

Career and College Pathways in the Information and Communications Technologies Sector

April 2015

Gary Page, Education Programs Consultant
California Department of Education

In November 2011, the Georgetown University Center on Education and the Workforce released two new reports in collaboration with the National Research Center for Career and the Technical Education (CTE) and the National Association of State Directors of Career Technical Education. Using forecasts, the report identifies the most promising clusters for job seekers with a high school diploma or less, middle skills such as a certificate or Associate's degree, and those with Bachelor's degrees or better.

Data presented in the [Career Clusters](#) and [State](#) level data reports highlight job opportunities and skill requirements through 2018 arranged by the 16 career technical education career clusters in the Carl D. Perkins Act of 2006 (Perkins IV). Much of the information below was extracted from the Career Clusters report. The term Information and Communication Technologies (ICT) Sector is synonymous with the term Information Technology (IT) cluster used in the Career Clusters report. ICT is an umbrella term, widely used outside the United States (U.S.), to encompass all rapidly emerging, evolving and converging computer, software, networking, telecommunications, Internet, programming, and information systems technologies.

The ICT Sector stands out as one of the top opportunities for students with jobs projected to increase by 27 percent making the ICT Sector the fastest growing career cluster through 2018. The ICT Sector meets national criteria for high demand, high wages, and high skills and is reported to be the driving force of innovation behind the efficiency initiatives of all career clusters. While this national trend data is useful, you should also consider information from your local economy and regional reports about ICT jobs that are referred to as [Environmental Scans](#).

Courses like [Exploring Computer Science](#) (ECS) would be helpful to all students and would also function well as a foundational course for all ICT Sector CTE courses that concentrate in particular subjects like computer applications and support, web design and development, networking, and software and systems development. The award winning ECS was developed in California through a partnership with the University of California, Los Angeles and Los Angeles Unified School District, has received national recognition and a–g and CTE approval.

Information and Communication Technology as an Innovative Driving Force

The Internet has revolutionized the way consumers and businesses relate to the economy, and information technologies have driven the innovations that have

revolutionized the workplace in the last quarter of a century. In the 19th and 20th centuries, electricity and the internal combustion engine drove the rise of manufacturing and America's shift away from an agrarian economy. Today, computers and related inventions are driving the information revolution, transforming the U.S. economic landscape once again. Just as building a mass kindergarten through grade twelve education systems was essential for producing workers capable of carrying out the industrial revolution, the information revolution is demanding the building of a mass postsecondary system to meet the needs of sophisticated new and rapidly changing industries, such as computer systems design or financial services.

Information technologies have managed to touch nearly every aspect of life. For example, initiatives in Health Science seek to improve coordination of care with electronic health records. ICT professionals design the protocol for these records and ensure their security and usability. The global spread of mobile phones provides evolving opportunities for workers to link service providers to consumers in new markets. This career cluster continues to revolutionize finance and banking, allowing for easier exchange and changing the way people purchase and consume goods.

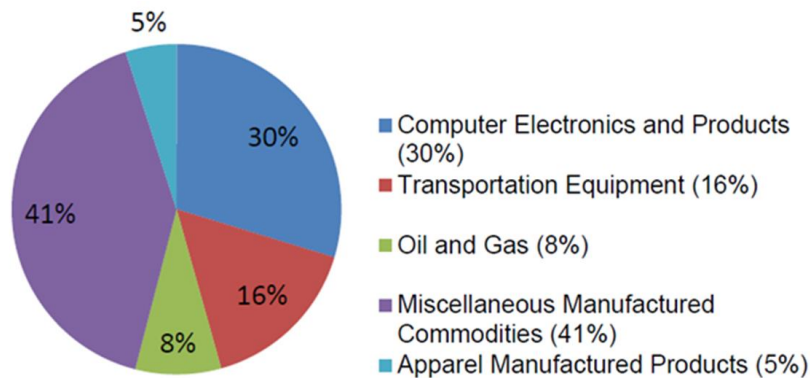
Not only has technology changed the way people consume, it has also dramatically changed the workplace. New computer programs have increased efficiency and productivity in nearly all industries: engineers in manufacturing can design and test new products in a fraction of the time previously required and instantly program their designs into automated assembly lines, thus keeping production up to date with market trends.

