Emerging Workforce Trends in Information and Computing Technology

2011 to 2018...

STEM Career Pathways for the
Washington State Community and Technical College System

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For More Information:

Center of Excellence for Information and Computing Technology
Bellevue College
3000 Landerholm Circle SE, N211
Bellevue, WA 98007-6484

URL: http://www.coeforict.org
Email: maureen.majury@bellevuecollege.edu
Phone: (425) 564-4215
Fax: (425) 564-6193

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Research and authorship: Maureen Majury
Cover design: Robyn Bell-Bangerter and Linda Walker
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STEM

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Foreword

Foreword

It has been five years since *Information Technology Trends Assessment: 2007–2008: Industry, The New Learner and Implications for Education* was published. Dr. Paula Boyum, Vice President of Workforce Development, recommended that the Center of Excellence for Information and Computing Technology, with headquarters at Bellevue College, Bellevue, Washington, research and publish a new technology trends report.

In respecting the tremendous value the 2007 report provided to the Washington State community and technical college (CTC) system, the research and development of the thematic tone for the final report took a different turn. Looking at how information and computing technology (ICT) both informs and influences technological advancement and innovation across industry sectors, while relying on mastery of specific fields of study in science, technology, engineering, and math (STEM), it was important to demonstrate the connectivity between the CTC system and workforce development and demand.

This report presents current and projected data to help educational administrators consider programmatic and curricula content updates, provide faculty with workforce projections, occupational profiles, current job descriptions, and programs that are built around future statewide, national, and global forecasting.

Educators can use this report to ensure CTC students are being presented with the most up-to-date technical knowledge and skills required by industry right now, as well as what might be required five to ten years from now so they can effectively enter the workforce.

Five years ago the recession that the United States and the international community are still working to overcome, was not factored into the actuality of 2011 as envisioned by the Department of Labor when its labor data projections reporting out to 2004 through 2014 were published. Thus, this report's research included reading and sourcing publications, taking into account current economic and environmental conditions, and presenting technological, demographic, workforce, and global projections through 2025. While this report presents forecasts which identify serious challenges, it also suggests solutions based upon future scenarios.

This information aims to assist now, and in the future, our state's CTC system as it strives to provide relevant academic and workforce education to students, and to best prepare them to successfully enter the workforce or articulate to a four-year educational institution.

It is important that you contact us to let us know how this report assisted you as an educator, and how it impacted any changes you made at your educational institution. Feedback and comments are welcome.

Maureen Majury, M.Ed.
Director
Center of Excellence for Information and Computing Technology

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Kelly Malleck, editor and technical writing instructor at Bellevue College, provided the final edit and deserves sincere thanks and acknowledgement. And, finally another group who contributed to this publication is Bellevue College's Printing Service team: Robyn Bell-Bangerter, Sharon Berg, Dianne Harbolt, and Mary Cox. The team provided excellence in creativity, editing, and the printing of the report.

Maureen Majury, M.Ed.
Director
Center of Excellence for Information and Computing Technology

Note: Quotes from experts and excerpts from publications are enclosed in text boxes throughout the report, along with source references and web URLs when available.

1: The Economy and Workforce Trends

"One of the soundest rules I try to remember when making forecasts in the field of economics is that whatever is to happen is happening already."

Sylvia Porter (18 June 1913 - 5 June 1991)

1.1 Why Forecasts Matter

Why predict or forecast future economic and workforce developments when change and uncertainty are a constant? Because as noted 20th century American economist Sylvia Porter said, *"One of the soundest rules I try to remember when making forecasts in the field of economics is that whatever is to happen is happening already."*

Four primary issues impacted the direction of this report:

- The current economy's effect on education, employment, and innovation
- The occupational outlook for career pathways aligned to STEM (science, technology, engineering, and math) disciplines
- The importance of preparing students for careers in STEM
- Considering 2025 global predictions and how new or hybrid occupational pathways will emerge in order to create energy and environmental solutions through the use of information and computing technologies

Information Technology Trends Assessment: 2007–2008: Industry, The New Learner and Implications for Education, published in 2007, projected 18.9 million United States (U.S.) jobs would be created by 2014. In fact, as of the last quarter of 2010, 14.9 million were officially unemployed, 8.9 million under-employed, and 6 million stopped looking for employment for a total of 29.8 million unemployed. This number is 26% higher than the total number of jobs that were supposed to have been created between 2008 and 2011.

One might question the need for a new research publication that posits exciting future opportunities in STEM career pathways when considering the 2010 unemployment numbers. Yet, no matter to which economic theory one subscribes, that of Stuart Mills, Alfred Marshall, John Maynard Keynes, or Milton Friedman, the U.S. economy will always experience periods of contraction, stability, and then, positively, growth.

According to the U.S. Bureau of Labor Statistics, Washington State's unemployment ranks 28th among the 51 states as of August 2010 (which means 8.9% unemployment). As a reference point, North Dakota has 3.7% unemployment and Nevada 14.4% unemployment. States whose major economic driver is the business and professional service industry have the largest percentage of unemployment.

The U.S. recession's starting point is believed to be between 2007 and 2008. Thus, the career outlook data published by the Department of Labor, using the time period of 2008 to 2018, did not consider current economic conditions in its projections. Projections indicate that the economy won't begin its tentative recovery until 2015. There is a widespread concern and growing realization that the majority of jobs lost between 2007 and 2010 will not return to the United States. The Center on Budget and Policy Priorities updated its report, *Recession Continues to Batter State Budgets; State Responses Could Slow Recovery*, on July 15, 2010. That small note of optimism about the economy is immediately followed with significant caveats.

Of course, a faster-than-expected recovery could reduce the size of future shortfalls. But several factors could make it particularly difficult for states to recover from the current fiscal situation. Housing markets might be slow to fully recover; their decline has already depressed consumption and sales tax revenue as people refrain from buying furniture, appliances, construction materials, and the like. This also would depress property tax revenues, increasing the likelihood that local governments will look to states to help address the squeeze on local and education budgets. And if the employment situation remains weak, income tax revenues will continue to lag and there will be further downward pressure on sales tax revenues as consumers are reluctant or unable to spend.

1.2 Structural Shifts in the U.S. Economy: the Decline of Manufacturing, the Rise of the Service Industry, and the Importance of the Healthcare Industry

The U.S. Department of Labor Strategic Plan for Fiscal Years 2011–2016

An important long-term structural shift in the American economy in recent decades has been the gradual decline in manufacturing employment and the expansion of the service industries. Examples of service industries include education and health services, professional and business services, information, and retail trade. Two important contributors to this shift have been changing patterns of consumption, with American households consuming more services than in the past; and international trade. Another important expansion is increased productivity. For reasons ranging from technological advances to increased capital intensity to improve skills of American workers, the manufacturing industry can make more goods than ever before while employing fewer people. This means resources are being used more effectively but it also means there has been a long-term decline in manufacturing employment.

The shift from manufacturing to services is not the only important structural shift. The healthcare industry has grown rapidly and is projected to grow in the future due to advances in medical knowledge and the increased need for medical services arising from an aging population. This will spur demand for medical professionals of all types, while changes in the way that medical care is provided are producing substantial increases in demand for nurses and for technicians who can operate advanced medical equipment. Over the next 10 years, healthcare occupations will account for about 2.7 million new jobs. Of the 20 fastest growing occupations, half are within the healthcare industry.

The Internet, telecommunications, and computer chip revolutions have changed how work is done in many other industries and has created entirely new industries. These changes have produced drastic declines in some occupations (e.g., secretaries, word processing) and reductions in the skill required for many others (e.g., retail clerks) while creating new opportunities in fields such as software engineering and Web design.

Structural shifts may result in shortages in specialized skills required by high growth industries, leading to increased wages for individuals with those skills, and creating a need for new training or education programs to fulfill the demand. In some cases there may be a long lag before a sufficient number of workers can obtain necessary education or training, particularly if changes must first occur in educational curricula.

Source: U.S. Department of Labor Strategic Plan for Fiscal year 2011-2016, http://www.dol.gov/_sec/stratplan/StrategicPlan.pdf

1.3 U.S. and Washington State: General Industry and Employment Outlook

Addressing the Senate Budget Committee in January 2011, Federal Reserve Chairman Ben Bernanke said the unemployment rate would be close to 8% two years from now, and added that it could take four or five more years for the job market to normalize. He said, "Persistently high unemployment, by dampening household income and confidence, could threaten the strength and sustainability of the recovery."

If prior projections, confirmed by Mr. Bernanke, maintain a depressed U.S. economy and record unemployment at least through 2015, this will have a profound effect on the national spirit of optimism. Yet, by focusing on what is possible right now and through 2018, coupled with future career pathways in STEM, new industry trends, and innovations propelling workforce demand, there are still opportunities that hold both hope and promise.

Excerpts above from CBSNews.com, http://www.cbsnews.com/stories/2011/01/07/business/main7222500.shtml

From the Bureau of Labor Statistics, consider the following:

- Budget problems in 2011. Fiscal year 2011 gaps—addressed with spending cuts and revenue increases by most states—totaled $121 billion, or 19% of budgets in 46 states. This total is likely to grow over the course of the fiscal year, which started July 1 in most states. It may well exceed $140 billion and would be higher still without federal assistance. The fact that the gaps have been filled and budgets are balanced does not end the story. Families hit hard by the recession will experience the loss of vital services throughout the year, and the negative impact on the economy will continue.
- Uncertainty for the future. States' fiscal problems will continue in the current fiscal year and likely beyond. Already 39 states have projected gaps that total $102 billion for the following year (fiscal year 2012). Once all states have prepared estimates these are likely to grow to some $120 billion.
- The effects of gaps in 2010 budgets. These new shortfalls are in addition to the gaps states closed in their fiscal year 2010 budgets. Counting both initial and mid-year shortfalls, 48 states addressed such shortfalls in their budgets for fiscal year 2010, totaling $192 billion or 29% of state budgets — the largest gaps on record.

Source: Bureau of Labor Statistics, *Occupational Outlook Handbook,* 2010-11, Overview of 2008-18 Projections, http://www.bls.gov/oco/oco2003.htm

Excerpt below from the Center on Budget and Policy Priorities, *Recession Continues to Batter State Budgets; State Responses Could Slow Recovery*, updated October 7, 2010, http://www.cbpp.org/files/9-8-08sfp.pdf

Most states are balancing their budgets on the assumption that the Medicaid funding will be extended, but are not assuming additional education funds. If the federal government fails to

extend this aid, many states will be forced to reopen their 2011 budgets to make even deeper spending cuts and more tax increases than previously planned.

Washington State's projected total 2011 shortfall after the pre-adopted biennial budget of 2009 through 2011 will be $2.1 billion and 12.9% of the budgeted shortfall. The 2012 gap between incoming revenue to offset expenditures is projected at $1.2 billion with a 7.2% shortfall from the 2011 budget. There is a more positive outlook for a Washington State recovery, as opposed to other states because the high-tech industry is a key economic driver of growth. Because there was a decrease in 2008–2009 spending for technology, the ability to upgrade businesses is in a holding pattern.

Some states will recover faster than others. One of the drivers of recovery is the technology industry. Technology spending tapered off between 2008 and 2009 due to economic factors, but this created a slow-down in spending on upgrades (system, hardware, software, etc.). In order to stay competitive, the delay in spending will have to end.

Excerpts below from msn.msnbc.com, http://www.msnbc.msn.com/id/30991972/ns/business-eye_on_the_economy/

In a June 2008 interview, "Which States Will Be Early Risers?" economist Andrew Gledhill of Moody's Economy.com said, "States that have a high concentration in tech-related industries are well positioned to take advantage of this trend, which is particularly true of Colorado, Idaho, Oregon, and Washington and to a lesser extent Texas." Two important considerations arise from Gledhill's statement. First, industries' reliance upon higher educational institutions' effectiveness in preparing a workforce-ready graduate, and second, Washington "is one of the top five states in the nation with job openings requiring postsecondary education."

One cannot focus on Washington State's workforce trends, emerging or shifting industry sectors, without thinking about:

- How Information and Computing Technology (ICT) works in both supporting and starring roles within STEM career pathways.
- How ICT is consistently a mainstay of workforce economic development and demand.
- How important it is to consider not only national factors affecting Washington State's economic well being, but also the broader impact of the global economy.

The European Union commissioned a study, *The World in 2025: Rising Asia and Socio-Ecological Transition,* http://ec.europa.eu/research/social-sciences/pdf/the-world-in-2025-report_en.pdf)

The following excerpts provide highlights:

- In 2025, nearly two thirds of the world population will live in Asia.
- According to the U.N., between now and 2025, the world population will increase by 20% to reach 8 billion inhabitants (6.5 today). Of this growth, 97% will occur in developing countries (Asia, Africa).
- The budgetary impact of aging (the need for public provision of age-related transfers and services) is expected to be substantial and to increase by more than five percentage points of GDP by 2060 in the Euro area, especially for pension, healthcare, and long-term-care spending.

Emerging and developing countries, which accounted for 20% of the world's wealth in 2005 will account for 34% of it in 2025.

1.4 Economic and Workforce Impacts of Baby Boomers

A changing global infrastructure must recognize the impact of an aging worldwide population. The United Kingdom, for example, does. Increased longevity and a healthier lifestyle indicate retirement is not an option for some due to economic factors or because of the aging worker's desire to continue working. Lifelong learning also takes on greater significance for an aging population. This means either meaningful professional development opportunities or training for new career pathways.

United States Population 2008-2018

Age	Decrease/Increase in Overall Population
16 and older	+25.1%
16 to 24	+3.4%
35 to 44	+0.2%
45 to 55	–4.4%
55 and older	+29.7%

With baby boomers making up almost one-third of the U.S. population by 2018, economic and workforce impacts cannot be overstated. Industry sectors will have to produce workers to support services in healthcare, including pharmaceutical, financial, and housing, for those 55 years and older. Additionally, with an aging, but healthier population, their ability to remain relevant in the workforce due to the desire to continue to work, even if they are financially able to retire or because economics demand they continue to work, holds interesting ramifications for both education and industry. Will those between 16 and 24 years old find employment if older workers do not move out of the workforce? The 16 to 24 year-old demographic will also experience the largest decline in long-term growth. These two critical factors: 1) a growing, aging population; and, 2) a shrinking, youth population, will dramatically impact education and economy.

1.5 Overview of 2008–18 Industry and Economic Projections

In analyzing employment trends for Washington State between 2010 and 2025, one cannot focus on ICT in isolation. Information and computing technology contributes major and minor functionality across all industry sectors. Thus, this report's research examined industry sectors driven by STEM to determine which new technologies will energize employment, create new types of jobs, and what role information and computing technology will play.

Service industries, as opposed to goods-producing industries, will still continue to drive the U.S. economy, particularly in healthcare, professional and technical services, educational services, administrative support, and waste management services. The Department of Labor has projected that by 2018, 14.5 million new jobs will be created.

