strategic alignment and funding effort from the State Chancellor's office, creating a Statewide ICT Sector Navigator (SN) and ten ICT Deputy Sector Navigator (DSN) roles, representing each CCC region. Most of those positions were initially funded and awarded in July of 2013. The vision is for CCC ICT/DM SN/DSNs to work with CCC Regional Consortia to more efficiently and effectively meet ICT sector needs, regionally, and Statewide.

[3] http://www.mpict.org/ict_industry_employment_research.html

[4] http://doingwhatmatters.cccco.edu/

[5] http://doingwhatmatters.cccco.edu/portals/6/docs/rfa/Sector_Selection_by_Region_Matrix_020613.pdf

BACCC had already been exploring interest in ICT/DM. May of 2013, it launched a BACCC ICT/DM Marketplace, modeled after a successful Healthcare Marketplace, with a kickoff meeting that gathered faculty and administrator representatives from most BACCC colleges, and this project was created to gather and report information on ICT/DM demand and supply in the greater SF Bay Area, so there is common understanding of what there is to work with in the region - and where to focus efforts in this broad and rapidly moving set of inter-related and inter-dependent fields.

Study Methodology

ICT Industry and Employment Demand

For the demand side data and information in this report, the study team revisited a methodology used in creating a 2010 statewide California ICT industry and employment demand report,[6] updating its review of NAICS and SOC codes and their mapping or crosswalks to ICT. Despite limitations of available industry and occupational data currently collected in the U.S., study of that data does show important patterns and trends. For this report, MPICT and COE analyzed secondary data from the California Employment Development Department Labor Market Information Division (EDD), Economic Modeling Specialists, Inc. (EMSI) and Burning Glass.

Industry and Occupational Crosswalks

Classification systems allow for standardization of data. However, neither the U.S. nor California have traditionally organized or aggregated industry or job classification data to an aggregated ICT framework. As a result, decision-makers studying this data do not easily recognize the size or importance of ICT in the U.S., California or San Francisco Bay Area economies. This report provides crosswalks from existing U.S. industry NAICS and employment SOC codes to an ICT industry and employment framework, providing an opportunity to scope the size and importance of ICT industries and occupations in the Bay Area region, sub-regions and economies.

The first step in developing a crosswalk to the ICT framework 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 ICT Industries," includes those industries where 100% of the firms are presumed to be directly involved with producing ICT goods or services. The second category, "Secondary ICT Industries," includes those where some percentage of the companies is ICT related, but because of the classification scheme, it is difficult to determine the percentage directly related to ICT.

This process was repeated for occupations (using existing SOC codes), again attempting to delineate occupational codes in which every worker is engaged in ICT functions ("Primary ICT Occupations") and those where only some portion of the workers work in ICT ("Secondary ICT Occupations").

Original Phase 2 study crosswalk drafts were reviewed by an advisory group comprised of experts from industry, academia, nonprofit organizations, and government. This group included human resource professionals, labor market analysts, college administrators and faculty, and small business owners. For this current study, crosswalk mapping was reviewed and revised by subject matter experts from MPICT, COEs, BACCC, the CCC Statewide ICT Sector Navigator, consulting economists and California EDD, in part to address NAICS code system changes that have occurred since the Phase 2 study.

These sets of NAICS and SOC codes were then used to query existing U.S. and California industry and employment databases. The results of those queries are summarized by NAICS code in Appendix 1 and by SOC code in Appendix 2. Because it is not easy to know how much of secondary NAICS industries and secondary SOC occupations are attributable to ICT, a conservative estimate of 25% of secondary ICT industries were added to primary industry and occupation findings to arrive at total or "Combined" estimates. This conservative estimate was also validated with the industry advisory group. In this study, secondary ICT occupation allocations were further reduced to 10%, to be extra conservative.

[6] Environmental Scan: Information and Communications Technologies (ICT): Phase 2 2010 ICT Industry and Employment Outlook http://www.mpict.org/ict_study_phase2.html

CCC ICT Supply

One objective of this report is to study ICT related programs and credentials across BACCC colleges. That effort leveraged prior work to develop the report, California Community College ICT Programs and Academic Credentials[7], which used CCC faculty and MPICT staff to search all CCC websites and research ICT related programs as of the 2010/2011 academic year. ICT related programs were summarized and described at each college in simple webpage portals on the MPICT website[8] and information was gathered on all CCC ICT related programs and their academic credentials. Information from that report was edited to reflect only the 28 BACCC colleges for this report.

Another objective of this report is to study ICT related enrollment, student and faculty demographics across BACCC colleges. That effort leveraged prior MPICT work to develop the report, California Community College ICT Student Enrollment and Demographics[9], which procured data from the CCC state system office through custom queries. To do so, this effort first mapped CCC Taxonomy of Programs (TOP) codes[10] to ICT. The Top Codes analyzed were:

- 0509XX Marketing and Distribution
- 0514XX Office Technology
- 0601XX Media Communications
- 0607XX Technical Communications
- 0610XX Mass Communications
- 0614XX Digital Media
- 0699XX Other Media & Communications
- 0701XX Information Technology, General
- 0702XX Computer Information System
- 0706XX Computer Science (Transfer)
- 0707XX Computer Software Development
- 0708XX Computer Infrastructure & Support
- 0709XX World Wide Web Administration
- 0799XX Other Information Technology
- 0860XX Educational Technology
- 0934XX Electronics & Electronics Technology
- 0936XX Printing and Lithography
- 0953XX Drafting Technology
- 1223XX Health Information Technology
- 1601XX Library Science
- 1602XX Library Technician
- 1699XX Other Library Science
- 2206XX Geography

Not all of the content and focus of instruction in these Top Codes is focused on technical ICT knowledge and skills. However, programs in in each of these Top Codes do lead to gainful employment in ICT. People may disagree whether each or all of these Top Codes should be included in ICT. However, it is easier to exclude data or findings from these lists than it is to add additional Top Codes to the list later, and these results do show relevant larger patterns.

The data were then further queried to produce only results relevant to the 28 BACCC colleges for this report.

A third objective of this section of the report is to study ICT related course offerings for the 28 BACCC colleges. The CCC Chancellor's Office Management Information System (COMIS) was queried to attain the relevant course data.

[7] http://www.mpict.org/pdf/CCC_ICT_Programs_and_Credentials_12-31-12.pdf
[8] http://www.mpict.org/ict_education_california_community_colleges.html
[9] http://www.mpict.org/pdf/CCC_ICT_Enrollments_and_Demographics_12-31-12.pdf
[10] http://extranet.cccco.edu/Portals/1/AA/BasicSkills/TopTax6_rev0909.pdf

ICT Industry and Employment Demand

ICT Industries (producing ICT related goods and services)

ICT Industries Overview

ICT industries consist of organizations whose primary businesses are to create, develop, sell, distribute, manage or otherwise provide ICT related goods and services. This study identified 38 Primary ICT industries (listed alphabetically by industry NAICS title):

- 519190 All Other Information Services
- 517919 All Other Telecommunications
- 334310 Audio and Video Equipment Manufacturing
- 425110 Business to Business Electronic Markets
- 811213 Communication Equipment Repair and Maintenance
- 423430 Computer and Computer Peripheral Equipment and Software Merchant Wholesalers
- 811212 Computer and Office Machine Repair and Maintenance
- 541513 Computer Facilities Management Services
- 334112 Computer Storage Device Manufacturing
- 541512 Computer Systems Design Services
- 334113 Computer Terminal Manufacturing
- 611420 Computer Training (Private)
- 811211 Consumer Electronics Repair and Maintenance
- 541511 Custom Computer Programming Services
- 518210 Data Processing, Hosting, and Related Services
- 323115 Digital Printing
- 334411 Electron Tube Manufacturing
- 454112 Electronic Auctions
- 334111 Electronic Computer Manufacturing
- 454111 Electronic Shopping
- 541430 Graphic Design Services
- 519130 Internet Publishing and Broadcasting and Web Search Portals
- 334613 Magnetic and Optical Recording Media Manufacturing
- 512110 Motion Picture and Video Production
- 334290 Other Communications Equipment Manufacturing
- 334119 Other Computer Peripheral Equipment Manufacturing
- 541519 Other Computer Related Services
- 334220 Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing
- 515111 Radio Networks
- 517410 Satellite Telecommunications
- 511210 Software Publishers
- 334611 Software Reproducing
- 335313 Switchgear and Switchboard Apparatus Manufacturing
- 517911 Telecommunications Resellers
- 334210 Telephone Apparatus Manufacturing
- 512191 Teleproduction and Other Postproduction Services
- 517110 Wired Telecommunications Carriers
- 517210 Wireless Telecommunications Carriers (except Satellite)

In 2012, 12,461 establishments employed 345,071 people in the greater SF Bay Area in these Primary ICT NAICS codes[11]. That was 4.3% of the total number of business establishments and 8.6% of all industry employment in the greater SF Bay Area. Together, these organizations generated $200.4 billion in sales revenue, roughly 17% of the total sales revenue produced by all business establishments in the greater Bay Area. Together, these organizations generated $77.1 billion in earnings, roughly 20.5% of the total earnings produced by all business establishments in the greater Bay Area. From 2012 to 2015, these industries are estimated to add 29,595 jobs (9% employment growth) and 9,865 jobs annually, on average. That is 15.7% of overall industry employment growth estimated for the entire Bay Region.

Additionally, this study identified 59 Secondary ICT industries, whose firms serve and depend on Primary ICT Industries, as suppliers, distribution channels, manufacturers or otherwise (alphabetically by NAICS):

- 541611 Administrative Management and General Management Consulting Services
- 335999 All Other Miscellaneous Electrical Equipment and Component Manufacturing
- 334516 Analytical Laboratory Instrument Manufacturing
- 334512 Automatic Environmental Control Manufacturing for Residential, Commercial, and Appliance Use
- 334412 Bare Printed Circuit Board Manufacturing
- 515210 Cable and Other Subscription Programming
- 335991 Carbon and Graphite Product Manufacturing
- 323111 Commercial Printing (except Screen and Books)
- 443120 Computer and Software Stores
- 331422 Copper Wire (except Mechanical) Drawing
- 335931 Current-Carrying Wiring Device Manufacturing
- 423620 Electrical and Electronic Appliance, Television, and Radio Set Merchant Wholesalers
- 423610 Electrical Apparatus & Equipment, Wiring Supplies, and Related Equipment Merchant Wholesalers
- 238210 Electrical Contractors and Other Wiring Installation Contractors
- 334414 Electronic Capacitor Manufacturing
- 334416 Electronic Coil, Transformer, and Other Inductor Manufacturing
- 334417 Electronic Connector Manufacturing
- 334415 Electronic Resistor Manufacturing
- 335921 Fiber Optic Cable Manufacturing
- 238330 Flooring Contractors
- 334515 Instrument Manufacturing for Measuring and Testing Electricity and Electrical Signals
- 334513 Instruments & Related Prod. Mfg. for Measuring, Displaying, & Controlling Industrial Process Variables
- 519120 Libraries and Archives
- 334613 Magnetic and Optical Recording Media Manufacturing
- 454113 Mail-Order Houses
- 519110 News Syndicates
- 335932 Noncurrent-Carrying Wiring Device Manufacturing
- 423420 Office Equipment Merchant Wholesalers
- 532420 Office Machinery and Equipment Rental and Leasing
- 561439 Other Business Service Centers (including Copy Shops)
- 532490 Other Commercial and Industrial Machinery and Equipment Rental and Leasing
- 335929 Other Communication and Energy Wire Manufacturing
- 334419 Other Electronic Component Manufacturing
- 423690 Other Electronic Parts and Equipment Merchant Wholesalers
- 541618 Other Management Consulting Services
- 541690 Other Scientific and Technical Consulting Services

[11] Source for all industry data (unless otherwise indicated): http://www.economicmodeling.com/, EMSI (Economic Modeling Specialists, Intl, a CareerBuilder Company)

- 611519 Other Technical and Trade Schools (Private)
- 423410 Photographic Equipment and Supplies Merchant Wholesalers
- 325992 Photographic Film, Paper, Plate, and Chemical Manufacturing
- 237130 Power and Communication Line and Related Structures Construction
- 334612 Prerecorded Compact Disc (except Software), Tape, and Record Reproducing
- 335912 Primary Battery Manufacturing
- 334418 Printed Circuit Assembly (Electronic Assembly) Manufacturing
- 561431 Private Mail Centers
- 443112 Radio, Television, and Other Electronics Stores
- 335314 Relay and Industrial Control Manufacturing
- 541712 Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology)
- 334413 Semiconductor and Related Device Manufacturing
- 333295 Semiconductor Machinery Manufacturing
- 335911 Storage Battery Manufacturing
- 561422 Telemarketing Bureaus and Other Contact Centers
- 515120 Television Broadcasting
- 532230 Video Tape and Disc Rental
- 334518 Watch, Clock, and Part Manufacturing
- 425120 Wholesale Trade Agents and Brokers

In 2012, 15,597 establishments employed about 267,457 people in the greater SF Bay Area in these Secondary ICT NAICS codes. That was 5.3% of the 291,738 total number of business establishments and 6.6% of 4,024,278 people employed in the greater SF Bay Area. Together, these organizations generated $120.2 billion in sales revenue, roughly 10.2% of the total sales revenue produced by all business establishments in the greater Bay Area. Together, these organizations generated $36.7 billion in earnings, roughly 9.8% of the total earnings produced by all business establishments in the greater Bay Area. 2012 to 2015, these organizations are estimated to add 11,441 jobs (4.3% employment growth). That is 6.1% of 188,267 overall industry employment growth estimated for the entire Bay Region.

Clearly, not everything these secondary industries do is fairly attributed to ICT. This study attributes 25% of these secondary industry measures to arrive at broad estimates for the combined ICT industry cluster.

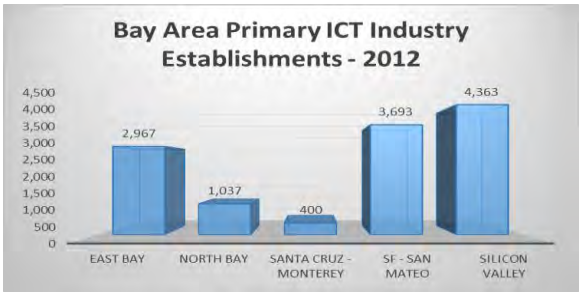
In 2012:

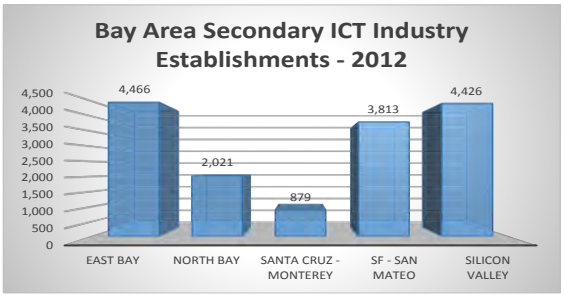
- 16,360 establishments (100% of Primary plus 100% of Secondary ICT Industries)
- 8.7% of the total number of firms
- employed about 411,335 people (100% of Primary plus 25% of Secondary ICT Industries)
- 10.2% of total industry employment in the greater SF Bay Area
- More than 1 in 10 jobs
- expecting 7.3% overall employment growth, or 32,455 net new jobs added, 2012 to 2015,
- 17.2% of the overall employment growth expected for all industry employment in the Bay Area.
- Primary and 25% of Secondary ICT industries generated $230.4 billion in sales revenue in the Bay Area, which was nearly 20% of total regional sales revenue for all industries.
- Primary and 25% of Secondary ICT industries generated $86.3 billion in earnings in the Bay Area, which was nearly 23% of total regional earnings for all industries.

See Appendix 1 for a detailed breakdown of this data, for the greater SF Bay Region and for the 5 BACCC Bay Area Sub-regions.

In 2012, 12,461 establishments were in Primary ICT Industries (4.3% of the total number of business establishments in the Bay Area) and 15,597 establishments were in Secondary ICT Industries (5.6% of the total number of establishments in the Bay Area). Together, Primary and Secondary ICT Industries represent 16,360 establishments, almost 10% of Bay Area establishments, distributed as indicated in the following graphs across the Bay Area sub-regions.

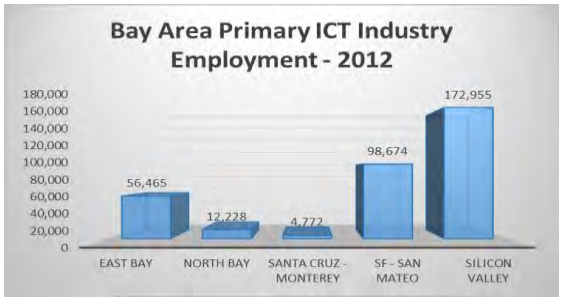
Graph 1: 2012 Bay Area Primary and Secondary ICT Industry Establishments

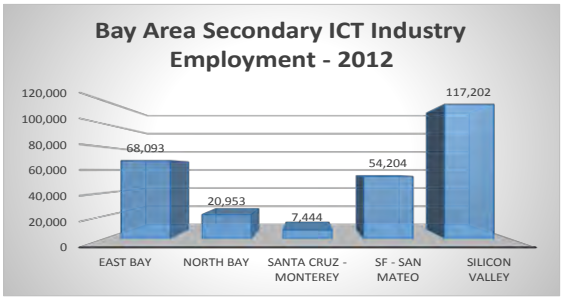


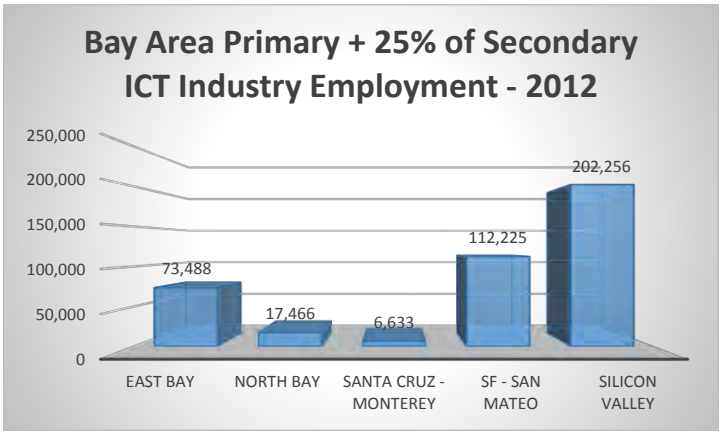


In 2012, total Primary ICT Industry employment was 345,071 (8.6% of total industry employment in the Bay Area, which was over 4 million jobs), and total Secondary Industry employment equaled 267,457 (6.6% of total people employed in the greater SF Bay Area). Combining 100% of Primary and 25% of Secondary ICT Industry employment produces an estimate of 411,335 people employed by a combined ICT Industry Cluster (about 10.2% of overall Bay Area industry employments). This employment is primarily located in the Silicon Valley, San Francisco – San Mateo, and East Bay sub-regions.

Graph 2: 2012 Bay Area Primary and Secondary ICT Industry Employment



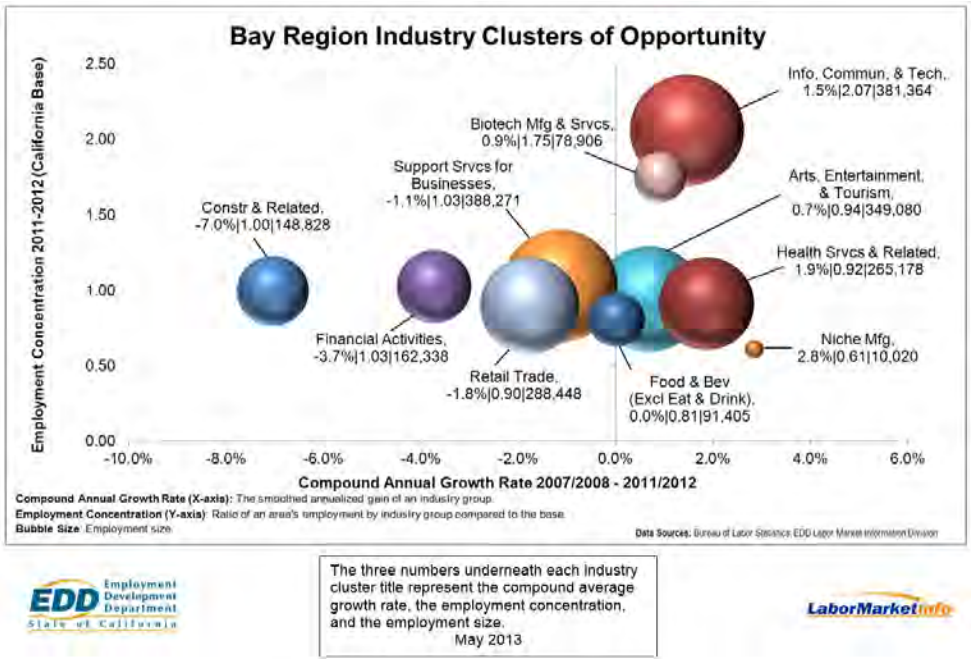




A variation of this method by California EDD showed ICT as the largest and fastest growing industry Bay Area cluster in 2013, with a much higher ICT industry concentration than average for the nation, and a June 2014 EDD report showed ICT as the 2nd largest Bay Area industry employment cluster[12].

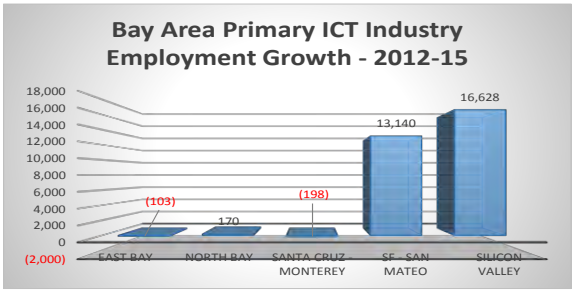
[12] Regional Economic Analysis Profile: San Francisco Bay Area Region, June 2014, http://www.calmis.ca.gov/SpecialReports/SF_REA_Profile_Jun2014.pdf

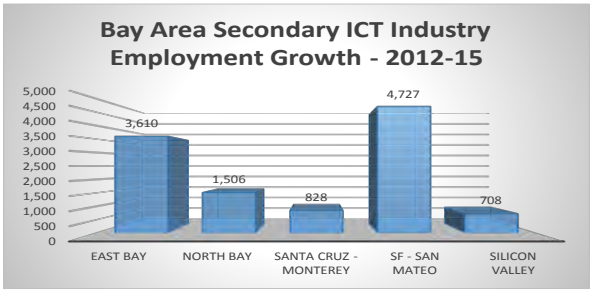
Graph 3: 2013 Bay Area Primary and Secondary ICT Industry Establishments

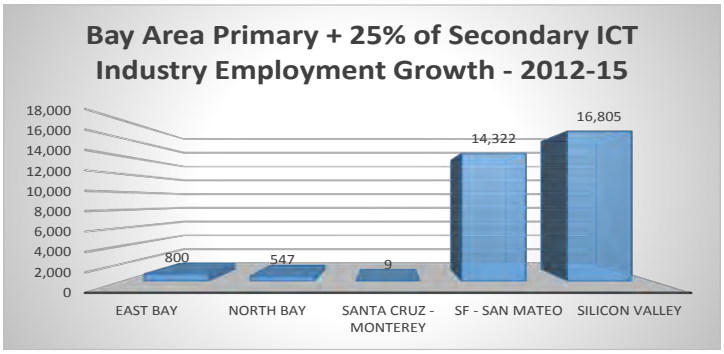


Between 2012 and 2015, Primary ICT Industries are estimated to add a net 29,595 jobs (9% employment growth) and 9,865 average jobs annually (15.7% of overall industry employment growth estimated for the entire Bay Region). Secondary ICT Industries are estimated to add a net 11,441 jobs (4.3% employment growth) and 3,813 average jobs annually (6.1% of overall industry employment growth estimated for the entire Bay Region). Combining 100% of Primary and 25% of Secondary ICT Industry employment growth produces an estimate of 32,455 net new jobs by a combined ICT Industry Cluster (about 17.2% of employment growth estimated for all Bay Area industry employment growth). This employment growth is primarily expected in the Silicon Valley and San Francisco – San Mateo sub-regions.

Graph 4: 2012 – 2015 Bay Area Primary and Secondary ICT Industry Net Employment Growth



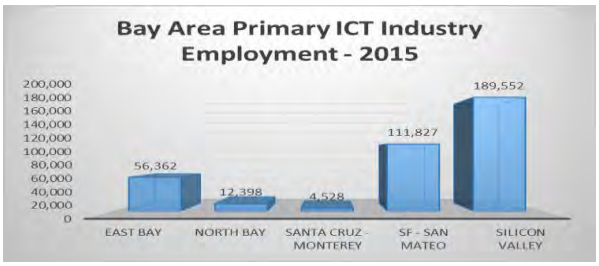


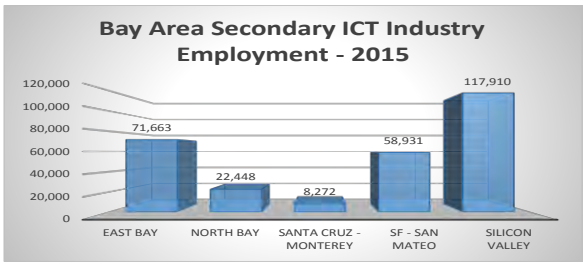


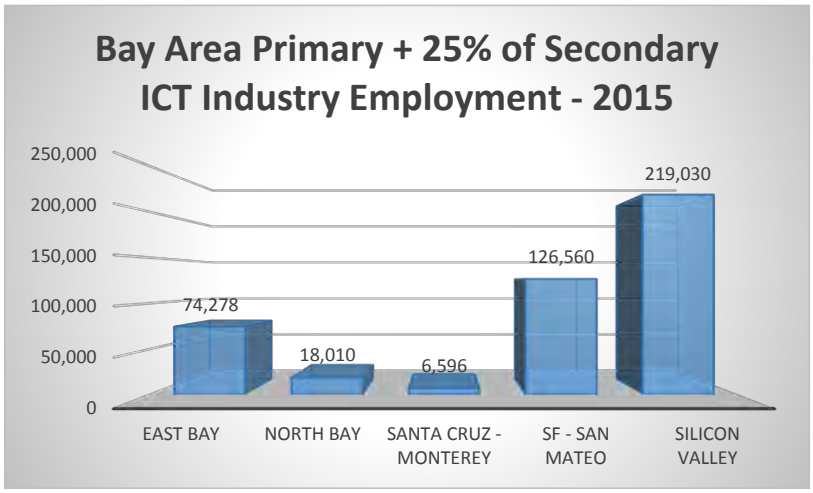
(Note low Secondary ICT Industry employment growth in Silicon Valley relative to other sub-regions and strong overall ICT industry employment growth in the SF–San Mateo and Silicon Valley sub-regions)

By 2015, Primary ICT Industries are estimated to employ 374,666 and Secondary ICT Industries are estimated to employ 278,882 people. Combining 100% of Primary and 25% of Secondary ICT Industry employment produces an estimate of 444,387 people employed by a combined ICT Industry Cluster.

Graph 5: Estimated 2015 Bay Area Primary and Secondary ICT Industry Employment







ICT Industry Rankings

The following sections show how Primary and Secondary ICT industries compare, in the greater Bay Area, and in each of the Bay Area sub-regions identified by the California Community College system: East Bay, North Bay, Santa Cruz – Monterey, San Francisco – San Mateo, and Silicon Valley.

Bay Area

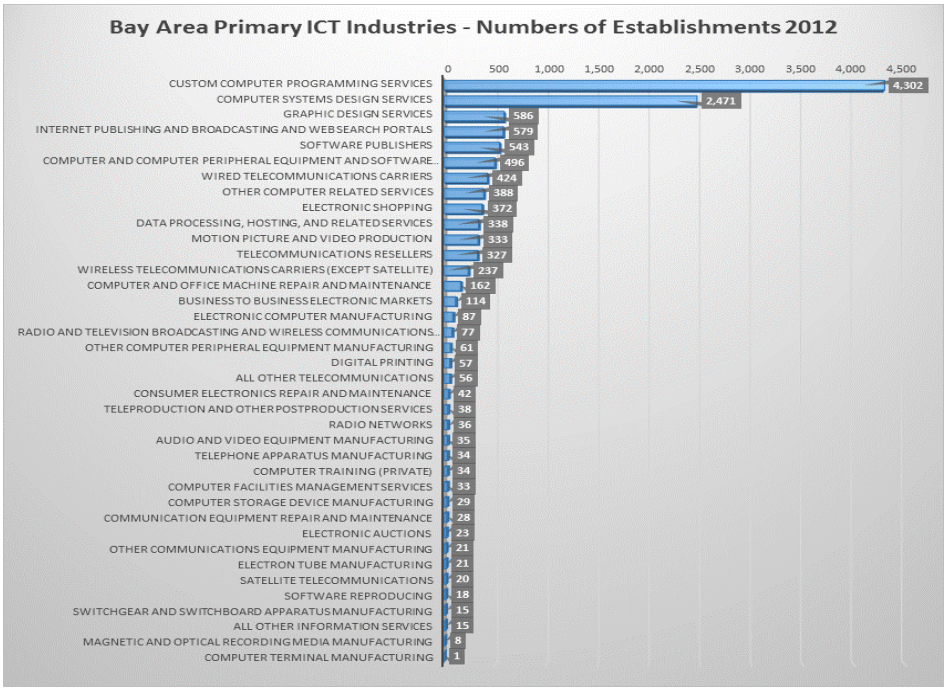
In 2012, the Top 5 Primary ICT Industries had 8,481 firms, over 2/3 of all Primary ICT Industry firms in the region. Custom Computer Programming Services had 35% and Computer Systems Design Services had 20%, together well over half of all Primary ICT Industry firms in the Bay Area.

Graph 6: 2012 Bay Area Top 5 Primary ICT Industries by Number of Firms

Top Bay Area Primary ICT Industries by # of Firms (2012)	# of Firms
Customer Computer Programming Services	4,302
Computer Systems Design Services	2,471
Graphic Design Service	586
Internet Publishing & Broadcasting & Web Search Portals	579
Software Publishers	543
TOTAL	**8,481**

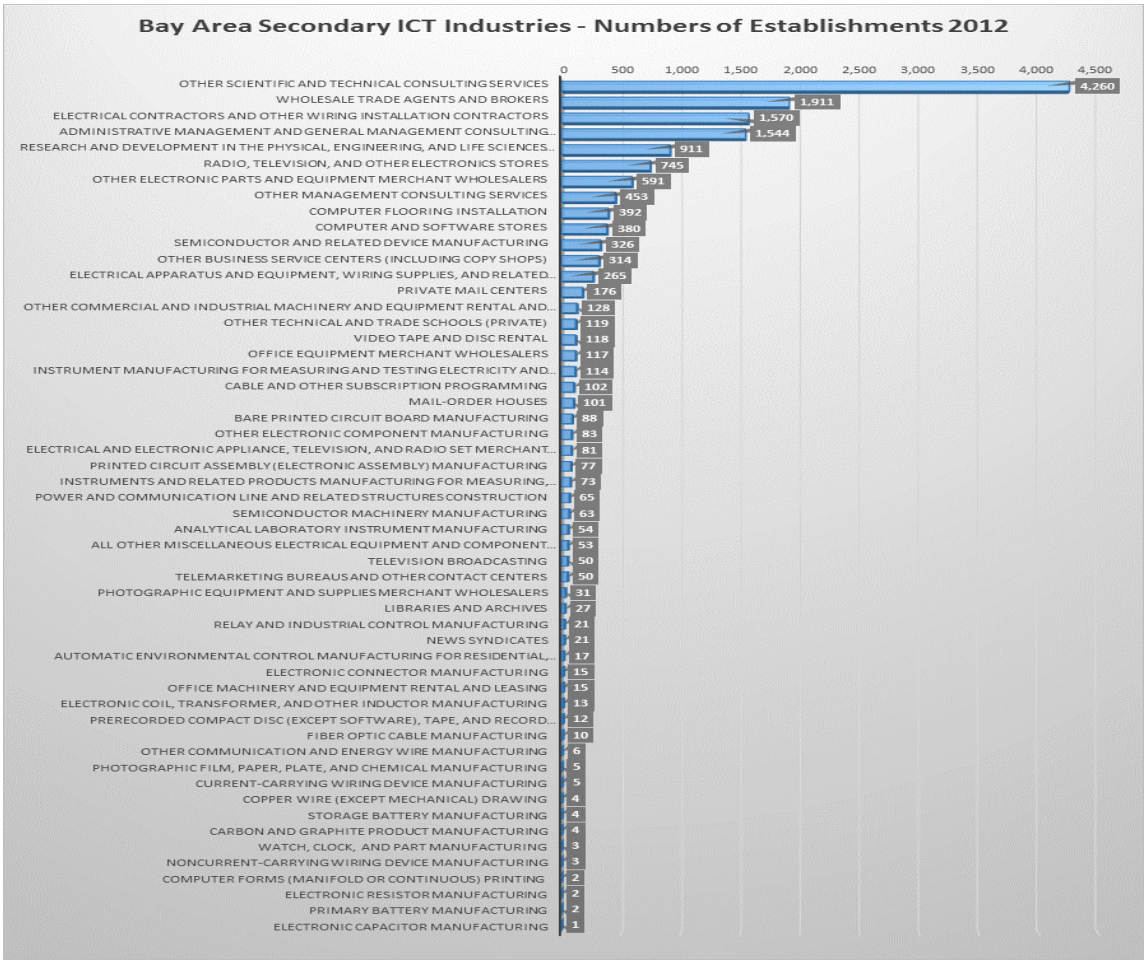
The following chart shows the top Primary ICT industries in the greater SF Bay Area by number of establishments. There were 12,461 Primary ICT industry establishments in 2012.

Graph 7: 2012 Bay Area Top Primary ICT Industries by Establishment Count



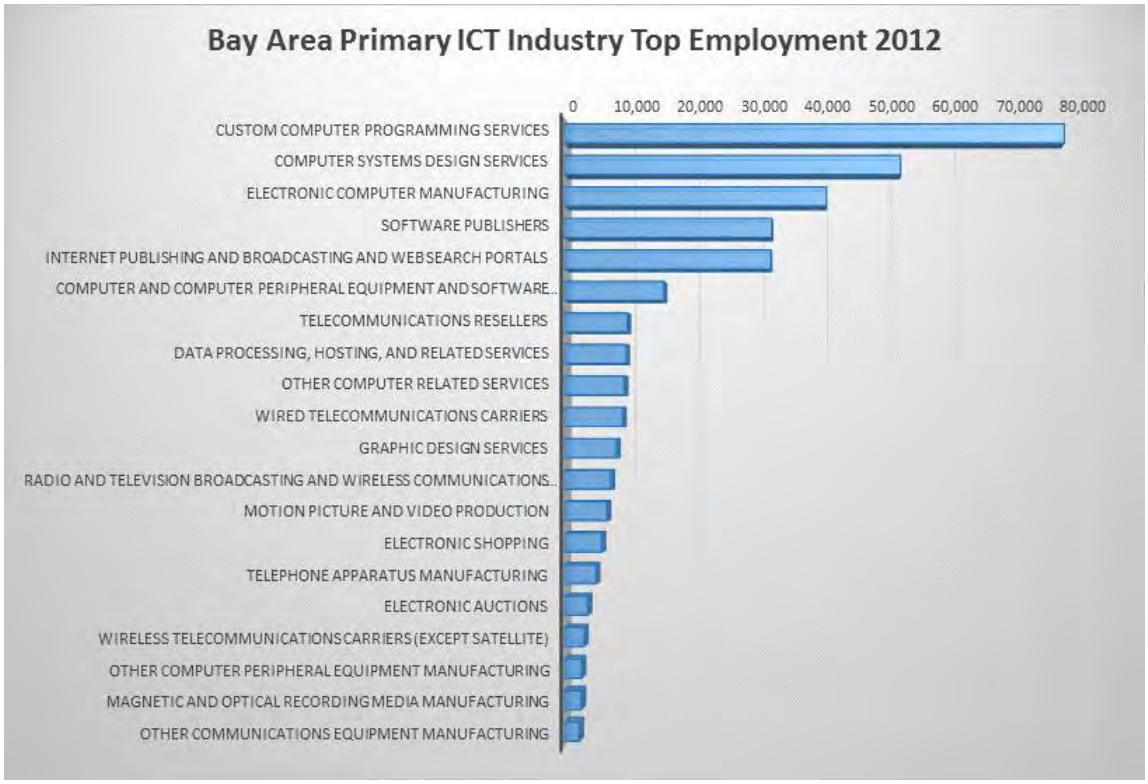
The following chart shows the top Secondary ICT industries in the greater SF Bay Area by number of establishments. There were 15,597 Secondary ICT industry establishments in 2012.

Graph 8: 2012 Bay Area Top Secondary ICT Industries by Establishment Count

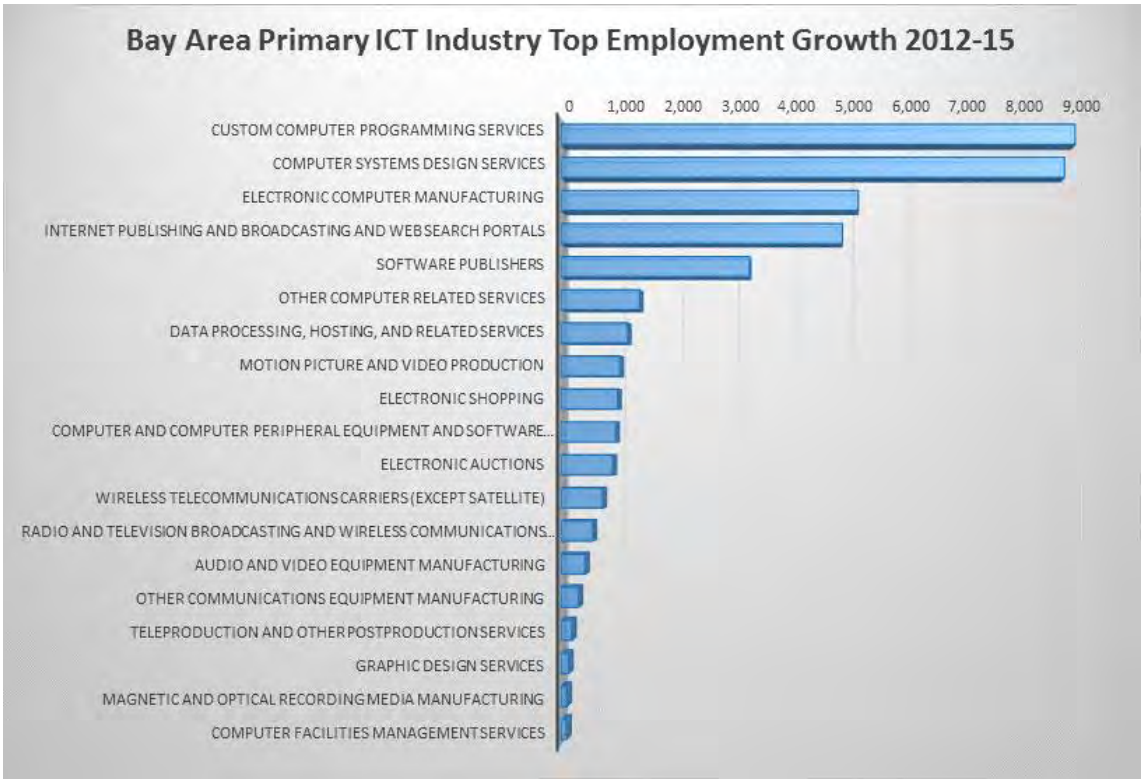


The following charts show top Primary ICT industries in the greater SF Bay Area by numbers of employees and employment growth. There were 345,071 Primary ICT industry employees in 2012, and there is a net growth expectation of 29,595 Primary ICT industry jobs between 2012 and 2015.

Graph 9: 2012 Bay Area Top Primary ICT Industries by Employment

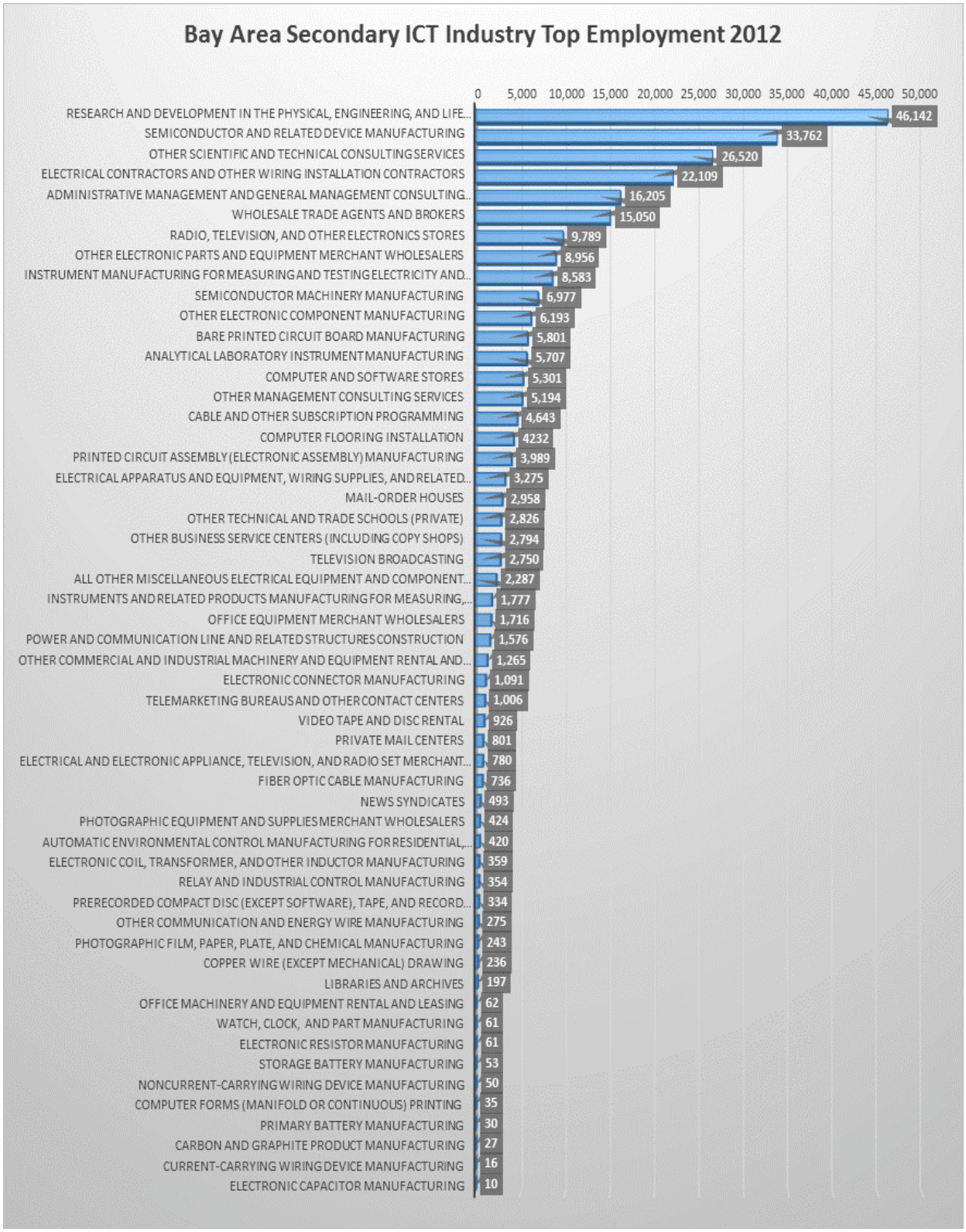


Graph 10: Bay Area Top Primary ICT Industries by Employment Growth 2012-2015

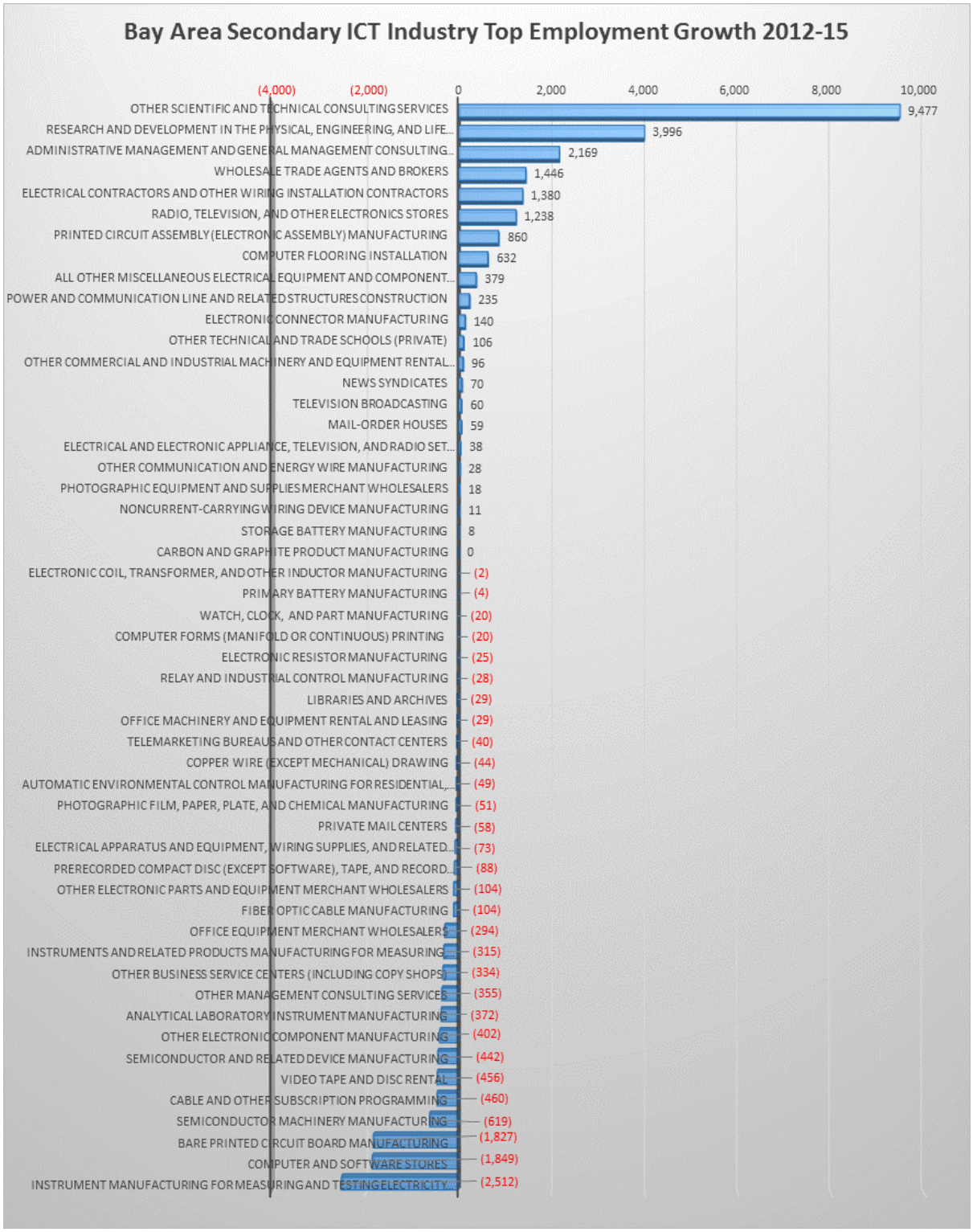


The following charts show ranked Secondary ICT industries in the greater SF Bay Area by numbers of employees and employment growth. There were 267,457 Secondary ICT industry employees in 2012, and there is a net growth expectation of 11,441 Secondary ICT industry jobs between 2012 and 2015.

Graph 11: 2012 Bay Area Top Secondary ICT Industries by Employment



Graph 12: Bay Area Top Secondary ICT Industries by Employment Growth 2012-2015



Following are the top 20 Primary ICT Industry firms in the San Francisco Bay Region, by numbers of employees.

Graph 13: 2012 Bay Area Largest Primary ICT Industry Employers by Employment

Top 20 Primary ICT Sector Firms in Bay Area Region[13]	# of Local Employees	Industry
Brocade Communications Systems, Inc.	2,500	Other Communications Equipment Manufacturing
AT&T Communications Of California, Inc.	2,000	Wired Telecommunications Carriers
AT&T California	2,000	Wired Telecommunications Carriers
Cadence Design Systems Inc	1,750	Computer Systems Design Services
IBM	1,501	Electronic Computer Manufacturing
HP Atalla Security Products	1,500	Electronic Computer Manufacturing
Oracle America, Inc.	1,400	Software Publishers
EMC Corporation	1,338	Computer Storage Device Manufacturing
Sandia National Laboratories	1,300	Telecommunications Resellers
Autodesk, Inc.	1,069	Software Publishers
Hewlett-Packard	1,050	Electronic Computer Manufacturing
Agilent Technologies Inc	1,050	Electronic Computer Manufacturing
Juniper Networks, Inc.	1,048	Other Computer Peripheral Equipment Manufacturing
Oracle	1,000	Software Publishers
Western Digital	1,000	Computer and Computer Peripheral Equipment and Software Merchant Wholesalers
Mercury Interactive Corporation	1,000	Electronic Computer Manufacturing
National Instruments	1,000	Software Publishers
Aspect Software, Inc.	1,000	Software Publishers
Aviat U.S., Inc.	1,000	Radio and Television Broadcasting and Wireless
Intuit Inc.	1,000	Custom Computer Programming Services

Note: Includes firms with >999 local employees

In 2012, total sales revenue for Primary ICT industries in the Bay Area was $200.4 billion, nearly 17% of total regional sales revenue for all industries. In 2012, the top 5 ICT Primary ICT Industries in terms of sales revenue in the Bay Area total $134.2 billion in sales, representing 67% of Primary ICT industry sales revenue[14].