The ICT Sector has shaped, and continues to shape, in countless ways staffing and employment patterns favoring more skilled workers. Two competing trends will decrease and increase the demand for skills during the next decade. On the one hand, information technology jobs that require limited technical skill, local knowledge, or innovation are liable to be outsourced overseas because computer programming is not place-specific and transportation costs are close to zero. However, the impending retirement of baby boomers guarantees a significant amount of job openings, at least temporarily, for qualified workers. Close to 40 percent of workers were between 45 and 63 years of age in 2009. Career opportunities will be best for workers with experience in information protection and security, as sensitive information (bank records, health records, and corporate and national secrets) increasingly shifts online and needs to be protected.

Information technology has been relatively sheltered from the worst of the recession, although it did experience some decline. During the recession, unemployment in the career cluster jumped from 6 to 8.4 percent between 2009 and 2010. However, for prime age workers (25–54), the unemployment rate dropped from 5.1 percent in 2009 to 4.5 percent in 2010 and is 4 percentage points lower than the national unemployment rate.

The Golden State

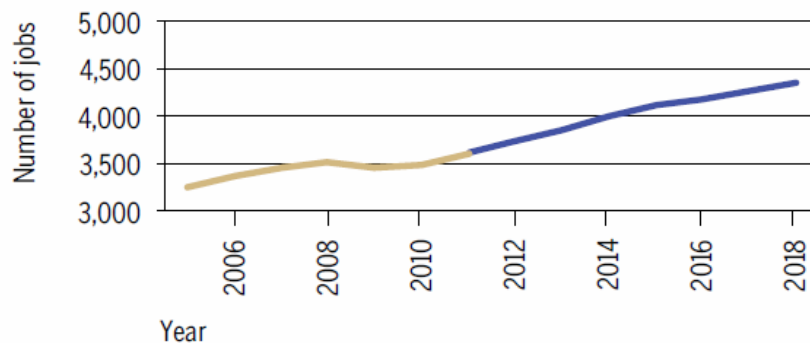
ICT is of great importance to California's economic welfare. In 2013, export of Computer and Electronics Products accounted for \$42.4 billion. As shown in the graph below, as reported by the Governor's Office of Business and Economic Development, ICT is California's largest export category:



Projected Job Growth in Information and Communication Technology

Knowing the demand for ICT workers by education requirements for employment provides information about which levels of educational attainment, particularly in critical areas of science and math, are in most need. This information is also necessary for making sure high school students are college and career-ready. According to the tables below from the Career Clusters report, State Data, ICT jobs in California will increase by 27 percent and ICT will be the fastest growing career sector through 2018.

Figure 30. Jobs in Information Technology are projected to grow by 23 percent between 2008 and 2018, demonstrating the career cluster's influence on every facet of industry and job requirements.



SOURCE: The Georgetown University Center on Education and the Workforce forecast of education demand through 2018.

	CLUSTER	JOBS IN 2008	JOBS IN 2018	DIFFERENCE	PERCENT CHANGE
<p>CALIFORNIA</p> <p>IN CALIFORNIA, the Business, Management, and Administration cluster will be the largest cluster overall, but Information Technology will be the fastest growing. Jobs in the Information Technology sector will increase by 27% by 2018.</p> <p>Marketing, Sales, and Service will add the most jobs in California through 2018.</p> <p>In 2018, 43% of all jobs in California will be found in the Business, Management and Administration, Marketing, Sales and Services, and Hospitality and Tourism clusters.</p>	Agriculture, Food, and Natural Resources	767,000	818,300	51,300	7
	Architecture and Construction	1,156,500	1,220,300	63,800	6
	Arts, A/V Technology, and Communications	339,800	369,500	29,700	9
	Business, Management, and Administration	2,756,700	2,998,100	241,400	9
	Education and Training	1,142,000	1,359,700	217,700	19
	Finance	471,700	502,600	30,900	7
	Government and Public Administration	214,600	231,000	16,400	8
	Health Science	1,054,900	1,293,200	238,300	23
	Hospitality and Tourism	2,179,300	2,475,500	296,200	14
	Human Services	674,500	782,600	108,100	16
	Information Technology	446,800	569,600	122,800	27
	Law, Public Safety, Corrections and Security	512,900	600,400	87,500	17
	Manufacturing	1,171,000	1,191,200	20,200	2
	Marketing, Sales, and Service	2,303,000	2,619,800	316,800	14
	Science, Technology, Engineering, and Mathematics	415,200	460,300	45,200	11
	Transportation, Distribution, and Logistics	1,322,800	1,388,200	65,400	5
	TOTAL	16,928,700	18,880,300	1,951,600	12

Many jobs in Information Technology require middle skills or a Bachelor's degree.