The Interconnected Relationships Between Population and Employment *and* Demand and Consumption

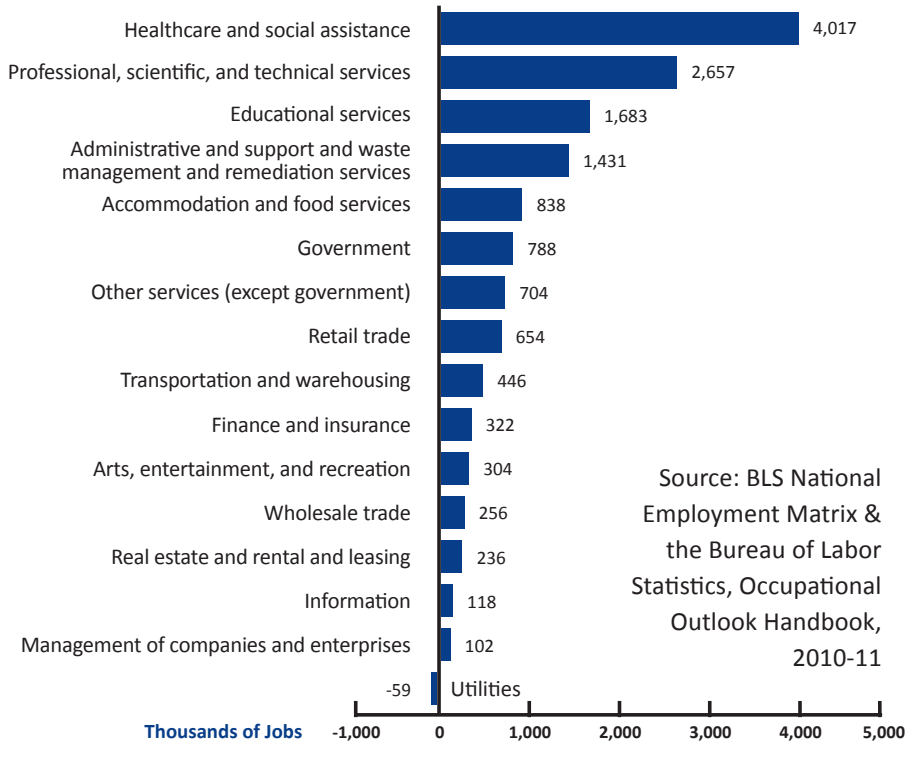
Job openings result from the relationship between the population, labor force, and demand for goods and services. The population restricts the size of the labor force, which consists of working individuals and those looking for work. The size and productivity of the labor force limits the quantity of goods and services that can be produced. In addition, changes in the demand for goods and services influence which industries expand or contract. Industries respond by hiring the workers necessary to produce goods and provide services. However, improvements to technology and productivity, changes in which occupations perform certain tasks, and changes to the supply of workers all affect which occupations will be employed by those industries. Examining past and present changes to these relationships in order to project future shifts is the foundation of the Employment Projections Program.

Source: *The Bureau of Labor Statistics,* http://www.bls.gov/oco/oco2003.htm

Employment projections are not as optimistic in the manufacturing sector as it will continue to decline. Any anticipated manufacturing jobs would be generated by the demand for medical supplies and pharmaceuticals. An interesting trend is the demand for clean water, which will encourage industry growth in water, sewage, and systems management. Information services will contribute to an increased demand for computer-related industries and software publishing workers, but telecommunication employment will decline by 9%.

Financial and insurance services will create moderate workforce demand due to baby boomers who retired with healthy savings, retirement, and pension plans. Outside of healthcare, their consumption is generally lower than those 55 years and younger.

Numeric Change in Wage and Salary Employment in Service-Providing Industries, 2008-2018 (Projected)



Source: BLS National Employment Matrix & the Bureau of Labor Statistics, Occupational Outlook Handbook, 2010-11

Thus, management of their savings will generate job development of 12% in finance and 14% in insurance.

Not unexpectedly, professional, technical, and scientific services will account for the highest workforce demand, anticipating 2.7 million new jobs by 2018.

Employment growth will be driven by a growing demand for the design and integration of sophisticated networks and Internet and intranet sites. Employment in management, scientific, and technical consulting services is anticipated to expand at a staggering 83%, making up an estimated 31% of job growth in this sector. Demand for these services will be spurred by businesses' continued need for advice on planning and logistics, the implementation of new technologies, and compliance with workplace safety, environmental, and employment regulations.

Source: Bureau of Labor Statistics, *Occupational Outlook Handbook,* 2010–11, Overview of 2008-18 Projections, http://www.bls.gov/oco/oco2003.htm

The Top Ten High Demand Occupations 2008-2018

#	Occupation	Employment		% Change + –	Earnings	Training Needed
		2008	2018			
1	Biomedical Engineers	16,100	27,600	72%	$$$$	Bachelor's Degree
2	Network Systems & Data Communications Analysts	292,000	447,800	53%	$$$$	Bachelor's Degree
3	Home Health Aides	921,700	1,382,600	50%	$	Short-Term On-the-Job Training
4	Personal & Home Care Aides	817,200	1,193,000	46%	$	Short-Term On-the-Job Training
5	Financial Examiners	27,000	38,100	41%	$$$$	Bachelor's Degree
6	Medical Scientists, except Epidemiologists	109,400	153,600	40%	$$$$	Doctoral Degree
7	Physician Assistants	74,800	103,900	39%	$$$$	Master's Degree
8	Skin Care Specialists	38,800	53,500	38%	$$	Postsecondary Vocational Award
9	Biochemists & Biophysicists	23,200	31,900	37%	$$$$	Doctoral Degree
10	Athletic Trainers	16,400	22,400	37%	$$$	Bachelor's Degree

Source: Bureau of Labor Statistics, *Occupational Outlook Handbook*, 2010-11, Overview of 2008-18 Projections

The majority of the national top ten fastest-growing occupations share a common trait: a minimum of a bachelor's degree (three of the ten occupations require an advanced degree). Another commonality is the majority of occupations require either course work or majoring in a STEM discipline.

1.6 Washington State Industry and Employment Outlook

Aligning with national data, the majority of the top ten high-demand occupations require a minimum of a bachelor's degree. An associate's degree is generally sufficient for technician-level occupations.

Excerpt from *Help Wanted: Projections of Jobs and Education Requirements through 2018,* June 2010, Anthony P. Carnevale, Nicole Smith, Jeff Strohl, June 2010, Georgetown University, http://www9.georgetown.edu/grad/gppi/hpi/cew/pdfs/State-LevelAnalysis-web.pdf

By 2018, about two-thirds of all employment will require some college education or better. The most intense concentrations of postsecondary workers are in the STEM; Education; Healthcare Professional and Technical; Community Services and Arts; and Managerial and Professional Office Occupations. These five clusters represent more than 30% of total occupational employment and about 45% of all jobs for postsecondary workers.

In general, occupations in a category with some postsecondary education are expected to experience higher rates of growth than those in an on-the-job training category. Occupations in the associate's degree category are projected to grow the fastest, at about 19%. In addition, occupations in the master's and first professional degree categories are anticipated to grow by about 18% each, with those occupations in the bachelor's and doctoral degree categories expected to grow by about 17% each. Occupations in the on-the-job training categories are expected to grow by 8% each.

Source: Overview of the 2008-18 Projections, *Occupational Outlook Handbook,* 2010–2011 Edition, http://www.bls.gov/oco/oco2003.htm

2: "Bright Outlook" Washington State Occupations Requiring a STEM Concentration or Degree

"Bright Outlook" Washington State Occupations Requiring a STEM Concentration or Degree (Chart 1)

Washington	Employment 2008	Employment 2018	% Change	Job Openings*
Business Intelligence Analyst (Computer Specialists, All Others)	8,430	9,040	+7%	250
Computer System Analyst	14,190	16,040	+13%	510
Computer Software Engineers, Applications	25,000	30,240	+21%	760
Computer Software Engineers, Systems Software	18,560	22,470	+21%	560
Home Health Aides	12,940	19,400	+50%	810

**Job Openings refers to the average annual job openings due to growth and net replacement.*

It is critical to put into context the importance of the United States emphasizing and strengthening successful student mastery in STEM disciplines. This is especially significant for two major industries and related occupations: information and computing technology and healthcare.

2.1 Information and Computing Technology and Healthcare Aligned to STEM Educational Needs and Workforce Trends

There is a growing concern that the United States is not preparing a sufficient number of students, teachers, and practitioners in STEM fields of study. A large majority of secondary school students fail to reach proficiency in math and science, and many students are taught by teachers who lack adequate STEM subject matter knowledge.

Categorizing emerging technologies and how they translate into viable career pathways, due to the evolution of a current industry

sector, the creation of a new industry sector, or merging industry sectors means more than one STEM definition exists.

"The **STEM fields** are those academic and professional disciplines that fall under the umbrella areas represented by the acronym." The National Science Foundation (NSF), the Department of Labor, and League for Innovation all categorize these slightly differently. However, there is enough commonality to organize career pathways that are coupled with the key elements that underlie the concept of STEM.

Excerpts above from Wikipedia, http://en.wikipedia.org/wiki/STEM_fields

What is common to all STEM career pathways is the vital and integral role that information and computing technology (ICT) plays. As information and computing technology has become ubiquitous throughout industry sectors, interconnectivity between STEM and ICT has evolved. This report will now examine the ICT alignment to STEM career pathways.

STEM occupations are broadly represented in all industries, but are most concentrated in Professional and Business Services (21%) and Information Services (14%) industries. This cluster of occupations is forecast to provide 2.8 million job openings through 2018, including 1.2 million net new jobs and an additional 1.6 million replacement openings. Here is a breakdown of projected STEM openings by education requirements:

- 9,000 high school dropouts
- 210,000 high school graduates
- 274,000 workers with some college but no degree
- 313,000 workers with associate's degrees
- 1.2 million workers with bachelor's degrees
- 779,000 workers with master's degrees or higher

The share of workers with at least some college in STEM occupations has always been high. Almost 83% of STEM employees had at least some postsecondary education in 1983, and that number climbed to 92% in 2008 and is projected to remain there through 2018.

By 2018, about two-thirds of all employment will require some college education or better. The most intense concentrations of postsecondary workers are in the STEM; Education; Healthcare Professional and Technical; Community Services and Arts; and Managerial and Professional Office Occupations. Those five clusters represent more than 30% of total occupational employment and about 45% of all jobs for postsecondary workers.

Source: *Help Wanted: Projections of Jobs and Education Requirements through 2018,* http://www9.georgetown.edu/grad/gppi/hpi/cew/pdfs/State-LevelAnalysis-web.pdf

STEM occupations include diverse scientific and technical job categories. Both the projected Department of Labor employment trends extracted from the *Occupational Outlook Handbook: Edition 2010–2011* and those that could potentially develop based upon research of emerging technologies and either expanded or hybrid industry sectors will be included.

The "Bright Outlook" occupations (Chart I) provide labor data and emerging trends, which might inform the state's CTC system's current educational programs.

This report will examine each occupation and include the following:

- A definition of each occupation based upon the Department of Labor's O*Net Online occupational profile
- Current and future technology trends within the industry associated with the occupation
- Future trend and technology alerts: how information and computing technology developments could inform and influence related or new STEM occupations

3. Business Intelligence Analyst (Computer Specialists, All Others)

3.1 What Does a Business Analyst Do?

Produce financial and market intelligence by querying data repositories and generating periodic reports. Devise methods for identifying data patterns and trends in available information sources.

Responsibilities:

- Generate standard or custom reports summarizing business, financial, or economic data for review by executives, managers, clients, and other stakeholders
- Synthesize current business intelligence or trend data to support recommendations for action
- Analyze competitive market strategies through analysis of related product, market, or share trends
- Analyze technology trends to identify markets for future product development or to improve sales of existing products
- Collect business intelligence data from available industry reports, public information, field reports, or purchased sources
- Conduct or coordinate tests to ensure that intelligence is consistent with defined needs
- Create business intelligence tools or systems, including design of related databases, spreadsheets, or outputs
- Disseminate information regarding tools, reports, or metadata enhancements
- Document specifications for business intelligence or information technology (IT) reports, dashboards, or other outputs
- Identify and analyze industry or geographic trends with business strategy implications

Education: This occupation may require a background in any of the following: science, technology, engineering, and mathematics (STEM) educational disciplines.

Employment: The median hourly wage is $37.02 and the annual salary is $77,010 as of May 2009.

Source: O-Net Online, http://online.onetcenter.org/link/summary/15-1099.10

3.2 Current and Future Technology Trends Associated with Business Intelligence

Business Intelligence (BI) is no longer a decision-making tool just for the financial and marketing industries. The underlying technical knowledge and skills (creating data structures to mine information and then use it to detect meaningful trends and influence decision-making) are crossing all industry sectors. With data expanding exponentially within seconds, finding ways to manage it is crucial for all decision-makers.

"Data quality should be built into processes so that data is correctly captured and stored, that errors are not introduced in other processes that use the data, and that the data is integrated, i.e., brought together from different systems so that the information that it provides can be compared and contrasted to provide intelligence," says Sarah Burnett of the Butler Group, a European ICT research company. It was only a matter of time before BI tools, as well as the other essential technical knowledge and skills used by database technologists, network and systems ICT workers, and intelligence analysts would create new educational program pathways as workforce demand continues to grow.

Excerpt above from the IT B*usiness Edge,* http://www.itbusinessedge.com/cm/community/features/interviews/blog/why-business-intelligence-matters-now-more-than-ever/?cs=32790

Programmatic changes to business intelligence programs should include:

Business Intelligence (BI) 2.0: According to Greg Neilson, president and CEO of ThotWave Technologies, social media can provide valuable information on how to use, change, and adapt BI tools to innovate. "The Web has moved from static pages to dynamic/database-driven content to online collaboration and Web properties as destinations."

- **Facebook:** As users login, information is constantly being updated and exchanged. Developers are being challenged to build new applications to meet user needs (graphs, reports, and visual interpretations of data).
- **Twitter:** Real-time, continuous flow of decisions, status about the business, complex event processing. Platform evolves through unplanned usage/organic evolution of capabilities. Succinct explanation of the state of the business. Search commentary; generate word clouds that provide a visualization of the 'vibe' or sentiment of the business. Tags and user comments.
- **E-mail:** Thought-patterns, conclusions, subjects, information, and ideas create a searchable record that can be found very quickly.
- **Forums, Discussion Groups, eRooms:** Information is exchanged and archived. This information can be curated and reformulated to find patterns for group decisions.
- **RSS:** Commentary should be available as an RSS feed. Reports or data updates could be delivered via RSS feed.

BI programs, in order to prepare for these changes, should consider incorporating Web 2.0 technologies (collaborative intelligence) content in their curriculum to ensure students are prepared to link data gathering to visual, interactive representation.