Graph 14: 2012 Bay Area Largest Primary ICT Industries by Revenue (in million$)

Top 5 Primary ICT Industries by Sales Revenue (2012) in Bay Area	Sales	% of Primary ICT Sales
Electronic Computer Manufacturing	$34,561	17.2%
Software Publishers	$27,404	13.7%
Computer Systems Design Services	$26,514	13.2%
Internet Publishing and Broadcasting and Web Search Portals	$26,163	13.1%
Custom Computer Programming Services	$19,542	9.8%
TOTAL	**$134,184**	**67.0%**

In 2012, Primary ICT industries had $77.1 billion in earnings, 20.5% of total earnings for all industries in the greater San Francisco Bay Area region[15]. The top 5 Primary ICT industries by earnings in the Bay Area had $57.7 billion in earnings, nearly ¾ of total ICT industry earnings for the region.

[13] Business Data by Equifax, a 3rd-party data provided by EMSI to its customers as a convenience. EMSI does not endorse or warrant its accuracy or consistency with other published EMSI data. Equifax data is collected using proprietary methods that differ significantly from EMSI's data sources. In many cases, Equifax data may show different establishment or employee counts for certain businesses, or may otherwise appear to be inaccurate to EMSI customers.

[14] The input-output model in this report is EMSI's gravitational flows multi-regional social account matrix model (MR-SAM), based on data from the Census Bureau's Current Population Survey and American Community Survey; as well as the Bureau of Economic Analysis' National Income and Product Accounts, Input-Output Make and Use Tables, and Gross State Product data. Also, several EMSI in-house data sets are used, as well as data from Oak Ridge National Labs on the cost of transportation between counties.

[15] The input-output model in this report is EMSI's gravitational flows multi-regional social account matrix model (MR-SAM). It is based on data from the Census Bureau's Current Population Survey and American Community Survey; as well as the Bureau of Economic Analysis' National Income

Graph 15: 2012 Bay Area Largest Primary ICT Industries by Earnings (in million$)

Top 5 Primary ICT Industries by Earnings* (2012) in Bay Area	Earnings	% of Primary ICT Earnings
Computer Systems Design Services	$16,483	21.4%
Custom Computer Programming Services	$13,548	17.6%
Electronic Computer Manufacturing	$11,494	14.9%
Internet Publishing and Broadcasting and Web Search Portals	$8,861	11.5%
Software Publishers	$7,348	9.5%
TOTAL	**$57,735**	**74.9%**

**Earnings is defined as a company's profits after expenses have been paid or Total Sales Revenue less Operating Expenses less Depreciation less Interest = Earnings*

In 2012, total Primary ICT industry employment equaled 345,071 in the Bay Area. The top 5 Primary ICT industries represented 2/3 of all Primary ICT employment, 5.7% of total industry employment in the Bay Area, which was over 4 million jobs. Employment in all Primary ICT Industries represented 8.6% of total Bay Area employment and is projected to grow to 8.9% by 2015.

Graph 16: 2012 Bay Area Largest Primary ICT Industries by Employment

Top 5 Bay Area Primary ICT Industries by Employment Share (2012)	Jobs	% of Primary ICT Employment
Customer Computer Programming Services	75,984	22.0%
Computer Systems Design Services	51,114	14.8%
Electronic Computer Manufacturing	39,823	11.5%
Software Publishers	31,547	9.1%
Internet Publishing & Broadcasting & Web Search Portals	31,379	9.1%
TOTAL	**229,847**	**66.6%**

Graph 17: 2012 Bay Area Largest Primary ICT Industries by Employment Growth

Top Bay Area Primary ICT Industries by Projected Employment Growth (2012-2015)	Change	% Change
Customer Computer Programming Services	8,758	11.5%
Computer Systems Design Services	8,574	16.8%
Electronic Computer Manufacturing	5,065	12.7%
Internet Publishing & Broadcasting & Web Search Portals	4,794	15.3%
Software Publishers	3,213	10.2%
TOTAL	**30,404**	**13.2%**

Projections for 2012-2015 are that 22 Primary ICT industries will account for 39,362 job gains (with the top 5 growing industries representing over 77% of the gains), while 16 are projected to lose 9,767 jobs (with the bottom 5 representing 80% of the losses), for a net gain of 29,595 ICT jobs in the region.

These shifts are summarized as follows:

- Net employment growth in the Bay Area from 2012-2015 for all Primary ICT Industry occupations is projected to be a net gain of 29,595.
- The top 5 Primary ICT Industries by employment growth are projected in the Bay Area to be 77% of all positive Primary ICT growth over the 3 year period, which is projected to be 39,362 jobs.
- The top 5 Primary ICT Industries are projected to represent 11% of the region's gain in industrial employment, which is projected increase by 276,276 jobs over the 3 year period. The top 5 Primary ICT Industries net job growth is expected to represent close to 16% of the region's net industrial employment change projected at 188,267.
- All Primary ICT Industries are projected to represent 14.2% of the region's gain in industrial employment and 15.7% of the region's net industrial employment change projected in 2012-15.
- For the same period, all ICT industry job losses are projected to account for 11.3% of the job losses in the region's industrial employment with losses expected in certain ICT industries such as:

▪ Wired Telecommunications Carriers	(1,988)
▪ Telephone Apparatus Manufacturing	(1,931)
▪ Telecommunications Resellers	(1,828)
▪ Computer Storage Device Manufacturing	(1,036)
▪ Electron Tube Manufacturing	(1,028)
▪ All other ICT Industries with projected job losses	(1,956)
	(9,767) 26.7% decrease in all 16 industries with job losses

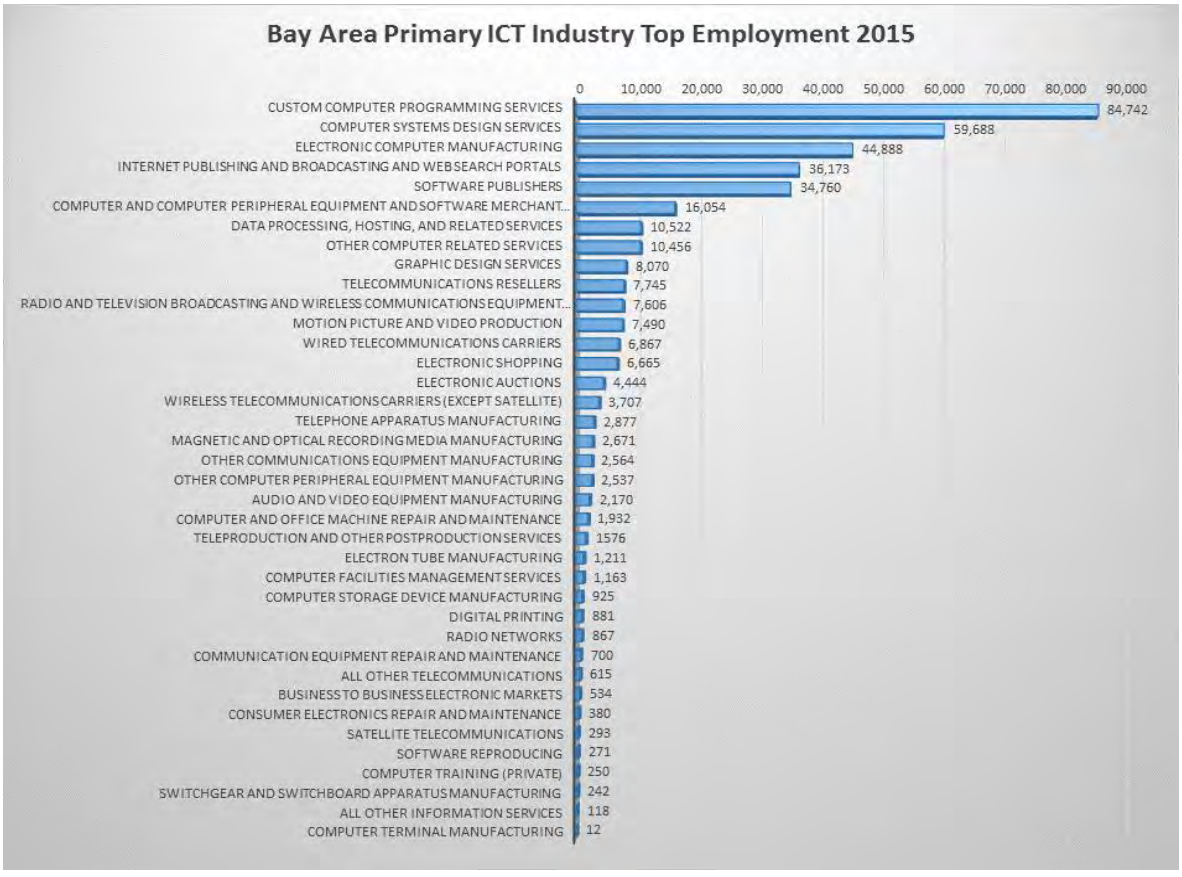
In 2013, annual wages and earnings[16] in Primary ICT Industries are projected to be significantly higher compared to those in all other industries in the Bay Area. Average earnings in Primary ICT Industries are projected to be $212,951. With 2013 average earnings for all industries in the Bay Area at $84,651, ICT industry average annual earnings per job are projected to be 152% higher.

Graph 18: 2013 Bay Area Largest Primary ICT Industries by Wages, Salaries & Proprietor Earnings

Top 5 Primary ICT Industries by 2013 Wages, Salaries & Proprietor Earnings for Bay Area Region	Annual Amount
Computer Systems Design Services	$264,878
Internet Publishing and Broadcasting and Web Search Portals	$254,620
Electronic Computer Manufacturing	$239,134
Electronic Auctions	$234,004
Magnetic and Optical Recording Media Manufacturing	$222,549

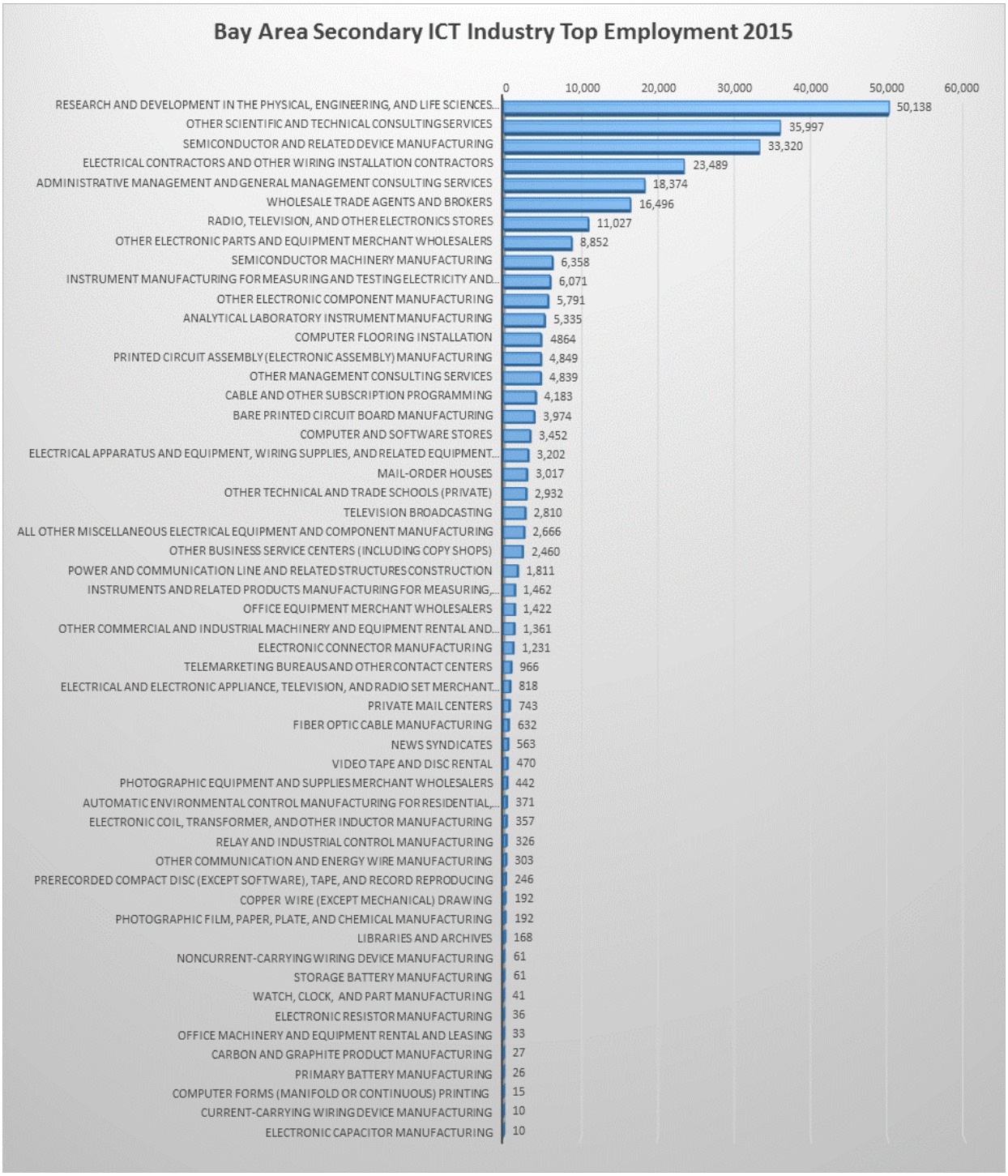
By 2015, Primary and Secondary ICT Industry rankings by employment are estimated in the following graphs, with 374,666 people employed in Primary ICT industries and 284,491 in Secondary ICT industries.

Graph 19: Bay Area Largest Primary ICT Industries by Employment - 2015



[16] Wages paid to employees plus proprietor/owner taxable earnings.

Graph 20: 2013 Bay Area Largest Secondary ICT Industries by Employment - 2015



Similar ICT industry rankings and charts for each of the five Bay Area sub-regions can be found in Appendix 4.

ICT Industries Summary Conclusions

ICT industries are a large and strategically important part of the greater San Francisco Bay Region economy and its sub-regions. They represent about one out of eighteen business establishments in the Bay Area and employ about one in ten Bay Area employees in stimulating and well-paid jobs. They generate lots of revenue (Primary ICT Industries alone produce almost 17% of Bay Area industry revenues), generate lots of tax revenue, and provide the revenue for many other local businesses by buying their services. Primary ICT Industries alone produce about 20.5% of the total earnings produced by all business establishments in the greater Bay Area.

Multiplier effects from ICT industry employees also enable employment by many other people in many other industries, because ICT industry employees are buying goods and services in the Bay Area. A Bay Area Council report provides a "local multiplier, which estimates that the creation of one job in the high-tech sector of a region is associated with the creation of 4.3 additional jobs in the local goods and services economy of the same region in the long run.[17]" If that is true, in 2012, Primary ICT Industries were responsible for creating 345,071 jobs directly and another 1,483,805 indirectly through multiplier effects, and Secondary ICT Industries were responsible for creating 267,457 jobs directly and another 1,150,065 indirectly through multiplier effects. The combined ICT cluster (100% of Primary and 25% of Secondary ICT Industries) are responsible for creating 411,935 jobs directly and 1,771,321 jobs indirectly, for a total of 2,183,257 jobs, or 54% of all industry employment in the greater San Francisco Bay Region.

It could easily be argued that the combined ICT Industry Cluster drives at least a fifth of the greater Bay Area economy, and that cluster is still growing rapidly.

Additionally, ICT industries are critically important to economic success in all industries, throughout the Bay Region, nationally and internationally, because ICT products and services enable other industries and efforts. ICT industries produce empowering technologies, products and services. Those technologies, products and services are increasingly strategically and operationally important to all kinds of organizations in all industries, in achieving efficiency, cost reductions and productivity, in finding and serving customers, in finding and working with suppliers, in planning and management, for marketing and sales, for customer service and support, for many forms of internal and external communications, enabling other kinds of products and services, empowering research, recordkeeping, interacting with government agencies, and all kinds of other activities.

The economic and strategic benefits generated by ICT industries in Bay Area and national economies are far greater than the revenue they generate, salaries they pay, or tax revenue they produce. Support for ICT industries should be a major economic development strategic priority for government policymakers. Preparing a highly skilled workforce to support these industries is an important public education priority.

Bay Area community colleges are better served focusing on specific ICT occupations than ICT industries in determining their ICT education and workforce development priorities, however. Specific ICT Workforce roles vary in terms of their educational and technical knowledge and skills requirements.

[17] Technology Works: High-Tech Employment and Wages in the United States, A Bay Area Council Economic Institute Report commissioned by Engine Advocacy, December 2012, www.bayareaeconomy.org/media/files/pdf/TechReport.pdf, page 5

ICT Employment (ICT workforce roles across all industries)

ICT Employment Overview

ICT industries employ a large technical ICT workforce, those creating, selling and managing ICT products and services. However, not all employment in ICT industries is ICT workforce. ICT industries employ accountants, financial managers, HR staff, maintenance people, and people in many other non-technical roles. So, it is not appropriate to count all ICT industry employment as specialized ICT workforce.

Unlike many other industries, ICT technical workforce employment is not limited to ICT industries. Healthcare occupational employment occurs primarily in Healthcare industries. Doctors and nurses work primarily for hospitals and medical clinics. ICT workers do not just work for ICT industry employers, like Microsoft or Cisco. ICT workforce is employed across all industries, like accountants and tax specialists are employed across all industries. They deploy and manage ICT infrastructure, systems and services to enable and support ICT users in their organizations. They strategically and operationally apply mature ICT technologies for the benefit of their organizations, industries, customers and suppliers, and they create custom ICT technical solutions for their industry and organizational needs. ICT workforce is increasingly strategically important to all kinds of organizations in all industries.

It is therefore important to study ICT workforce employment across all industries to understand the overall demand for people with ICT technical knowledge and skills. Following is an alphabetical list of Primary Standard Occupational Codes (SOC), in which all employees are assumed to be ICT workforce:

- 27-4011 Audio and Video Equipment Technicians
- 27-4012 Broadcast Technicians
- 27-4031 Camera Operators, Television, Video, and Motion Picture
- 43-2099 Communications Equipment Operators, All Other
- 15-1111 Computer and Information Research Scientists
- 11-3021 Computer and Information Systems Managers
- 17-2061 Computer Hardware Engineers
- 15-1143 Computer Network Architects
- 15-1152 Computer Network Support Specialists
- 15-1199 Computer Occupations, All Other
- 43-9011 Computer Operators
- 15-1131 Computer Programmers
- 15-1121 Computer Systems Analysts
- 15-1151 Computer User Support Specialists
- 49-2011 Computer, Automated Teller, and Office Machine Repairers
- 15-1141 Database Administrators
- 43-9031 Desktop Publishers
- 49-2097 Electronic Home Entertainment Equipment Installers and Repairers
- 17-2072 Electronics Engineers, Except Computer
- 27-4032 Film and Video Editors
- 19-4041 Geological and Petroleum Technicians
- 27-1024 Graphic Designers
- 15-1122 Information Security Analysts
- 27-4099 Media and Communication Equipment Workers, All Other
- 29-2071 Medical Records and Health Information Technicians
- 27-1014 Multimedia Artists and Animators

- 15-1142 Network and Computer Systems Administrators
- 49-2021 Radio, Cellular, and Tower Equipment Installers and Repairs
- 15-1132 Software Developers, Applications
- 15-1133 Software Developers, Systems Software
- 27-4014 Sound Engineering Technicians
- 43-9111 Statistical Assistants
- 43-2011 Switchboard Operators, Including Answering Service
- 49-2022 Telecommunications Equipment Installers and Repairers, Except Line Installers
- 49-9052 Telecommunications Line Installers and Repairers
- 43-2021 Telephone Operators
- 15-1134 Web Developers

In 2012[18]:

- 5,764,022 people were employed in the U.S. in these Primary ICT SOC codes,
- 3.9% of total occupational employment in the country,
- with a projected 5% net increase of 287,829 jobs between 2012 and 2015,
- through 650,656 jobs openings,
- 3.8% of all job openings in the country,
- with 216,885 average job openings each year in the U.S.
- 294,177 people were employed in the greater SF Bay Area in these Primary ICT SOC codes,
- 7.3% of greater SF Bay Area total occupational employment,
- nearly 3.5% more of total occupational employment than nationally,
- paid a median annual salary of about $95,000,
- at least 20.8% of which do not require a bachelor degree, 61,000 jobs,[19]
- estimating a net increase of 19,002 jobs (6.5% growth) between 2012 – 2015,
- 1.5% more growth than the national average for these occupations,
- estimating 17,850 total replacement jobs between 2012 – 2015,
- estimating 38,328 total job openings (7.3% of all job openings) between 2012 – 2015,
- estimating 12,779 annual job openings 2012 – 2015,
- with an average entry level salary of $45,643 (10th percentile earnings),
- about 28% higher than the national average entry level salaries in these occupations.

The following alphabetical list of Secondary ICT SOC codes include occupations in which some portion of employees are assumed to have ICT workforce roles, or to be directly dependent on ICT industry needs.

- 51-4012 Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic
- 43-4051 Customer Service Representatives
- 51-2022 Electrical and Electronic Equipment Assemblers
- 17-3023 Electrical and Electronics Engineering Technicians
- 17-2071 Electrical Engineers
- 17-3024 Electro-Mechanical Technicians
- 17-2072 Electronics Engineers, Except Computer
- 17-2199 Engineers, All Other
- 41-1012 First-Line Supervisors of Non-Retail Sales Workers

[18] Source for all occupational data is from EMSI at http://www.economicmodeling.com/, EMSI (Economic Modeling Specialists, Intl, a CareerBuilder Company) or Burning Glass at http://laborinsight.burning-glass.com/us/

[19] Some occupations categorized as requiring a bachelor degree do not, actually, require a bachelor degree

- 43-1011 First-Line Supervisors of Office and Administrative Support Workers
- 41-1011 First-Line Supervisors of Retail Sales Workers
- 25-9031 Instructional Coordinators
- 19-4099 Life, Physical, and Social Science Technicians, All Other
- 25-1099 Postsecondary Teachers
- 27-2012 Producers and Directors
- 41-2031 Retail Salespersons
- 41-3099 Sales Representatives, Services, All Other
- 41-4011 Sales Representatives, Wholesale & Manufacturing, Technical & Scientific Products
- 51-9141 Semiconductor Processors
- 17-3031 Surveying and Mapping Technicians
- 27-3042 Technical Writers
- 13-1151 Training and Development Specialists

In 2012, 390,518 people were employed in the greater SF Bay Area in these Secondary ICT SOC codes, 9.7% of SF Bay Area total occupational employment. Their median annual salary was about $53,000, and about 74% of the jobs did not require bachelor degrees. Estimates from 2012 to 2015 are for:

- a net increase of 12,947 jobs (3.3% growth),
- 33,283 replacement jobs ,
- 47,255 total job openings (9% of all job openings),
- 15,750 annual job openings.

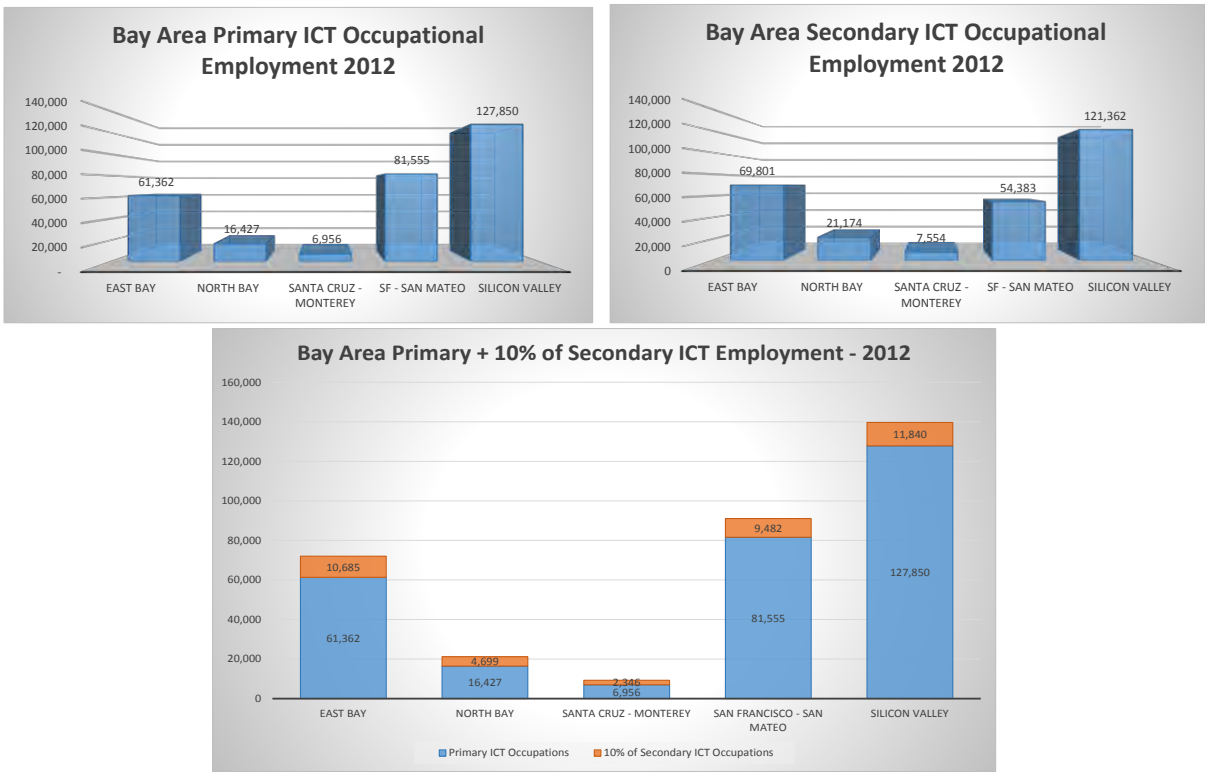
It would be unfair to allocate all of the employment in these occupations to ICT. This study conservatively allocates 10% of employment in these Secondary SOC codes as ICT workforce employment. Adding 100% of Primary SOC and 10% of Secondary SOC employment produces the following combined estimates for ICT Workforce employment in the greater SF Bay Area:

- 333,229 people employed in 2012 (100% of Primary plus 10% of Secondary ICT Occupations),
- 8.3% of all Bay Area employees (about 1 in 12 jobs),
- median annual salaries of about $90,000,
- 20,297 net job growth (6.1%) anticipated between 2012 and 2015,
- 21,178 total replacement jobs between 2012 and 2015,
- 43,054 total job openings (8.2% of all job openings) between 2012 and 2015,
- 14,354 average annual job openings between 2012 and 2015.

See Appendix 2 for a detailed breakdown of this data, for the greater SF Bay Region and for the 5 BACCC Bay Area Sub-regions, which are summarized in the following graphs.

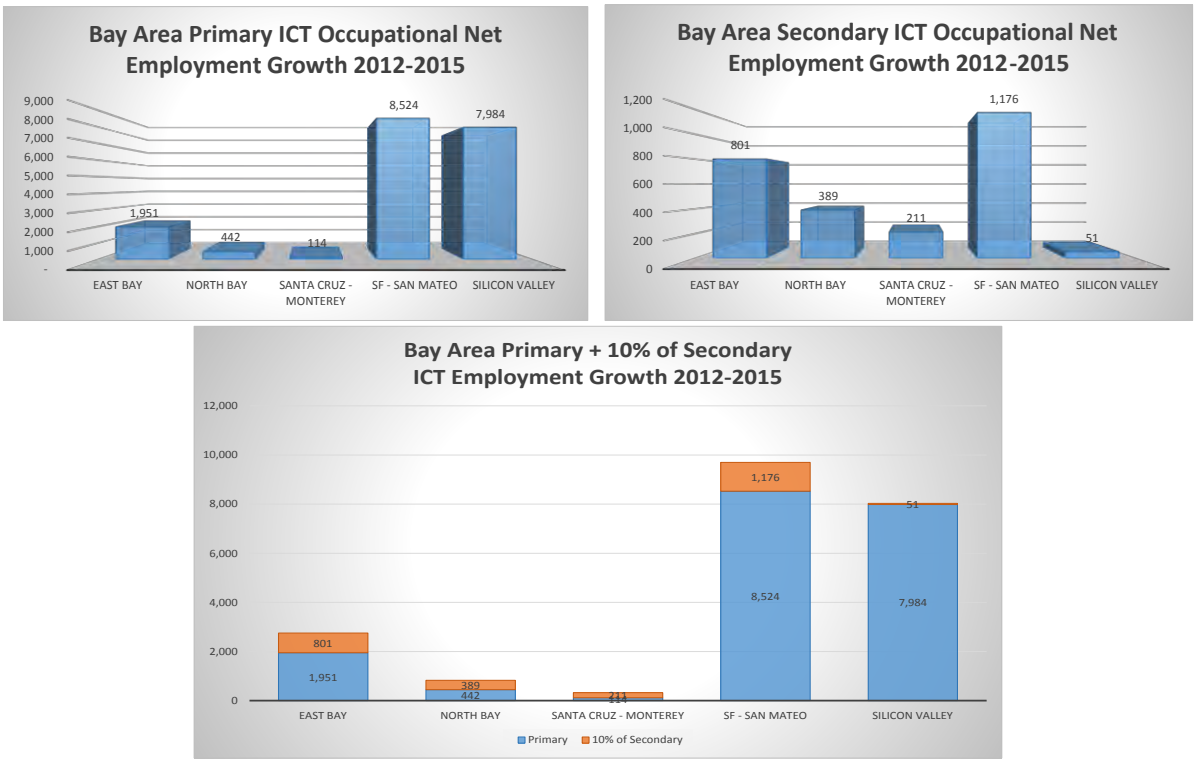
In 2012, there were 294,177 people employed in the greater SF Bay Area in Primary ICT SOC codes and 390,518 employed in these Secondary ICT SOC codes, or a conservatively estimated 333,229 people employed by the combined ICT Occupational Sector (100% of Primary plus 10% of Secondary SOCs).

Graph 21: Bay Area ICT Occupational Employment by Sub-Region 2012



Between 2012 and 2015, it is estimated that there will be a net increase of 19,002 jobs (6.5% growth) in Primary ICT occupations and 12,947 jobs (3.3%) in Secondary ICT occupations, with exceptional growth in the San Francisco - San Mateo sub-region.

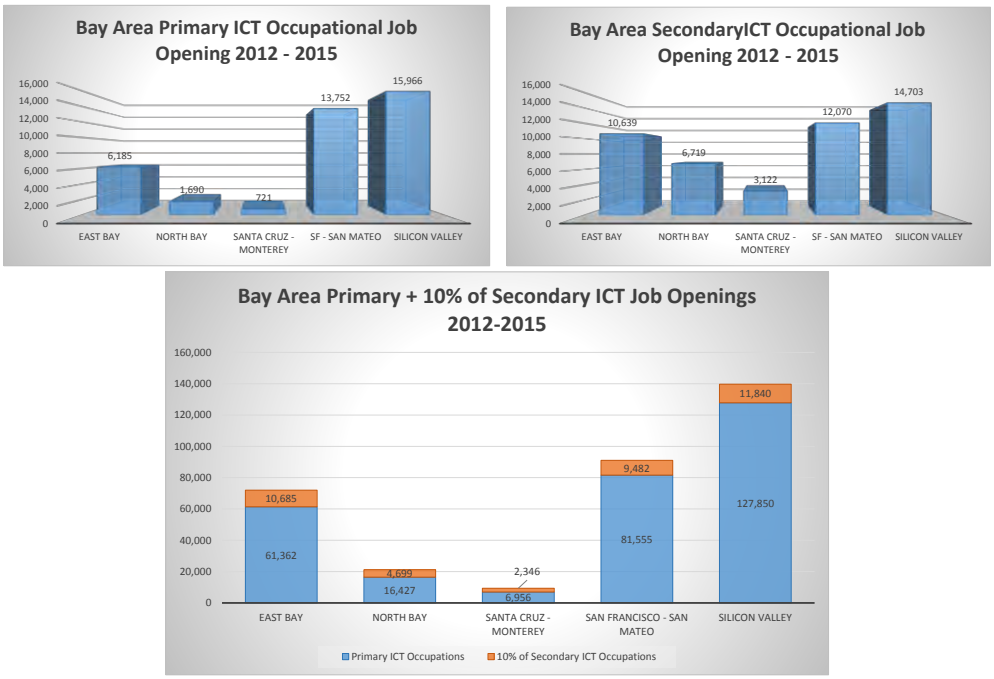
Graph 22: Bay Area ICT Occupational Employment Growth by Sub-Region 2012 - 2015



(Note low ICT Secondary Occupational Growth in Silicon Valley)

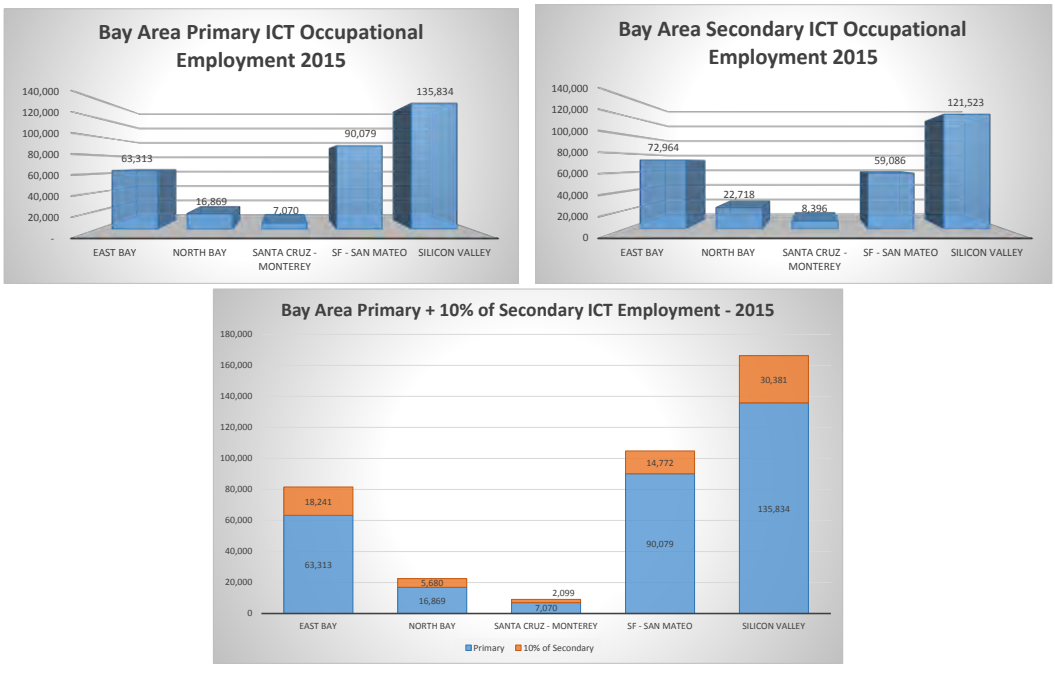
Between 2012 and 2015, estimates are for 38,328 total job openings, 12,779 annual job openings, in Primary ICT Occupations (7.3% of all job openings), with 17,850 of those as replacement jobs and 19,002 of those as net new job growth. Estimates for the combined ICT Occupational Sector (100% of Primary plus 10% of Secondary) are for 43,054 total job openings (8.2% of all job openings), 20,297 net new job growth and 21,178 replacement jobs, 14,354 average annual job openings.

Graph 23: Bay Area ICT Occupational Job Openings by Sub-Region 2012 - 2015



In 2015, there an estimated 313,179 people will be employed in greater SF Bay Area in Primary ICT SOC codes and 403,465 in Secondary ICT SOC codes, or a conservatively estimated 353,526 people employed by the combined ICT Occupational Sector (100% of Primary plus 10% of Secondary SOCs).

Graph 24: Estimated 2015 Bay Area Primary and Secondary ICT Occupational Employment

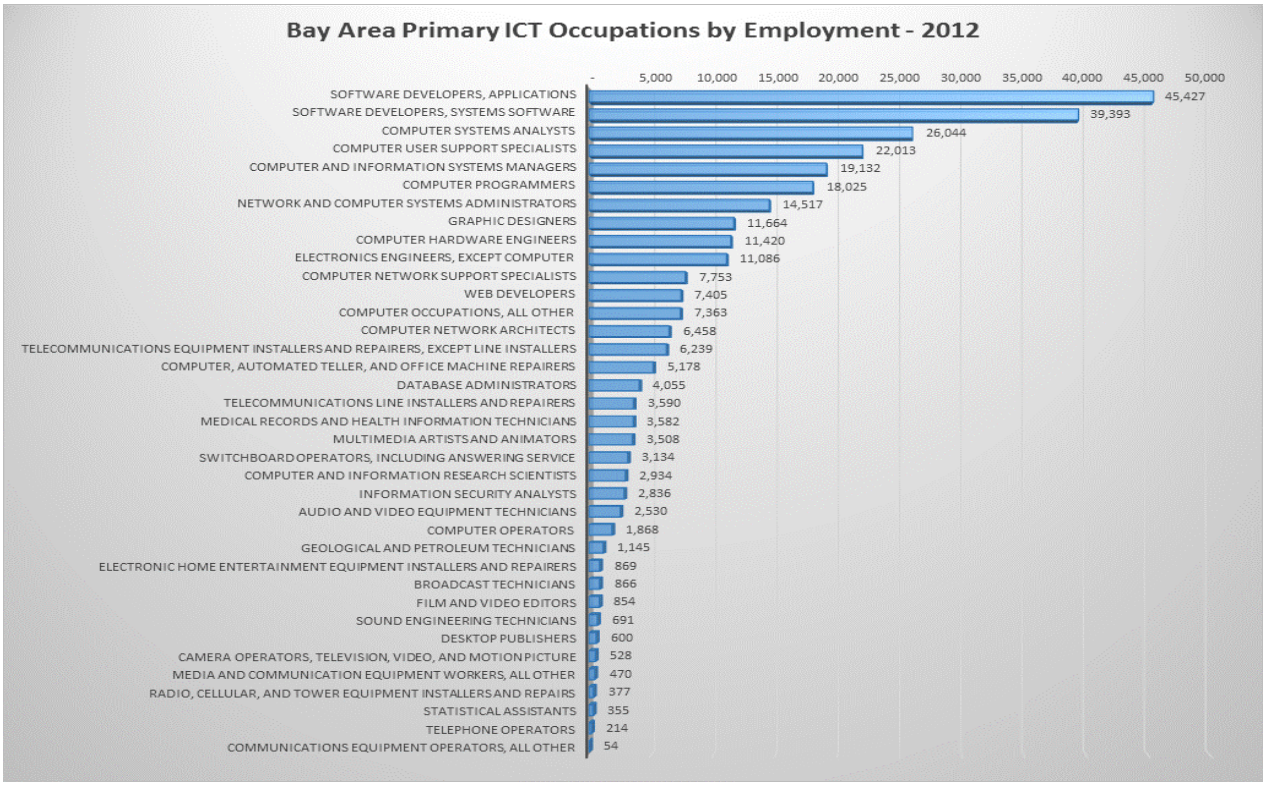


ICT Occupation Rankings

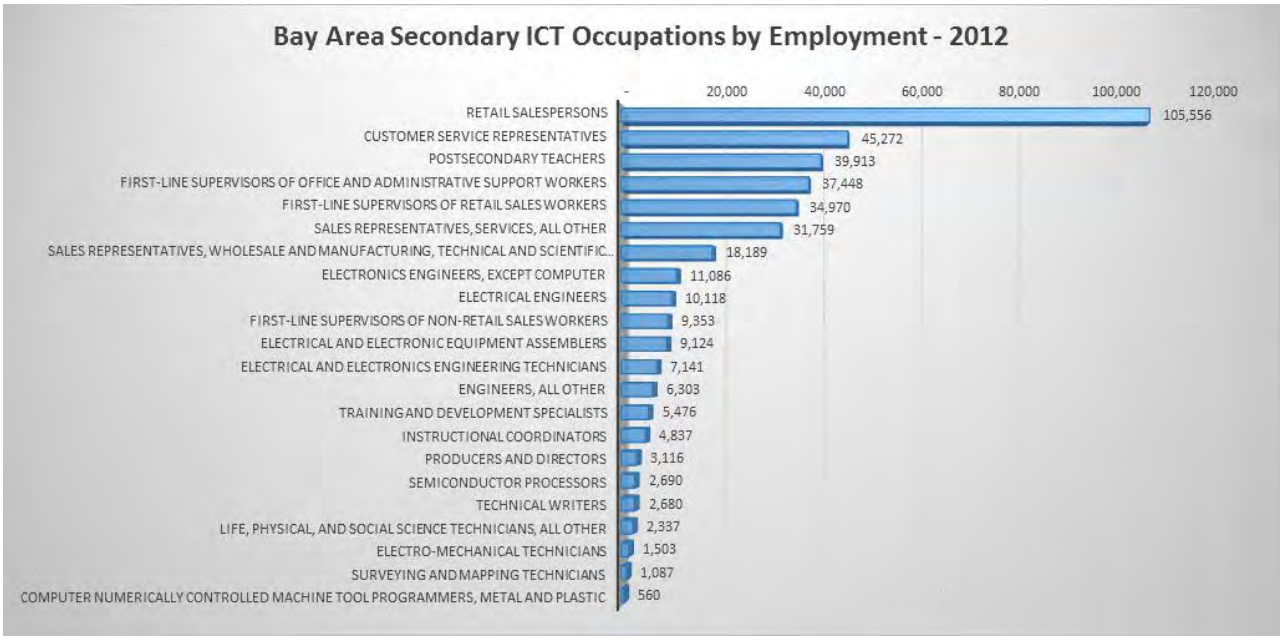
Bay Area

The following charts show ranked Primary and Secondary ICT occupations in the greater SF Bay Area by number of employees in 2012:

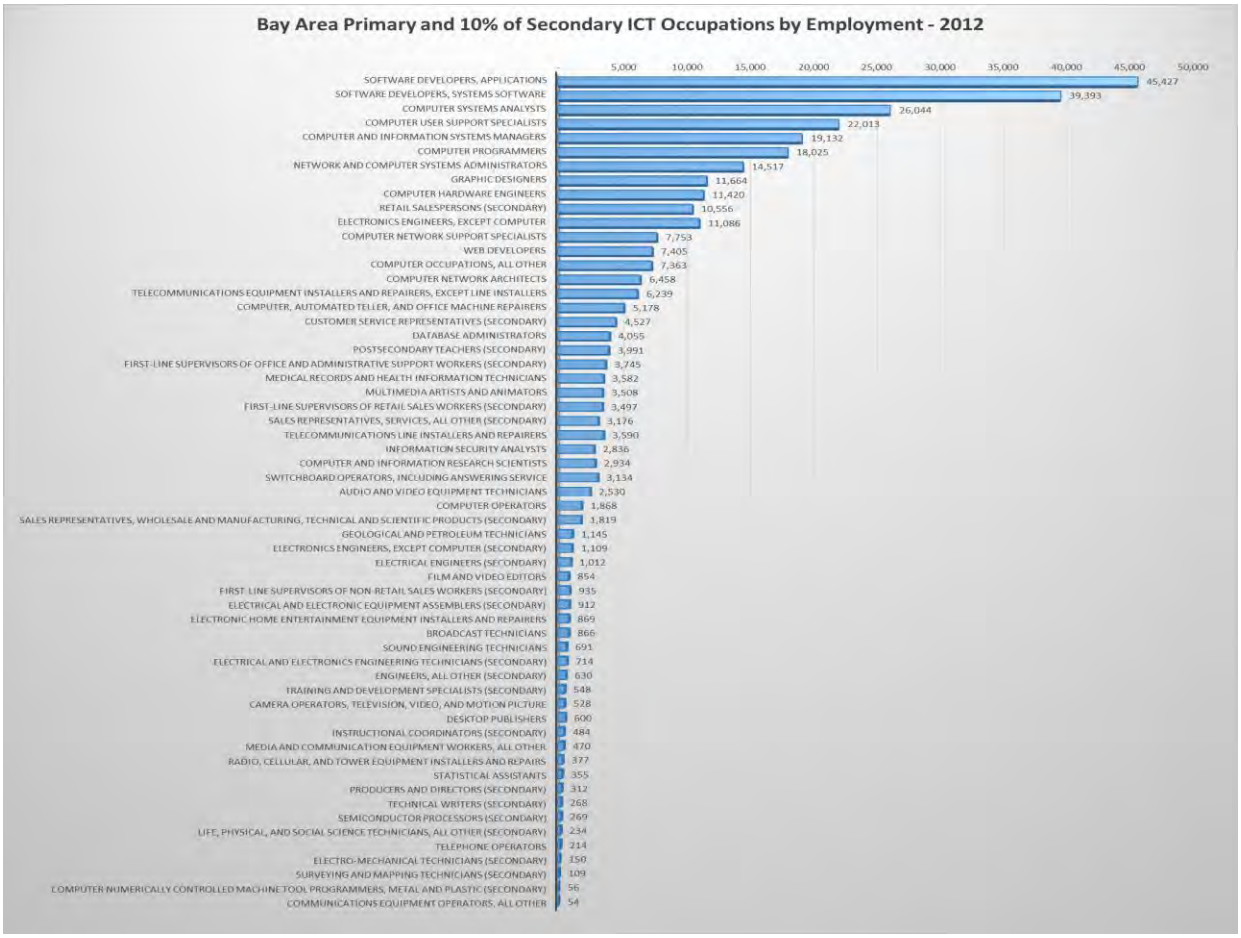
Graph 25: 2012 Bay Area Ranked Primary ICT Occupations by Employment



Graph 26: 2012 Bay Area Ranked Secondary ICT Occupations by Employment

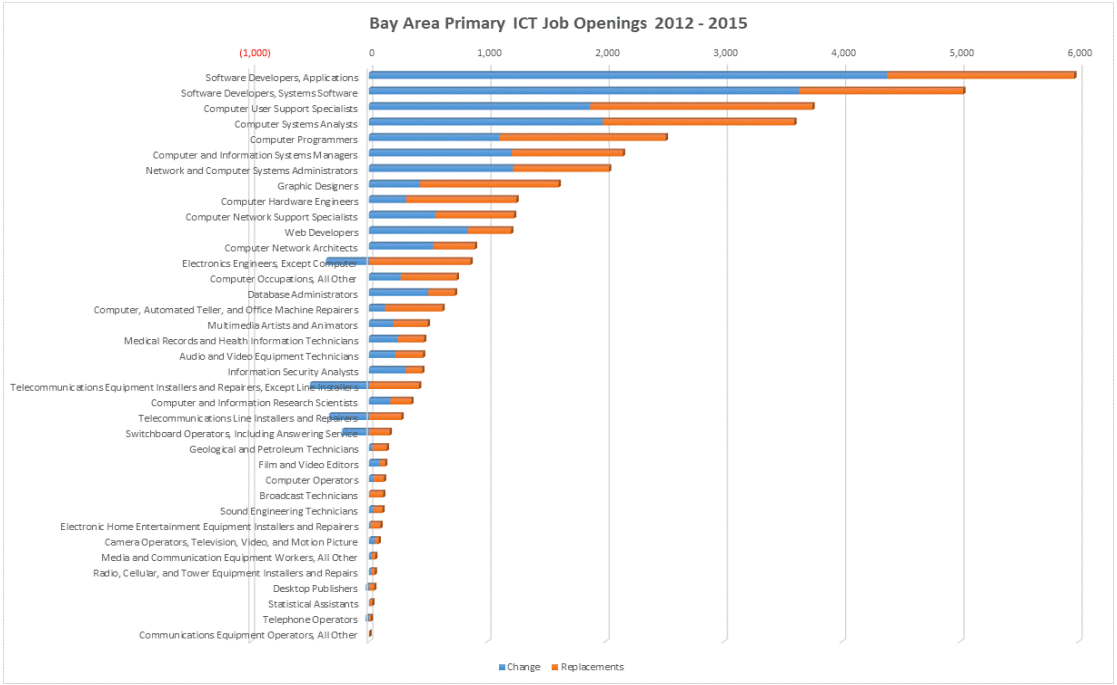


Graph 27: 2012 Ranked Bay Area Primary and 10% of Secondary ICT Occupations by Employment

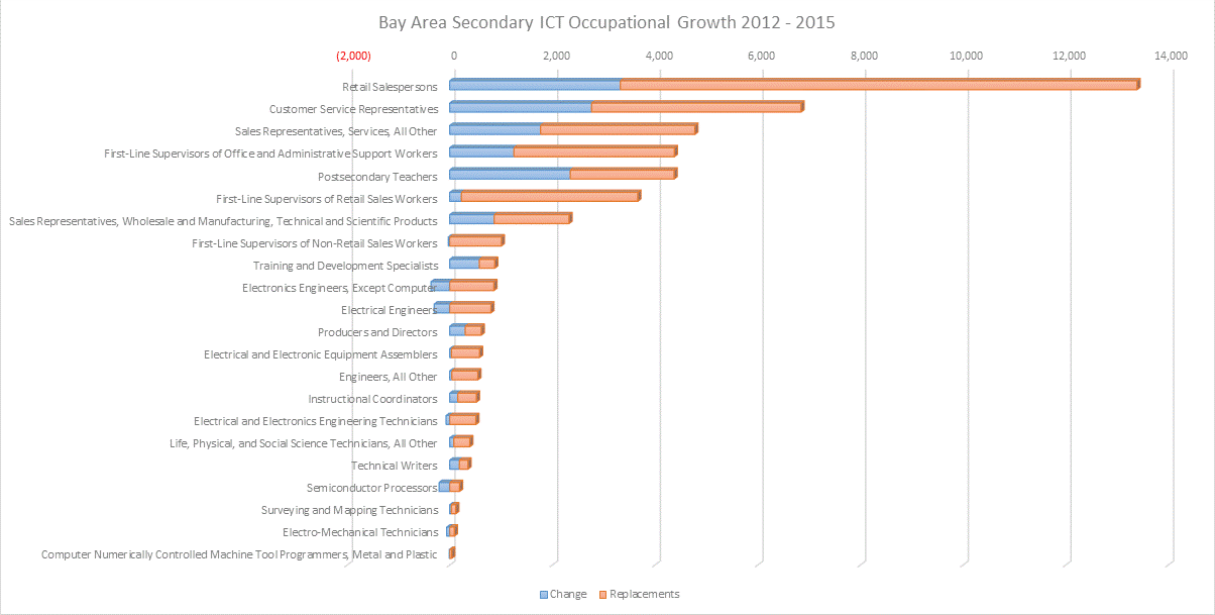


These charts show Primary, Secondary and Combined ICT occupations in the greater SF Bay Area by estimates of job openings between 2012 and 2015.