Good Pay for Middle Skill level jobs

ICT jobs pay relatively high wages for workers whose highest educational attainment is a high school diploma. Workers with only a high school diploma in ICT can easily earn wages above the minimum earnings threshold. Effective high school CTE programs must provide not only solid academics but also offer state-of-the-art training.

ICT workers often obtain industry based certifications or licenses that attest to their ability to perform particular tasks. Certifications like certified professional engineer, CompTIA A+ service technician, Microsoft Office specialist, and Excel certification are a significant driver influencing wages for ICT even at relatively lower education levels. While students can get good paying jobs in the ICT Sector with a strong high school technical program, postsecondary education has become the new norm.

Table 56. Workers with only a high school diploma in Information Technology can easily earn wages above the MET.

	YEARLY WAGES BY EDUCATION (SAMPLE, 2007-2009)					
	LESS THAN HIGH SCHOOL (\$)	HIGH SCHOOL DIPLOMA (\$)	SOME COLLEGE/NO DEGREE ^a (\$)	ASSOCIATE'S DEGREE (\$)	BACHELOR'S DEGREE (\$)	MASTER'S DEGREE OR BETTER (\$)
Computer and information systems managers	—	70,400	80,700	79,200	97,700	113,700
Computer programmers	—	56,200	66,500	64,600	73,000	82,700
Computer software engineers, applications	—	—	78,200	74,000	85,400	94,100
Computer support specialists	—	48,200	50,200	49,900	58,900	67,200
Database administrators	—	50,900	62,200	62,300	75,400	83,600
Network and computer systems administrators	—	58,500	62,500	60,100	69,400	81,500
Network systems and data communications analysts	—	52,600	57,700	57,500	62,500	75,300

^a Some college includes postsecondary vocational certificates.
 — Cell data suppressed due to small sample size.

More Pay for Higher Skill level jobs

Given the recent emphasis on improving college completion, specifically at the postsecondary middle-skills level, identifying those career clusters where employment demand is highest may provide the information needed to target programs that would increase both completion rates and placement of graduates. More than one-quarter of computer support specialists and network and computer systems administrators have completed some college courses.

The ICT Sector, the fastest-growing career cluster, is also the cluster with the highest overall share of postsecondary employment, most of which requires a Bachelor's degree or better. More than 70 percent of jobs in Information Technology will require a Bachelor's degree or better by 2018. College-level workers in many ICT jobs earn wages well above the minimum earnings threshold. The [California Statewide Career Pathways](#) project offers resources to articulate high school and community college courses.

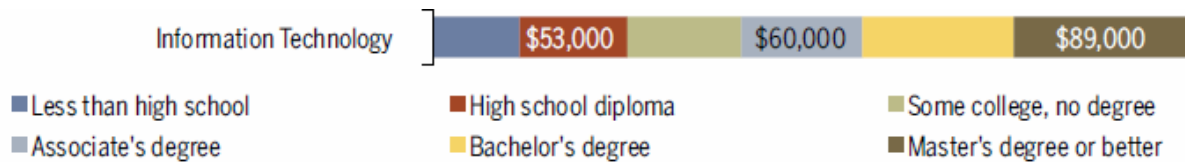
The number of graduates in ICT dropped sharply during the years following the dot-com collapse and amid the increasing trend in off-shoring jobs in programming. Enrollment has rebounded somewhat, but increased demand for new graduates with skills in new applications plus business skills has led to a shortage of employees, problem-solving, and technical-skill gaps, particularly in areas requiring database managers, software developers, and architects.

Professionals looking to work in career clusters such as Business, Management, and Administration or Finance are expected to possess some specialized coursework or professional experience. As a result, computer and information systems managers must acquire administrative skills in addition to a strong technical background. Some positions are available for workers at the pre-baccalaureate level, although most require at least a Bachelor's degree in a related field.