Source: ThotWave Technologies, http://support.sas.com/resources/papers/proceedings10/040-2010.pdf

3.3 Future Business Intelligence Career Pathway: Competitive Intelligence

A broad definition of **competitive intelligence (CI)** is the action of defining, gathering, analyzing, and distributing intelligence about products, customers, competitors, and any aspect of the environment needed to support organizational strategic decision-making.

Key points:

1. Competitive intelligence is an ethical and legal business practice.
2. The focus is on the external business environment.
3. There is a process involved in gathering information, converting it into intelligence, and then using this in business decision-making. If the intelligence gathered is not usable (or actionable), then it is not intelligence.
4. It involves early identification of risks and opportunities in the market before they become *obvious*. Experts also call this process the early signal analysis.
5. It is a perspective on developments and events aimed at yielding a competitive edge.

Source: http://en.wikipedia.org/wiki/Competitive_intelligence

Educational programs, whether by design or necessity, are evolving into interdisciplinary career pathways. ICT is often the engine driving these changes as imagination and the need for innovation take what were traditional stand-alone disciplines that are now increasingly reliant on ICT to create these new possibilities. Business, information, and computing technology programs at the CTC level for both students planning to transfer, as well as students who plan to enter the workforce upon completion of their associate of arts (A.A.) degree, could consider incorporating elements of Notre Dame's Competitive Intelligence certificate into their own curricula.

Competitive Intelligence
Notre Dame, Indiana

The Competitive Intelligence certificate is a valuable complement to a degree in:

- Business
- Marketing
- Financial Management and Analysis
- Accounting

Certificate Content:

- Competitive Intelligence in a Global Economy
- Business Intelligence
- Writing for Business Intelligence
- Executive Briefs
- Research and Business Decision Making for Competitive Intelligence
- Analytical Techniques for Business Intelligence

Source: http://www.elearnportal.com/ndc/certificate-in-competitive-intelligence

3.4 Business Intelligence Trend Alert: How Information and Computing Technology Developments Could Inform and Influence STEM Occupations (Financial Analyst)

3.4.1 What Does a Financial Analyst Do?

Conduct quantitative analyses of information affecting investment programs of public or private institutions

Responsibilities:

- Draw charts and graphs, using computer spreadsheets, to illustrate technical reports
- Inform investment decisions by analyzing financial information to forecast business, industry, or economic conditions
- Monitor developments in the fields of industrial technology, business, finance, and economic theory
- Interpret data on price, yield, stability, future investment-risk trends, economic influences, and other factors affecting investment programs
- Monitor fundamental economic, industrial, and corporate developments by analyzing information from financial publications and services, investment banking firms, government agencies, trade publications, company sources, or personal interviews
- Recommend investments and investment timing to companies, investment firm staff, or the public
- Determine the prices at which securities should be syndicated and offered to the public
- Prepare plans of action for investment, using financial analyses
- Evaluate and compare the relative quality of various securities in a given industry
- Present oral or written reports on general economic trends, individual corporations, and entire industries

Education: This occupation may require a background in any of the following: science, technology, engineering, and mathematics (STEM) educational disciplines.

Employment: The median hourly wage is $35.42 and the annual salary is $73,700 as of May 2009.

Source: O-Net Online, http://online.onetcenter.org/link/summary/13-2051.00

The current reality is the banking and financial industry suffered serious damage to its reputation. It damaged the financial stability of the U.S. economy through a number of financial practices that have been analyzed, dissected, penalized, and "bailed out." As an industry, it is still perceived as an ambivalent player and contributor to the economic uncertainty the U.S. is still facing. This is especially true when one considers baby boomer antipathy towards not only curtailing expected benefits (Medicare and Medicaid), as well the impact to public and private pensions and investment accounts. Not unexpectedly, baby boomers anticipated their investments of savings (bank-held, stocks, life insurance policies) to carry them through their lifetime. Even though they do not have financial subject matter expertise, when that expectation was threatened, baby boomers became leery of entrusting fiscal decisions to financial analysts, managers, advisors, or specialists.

However, properly managing investments and taxes, and ensuring retirement savings and income is essential. A professional with the proper education, knowledge, and certifications, is a necessary professional service element of the U.S. and global economics. As the baby boomer demographic continues to increase, the complexity of managing income necessitates a return towards securing the professional services of the financial analyst and the personal financial advisor.

When scanning data of net worth in Table 705 on page 24, and using the median, the majority of wealth is held by those aged 55 to 75. (Note: the median is the more reliable number when looking for the most common occurrences along a distribution analysis.)

Table 705: Family Net Worth – Mean and Median Net Worth in Constant (2007) Dollars by Selected Family Characteristics: 1998 to 2007

[Net worth in thousands of constant (2007) dollars (359.7 represents $359,700). Constant dollar figures are based on consumer price index for all urban consumers published by U.S. Bureau of Labor Statistics. Families included one-person units and as used in this table are comparable to the U.S. Census Bureau's, household concept. Based on Survey of Consumer Finance.]

Family Characterisitic	1998		2001		2004		2007	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
All Families	**359.7**	**91.3**	**464.4**	**101.2**	**492.3**	**102.2**	**556.3**	**120.3**
Age of Family Head:								
Under 35 years old	81.3	11.6	106.1	13.7	80.7	15.6	106.0	11.8
35 to 44 years old	249.9	80.8	303.7	90.7	328.6	76.2	325.6	86.6
45 to 54 years old	461.5	134.5	568.4	155.4	596.1	158.9	661.2	182.5
55 to 64 years old	677.6	162.8	856.0	216.8	926.7	273.1	935.8	253.7
65 to 74 years old	594.2	186.5	793.5	207.9	758.8	208.8	1,015.2	239.4
75 years old and over	395.7	159.9	548.6	181.6	580.0	179.1	638.2	213.5
Race or Ethnicity of Respondent:								
White Non-Hispanic	429.5	121.9	571.2	143.0	617.0	154.5	692.2	170.4
Non-White or Hispanic	128.0	21.2	137.4	21.0	168.2	27.2	228.5	27.8
Tenure:								
Owner Occupied	514.7	168.2	655.5	201.8	686.3	202.6	778.2	234.2
Renter Occupied or other	55.3	5.4	64.4	5.6	59.4	4.4	70.6	5.1

Source: Board of Governors of the Federal Reserve System, "2007 Survey of Consumer Finances" (published 7 May 2009); <http://www.federalreserve.gov/pubs/oss/oss2/2007/scf2007home.html>.

The above numbers demonstrate why financial analysts are projected to experience a 14% increase by 2018. Following is an excerpted overview of the financial services industry.

3.4.2 Financial Services Industry: An Overview

Financial specialist occupations account for about 2% of all jobs. They are concentrated in the finance, professional services, and real estate industries.

Although 537,000 financial jobs have been lost since the start of the recession five years ago, the industry is far from decimated. Financial specialist occupations include appraisers/budget specialists, credit specialists, and financial analysts, loan officers, and tax return consultants/preparers, as well as examiners. These occupations will grow from 2.9 million jobs in 2008 to 3.3 million by 2018, a net increase of 400,000 jobs.

Postsecondary degrees are highly concentrated in this occupation category. Seventy percent of current workers have bachelor's degrees or higher, and 21% have some college or associate's degrees.

As measured by economic output, financial services is the second-largest industry in the economy and will remain so through 2018. It will grow from $3 trillion to almost $4 trillion over the next decade.

While financial services ranks second as measured by economic output, it was seventh in overall employment in 2008 and will keep that ranking in 2018. The industry employed 7% of all workers in 2008. Although its share of employment will remain stable, the financial services industry will increase its actual employment by 1.2 million workers over the decade, growing from 10 million jobs to 11.2 million. The industry will rank eighth in overall job openings between 2008 and 2018. It will create 3.1 million job openings that will include 1.2 million new jobs and 1.9 million jobs to replace retiring workers.

Financial services has grown markedly over recent decades as a result of several factors. Among them are:

- the shift from defined benefit to defined contribution retirement plans
- increasing consumer debt for mortgages
- postsecondary education, and consumer durables such as automobiles

Workers in this sector have been hit hard by the recession of 2007, largely because the crisis was triggered by a financial and housing market collapse. But because of their pervasive role in modern economic institutions and because of the steep loss of jobs in the recession, they will grow back rapidly as the recovery proceeds. The industry should go from 3 million jobs in 2008 to almost 4 million by 2018.

Source: *Help Wanted: Projections of Jobs and Education Requirements through 2018,* http://www9.georgetown.edu/grad/gppi/hpi/cew/pdfs/FullReport.pdf

3.4.3 Financial Services Technology Trend Alert

Typical business and financial querying and reporting is like watching business through the rear-view mirror; you only see what has already passed. Real-time analytics capture and respond to data as it arrives from numerous systems, such as POS terminals.

Real-time analytics often fall into the category of context-aware systems. Increasingly, everything in business is being automated, instrumented, metered, and measured. Radio frequency identification (RFID) tags are intelligent bar codes that communicate with a networked system that tracks every product a consumer purchases from a grocery store or retailer, for example.

RFID is just one example of the instrumentation that is spreading throughout the business. Real-time analytics enables decision-making when it matters; for example, preventing fraud, improving customer service, or seizing a sudden (financial) opportunity.

Excerpt above from wiredFinance, http://bigfatfinanceblog.com/2010/12/30/2011-tech-trends-for-the-cfo/

Based upon the innovations and technology-based solutions generated with increasing rapidity, business intelligence as a decision support system will play an expanded and significant part across all industry sectors, including financial services. With data growing exponentially, Gartner, in an excerpt from its "Emerging Trends: 2010 through 2015" PowerPoint presentation slides (see directly below), predicts that specific technological tools will drive technology solutions. Thus, BI, as a technological support system will drive quicker, effective, and more reliable efficiencies as both a "force" and a "technology."

Data Will Increase 10X. . .Every 5 Years

Whatever your budget, you will always need more IT staff than you think!

Forces	Technologies
■ Compliance Records ■ Data Mining and Forecasts ■ Voice and Video ■ Sensor Networks and RFID ■ Labor-capital Imbalance ■ Standardization ■ Autolocation	■ Scale-out Architectures ■ Service-oriented Architectures ■ Network Self-assembly ■ Hardware Virtualization ■ Service Virtualization ■ Autolocation

Source: Gartner, http://www.docstoc.com/docs/9488160/Emerging-Trends-2010-Through-2015

The rationale for including business intelligence and analytics within financial, accounting, and economic degrees and certificates is due in part to the current uncertainty of U.S. and global financial markets. An increasing emphasis within the financial industry is to reduce risk and increase the probability that the final outcome minimizes unexpected outcomes. This makes the use of information and computing technology to inform financial services decisions even more essential. When reviewing job descriptions, increasingly the occupation expects the technical knowledge and skills of a financial analyst to include business intelligence. And, the job title may not always be "financial analyst." In many instances, the job title includes the words "data,""analyst," "IT," and "business."

Sample Job: IT Business Analyst—Financial Services Industry

Note: Resources Global confirms the interdisciplinary nature of information technology, business, and accounting. "With experience across many disciplines—finance and accounting, information management, human capital, supply chain management, legal and internal audit—we help teams address complex situations on the inside of business. Working side by side with the client team, we solve problems, and execute and transfer knowledge."

Source: http://seeker.dice.com/jobsearch/result/rconnga/10716/US/MS-Access/Hartford~CT/it-business-analysts---financial-services-industry-expertise

Requirements:

- Significant financial services industry experience and strong knowledge of financial products within the banking and/or broker-dealer industries is a must.
- Strong IT business analysis skills and expertise in Microsoft Project and Visio. Skills should include: gathering user requirements and developing functional and technical specifications, system and user acceptance testing, and process mapping.
- Strong data analysis, report development, and automation skills including: expertise in SQL queries, Microsoft Excel, Excel VBA, and Microsoft Access. Strong data mapping, building queries, data extraction, manipulation and conversion, and experience working with data warehouses or databases.
- Significant interaction with functional business users, especially within one or more of the following areas: finance or financial reporting, Basel II, regulatory reporting, product control, or financial control areas.
- Proven experience with reporting tools such as Business Objects, Hyperion, Cartesis, Cognos, Crystal Reports, OutlookSoft, and Khalix.
- Finance and accounting experience a plus.

An example of a financial analyst certificate relies substantially on knowledge of business intelligence and its application to financial decision-making within the context of working in the financial services industry. The Extension Program at the University of California, San Diego, provides an opportunity for existing CTC business intelligence programs to examine current course offerings, and creates an interdisciplinary financial analyst/business intelligence degree or certificate (See Financial Analyst Certificate Course Matrix).

Financial Analyst Certificate Course Matrix

Course Title	Course #	Units	FA	WI	SP	SU
Prerequisite (These courses are strongly recommended for those who need a refresher in accounting concepts)						
Financial Accounting for Non-Accountants	BUSA-40009	4	L, O	L, O	L, O	L, O
Required Courses (ALL FOUR ARE REQUIRED - TAKE IN THIS ORDER)						
Finance Management	BUSA-40439	4	L	L	L	L
Financial Statement Analysis	BUSA-40130	4	L	L	L	L
Financing Strategy: Sources of Capital and Business Plans	BUSA041026	3	L	L	L	L
Financial Decision Making	BUSA-40435	3	L	X	L	
Elective Courses (Completion of ten units is required)						
Business Valuation	BUSA-40477	3	X	X	X	L
Cost Accounting	BUSA-40049	4	L	L	L	L
Organizational Dynamics	BUSA-40013	4		L		L
Enterprise Systems Evaluation and Management Issues	BUSA-40006	3	X		X	
Federal Individual Income Taxation	BUSA-40047	4	L	L, O	X	L
Financial Modeling	BUSA-40549	3	L	X	L	L
Financing Options and Derivatives Management	BUSA-40549	3	L	X	L	L
Financial Markets and Investment Strategies	BUSA-40014	4	L		X	
International Finance and Capital Markets	BUSA-40162	3	L	L	L	L
Introduction to Sustainability	BUSA-40725	3	L, O	L, O	L, O	L, O
Security and Investment Analysis	BUSA-40124	4				X

Source: http://extension.ucsd.edu/programs/index.cfm?vAction=certDetail&vCertificateID=47&vStudyAreaID=5

4: Computer Systems Analyst

4.1 What Does a Computer Systems Analyst Do?

Analyze science, engineering, business, and all other data processing problems for application to electronic data processing systems. Analyze user requirements, procedures, and problems to automate or improve existing systems and review computer system capabilities, workflow, and scheduling limitations. May analyze or recommend commercially available software.

Responsibilities:

- Analyze information processing or computation needs and plan and design computer systems, using techniques such as structured analysis, data modeling, and information engineering
- Assess the usefulness of pre-developed application packages and adapt them to a user environment
- Coordinate and link the computer systems within an organization to increase compatibility so information can be shared
- Define the goals of the system and devise flow charts and diagrams describing logical operational steps of programs
- Determine computer software or hardware needed to set up or alter system
- Develop, document, and revise system design procedures, test procedures, and quality standards
- Expand or modify system to serve new purposes or improve work flow
- Prepare cost-benefit and return-on-investment analyses to aid in decisions on system implementation
- Recommend new equipment or software packages

Education: This occupation may require a background in any of the following: science, technology, engineering, and mathematics (STEM) educational disciplines.