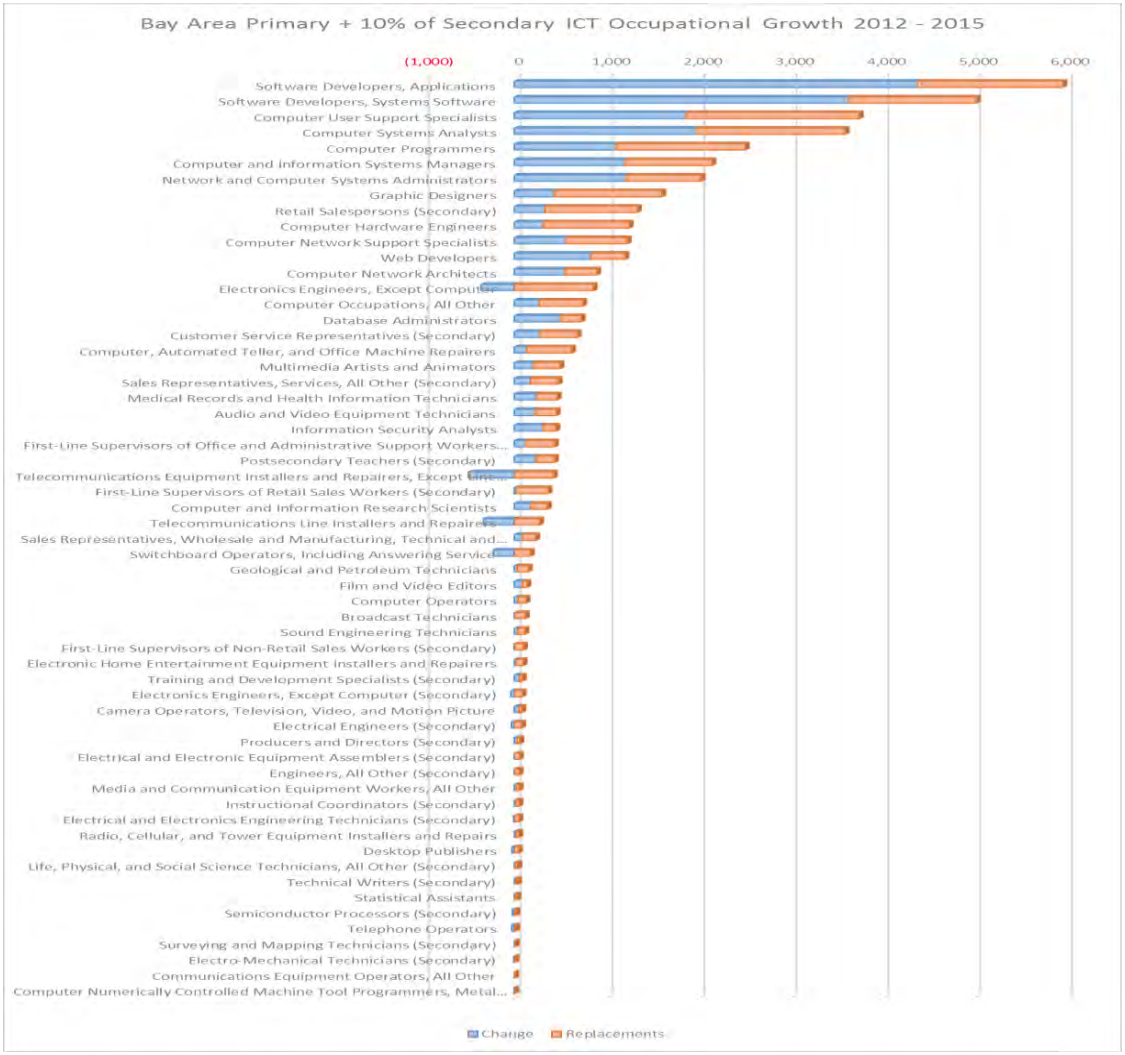
Graph 28: Ranked Bay Area Primary ICT Occupations by Employment Growth 2012 - 2015



Graph 29:: Bay Area Secondary ICT Occupations by Employment Growth 2012 - 2015



Graph 30: Bay Area Primary and 10% of Secondary ICT Occupations by Employment Growth 2012 - 2015



The San Francisco – San Mateo and Silicon Valley sub-regions account for most of the ICT openings projected for 2012-2015 in the Bay Area region, with over 17K openings combined. The other three sub-region's openings are projected at less than 4,000.

In addition, ICT occupational openings account for higher percentages of total openings in the San Francisco – San Mateo and Silicon Valley sub-regions, with ICT representing 9.7% in SF – San Mateo and 12.1% in Silicon Valley (compared to the 7.3% for the region as a whole).

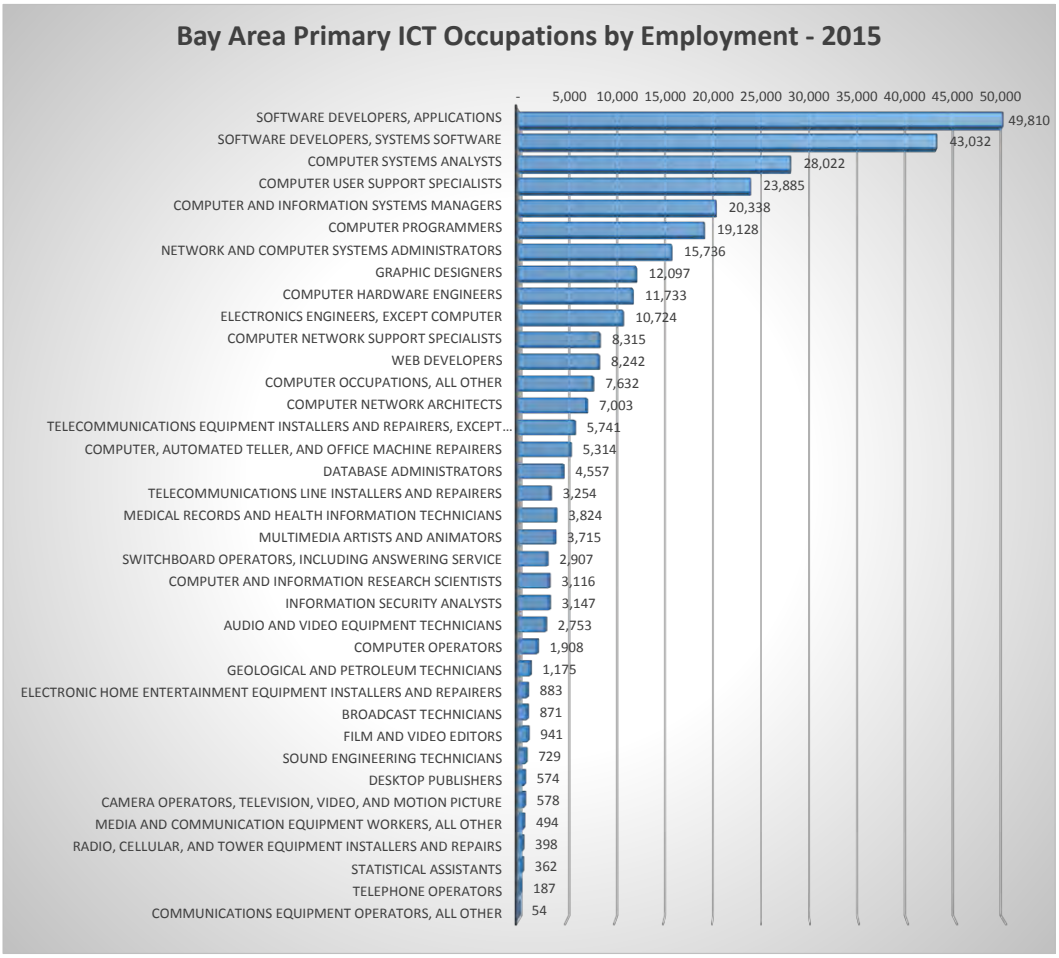
In 2012, the average annual entry level wage in Primary ICT occupations, defined as 10th percentile, was $45,643 in the Bay Area. In 2012, the average annual entry level wage for the top 5 ICT occupations was $83,108 or 82% higher than the average entry level wage for all Primary ICT occupations. In the Bay Area, the average annual entry level wage was 20% higher for all Primary ICT occupations than the average for all industry occupations, which was $38,010 in 2012.

Graph 31: 2015 Bay Area Top 5 Primary ICT Occupations by Annual Salary

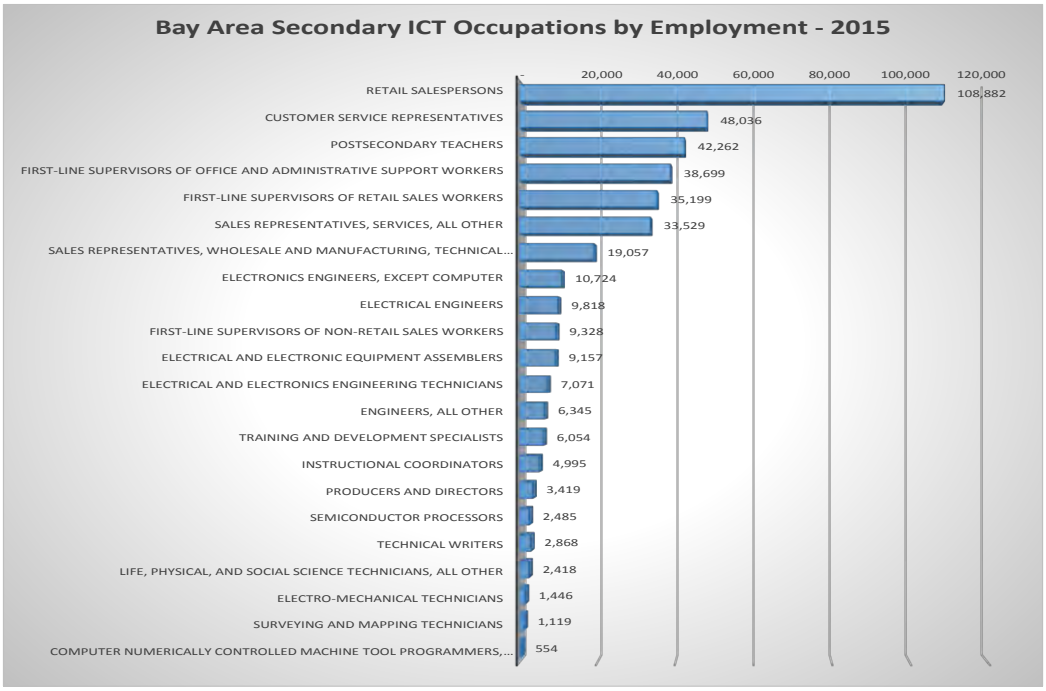
Top 5 ICT Occupations by 2012 Entry-level Wage Bay Area	Annual Salary
Computer and Information Systems Managers	$106,330
Computer Hardware Engineers	$81,182
Software Developers, Systems Software	$78,187
Computer Network Architects	$76,461
Electronics Engineers, Except Computer	$73,382

The following charts show the top Primary and Secondary ICT occupations in the greater SF Bay Area by estimated number of employees in 2015:

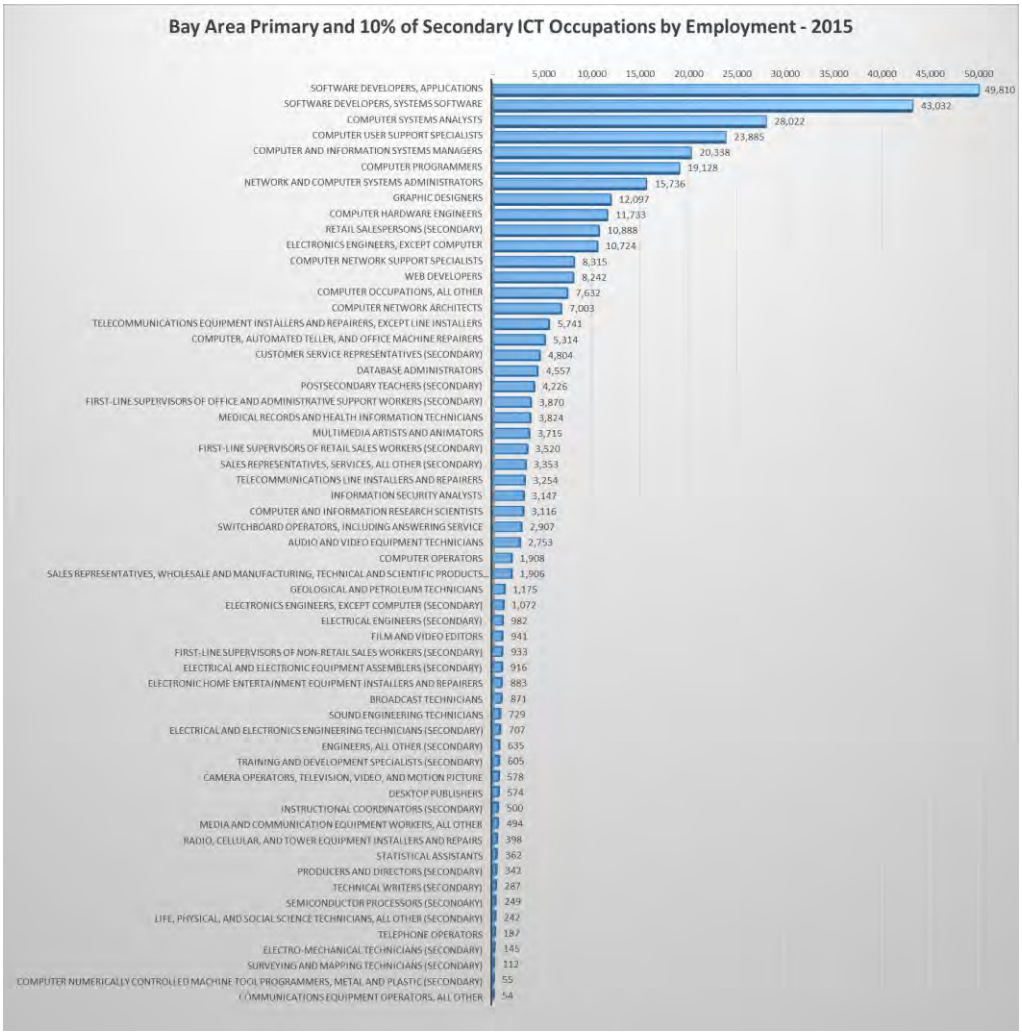
Graph 32: 2015 Bay Area Top Primary ICT Occupations by Employment



Graph 33: 2015 Bay Area Top Secondary ICT Occupations by Employment



Graph 34: 2015 Bay Area Primary and 10% of Secondary ICT Occupations by Employment



The following chart shows primary ICT occupations ranked by whether EMSI claims they need a bachelor's degree or higher. According to that data, roughly 20% of Primary ICT employment does not require a bachelor's degree. Top ranked among those occupations are user and system support, help desk kinds of roles, telecom installers, health records and healthcare IT technicians and technicians who repair equipment.

(However, anecdotally, many Bay Area employers do not require bachelor's degrees for many positions listed as requiring bachelor's degrees. Also anecdotally, the articulation pathway for many students making their way into primary ICT occupations listed as requiring bachelor's degrees is often to develop hands-on technical skills required for the jobs at community colleges, after already having bachelor's degrees. Academic transfer pathways for students who have desired hands-on skills and then want to transfer to obtain a bachelor's degree at public 4-year colleges and universities are largely broken, because transfer universities often do not accept the hands-on courses for academic credit.)

Graph 35: Bay Area Ranked Primary ICT Occupations by Educational Requirements

Primary ICT Occupations - Bay Region (Alameda, Contra Costa, Marin, Monterey, Napa, San Benito, San Francisco, San Mateo, Santa Clara, Santa Cruz, Solano, and Sonoma counties)		Employment							Hourly Wages			Education Level
SOC	Description	2012	2015	Change	% Change	Replacements	Openings	Annual Openings	10th	25th	Median	
15-1151	Computer User Support Specialists	22,013	23,885	1,872	9%	1,881	3,753	1,251	$17.05	$21.63	$29.80	Associate's degree
15-1152	Computer Network Support Specialists	7,753	8,315	562	7%	667	1,229	410	$23.13	$29.12	$38.41	Associate's degree
49-2022	Telecommunications Equipment Installers and Repairers, Except Line Installers	6,239	5,741	(498)	(8%)	425	425	142	$18.19	$24.05	$31.01	Postsecondary non-degree award
49-2011	Computer, Automated Teller, and Office Machine Repairer	5,178	5,314	136	3%	487	623	208	$12.97	$15.20	$18.58	Postsecondary non-degree award
29-2071	Medical Records and Health Information Technicians	3,582	3,824	242	7%	226	468	156	$14.41	$17.43	$22.17	Postsecondary non-degree award
49-9052	Telecommunications Line Installers and Repairers	3,590	3,254	(336)	(9%)	276	276	92	$19.49	$24.25	$30.60	Long-term on-the-job training
43-2011	Switchboard Operators, Including Answering Service	3,134	2,907	(227)	(7%)	176	176	59	$10.54	$12.98	$16.74	Short-term on-the-job training
27-4011	Audio and Video Equipment Technicians	2,530	2,753	223	9%	235	458	153	$15.20	$17.98	$22.42	Postsecondary non-degree award
43-9011	Computer Operators	1,868	1,908	40	2%	88	128	43	$14.46	$18.25	$22.89	Moderate-term on-the-job training
19-4041	Geological and Petroleum Technicians	1,145	1,175	30	3%	122	152	51	$15.37	$24.70	$39.62	Associate's degree
49-2097	Electronic Home Entertainment Equipment Installers and Repairers	869	883	14	2%	84	98	33	$13.03	$14.52	$16.70	Postsecondary non-degree award
27-4012	Broadcast Technicians	866	871	5	1%	116	121	40	$10.73	$14.09	$23.71	Associate's degree
27-4014	Sound Engineering Technicians	691	729	38	5%	77	115	38	$13.35	$15.03	$22.71	Postsecondary non-degree award
43-9031	Desktop Publishers	600	574	(26)	(4%)	45	45	15	$16.89	$20.10	$25.06	Associate's degree
27-4099	Media and Communication Equipment Workers, All Other	470	494	24	5%	30	54	18	$22.12	$28.69	$36.21	Moderate-term on-the-job training
49-2021	Radio, Cellular, and Tower Equipment Installers and Repa	377	398	21	6%	29	50	17	$14.09	$16.86	$22.34	Associate's degree
43-2021	Telephone Operators	214	187	(27)	(13%)	17	17	6	$13.74	$17.21	$21.91	Short-term on-the-job training
43-2099	Communications Equipment Operators, All Other	54	54	0	0%	5	5	2	$9.99	$10.45	$14.74	Short-term on-the-job training
15-1132	Software Developers, Applications	45,427	49,810	4,383	10%	1,584	5,967	1,989	$33.92	$41.77	$53.02	Bachelor's degree
15-1133	Software Developers, Systems Software	39,393	43,032	3,639	9%	1,389	5,028	1,676	$37.59	$46.66	$57.63	Bachelor's degree
15-1121	Computer Systems Analysts	26,044	28,022	1,978	8%	1,621	3,599	1,200	$27.69	$34.98	$44.08	Bachelor's degree
11-3021	Computer and Information Systems Managers	19,132	20,338	1,206	6%	943	2,149	716	$51.12	$62.21	$75.31	Bachelor's or higher degree, + work experie
15-1131	Computer Programmers	18,025	19,128	1,103	6%	1,409	2,512	837	$29.70	$35.11	$43.68	Bachelor's degree
15-1142	Network and Computer Systems Administrators	14,517	15,736	1,219	8%	813	2,032	677	$26.88	$34.00	$43.18	Bachelor's degree
27-1024	Graphic Designers	11,664	12,097	433	4%	1,172	1,605	535	$16.30	$19.65	$24.57	Bachelor's degree
17-2061	Computer Hardware Engineers	11,420	11,733	313	3%	936	1,249	416	$39.03	$49.11	$60.94	Bachelor's degree
17-2072	Electronics Engineers, Except Computer	11,086	10,724	(362)	(3%)	860	860	287	$35.28	$44.17	$55.92	Bachelor's degree
15-1134	Web Developers	7,405	8,242	837	11%	367	1,204	401	$21.00	$27.64	$35.28	Bachelor's degree
15-1199	Computer Occupations, All Other	7,363	7,632	269	4%	475	744	248	$23.37	$30.66	$41.24	Bachelor's degree
15-1143	Computer Network Architects	6,458	7,003	545	8%	352	897	299	$36.76	$46.26	$57.07	Bachelor's degree
15-1141	Database Administrators	4,055	4,557	502	12%	226	728	243	$24.91	$32.07	$44.28	Bachelor's degree
27-1014	Multimedia Artists and Animators	3,508	3,715	207	6%	292	499	166	$15.83	$19.87	$25.52	Bachelor's degree
15-1122	Information Security Analysts	2,836	3,147	311	11%	141	452	151	$33.32	$41.43	$50.38	Bachelor's degree
15-1111	Computer and Information Research Scientists	2,934	3,116	182	6%	178	360	120	$34.29	$47.20	$56.73	Doctoral degree
27-4032	Film and Video Editors	854	941	87	10%	51	138	46	$18.51	$21.12	$26.05	Bachelor's degree
27-4031	Camera Operators, Television, Video, and Motion Picture	528	578	50	9%	33	83	28	$14.52	$16.91	$20.48	Bachelor's degree
43-9111	Statistical Assistants	355	362	7	2%	22	29	10	$17.14	$19.61	$23.16	Bachelor's degree
	Primary Requiring Less Than Bachelor's Degree	**61,173**	**63,266**	**2,093**	**3%**	**4,986**	**8,193**	**2,734**				
	Primary Requiring At Least a Bachelor's Degree	**233,004**	**249,913**	**16,909**	**7%**	**12,864**	**30,135**	**10,045**				

Looking at 100% of Secondary ICT Occupations in the table below, roughly 75% of jobs do not require a bachelor's degree or higher. The majority of those positions are in sales. For Secondary ICT Occupations that do require a bachelor's degree or higher, the primary demand is in teaching.

Graph 36: Bay Area Ranked Secondary ICT Occupations by Educational Requirements

Secondary ICT Occupations - Bay Region (Alameda, Contra Costa, Marin, Monterey, Napa, San Benito, San Francisco, San Mateo, Santa Clara, Santa Cruz, Solano, and Sonoma counties)		Employment							Hourly Wages			Education Level
SOC	Description	2012	2015	Change	% Change	Replacements	Openings	Annual Openings	10th	25th	Median	
41-2031	Retail Salespersons	105,556	108,882	3,326	3%	10,065	13,391	4,464	$8.97	$9.71	$11.36	Short-term on-the-job training
43-4051	Customer Service Representatives	45,272	48,036	2,764	6%	4,081	6,845	2,282	$12.37	$15.55	$19.96	Short-term on-the-job training
43-1011	First-Line Supervisors of Office and Administrative Support Workers	37,448	38,699	1,251	3%	3,127	4,378	1,459	$18.70	$22.90	$28.96	Work experience in a related occupation
41-1011	First-Line Supervisors of Retail Sales Workers	34,970	35,199	229	1%	3,436	3,665	1,222	$12.71	$15.11	$18.65	Work experience in a related occupation
41-3099	Sales Representatives, Services, All Other	31,759	33,529	1,770	6%	3,006	4,776	1,592	$15.98	$21.39	$31.88	Short-term on-the-job training
41-1012	First-Line Supervisors of Non-Retail Sales Workers	9,353	9,328	(25)	0%	1,006	1,006	335	$18.88	$23.89	$32.72	Work experience in a related occupation
51-2022	Electrical and Electronic Equipment Assemblers	9,124	9,157	33	0%	548	581	194	$9.96	$12.18	$15.65	Short-term on-the-job training
17-3023	Electrical and Electronics Engineering Technicians	7,141	7,071	(70)	(1%)	509	509	170	$18.61	$22.91	$28.72	Associate's degree
51-9141	Semiconductor Processors	2,690	2,485	(205)	(8%)	192	192	64	$11.17	$13.14	$16.79	Associate's degree
19-4099	Life, Physical, and Social Science Technicians, All Other	2,337	2,418	81	3%	309	390	130	$15.70	$18.69	$22.66	Associate's degree
17-3024	Electro-Mechanical Technicians	1,503	1,446	(57)	(4%)	91	91	30	$16.95	$20.98	$26.30	Associate's degree
17-3031	Surveying and Mapping Technicians	1,087	1,119	32	3%	86	118	39	$20.04	$23.72	$29.19	Moderate-term on-the-job training
51-4012	Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic	560	554	(6)	(1%)	40	40	13	$15.81	$20.50	$27.01	Moderate-term on-the-job training
25-1099	Postsecondary Teachers	39,913	42,262	2,349	6%	2,023	4,372	1,457	$20.05	$26.34	$35.35	Doctoral degree
41-4011	Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	18,189	19,057	868	5%	1,457	2,325	775	$22.02	$30.25	$44.47	Bachelor's degree
17-2072	Electronics Engineers, Except Computer	11,086	10,724	(362)	(3%)	860	860	287	$35.28	$44.17	$55.92	Bachelor's degree
17-2071	Electrical Engineers	10,118	9,818	(300)	(3%)	802	802	267	$35.00	$41.88	$52.73	Bachelor's degree
17-2199	Engineers, All Other	6,303	6,345	42	1%	505	547	182	$32.26	$38.80	$48.54	Bachelor's degree
25-9031	Instructional Coordinators	4,837	4,995	158	3%	362	520	173	$20.89	$25.25	$31.65	Master's degree
27-2012	Producers and Directors	3,116	3,419	303	10%	310	613	204	$17.52	$24.67	$34.19	Bachelor's or higher degree, + work experie
27-3042	Technical Writers	2,680	2,868	188	7%	169	357	119	$27.55	$34.85	$43.90	Bachelor's degree
	Primary Requiring Less Than Bachelor's Degree	**288,800**	**297,923**	**9,123**	**3%**	**26,496**	**35,982**	**11,994**				
	Primary Requiring At Least a Bachelor's Degree	**96,242**	**99,488**	**3,246**	**3%**	**6,488**	**10,396**	**3,464**				

Looking at the ranked listings of 100% of Primary and 10% of Secondary ICT Occupations in the table below, roughly 73% of jobs do require a bachelor's degree or higher, and job growth for occupations requiring a bachelor's degree will increase by 7%, versus 3% for those requiring less than a bachelor's degree. Again, anecdotally however, many occupations listed as requiring a bachelor degree do not actually require a bachelor's degree, according to many employers.

Graph 37: Bay Area Ranked Primary and 10% of Secondary ICT Occupations by Educational Requirements

ICT Occupations - Bay Region (Alameda, Contra Costa, Marin, Monterey, Napa, San Benito, San Francisco, San Mateo, Santa Clara, Santa Cruz, Solano, and Sonoma counties)			Employment							Hourly Wages			Education Level
Group	**SOC**	**Primary and 10% of Secondary Description**	**2012**	**2015**	**Change**	**% Change**	**Replacements**	**Openings**	**Annual Openings**	**10th**	**25th**	**Median**	
Primary	15-1151	Computer User Support Specialists	22,013	23,885	1,872	9%	1,881	3,753	1,251	$17.05	$21.63	$29.80	Associate's degree
Secondary	41-2031	Retail Salespersons	10,556	10,888	333	3%	1,007	1,339	446	$8.97	$9.71	$11.36	Short-term on-the-job training
Primary	15-1152	Computer Network Support Specialists	7,753	8,315	562	7%	667	1,229	410	$23.13	$29.12	$38.41	Associate's degree
Primary	49-2022	Telecommunications Equipment Installers and Repairers, Except Line Installers	6,239	5,741	(498)	(8%)	425	425	142	$18.19	$24.05	$31.01	Postsecondary non-degree award
Primary	49-2011	Computer, Automated Teller, and Office Machine Repairers	5,178	5,314	136	3%	487	623	208	$12.97	$15.20	$18.58	Postsecondary non-degree award
Secondary	43-4051	Customer Service Representatives	4,527	4,804	276	6%	408	685	228	$12.37	$15.55	$19.96	Short-term on-the-job training
Secondary	43-1011	First-Line Supervisors of Office and Administrative Support Workers	3,745	3,870	125	3%	313	438	146	$18.70	$22.90	$28.96	Work experience in a related occupation
Primary	49-9052	Telecommunications Line Installers and Repairers	3,590	3,254	(336)	(9%)	276	276	92	$19.49	$24.25	$30.60	Long-term on-the-job training
Primary	29-2071	Medical Records and Health Information Technicians	3,582	3,824	242	7%	226	468	156	$14.41	$17.43	$22.17	Postsecondary non-degree award
Secondary	41-1011	First-Line Supervisors of Retail Sales Workers	3,497	3,520	23	1%	344	367	122	$12.71	$15.11	$18.65	Work experience in a related occupation
Secondary	41-3099	Sales Representatives, Services, All Other	3,176	3,353	177	6%	301	478	159	$15.98	$21.39	$31.88	Short-term on-the-job training
Primary	43-2011	Switchboard Operators, Including Answering Service	3,134	2,907	(227)	(7%)	176	176	59	$10.54	$12.98	$16.74	Short-term on-the-job training
Primary	27-4011	Audio and Video Equipment Technicians	2,530	2,753	223	9%	235	458	153	$15.20	$17.98	$22.42	Postsecondary non-degree award
Primary	43-9011	Computer Operators	1,868	1,908	40	2%	88	128	43	$14.46	$18.25	$22.89	Moderate-term on-the-job training
Primary	19-4041	Geological and Petroleum Technicians	1,145	1,175	30	3%	122	152	51	$15.37	$24.70	$39.62	Associate's degree
Secondary	41-1012	First-Line Supervisors of Non-Retail Sales Workers	935	933	(3)	0%	101	101	34	$18.88	$23.89	$32.72	Work experience in a related occupation
Secondary	51-2022	Electrical and Electronic Equipment Assemblers	912	916	3	0%	55	58	19	$9.96	$12.18	$15.65	Short-term on-the-job training
Primary	49-2097	Electronic Home Entertainment Equipment Installers and Repairers	869	883	14	2%	84	98	33	$13.03	$14.52	$16.70	Postsecondary non-degree award
Primary	27-4012	Broadcast Technicians	866	871	5	1%	116	121	40	$10.73	$14.09	$23.71	Associate's degree
Secondary	17-3023	Electrical and Electronics Engineering Technicians	714	707	(7)	(1%)	51	51	17	$18.61	$22.91	$28.72	Associate's degree
Primary	27-4014	Sound Engineering Technicians	691	729	38	5%	77	115	38	$13.35	$15.03	$22.71	Postsecondary non-degree award
Primary	43-9031	Desktop Publishers	600	574	(26)	(4%)	45	45	15	$16.89	$20.10	$25.06	Associate's degree
Primary	27-4099	Media and Communication Equipment Workers, All Other	470	494	24	5%	30	54	18	$22.12	$28.69	$36.21	Moderate-term on-the-job training
Primary	49-2021	Radio, Cellular, and Tower Equipment Installers and Repairs	377	398	21	6%	29	50	17	$14.09	$16.86	$22.34	Associate's degree
Secondary	51-9141	Semiconductor Processors	269	249	(21)	(8%)	19	19	6	$11.17	$13.14	$16.79	Associate's degree
Secondary	19-4099	Life, Physical, and Social Science Technicians, All Other	234	242	8	3%	31	39	13	$15.70	$18.69	$22.66	Associate's degree
Primary	43-2021	Telephone Operators	214	187	(27)	(13%)	17	17	6	$13.74	$17.21	$21.91	Short-term on-the-job training
Secondary	17-3024	Electro-Mechanical Technicians	150	145	(6)	(4%)	9	9	3	$16.95	$20.98	$26.30	Associate's degree
Secondary	17-3031	Surveying and Mapping Technicians	109	112	3	3%	9	12	4	$20.04	$23.72	$29.19	Moderate-term on-the-job training
Secondary	51-4012	Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic	56	55	(1)	(1%)	4	4	1	$15.81	$20.50	$27.01	Moderate-term on-the-job training
Primary	43-2099	Communications Equipment Operators, All Other	54	54	0	0%	5	5	2	$9.99	$10.45	$14.74	Short-term on-the-job training
Primary	15-1132	Software Developers, Applications	45,427	49,810	4,383	10%	1,584	5,967	1,989	$33.92	$41.77	$53.02	Bachelor's degree
Primary	15-1133	Software Developers, Systems Software	39,393	43,032	3,639	9%	1,389	5,028	1,676	$37.59	$46.66	$57.63	Bachelor's degree
Primary	15-1121	Computer Systems Analysts	26,044	28,022	1,978	8%	1,621	3,599	1,200	$27.69	$34.98	$44.08	Bachelor's degree
Primary	11-3021	Computer and Information Systems Managers	19,132	20,338	1,206	6%	943	2,149	716	$51.12	$62.21	$75.31	Bachelor's or higher degree, + work experie
Primary	15-1131	Computer Programmers	18,025	19,128	1,103	6%	1,409	2,512	837	$29.70	$35.11	$43.68	Bachelor's degree
Primary	15-1142	Network and Computer Systems Administrators	14,517	15,736	1,219	8%	813	2,032	677	$26.88	$34.00	$43.18	Bachelor's degree
Primary	27-1024	Graphic Designers	11,664	12,097	433	4%	1,172	1,605	535	$16.30	$19.65	$24.57	Bachelor's degree
Primary	17-2061	Computer Hardware Engineers	11,420	11,733	313	3%	936	1,249	416	$39.03	$49.11	$60.94	Bachelor's degree
Primary	17-2072	Electronics Engineers, Except Computer	11,086	10,724	(362)	(3%)	860	860	287	$35.28	$44.17	$55.92	Bachelor's degree
Primary	15-1134	Web Developers	7,405	8,242	837	11%	367	1,204	401	$21.00	$27.64	$35.28	Bachelor's degree
Primary	15-1199	Computer Occupations, All Other	7,363	7,632	269	4%	475	744	248	$23.37	$30.66	$41.24	Bachelor's degree
Primary	15-1143	Computer Network Architects	6,458	7,003	545	8%	352	897	299	$36.76	$46.26	$57.07	Bachelor's degree
Primary	15-1141	Database Administrators	4,055	4,557	502	12%	226	728	243	$24.91	$32.07	$44.28	Bachelor's degree
Secondary	25-1099	Postsecondary Teachers	3,991	4,226	235	6%	202	437	146	$20.05	$26.34	$35.35	Doctoral degree
Primary	27-1014	Multimedia Artists and Animators	3,508	3,715	207	6%	292	499	166	$15.83	$19.87	$25.52	Bachelor's degree
Primary	15-1111	Computer and Information Research Scientists	2,934	3,116	182	6%	178	360	120	$34.29	$47.20	$56.73	Doctoral degree
Primary	15-1122	Information Security Analysts	2,836	3,147	311	11%	141	452	151	$33.32	$41.43	$50.38	Bachelor's degree
Secondary	41-4011	Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	1,819	1,906	87	5%	146	233	78	$22.02	$30.25	$44.47	Bachelor's degree
Secondary	17-2072	Electronics Engineers, Except Computer	1,109	1,072	(36)	(3%)	86	86	29	$35.28	$44.17	$55.92	Bachelor's degree
Secondary	17-2071	Electrical Engineers	1,012	982	(30)	(3%)	80	80	27	$35.00	$41.88	$52.73	Bachelor's degree
Primary	27-4032	Film and Video Editors	854	941	87	10%	51	138	46	$18.51	$21.12	$26.05	Bachelor's degree
Secondary	17-2199	Engineers, All Other	630	635	4	1%	51	55	18	$32.26	$38.80	$48.54	Bachelor's degree
Secondary	13-1151	Training and Development Specialists	548	605	58	11%	30	88	29	$19.93	$26.66	$36.72	Bachelor's degree
Primary	27-4031	Camera Operators, Television, Video, and Motion Picture	528	578	50	9%	33	83	28	$14.52	$16.91	$20.48	Bachelor's degree
Secondary	25-9031	Instructional Coordinators	484	500	16	3%	36	52	17	$20.89	$25.25	$31.65	Master's degree
Primary	43-9111	Statistical Assistants	355	362	7	2%	22	29	10	$17.14	$19.61	$23.16	Bachelor's degree
Secondary	27-2012	Producers and Directors	312	342	30	10%	31	61	20	$17.52	$24.67	$34.19	Bachelor's or higher degree, + work experie
Secondary	27-3042	Technical Writers	268	287	19	7%	17	36	12	$27.55	$34.85	$43.90	Bachelor's degree
		Primary Requiring Less Than Bachelor's Degree	**90,053**	**93,058**	**3,005**	**3%**	**7,636**	**11,791**	**3,933**				
		Primary Requiring At Least a Bachelor's Degree	**243,176**	**260,467**	**17,291**	**7%**	**13,543**	**31,262**	**10,421**				

The following table shows the percent of employment within each of the Primary ICT Occupations that is self-employment, based on 2012 EMSI data.

Graph 38: Bay Area Self-Employment Percentages of Primary ICT Occupations in 2012

San Francisco Bay Area

2012 Self-Employed Percent of Primary ICT Occupational Employment

SOC	Description	% Self
49-2097	Electronic Home Entertainment Equipment Installers and Repairers	43.0%
27-1014	Multimedia Artists and Animators	41.9%
27-4031	Camera Operators, Television, Video, and Motion Picture	41.5%
27-1024	Graphic Designers	37.1%
49-2011	Computer, Automated Teller, and Office Machine Repairers	28.5%
27-4032	Film and Video Editors	28.1%
15-1134	Web Developers	25.2%
43-9031	Desktop Publishers	21.1%
27-4014	Sound Engineering Technicians	20.4%
49-2021	Radio, Cellular, and Tower Equipment Installers and Repairs	15.5%
27-4011	Audio and Video Equipment Technicians	12.5%
27-4099	Media and Communication Equipment Workers, All Other	11.4%
15-1131	Computer Programmers	8.0%
15-1199	Computer Occupations, All Other	6.5%
15-1121	Computer Systems Analysts	6.2%
43-9011	Computer Operators	6.1%
27-4012	Broadcast Technicians	4.2%
49-9052	Telecommunications Line Installers and Repairers	4.1%
15-1141	Database Administrators	2.8%
11-3021	Computer and Information Systems Managers	2.7%
49-2022	Telecommunications Equipment Installers and Repairers, Except Line Insta	2.5%
15-1143	Computer Network Architects	2.5%
15-1132	Software Developers, Applications	2.3%
15-1151	Computer User Support Specialists	2.2%
15-1152	Computer Network Support Specialists	2.2%
15-1142	Network and Computer Systems Administrators	2.0%
15-1133	Software Developers, Systems Software	1.7%
17-2061	Computer Hardware Engineers	0.8%
17-2072	Electronics Engineers, Except Computer	0.6%
19-4041	Geological and Petroleum Technicians	0.3%
15-1111	Computer and Information Research Scientists	0.2%
15-1122	Information Security Analysts	0.2%
29-2071	Medical Records and Health Information Technicians	0.0%
43-2011	Switchboard Operators, Including Answering Service	0.0%
43-2021	Telephone Operators	0.0%
43-2099	Communications Equipment Operators, All Other	0.0%
43-9111	Statistical Assistants	0.0%

A breakdown of Primary ICT Occupation self-employment percentages by sub-region can be found in Appendix 3.

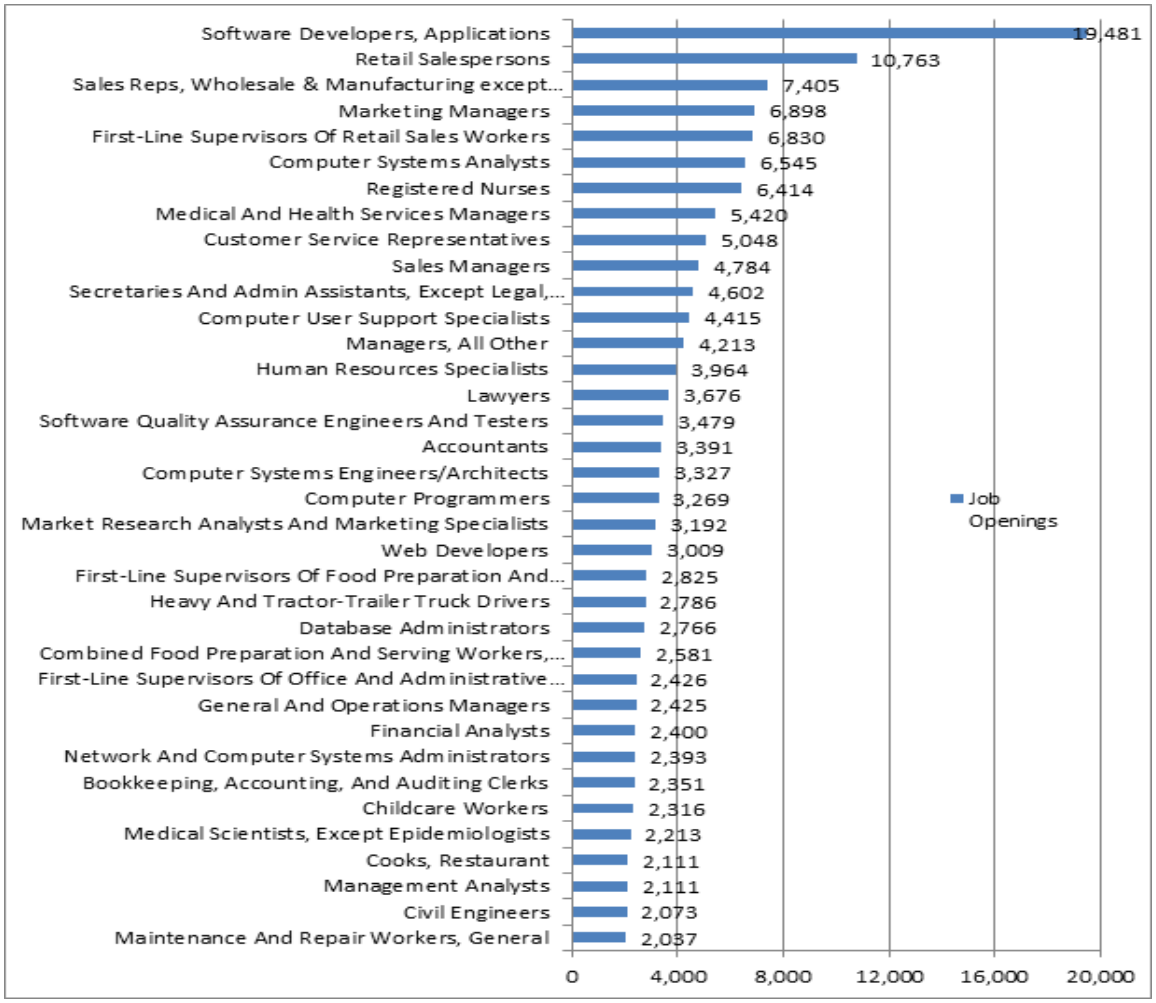
Primary ICT Occupation job postings represented nearly 1/5 of all online job postings in Burning Glass over a 90 day period. For all sub-regions, ICT job openings are significant as a percent of total job openings during the 3 month period. Nearly 1/3 of all online job postings in Silicon Valley for that time period were for openings in Primary ICT occupations.

Graph 39: Bay Area Primary ICT Occupation Job Ads As Percentages Over 90 Days in Burning Glass[20]

Region or Subregion (Included Counties)	# of ICT Primary Job Openings	% of Primary ICT Job Openings in the Region	% of All Job Openings in Region or Subregion
Bay Area Region (12 counties):	63,183		19.9%
East Bay (Alameda & Contra Costa)	8,121	12.9%	13.6%
North Bay (Marin, Napa, Solano, Sonoma)	1,393	2.2%	6.2%
Santa Cruz & Monterey (SC & Monterey)	829	1.3%	6.3%
San Francisco Bay (SF & San Mateo)	27,252	43.1%	19.4%
Silicon Valley (Santa Clara & San Benito)	25,588	40.5%	31.3%

The Primary ICT Occupations by 90 day Burning Glass ads identified are indicated in the following.

Graph 40: Bay Area Top Primary ICT Occupation by Job Ads Over 90 Days in Burning Glass



Note: Includes titles with online ICT job postings with openings >2000 for the 3 month period

Burning Glass Primary ICT Occupation online job postings for the 3 month period were concentrated, with the top 10 occupations accounting for over ¾ of all Bay Area Primary ICT online job postings. Over 40% of all Primary ICT online job announcements in the Bay Area are accounted for by openings in two occupations: Software Developers, Applications and Computer Systems Analysts. For that period, online openings for Primary ICT occupations represented 20% of all online job postings in the Bay Area. Software Developers, Applications was the #1 job in terms of online openings for that period. It alone accounted for 6% of all Bay Area online job openings.

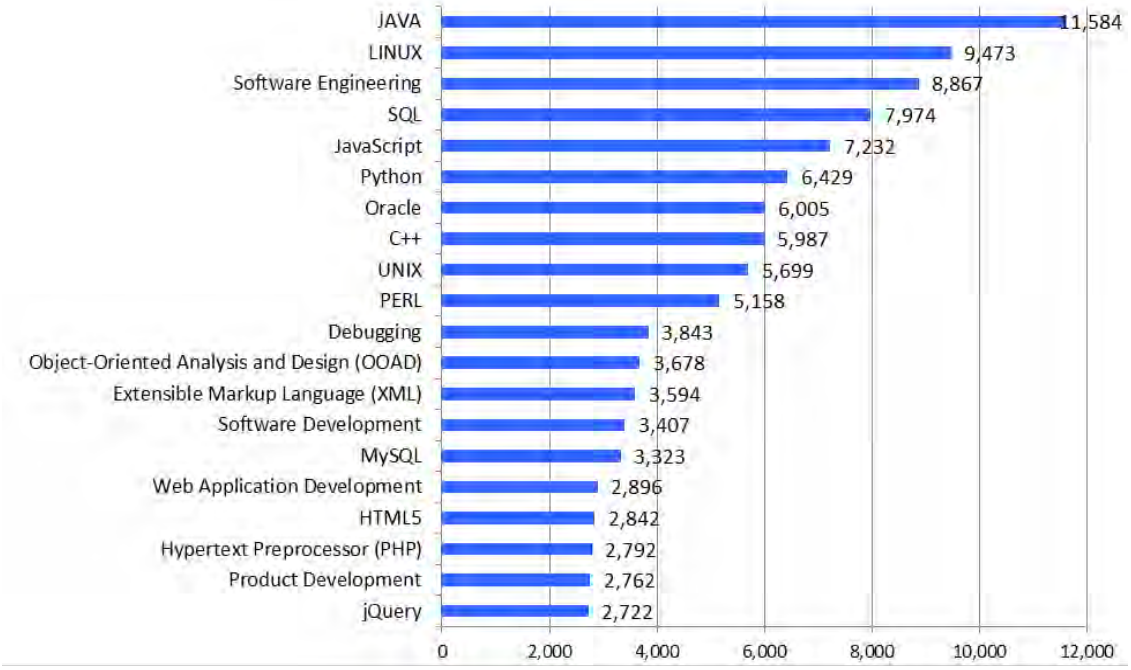
[20] Source: Burning Glass queries, 07/1/13 – 09/30/13

Graph 41: Top 10 Primary ICT Occupations in Bay Area for ICT Online Job Postings (07/1-09/30/13)

Occupation	% of ICT Postings	Occupation	% of ICT Postings
1 Software Developers, Applications	30.8%	6 Web Developers	4.8%
2 Computer Systems Analysts	10.4%	7 Database Administrators	4.4%
3 Computer User Support Specialists	7.0%	8 Network And Computer Systems Administrators	3.8%
4 Software Quality Assurance Engineers & Testers	5.5%	9 Business Intelligence Analysts	2.9%
5 Computer Systems Engineers/Architects	5.3%	10 Software Developers, Systems Software	2.5%

The following graph and table show Bay Area Top Specialized Skills in Burning Glass Primary ICT Online Openings (07/01-09/30/13) and the Number of Times Indicated by Employers in Postings.