Projected Earnings

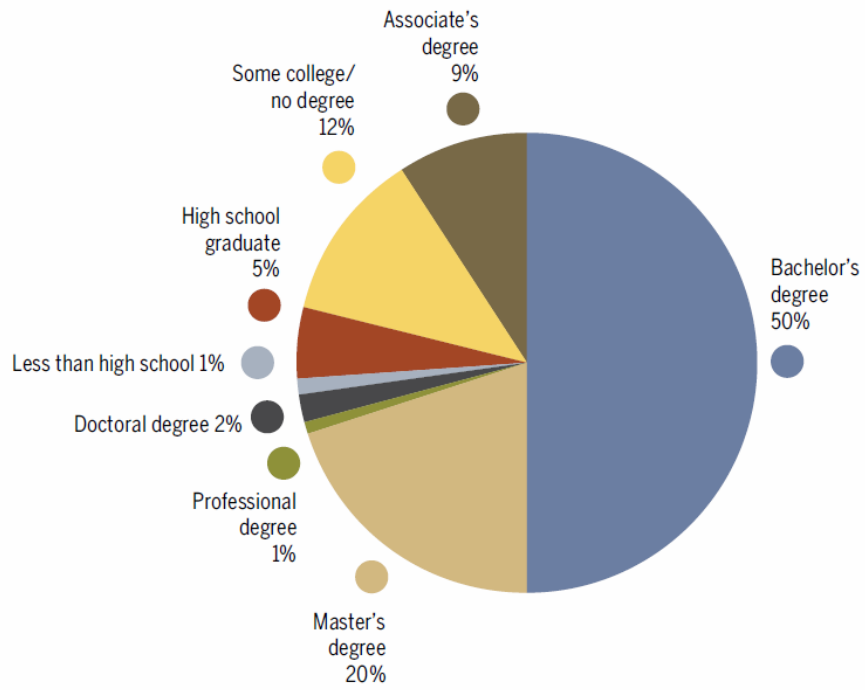
Whereas computer support specialists with some college/no degree earn \$50,000, network and computer systems administrators with similar education earn \$63,000 on average. Close to one-half of computer and information systems managers and computer software engineers obtain their Bachelor's degree, and earn \$98,000 as a result.

Workers in these categories can earn significantly more if they obtain their graduate degree, as over one-quarter do. Computer software engineers can earn \$9,000 more with a Master's degree, \$94,000.



SOURCE: Authors' Analysis of ACS data, 2006-2009

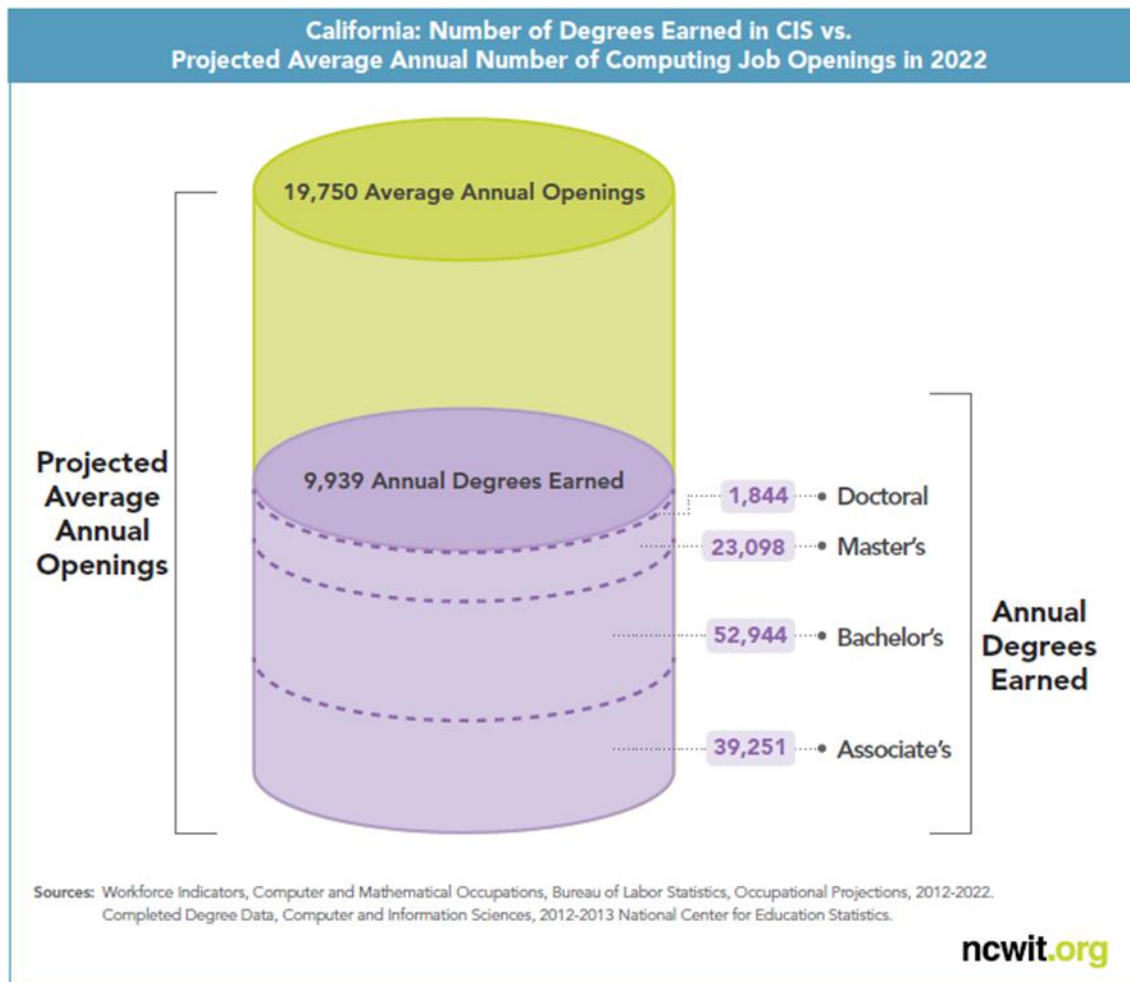
Figure 31. More than 70 percent of jobs in Information Technology will require a Bachelor's degree or better by 2018.