Employment: The median hourly wage is $38.96 and the annual salary is $77,110 as of May, 2009.

Source: O-Net Online, http://online.onetcenter.org/link/summary/15-1051.00

4.1.1 Computer Systems Analyst Trend Alert: How Information and Computing Technology Developments Could Inform and Influence STEM Occupations (Pharmacy and Healthcare Informatics)

What is Pharmacy Informatics?

It is the scientific field that focuses on medication-related data and knowledge within the continuum of healthcare systems—including its acquisition, storage, analysis, use and dissemination—in the delivery of optimal medication-related patient care and health outcomes.

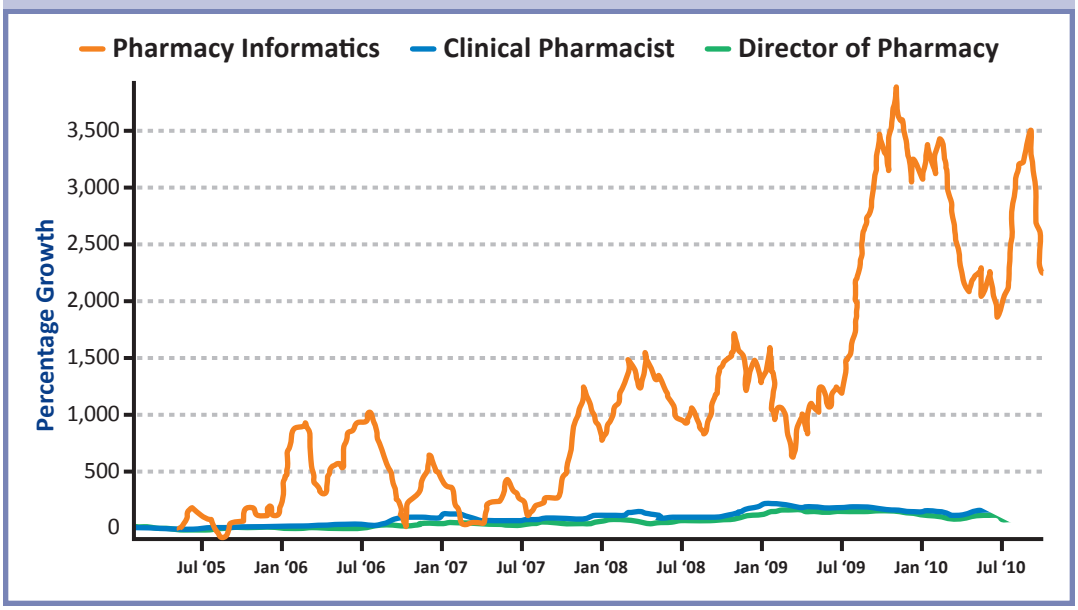
Source: HIMSS, http://www.himss.org/ASP/topics_pharmacyInformatics.asp

Pharmacy informaticist focuses on the application of technology for pharmacists in supporting, streamlining, improving workflow, increasing patient safety incorporating best practices, and using reliable systems. Recognizing the rapidly increasing role of the pharmacist in the use of healthcare information and management systems, Health Information and Management Systems Society (HIMSS) established the Pharmacy Informatics Task Force for its members with a role in pharmacy informatics in September 2006.

J. Fahrni with RXInformatics.com said, "The healthcare technology market is expanding rapidly. This expansion is creating a need for pharmacists with technology know-how. To prove my point I created a job trends graph (see page 31) from indeed.com using the following search criteria: 'pharmacy informatics', 'clinical pharmacist' and 'director of pharmacy'. As expected the search trends for 'clinical pharmacist' and 'director of pharmacy' are relatively flat, but the trend line for 'pharmacy informatics' is striking. It looks like a new pharmacy career path is born."

Source: What is the future of pharmacy informatics as a career choice? J. Fahrni, 2010, http://rxinformatics.com/content/what-future-pharmacy-informatics-career-choice

Job Trends from Indeed.com



When comparing the technical knowledge and skills required by a computer systems analyst (and, also those required by a data analyst) and a pharmacy data analyst, they are well aligned. Pharmaceutical knowledge would be an added component to a degree or certificate. In reviewing labor trend data published by the U.S. Bureau of Statistics, "pharmacy technicians" was ranked 25th in the "Top 50 Fastest-Growing Occupations." With the pharmaceutical industry expanding production to meet increased workforce demand, the number of pharmacist graduates will not meet demand and will be hard pressed to individually meet customer demand. Support and analytical positions will be created to sustain an expanding occupational infrastructure.

4.1.2 What Does a Pharmacy (Informatics) Systems Analyst Do?

- A pharmacy systems analyst has the responsibility of overseeing the drug master file within the hospital pharmacy. This involves entering data, comparing information and data, and reporting discrepancies or possible errors to the appropriate agency or regulatory body.
- The position of a pharmacy systems analyst includes maintaining the computer system and ensuring that all reporting and data collection methods follow appropriate guidelines and regulations.
- The pharmacy systems analyst also provides in-service, support, and information on the new software programs that are implemented to track and monitor the use of prescription drugs throughout the hospital. The pharmacy systems analyst must have an ability to work with others, be effective in public speaking and working with other staff, and have good documentation, communication, and organizational skills.
- Most pharmacy systems analysts work with no supervision and are required to initiate problem solving or troubleshooting solutions if any glitches or problems are found within the system. A strong background in software, computer systems, and data analysis is a definite asset to a pharmacy systems analyst.
- Pharmacy systems analysts usually work within the pharmacy office or with the pharmacists. They report to the systems analyst and the manager of pharmacy informatics in larger

hospitals, but may report to any senior management position in a smaller hospital. Most pharmacy systems analysts work a standard day shift with no weekend or overtime hours.

Source: University of Illinois at Chicago, http://healthinformatics.uic.edu/pharmacy-systems-analyst/

Informatics Nurse Specialist

The U.S. Careeronestop, sponsored by the U.S. Department of Labor, included "Informatics Nurse Specialist" as a related occupational profile to "Computer Systems Analyst." The technical knowledge and skills are again, synchronized to those required by the computer systems analyst, and abetted by medical experience.

4.1.3 What Does an Informatics Nurse Specialist Do?

- Analyze and interpret patient, nursing, or information systems data to improve nursing services
- Analyze computer and information technologies to determine applicability to nursing practice, education, administration, and research
- Apply knowledge of computer science, information science, nursing, and informatics theory to nursing practice, education, administration, or research, in collaboration with other health informatics specialists
- Design, conduct, or provide support to nursing informatics research
- Design, develop, select, test, implement, and evaluate new or modified informatics solutions, data structures, and decision-support mechanisms to support patients, healthcare professionals, and their information management and human-computer and human-technology interactions within healthcare contexts
- Develop or deliver training programs for health information technology, creating operating manuals as needed
- Develop or implement policies or practices to ensure the privacy, confidentiality, or security of patient information
- Develop strategies, policies or procedures for introducing, evaluating, or modifying information technology applied to nursing practice, administration, education, or research
- Develop, implement, or evaluate health information technology applications, tools, processes, or structures to assist nurses with data management

Source: http://www.careerinfonet.org/occ_rep.asp?next=occ_rep&level=&optstatus=011111111101&id=1&nodeid=2&soccode=151051&stfips=53&jobfam=15

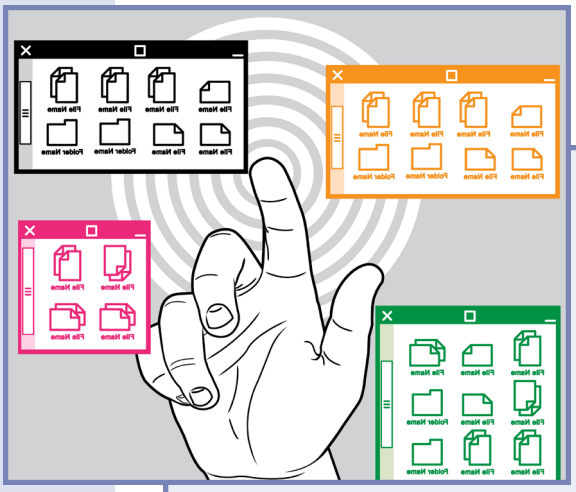
A sample of a healthcare systems analyst certificate is offered by Richland College in Texas. It is a degree the CTC system might consider adopting or adapting.

Healthcare Software Analyst Certificate Coursework

Class	Hours
Medical Terminology I	64
Medical Law and Ethics for Health Professionals	16
Computers in Health Care	32
Electronic Medical Records	16
MS Office 2007	32
Word I	16
Excel I	16
Basics of Programming	20
Introduction to Project Management	48
Managing Complex Projects	48
Total	**308**

Source: http://www.richlandcollege.edu/certs/healthSoftware.php

5. Computer Software Engineers (Applications and Systems)



5.1 What Does a Computer Software Engineer (Applications) Do?

Develop, create, and modify general computer applications software or specialized utility programs. Analyze user needs and develop software solutions. Design software or customize software for client use with the aim of optimizing operational efficiency. May analyze and design databases within an application area, working individually or coordinating database development as part of a team.

Responsibilities:

- Modify existing software to correct errors, allow it to adapt to new hardware, or to improve its performance
- Develop and direct software system testing and validation procedures, programming, and documentation
- Design, develop, and modify software systems, using scientific analysis and mathematical models to predict and measure outcome and consequences of design
- Store, retrieve, and manipulate data for analysis of system capabilities and requirements
- Consult with customers about software system design and maintenance
- Supervise the work of programmers, technologists, and technicians and other engineering and scientific personnel
- Coordinate software system installation and monitor equipment functioning to ensure specifications are met
- Obtain and evaluate information on factors such as reporting formats required, costs, and security needs to determine hardware configuration

Education: This occupation may require a background in the following: science, technology, engineering, and mathematics (STEM) educational disciplines.

Employment: The median hourly wage is $42.06 and the annual salary is $87,480 as of May, 2009.

Source: O-Net Online, http://online.onetcenter.org/link/summary/15-1031.00

5.2 What Does a Computer Software Engineer (Systems) Do?

Research, design, develop, and test operating systems-level software, compilers, and network distribution software for medical, industrial, military, communications, aerospace, business, scientific, and general computing applications. Set operational specifications and formulate and analyze software requirements. Apply principles and techniques of computer science, engineering, and mathematical analysis.

Responsibilities:

- Modify existing software to correct errors, adapt it to new hardware, or upgrade interfaces and improve performance
- Advise customer about, or perform maintenance of software system
- Analyze information to determine, recommend, and plan installation of a new system or modification of an existing system
- Consult with engineering staff to evaluate interface between hardware and software, develop specifications and performance requirements, and resolve customer problems
- Direct software programming and development of documentation
- Store, retrieve, and manipulate data for analysis of system capabilities and requirements
- Confer with data processing and project managers to obtain information on limitations and capabilities for data processing projects
- Consult with customers or other departments on project status, proposals and technical issues such as software system design and maintenance
- Coordinate installation of software system
- Prepare reports and correspondence concerning project specifications, activities, and status

Education: This occupation may require a background in any of the following: science, technology, engineering, and mathematics (STEM) educational disciplines.

Employment: The median hourly wage is $44.94 and the annual salary is $93,470 as of May, 2009.

Source: O-Net Online, http://online.onetcenter.org/link/summary/15-1032.00

5.3 Computer Software Engineer: Current Technology Trends and Workforce Demand

5.3.1 What is Data Compression?

Data compression is the process of reducing the amount of data needed for storage or transmission of a given piece of information (text, graphics, video, sound, etc.), typically by use of encoding techniques. Data compression is characterized as either lossy or lossless depending on whether some data is discarded or not, respectively. Lossy compression is frequently used for photographs, video, and sound files where the loss of some detail is generally unnoticeable. JPEG and MPEG are the most common lossy formats. Lossless compression scans the data for repetitive sequences or regions and replaces them with a single "token." For example, every occurrence of the word *the* or region with the color red might be converted to *$*. ZIP and GIF are the most common lossless formats for text and graphics, respectively.

Source: The Concise Encyclopedia Britannica, http://www.answers.com/topic/data-compression

5.3.2 Why Math is Important to Understanding Data Compression and Overall Educational and Employment Success

Data compression is a critical body of knowledge for software engineering majors. If it moves into the CTC system as required coursework, students need to have successfully mastered mathematics. In the U.S. Department of Education's *Highlights from PISA 2009: Performance of U.S. 15-Year Old Students in Reading, Mathematics, and Science Literacy* results were compiled based upon the average mathematics literacy scores of 15-year-old students by country. The Organization for Economic Co-Operation and Development (OECD) average is 496. The top 17 countries all scored above 497. The United States tied with two other countries for the 25th ranking, with a score of 487, 9 points below the average.

Excerpts above from *Highlights from PISA 2009: Performance of U.S. 15-Year Old Students in Reading, Mathematics, and Science Literacy*, http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2011004

5.3.3 Math, Career Pathways, and Earning Potential: They're Connected

Mathematics mastery is essential, particularly for students interested in careers in ICT, and, as already demonstrated, ICT demand for employees will continue to grow. Consistent publications from state government and non-profit organizations stress the importance of student mathematics success. Students who do not master mathematics competencies are denied two crucial components: 1) cognitive development that enables problem solving with a higher rate of accuracy; and, 2) acceptance to higher education degree-granting institutions that equate to higher levels of pay.