Graph 42: 90 Day Burning Glass Ranked Skills Demand in Online Primary ICT Job Postings



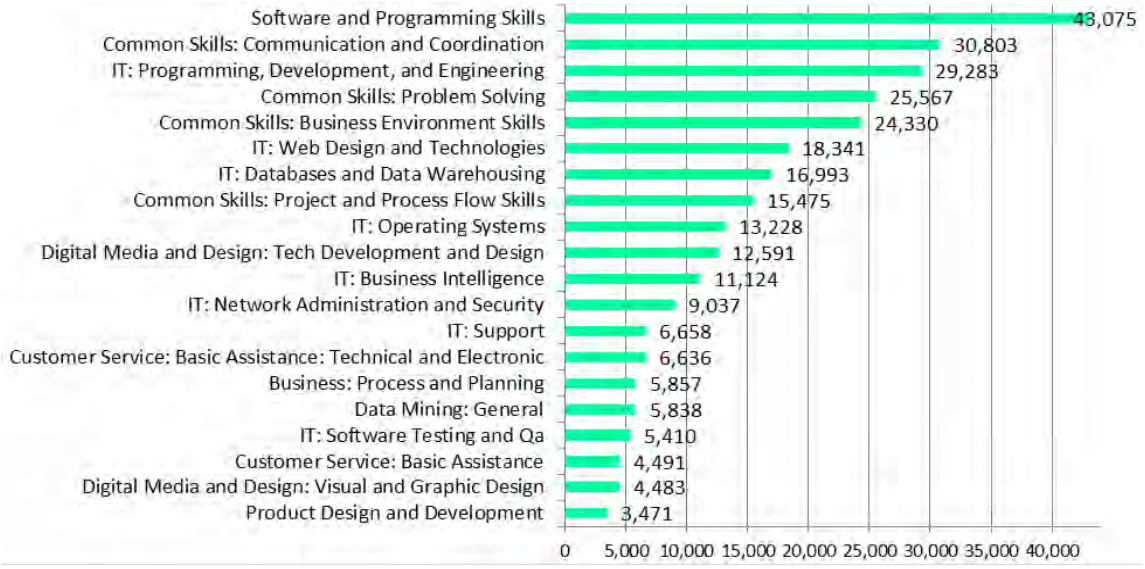
Bay Area Region Specialized Skills….. continued

Specialized Skill	# of Times
Product Management	2,714
Business Process	2,656
Web Site Development	2,589
Microsoft C#	2,523
User Interface (UI) Design	2,225
Transmission Control Protocol/Internet Protocol (TCP/IP)	2,181
AJAX	2,177
System & Network Configuration	2,130
Data Analysis	2,038
Validation	2,034
Mathematics	2,008
3Apache Hadoop	1,952
Relational Databases	1,925
Electrical Engineering	1,915
Cisco	1,910
Software Architecture	1,898
System Administration	1,875
Scrum	1,849
Adobe Photoshop	1,833
Data Warehousing	1,718
Systems Engineering	1,768
SQL Server	1,771
SAP	1,806
Apache Webserver	1,805
SQL Server	1,771
Systems Engineering	1,768
Data Warehousing	1,718
E-Commerce	1,708
Mentoring	1,705
Database Administration	1,670
Computer Engineering	1,669
Technical Writing / Editing	1,613
Business Intelligence	1,589
.NET Programming	1,575
Systems Dev. Life Cycle (SDLC)	1,574
System Architecture	1,572

Note: Out of the over 63K online primary ICT postings for the 3 month period studied, 80% of the listings included specialized skills in the announcements. Includes specialized skills with # of times mentioned in postings >1,560.

The following graph and table show Bay Area Top 20 Skill Clusters in Burning Glass Primary ICT Online Openings (07/01-09/30/13) and the Number of Times Indicated by Employers in Postings.

Graph 43: 90 Day Burning Glass Ranked Skill Cluster Demand in Online Primary ICT Job Postings



Bay Area Skill Clusters….. continued

Skill Clusters	# of Times
Engineering: Electrical & Electronic	3,354
Research: Quantitative	3,203
Finance: Accounting, Bookkeeping, & Tax Prep	2,928
Marketing: General	2,713
Engineering: General	2,707
Digital Media & Design: Digital Strategy	2,666
IT: General	2,581
Sales: General	2,106
Supply Chain and Logistics: General	2,054
Common Skills: Language	1,878
Admin Support: General	1,650
Arts: Writing: Technical	1,610
Legal: General	1,454
Repair: General	1,225
HR: Training	1,146
Finance: Fin. Compliance & Risk Mgnt	1,109
Customer Service: Sales	956
Finance: Fin. Analysis	904
Health: Advanced Patient Care	886
Mgnt: Process Improvemnt	871
Health: Informatics	833
HR: Solutions	767
Sciences: Biotech	754

Note: Out of the over 63K online primary ICT postings for the 3 month period studied, employers in 93% of their listings included skill clusters in their announcements. Includes skill clusters with # of times mentioned in postings >700.

Graph 44: Burning Glass 90 Day TOP 10 Specialized Skills in the Bay Area and Rankings in the Sub-regions

Top 10 Skill	Bay Area	East Bay	North Bay	SC & Monterey	SF-San Mateo	Silicon Valley
JAVA	1	2	5	4	1	1
LINUX	2	3	2	5	4	3
Software Engineering	3	6			5	2
SQL	4	1	1	3	2	7
JavaScript	5	7		10	3	6
Python	6				6	5
Oracle	7	4	9	1	7	
C++	8					4
UNIX	9	5			8	9
PERL	10	9			9	8

- JAVA, LINUX and SQL are in the top 10 specialized skills in ICT online openings in all sub-regions.
- JAVA has the most mentions in online ICT job postings for the period studied 07/01-09/30/13 in San Francisco – San Mateo and Silicon Valley sub-regions.
- SQL is indicated the most in the East Bay and North Bay sub-regions.
- JavaScript and Oracle are in the top 10 ICT specialized skills in all sub-regions, except one.
- Software Engineering, UNIX and PERL are in the top 10 ICT specialized skills in all sub-regions, except North Bay and Santa Cruz Monterey.

Graph 45: Burning Glass 90 Day TOP 10 Skill Clusters in the Bay Area and Rankings in the Sub-regions

Top 10 Skill Clusters	Bay Area	East Bay	North Bay	SC & Monterey	SF – SM	Silicon Valley
Software and Programming Skills	1	1	1	1	1	1
Common Skills: Communication and Coordination	2	2	2	2	2	3
IT: Programming, Development, and Engineering	3	5	6	6	3	2
Common Skills: Problem Solving	4	3	4	4	5	4
Common Skills: Business Environment Skills	5	4	3	3	4	5
IT: Web Design and Technologies	6	8		9	6	6
IT: Databases and Data Warehousing	7	6	7	7	7	8
Common Skills: Project and Process Flow Skills	8	7	5	5	8	9
IT: Operating Systems	9	9			10	7
Digital Media and Design: Tech Development and Design	10		10	8	9	10

- As the table above shows, there is clear alignment across the sub-regions in terms of top 10 skill clusters mentioned in ICT online job postings for the 3 month period.
- Software and Programming Skills are indicated most often by employers in all sub-regions.
- Common Skills: Communication & Coordination is in the #2 spot for all sub-regions (except Silicon Valley where it is #3.

Detailed information and graphs for each of the Bay Area sub-regions can be found in Appendix 5.

ICT Occupations Summary Conclusions

Without controversy, ICT Occupations are important to the Bay Area economy – and to most Bay Area employers, in every industry. Employer organizations are increasingly integrating information and communication technologies into their operations, whatever those operations are, to improve efficiency and productivity in the rest of their workforce, for strategic advantages, to interact with customers and suppliers, to manage their operations, for internal business processes and systems, and for other purposes. So, the economic impact of an ICT Workforce is far greater than the salaries paid to that workforce.

ICT employment represents a large proportion of the total number of jobs in the Bay Area (1 in 12 jobs), employing more than 333,000 people. These are good jobs, jobs that pay well and are typically transferable across industries. ICT employment has better job growth prospects than most other employment clusters, with about 14,000 annual job openings anticipated between 2012 and 2015, about 1 in 12 job openings anticipated for the Bay Region overall.

Roughly half of California employers report difficulty finding appropriately skilled ICT Workforce, and much of the ICT Workforce is imported from elsewhere, rather than grown locally. More than a quarter of ICT Workforce jobs do not require bachelor degrees or higher and represent excellent entry points for rewarding careers and life supporting wages.

It is time for the greater Bay Area community, including Workforce Investment Boards, K-12 systems, community colleges, 4-year colleges and universities, government entities, community based organizations and citizens, to recognize the importance of this employment sector and collaborate in various ways to develop a competent ICT Workforce within the region. Too many Bay Area citizens are being driven out of the Bay Area because they lack 21st century skills demanded by 21st century employers in the Bay Area and can no longer afford the high cost of living here.

The next section of this report focuses on the greater Bay Area region California Community College system and its roles, resources and potential in developing the ICT Workforce needed by Bay Area employers and the Bay Area economy.

BACCC Community College ICT Education Supply

Colleges

There are 28 colleges in the BACCC Region, each offering ICT related programs:

Berkeley City College
2020 Milvia St., 3rd Floor
Berkeley, CA 94704-5102

Cabrillo College
6500 Soquel Dr.
Aptos, CA 95003

Cañada College
4200 Farm Hill Blvd.
Redwood City, CA 94061

Chabot College
25555 Hesperian Blvd
Hayward, CA 94545

College of Alameda
555 Atlantic Ave.
Alameda, CA. 94501

College of San Mateo
1700 W. Hillsdale Blvd.
San Mateo, CA 94402

Contra Costa College
2600 Mission Bell Dr.
San Pablo, CA 94806

De Anza College
21250 Stevens Creek Blvd.
Cupertino, CA 95014

Diablo Valley College
321 Golf Club Rd.
Pleasant Hill, CA 94523

Evergreen Valley College
3095 Yerba Buena Rd.
San Jose, CA 95135

Foothill College
12345 El Monte Rd.
Los Altos Hills, CA 94022

Gavilan College
5055 Santa Teresa Blvd
Gilroy, CA 95020

Hartnell College
411 Central Avenue
Salinas, CA 93901

Laney College
900 Fallon St.
Oakland, CA 94607

Las Positas College
3033 Collier Canyon Rd.
Livermore, CA 94551-9797

Los Medanos College
2700 East Leland Rd.
Pittsburg, CA 94565

College of Marin
835 College Ave.
Kentfield, CA 94904

Merritt College
12500 Campus Dr.
Oakland, CA 94619

Mission College
3000 Mission College Blvd.
Santa Clara, CA 95054-1897

Monterey Peninsula College
980 Fremont St.
Monterey, CA 93940-4799

Napa Valley College
2277 Napa-Vallejo
Highway
Napa, CA 94558

Ohlone College
43600 Mission Blvd.
P.O. Box 3909
Fremont, CA 94539-0390

City College of San Francisco
50 Phelan Ave.
San Francisco, CA 94112

San Jose City College
2100 Moorpark Ave.
San Jose, CA 95128

Santa Rosa Junior College
1501 Mendocino Ave.
Santa Rosa, CA 95401

Skyline College
3300 College Dr.
San Bruno CA 94066-1698

Solano Community College
4000 Suisun Valley Rd.
Fairfield, CA 94534-3197

West Valley College
14000 Fruitvale Ave.
Saratoga, CA 95070-5698

See Appendix 6 for summary descriptions of each college and its ICT related programs.

They are distributed around the greater San Francisco Bay Area as indicated in the following graphic.

Graphic 46: BACCC College Map

Programs 2010/11

Following is a list of BACCC colleges and their ICT related programs (with links), as deduced from websites. Again, see Appendix 7 for summary descriptions of each college and its ICT related programs.

Berkeley City College (3):

- BCC's Computer Information Systems (CIS) Department
- BCC's Business Program
- BCC's Multimedia Arts Program

Cabrillo College (5):

- Computer Networking and System Administration
- Computer Science (CS) Program
- Computer Support Specialist (CSS) program
- Digital Media Department
- Computer Applications/Business Technology

Cañada College (3):

- Computer Information Science
- Computer Business Office Technology
- Multimedia Art

Chabot College (3):

- Computer Application Systems
- Computer Science Department
- Digital Media

College of Alameda (1):

- COA's Computer Information Systems Department

College of San Mateo (6):

- The Computer and Information Science (CIS) Program
- The Digital Media Program
- The Electronics Technology Program
- Engineering
- Graphics
- Business

Contra Costa College (3):

- Computer and Communications Technology (Electronics)
- Computer Information Systems (CIS)/ Business Office Technology (BOT)
- Computer Science (CS)

DeAnza College (3):

- Computer Information Systems
- The Computer Applications & Office Systems (CAOS)
- Computer Aided Design and Digital Imaging Department

Diablo Valley College (3):

- Computer Information Systems
- Electronics, Alternate Energy, Electricity, Computer Technical Support, and Computer Networking department
- Computer Science Department

Evergreen Valley College (3):

- Business Information Systems (BIS),
- Computer Science (CS)

- Computer Information Technology (CIT)

Foothill College (3):

- Graphic & Interactive Design
- Computer Science Department
- Geography and Geographic Information Systems (GIS)

Gavilan College (3):

- Computer Science and Information Systems Department
- Computer Graphics and Design
- Digital Media

Hartnell College (1):

- Computer Science and Information Systems

Laney College (1):

- Computer Information Systems (CIS) Department

Las Positas College (4):

- Computer Information Systems
- Computer Networking Technology
- Computer Science
- Electronics Technology

Los Medanos College (1):

- LMC's Computer Science (CS) Department

College of Marin (4):

- Business and Information Systems department Computer Information Systems
- Business and Information Systems department Business Office Systems
- Physical Sciences Department Computer Science program
- Career Education department program of Electronic Technology

Merritt College (1):

- Merritt's Technology and Business Program

Mission College (6):

- Computer Network Electronics Technology - CNET
- Department of Technology Studies
- Computer Information System (CIS)
- Computer Applications
- Computer Information Technology
- Graphic Design and Multimedia

Monterey Peninsula College (2):

- Computer Science and Information Systems Department
- Business Department Business Skills Center

Napa Valley College (2):

- NVCC Business and Computer Studies Division Business Skills Center (BSC)
- Napa Valley College's Digital Design Graphics Technology

Ohlone College (3):

- Computers, Networks, and Emerging Technology
- Computer Science
- Multimedia

City College of San Francisco (5):

- Computer Networking and Information Technology (CNIT) Department
- Computer Science Department
- Multimedia Studies Program
- Broadcast Electronic Media Arts Department
- Business Department

San Jose City College (3):

- Computer Applications
- Computer Information Systems (CIS)
- Media Arts

Santa Rosa Junior College (2):

- SRJC's Computer Studies Department
- Applied Technology Department Geospatial Technology Major

Skyline College (3):

- Computer Science
- Telecommunications & Network Technology (TCOM)
- Business Division

Solano Community College (2):

- Computer and Information Science (CIS)
- SCC's Electronics-Computer Servicing Technology Program

West Valley College (4):

- Computer and Information Systems Department
- Digital Media
- Computer Applications Department
- Business Careers Department

From CCC system office data, following are summary statistics about 2010/11 program names:

- The 28 colleges in the Bay Area Community College Consortium (BACCC) have 82 departments/programs teaching ICT related topics.
- Ohlone College has the most of any college, with 8 departments teaching ICT related topics.
- Four colleges have only one department/program teaching ICT related topics: College of Alameda, Las Positas College, Los Medanos Colleges, and Merritt College.
- Of the 82 ICT related departments/programs, only 6 department names are used more than once across the 28 colleges:

    - Computer Information Systems 8 times
    - Business 7 times
    - Computer Science 4 times
    - Computer Applications 3 times
    - Business Administration 2 times
    - Digital Media 2 times

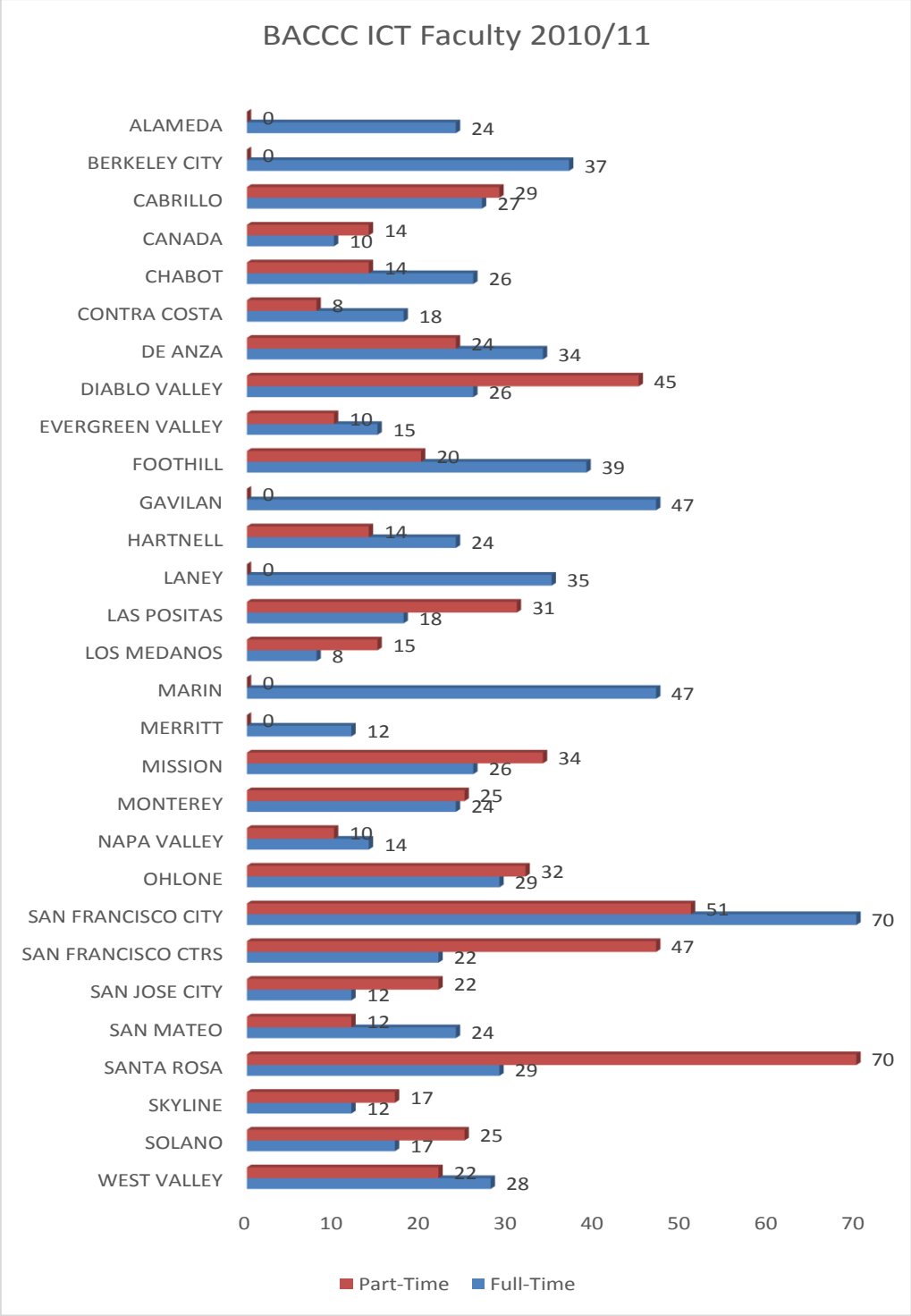
- 56 of the 82 department/program names are unique across the 28 colleges.

See Appendix 7 for an alphabetical list of BACCC ICT related department/program names.

ICT Related Faculty 2010/11

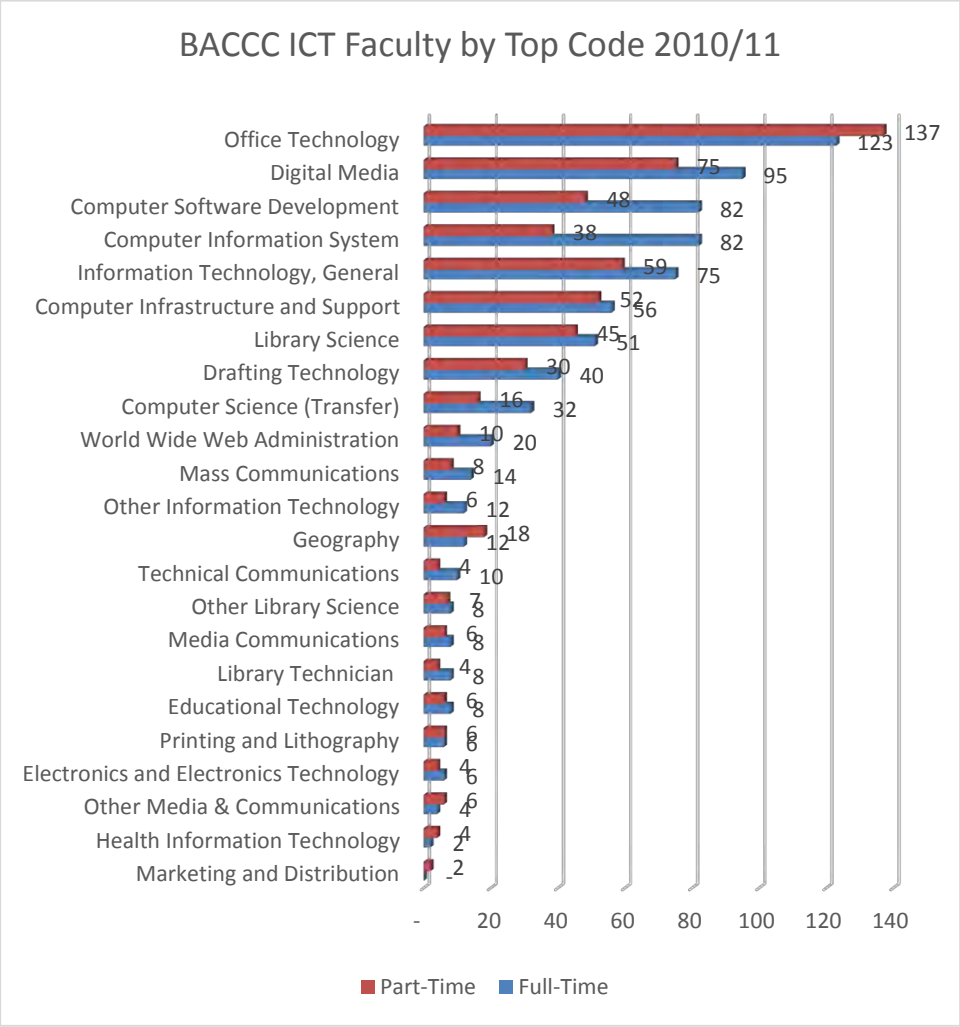
Across the 28 BACCC colleges there were 754 full-time and 591 part-time, a total of 1,345 faculty teaching in identified ICT Top codes in 2010/11.

Graph 47: BACCC ICT Related Faculty 2010/11



They were distributed as following across Top Codes.

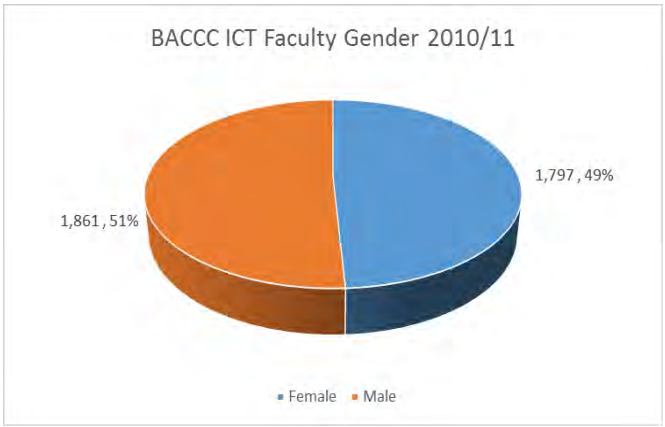
Graph 48: BACCC ICT Related Faculty by Top Code 2010/11



Gender

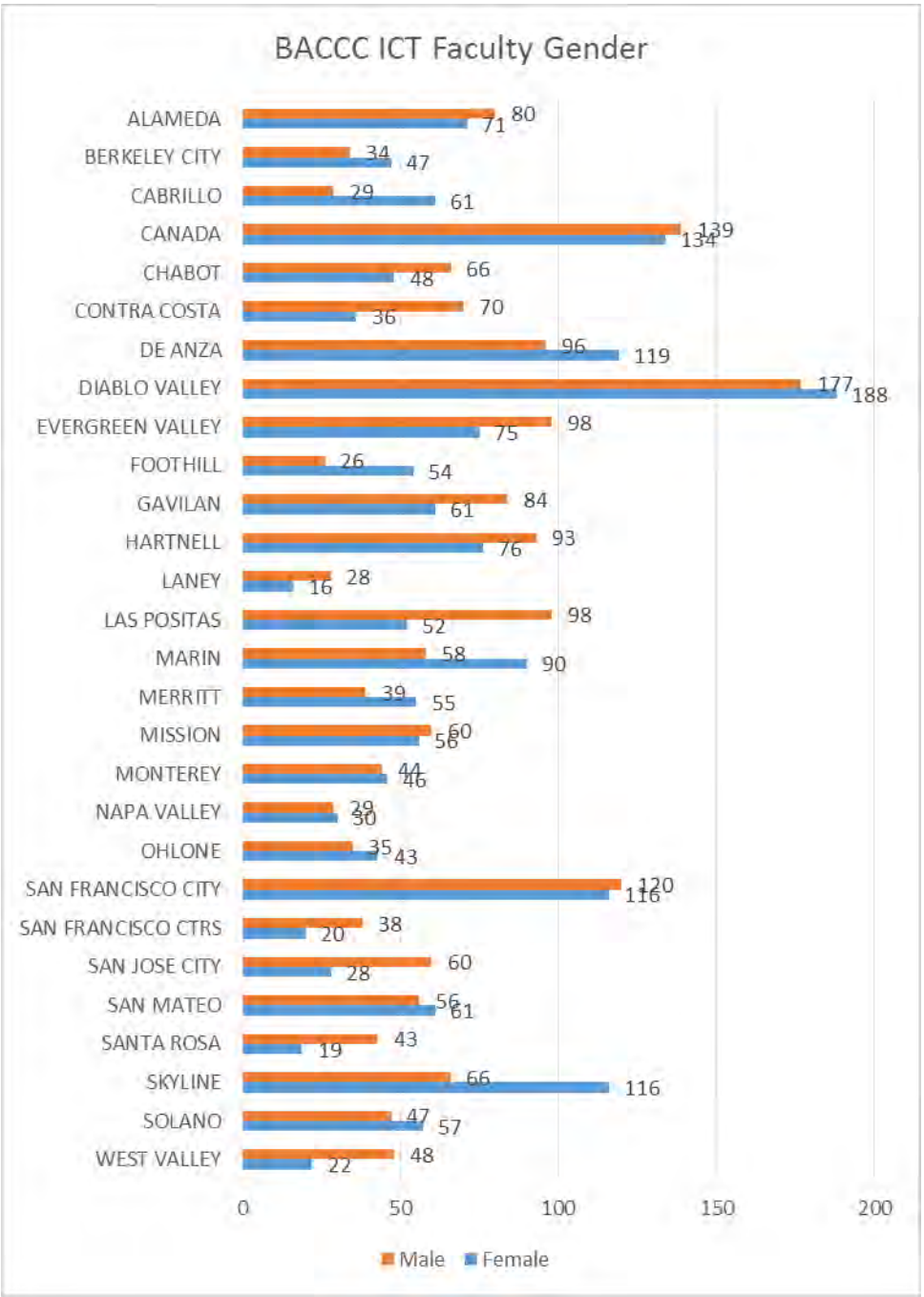
Overall, 51% of BACCC ICT faculty are male and 49% are female.

Graph 49: BACCC ICT Related Faculty Gender 2010/11



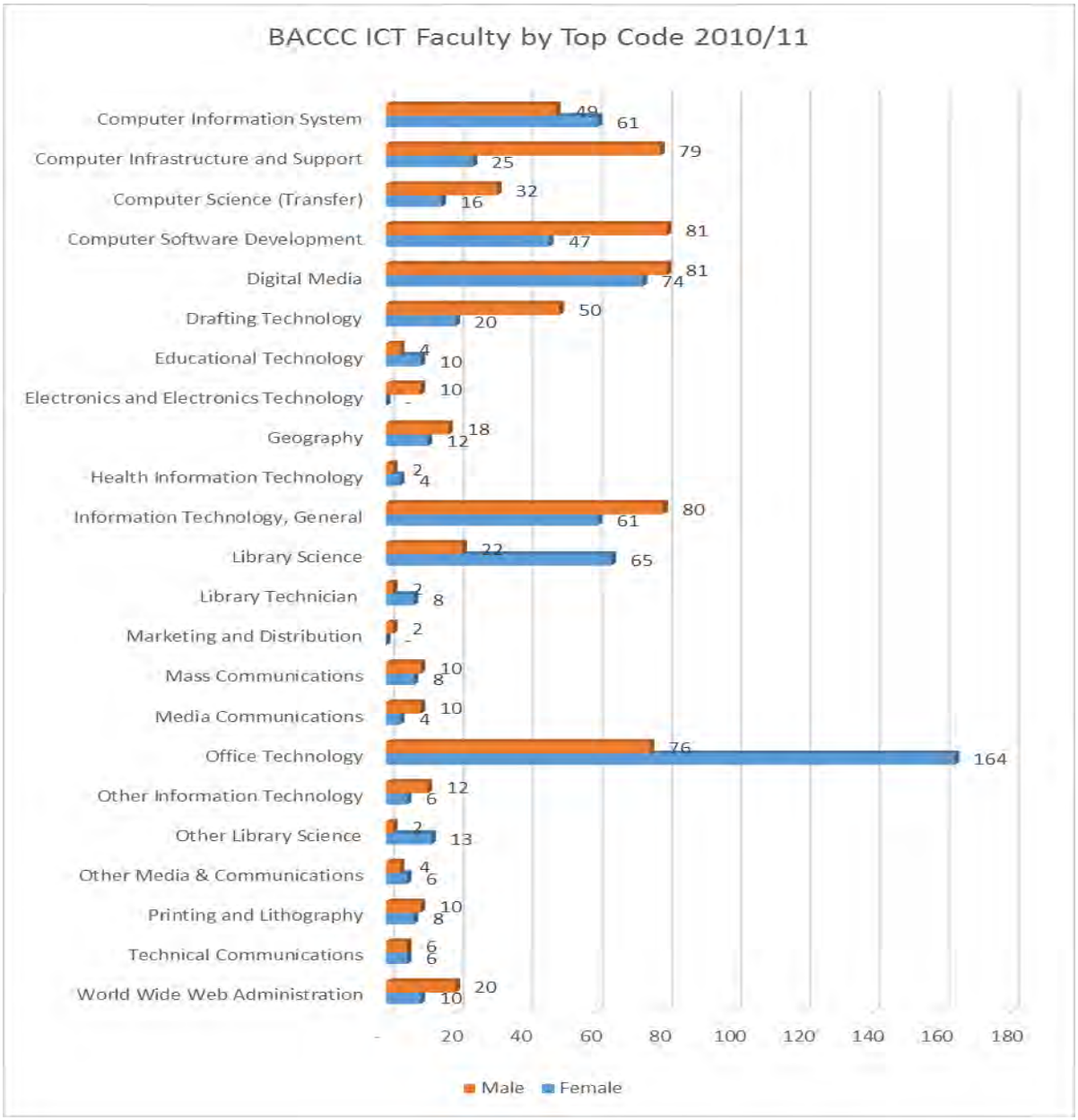
Following is BACCC ICT faculty gender by college.

Graph 50: BACCC ICT Related Faculty Gender by College 2010/11



Following is BACCC ICT faculty gender by Top Code, which shows large gender differences in certain Top Codes, including females outnumbering males in Library Science, Library Technician, and Office Technology. (The high numbers of overall faculty in Office Technology skews overall female representation.) Male faculty significantly outnumber female faculty in at least Computer Infrastructure and Support, Computer Software Development, and Worldwide Web Administration.

Graph 51: BACCC ICT Related Faculty Gender by Top Code 2010/11

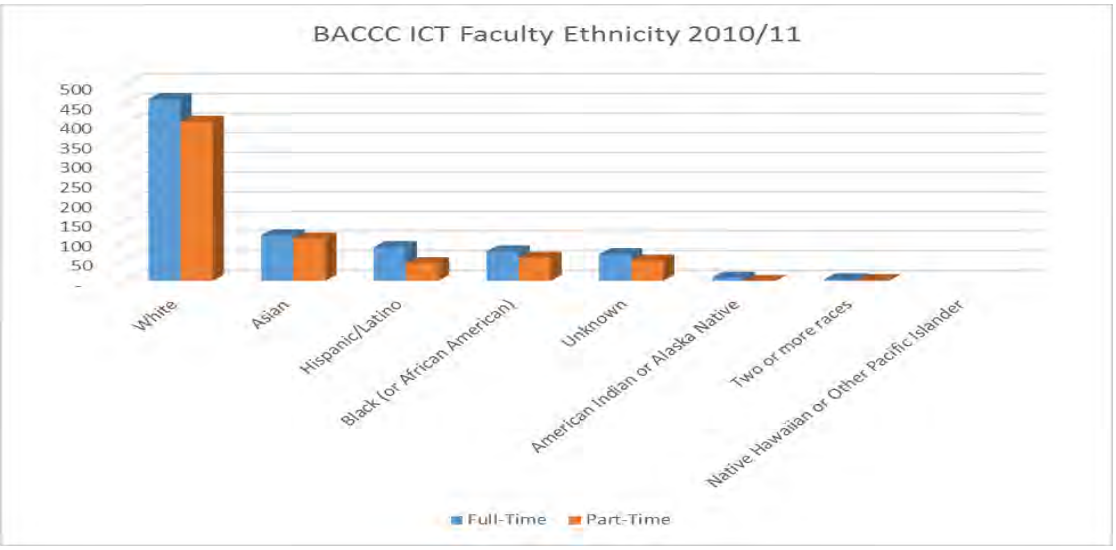


See Appendix 8 for a list of ICT related faculty by college, gender and Top Code.

Ethnicity

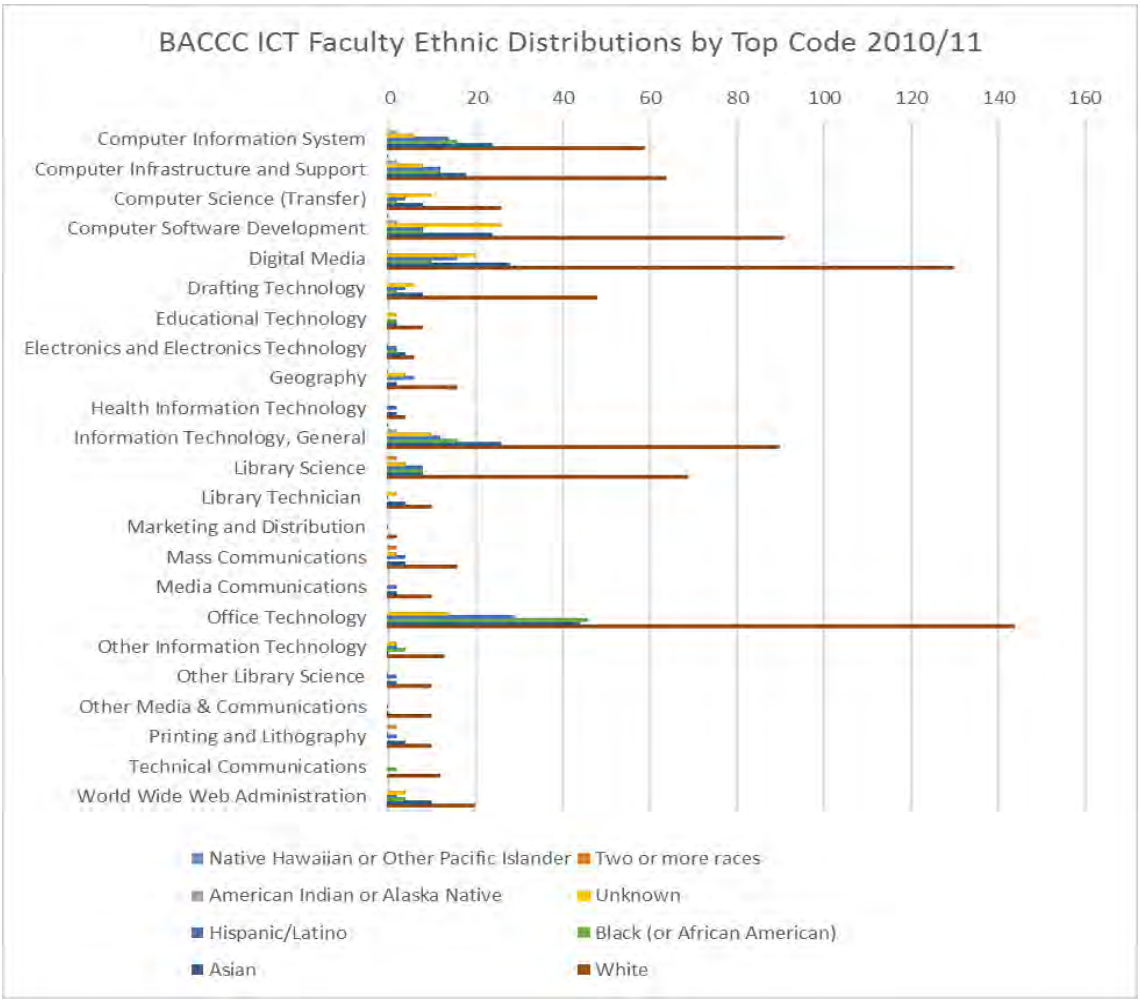
BACCC ICT faculty is overwhelmingly white, in every Top Code. Faculty ethnicity does not reflect the ethnic diversity of the communities BACCC ICT related programs are trying to serve. This is likely a barrier to effectively attracting, serving and assuring the success of ethnic student populations currently under-represented in ICT programs.

Graph 52: BACCC ICT Related Faculty Ethnicity 2010/11



BACCC ICT faculty are primarily white in every Top Code.

Graph 53: BACCC ICT Related Faculty Ethnicity by Top Code 2010/11

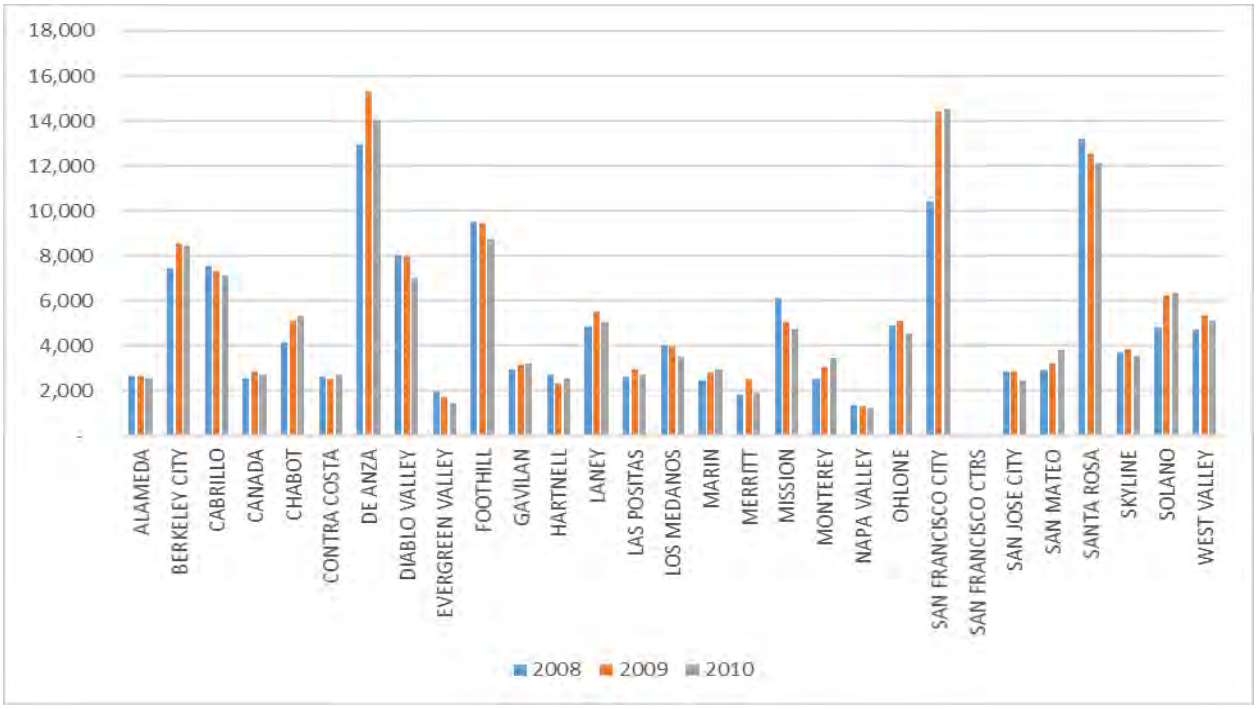


See Appendix 9 for a list of BACCC ICT related faculty demographics by college, Top Code and Ethnicity.

ICT Related Student For-Credit Enrollment 2010/11

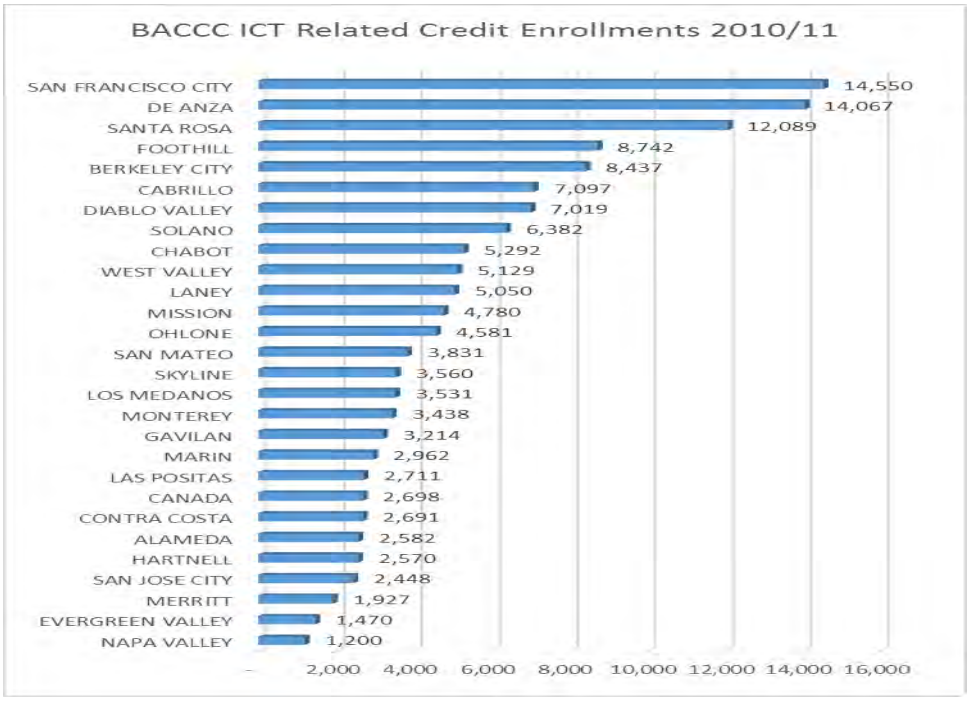
In the 2010/11 academic year, there were more than 140,000 ICT related for-credit enrollments in ICT related courses, by identified TOP codes in BACCC colleges.

Graph 54: BACCC ICT Related For-Credit Enrollments 2008/09 - 2010/11



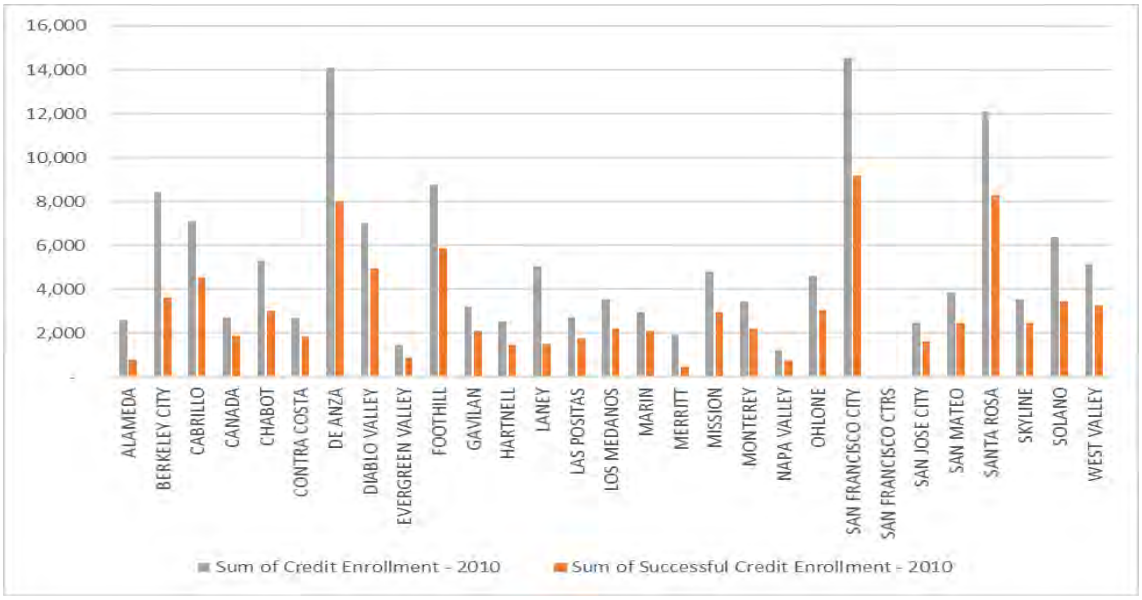
They are ranked by college by number of credit enrollments in the following graphic.

Graph 55: Ranked BACCC ICT Related For-Credit Enrollments 2010/11



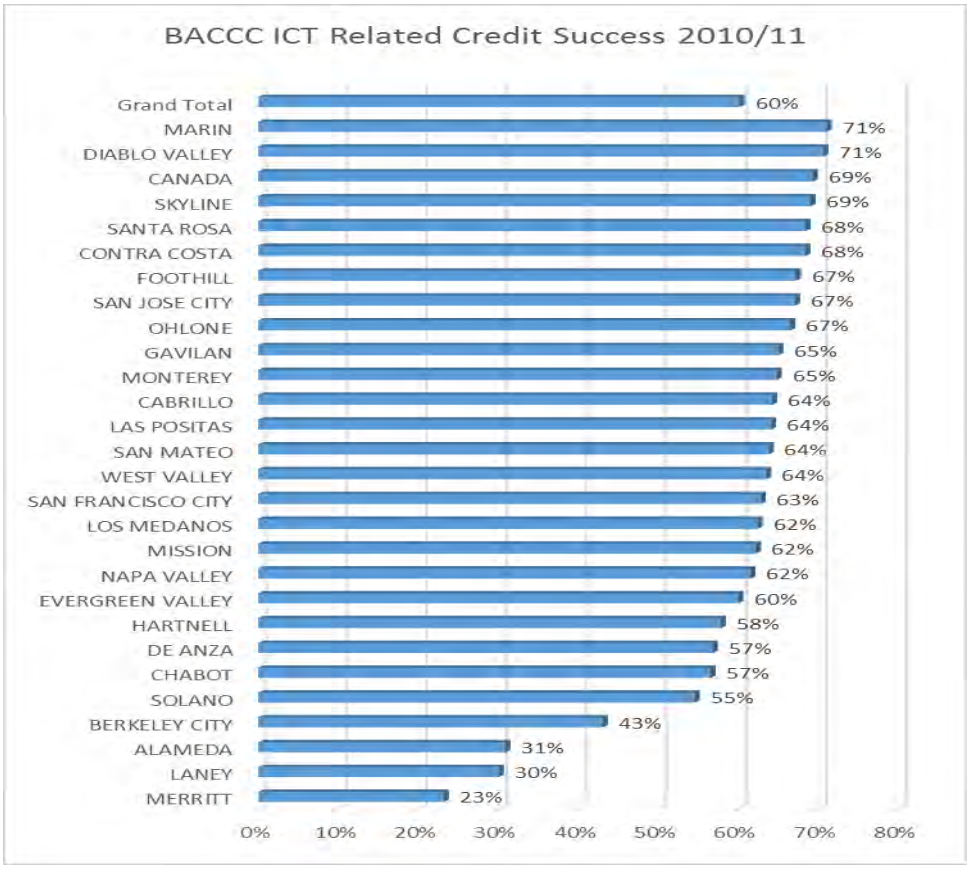
Roughly 60% of those for credit enrollments were successful (e.g. students passed the class).