SOURCE: The Georgetown University Center on Education and the Workforce forecast of education demand through 2018.

Educating California's 21st Century Information and Communication Technology Workforce

While there were 80,807 open computing jobs in California in 2014, according to the National Center for Women & Technology (NCWIT), California's colleges graduated only 5,127 students with computer science degrees. As shown in the below graph, the projected average annual openings related to computer information systems will greatly exceed the number of projected annual degrees earned.



California Imports Information and Communication Technology Talent from other Countries

California's employers sponsor more workers through the H1-B Visa program than any other State. Education systems outside of the United States are developing students with 21st century knowledge and skills needed by California's businesses.

The below table shows the number of H1-B Visas issued in 2014 for Californian cities that ranked in the top 50 for the number of visas sponsored:

Top H1B Visa Work Cities in California¹

<u>National Rank</u>	<u>City</u>	<u>Number of Visas</u>	<u>Average Salary</u>
3	San Francisco	11,347	\$103,234
4	San Jose	9,264	\$100,159
7	Sunnyvale	6,555	\$98,196
9	Mountain View	5,319	\$116,333
11	Santa Clara	5,125	\$102,136
15	San Diego	4,921	\$94,229
20	Los Angeles	4,073	\$78,194
24	Irvine	3,253	\$84,769
27	Palo Alto	3,086	\$110,416
33	Fremont	2,467	\$79,118
35	Cupertino	2,303	\$117,323
41	Milpitas	1,971	\$92,611

The five occupations receiving the highest number of H1B visas are:

- Programmer Analyst
- Software Engineer
- Computer Programmer
- Systems Analyst
- Software Developer

Opportunities to Align Instruction through Transfer Model Curriculum

The Legislative Analyst’s Office released on February 2, 2015, a [report](#) entitled: *Implementation Update: Reforming Transfer from CCC to CSU* that makes recommendations for improving college pathway success for students.

This report recommends colleges that participate in the Transfer Model Curriculum initiative provide additional information for counselors and advisers so that students can understand how courses they take at a community college can transfer to a state university.

¹ www.myvisajob.com

Students taking courses in the ICT Software and Systems Development pathway should know, for example, that up to 60 units of credit earned at Community Colleges that use Computer Science Transfer Model Curricula can be transferred to the following California State Universities:

- Long Beach
- East Bay
- Monterey Bay
- Fresno
- San Francisco
- Humboldt
- Sonoma
- Stanislaus
- San Diego

Industry Certifications Are a Common Requirement for Information and Communication Technology Professionals

Information Technology is the career cluster with the greatest emphasis for workers to continually upgrade their knowledge and skills as a prerequisite for remaining competitive in the industry. Employers often prefer workers that have college degrees and certification. Some workers demonstrate competency by dedicating many years to working with a particular product; whereas others prove their mastery by obtaining certifications administered by software or hardware companies. Because technology changes rapidly, ICT professionals must renew certifications on a cyclical basis to remain competitive.