The U.S. College Board identified four important skills students gain from math courses:

- Ability to identify and analyze patterns
- Logic and critical thinking skills
- Ability to see relationships
- Problem solving skills

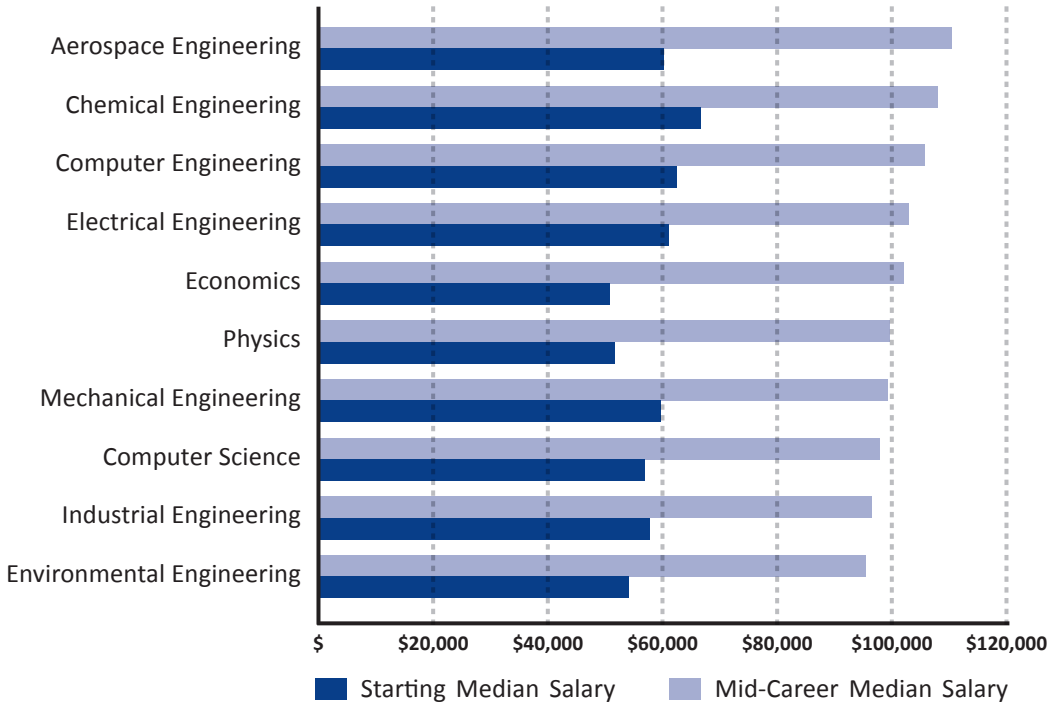
The relationship between the skills listed by the U.S. College Board and those essential to succeed in ICT degrees at two- and four-year educational institutions is apparent. Math mastery also leads to higher paying jobs when examining the charts "Best Undergrad College Degrees by Salary" and "Top Ten College Majors that Lead to Higher Salaries" from Payscale.com.

Source: http://www.payscale.com/best-colleges/degrees.asp

Best Undergraduate College Degrees by Salary

Degree	Median Salary	
	Starting	Mid-Career
Aerospace Engineering	$59,000	$109,000
Chemical Engineering	$65,700	$107,000
Computer Engineering	$61,700	$105,000
Electrical Engineering	$60,200	$102,000
Economics	$50,200	$101,000
Physics	$51,100	$98,800
Mechanical Engineering	$58,900	$98,300
Computer Science	$56,400	$97,400
Industrial Engineering	$57,100	$95,000
Environmental Engineering	$53,400	$94,500
Statistics	$48,600	$94,500
Biochemistry	$41,700	$94,200
Mathematics	$47,000	$93,600
Civil Engineering	$55,000	$93,000
Construction Management	$53,400	$89,600
Finance	$48,500	$89,400
Management Information Systems	$51,900	$87,200
Computing and Information Systems	$50,900	$86,700
Geology	$45,100	$84,200
Chemistry	$42,900	$82,300
Marketing	$41,500	$81,500
International Relations	$41,400	$80,500
Industrial Technology	$49,500	$79,600
Environmental Science	$43,300	$78,700
Architecture	$42,900	$78,300
International Business	$41,900	$77,800
Accounting	$46,500	$77,600
Political Science	$41,300	$77,300
Urban Planning	$43,300	$77,000
Philosophy	$40,000	$76,700
Information Technology	$49,400	$75,200

Top 10 College Majors That Lead to High Salaries



Methodology: Annual pay for bachelor's graduates without higher degrees. Typical starting graduates have two years of experience; mid-career have 15 years. Source: ©PayScale, Inc. @ www.payscale.com

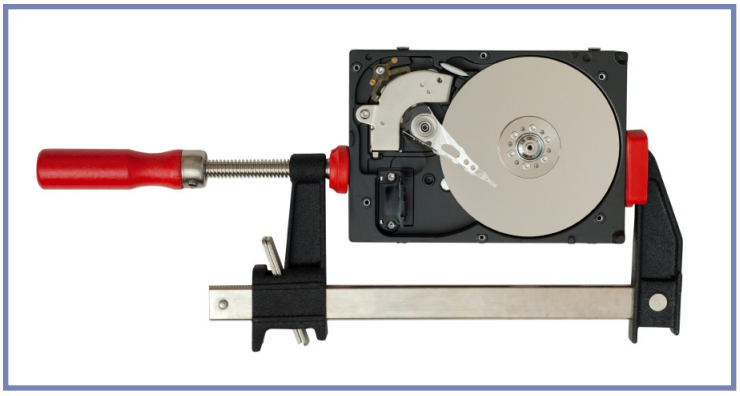
Is U.S. Culture Toward Math Affecting Student Success?

William Schmidt, Distinguished Professor of Education at the University of Michigan, tells the National Science Foundation (NSF) he believes that one of the likely reasons why math is perceived as being difficult is simply based on a longstanding accepted culture of "math phobia."

"Other countries [on the other hand] respect mathematics and expect all kids to learn it to some basic level," he says. But, in the U.S., "it's acceptable for an adult to declare, 'I'm no good at math,' [and leave it at that]."

The Chronicle of Higher Education recommends that math become a "gateway" rather than a "gate keeper" to a student's successful college education. Among other things, the magazine noted that as part of math instruction, an emphasis should be placed on learning "statistical reasoning," which supports decision-making under conditions of uncertainty—an inescapable condition of modern life. As the article states, "A grasp of statistical reasoning will help students to understand the world around them. It's math they can use right now."

Source: ATETV.org, http://blog.atetv.org/?p=785



5.3.4 Does Statistics Provide a Better Understanding of Mathematical and Science Concepts than Calculus?

The gatekeeper subject to entering a computer science or engineering major is mathematics. The community and technical college system has a series of pre-college mathematics courses designed to prepare students for college-level mathematics. Four-year colleges and universities require pre-calculus and calculus for entry into computer science and engineering majors. The CTC system is uniquely designed to assist students in mastering advanced mathematics due to smaller class sizes, lower tuition to enroll in these courses, and academic support in the form of tutoring services and math laboratories.

Information and computing technology programs have designed a number of courses, which apply mathematical concepts to ICT scenarios to ease entrance requirements. However, the success rate in further advanced college mathematics courses is low. There is an alternative viewpoint expressed that the logic and problem-solving knowledge and skills needed to be successful in programming can be found by mastering statistics as opposed to calculus.

Arthur Benjamin is a Professor of Mathematics at Harvey Mudd College, Claremont, California

Source: TED, http://www.ted.com/talks/arthur_benjamin_s_formula_for_changing_math_education.html

Transcript of his February 2009 Address at TED

I have a suggestion for him that I think would vastly improve the mathematics education in this country. And, it would be easy to implement and inexpensive.

The mathematics curriculum that we have is based on a foundation of arithmetic and algebra. Everything we have is based on the foundation of arithmetic and algebra. Everything we learn after that is building up towards one subject. On top of that pyramid, it is calculus. I'm here to say that I think that is the wrong summit of the pyramid. . . that the correct summit—that all of our students, every high school graduate should know, should be statistics: probability and statistics.

I mean, don't get me wrong, calculus is an important subject. It's one of the great products of the human mind. The laws of nature are written in the language of calculus. Every student who studies math, science, engineering, economics, should definitely learn calculus by the end of their freshman year of college. But, I'm here to say, as a professor of mathematics, that very few people actually use calculus in a conscious, meaningful way in their day-to-day lives. On the other hand, statistics is a subject that you could, and should, use on a daily basis. Right? It's risk. It's reward. It's randomness. It's understanding data.

I think if our students, if our high school students—if all American citizens—knew about probability and statistics, we wouldn't be in the economic mess we are in today. . . . Not only that, but, if it's taught properly, it can be a lot of fun. I mean, probability and statistics, it's the mathematics of games and gambling. It's analyzing trends. It's predicting the future. Look, the world has changed from analog to digital. It's time for our mathematics curriculum to change from analog to digital. From the more classical, continuous mathematics, to the more modern, discrete mathematics. The mathematics of uncertainty, of randomness, of data—and that is probability and statistics.

In summary, instead of our students learning about the techniques of calculus, I think it would be far more significant if all of them knew what two standard deviations from the mean means. I mean it.

5.3.5 Why Data Compression is Important

All of this leads to the symbiotic relationship between mastering and understanding mathematical concepts and success in information and computing technology. If this is not accomplished by CTC students, then solving the challenges data compression poses will prove to be difficult.

According to Alvis Brigis, *The Future of Gadgets*, "For years, decades, data compression has formed a frustrating bottleneck for the development and diffusion of not only rich video games, but also more broadly important communication technologies such as virtual worlds—(Second Life, Multiverse, VastPark), mirror worlds (Google Earth, Open Street Map) and high definition streaming Web TV (You Tube HD, Hulu)—just to name a few. A breakthrough in compression of this magnitude. . . (which depends on the development of smarter algorithms) is tantamount to throwing more broadband piping at the Web and could result in: 1) massive acceleration of VW, MW, and WebTV adoption; 2) increases in the resolution of these cloud-based systems."

Source: The Future of Gadgets, http://www.futureofgadgets.com/futureblogger/public_blog_post/Alvis%20Brigis

"The types of applications and services delivered to end users primarily through the Internet now are amazing," says Rich James, Senior Manager, Recruiting, F5 Networks. "Bill paying, phone calls, music and book purchases, news reading, et cetera, began this shift." The shift continued, James says, "with high-definition image content (movies, gaming, TV shows and more) which is extremely bandwidth-intensive. One hour of full-HD content is over 10 gigabytes. Just imagine the strain on Internet service providers."

James indicates, "Companies that provide this content to users and the service providers that deliver it are already in 'scramble-mode' to develop compression technologies. Compressing files allows faster downloading, and real-time streaming of content." James believes, "Students who leave college with experience working with compression algorithms and protocols would be cutting-edge job candidates, and very valuable."

Community and technical college computer science and information technology programs should review their programming curriculum and consider incorporating the following content if they have not already done so:

- Channel coding
- Entropy
- Information transmission and storage

- Lossless data compression
- Lossy data compression
- Representing and processing video data
- Source-channel separation

The following is the course overview and sequencing of content, courtesy of Professor Jay Kuo Ming Hsieh of the University of Southern California.

Source: http://sipi.usc.edu/assets/001/66364.pdf

Multimedia Data Compression: Students are expected to comprehend existing C/C++ programs and modify the codes for various goals. The students may also be required to write small programs from scratch. Provided sample codes come with makefiles for compilation under UNIX environment. Either familiarity with basic UNIX commands or the ability to convert the code to a Windows project is required.

1. An overview of image compression, important information theory concepts, entropy definition, and interpretation
2. Shannon-Fano coding, Huffman coding, adaptive Huffman coding, QM codec, context-based QM coder
3. Lempel-Ziv codec, examples of lossless compression
4. Audio and speech compression
5. Scalar quantization, optimal scalar quantizer, compander
6. Vector quantization
7. JPEG still image compression
8. Scalar image coding, JPEG-2000, and fractal image compression
9. MPEG-1, -2, -4, and H.26x video compression standards
10. Fast motion search algorithm and applications of video coding in DVD and DTV
11. Pre- and post-processing techniques, deblocking filters, deranging filters, rate control techniques
12. Multimedia delivery/streaming over wired and wireless networks
13. Multimedia content protection, encryption and watermarking, MPEG-21
14. 3D graphic coding, examples of multimedia systems (VOD systems, game server systems), embedded multimedia systems for mobile applications

5.4 Technology Trend Alert (Computer Software Engineer Applications): Mobile Applications in the Clouds

With heightened interest and consumer demand centered on mobile applications (fueled in large part by Apple), where will all this information be stored? An understanding of the expanding role of applications, data storage, and how this type of data pushes servers to capacity, provides a viable solution. It's not taking a lofty position to state: the answer lies in the clouds.

5.4.1 Why Cloud Computing is the Future of Mobile

What does the term "mobile cloud computing" really mean? Basically, it refers to an infrastructure where both the data storage and the data processing happen outside of the mobile device. Today, there are already some good examples of mobile cloud computing applications including mobile Gmail, Google Maps, and some navigation apps. However, the majority of applications today still do most of the data storage and processing on the mobile devices themselves and not in the cloud.

Not everyone owns a smartphone. There are still large numbers of markets worldwide where the dominant phone is a feature phone, and these lower-end phones are not going away anytime soon. And it's their very existence, which will help drive the mobile cloud computing trend.

Not only is there a broader audience using feature phones in the world, there are also more Web developers capable of building mobile Web applications than there are developers for any other type of mobile device. Those factors will have an impact on mobile cloud computing's growth.

Cloud computing will become a disruptive force in the mobile world. The number of users technology has the power to reach is far more than the number of smartphone users alone. Mobile applications distribution is tied to the mobile carrier. With mobile cloud computing applications, as long as users have access to the Web, they have access to the mobile application.

Mobile applications will begin to store your data in the cloud, and the applications will become more powerful as processing power is also offloaded to the cloud.

The first mobile apps powered by the cloud will likely be business-focused mobile productivity applications where collaboration, data sharing, multitasking, and scheduling are key factors. For consumers, though, navigation and mapping applications will be the most obvious examples of the trend.

Source: http://www.readwriteweb.com/archives/why_cloud_computing_is_the_future_of_mobile.php

Mobile applications are proving to be invaluable to innovation in the healthcare, education, financial services, and advertising industries. The CTC system has an opportunity to offer degrees or certificates focusing on mobile applications as opposed to students waiting until they articulate to a four-year educational institution for exposure to this technical knowledge. Currently, the state's CTC system does not offer a comprehensive mobile applications degree or certificate to its students.

In order to ensure students are exposed to and learn the latest technologies, the CTC system should consider, if not developing an entirely new degree or certificate: 1) creating a mobile applications technology course; or 2) begin to incorporate and/or introduce students to some of the required technical knowledge and skills within its current course offerings.

Content might include:

- Authentication
- Camera access
- Content syndication
- Browser and server setup
- Designing and developing mobile tools for the active market
- Geolocation
- HTML, CSS, and DOM
- Introduction to jQuery
- Mobile applications landscape
- Mobile applications history
- Mobile Web mechanics
- Mobile platforms
- Scripting with JavaScript
- Scripting with server access
- Speeding up mobile applications
- Structured data: XML and JSON
- Web foundations (URL and HTTP)

Most two-year institutions across the country do not offer mobile computing degrees or certificates. Examples of degrees are found primarily from ICT programs at the four-year higher-education level. Mobile applications certificates are currently being offered *after* a student has completed a four-year degree. Thus, determining which example of a degree or certificate was best was based upon the exploratory nature of the certificate offered at a two-year community college and funded through corporate sponsorships.

This certificate is offered by Virginia Western Community College's Business, Engineering, and Technology Division. It is sponsored by Verizon and Hewlett Packard.

Mobile Programming Certificate Coursework

Fall	Spring	Fall
ITN 101 Introduction to Networks	ITP 112 Visual Basic .NET	ITP 214 Windows Mobile Development
ITP 100 Software Design	ITP 120 Java Programming	ITP 224 Mobile Java ME
ITD 120 Design Concepts for Mobile Applications		ITD 238 Data Storage for Wireless Devices

Source: http://www.virginiawestern.edu/documents/MobileProgramming.pdf

6: Home Health Aide and Registered Nurse

6.1 What Does a Home Health Aide Do?

Provide routine, personal healthcare, such as bathing, dressing, or grooming to elderly, convalescent, or disabled persons in the home of patients or in a residential care facility.

