Why IT Works

Identifying Employer Needs, Talent Gaps, & Strategies to Grow a Stronger Information Technology Workforce in Rhode Island

Rhode Island Information Technology Industry

Skills Study 2013

tech collective

Governor's Workforce Board Rhode Island

Today's Vision... Tomorrow's Opportunity.

About Tech Collective

Tech Collective is Rhode Island's Bioscience and Information Technology Industry Association. Uniting industry, government and academic stakeholders, our mission is to inspire, engage, educate, and employ a high-skill, high-wage Knowledge Economy in Rhode Island. Get connected at www.tech-collective.org

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Introduction

Information Technology (IT) Skills Matter: A Growing Demand

As technology has become increasingly central to our lives, so has the role of the workforce which supports it. The number of IT professionals employed in Rhode Island is at an all-time high in 2013 and growing. Yet, employers tell us that it is often challenging to hire professionals with the right combination of technology, business, and professional skills. Individuals who bring all these skills together can create immense value for business competitiveness and growth.

Study Approach

This "Why IT Works" Skills Gap Study is undertaken by Tech Collective and funded by the Governor's Workforce Board of Rhode Island. The study examines IT skill needs from the perspectives of Rhode Island IT employers, including: what types of IT positions are most difficult to fill; what skills are hardest to find in job candidates; and what skills IT professionals need to support the success of the company as well as their career. The findings of this report aim to raise awareness of and guide investments in Rhode Island's IT workforce. Recommendations are provided at the closing of this report.

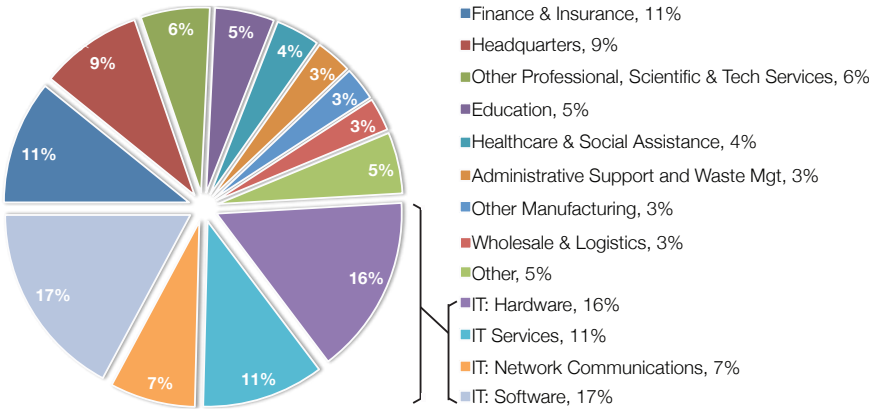
In its study approach, Tech Collective spoke with IT employers, IT educators, and IT professionals through interviews and focus groups. Guided by this input, Tech Collective used a web-based Employer Survey to gather quantitative data from employers about company hiring and skill requirements. An IT Practitioner Survey was forwarded to IT professionals to gather their individual perceptions of necessary skills.

This study looks at the Rhode Island IT workforce across industries and practice areas. The IT workforce includes 1) IT professionals employed in "core" IT industry sectors (e.g. IT services, software, network communications, and hardware manufacturing); and 2) IT professionals employed in IT "utility" companies across other industries (e.g. finance, health care, education, and other professional service industries). As an accountant or marketing/communications professional might be employed across any industry, so are IT professionals. Across all industries,

Rhode Island's IT Workforce

13,500 and growing

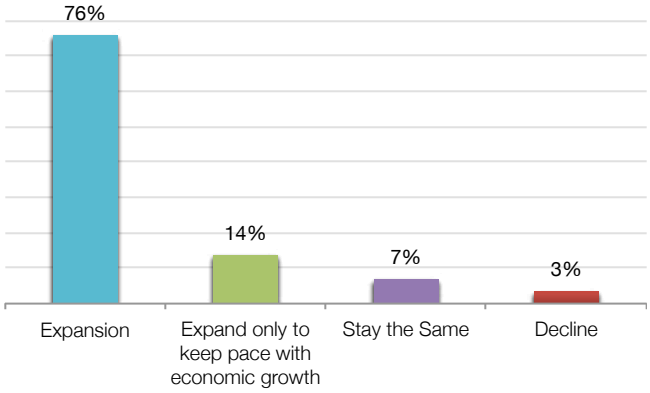
There are 13,500 people working in Rhode Island as IT professionals. Half (51%) work in "core" IT industry sectors: IT services, software, network communications, and hardware manufacturing. The other half (49%) work across other industries. Financial services, corporate headquarters, healthcare, education, and professional services are the sectors outside IT that depend most heavily on IT professionals in their workforce. Industry employment in Rhode Island's core IT industry sectors tops 19,000, a number which includes many people in non-IT occupations.