Graph 56: BACCC ICT Related For-Credit Enrollment Success 2010/11



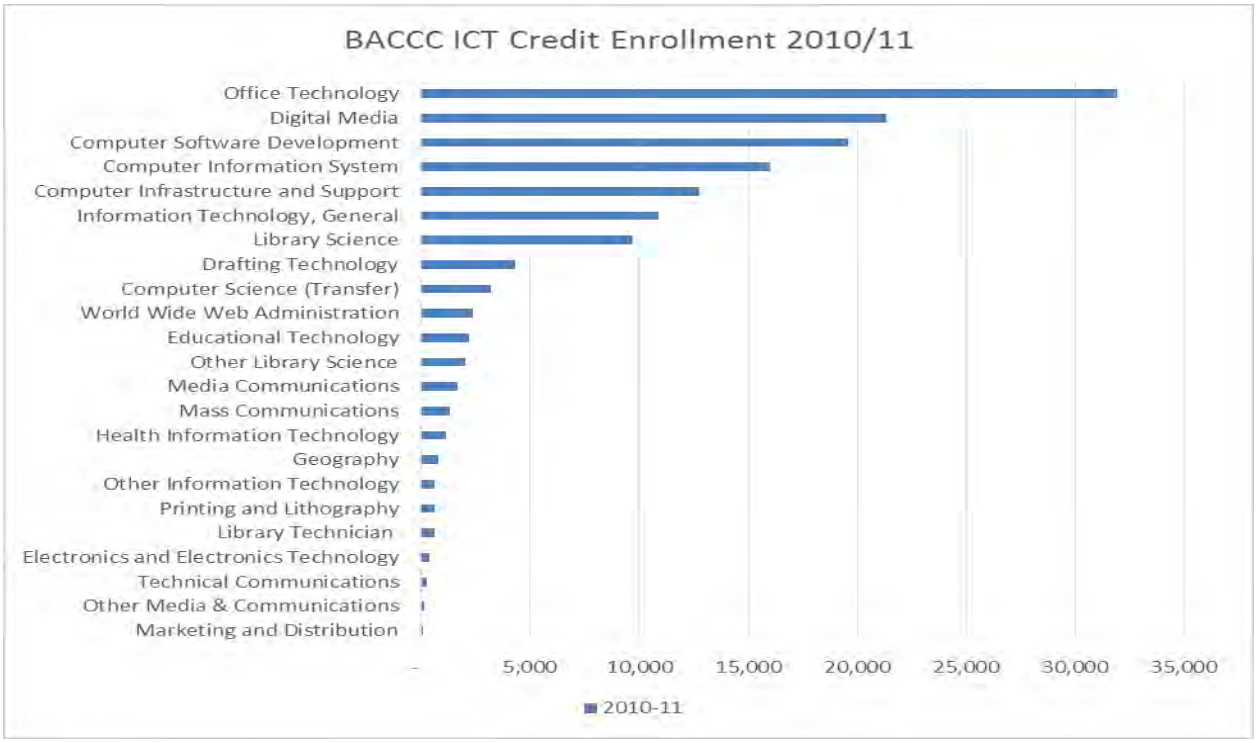
Across the region, successful credit rates averaged about 60%. They ranged from 71% at Marin to 23% at Merritt, as indicated in the following chart.

Graph 57: BACCC Ranked ICT Related For-Credit Success Rates 2010/11



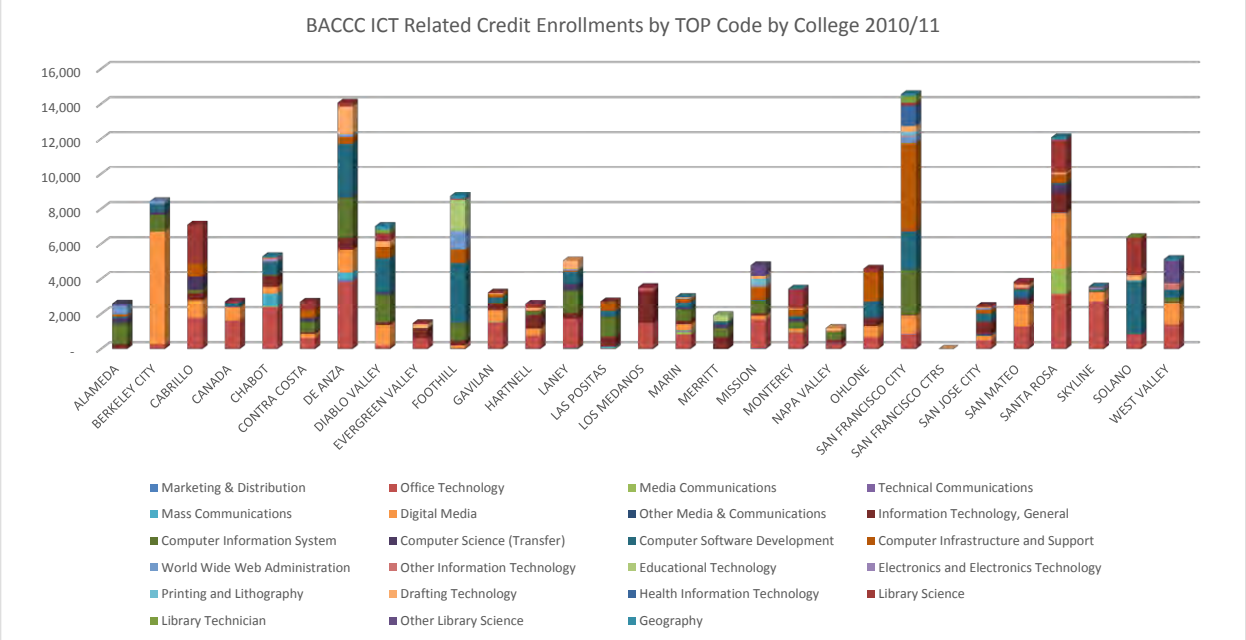
Credit Enrollment success ranged from 0% in one college program to 100% in another, and they were distributed as follows across ICT related TOP Codes.

Graph 58: BACCC ICT Related For-Credit Enrollment by TOP Code 2010/11



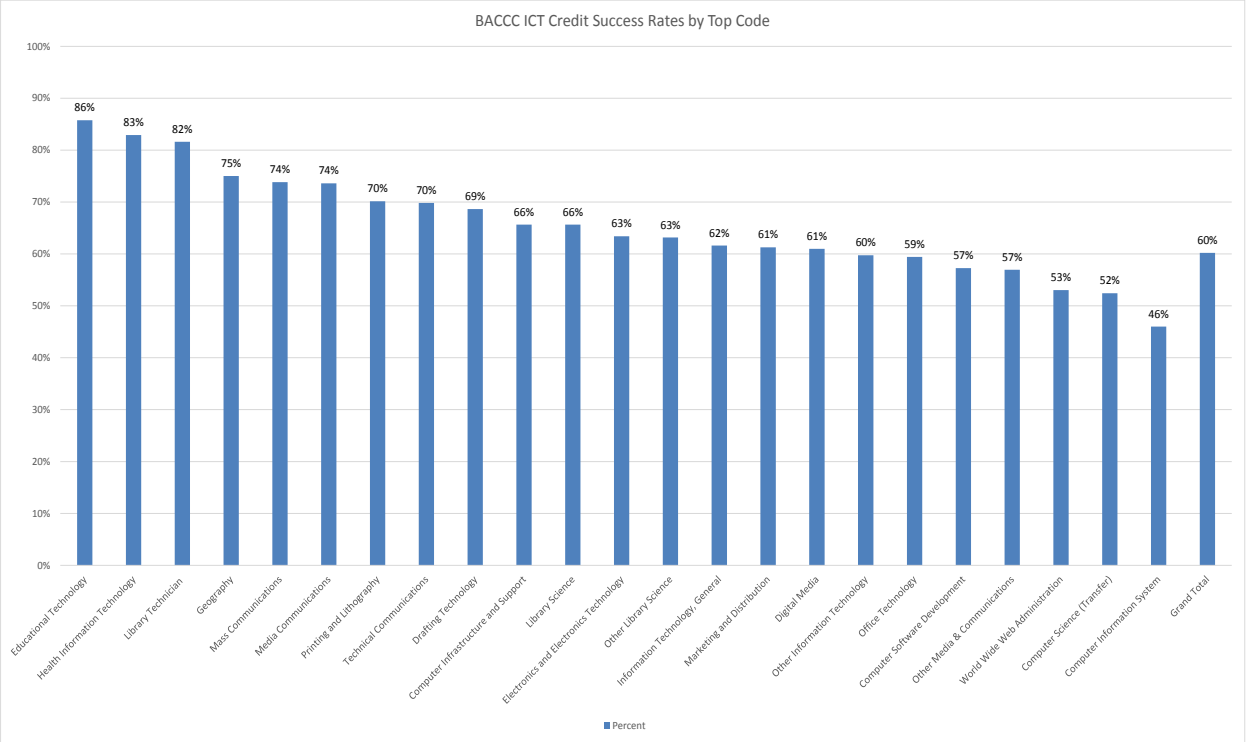
The following chart shows the distribution of credit enrollments by Top Code in each of the BACCC colleges in 2010/11. Appendix 10 shows the numerical distributions in a table.

Graph 59: BACCC ICT Related For-Credit Enrollment by TOP Code by College 2010/11



Credit Enrollment success rates in ICT related TOP Codes ranged from 86% in Educational Technology to 46% in Computer Information Systems, as indicated in the following graphic.

Graph 60: BACCC ICT Related For-Credit Enrollment Success Rates by TOP Code 2010/11

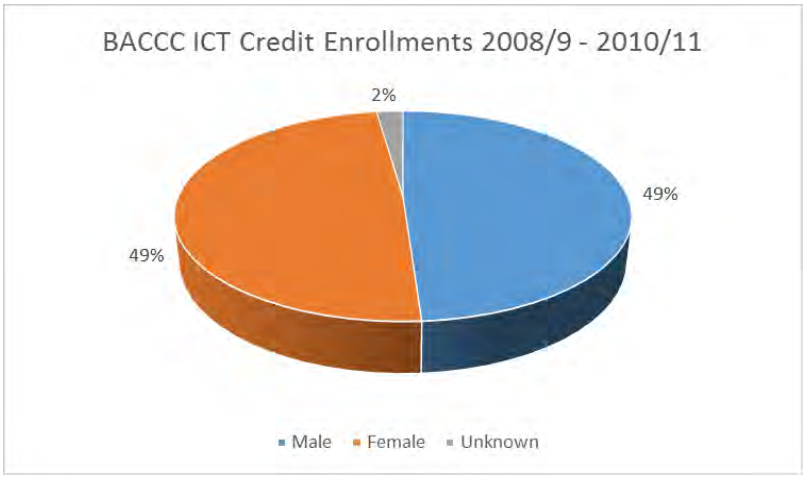


Appendix 11 shows BACCC college for credit success rates and numbers by college by Top Code.

Gender

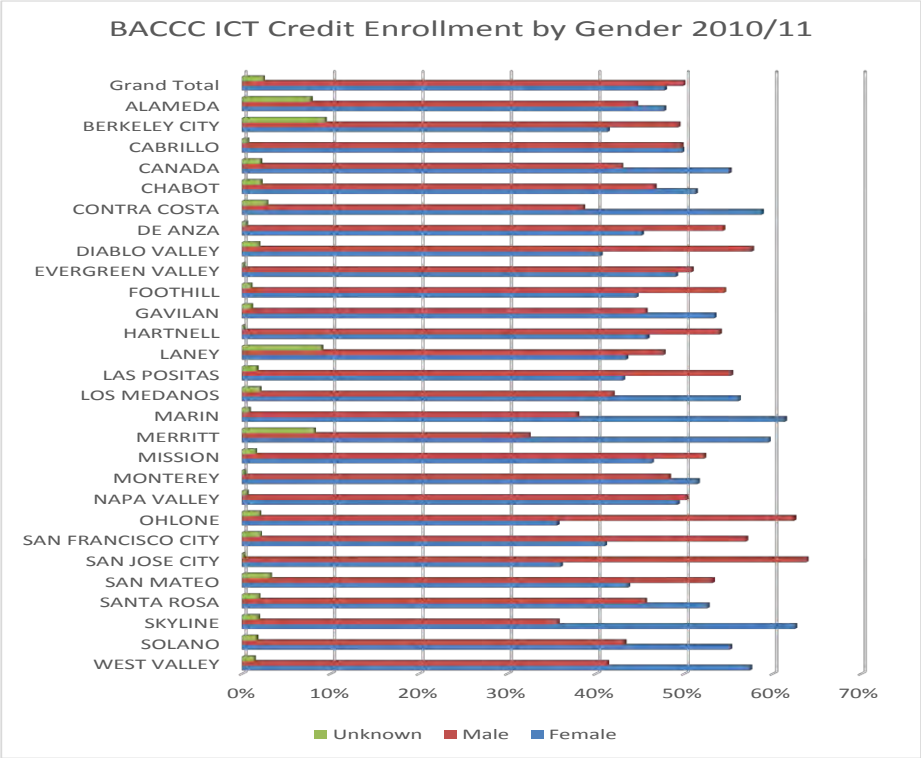
Interestingly, between 2008/09 and 2010/11, overall ICT related for credit enrollments in ICT related courses, as defined by these Top Codes, are roughly evenly distributed across gender.

Graph 61: BACCC ICT Related For-Credit Enrollment Gender 2008/9 - 2010/11



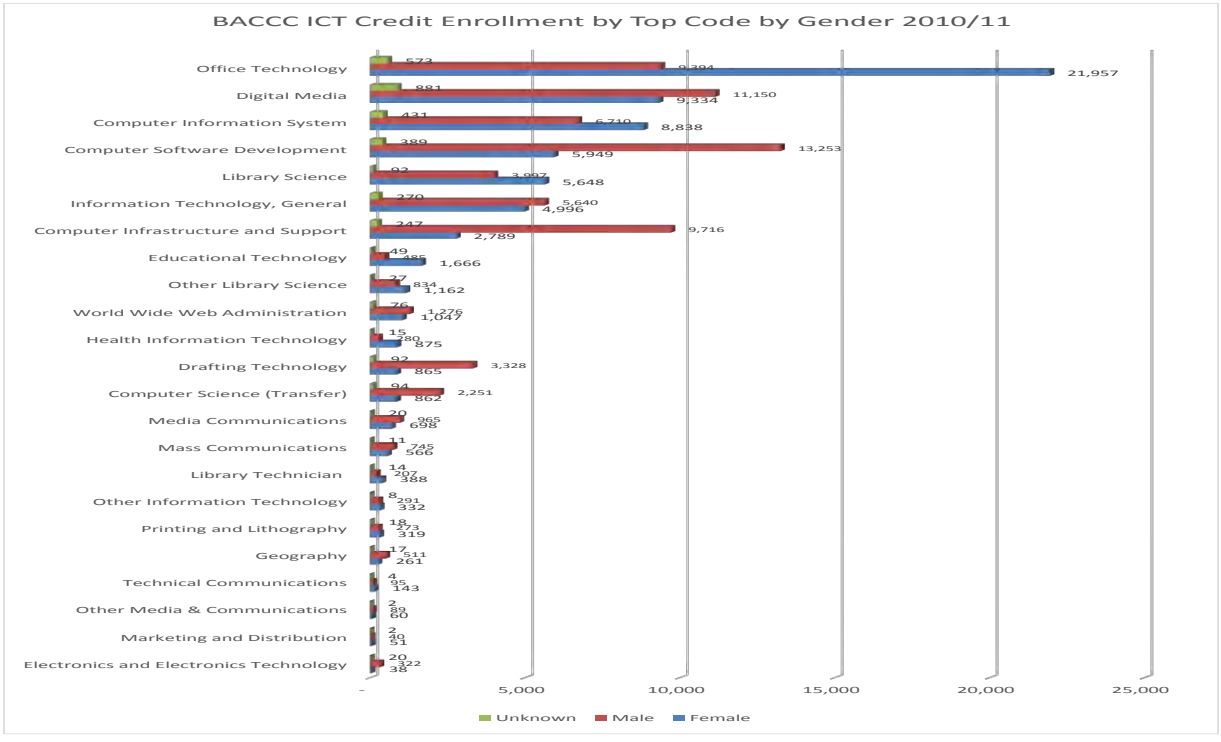
Overall distributions vary by college as indicated in the following graph.

Graph 62: BACCC ICT Related For-Credit Enrollment by Gender by College 2010/11



Overall gender distributions are skewed by very high female participation in the Office Technologies Top Code, which has the largest overall credit enrollment numbers. Females outnumber males in only Office Technology, Computer Information System, Library Science, Educational Technology, Other Library Science, Health IT, and Library Technician. Males outnumber females in other Top Codes, including, notably, Computer Software Development, Computer Infrastructure and Support, and Computer Science (Transfer).

Graph 63: BACCC ICT Related For-Credit Enrollment by Gender by Top Code 2010/11



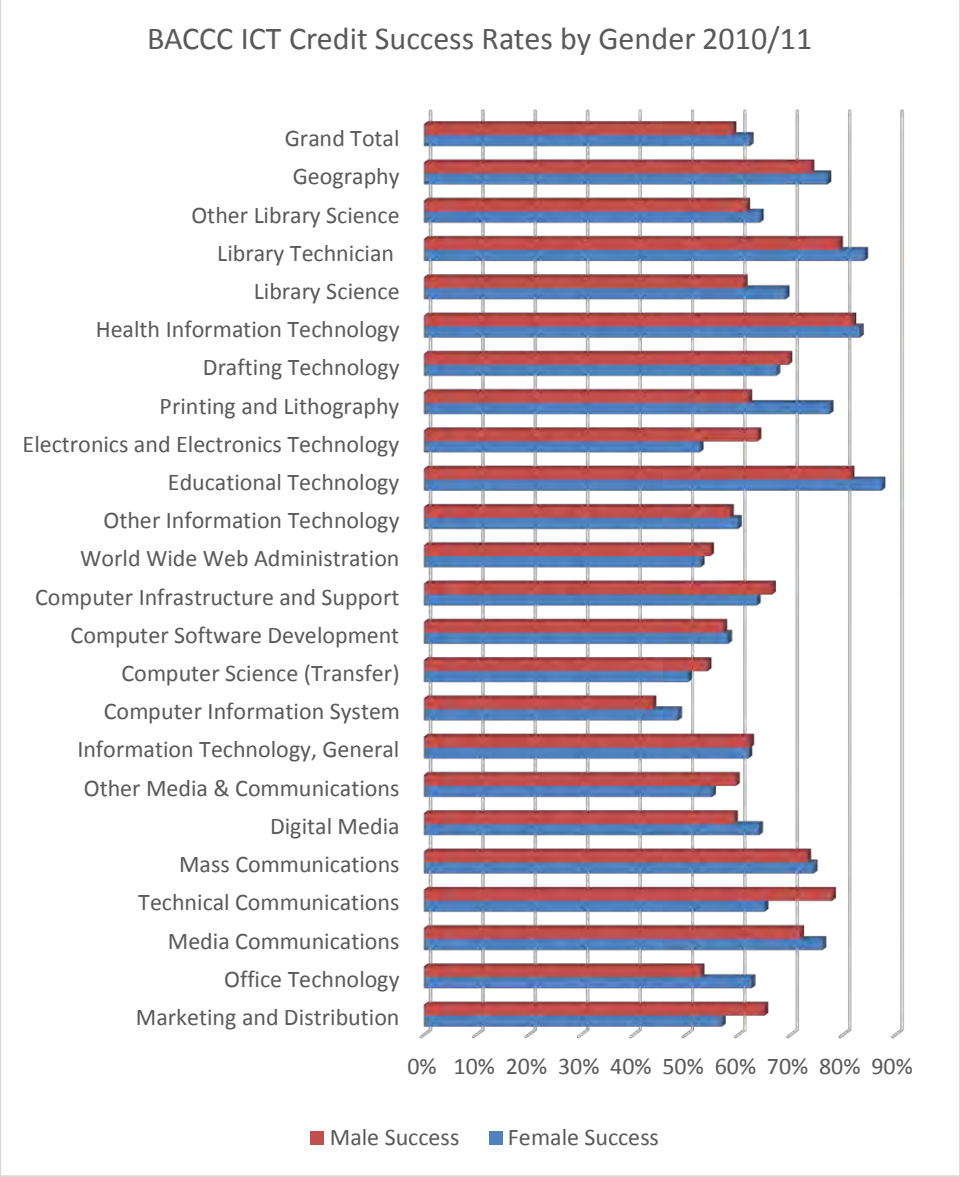
Overall, females complete more ICT related courses successfully than males.

Graph 64: BACCC ICT Related For-Credit Success Rates by Gender 2010/11

Gender	Credit Enrollment	Successful	Percent
Female	68,844	42,805	**62%**
Male	71,852	42,310	**59%**
Unknown	3,352	1,634	**49%**
Grand Total	**144,048**	**86,749**	**60%**

Again, that figure is skewed by high relative numbers in Office Technologies, but females are typically about as successful as males in ICT related courses across Top Codes.

Graph 65: BACCC ICT Related For-Credit Success Rates by Gender by Top Code 2010/11

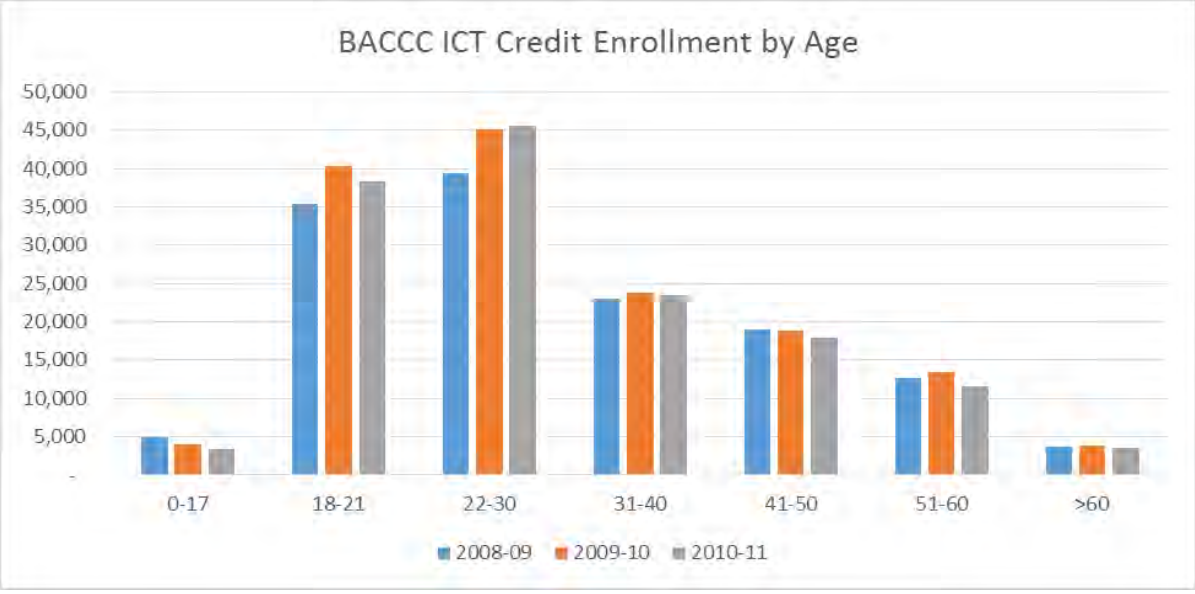


Appendix 12 shows a list of ICT for credit enrollment success by college, Top Code and gender.

Age

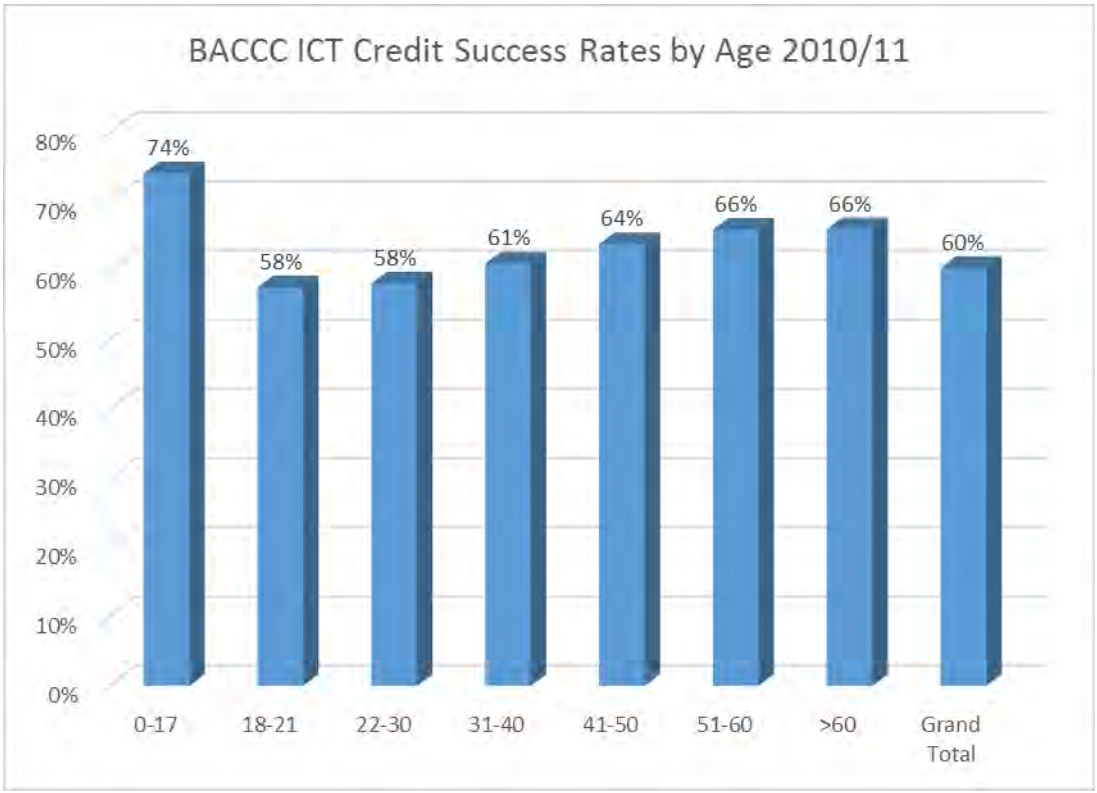
Students enrolling in for credit ICT related courses at BACCC colleges range in age from teenagers to adults well past retirement age, distributed as indicated in the following chart.

Graph 66: BACCC ICT Related For-Credit Enrollment by Age 2008/9 - 2010/11



Interestingly, the highest for credit success rates are with students 17 and under, but then generally improve with age.

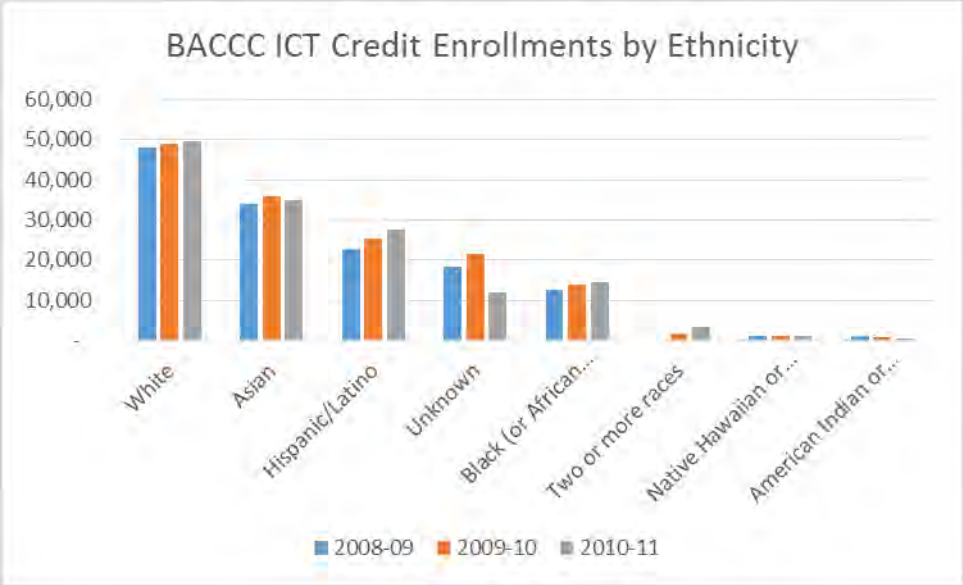
Graph 67: BACCC ICT Related For-Credit Success by Age 2010/11



Ethnicity

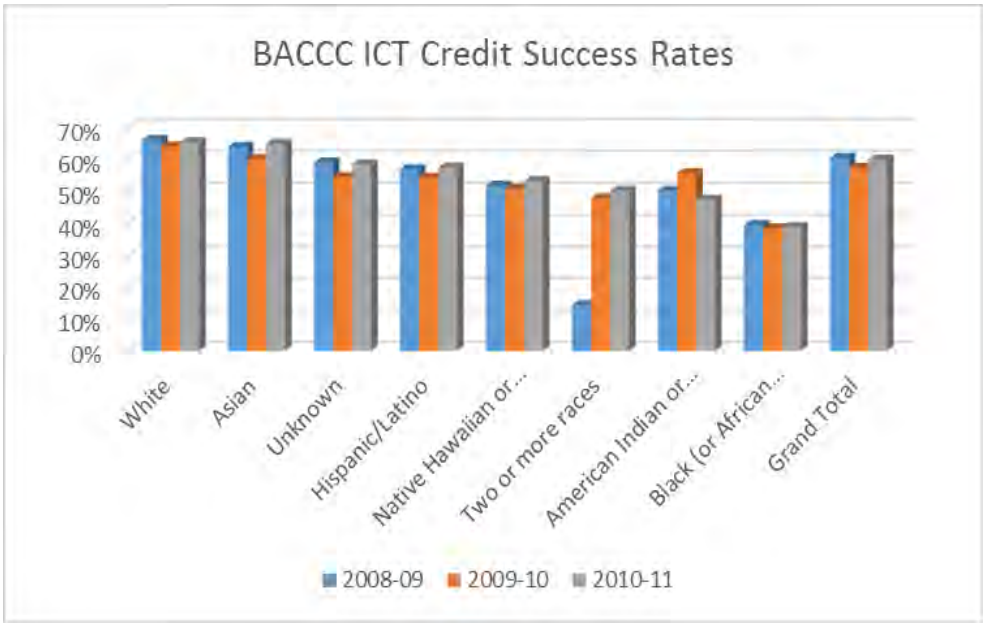
ICT credit enrollments are led by whites, followed by asian and hispanic populations.

Graph 68: BACCC ICT Related For-Credit Enrollments by Ethnicity 2008/9 - 2010/11



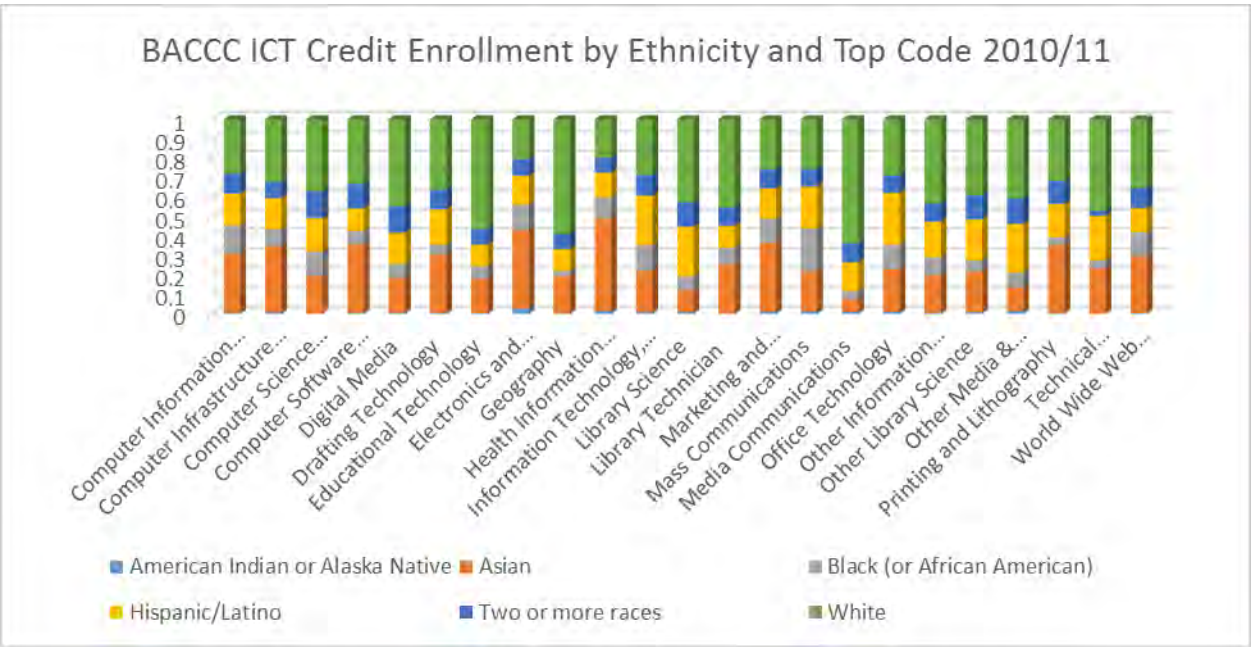
Credit success rates by ethnicity are in roughly the same order.

Graph 69: BACCC ICT Related For-Credit Success Rates by Ethnicity 2008/9 - 2010/11



Credit ethnicity ratios in for credit ICT courses by Top Code are shown in the following chart.

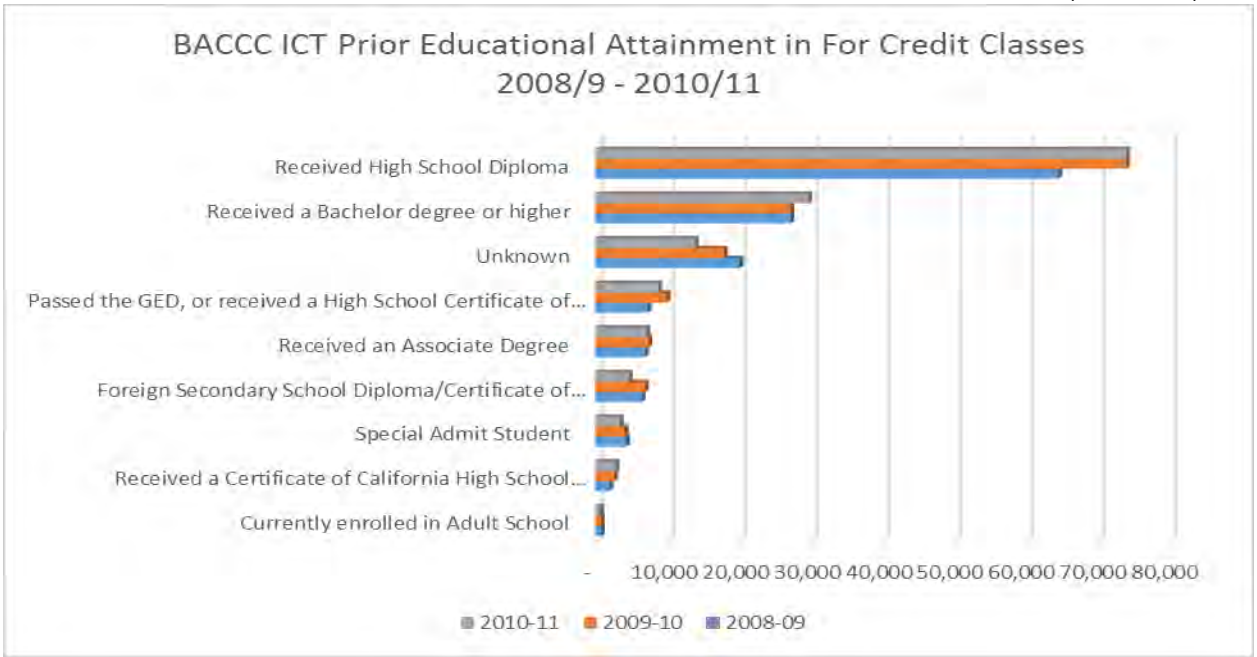
Graph 70: BACCC ICT Related For-Credit Enrollments by Ethnicity and Top Code 2010/11



Prior Educational Attainment

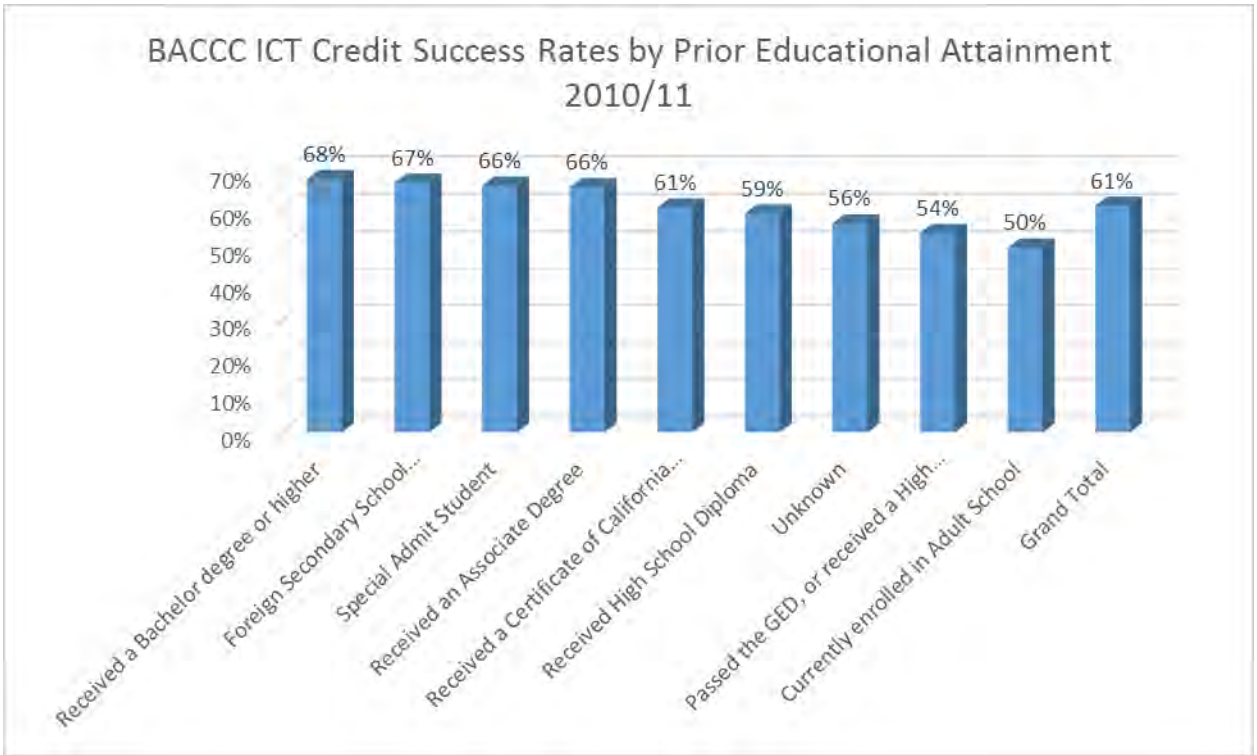
The majority of students in ICT related for credit courses at BACCC colleges had so far received only high school diplomas or their equivalents. However, a very significant number had already received associate or bachelor degrees. This is important, if ICT programs are going to be evaluated based on a definition of "success" as academic degree, transfer or certificate completion, because it is logical that the motivation for a student who already has a bachelor degree to be knowledge and skill attainment, rather than transfer, associate degree or CCC academic certificate.

Graph 71: BACCC ICT Related For-Credit Enrollments by Prior Educational Attainment 2008/9 - 2010/11



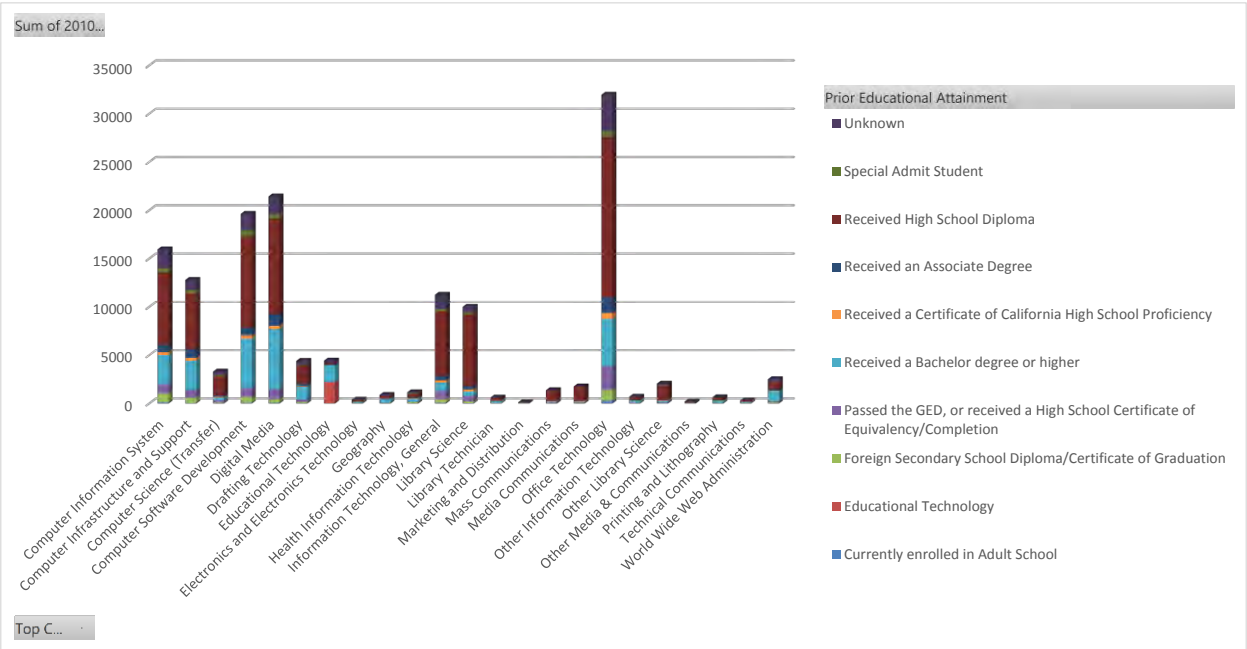
Generally, higher previous educational attainment correlates with higher ICT for credit enrollment success rates.

Graph 72: BACCC ICT Related For-Credit Enrollments by Prior Educational Attainment 2008/9 - 2010/11



Those with more advanced degrees appear to be gravitating toward the more technical classes, including Computer Information System, Computer Infrastructure and Support, Computer Software Development, Digital Media, Educational Technology and World Wide Web Administration, but they also take a many Office Technology classes.

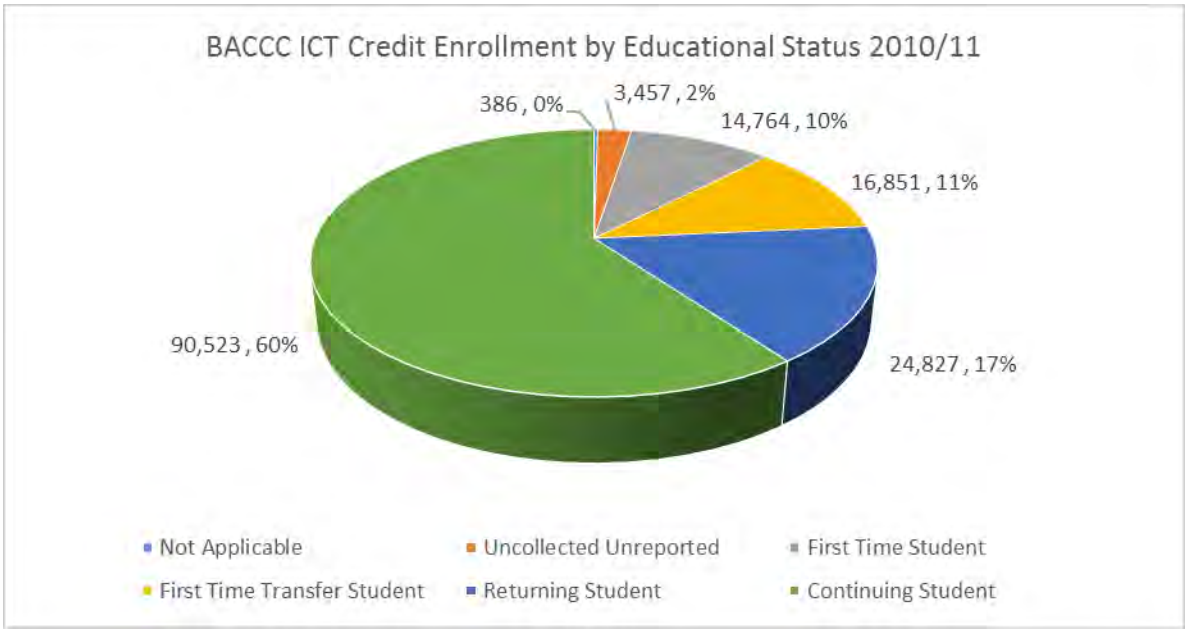
Graph 73: BACCC ICT Related For-Credit Enrollments by Prior Ed. Attainment by Top Code 2010/11



Student Status

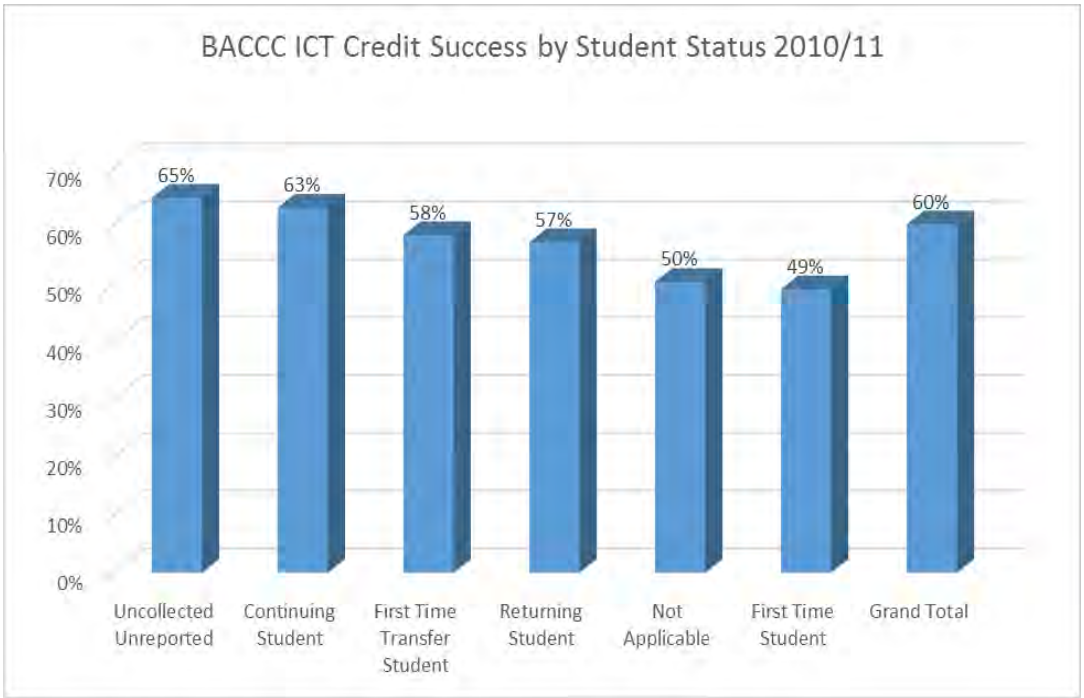
By far, the majority of for credit students are continuing and returning.

Graph 74: BACCC ICT Related For-Credit Enrollments by Educational Status 2010/11



Following are credit success rates by student educational status.