Responsibilities:

- Accompany clients to doctors' offices and on other trips outside the home, and provide transportation, assistance, and companionship
- Administer prescribed oral medications, under the written direction of physician or as directed by home care nurse or aide, and ensure patients take their medicine
- Care for children who are disabled or who have sick or disabled parents
- Care for patients by changing bed linens, washing and ironing laundry, cleaning, or assisting with their personal care
- Entertain, converse with, or read aloud to patients to keep them mentally healthy and alert
- Maintain records of patient care, condition, progress, or problems to report, and discuss observations with supervisor or case manager
- Massage patients and apply preparations and treatments, such as liniment, alcohol rubs, and heat-lamp stimulation
- Provide patients and families with emotional support and instruction in areas such as caring for infants, preparing healthy meals, living independently, or adapting to disability or illness
- Provide patients with help moving in and out of beds, baths, wheelchairs or automobiles, and with dressing and grooming

Education: This occupation requires a background in any of the following: science, technology, engineering, and mathematics (STEM) educational disciplines.

Employment: The median hourly wage is $10.87 and the annual salary is $22,600 as of May, 2009.

Source: O-Net Online, http://online.onetcenter.org/link/summary/31-1011.00

6.2 What Does a Registered Nurse Do?

Assess patient health problems and needs, develop and implement nursing care plans, and maintain medical records. Administer nursing care to ill, injured, convalescent, or disabled patients. May advise patients on health maintenance and disease prevention or provide case management. Licensing or registration required. Includes advance practice nurses such as: nurse practitioners, clinical nurse specialists, certified nurse midwives, and certified registered nurse anesthetists. Advanced practice nursing is practiced by RNs who have specialized formal, post-basic education and who function in highly autonomous and specialized roles.

Responsibilities:

- Administer local, inhalation, intravenous, and other anesthetics
- Assess the needs of individuals, families, or communities, including assessment of individuals' home or work environments to identify potential health or safety problems
- Conduct specified laboratory tests
- Consult and coordinate with healthcare team members to assess, plan, implement, and evaluate patient care plans
- Consult with institutions or associations regarding issues and concerns relevant to the practice and profession of nursing
- Direct and coordinate infection control programs, advising and consulting with specified personnel about necessary precautions
- Direct and supervise less skilled nursing or healthcare personnel or supervise a particular unit
- Engage in research activities related to nursing
- Hand items to surgeons during operations
- Inform physician of patient's condition during anesthesia
- Instruct individuals, families and other groups on topics such as health education, disease prevention, and childbirth, and develop health improvement programs
- Maintain accurate, detailed reports and records
- Modify patient treatment plans as indicated by patients' responses and conditions
- Monitor all aspects of patient care, including diet and physical activity
- Monitor, record, and report symptoms and changes in patients' conditions
- Observe nurses and visit patients to ensure proper nursing care

Education: This occupation requires a background in any of the following: science, technology, engineering, and mathematics (STEM) educational disciplines.

Employment: The median hourly wage is $34.60 and the annual salary is $72,000 as of May, 2009.

Source: O-Net Online, http://online.onetcenter.org/link/summary/29-1111.00

6.3 The Significance of Aging Baby Boomers on Healthcare

"Highly-skilled healthcare professionals, like doctors and specialists, will be in demand because of aging baby boomers, which means big salaries," Lena Bottos, Salary.com director, said. Healthcare careers overall will likely enjoy job security. According to the U.S. Labor Department, 13 of the 20 fastest-growing occupations between 2004 and 2014 are related to healthcare. Home health aides, medical assistants, and physician assistants are in the top five.

Excerpt from *Future of Business,* mnsbc.com, http://www.msnbc.msn.com/id/20284970/ns/business-future_of_business/

Healthcare Employment by Industry, Occupation and % Distribution, 2008 and Projected 2018

Occupation	Employment, 2008		% Change, 2008-18
	Number	%	
All Occupations	**14,336.0**	**100.0**	**22.5**
Management, Business, and Financial Occupations	**614.6**	**4.3**	**16.8**
Professional and Related Occupations	**6,283.9**	**43.8**	**22.5**
Counselors	171.3	1.2	22.6
Social Workers	206.7	1.4	19.5
Dietitians and Nutritionists	35.5	0.3	9.8
Pharmacists	67.5	0.5	14.0
Physicians and Surgeons	512.5	3.6	26.0
Registered Nurses	2,192.4	15.3	23.4
Clinical Laboratory Technologists and Technicians	278.8	1.9	14.0
Emergency Medical Technicians and Paramedics	142.1	1.0	9.2
Licensed Practical and Licensed Vocational Nurses	619.1	4.3	21.9
Office and Administrative Support Occupations	**2,540.3**	**17.7**	**19.7**
Billing and Posting Clerks and Machine Operators	194.8	1.4	19.7
Receptionists and Information Clerks	386.3	2.7	16.1
Secretaries and Administrative Assistants	770.7	5.4	26.5

Note: Columns may not add to total due to omission of occupations with small employment. Source: BLS National Employment Matrix, 2008-18.

Source: ftp://ftp.bls.gov/pub/special.requests/ep/ind-occ.matrix/ind_pdf/ind_621000-3000.pdf

6.4 Healthcare Trend Alert: How Information and Computing Technology Developments Could Inform and Influence STEM Occupations (Telemedicine Technician)

Jobs will be changing for licensed nurse practical/vocational nurses (LPNs), nurse practitioners (NPs), and registered nurses (RNs), partially due to the expanding number of baby boomers who will require more time and care. As these healthcare workers retire, the need for nurses will outpace the actual number who graduate from educational programs and enter the workforce. The NP's role will also change as doctors experience the same increase in the number of patients for whom they are responsible. The healthcare system will expect and depend upon the healthcare workers in general (home health aides and all nursing professionals) to take on a role, which will share many of the same job duties as a doctor.

The Obama administration's healthcare plan, even taking into consideration either future restrictions or expansions, projects there will be between 12 to 15 million (the low estimate) to 32 million (the high estimate) new individuals eligible for healthcare. The system, already stretched, will become even more so. Emergency care will be hit hardest, but all medical practices will experience increased stress due to increased patient loads. This means higher education must substantially increase the number of class seats for nursing programs in order to accommodate demand. Thus, nurses and homecare aides will not only be required to master the traditional knowledge and skills required by their occupation, but will also be required to *expand* their information and computing technology knowledge and skills in order to meet advances in treating the medical conditions of elderly patients.

Excerpt below from the New York State Department of Health, http://www.nyhealthcarecommission.org/docs/commssion_hospitals_and_nhs_of_the_future.pdf

The following factors necessitate non-traditional ways to treat patients:

- Technology
- Patient preference and acuity
- Fiscal pressures—providers, payers, employers
- Reserve capacity
- Staffing issues—cost, recruitment
- Shortages
- Difficulty navigating the convoluted system
- Competition between unregulated and regulated entities

One of the changing roles of the healthcare practitioner resulting from the aforementioned healthcare challenges is *telemedicine*, defined by Medicine.net, as "the use of medical information exchanged from one site to another via electronic communications for the health and education of the patient or healthcare provider and for the purpose of improving patient care. Telemedicine includes consultative, diagnostic, and treatment services."

In the *Newsweek* article excerpted in Section 6.4.1, Harvard Medical School has achieved vast success with sending medically, electronically, and technically equipped vans to reach poor, underserved, and rural populations.

6.4.1 A Little Van With a Big Impact: This RV Could Change the Face of Healthcare in America

The Family Van, a nonprofit organization affiliated with Harvard Medical School, has been operating for 18 years now, but it is only in the last year that many people have begun to realize what Jackson figured out a long time ago: "mobile health clinics" like the Family Van don't just provide healthcare to people who don't have any. They also help a lot of people who can get traditional healthcare by other means, and they do so in an astonishingly cost-effective and efficient way. In other words, they solve one of the most pressing problems facing the new healthcare-reform law: how to expand access while controlling costs. In Massachusetts the need is particularly acute; spending on healthcare has increased by 52% since the state enacted its own major health reform in 2006.

That number would be even higher if not for the Family Van. For every dollar invested in the van's operations, an estimated $36—in avoided ER visits, in prevention of diseases, in management of chronic illnesses that can spiral out of control—has been saved. The Family Van spared the health-care system more than $20 million last year, and it did that on a meager budget of a half million dollars.

Twelve years passed before one of the project's major funders, Putnam Investments, asked Oriol what kind of results the van might be delivering, financially speaking. "They wanted to know about the ROI—the return on investment," she says. "But I didn't know what ROI was. They don't teach you that in medical school." Oriol's students cobbled together an informal way of assessing the van's performance, but it took several years and some extensive number crunching before the Harvard group could come up with a more rigorous formula for measuring the cost-effectiveness of mobile health. It was published last year, and even the van's staffers were a little surprised at the 36-to-1 figure that popped out when they applied it to their own operation. (Investment in conventional preventive medicine tends to have an ROI more like 3 to 1.) The algorithm has now been applied to 10 other mobile health programs around the country. The data are as yet unpublished, but they're impressive: $20 saved for each dollar of funding.

There are now more than 2,000 mobile health clinics across the country. But they can do only so much. Obviously, there's a limit to the services a van can provide without doctors, and to the amount of money that can be funneled into such projects, either through philanthropy or (as with some other vans) government grants. Still, it's worth looking at the advantages of the Family Van and asking why these can't be applied to conventional healthcare, too. It's great that people in need have access to cheap, convenient, effective preventive care in a relaxed and friendly atmosphere. Shouldn't we all?

Source: *Newsweek,* http:// www.newsweek.com/2010/07/.../a-little-van-with-a-big-impact.html

Conclusions from "A Little Van With a Big Impact":

- "Cheap, portable screening tools and questionnaires" save money.
- The ability for the healthcare provider and patient to actually take the time to discuss symptoms and solutions, which typically doesn't happen in traditional medical organizations.
- Paperwork (insurance forms, reimbursements for Medicare/Medicaid) is unnecessary as the healthcare providers are paid through donations.
- The mobile health clinic is convenient for patients (walk-ins only) and enables more frequent follow-up visits.
- Doctors aren't needed to provide medicine.

Implications for the CTC System

The CTC system has two emerging trends to explore:

1. Telemedicine's growth potential; and
2. New occupational changes to accommodate the systemic impact telemedicine will have on healthcare provider positions.

The state's CTC allied health and medical assistant programs, in anticipation of this next generation of healthcare professionals, might consider examining their current programs in preparation for a healthcare transformation.

If the physician is remotely working with a nurse practitioner to deliver healthcare to poor, underserved, or rural community patients, the nurse practitioner must acquire the technical knowledge and skills of a telemedicine technician, or the nurse practitioner's traditional role and responsibilities will create hybrid occupational profile—the telemedicine technician. This new occupation would need to be able to successfully employ mobile technology to provide effective healthcare. The telemedicine technician would:

- Match patients with medications
- Track samples from bedside to lab
- Positively identify patients
- Track blood from donation to transfusion
- Quickly locate critical equipment anywhere in the facility
- Communicate, both with patients and other personnel
- Download appointment schedules
- Capture charges
- Order lab tests and view results
- Manage inventory

Source: Motorola http://www.motorola.com/web/Business/Solutions/Industry%20Solutions/Healthcare/Motorolahealthcarebrief_wireless.pdf

Telemedicine in the 'Hood: Treating Patients from a Remote Location with Aid of High-Technology Communications

Exploring possible program changes or updates to anticipate an occupation like the telemedicine technician are in the early stages across the country.

Physicians at urban hospitals around the country can testify to the frequent bottlenecks that occur in waiting rooms, which service treatment facilities for uninsured and Medicaid/Medicare patients.

"In our setting, we just don't have enough board-certified physicians available to meet the heavy demand," Dr. Richard S. Baker, King-Drew Medical Center, says. "With telemedicine coming in at a third of the cost, we can staff these clinics and we can optimize the allocation of our primary resource, which is manpower."

One of the innovations arising from this urban informatics test bed will be a new "telemedicine technician," who will already have the basic training of an allied health professional or medical assistant. The technician will then get cross-trained in a variety of fields.

Source: *Black Issues in Higher Education,* http://www.jordanelgrably.com/telemedicine.html

Excerpt below from *Changes Needed in Nurses' Education and Work Environments*, Yale Office of Public Affairs and Communication, http://www.opa.yale.edu/news/article.aspx?id=6889

1) Targeted Treatments

New medical treatments are being developed more and more based on genetic and other molecular tests. These advances in healthcare technology will provide more tests that reveal whether people are likely to respond well to specific drug treatments, meaning a more targeted, individualized approach for each patient. Roughly a dozen of these targeted treatments are currently being used in the medical field, with many more predicted for the future.

2) Telemedicine

Telemedicine utilizes modern technology such as the Internet to connect patients and physicians. Telemedicine allows a physician to interact with a patient online in real-time, cutting back on time and expenses associated with the typical office visit. Telemedicine is a growing trend that will continue to progress as technology increases.

3) Patient-centered Medical Homes

Patient-centered medical homes are a technology-driven, holistic approach to healthcare in which a physician acts as the patient's health coach, with 24-hour access, electronic medical records, e-mail, phone communication, and patient feedback being key concepts. These types of programs are currently being piloted by Medicaid in several states to test their effectiveness for the future.

7: Conclusions: Information and Computing Technology and Healthcare Aligned to STEM

7.1 Educational Needs and Workforce Trends

It is increasingly apparent that information and computing technology (ICT) is taking on a transformational role, which enables change across industry sectors and within occupations. The ICT partnerships with other industry sectors make technological advances possible.

The trends explored are offered to assist the CTC system in anticipating changes in workforce trends and technologies, and to then review and consider changes to, and/or develop new:

- Programs
- Degrees and certificates
- Career pathways
- Curricula
- Syllabi

How five "hot outlook" occupations look today and how they might look in the future will impact the next generation of learners who move through the CTC system. If the system decides to make any changes based upon this report, it should factor into its decision the types of learner it can expect by the time any changes are incorporated. Given the economic uncertainty, how are the millennials now entering the workforce faring? Will retired baby boomers rethink their decisions and consider re-entering the workforce? Millennials and baby boomers face both education and employment challenges and opportunities.

8. Education and Employment for Baby Boomers and Millennials

The share of the youth labor force, workers aged 16 to 24, is expected to decrease from 14.3% in 2008 to 12.7% by 2018. The primary working-age group, those between 25 and 54 years old, is projected to decline from 67.7% of the labor force in 2008 to 63.5% by 2018. Workers aged 55 years and older, by contrast, are anticipated to leap from 18.1% to 23.9% of the labor force during the same period.