Sources: Estimates by author based on 2011 RI LMI employment by industry and the BLS National Occupation-Industry Matrix.

IT Employers Anticipated Outlook for Growth

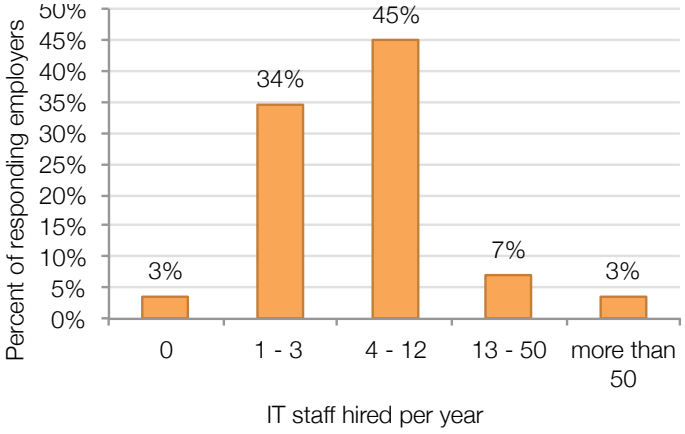
What is the anticipated outlook for your business in Rhode Island in the next 3-5 years?



Source: Tech Collective 2013 IT Employer Survey.

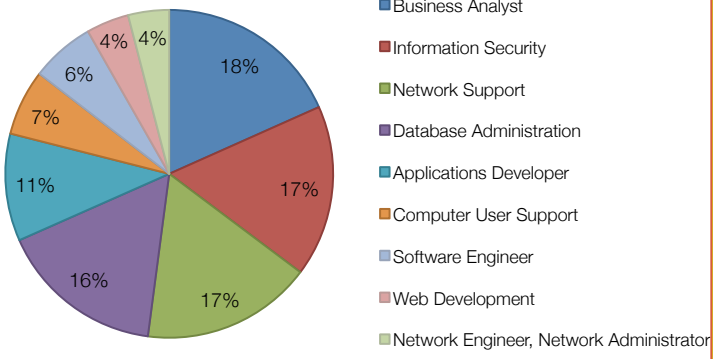
Anticipated Hiring of IT Professionals per Employer

How many IT professionals do you anticipate your company hiring in Rhode island over the next 24 months?



Source: Tech Collective 2013 IT Employer Survey.

Distribution of IT Job Advertisements, Rhode Island



Source: Indeed.com. June 1, 2013.

there are 13,500 IT professionals working in Rhode Island.

Tech Collective's 2007 *Rhode Island IT Skills Gap Study* focused on entry-level IT positions based on employer needs at that time. In the six years since that study's release, the need for entry-level talent still exists, but has shifted to also include a greater challenge in meeting skills gaps at the mid-level (3-5 years of experience). This study looks at those IT workforce skill needs and those of mid-level IT positions.

What is a "Skills Gap" and Does Rhode Island Have One?

A "Skills Gap" is a dynamic concept, determined by business opportunities, availability of IT professionals, preparedness of those IT professionals, availability of training resources, and overall workforce support and investment by the industry as well as outside entities.

Just as the national IT skills gap is a critical economic competitiveness issue for the United States, so it is for Rhode Island. Rhode Island employers face an IT skills gap and it is a factor limiting economic growth.

Rhode Island is not alone in facing an IT skills gap. In fact, with its concentration of IT professionals comprising 2.7% of all employment in the state, Rhode Island is at the U.S. average. And even leading technology metros such as Boston, which have economies powered by twice as many IT professionals as a share of workers, still rate IT talent acquisition as one of their top barriers to growth. However, for Rhode Island employers, who think about IT workforce availability within the context of the greater Boston labor market, it is a challenge to attract and retain talent otherwise lured away to seemingly larger than life companies over the border.