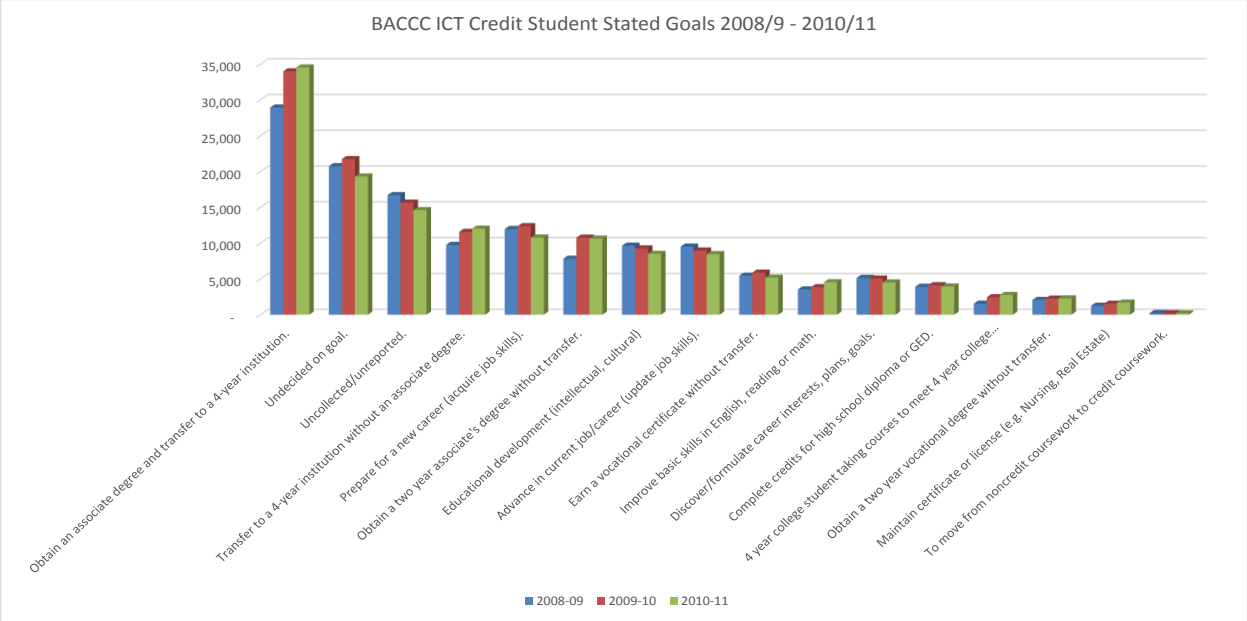
Graph 75: BACCC ICT Related For-Credit Success by Educational Status 2010/11



Student Educational Goal

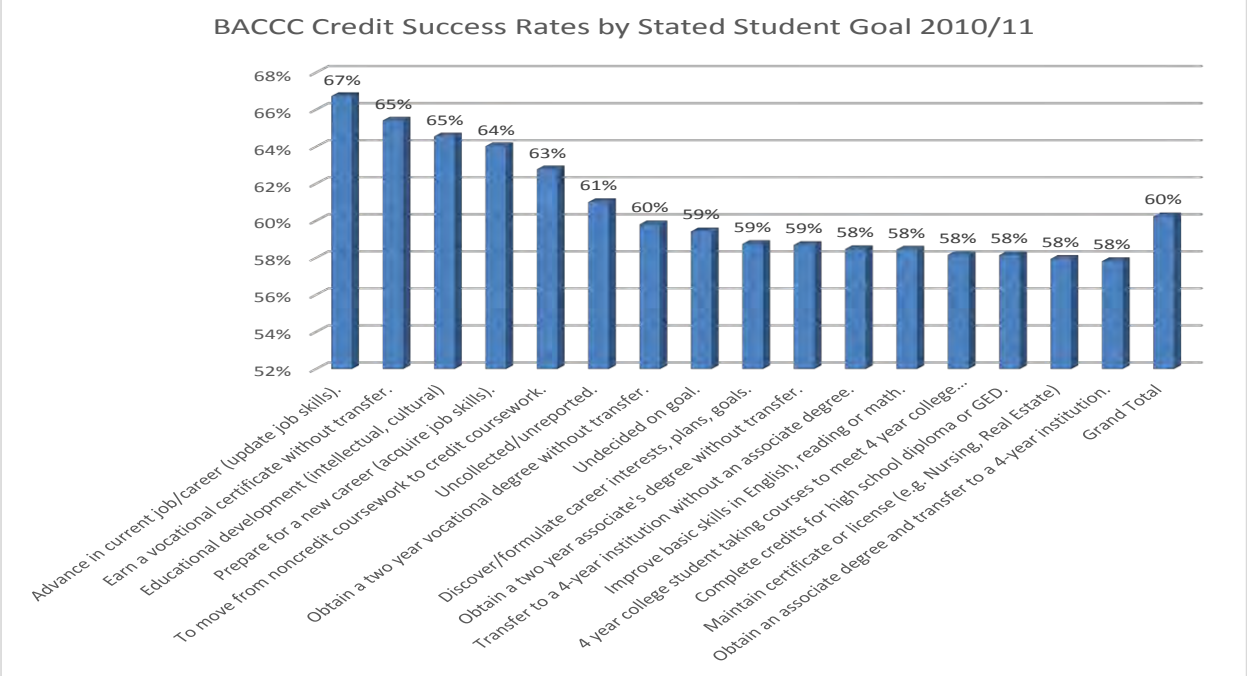
Most students in ICT for credit courses report their goal as obtaining and associate degree and transferring to a 4 year college or university or just transferring to a 4 year college, though undecided and uncollected have high results.

Graph 76: BACCC ICT Related For-Credit Enrollment by Educational Goal 2008/9 - 2010/11



Students with the academic goal of transferring to a 4 year college or university are the least successful at passing ICT courses, overall. The most successful are those with workforce readiness goals.

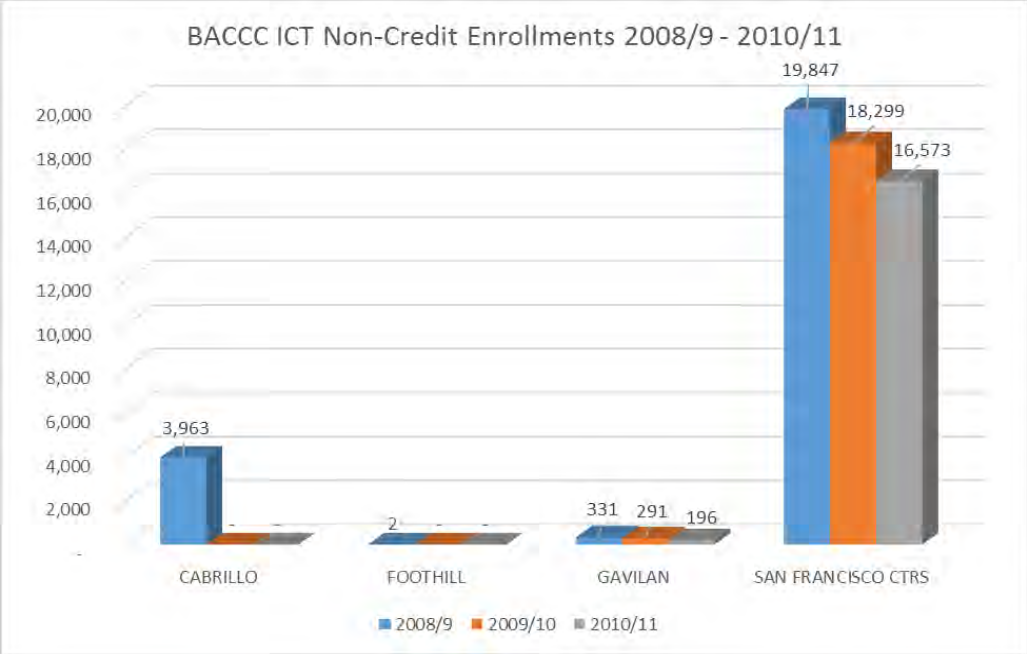
Graph 77: BACCC ICT Related For-Credit Success by Educational Goal 2010/11



ICT Related Student Non-Credit Enrollment 2010/11

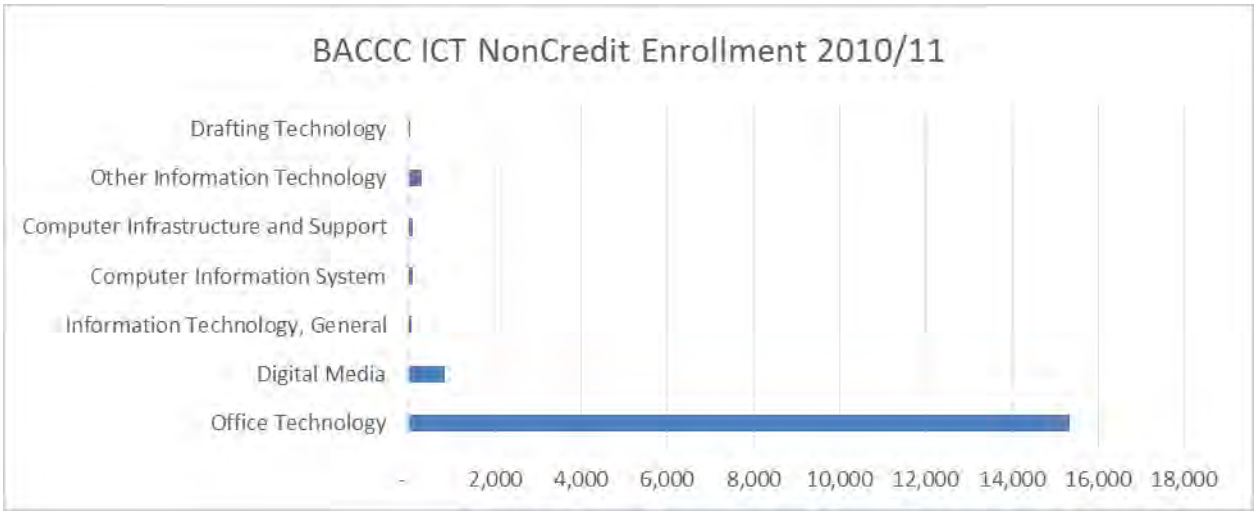
In the 2010/11 academic year, there were also more than 16,000 ICT related non-credit enrollments in ICT courses, by identified TOP codes in BACCC colleges. Almost all of them were offered by City College of San Francisco.

Graph 78: BACCC ICT Related Non-Credit Enrollment 2008/9 - 2010/11



Almost all non-credit enrollments were in Office Technologies and Digital Media.

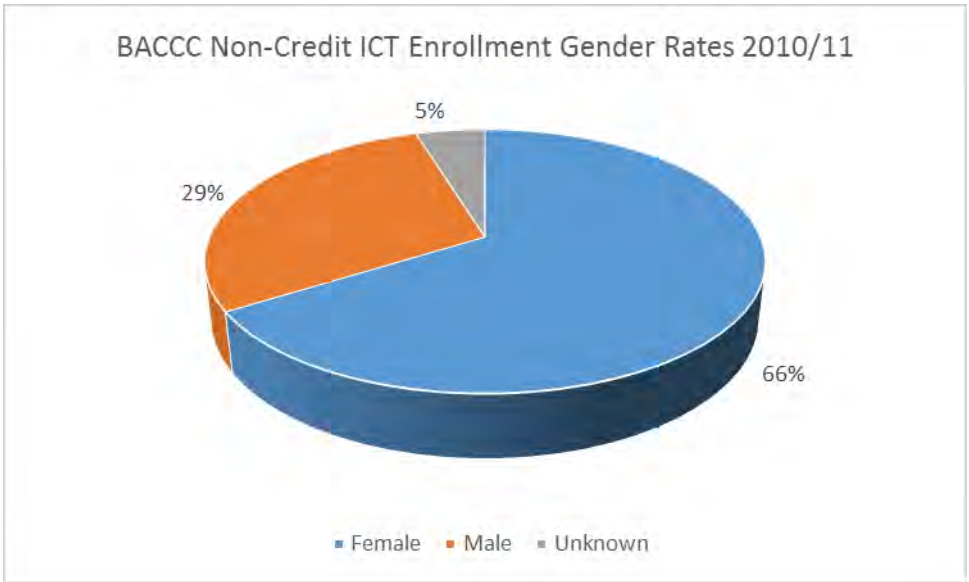
Graph 79: BACCC ICT Related Non-Credit Enrollment 2010/11



Gender

Roughly two-thirds of those were by females.

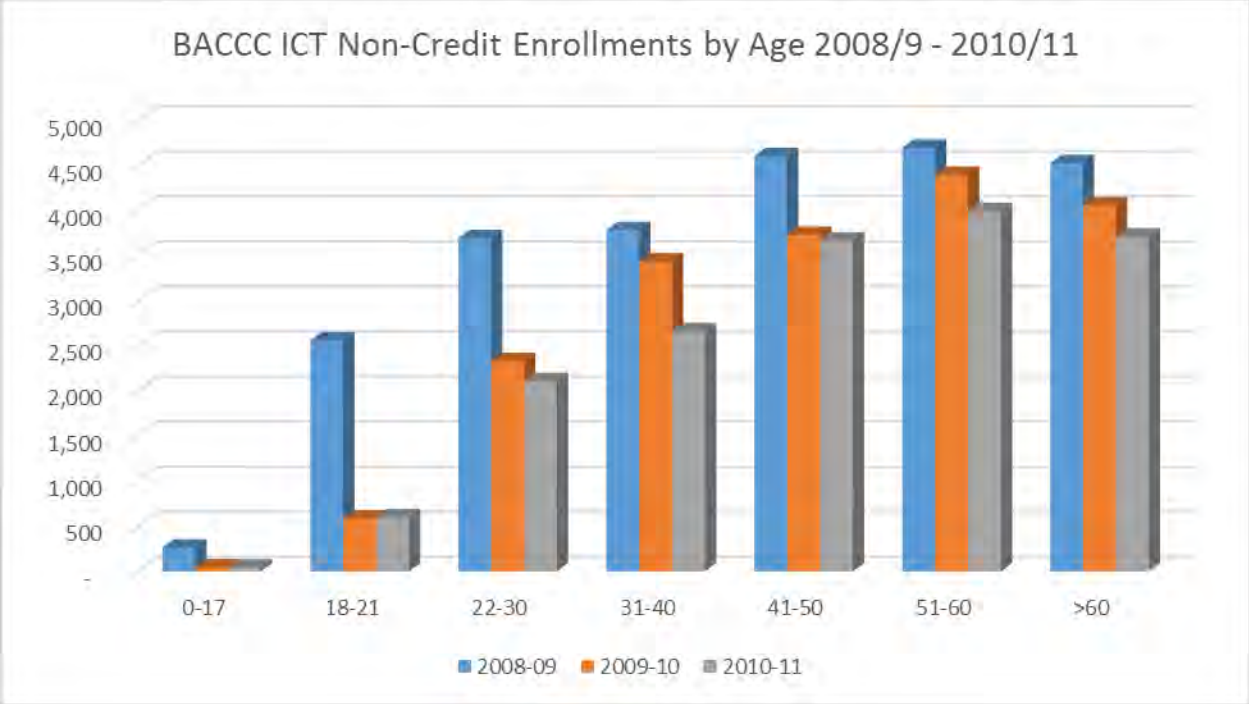
Graph 80: BACCC ICT Related Non-Credit Enrollment by Gender 2010/11



Age

Students enrolling in non-credit courses tend to be older than students in for credit courses.

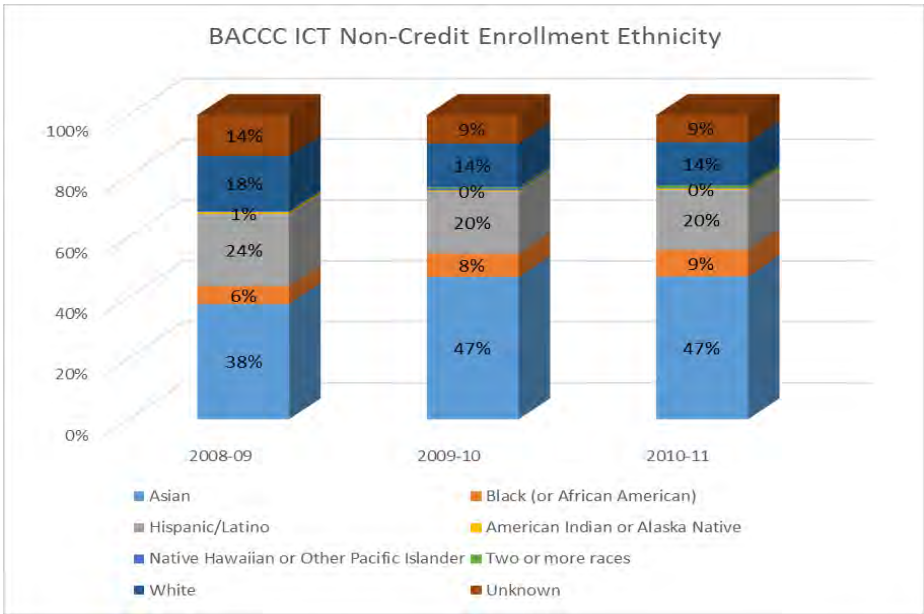
Graph 81: BACCC ICT Related Non-Credit Enrollment by Age 2010/11



Ethnicity

Two-thirds of non-credit ICT enrollments are by Asian and Hispanic populations.

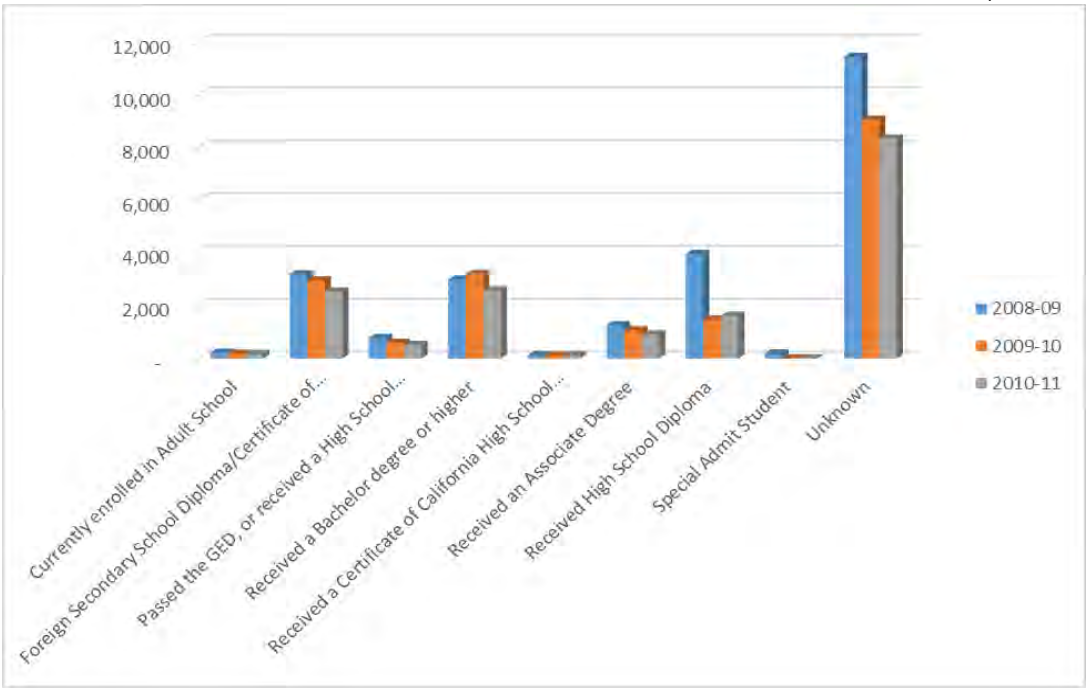
Graph 82: BACCC ICT Related Non-Credit Enrollment by Ethnicity 2010/11



Prior Educational Attainment

The majority of non-credit ICT related enrollments is by students with unknown educational backgrounds, but a significant number already have associate or bachelor degrees.

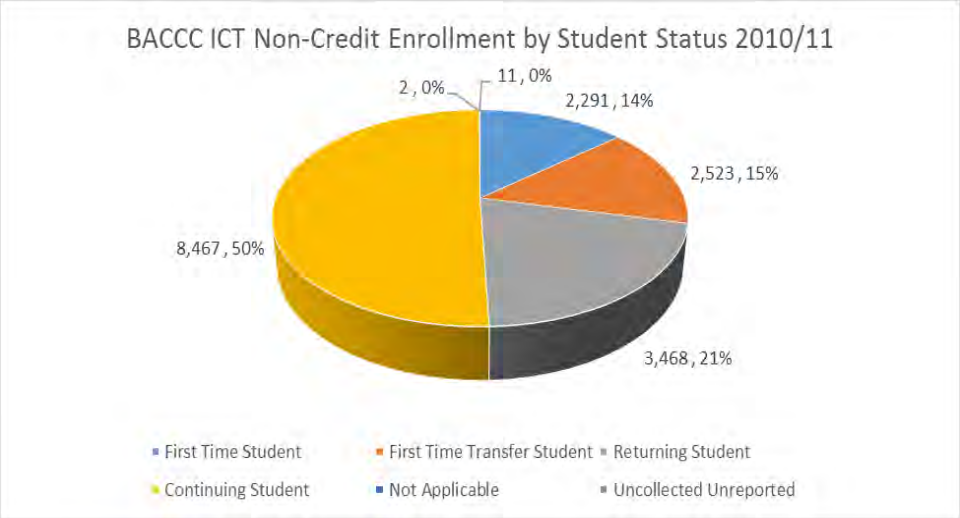
Graph 83: BACCC ICT Related Non-Credit Enrollment by Prior Educational Attainment 2008/9 - 2010/11



Student Status

Following are non-credit enrollments by student status. Most are continuing and returning students.

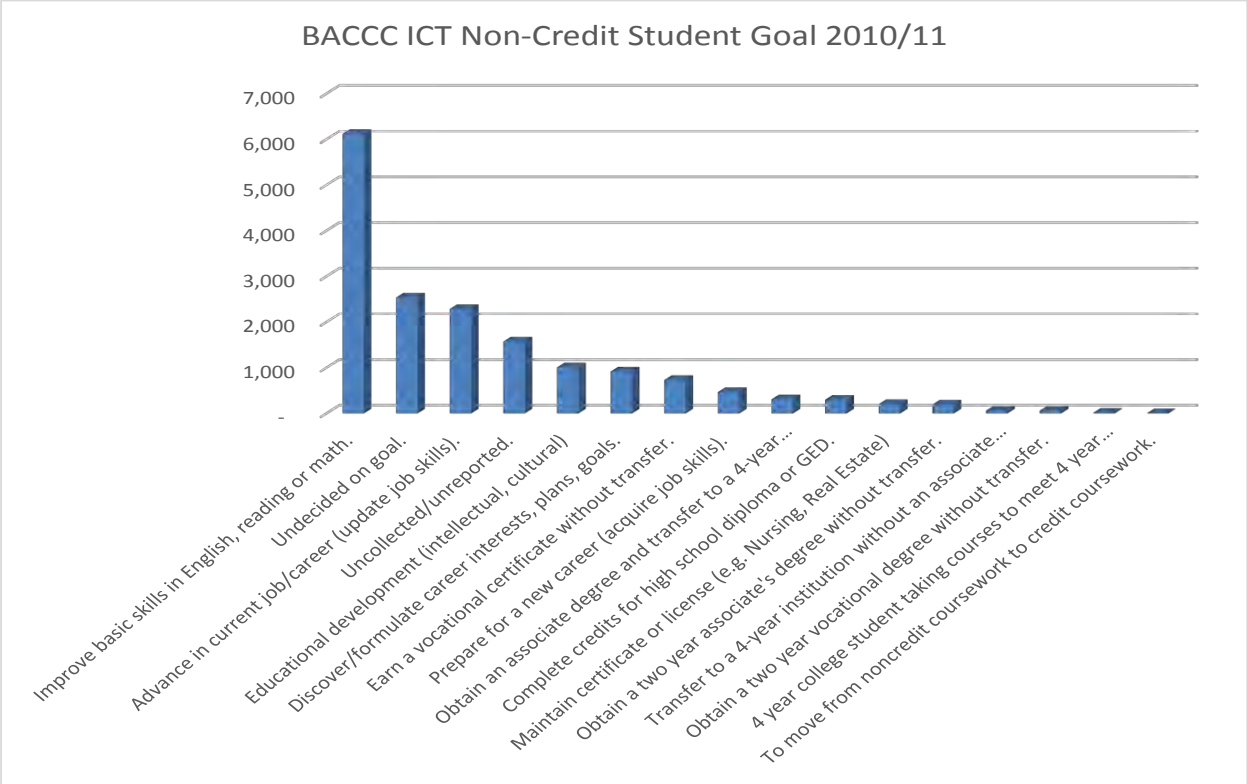
Graph 84: BACCC ICT Related Non-Credit Enrollment by Student Status 2010/11



Student Educational Goals

Following are the stated goals of students enrolling in non-credit ICT courses.

Graph 85: BACCC ICT Related Non-Credit Enrollment by Student Goal 2010/11



Degrees Offered 2010/11

- The 82 departments/programs of the 28 colleges in the Bay Area Community College Consortium (BACCC) offer 180 ICT related Associate Degrees.
- Ohlone College has the most of any college, with 21 ICT related Associate Degree options.
- College of Alameda has the fewest number of Associate Degree options, with one.
- Of the 180 ICT related degrees, 17 degree names are used more than once across the 28 colleges, and 12 of those are used twice:

A.S. Computer Science	10 times
A.S. Computer Programming	5 times
A.S. Administrative Assistant	4 times
A.A. Computer Science	3 times
A.S. Computer Information Systems	3 times
A.A. Administrative Assistant	2 times
A.A. Computer Information Systems	2 times
A.S. Cisco Certified Network Professional (NETWORK+, CCNA, CCNP)	2 times
A.S. Computer Applications	2 times
A.S. Computer Networking	2 times
A.S. Computer Support Specialist	2 times
A.S. Desktop Support Technician (A+, NETWORK+, MCP)	2 times
A.S. Microsoft Systems Engineer (NETWORK+, MCP, MCSE)	2 times
A.S. Network Administrator (NETWORK+, MCP OR UNIX, CCNA)	2 times
A.S. Office Information Systems	2 times
A.S. Technical Support Specialist (A+, NETWORK+, MCP)	2 times
A.S. UNIX/LINUX Systems Administrator	2 times

- 131 of 180 degree names are unique across the 28 colleges in the BACCC region.
- The number of units required for a degree range from 90 at Ohlone to 6 at Napa.

There are likely some errors in this data that reflect the accuracy of this information, but major patterns would not change.

See Appendix 13 for an alphabetical list of BACCC ICT related degree titles. See Appendix 14 for a list of BACCC ICT related degree titles by college.

ICT Degrees Awarded

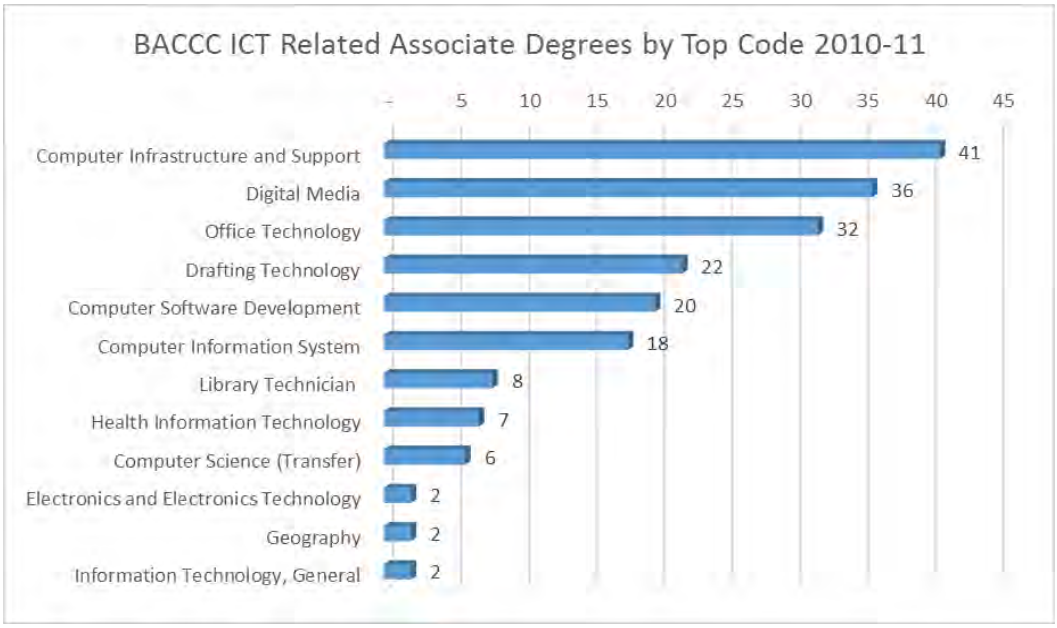
In the 2010/2011 academic year, students at the 28 BACCC colleges earned 196 ICT related Associate degrees, an increase over immediately preceding years. Degree awards ranged from 25 at City College of San Francisco to zero at several of the colleges.

Graph 86: BACCC ICT Related Associate Degrees 2008/09 - 2010/11

Associate Degrees Awarded	Year		
College Name	2008-09	2009-10	2010-11
ALAMEDA	2	-	2
BERKELEY CITY	-	-	6
CABRILLO	23	25	17
CANADA	4	6	4
CHABOT	4	4	-
CONTRA COSTA	2	2	4
DE ANZA	16	13	21
DIABLO VALLEY	12	17	18
FOOTHILL	6	16	12
GAVILAN	6	8	12
HARTNELL	13	4	9
LANEY	2		4
LAS POSITAS	4	6	6
LOS MEDANOS	7	2	5
MARIN	8	8	4
MERRITT			-
MISSION	6	6	10
MONTEREY	2	-	11
NAPA VALLEY	6	-	4
OHLONE	2	2	8
SAN FRANCISCO CITY	10	20	25
SAN JOSE CITY	4	6	4
SAN MATEO	2	12	-
SANTA ROSA	2	4	4
SKYLINE	4	11	
SOLANO	7	10	4
WEST VALLEY	4	4	2
Grand Total	**158**	**186**	**196**

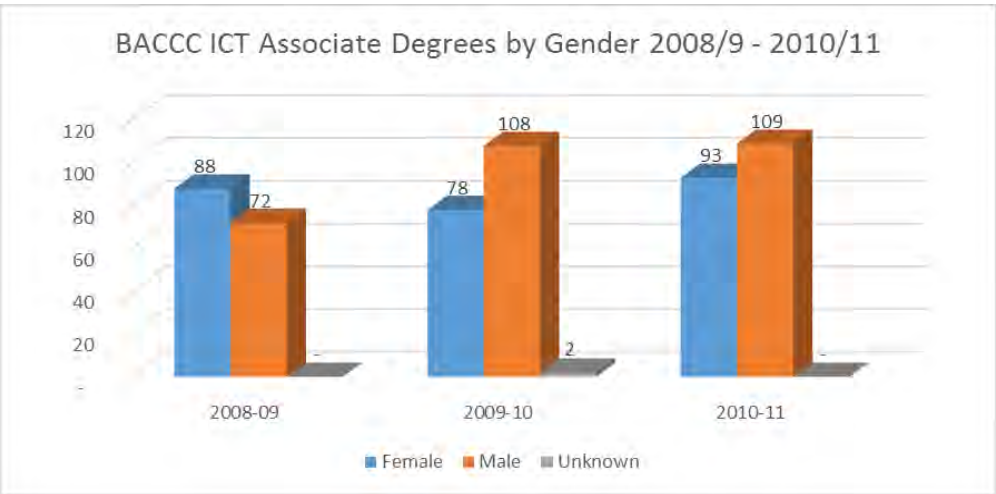
BACCC college ICT related Associate Degrees ranged from 41 in Computer Infrastructure and Support, 36 in Digital Media and 32 in Office Technology to zero in multiple Top Codes in 2010/11.

Graph 87: BACCC ICT Related Associate Degrees by Top Code 2010/11



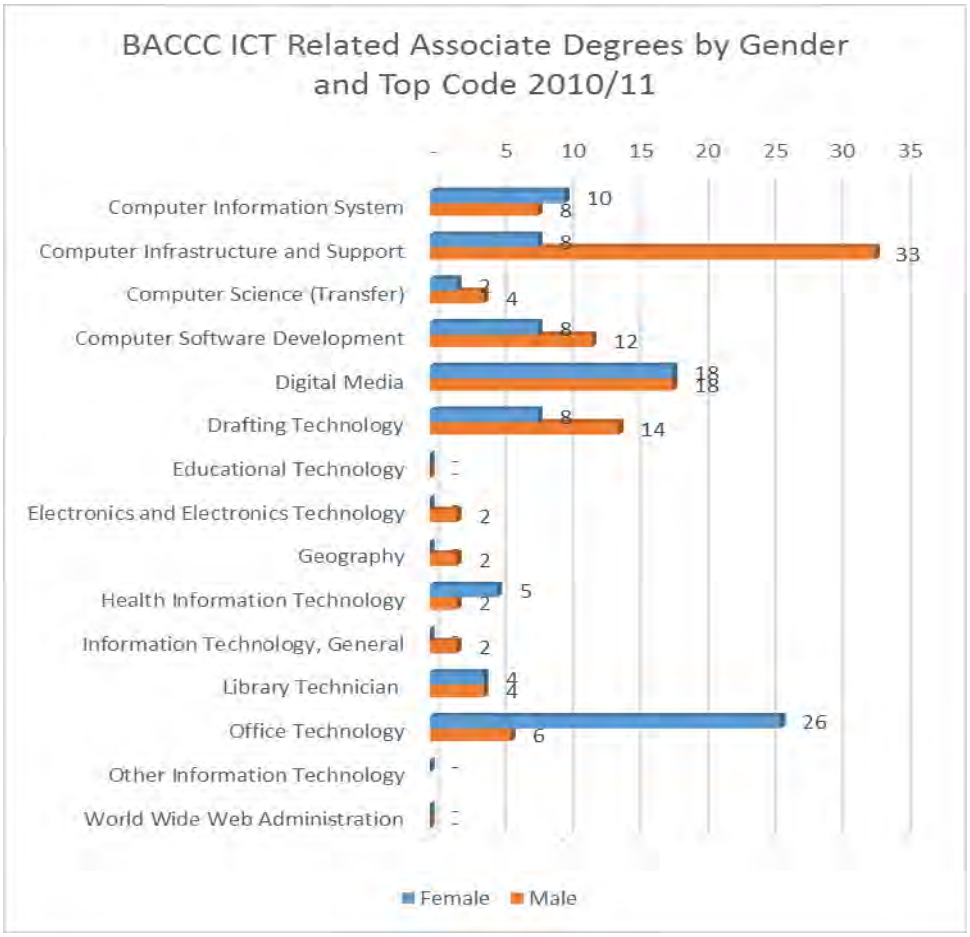
Overall by gender, females have been getting more ICT related Associate degrees than males recently.

Graph 88: BACCC ICT Related Associate Degrees by Gender 2008/9 - 2010/11



Again, looking at gender by Top Code, it is high participation and success rates in Office Technology that bring overall female numbers as high as they are.

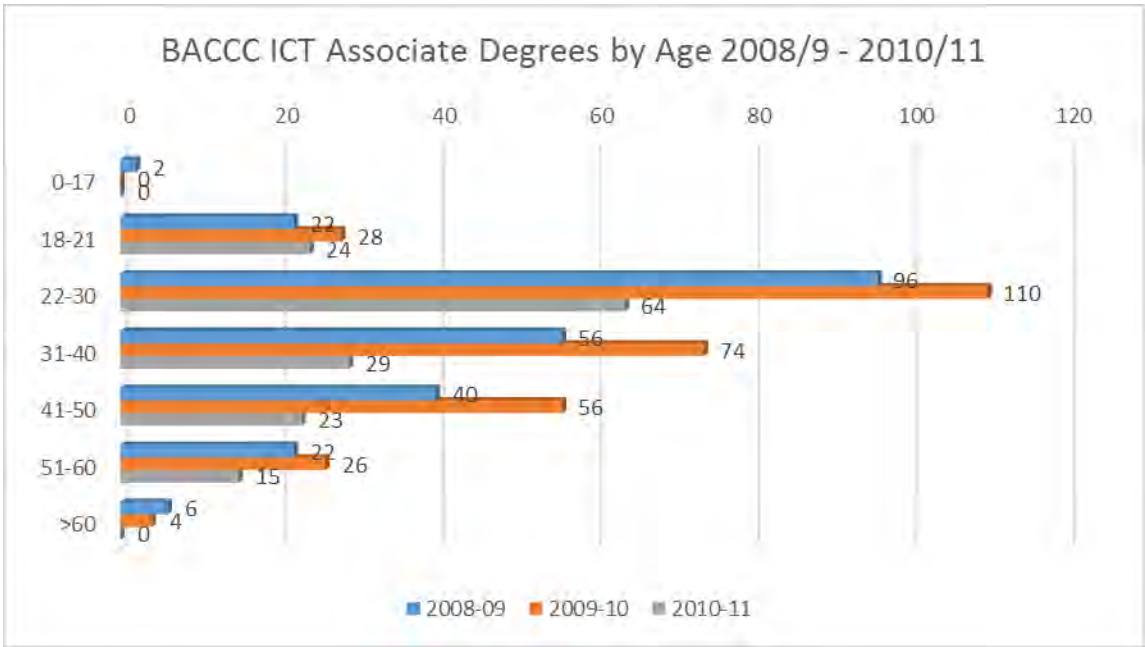
Graph 89: BACCC ICT Related Associate Degrees by Gender and Top Code 2010/11



See Appendix 15 for a list of 2010/11 ICT related degrees awarded by college, Top Code and gender.

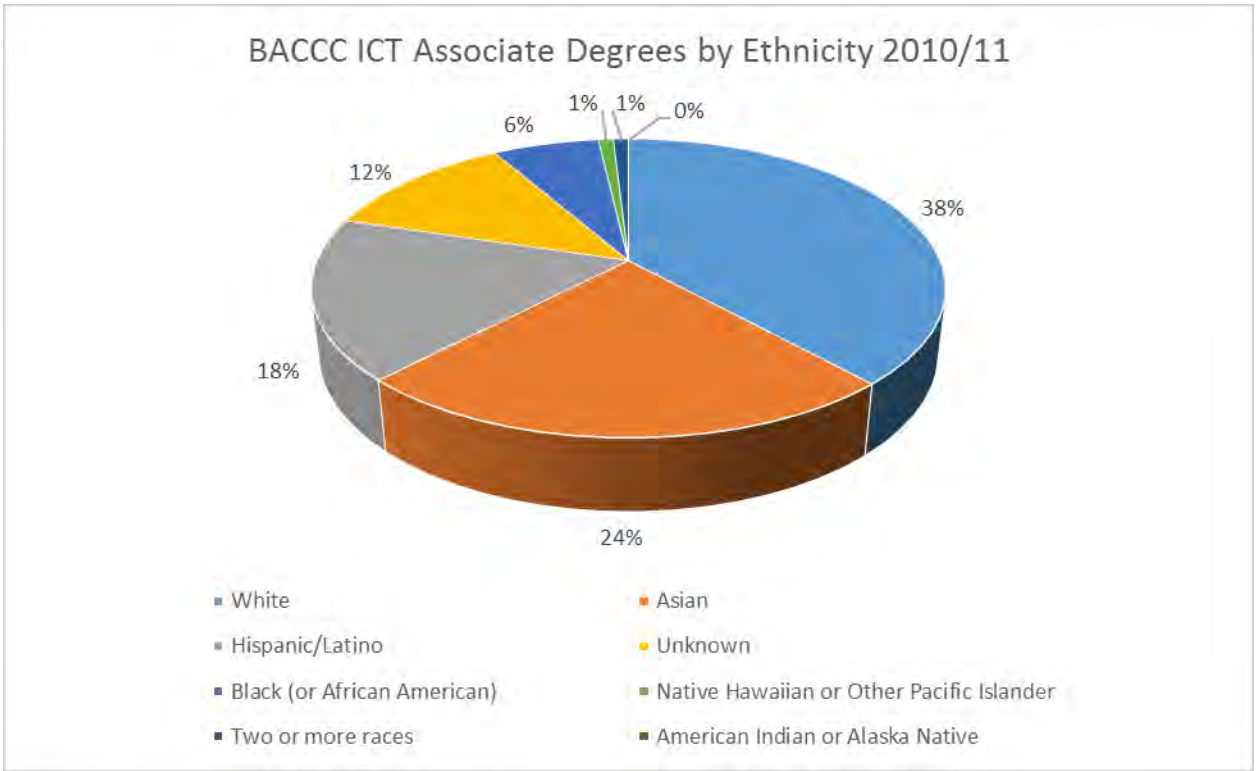
By age, Associate degrees were distributed as follows.

Graph 90: BACCC ICT Related Associate Degrees by Age 2008/9 - 2010/11



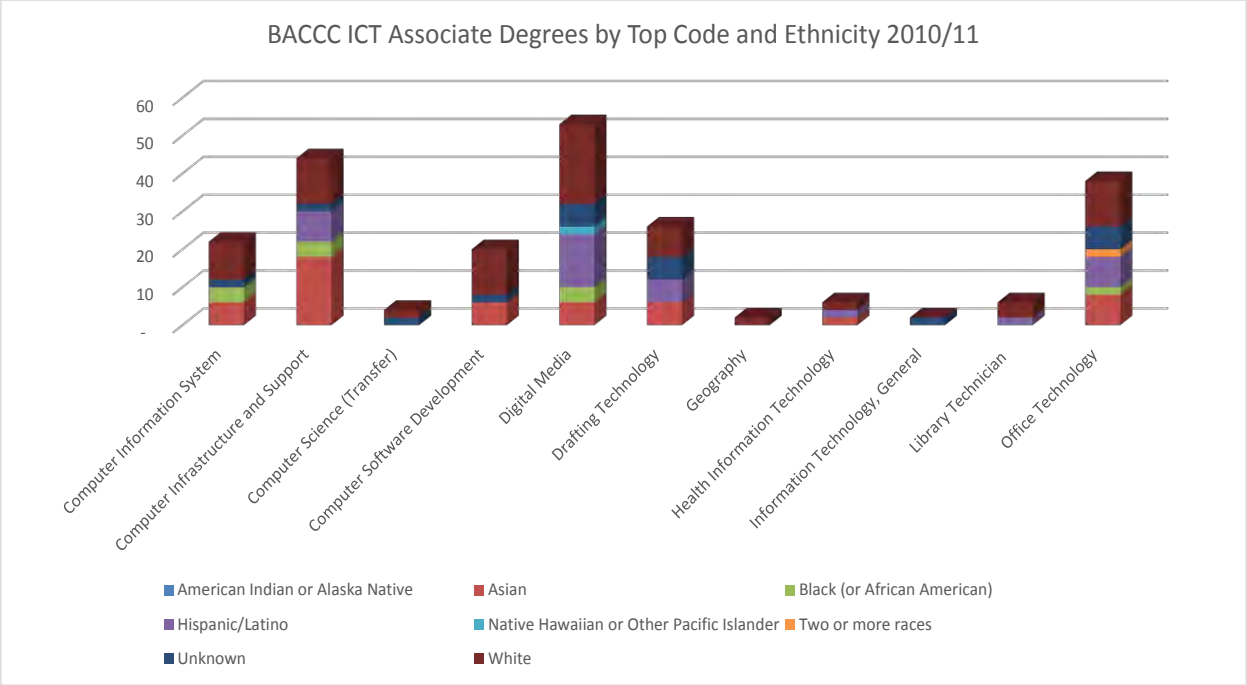
Whites led Associate degree awards by ethnicity in 2010/11, followed by Asians.

Graph 91: BACCC ICT Related Associate Degrees by Ethnicity 2010/11



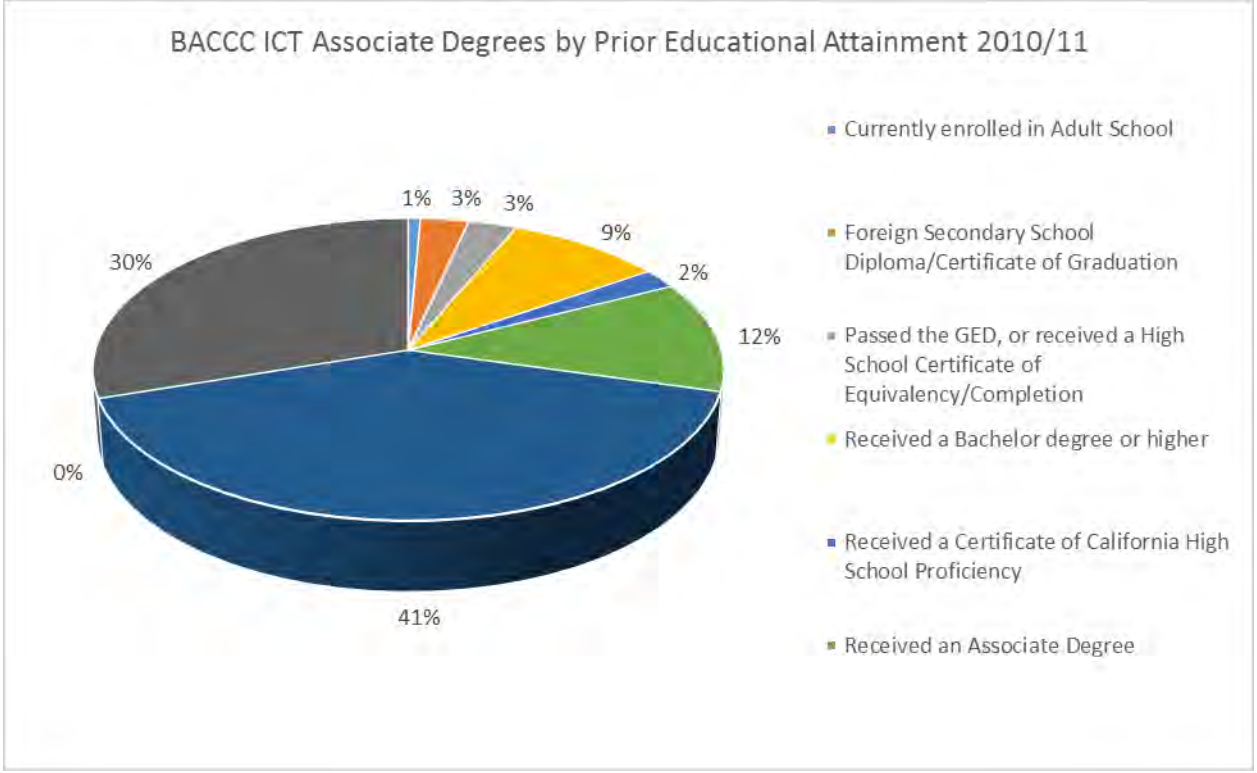
Whites outnumbered all other ethnic backgrounds for degree awards in 2010/11, except Healthcare IT where whites tied for the greatest number.

Graph 92: BACCC ICT Related Associate Degrees by Ethnicity and Top Code 2010/11



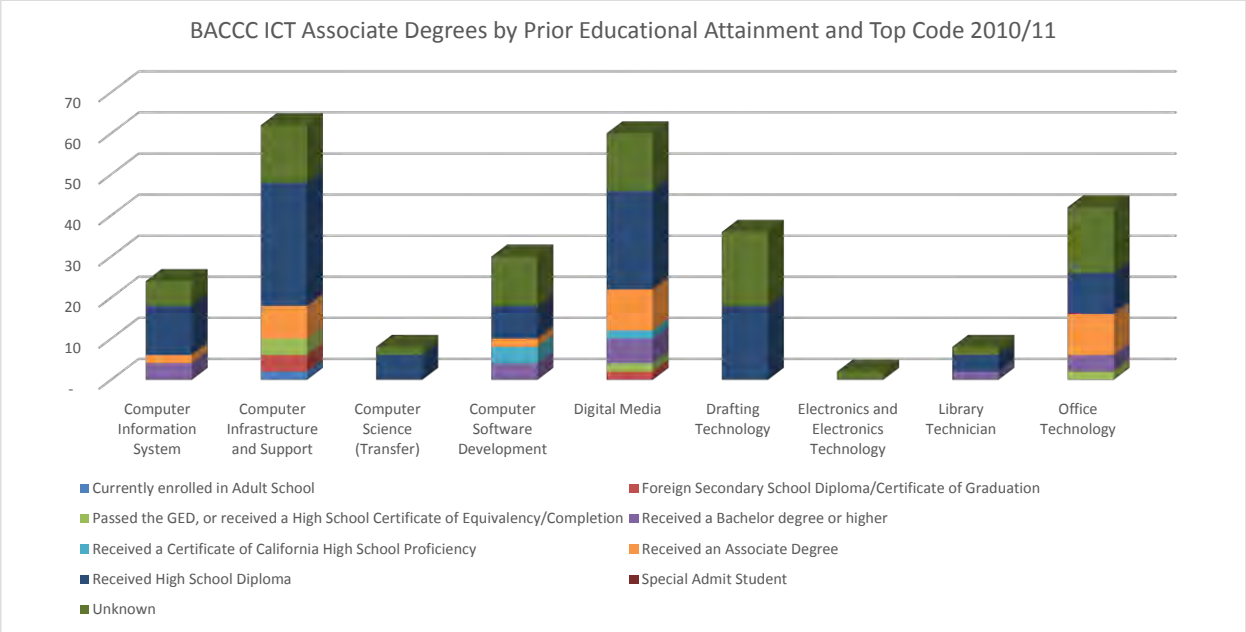
Degrees awarded by prior educational attainment is indicated in the following chart.