Source: Overview of 2008–18 Projections, *Occupational Outlook,* Bureau of Labor Statistics, http://www.bls.gov/oco/oco2003.htm

8.1 Baby Boomers Go Back to School

If future projections transpire, the need to meet tomorrow's workforce demand and determine how to up-skill employed or retired workers presents challenges and opportunities. These involve customizing educational and training methods to the learning styles of a population that did not grow up with today's current technologies. Technological advances have modified productivity, created, and redefined all industry sectors. Educational institutions across the country, and specifically the CTC system, have a unique opportunity to create learning and on-the-job training environments compatible with Washingtonians 55 years and older.

A Projection from 2003: Recruiting Older Workers

With the graying of the workforce, American business is going to have to pay attention to what older workers want and how to recruit them, says Deborah Russell, manager of Economic Security and Work at the American Association of Retired Persons (AARP). "Terms such as 'fast-paced,' 'high-energy,' 'young,' and 'vital' are often signals to older workers that they need not apply," she says. AARP encourages companies to use terminology that better reflects age diversity such as "experienced workers" and "age-diverse."

An AARP-sponsored study, using a nationally representative sample of 1,500 workers age 45 to 74, shows that 69% plan to work in some capacity during their retirement years. They work not only for money but also for intangible benefits such as enjoyment and a sense of purpose. Poll participants focused on "soft benefits" such as adequate time off and flexible schedules as well as "hard benefits," including health-care benefits and insurance and good pension benefits as "absolutely essential parts of their ideal jobs."

Source: *Workforce Management,* http://www.workforce.com/section/hr-management/feature/fast-forward-25-trends-will-change-way-do/

8.2 Where are Baby Boomer Educational Opportunities?

What is currently being done when considering baby boomers' educational needs? Are there any programs in place that could either be implemented in Washington State or researched and created? The American Association of Community Colleges (AACC) has launched just such a program worth examining.

Experts below from Examiner.com, http://www.examiner.com/baby-boomer-in-national/baby-boomer-training-program-gains-steam

A nationally coordinated effort among community colleges to train and retrain baby boomers for new jobs is gaining momentum. The effort is called the Plus 50 Initiative—a three-year program to help community colleges attract baby boomers 50 years and older train for new jobs and sharpen their skills to help market themselves in the job market.

The initiative is expanding to include more community colleges as "affiliates" in an effort to get more colleges to reach out to a greater number of baby boomers. The three-year project is sponsored by the AACC with a $3.2 million grant from the Atlantic Philanthropies.

The AACC has detailed information on its Web site:

- Starting a Plus 50 Program
- 50+ Population
- Practical Tips for Colleges
- Plus 50 College Profiles

Source: *American Association for Community Colleges,* http://plus50.aacc.nche.edu/colleges/plus50program/Pages/default.aspx

8.3 Job Opportunities for the Millennials: Are There Any?

Excerpts below from *USA Today,* http://www.usatoday.com/news/education/2010-02-24-millennials24_ST_N.htm

The most detailed study to date of the 18- to 29-year-old millennial generation finds this group probably will be the most educated in American history. But the 50 million millennials also have the highest share that are unemployed or out of the workforce in almost four decades, according to a recent study, released by the Pew Research Center.

Pew's analysis includes its own data, such as a new survey of 2,020 adults, including 830 millennials, conducted by landline and cell phone. It also analyzes data from other sources, such as the census, which shows 40% of those 18–24 were in college in 2008, a higher percentage than any previous generation.

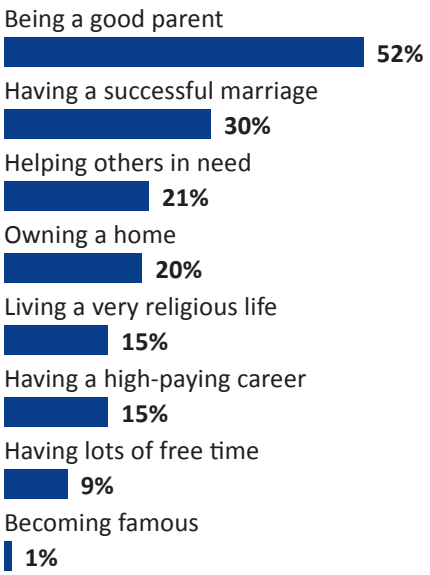
As the "Millennials' Priorities" chart demonstrates Generation X exceeds Millennials 24% in full-time employment and Baby Boomers by 11%.

8.4 The Transformed Employment Landscape for Millennials

Millennials, the most technologically savvy generation to enter and graduate from the CTC system, are arriving into a workforce that could and should be able to take full advantage of their expertise and education. However, due to economic realities they are not experiencing the employment opportunities the DOL projected and they consequently expected. One of the emerging developments due to a challenged economy is traditional full-time, permanent job with benefits and a pension plan is no longer a guaranteed option. This is due to two factors: 1) the "full-package" employment offer is no longer as financially viable for or attractive to employers; and 2) the new reality is workers are willing to accept less in order to secure employment.

Millennials' Priorities

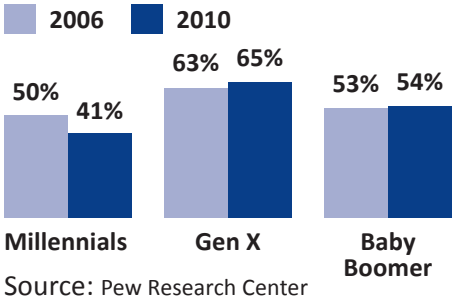
Percentage who say the following is one of the most important things in their lives:



Note: Based on adults ages 18-29

Full-time employment by generation

Percentage of each generation employed full-time:



Source: Pew Research Center by Karl Gelles, USA Today

Changes Being Made to "Traditional" Jobs

Jobs may be coming back, but they aren't the same ones workers were once used to.

Many of the jobs employers are adding are temporary or contract positions, rather than traditional full-time jobs with benefits. With unemployment remaining near 10%, employers have their pick of workers willing to accept less secure positions.

In 2005, the government estimated that 31% of U.S. workers were already so-called contingent workers. Experts say that number could increase to 40% or more in the next 10 years.

James Stoeckmann, senior practice leader at WorldatWork, a professional association of human resource executives, believes that full-time employees could become the minority of the nation's workforce within 20 to 30 years, leaving employees without traditional benefits that most workers take for granted today, such as health coverage, paid vacations, and retirement plans.

"The traditional job is not doomed. But it will increasingly have competition from other models, the most prominent is the independent contractor model," he said.

Demographic factors are feeding the shift as well. Stoechmann said many younger workers are more open to the idea of not tying themselves to a single employer.

And as baby boomers reach the age when they are eligible for Medicare and not dependent upon their employer for health insurance, many are more open to contract work.

Not everyone who works as a freelancer or independent contractor is unhappy with his or her situation. About 30% are satisfied with the arrangement, about equal to the number who desperately want to find a full-time job with benefits. The other 40% are somewhere in the middle, feeling pleased by aspects of their job and unhappy about others.

Source: *CNN Money,* http://money.cnn.com/2010/06/01/news/economy/contract_jobs/index.htm

A new practice has emerged for the 2011 employer: contingent workers. This type of employee "works for an organization on a non-permanent basis, also known as freelancers, independent professionals, temporary contract workers, independent contractor, or consultants."

Source: http://en.wikipedia.org/wiki/Contingent_workers

If the trend of hiring contingent work increasingly replaces the traditional vision students have of employment (full-time, permanent, with healthcare/dental benefits and some type of employer-sponsored pension plan), the CTC system must consider how to prepare students and graduates for employers by meeting employment needs with contingent workers.

This could have a substantial impact on the following CTC advising and counseling support systems:

- Academic
- College career
- Direct faculty-to-student
- Financial-aid

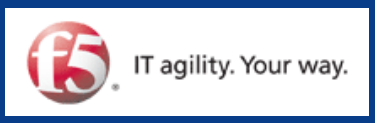
The CTC system will have to prepare students for a very different way of not only navigating their two-year college experience, but how to make effective decisions moving forward into either the workplace or articulating to a four-year educational institution. It would also affect community and technical colleges' essential linkages and partnerships with local and regional businesses. Essentially, the CTC system would have to re-envision its role in preparing students for this nontraditional employee-employer relationship. One possibility is to explore how cooperative educational programs might better prepare students entering a potentially seismic shift in what constitutes employment upon graduation.

8.5 The Cooperative Education Program

The CTC system may want to revisit the cooperative education program. The University of Waterloo, Ontario, Canada, describes its co-op model as one that "formally integrates academic studies with relevant work experience." Co-op students alternate school terms and work in appropriate professional fields. Work terms are typically four months long.

Read more at: http://www.cecs.uwaterloo.ca/employers/prospective/about.php

Washington State might consider a collective approach and research implementing Waterloo's model as a consortium of CTCs. With securing internships being a challenge for two-year college students at information and computing technology companies, a comprehensive approach could prove viable. The following suggests an employer base for the cooperative approach to on-the-job training.



Why Waterloo University's Co-Op Works
By Dan Matte, F5 Networks

Waterloo University's Co-op Process:

- Companies submit their job postings
- Co-op receives information from student applicants (resume, evaluation from previous employers and school-related information)
- Co-op conducts interviews (most employers use phone or video for this step); then,
- Employers submit a prioritized list of applicants to Waterloo, and the university matches students to employers

Northeastern, Drexel, and the University of Cincinnati also have co-op programs. Currently they are not as large as Waterloo's. Waterloo has approximately 5,700 students on the work co-op program.

The following Seattle companies have students working on a four-month co-op term: Microsoft, Amazon, Google, Airline Intelligence, RIM Bellevue, nVidia, and Expedia.

9: Information and Computing Technology and Emerging Workforce Trends: 2018 and Beyond…

Employment growth projections published by the Department of Labor's *Occupational Outlook Handbook* used to illustrate how the CTC system might consider updating or creating new educational programs, degrees, or certificates, was based upon forecasts through the year 2018. Bureau of Labor Statistics has not published projections beyond 2018. Researching employment growth, based upon future 2025 scenarios, has led to an exploration of potential workforce demand as well as subsequent educational programs that might evolve.

9.1 What Will the World Look Like in 2025?

Research conducted by the international community, specifically the European Union, New Zealand, the U.S. National Intelligence Council, and the World Economic Forum, including related government agencies and councils, and non-profit organizations, indicate the following primary concerns:

- Natural resources (supply and demand)
- Changing climate (global warming) and expected and unexpected outcomes related to its impact upon natural resources
- Demographic shifts (birth rates, aging populations, and international mobility—immigration)

In anticipation of the projections, solutions have been postulated not just by research bodies, but also by corporations across the globe. The effects will be profound as industries shift, refocus, and re-imagine their role as providers of goods and services. Workforce demand may increase to match these anticipated projections, and take the economic market aback with either: 1) a by-product technology that creates demand where none was expected; or 2) compel a rapid readjustment by the CTC system as the expected profile of the "learner of tomorrow" does not materialize.

Highlights of some of the projections made by multiple reports, white papers, and studies commissioned by international and national bodies substantiate the following excerpt from the European Union's *The World in 2025: Rising Asia and Socio-Ecological Transition*, published in 2009.

9.2 Impact of Growing Worldwide Demand for Energy

- According to the International Energy Agency in 2025 the world energy demand will have increased by 50% in relation to 2005 and will reach 15 billion tons of oil equivalent.
- Oil production will have started to stagnate (peak); coal is expected to become the first energy source between now and 2050. But in 2025 oil will still be in the lead.
- The recycling of raw materials will become an important industrial activity.
- The progress achieved during the last twenty years in the fight against climate change remained limited in comparison to what a "successful transition" would call a priority. Measurements taken by scientists since 2000 have shown that the world emissions of carbon dioxide now grows more quickly than the most pessimistic scenario of IPCC. A warming of less than two degrees in a century seems now quite unlikely. The European objective of not exceeding an average 2° Celsius increase (in relation to the preindustrial era) seems difficult to attain.
- The need for water will increase sharply with the increases in world population. The rise in the standard of living in emerging countries will create strong tensions with the quantities available, which are likely to decrease due to climate change.
- If it is true that the first generation of desalination technologies will use a great deal of combustion energy, it will contribute to CO2 emissions. First located in the Middle East (producing today half of the desalinated water of the world), desalination technologies are proliferating around the Mediterranean, and in Asia, Australia, and California. Will desalination technologies, with the help of renewable energy, be developed on a large scale in time for these tensions to be reduced?
- The changes in social behavior will contribute, if they are stimulated by appropriate policies, to a drastic reduction in energy consumption, and this remains the major objective. Consumers will insulate their houses, replace their cars with smaller ones, walk rather than drive, and use public transportation. Companies will reorganize their logistics, adapt their products and processes, and relocate certain activities. They will locate their warehouses closer to train stations, substitute wood for plastics, and produce more easily repairable products or recycle them. States will develop spatial planning approaches that take into account increasing transportation costs. They will encourage renewable energy, "clean" fossil fuels technologies, and nuclear energy.
- The approach towards aging and retirement age will depend on longer life expectancy and financial needs. New markets (on which Europe could play a part given its strengths in pharmaceuticals, medical equipment, and cultural products) and new social services will be developed to meet the needs and problems of elderly people.

Source: *European Union Commission,* http://ec.europa.eu/research/social-sciences/pdf/the-world-in-2025-report_en.pdf

Some occupations are aligned to create possible answers to the 2025 global challenges. These occupations are reliant on the CTC system, which integrates information, technical knowledge, and skills within all industry sector career pathways. The following industries will create new or revised jobs that rely on or incorporate ICT. They will partner with community and technical colleges in the following fields:

Energy and the Environment

- Building cool (due to global warming)
- Clean coal
- Cultural product planning
- Desalination
- Industrialized and widespread recycling
- Nuclear energy
- Renewable energy (an increased focus)
- Waste management
- Water manufacturing and refineries

Health

- Global health
- Pharmacology

Transportation and Logistics

- Spatial and urban planning
- Transit systems design (Intelligent Transportation System)

9.3 2025: Science, Technology, Engineering, and Math (STEM) Educational Needs and Projected Workforce Trends

The projections found in the research and white papers published envision some major challenges for international and national economies. Whenever natural resources become scarce or compromised, either through man-made or spontaneous geo-occurrences, complex questions about how problems posed by these forecasts will be solved. However, anticipating the *possibility* of such occurrences now, as opposed to 2020, for example, small pockets of workforce growth could shift radically and boost workforce demand.

2025 E.U. global projections, bolstered by the U.S. National Intelligence Council's report, *Global Trends 2025: A Transformed World*, anticipate the following occupations highlighted in the table, *"Bright Outlook" Environmental and Energy Occupations: Looking Towards 2025 (see page 64)*. These workers could potentially play an intrinsic role in bolstering the economies of Washington State and the United States. Programmatic examination is highly recommended when factoring in consideration of the 2025 globality forecast.

Even considering the 2025 global scenarios presented, these "bright outlook" occupations do not currently indicate significant workforce demand for Washington State or for the United States through 2018. However, the percentage change amounts to an average increase of 13% for Washington State and 23% for the United States. All of these occupations will work in teams with other energy and environmental occupations to create solutions to future energy

and environmental issues and challenges. While occupations in science and engineering require earning at least a bachelor's degree, a technician occupation typically requires an associate's degree.

"Bright Outlook" Environmental and Energy Occupations: Looking Towards 2025

Washington	Employment		Percent Change	Job Openings
	2008	2018		
Civil Engineers	14,330	16,630	+16%	490
Civil Engineering Technicians	2,590	2,810	+19%	100
Environmental Science and Protection Technicians, including Health	780	1900	+16%	50
Geoscientists, except Hydrologists And Geographers	1,150	1,340	+17%	60
Hydrologists	430	480	+12%	20
Urban and Regional Planners	3,050	3,390	+11%	120
Water and Liquid Waste Treatment Plant and System Operators	1,620	1,820	+12%	70

As the nation begins the process of envisioning how its collective infrastructure prepares for 2025, interdisciplinary educational programs are already being developed to meet the increasingly complex challenges the United States faces. Thus, programs will no longer be created for a career solely in civil engineering without 1) considering the role the civil engineer will play within specific industries (energy, environment, transportation, and logistics); and 2) how information and computing technologies can be used to increase the speed at which solutions are created. Degrees and certificates will be designed to create a holistic approach to solving problems, creating solutions, and decision-making focused on energy and environmental issues. These "global superhero" occupations will have significant interaction and co-dependencies because their work will all center on a common cause: ensuring the viability and sustainability of the earth.

A core philosophy is evolving as all career pathways begin to incorporate how the actions taken today impact what the world will look like 14 years from now. A primary consideration is how to adapt to shifting demographic patterns, economic market uncertainty and fluidity, and climate vagueness.

Increasingly, degrees and certificates will be offered as a combined suite of courses. These new hybrid degrees will require interdisciplinary mastery in order to generate solutions for complex global scenarios.

Future U.S. economic growth will rely on cranial ambidexterity of STEM as well as:

- Creativity
- Innovation
- Modality (logic and human-computer interaction)
- Cultural synchronization
- Necessity of an educational renaissance

9.4 A 2025 Case Study: Three Occupations Tackle the Projected Future Water Crisis

9.4.1 2025 Projection: The Global Need for Water

2025: Environmental Superheroes

Washington	Employment		Percent Change	Job Openings
	2008	2018		
Civil Engineering Technicians	2,590	2,810	+8%	70
Environmental Science and Protection Technicians, including Health	780	900	+16%	50
Hydrologists	430	480	+12%	20

The three occupations highlighted in the case study (the civil engineer, environmental technician, and hydrologist) will all play a role in working with one of the resources that the United States, and especially Washington State, take for granted: access to clean and plentiful water supplies. Globally, this is not the case. And, it is projected to become increasingly problematic as specific continents will face both increased population growth and reduced access to water. Increasingly contaminated water will be commonplace. Creating solutions to resolve these issues necessitate relying on current processes already in place, as well as developing new processes and technologies to purify or create water. It is worth noting that only one of the three occupations highlighted requires a four-year degree. However, the CTC system, in order to meet potential workforce demand, might consider researching the viability of creating CTC technician-level, workforce ready, and transferable associate's degrees.

All three "superhero" occupations will play a role in how this issue is approached. The CTC system is asked how interdisciplinary program preparation might develop in creating a degree or certificate based upon the technical knowledge and skills of the environmental superheroes.

In examining water-cleaning treatments, one such process, desalination, was created in the United States in 1952, when Dow Chemical Company opened its first plant in Freeport, Texas. The following sections define "desalination," review the "superhero" occupations, provide a U.S. industry perspective, and offer CTC program possibilities.

9.4.2 What is Desalination?

From the *Encyclopedia Britannica*: **Desalination,** also called desalting, removal of dissolved salts from seawater and in some cases from the brackish waters of inland seas, highly mineralized groundwaters (e.g., geothermal brines), and municipal wastewaters. This process renders such otherwise unusable waters fit for human consumption, irrigation, industrial applications, and various other purposes. Existing desalination technology requires a substantial amount of energy, which makes the process expensive. For this reason it is generally used only where sources of fresh water are not economically available.

Source: http://www.britannica.com/EBchecked/topic/158740/desalination

9.4.3 What Does a Civil Engineering Technician Do?

Apply theory and principles of civil engineering in planning, designing, and overseeing construction and maintenance of structures and facilities under the direction of engineering staff or physical scientists.

Responsibilities:

- Draft detailed dimensional drawings and design layouts for projects to ensure conformance to specifications
- Calculate dimensions, square footage, profile and component specifications, and material quantities using calculator or computer
- Read and review project blueprints and structural specifications to determine dimensions of structure or system and material requirements
- Confer with supervisor to determine project details such as plan preparation, acceptance testing, and evaluation of field conditions
- Inspect project site and evaluate contractor work to detect design malfunctions and ensure conformance to design specifications and applicable codes
- Develop plans and estimate costs for installation of systems, utilization of facilities, or construction of structures
- Prepare reports and document project activities and data
- Respond to public suggestions and complaints
- Report maintenance problems occurring at project site to supervisor and negotiate changes to resolve system conflicts
- Evaluate facility to determine suitability for occupancy and square footage availability

Education: This occupation may require a background in any of the following: science, technology, engineering, and mathematics (STEM) educational disciplines.

Employment: The median hourly wage is $25.22 and the annual salary is $52,500 as of May, 2009.

Source: O-Net Online, http://online.onetcenter.org/link/summary/17-3022.00

9.4.4 What Does an Environmental Science and Protection Technician Do?

Performs laboratory and field tests to monitor the environment and investigate sources of pollution, including those that affect health. Under direction of an environmental scientist or specialist, may collect samples of gases, soil, water, and other materials for testing and take corrective actions as assigned.

Responsibilities:

- Collect samples of gases, soils, water, industrial wastewater, and asbestos products to conduct tests on pollutant levels and identify sources of pollution
- Record test data and prepare reports, summaries, and charts that interpret test results
- Develop and implement programs for monitoring of environmental pollution and radiation
- Discuss test results and analyses with customers
- Set up equipment or stations to monitor and collect pollutants from sites, such as smoke stacks, manufacturing plants, or mechanical equipment
- Maintain files such as hazardous waste databases, chemical usage data, personnel exposure information and diagrams showing equipment locations
- Develop testing procedures or direct activities of workers in laboratory
- Prepare samples or photomicrographs for testing and analysis
- Calibrate microscopes and test instruments
- Examine and analyze material for presence and concentration of contaminants such as asbestos, using variety of microscopes

Education: This occupation may require a background in any of the following: science, technology, engineering, and mathematics (STEM) educational disciplines.

Employment: The median hourly wage is $19.61 and the annual salary is $40,790 as of May, 2009.

Source: O-Net Online, http://online.onetcenter.org/link/summary/19-4091.00

9.4.5 What Does a Hydrologist Do?

Research the distribution, circulation, and physical properties of underground and surface waters; study the form and intensity of precipitation, its rate of infiltration into the soil, movement through the earth, and its return to the ocean and atmosphere.

Responsibilities:

- Evaluate data and provide recommendations regarding the feasibility of municipal projects, such as hydroelectric power plants, irrigation systems, flood warning systems, and waste treatment facilities
- Study and analyze the physical aspects of the earth in terms of the hydrological components, including atmosphere, hydrosphere, and interior structure
- Administer programs designed to ensure the proper sealing of abandoned wells
- Install, maintain, and calibrate instruments, such as those that monitor water levels, rainfall, and sediments
- Answer questions and provide technical assistance and information to contractors or the public regarding issues such as well drilling, code requirements, hydrology, and geology
- Measure and graph phenomena such as lake levels, stream flows, and changes in water volumes
- Investigate properties, origins, and activities of glaciers, ice, snow, and permafrost
- Review applications for site plans and permits and recommend approval, denial, modification, or further investigative action
- Apply research findings to help minimize the environmental impacts of pollution, waterborne diseases, erosion, and sedimentation
- Develop or modify methods of conducting hydrologic studies

Education: This occupation may require a background in any of the following: science, technology, engineering, and mathematics (STEM) educational disciplines.

Employment: The median hourly wage is $35.42 and the annual salary is $73,670 as of May, 2009.

Source: O-Net Online, http://online.onetcenter.org/link/summary/19-2043.00

9.4.6 An Industry Perspective and Position

GE Power & Water
Water & Process Technologies

Reliable fresh water supplies from challenging water sources

The world's water consumption rate is doubling every 20 years, outpacing by two times the rate of population growth. It is projected that by the year 2025 water demand will exceed supply by 56%, due to persistent regional droughts, shifting of the population to urban coastal cities, and water needed for industrial growth. The supply of fresh water is on the decrease. Water demand for food, industry and people is on the rise.

Lack of fresh water reduces economic development and lowers living standards. Clearly, there is a critical worldwide need to better manage this increasingly valuable resource. Desalination systems from GE Water & Process Technologies can make abundant fresh water both from seawater and from challenging brackish sources.

Seawater Desalination

Oceans make up 97% of the world's supply of water. Desalination using seawater reverse osmosis (SWRO) membrane technology has become a viable option for the development of new regional water supplies.

GE Water & Process Technologies is the world leader in the supply of reliable seawater SWRO membrane desalination systems. GE's desalination projects range in size from small 2,000 cubic meter/day (370 gpm) plants—providing potable water to hotels and resort complexes—all the way up to projects like the 200,000 cubic meter/day (53 MGD) Hamma Desalination Plant, the largest of its kind in Africa.

Brackish Water Desalination

Brackish water, containing minerals and salts typically less than 5,000 ppm total dissolved solids (TDS), can be economically treated with today's reverse osmosis (RO) and electro-dialysis reversal (EDR) systems. Effective mineral and salt removal converts previously unusable waters to high-purity resources for drinking, irrigation, or industrial process uses.

Source: Water and Process Technologies, General Electric, http://www.gewater.com/what_we_do/water_scarcity/desalination.jsp

9.4.7 Community and Technical College Program Possibilities

Environmental Management and Assessment
Niagara College, Canada

Environmental Management and Assessment Coursework

Term One		Term Two	
ENVR9100	Environmental Laws and Regulations	ENVR9101	Pollution Prevention
ENVR9102	Environmental Analysis I	ENVR9103	Environmental Analysis II
ENVR9104	Environmental Communications	ENVR9120	Environmental Audits
ENVR9107	Waste Management Systems	ENVR9200	Hazardous Materials Management
ENVR9140	Occupational Health and Safety	ENVR9190	Organizational Sustainability
ENVR9171	Environmental Assessment	ENVR9204	Public and Media Relations
ENVR9201	Environmental Site Assessments	ENVR9240	Project Management
ENVR9202	Industrial Process and Environmental Control	ENVR9207	Environmental Impact and Risk Assessment

Source: http://www.niagaracollege.ca/content/Programs/EnvironmentalStudies EnvironmentalManagementandAssessment.aspx

Civil Engineering Technology Associate's Degree
Ferris State University, Big Rapids, Michigan

Civil Engineering Technology Associate Degree Coursework

Course #	Course Name	Credit Hrs
General Education		
ENGL 150	English I	3
ENGL 211	Industrial and Career Writing	3
MATH 115	Intermediate Algebra	3
MATH 120	Trigonometry	3
PHYS 211	Introductory Physics I	4
Elective	Cultural Enrichment	3
Elective	Social Awareness	3
ISYS 105	Introduction to Micro Systems – Software	3
Major		
CETM 214	Advanced Materials Properties – Testing	3
CETM 215	Construction Equipment – Operations	3
CETM 226	Highway Technology	3
CETM 230	MDOT Certification Preparation	1
CETM 327	Hydraulics and Hydrology	3
CONM 111	Construction Practices	3
CONM 112	Plans and Specifications	3
CONM 116	Construction Graphics	2
CONM 121	Materials Properties – Testing	3
CONM 122	Construction Surveying – Layout	3
CONM 211	Construction Quantity Estimating	3
CONM 212	Soils and Foundations	3
CONM 221	Statistics and Structures	3
CONM 222	Construction Administration	3
Minimum credit hours required for A.A.S. degree		**63/64**

Source: http://catalog.ferris.edu/programs/227/

10: Conclusions

"The middle game, where the struggle is really fought, will take a variable number of moves, and will be named so until the certainty of mate for one of the two players is ninety percent."

Madame Flash, Je gangne aux eches, Marabout-Flash, 1962

10.1 The Two Best Investments: Education and You

The title *Conclusions* suggests a summarization ultimately resulting in an end point. But the large body of research collected and scanned to inform this report is only a starting point. We are not, as Madame Flash implies, at the "certainty" of a particular outcome. What we do know, however, is the United States and, specifically Washington State, will play a dynamic role within this national and international economic "chess game."

What was an underlying thematic motivation for this examination of what is happening now, what might happen within the next five years, and then, analyzing projections made about 2025, was a return to remembering and recognizing the United State's determination, commitment to excellence and the hard work that it takes to forge a pathway to success. Washington State has always been an incubator and an e-laboratory of innovation, creativity, and fortitude; it has been a major contributor to the overall success and growth of U.S. industries and workforce, and will continue to play a significant role.

The state's community and technical college system has fostered and contributed, as both a feeder to four-year institutions, but also as a swifter and nimbler agent of change when economic forces require rapid adjustments. The CTC system has been consistently asked to play the middle game, when realistically, it should now be in a position to play the end game. This helps our economy by helping our students to a pathway towards positive academic achievement.

The CTC system has the bandwidth, the intellectual property, the infrastructure, and the passion to ensure our students graduate by either securing employment or earning their four-year degree at their local community or technical college, or if seats are available through an articulation with a four-year institution. This report was designed to provide educators

with programmatic possibilities that might assist in preparing higher education for inevitable change, as well as technological and economic developments.

This report performed a comprehensive survey, investigating the vast array of curricular, programmatic, and workforce data available to inform educational change. And, while there is nothing certain when examining future trends and projected labor data, recalling what Sylvia Porter stated, whatever the future holds, it has already begun.

While this report provided program, degree, and certificate options, other examples of occupations the CTC system might consider researching, in order to develop and creating programs of study include:

- Biological Technicians
- Human Computer Interface Designers
- Market Research Analysts
- Management Analysts
- Military Intelligence Analysts
- Multi-Media Artists and Animators
- Systems Biologists
- User Interface Developers
- Water and Liquid Waste Treatment Plant and System Operators
- Web Analytics

"Invest in yourself, in your education. There's nothing better."

Sylvia Porter
(18 June 1913-5 June 1991)

A crucial recognition for those reading this report is this acknowledgement: information and computing technology is no longer an industry sector that flourishes in isolation—it currently problem-solves, drives, and creates solutions advancement for all industry sectors and will continue to do so.

These final words reinforce the core motivation of the CTC system—its commitment to its students and itself as a collective body pursuing excellence as it moves into the next decade.

Center of Excellence
for information & computing technology

coeforict.org