Graph 93: BACCC ICT Related Associate Degrees by Prior Educational Attainment 2010/11



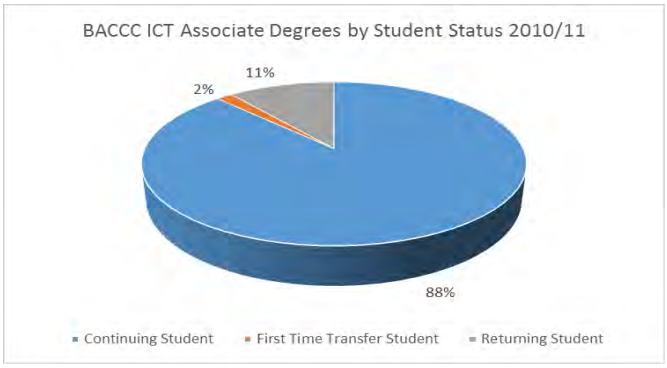
Degrees awarded by prior educational attainment by Top Code is indicated in the following chart.

Graph 94: BACCC ICT Related Associate Degrees by Prior Educational Attainment and Top Code 2010/11



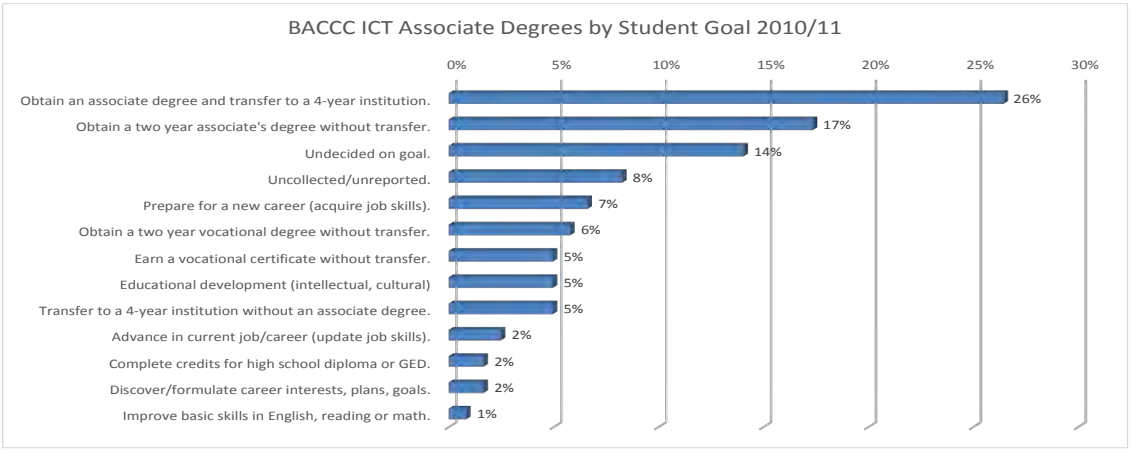
Most BACCC ICT related associate degree awards were to continuing and returning students.

Graph 95: BACCC ICT Related Associate Degrees by Student Status 2010/11



Most BACCC students receiving ICT related Associate degrees had a degree as a stated goal in 2010/11, but 14% were undecided on their goals.

Graph 96: BACCC ICT Related Associate Degrees by Stated Student Goal 2010/11



Academic Certificates Offered 2010/11

- The 82 departments/programs of the 28 colleges in the Bay Area Community College Consortium (BACCC) offer 405 ICT related Academic Certificates.
- Ohlone College has the most of any college, with 53 ICT related Academic Certificate options.
- Cañada and Solano Colleges have the fewest number of Associate Degree options, with 3 each.
- Of the 405 ICT related academic certificates, 33 certificate names are used more than once across the 28 colleges, and 25 of those are used twice:

○ Administrative Assistant	6 times	○ Enterprise Security Professional	2 times
○ Computer Programming	5 times	○ General Office	2 times
○ A+, Network+, MCP	4 times	○ Graphic Design	2 times
○ Web Development	4 times	○ Informatics	2 times
○ Multimedia	3 times	○ Information Processing Specialist	2 times
○ Network Administration	3 times	○ Java Programming	2 times
○ Network Security	3 times	○ MCSA	2 times
○ Web Design	3 times	○ MCSE	2 times
○ A+	2 times	○ Microsoft Cert. Systems Eng. (MCSE)	2 times
○ Admin. Asst. Office Technology	2 times	○ NETWORK+, CCNA, CCNP	2 times
○ CCNA (Cisco Cert. Network Ass.)	2 times	○ NETWORK+, MCP or UNIX, CCNA	2 times
○ Cisco CCNA	2 times	○ NETWORK+, MCP, MCSE	2 times
○ Cisco CCNP	2 times	○ Office Information Systems	2 times
○ Computer Applications	2 times	○ Office Technology	2 times
○ Computer Information Systems	2 times	○ Programming	2 times
○ Computer Networking	2 times	○ Web Programming	2 times
○ Computer Support Specialist	2 times		

- 324 of 405 certificate names are unique across the 28 colleges in the BACCC region.
- The number of units required for a certificate range from 90 at Ohlone to 4 at Ohlone.

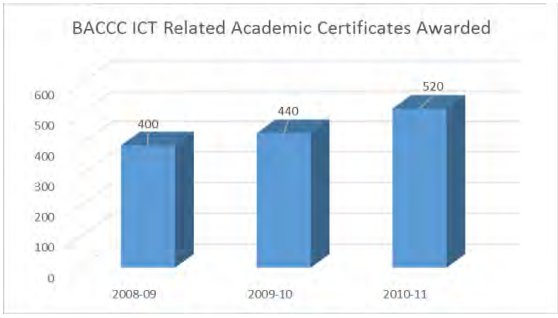
There are likely some errors in this data that reflect the accuracy of this information, but major patterns would not change.

See Appendix 16 for an alphabetical list of BACCC ICT related academic certificate titles. See Appendix 17 for a list of BACCC ICT related degree titles by college.

Academic Certificates Awarded

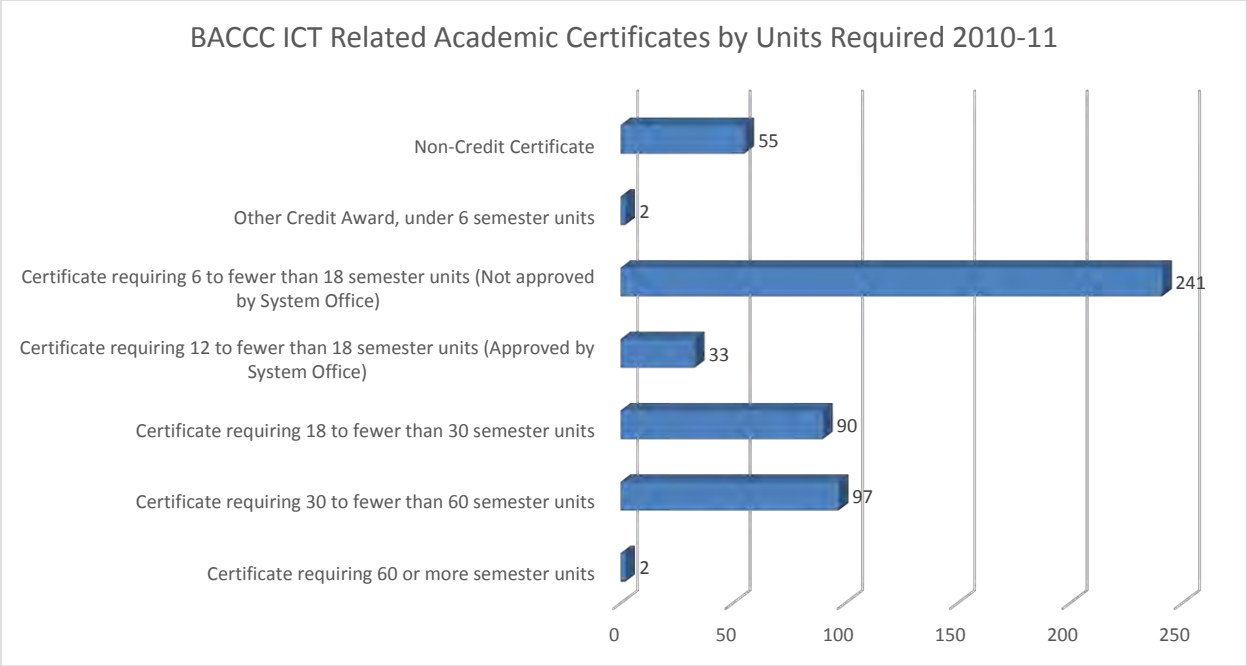
In 2010/11, BACCC colleges awarded 520 ICT related academic certificates, a 30% increase from 2008/9.

Graph 97: BACCC ICT Related Academic Certificates Awarded 2008/9 - 2010/11



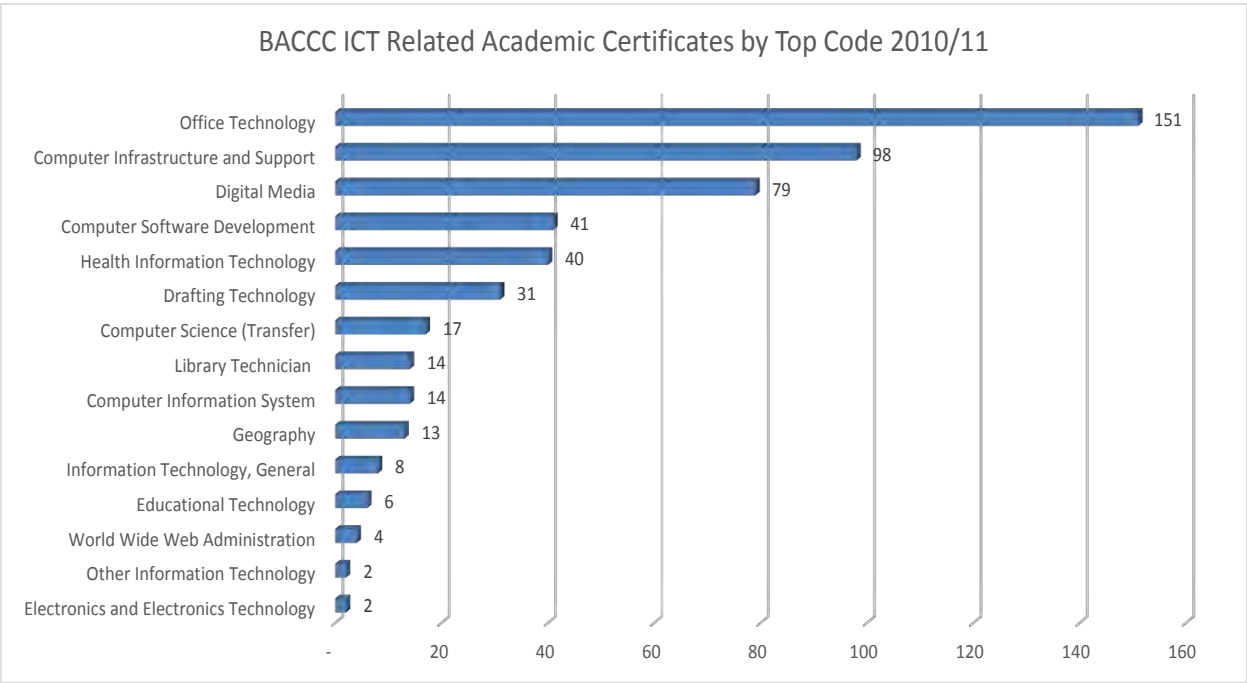
Those academic certificates range in requirements from less than 6 to more than 60 academic units.

Graph 98: BACCC ICT Related Academic Certificates Awarded by Units Required 2010/11



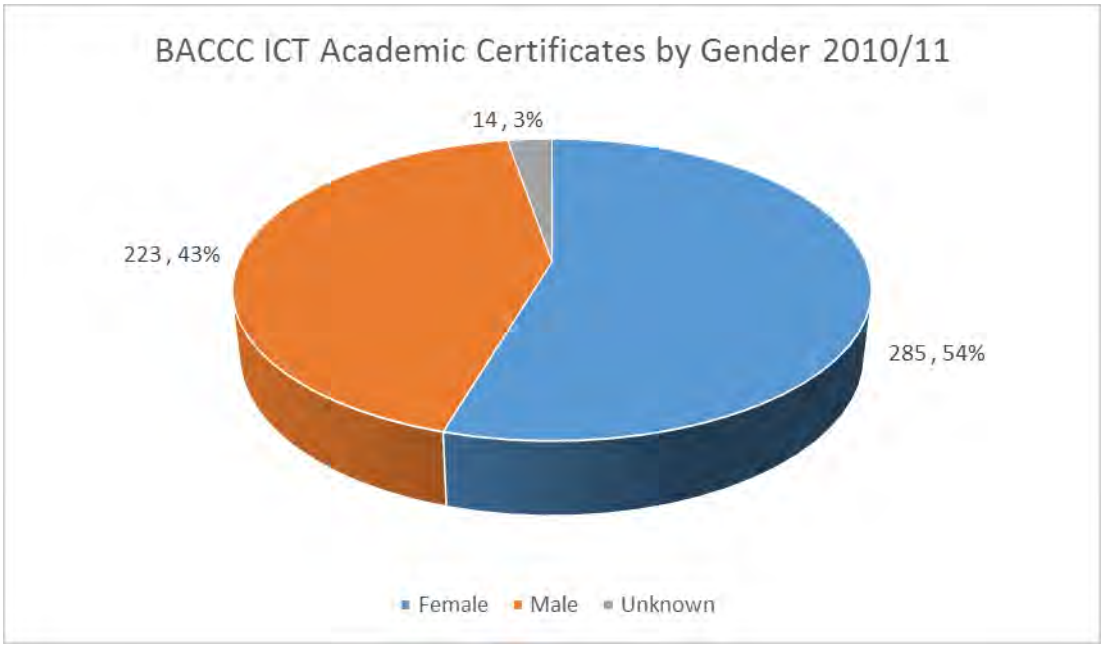
They were distributed as follows across ICT related Top Codes.

Graph 99: BACCC ICT Related Academic Certificates Awarded by Top Code 2010/11



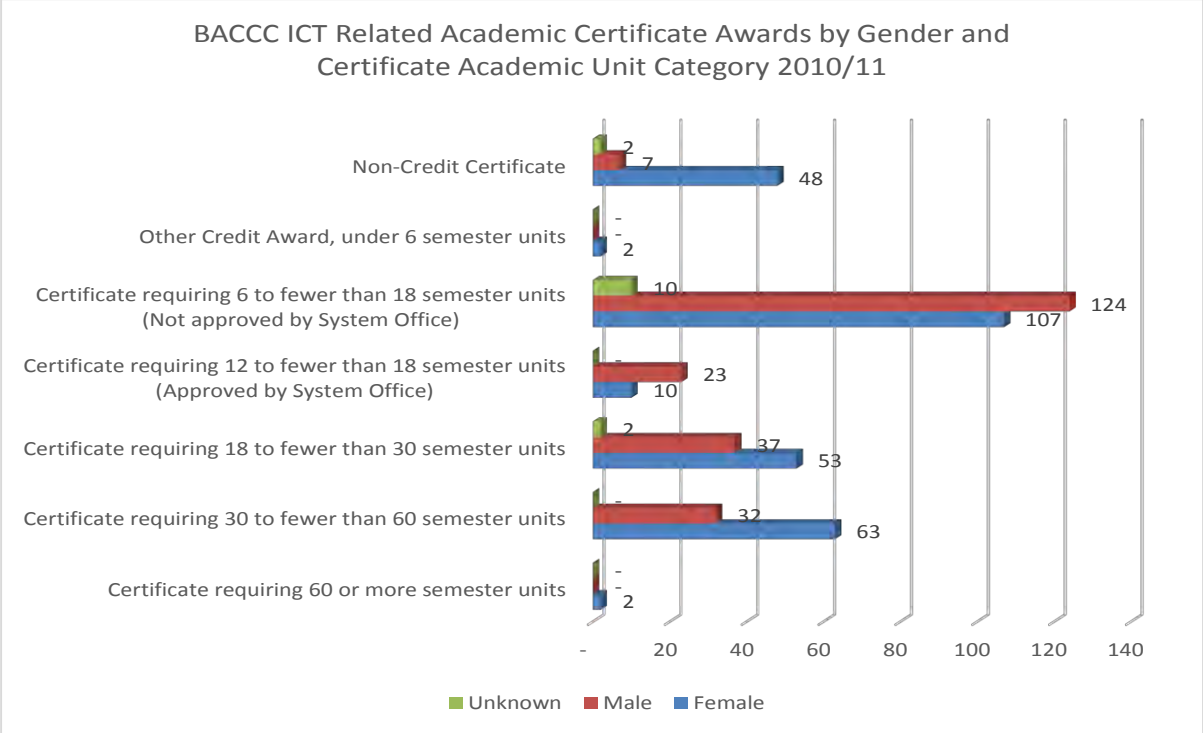
Overall, females earned more ICT related academic certificates than males in 2010/11, 54% versus 43%.

Graph 100: BACCC ICT Related Academic Certificates Awarded by Gender 2010/11



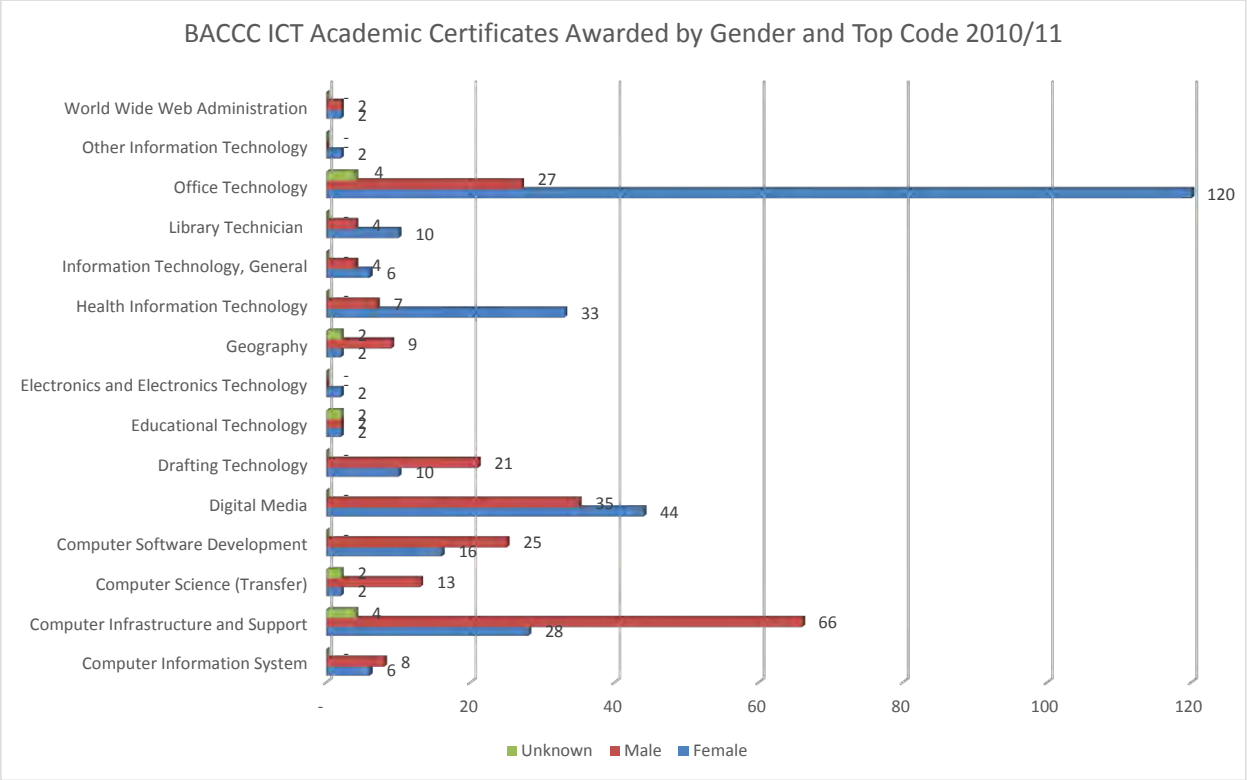
Females also got more academic certificates than males in most certificate academic unit categories, including non-credit and higher academic unit count certificates.

Graph 101: BACCC ICT Related Academic Certificates Awarded by Gender and Rigor 2010/11



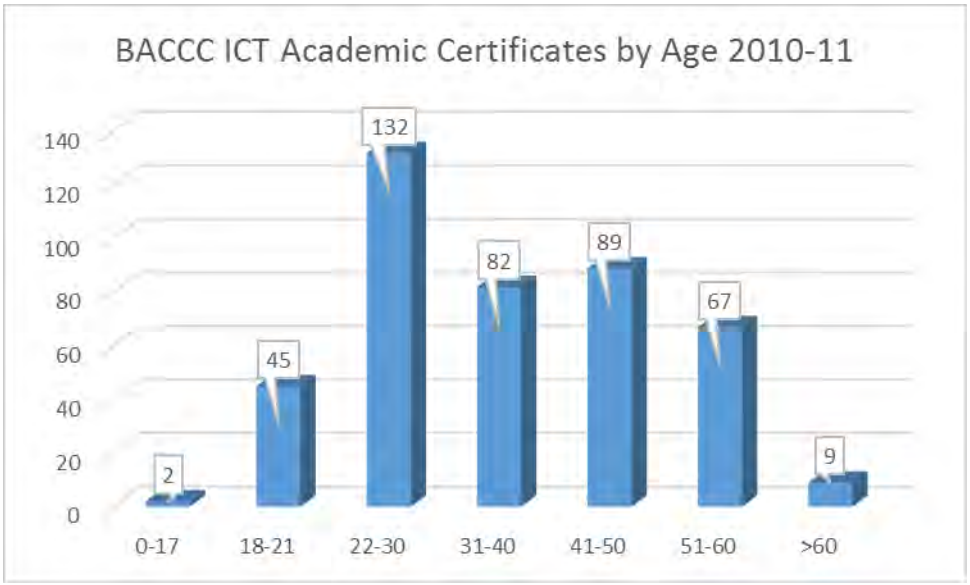
However, overall gender representation is skewed by very high numbers of females enrolled in and completing certificates in the Office Technology Top Code. For certificate completion, females only outnumber males in Office Technology, Library Technician, Health IT and Digital Media. Males outnumber females in all other Top Codes for academic certificate completion.

Graph 102: BACCC ICT Related Academic Certificates Awarded by Gender and Top Code 2010/11



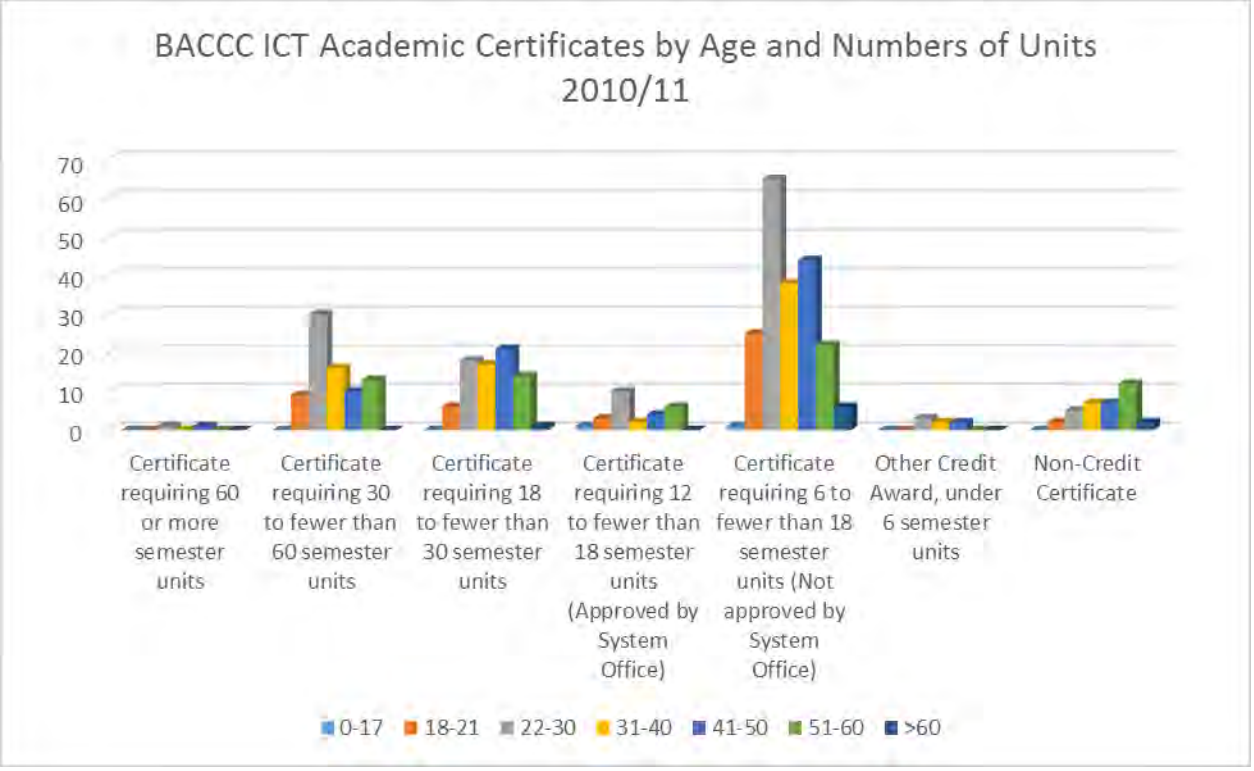
Ages for BACCC college ICT related academic certificates ranged from 14 to 69 in 2010/11, with significant representation of older populations not traditionally thought of as college age. Ages 18-21 had lower certificate awards than 22-30, 31-40, 41-50 and 51-60.

Graph 103: BACCC ICT Related Academic Certificates Awarded by Age 2010/11



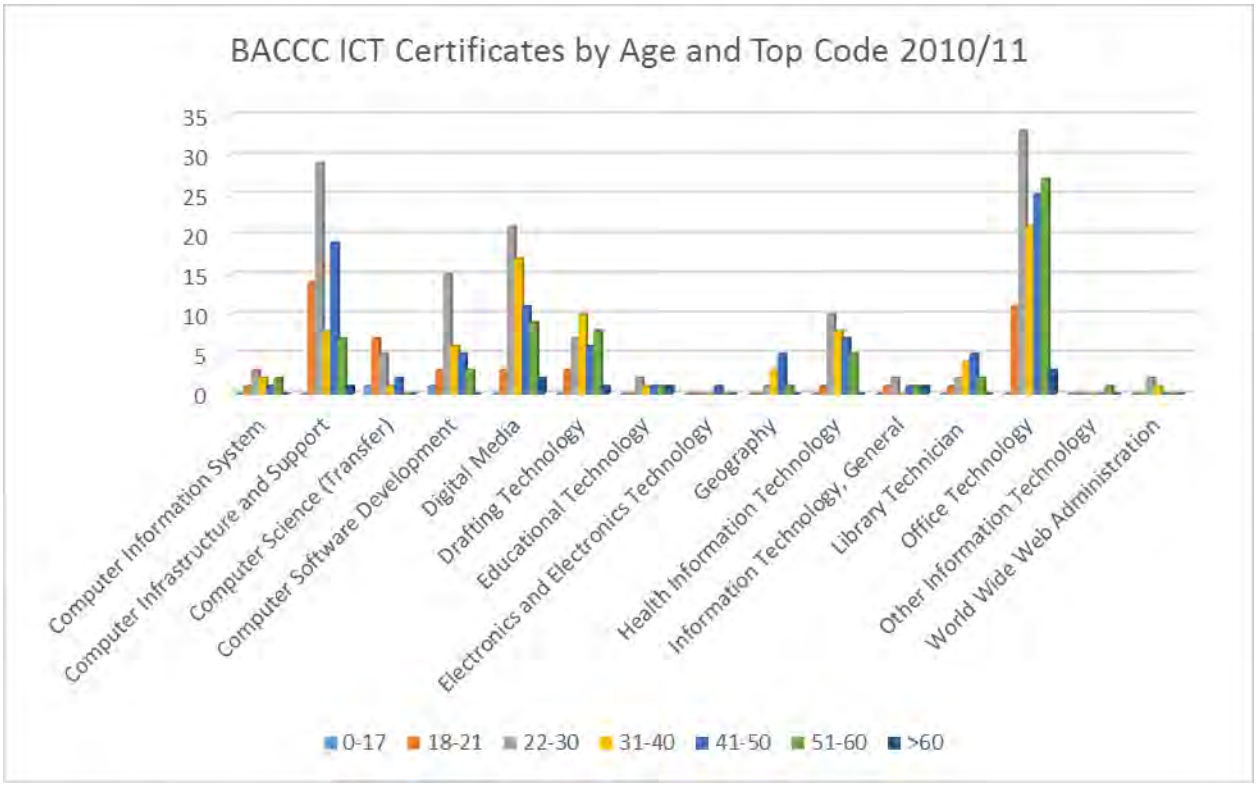
These distributions are similar across certificates with different unit requirements. A notable exception is non-credit certificates, which have a higher representation of older populations.

Graph 104: BACCC ICT Related Academic Certificates Awarded by Age and Academic Units 2010/11



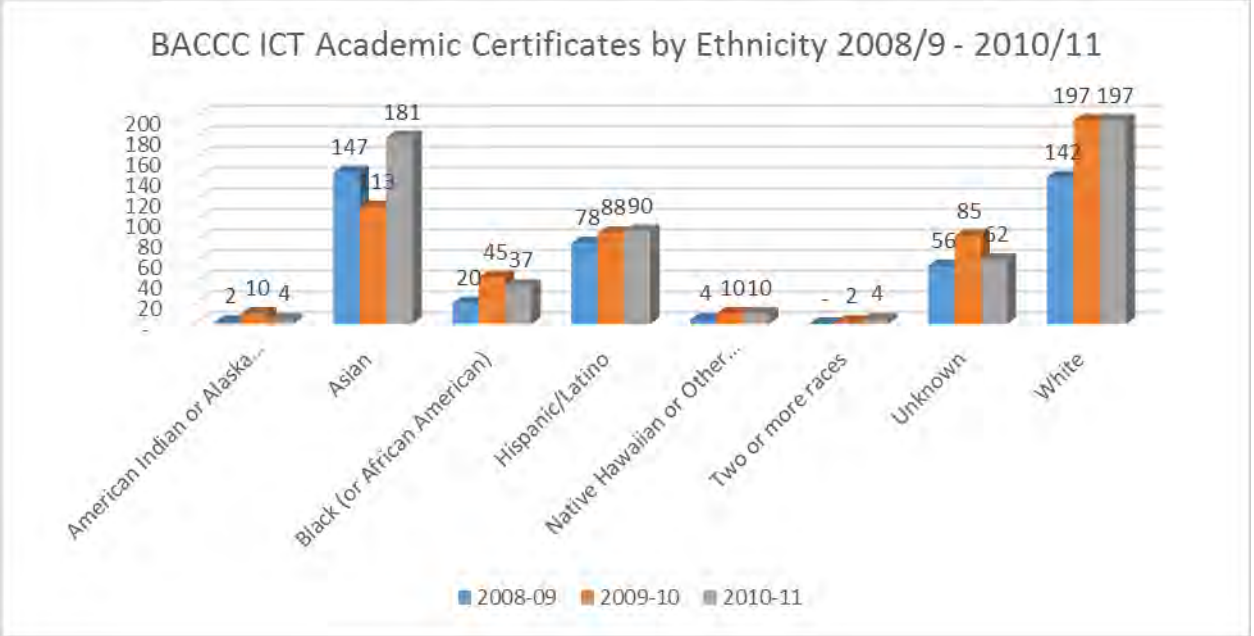
There are a few interesting deviations in academic certificate awards by Top Code. For example, Computer Science (Transfer) certificates are primarily students in the 18-21 range, and Library Technician certificates tend toward older students.

Graph 105: BACCC ICT Related Academic Certificates Awarded by Age and Top Code 2010/11



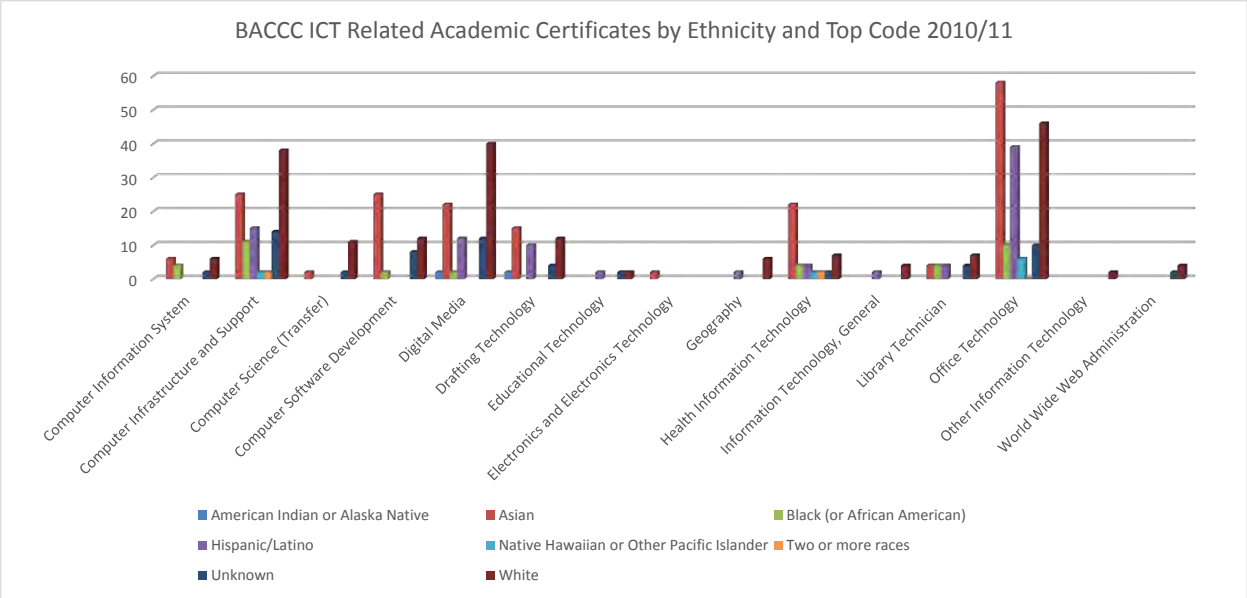
Overall, there have been increases in numbers of ICT related academic certificates awarded to Asians, Hispanics and Whites between 2008/9 and 2010/11.

Graph 106: BACCC ICT Related Academic Certificates Awarded by Ethnicity 2008/9 - 2010/11



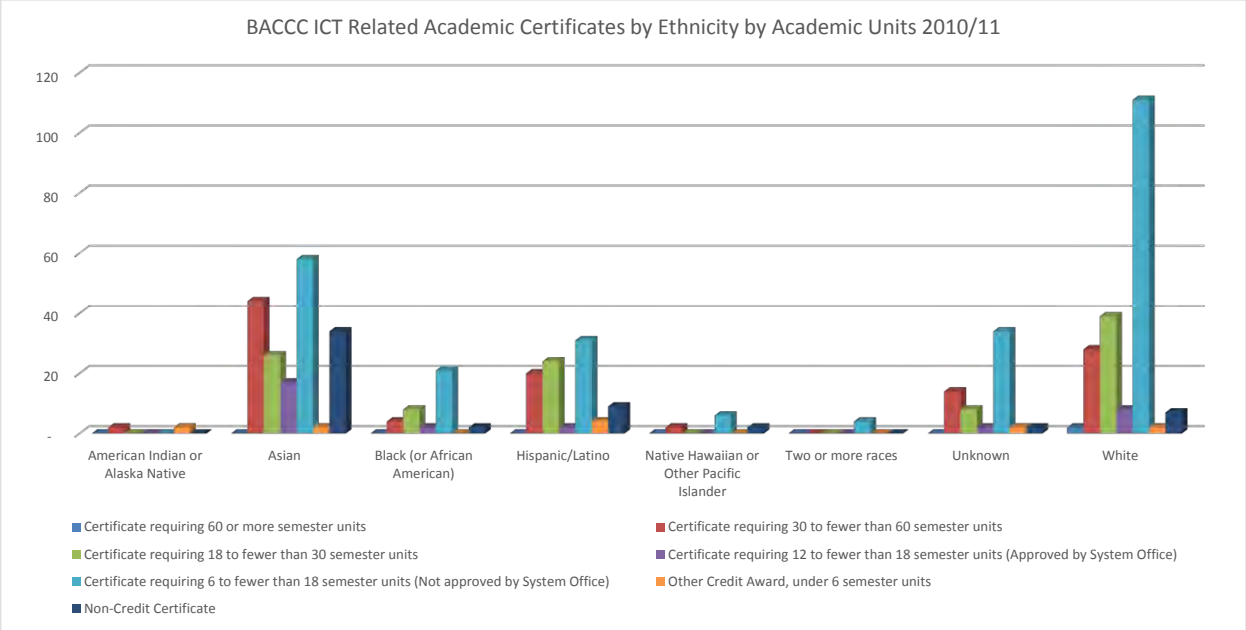
Whites received the majority of academic certificates in most Top Codes in 2010/11. Exceptions were Office Technology, Computer Science (Transfer) and Health IT, which had more awards to Asians.

Graph 107: BACCC ICT Related Academic Certificates Awarded by Ethnicity and Top Code 2010/11



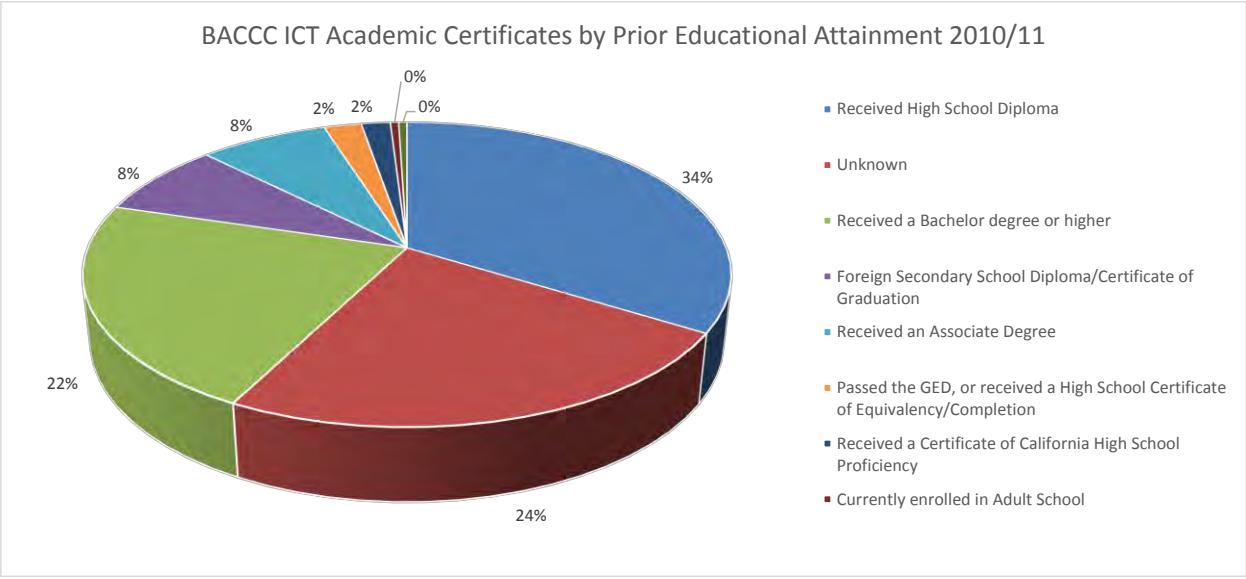
The following graph shows the distributions of unit requirements for academic certificates awarded by ethnicity in 2010/11.

Graph 108: BACCC ICT Related Academic Certificates Awarded by Ethnicity and Academic Units 2010/11



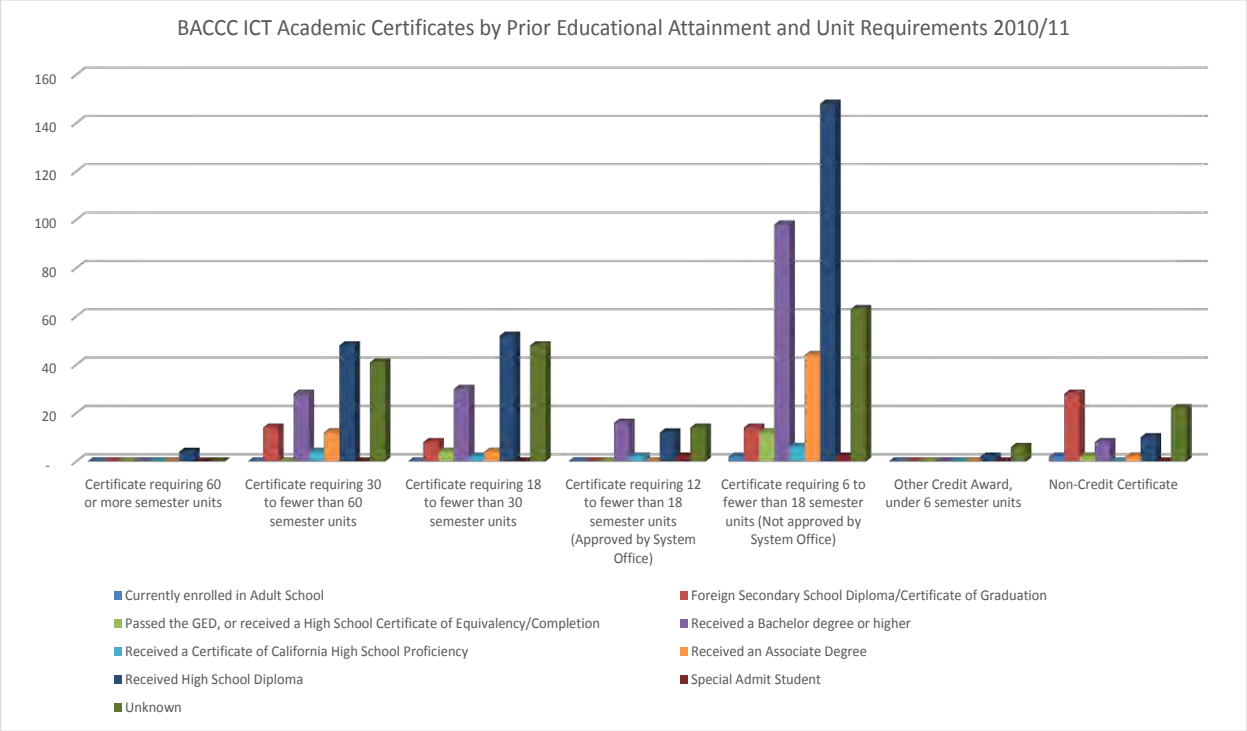
Regarding prior educational attainment for students receiving ICT related certificates at BACCC colleges, it is interesting to note high levels of Unknown prior educational attainment (24%) and already Received Bachelor Degree or Higher (22%). The greatest number were in the category of Received High School Diploma (34%).

Graph 109: BACCC ICT Related Academic Certificates Awarded by Prior Educational Attainment 2010/11



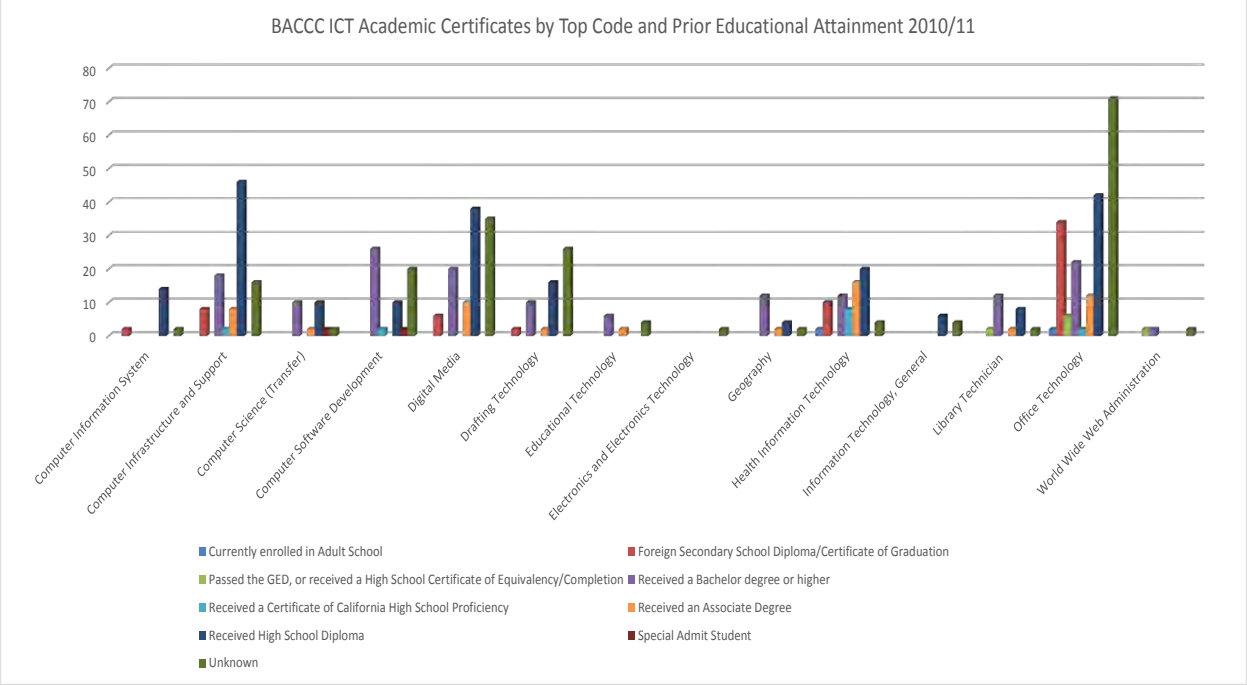
The following graph shows the distribution of BACCC ICT academic certificate awards in 2010/11 by Prior Educational Attainment and the academic unit requirements of those certificates.

Graph 110: BACCC ICT Academic Certificates by Prior Educational Attainment and Unit Requirements 2010/11



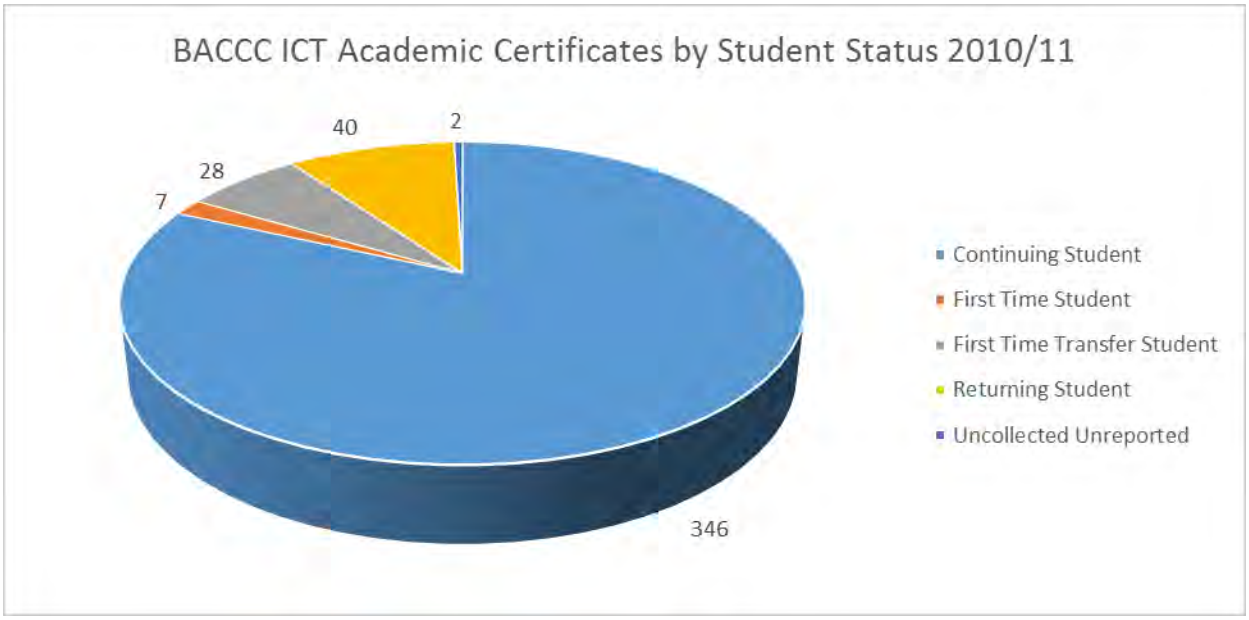
The following graph shows BACCC college ICT related academic certificates by Top Code and student Prior Educational Attainment levels for 2010/11.

Graph 111: BACCC ICT Academic Certificates by Prior Educational Attainment and Top Code 2010/11



By far, the majority of students receiving academic certificates related to ICT from BACCC colleges in 2010/11 were continuing and returning students.

Graph 112: BACCC ICT Academic Certificates by Student Status 2010/11



Courses Offered 2010/11

In 2010/11, the 28 BACCC colleges offered 7,398 sections of 2,366 courses related to ICT, as defined by identified Top Codes. There were 17,784 full-time equivalent students enrolled in those courses. Approximately 931 of the course titles are unique and used only one time across the 28 colleges. It is difficult to determine whether course content and rigor are similar when course titles are the same.

See Appendix 18 for a list of these ICT related courses by college and Top Code.

Bay Area University ICT Education Supply

There are 10 public universities in the greater San Francisco Bay Area region, and 9 have ICT related offerings.

California State University

With 23 campuses, almost 450,000 students, and 47,000 faculty and staff, the California State University System is the largest, the most diverse, and one of the most affordable university systems in the country. More than 2 million students have graduated from C.S.U.s.

There are currently 6 CSU campuses in the greater San Francisco Bay Area:

- CSU - East Bay
- California Maritime Academy
- CSU - Monterey Bay
- San Francisco State University
- San Jose State University
- Sonoma State University

All but the California Maritime Academy have ICT related departments and academic offerings. Together, these universities have at least the following ICT related offerings:

- 23 departments with ICT related offerings
- 30 ICT related bachelor level degrees, some with multiple options
- 11 ICT related academic minors
- 23 ICT related master degrees
- 11 ICT related academic certificates

These programs prepare students for careers in business, computer engineering, electrical engineering, software engineering, computer science, management, information systems, educational technology, project management, technical communications, and other specialty areas.

There are currently 17 CSU campuses outside of the greater San Francisco Bay Area:

- CSU - Bakersfield
- CSU - Channel Islands
- CSU - Chico
- CSU - Dominguez Hills
- CSU - Fresno
- CSU - Fullerton
- Humboldt State University
- CSU - Long Beach
- CSU - Los Angeles
- CSU - Northridge
- California State Polytechnic University, Pomona
- CSU - Sacramento
- CSU - San Bernardino
- San Diego State University
- California Polytechnic State University, San Luis Obispo
- CSU - San Marcos
- CSU -Stanislaus

All but the California Maritime Academy have some ICT related departments and academic offerings. Together, these universities have at least the following ICT related offerings:

- 51 departments with ICT related offerings
- 71 ICT related bachelor level degrees, some with multiple options
- 16 ICT related academic minors
- 42 ICT related master degrees
- 20 ICT related academic certificates

Together, campuses in the CSU system have a rich variety of settings, departments and academic credentials related to ICT. However, they often have not worked well with community colleges to articulate efficient pathways from community college to CSU. That is especially true of hands-on Career Technical Education pathways, which many CSUs ignore or avoid in favor of more traditional, abstract, academic pathways and offerings.

See Appendix 19 for more detailed information and college, department and credential names and links.

University of California

There are 10 campuses serving some 220,000 students in the outstanding University of California system. Nine offer academic programs related to ICT.

There are currently 4 UC campuses in the greater San Francisco Bay Area:

- Berkeley
- Davis
- San Francisco
- Santa Cruz

All but UC San Francisco have ICT related departments and academic offerings. Together, these universities have at least 9 departments offering a variety of ICT related bachelor, master and doctoral degree options, as well as academic certificates and advanced research efforts.

There are currently 6 UC campuses outside of the greater San Francisco Bay Area:

- Irvine
- Los Angeles
- Merced
- Riverside
- San Diego
- Santa Barbara

These all have some ICT related departments and academic offerings.

See Appendix 20 for more detailed information and college, department and credential names and links.

Others

There are also a wide array of private college, universities and training opportunities in the Bay Area, ranging from world class Stanford University to sole proprietor training organizations.[21] Some offer more cost or time effective transfer pathways to advanced degrees than public universities. Community college programs and students often benefit from exploring these options.

[21] Some options for exploring these private organizations are available at http://www.mpict.org/ict_education_private_colleges_universities.html

Bay Area Regional Issues and Opportunities

ICT is likely the largest and most important industry sector in the greater San Francisco Bay Area economy. ICT Workforce is increasingly strategically important to most organizations in all industries, because their contributions build infrastructure and services that enable capabilities, productivity and efficiency across their entire workforce, and ICT employment demand is large and growing rapidly.

So, how can we, as diverse stakeholders in the Bay Area economy, come together to contribute to improving the Bay Area economy, Bay Area employer performance and Bay Area citizens' livelihoods by making ICT education and workforce development better? This is an important economic and workforce development question. Stakeholders to this issue include:

- ICT industry representatives
- ICT Workforce employers
- Various U.S., State and local government entities
- Workforce Investment Boards (WIBs) and others in the California Workforce System
- K-12 educational systems, administrators and educators
- California community college systems, administrators and educators
- California State University systems, administrators and educators
- University of California systems, administrators and educators
- Private college and university systems, administrators and educators
- Non-profits, community based organizations and grant funded efforts
- Business and industry associations
- Students and potential students
- Parents and prospective parents
- Bay Area citizens
- Philanthropists and grant funding entities

This report is focused, primarily, on a California community college audience. However, much of the data, and many of the issues and ideas in this report should be relevant to others, including community colleges in other regions of the State and country.

California Community Colleges "Doing What Matters for Jobs and the Economy"

At MPICT's inception, Information and Communication Technologies (ICT) was not an actively used term in the MPICT region, including all of California, and there was little proactive strategic attention being paid to ICT as an economic or workforce development priority, regardless of the terminology. Computer Science enrollments were in decline. IT career technical education was chaotic. Few recognized how big and important ICT is to the California economy or how pervasive and fast growing high quality ICT Workforce roles are in California.

California community colleges (CCCs) have heard the call and are responding!

As part of the CCC Chancellor's office "*Doing What Matters for Jobs and the Economy*"[22] reorganization and strategic campaign, led by CCC Vice Chancellor Van Ton Quinlivan, ICT/Digital Media is now a named economic and workforce development strategic sector for California community colleges. In 2013, when the 10 CCC Regional Consortia were asked to vote on which strategic sectors CCCs had the greatest opportunities to address to have a positive impact on the California economy and workforce, ICT/DM received the 2nd highest overall votes in the State, behind Healthcare. Ten strategic sectors[23] were chosen altogether.

In response, ICT/DM is getting significant support in the CCC system, which includes roughly $3.5m in annual grant funding for a Statewide ICT Sector Navigator (SN) and 10 ICT Deputy Sector Navigator (DSN) positions, one for each of the 10 CCC geographic regions.[24]

The strategic vision is for these ICT sector focused people to use current and future grant resources to work with colleges, faculty, administrators, K-12 systems and teachers, business and industry, and community based organizations and efforts in their regions, in close collaboration with the 10 CCC Regional Consortia,[25] to improve how ICT sector needs are met.

The CCC system divides the state into 10 geographic regions. CCC Regional Consortia are leadership collaboratives of the California community colleges in each geographic region. Strategic sector leadership, regional consortia, college administrators, staffs, deans and faculty are also supported by a variety of grant funded CCC Technical Assistance providers, which include CCC Centers of Excellence, that provide economic and labor market research services, including collaboration on this report, and a variety of other valuable efforts. All are being driven toward common Metrics and Accountability Measures.[26]

The strategy is to identify what to focus on first, those sectors and efforts that have the greatest opportunity for economic and workforce impact, focus attention and resources on those sectors, use common metrics to determine what works and what doesn't, braid different funding sources together to provide resources for those sectors, and go to work making a difference. These efforts have exciting prospects and implications.

Bay Area Community College Consortium (BACCC)

The California Community College regional consortium covering the greater San Francisco Bay Area is the Bay Area Community College Consortium (BACCC).[27] The BACCC works with 28 CCCs in the Bay Region. As detailed in the 2nd section of this report, BACCC colleges have significant efforts to address ICT sector needs already, and the BACCC and its ICT Deputy Sector Navigators have gone to work developing regional strategies and efforts to serve the sector. BACCC is divided into two sub-regions from the perspective of ICT DSNs. There are six sub-regions identified in this report, for additional granularity. Among the good ideas for addressing the ICT sector currently being discussed are the following.

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[22] http://doingwhatmatters.cccco.edu/

[23] http://doingwhatmatters.cccco.edu/Contact.aspx

[24] Contact information for CCC ICT SN and DSNs are at http://www.cccewd.net/initiative_iima4biz.cfm

[25] http://extranet.cccco.edu/Divisions/WorkforceandEconDev/CareerEducationPractices/PerkinsIV/PerkinsIVTitleIPartB/RegionalConsortia.aspx

[26] http://doingwhatmatters.cccco.edu/portals/6/docs/RFA/Common%20Metrics%20-%20Accountability%20Measures%20V19%20-%20010913.pdf

[27] http://baccc.net/

Regional ICT Faculty Professional Development

Even more than in most other sectors, the pace of innovation and change in ICT is extremely rapid. New technologies are emerging and evolving constantly. New applications of ICT technologies are being developed and implemented continually. If ICT faculty and programs do not quickly evolve with those changes, they quickly become dated and irrelevant. That is a serious challenge in this sector.

Historically, programs and colleges have figured out how to develop ICT faculty independently, with widely varying approaches and focuses. There are opportunities for efficiencies of scale, which reduce costs per faculty member developed, by coming together as a region to organize and implement ICT faculty professional development more effectively and efficiently. Faculty professional development should also include work based learning opportunities. How can we expect teachers to be preparing students for current ICT workplaces if they have not recently experienced those personally? Faculty development should include teaching methods, in addition to content. Employers routinely cite the importance of non-technical skills in their workforce requirements, but CCCs rarely respond adequately. The most effective methods to address those needs involve "how to teach," not "what to teach."

Regional Strategies for Meeting the Needs of Key ICT Occupations

There are many different ICT Workforce occupations included in this report. Some are better fits or higher short term priorities for community college workforce preparation efforts than others. For example, some community college students may transfer on to 4-year colleges and universities, end up with Ph.D. degrees and fill important Computer and Information Research Scientists roles, which drive the innovation economies of the future. Those are important roles in society, and CCCs should continue to create possibilities for those transfer pathways. However, there are only about 120 openings for those roles in the whole Bay Area every year, and there are many 4-year colleges and universities targeting graduates for those roles, universities which do not really prepare people well for so many of the hands-on workforce roles that community colleges do. Community colleges might better focus on preparing students for Computer User Support roles quickly, launching many life sustaining careers where there are 1,251 annual job openings. The largest unmet demand for ICT Workforce is in the areas of software development and programming. How can we leverage the strengths of Bay Area CCCs to better meet this demand?

Come together regionally, figure out which of these occupations are the best fits for community colleges, figure out which community colleges are best positioned to serve workforce preparation efforts for that occupation, really understand what is needed by employers for that occupation, including both technical and non-technical knowledge and skills, and develop and deliver programs optimized to develop appropriately sized, high quality workforce for those occupations. Every college does not have to do everything. Coordinate across the colleges to maximize results for the greater Bay Area.

Regional Strategies for Meeting Needs for Non-Technical Skills Development

It is rare to have a conversation with an ICT Workforce employer where the importance of non-technical skills is not one of the key topics. Community college ICT advisory groups routinely emphasize the critical importance of this topic. With 99% confidence, more than ¾ of California employers agree "Non-technical (soft, workplace or employability) skills are at least as important as technical skills in what we look for in our ICT Workforce."[28] Community college educators nod along, but rarely go back and really do anything about it. This is a very serious topic. Figure out how to deal with it, regionally.

[28] http://www.mpict.org/pdf/CA_ICT_Competencies_2013.pdf, page 5

Regional Strategies to Improve ICT Education and Workforce Diversity

To achieve the numbers needed for California and Bay Area ICT Workforce it is necessary to attract and serve students from all categories of our population. The demographics of the State and its various regions include many groups that are under-represented in ICT education and workforce. Hispanics, African Americans and other ethnic groups, women, less-privileged socio-economic groups, and others are not adequately represented in many ICT related educational programs and occupations. For example, data in this report shows that women are equally represented in ICT courses overall, but women are under-enrolled in traditional Computer Science and hands-on technical fields. Faculty demographics do not reflect the demographics of the State or region.

There are important opportunities to come together regionally and develop strategies, plans and efforts to improve the diversity of faculty and student demographics and ICT Workforce in the region.

Regional ICT Industry and Employer Advisory Groups

CTE programs in California are required to have business and industry advisory groups, to inform program content, strategies and tactics. It is a lot of work to develop, maintain and manage those advisories. Industry and employer representatives churn in and out of job roles frequently. Often, similar programs are contacting the same employers and industry representatives to serve on multiple advisories, which is not efficient from their perspectives. While it is true that there are variations in demand across regions, especially those dominated by a few major employers, it is also true that ICT technologies themselves work the same way across regions, and there are major technical content issues which are essentially universal.

Another important issue for the region to consider is how to be better prepared to respond to the emerging skill and occupational needs of employers in the ICT sector. This is a sector which is rapidly evolving, with very short life-cycles for products. New products are developed every 12-18 months– both software and hardware – which means the skills needed by ICT workers in the future may not even be known yet. How will community colleges respond to this challenge, move quickly to meet future needs and stay relevant to students and employers?

There are opportunities to improve ways that community colleges interact with business and industry advisors regionally, including implementation of remote access technologies, statistically significant polling techniques, and regional labor market information research.

Regional Efforts to Address Digital Literacy as a Basic Skill

MPICT/COE and other studies compellingly support the idea that Digital Literacy, or basic ICT User knowledge and skills, are essential to student success, no matter the field of study, workplace success, no matter the industry or occupation, and life success, no matter the position in society. Digital Literacy is now an essential basic skill, as important to student, work and life success as reading, writing and arithmetic. Yet, we have no consensus on what Digital Literacy means, what needs to be taught at what age level and how that should be assessed and validated. This issue is huge. Ideally, it would be solved at a national or State level. However, it is too important to ignore if State and Federal efforts do not emerge quickly. Come together as a region and figure out how to assure Digital Literacy of all K-12 system graduates, and how to assess and remediate it for incoming higher education students who do not already have it.

Regional Harmonization of Curriculum and Credentials

As the data in the second section of this report shows, rich and diverse CCC ICT related programs, courses and credentials have historically been developed independently by colleges, with little coordination or consistency. That makes it hard for employers to understand course content or what academic credentials represent. When an employer gets a resume with a CCC ICT credential, it is often extremely difficult to understand what that graduate knows and can do. Harmonization of curriculum and credentials could make that much easier, increasing the value of those credentials for students, programs and employers.

Further, the proliferation of courses and credentials makes it extremely complex and difficult to articulate courses and credentials and provide transfer credit for courses across colleges. There are literally thousands of different articulation negotiation possibilities just between CCCs in the Bay Area. There are thousands more between CCC programs and K-12 schools and 4-year colleges and universities. Harmonizing those courses and credentials would make it much easier for students to efficiently transfer and articulate between schools, complete programs and achieve academic credential successes.

Regional ICT Demand and Supply Gap Analyses

This report does not provide a supply vs. demand "gap analysis" for ICT occupations in the region. A gap analysis attempts to determine if colleges are under or over supplying the labor market with graduates for a specific occupation or cluster of occupations. The demand side data for ICT occupations is provided in this report, however the BACCC college data that would be needed to match the supply of graduates to a cluster of ICT occupations is not readily available. To do this analysis, the specific occupation(s) that each college's ICT programs prepare students for would need to be identified. With colleges having numerous ICT programs under different TOP codes, it would require further investigation to quantify the number of graduates from certificate or degree programs that a college is producing annually for various occupations. This would then need to be repeated for each college in the region to get an aggregate number of graduates annually who are prepared for specific ICT occupations. At that point, a regionally supply vs. demand gap analysis could be done.

Similarly, this report does not provide a skills "gap analysis" for ICT occupations in the region. A skills gap analysis would attempt to determine if colleges are preparing graduates with the ICT skills that employers are seeking in the work place. This analysis would require a skills inventory for each ICT course, certificate or degree program that a college has, in order to identify what skills are being taught to students and at what level of competency. Then a college could compare what skills it is teaching to the skills that are in demand by employers. For a regional analysis, a skills inventory would need to be conducted at each regional college with ICT courses, certificates and degrees so that the data from all colleges can be aggregated and compared to regional employer demand for specific ICT skills. This would be an enormous but valuable undertaking because it would help colleges understand if they are preparing students with the right skills for employment in the ICT sector.

Regional ICT CTE Employment Outcomes Data Collection and Dissemination

One source of data on employment of ICT graduates and ICT "skill builders" (9 or more CTE units in ICT courses) is the CTE Employment Outcomes Survey that 35 CCCs participated in in 2013. Colleges who do have employment data at the ICT program level could potentially share this with the other colleges across the region who have similar data, to begin to understand the employment and wage rates of ICT program graduates in the regional labor market. In addition, colleges in the region not currently participating in this survey could be encouraged to do so, in order to gather more of this data for the region.

Regional Coordination of Industry Academy Programs

Industry and vendor neutral academy and certification programs are trying to help ICT education and workforce development efforts by providing widely adopted and understood curriculum, instructional resources, certification testing services, certification credentials, and instructor training and support. These programs and courses that prepare students for industry or vendor neutral certifications are excellent candidates for ICT program, course and credential coordination and articulation, because those offerings are already likely to be closely aligned. Among many organizations with such resources are:

- Adobe
- Apple Computer
- Brocade
- Cengage Learning
- Certiport
- Cisco Networks
- Citrix
- CompTIA
- Computer Associates
- ECS
- EMC
- Hewlett Packard
- IBM
- International Computer Driving License (ICDL)
- Juniper Networks
- Linux Professional Institute
- Microsoft
- NetApp
- Oracle
- Pearson VUE
- Prometric
- Red Hat
- VMware

It is hard work for those organizations to try to identify appropriate contacts at individual CCCs for their educational programs and resources, and there is large inconsistency in which of these programs and resources are adopted at CCCs. Some are widely adopted, more than meeting regional need, while others are hardly adopted at all, leaving large areas of demand unserved. Further, individual CCCs that do adopt these programs and resources often address only the foundational or lower level courses and certifications, leaving no colleges serving the need for advanced certifications and training, while there is certainly adequate demand across the region to justify those offerings.

There are tremendous opportunities to improve regional CCC services to ICT industry and employment needs by coordinating industry academy, certification and resources regionally. For example, having one college offer a full suite of Cisco Networking Academy curriculum and certifications, while the neighboring college serves a full suite of Juniper Networking Academic Alliance offerings better meets student and employer demand, without duplicating efforts and wasting resources. Allowing students who have completed one certification (via preparation at one college) to get credit for that at a new college and be able to enroll right away in a more advanced certification preparation course makes the system work better for all. It could allow for a significant expansion of overall program capacity without significantly increased overall program expenses.

Regional Data Collection on ICT Industry Certifications

CCCs do not currently collect data in any systematic way on the number of students acquiring industry or industry neutral certifications related to ICT Academy programs, such as a Cisco Networking Academy or a Microsoft Academy. In other words, these are not reported to the CCC Chancellor's Office MIS system, so there is no way to know how many BACCC college students acquire these "micro-credentials," or the benefits accruing to students from these certifications in acquiring jobs, advancing in their careers or receiving wage improvements. This data gap is significant because employers understand these credentials and use them when screening for qualified candidates to hire. This information would be useful for colleges as they attempt to align their program offerings with employer demand for skilled workers.

Regional ICT Lab Facilities

For many ICT related courses, hands-on experience is an integral part of student preparation. Facilities to support labs for that are expensive to supply, and complex and difficult to set up, maintain and manage. It takes significant faculty and/or staff time and energy, and it drains both capital and operations budgets. Then, equipment quickly becomes obsolete, needing replacement, at even greater expense. Further, college administrations have different budget priorities, creating different levels of support for these investments. That leaves students at different colleges with very different technical lab experiences.

With the advent of reliable remote access technologies, it would be possible to create much better and more widely available, centralized or distributed technical lab facilities to serve all or multiple programs in the region. Imagine one state-of-the-art lab facility with the capacity to serve technical lab access needs of all students at all 28 BACCC colleges, professionally managed and maintained as "cloud services," at less cost than colleges are spending today!

Regional Curriculum, Resource and Subject Matter Expert Clearinghouse

There is currently extraordinary duplication of effort across different colleges and programs in developing and maintaining ICT related curriculum, teaching resources and subject matter expertise. All of that is taxpayer funded. There are great opportunities for making all faculty lives easier and better and for improving programs and courses by open source or other sharing efforts.

If there was a central repository for course outlines, marketing materials, student testimonials, video content, lab exercises, white papers, audio content, teaching methodologies, Problem Based Learning challenges, Scenario Based Learning scenarios, guest lecturers and other resources, all could benefit. Just creating a simple method for faculty to be able to identify their peers across the region, to be able to connect, consult and confer could have great benefits.

Establish a Bay Area regional ICT program and faculty Community of Practice, with appropriate resource sharing tools and systems.

Regional Marketing and Public Relations Efforts

Unfortunately, many industry representatives, employers, students, families, community based organizations and other potential strategic partners do not yet understand the incredible role that California community colleges play in our society, or their extraordinary capacity in delivering ICT education and workforce development services. CCCs are among the most cost-effective way of pushing badly needed ICT knowledge and skill sets out into California society. For $100, a student can get the same certification preparation course that often costs $2,500 or more at private training organizations. The numbers related to ICT education in the second set of this report demonstrate that CCCs are already teaching more ICT related topics, courses and students than any other system in the Bay Area.

Historically, most colleges do not have exceptional public relations and marketing capacity in-house, nor do they typically have budgets to allow for exceptional outside PR and marketing assistance. However, across 28 colleges there are more than enough resources to bring in top-notch assistance in helping all kinds of stakeholders understand CCCs value and ICT education capacity, recruit students, engage partners in other kinds of efforts, improve the value of CCC ICT education credentials, etc.

Regional Development and Delivery of Distance Education Solutions

It is difficult for many community college students to physically get to CCC classrooms and labs and realize student success with their diverse goals, especially since so many work and have economic disadvantages. That prevents many from taking CCC classes, or successfully completing them. Today, technologies exist that can bring the classroom to students anywhere, in real time or asynchronously. The CCC Confer[29] and 3C Media[30] suite of services, free to California community college ICT programs, faculty and students from anywhere, any time, on any device, at any network connection speed, can be used to effectively service students remotely in real time, while students are being instructed in person, while also providing recorded class archives, which can be made ADA compliant and available for viewing offline in mobile media formats. CCC Confer is also very effective for remote online faculty office hours, helping students succeed.

This multi-modal delivery serves more student situations and learning styles simultaneously, increasing the accessibility of CCC classes and the likelihood of student success in them. More traditional, asynchronous online classes can serve students anywhere. Current efforts to revitalize the California Virtual Campus[31] could provide an efficient clearinghouse for CCC ICT distance education courses statewide. Further, Bay Area CCCs, which can justify development and delivery of diverse ICT programs and courses through strong local demand, could also serve students in more remote and rural regions of the State (with adequate "broadband" infrastructure), where local colleges have much more difficulty justifying ICT offerings based on local student demand alone.

Efforts to develop, coordinate, distribute and market ICT courses via distance education formats have extraordinary potential for impact.

Regional ICT Purchasing Agreements

Simply stated, it is possible to make better deals with vendors and service providers if the deals are fewer and larger than if each program or college is tasked with negotiating their own deals individually and separately. For example, the price per server to buy 5 servers at one school is likely to be higher than the price to purchase 140 servers (5*28) to meet the needs of all programs or colleges in the region.

There are many opportunities to realize economies of scale by coordinating buying efforts across ICT programs and colleges in the region: software licensing agreements, online tutoring services, learning management systems, faculty professional development, computers for students, etc.

Regional Contract Education Services

Community colleges have wonderful ICT related education, faculty, curriculum and other services, which can be offered as custom contract education services directly to employers, other educational institutions, community based organizations, workforce investment boards (WIBs), and others. It is difficult for any single college to develop, market and manage those services optimally. There are great opportunities to expand and improve in demand CCC ICT contract education services by organizing those services regionally. These could become profit centers, providing resources to further improve ICT education delivered in more traditional ways.

[29] http://www.cccconfer.org/

[30] http://www.3cmediasolutions.org/

[31] http://www.cvc.edu/

Regional Experiential or Work-Based Learning Systems

For a variety of good reasons, employers respect and often demand real world experiences before hiring ICT Workforce. Those include uncertainty about the content and value of ICT academic credentials, the very real importance of interpersonal, employability, career navigation and soft skills, whatever they are called, and the important learning that takes place in the real world about how things work in the real world. It is rare to find an employer voice that does express the importance of these "soft skills" and real world experience when asked about what they are looking for in their workforce. Yet, community college programs rarely do enough to develop those capacities in students. Part of the reason for that, is that this is a challenge to pedagogy, rather than a matter of new content to teach in old ways. Faculty are challenged to adopt new teaching strategies and methods to address this need, things like problem-based or scenario-based learning and "flipped" classrooms. Work based and experiential learning opportunities include: internships, site visits, job shadowing, mentoring, industry or employer partner co-teaching, service learning, contract job placement, and problem- and scenario-based learning.

The most successful work-based learning solutions involve competent, dedicated resources: full-time staff and adequate systems focused on industry and employer outreach and relationship management, program and faculty outreach and coaching, pre-screening students, support services to prepare students, ongoing efforts to be sure student placements are working out for employers, replacing poorly performing students, figuring out and managing student compensation, marketing, data gathering and reporting. Few individual colleges have the resources to do that well alone, and different colleges interfere with each other in employer relationships by providing different and competing programs, messages and qualities.

With a centrally organized and managed professional organization devoted to ICT work-based learning systems and solutions, all would be better served than they are today.

Regional Alumni Networks

Past students of ICT programs at California community colleges are a vast and typically under-utilized resource for colleges and their ICT programs. Few understand the value and potential of industry and employer relationships better than industry and employer representatives who have come through the CCC system. Most individual colleges lack the resources to develop and manage alumni networks well. This could be done more cost effectively and better across a portfolio of colleges than by individual colleges. Alumni networks are used very effectively elsewhere in education, for fund-raising, job placement, experiential and work based learning, and public relations. Social networks like Linked-In can be used very effectively for that. CCCs could do that also, for the benefit of ICT education and workforce development.

Regional K-12 Pathways Development and Coordination

K-12 educational systems are struggling to adapt to 21st century economies and the demands related to ICT education and workforce development also. It is important that community colleges and K-12 systems step out of their silos and work together to create solutions for digital literacy education and for functional pathways from K-12 to community colleges. The California Department of Education has also adopted ICT nomenclature and has revised its Career Technical Education ICT pathway standards.[32]

[32] http://www.cde.ca.gov/ci/ct/sf/documents/infocomtech.pdf

To attract and develop the numbers of ICT Workforce needed in the Bay Area, it is important that we expose students to ICT technologies and career opportunities early, ideally in middle schools. It is also important that we create viable, stimulating and rewarding opportunities for students interested in ICT to pursue those interests while they are in high schools. As the ICT economy booms in San Francisco, recognized globally as an ICT industry and technology leader and "name brand," half of its 17 high schools do not offer any ICT related classes[33]. It is even worse in many other districts.

There are many opportunities to improve ICT education and workforce development efforts, and ICT pathways from K-12 to community colleges. Establishing regional working groups focused on those issues has more systemic promise than expecting colleges and their ICT programs to figure this all out on their own, without support or guidance. That approach leads to inconsistencies across the systems and, at best, one-to-one kinds of relationships and solutions that do not scale or fit together.

Opportunities include:

- CCCs providing or assisting with K-12 faculty professional development in ICT. (We can't really expect K-12 teachers to do a good job teaching ICT if they do not know what they are teaching.)
- Developing ICT dual and concurrent enrollment courses, in which K-12 students receive both high school and college credit for ICT courses taken in high school. (This is a powerful tool for increasing student incentives to take ICT electives in high school and to pursue higher education.)
- Researching and sharing information on high school and community college programs, courses and credentials related to ICT, to facilitate contact between interested parties and informed interactions between them.
- Developing formal articulation agreements for ICT courses between high schools and community colleges, especially related to high school courses complying with CDE ICT CTE standards.
- Collaborating to create functional and valuable ICT work based learning opportunities and systems that serve both high school and community college students.
- Collaborating to develop and share industry and employer relationships and collaborations that can benefit both high school and community college ICT programs and students.
- Creating community college ICT workplace learning programs that give college students valuable real world experiences by developing and supporting ICT infrastructure at K-12 schools.
- Jointly developing and implementing ICT education and career fairs to turn students on to ICT.
- Working together to establish digital literacy standards, curriculum and assessments for all students.
- Conducting cybersecurity and other competitions, to make it all more fun and engaging

Regional University Pathways Development and Coordination

Four year colleges and universities are also struggling to adapt to 21st century economies and ICT Workforce needs. In California, community college, California State University and University of California systems and colleges largely operate in isolated silos. There is inadequate interaction, cooperation and coordination between these systems and their members to efficiently meet 21st ICT education and workforce development needs.

[33] http://www.mpict.org/pdf/San%20Francisco%20Education%20Pathways%20to%20ICT%20Careers.pdf

One particularly broken pathway related to ICT has to do with, often uninformed, employer requirements for bachelor degrees for IT operational roles that also demand hands-on technical skills. Many of the universities look at hands-on education and training with disdain and do not accept hands-on coursework for academic transfer credit. This creates a disincentive for students to try to transfer to universities to complete bachelor degrees, because there is too much wasted time and credit. Interestingly, a prevalent higher education articulation pathway today is for students who have already received bachelor degrees (about half living at home again with student debt, unable to get jobs without workplace skills) recognizing how many jobs require ICT skills, and then taking ICT classes at the community college which enable them to get good jobs. We need to develop cost effective, efficient and viable community college to 4-year college and university transfer and articulation pathways in ICT, specifically in applied technology areas that lead to employment in IT operations.

Another serious problem is severely inadequate enrollment in computer science pathways that lead to software development and programming workforce roles. These have the highest workforce demand in the Bay Area, and we are not even remotely close to having the numbers of students needed in pathways to those jobs. University CS programs need to be collaborating with CC and K-12 partners to attract and serve many more students in CS pathways.

Responsive to California Assembly Bill AB1440, which basically said, we the lawmakers and taxpayers of California are tired of paying for students to take classes at community colleges which they do not get credit for when they transfer to the state universities, get together and develop real 2+2 models, which use common courses and course numbering, referred to as C-ID. This was exciting, because it could cause real curricular change in obstinate educators, because it has the power of law behind it. Educators would be directed to align to these transfer pathways and courses.

Related to ICT, a transfer model curriculum was pretty quickly approved for traditional Computer Science (in large part because of its maturity and the structure developed through ACM efforts). A Faculty Discipline Review Groups (FDRG) attempted two others: one in business information systems that would transfer into university business school MIS kinds of programs - and another in IT, focused on working with applied technologies in IT operations employment. The business pathway effort was killed with the objection that there was not enough room in the curriculum (after General Education requirements) to adequately differentiate the pathway from the straight business degree transfer pathway. The IT focused effort was rejected, because there are not enough CSU campuses teaching IT subjects for there to be enough places for community colleges to transfer students to.

The FDRG group then went on to create a draft, recommended "Model Curriculum" for IT or ICT. It will not have the power of law behind it, unfortunately, but it would still be encouraging and enabling movement toward IT curricular harmony in California. That effort built on MPICT's study[34] validating U.S. Department of Labor IT Competency Model[35]. If not any of these, CCCs and CSUs should align on something.

Community colleges and 4-year colleges and universities should also be working together to establish definitions, standards and standard assessments for digital literacy. Digital literacy is essential for student, workplace and life success in the 21st century. We should have a common definition of Digital Literacy, and we should be assessing incoming higher education students to determine whether they are digitally literate. If not, there should be consistent efforts to remediate digital literacy across higher education.

[34] http://www.mpict.org/pdf/CA_ICT_Competencies_2013.pdf

[35] http://www.careeronestop.org/competencymodel/pyramid.aspx?IT=Y

Regional Development of CCC ICT Related Bachelor Degrees

Another challenge is that within the community colleges, ICT education roles are often overlapping and not coordinated between ICT academic programs that are preparing students for transfer to four-year colleges and CTE programs focused on ICT that are preparing students for employment. Related to this there are currently inadequate Bachelor's degree options for hands-on ICT skills being awarded by community colleges or within the CSU system. Many employers want a four year degree for technical positions, but our higher education system in California does not currently have enough technical hands-on ICT education programs that award a Bachelor degree. CSUs can be encouraged to step up to serving this demand, or CCCs could theoretically find a way to offer these in-demand bachelor degrees. Encouragingly, community colleges now have the authority to offer a limited number of bachelor degrees. Advocate for use of this ability for ICT degrees, rather than for disciplines with less compelling needs.

Regional Workforce Investment Board Collaborations

In coordination with the California Community College system, the California workforce system has also adopted the ICT/Digital Media sector name. That system includes the California State Workforce Investment Board (CWIB)[36], the California Workforce Association (CWA)[37], and each of the 49 individual Workforce Investment Boards (WIBs)[38] in the State.

Like California community college regions, each of the 49 Workforce Investment Boards in California was asked to vote on priority and emerging strategic sector priorities, and with relatively little information on which to base the decision ICT/DM was within the top 5 sectors statewide. It was the number two WIB sector choice within the great San Francisco Bay Region, behind Healthcare.[39]

The greater Bay Area community should collaborate to help Bay Area WIBs better understand the strategic importance of ICT/DM and to develop and coordinate strategies and programs to better meet ICT sector needs in the greater Bay Area economy. Community colleges should be collaborating with WIBs, in a regionally coordinated manner to, among other things:

- Help WIBs refer clients to CCC ICT related program and course offerings
- Have CCCs assist in ICT related workforce training for WIBs, perhaps as contract education
- Have CCCs provide ICT related staff technical professional development for WIBs
- Agree on definitions, standards, assessments and solutions for digital literacy
- Build efficient and effective industry and employer relationships and collaborations
- Collaborate on grant applications and efforts
- Get WIBs to assist CCCs with support services needed for ICT student success, like soft skills training, job search strategies, resume coaching, interview practice, and self-assessments.
- Do regional marketing and PR to promote the ICT sector and WIB/CCC ICT sector services
- Collaborate on meeting specific requirements of WIA, TAACT and other U.S. Department of Labor initiatives and grant opportunities

[36] http://www.cwib.ca.gov/

[37] http://calworkforce.org/

[38] http://www.servicelocator.org/wibcontacts/default.asp?state=CA&lst=11

[39] http://www.cwib.ca.gov/res/docs/meeting_agendas/2013/CWIB%20Full%20Board%20Meeting/081313%20Part%203%20Item%204%20B1%20pg1.pdf

Regional Grant Proposal and Project Efforts

For a long time, most funding streams have been negatively impacted by the economic collapse. Now, however, funding streams are opening up again. Funders are seeking to make high quality public investments that will produce the best possible results for economic growth and workforce development. Many prefer grant proposals that show strong collaborations across traditional silos, because they know that the potential impact of those collaborations is better than for efforts of any single party, organization or system. For example, California Assembly Bill 86 authorized an initial $250 million in Career Technical Education grants for improving pathways from K-12 to community college to career. ICT proposals in the Bay Area should be very compelling, if they fairly represent the demand detailed in this report and strategies and activities like those in this section. Identify prioritized strategies and activities to improve ICT sector services, build teams and proposals for solutions, and seek funding to implement those solutions.

Regional Event Planning and Execution

There is a great deal of confusion, misinformation and misunderstanding about ICT/DM. For example, many people still, utterly falsely, believe that "all of the ICT jobs went to China or India." In addition to other regional ICT marketing and public relations work, there are many opportunities to infuse ICT technologies, outreach, information and advocacy into a wide variety of Bay Area public events, like:

- Job and career fairs
- Sporting events
- College fairs
- High school events
- Science fairs
- Makers fairs
- Entertainment events
- Hackathons

Regional coordination of those efforts should yield better results.

Community Based Organization (CBO) Collaborations

A wide variety of community based and non-profit organizations and other social enterprises have identified gaps in our social systems for meeting ICT workforce demands and stepped in to serve groups affected by those problems and "missed" or "overlooked" by the systems. For example, there are many after school programs and clubs that try to help students gain access to ICT and learn to use it in schools that do not offer adequate student choices. CBOs target specific populations with specific strategies and services to assure their participation and success in ICT. Develop an understanding of these organizations and efforts, how they work, their "critical success factors," and figure out how to work with them for mutual benefit. Many would love to be able to offer college credit in their programs, for example.

Regional Efforts to Inform K-12 and College Administrators, Boards and Deans

Most education administrative and academic decision-making is typically mostly done locally. Different schools or districts make different decisions, and have different priorities and rationales, depending on who those decision-makers are, what they know and their personal perspectives and biases. There is a shared need across all Bay Area colleges, K-12 schools and systems, and 4-year college and university schools and systems to help governmental and administrative decision-makers understand the complex ICT sector and its unique demands.

It is not uncommon, especially during difficult economic conditions, for college administrators to cut ICT related programs, because they are more expensive than others. It costs more to run a technical curriculum that requires technical lab facilities than it does to run (random examples) history or math classes, which only need textbooks and chalk. However, that technical curriculum may lead quickly and directly to gainful employment, while the history or math class may not. That technical curriculum has a bigger short term impact on economic and workforce development and the real world success of its students. How can we help college administrators better understand and prioritize ICT sector opportunities?

College administrators tend to evaluate program success by numbers of academic transfer, degree or certificate completions, which are tracked and measured by CCCs. ICT student goals often do not include academic transfer, degree or certificate completion. They seek knowledge and skills that allow them to gain ICT Workforce employment or advance in their careers. A few classes at a CCC often allows them to accomplish their goals. They take a few classes or get an industry certification and get good jobs or pay raises. Yet, they are counted as academic failures by college administrators, often leading to ICT program penalization. How can we work together regionally to help them understand this better?

Increased and informed use of the new CCC CalPass Launchboard system, designed to provide data relevant to assessing the success of CTE programs and student success in entering and advancing in the workplace, has great potential in this area.[40]

Other Regional Data Collection on ICT Student Employment Outcomes

Anecdotally, students in CCC ICT related programs and classes are getting ICT related jobs. Yet, community colleges have not historically tracked employment outcomes, and they have not been evaluated based on employment outcomes. Rather, their incentives have been "butts in seats," or degrees or certificates completed. Especially for Career Technical Education, those incentives are often misaligned. Student success is ultimately workplace success. Efforts are underway at the CCC system level to try to address this problem. Get engaged in those efforts. Advocate on behalf of ICT. Tell stories of student employment success until you can get data.

Badging/Micro-credentials

In large part due to an effort by the Mozilla Foundation Open Badges initiative[41], there is a lot of talk now about the prospects and possibilities of badges, or micro-credentials to validate and communicate ICT student skills. These are often referred to as Digital Badges, because they could be issued and tracked electronically via the web. The idea is great. Provide incentives and credentials for bite-sized skill chunks which employers can understand and validate quickly and match to employment demand.

This idea is risky when it comes to implementation. This report details big problems within the CCC system, just here in the Bay Area, when too many different programs and institutions offer too many differing courses and credentials. The value and understanding of those offerings and credentials gets diluted, because there are simply too many of them, and they are not adequately coordinated or communicated. This problem can become much worse if digital badges are implemented widely at different college or program levels. The ensuing proliferation of microcredentials chaos threatens to devalue all of them.

[40] http://www.calpassplus.org/Launchboard/Home.aspx

[41] http://www.openbadges.org/

The Boy Scouts operate perhaps the best known and most successful badging system. Imagine the Boy Scouts if every troop was able to make up and distribute whatever badges it wanted. The Boy Scout badging system works because there is a centrally administered system of widely understood, clearly defined, clearly communicated and broadly adopted limited set of badges. Everybody knows what a Tenderfoot and Eagle Scout are.

Resist the temptation to proliferate low or no value badges and work instead to get badging systems implemented in a widespread way by reputable and centrally administered organizations, like vendor-neutral and industry academy programs, IEEE, ACM and the CCC system itself.

Digital Divide Advocacy

The "Digital Divide" is a term describing inequalities related to access to information and communication technologies and abilities to use them effectively. Significant segments of our populations still do not have, cannot afford, or do not choose to buy access to ICT hardware, systems and services. ICT access and capabilities are essential for life, education and workplace success in the 21st century, though. These differences create a separation between digital "Haves" and digital "Have Nots." Those without access and competent use of ICT systems and services are at a serious disadvantage relative to those who do access and use ICT effectively.

A recent California Emerging Technology Fund report shows that a quarter of Californians lack access to "broadband" Internet services at home, and certain populations have even lower access rates, including:

- Not a high school graduate (32% broadband adoption rate)
- Spanish-speaking Latinos (46%)
- All Latinos (63%)
- 65 or older (47%)
- Household income of less than $20,000 (53%)
- People with disabilities (59%)
- Non-citizens (60%)[42]

Participate in advocacy efforts and solutions to address this problem.

Regional ICT Apprenticeship Programs

President Obama mentioned apprenticeships some 26 times in his 2014 State of the Union Address. Other countries very effectively manage apprenticeship programs in ICT, which balance classroom and workplace learning and provide very efficient pathways to employment. The US Department of Labor is working on developing Registered Apprenticeships in ICT, and it held its only meeting with employers in the country so far to plan ICT Registered Apprenticeship programs, June 2014 in San Francisco.

Engage with those efforts. Community colleges are a natural and broad scale partner in ICT Registered Apprenticeship programs.

[42] http://www.field.com/fieldpollonline/subscribers/Rls2476.pdf

Regional Advocacy Efforts

There are many other issues related to ICT in 21st century economies that are larger than the greater Bay Area in scope. Advocacy efforts to address those issues are much more effective when they are coordinated. Many individuals and organizations speaking the same messages with one loud voice get better results than many individuals and organizations all saying different things with different words.

Issues for statewide and/or national advocacy efforts related to ICT could include needs for:

- Comprehensive, detailed, teachable and assessable definitions and standards to be rolled out throughout all of public education, public workforce systems and society for Digital Literacy, which, with 99% confidence, an MPICT/COE study showed 85% of California IT Operation representatives saying is now as important as reading, writing and arithmetic, a basic skill which should be taught to all.[43]
- Common CTE standards for ICT in California community colleges to be able to better align and harmonize CCC programs, courses and credentials statewide.
- Local, state and federal lawmakers, policymakers and planners who are knowledgeable about the ICT sector and its needs, so they can be making more informed and better decisions impacting ICT economic development, education and workforce development.
- K-12, community college, 4-year college and university administrators, policymakers and deans to be educated about the ICT sector and its needs, so they can be making more informed and better decisions impacting ICT economic development, education and workforce development.
- More and better ICT infrastructure for K-12 schools and students, computers, high-speed internet access and software.
- Increased compensation for ICT faculty, so education can compete with the private sector in recruiting talent to teaching ICT.
- Increased diversity of students on pathways to ICT careers to reverse downward trends, with a vision of an ICT workforce that reflects state, regional and local demographics.

Regional advocacy efforts might also include efforts to develop additional statewide systems and resources that would improve the efficiency of ICT education and workforce development efforts regionally, as they improve ICT education and workforce development efforts statewide, like:

- Negotiating statewide/system master contracts to secure much lower equipment, software licensing and other pricing for things needed by ICT programs.
- Developing a single and coordinated learning management system for all colleges.
- Making the California Virtual Campus (CVC) really work as a single source for all asynchronous and synchronous online or distance education offerings of the CCC system, so students anywhere could realistically take ICT courses from any CCC.
- Negotiating transfer and model curriculum agreements with CSUs that force alignment.

Gather ICT education and workforce development stakeholders regionally, focus on developing opportunities for improving ICT sector service performance like those above, prioritize among them those with the greatest potential impacts and the shortest implementation timelines, develop strategic partnerships and plans for implementing those changes, pursue any needed funding, and go to work!

[43] http://www.mpict.org/pdf/CA_ICT_Competencies_2013.pdf, page 5

Engagement with ICT Industry and Employer Organizations and Other Groups

The San Francisco Bay Area is special with regard to ICT. It is a world leading nexus, a hub and innovation center for ICT. Many of the world's leading ICT industry companies have a presence in the Bay Area, and many of these organizations have significant resources, capabilities, power and influence: Google, Facebook, Intel, Apple, Oracle… Many of them have philanthropic funds. ICT venture capital is big in the Bay Area. There are many individuals who have made fortunes in ICT who would like to give back. This Who's Who in ICT is an extraordinary list of collaboration candidates. In addition, there are many organizations with members from these organizations that have great collaboration potential, like the Silicon Valley Education Foundation and the Bay Area Council.

Successfully engaging the support and assistance of organizations like these has extraordinary opportunities. Go for it, with well thought-out and articulated expressions of problems and opportunities and "asks" for how to address them.

Improve CCC ICT Student Success Rates

Data in this report shows wide variations across colleges, programs and TOP codes in student success rates, the rates at which they pass classes and the rates at which they successfully complete academic degree, certificate and transfer goals. Figure out why students are and are not successful. Replicate practices that improve student success and reduce practices that reduce student success, so that more of these students are progressing through ICT educational and career pathways.

Conclusion

ICT industries, which create, market and deliver ICT related goods and services, are among the largest and most important strategic industry sector clusters in the greater San Francisco Bay region. In 2012:

- 16,360 establishments (100% of Primary plus 100% of Secondary ICT Industries),
- 8.7% of the total number of firms,
- employed about 411,335 people (100% of Primary plus 25% of Secondary ICT Industries),
- 10.2% of total industry employment in the greater SF Bay Area,
- More than 1 in 10 jobs,
- expecting 7.3% overall employment growth, or 32,455 net new jobs added, 2012 to 2015,
- 17.2% of the overall employment growth expected for all industry employment in the Bay Area.
- Primary and 25% of Secondary ICT industries generated $230.4 billion in sales revenue in the Bay Area, which was nearly 20% of total regional sales revenue for all industries.
- Primary and 25% of Secondary ICT industries generated $86.3 billion in earnings in the Bay Area, which was nearly 23% of total regional earnings for all industries.

Multiplier effects expand the economic impact of this sector hugely, perhaps accounting for as much as half of Bay Area employment. ICT industry support should be a high, ongoing economic development priority in the San Francisco Bay Area.

ICT Workforce doesn't just work for ICT industry employers. ICT Workforce is now strategically essential to most organizations, across all industry sectors in the State, because that workforce enables the productivity of all workforce and the strategic efforts of all business functions. ICT Workforce demand in the Bay Area is huge and growing. In 2012:

- 333,229 people employed (100% of Primary plus 10% of Secondary ICT Occupations)
- 8.3% of all Bay Area employees (about 1 in 12 jobs)
- With median annual salaries of about $90,000
- 20,297 net job growth (6.1%) anticipated between 2012 and 2015
- 21,178 total replacement jobs between 2012 and 2015
- 43,054 total job openings (8.2% of all job openings) between 2012 and 2015
- 14,354 average annual job openings between 2012 and 2015

There are many different standard occupations with the ICT Workforce cluster. Those are hard for education and workforce systems to keep up with, because they change and evolve quickly, and because employers do not typically use standard or consistent job titles or requirements. However, ICT Workforce occupations are the best places for CCCs to focus ICT related program and planning attention.

The 28 colleges in the Bay Area Community College Consortium (BACCC) have wonderful resources, faculty, curriculum and credentials related to ICT. In 2010/11:

- 82 departments
- Some 1,350 faculty
- 140,000 for-credit enrollments
- 16,000 non-credit enrollments
- 180 associate degrees
- 405 academic certificates
- Strong vendor neutral and industry academy programs
- Industry certification test preparation
- Service all Bay Area geographic areas
- Affinity to K-12 systems and schools
- Affinity to 4-year colleges and universities

Historically, those college offerings have been developed and delivered locally, with little regional coordination. However, today there is a new strategic emphasis and plan to bring those colleges together to better address ICT sector needs through the CCC "Doing What Matters for Jobs and the Economy" effort. That effort includes a Statewide ICT Sector Navigator and two Bay Area region ICT Deputy Sector Navigators. These are exciting developments.

There are many ways the diverse stakeholders to a thriving ICT industry and employment sector in the San Francisco Bay Area can collaborate to improve ICT economic and workforce development. This report makes a number of suggestions, but there are certainly many others.

21st century economies and workforce are different from 20th century economies and workforce. Let's wake up to and embrace these new realities, recognizing our strengths in the Bay Area around ICT and organizing ourselves and our efforts around making that work even better!

We need to be able to grow the ICT Workforce needed by Bay Area ICT industries and ICT Workforce employers right here in the Bay Area, for the benefit of our local economies, communities and citizens!