The critical role of soft skills highlighted in Rhode Island's *2007 IT Skills Gap Study* remains a central concern of IT employers. Employers tell us that communication among lines of business is increasingly important and that jobs have continued to evolve from a break/fix role to a consultative role. Some jobs, such as network and user support services have become commoditized, largely because well-established, industry-recognized training curricula prepare individuals well for these specific roles. New challenges employers face include the rise in mobile and tablet devices, accommodating "bring-your-own-

Growth of IT Occupations, Previous Five Years and Projected Five Years, Rhode Island

	RI Jobs 2012	Projected Annual RI Job Openings	US Projected Growth (5 yrs)	RI Projected Growth (5 yrs)	RI Recent Growth (5 yrs)
Computer User Support Specialists	1,180	91	9%	7%	-22%
Software Developers, Systems Software	1,390	63	16%	17%	10%
Computer Systems Analysts	1,540	57	11%	10%	
Network and Computer Systems Administrators	1,490	54	14%	13%	66%
Security Analysts, Web Developers, & Network Architects	-	40	11%	8%	
Information Security Analysts	240	-	-	-	-
Web Developers	350	-	-	-	-
Computer Network Architects	390	-	-	-	-
Computer Network Support Specialists	890	-	-	-	-
Computer Programmers	1,260	40	6%	3%	-10%
Computer and Information Systems Managers	1,080	39	9%	9%	
Software Developers, Applications	1,090	38	14%	14%	-5%
Computer Occupations, All Other	570	17	3%	2%	
Database Administrators	400	14	15%	14%	54%
Computer and Information Research Scientists	370	8	9%	0%	16%
Graphic Designers	610	33	7%	5%	-15%
Multimedia Artists and Animators	40	3	4%	1%	-33%
Computer and Office Machine Repairers	400	12	3%	1%	25%
Computer Hardware Engineers	300	8	5%	4%	0%
ALL	13,590	498			

Source: Bureau of Labor Statistics. Occupational Employment Statistics and Occupational Employment Projections. Blank cells indicate data is not available either because it is not disclosed or because it could not be calculated due to changes in occupational definitions.

device" (BYOD) in the workplace, and the expansion of cloud-based computing. Systems and data security have become cross-cutting concerns that more and more IT professionals must address. Across the economy, companies are also investing to unlock the value-potential of data analytics.

There are not enough people completing IT degrees and IT certifications to enable Rhode Island companies to realize their full potential. Information technology stands out for its transformative potential to support productivity and innovation across industries and contribute materially to economic growth in Rhode Island. This transformative power lies at the intersection of business and technology – an area where the skill gap is most acute. What distinguishes the highest-value IT professionals is a whole suite of skills that make them effective at applying technical knowledge to business opportunities.

Rhode Island Outlook

The outlook for IT occupations is strong. According to labor market information, Rhode Island can expect continued growth in demand for IT professionals. Correspondingly, Rhode Island IT employers responding to our survey indicated a positive outlook for business growth, with 76% of respondents anticipating expanding, 21% expecting to stay the same or grow with inflation, and only 3% anticipating a decline in their business over the next three to five years.

To evaluate which types of IT jobs have the strongest outlook for growth, we look at three statistics: recent job growth, projected job growth, and estimated annual openings. Based on these factors, the most consistently strong growth is expected in Computer Systems Analysts, Systems Software Developers, Database Specialists, Network Administrators, and IT Managers. Applications Software Developers declined in number by 5% from 2007

to 2012, but are expected to rebound in the next five years and have around 38 job openings per year in Rhode Island. The outlook for Computer User Support Specialists is also worthy of comment. The number of jobs in this category declined over the last five years, but projections for annual openings are larger than any other IT occupational category. Even with slower growth, the Computer User Support Specialists will continue to represent a large number of entry and mid-level IT hires.

Posted job listings on Indeed.com June 2013 show far more Business Analyst, Information Security Analyst, Database, and Network Support positions as a percent of IT openings than we would expect based on Bureau of Labor Statistics projections. This is consistent with these positions being harder to fill and remaining open longer, as indicated by employers in our focus groups. Job postings cluster around two, three, and five years of required experience. Less than 1% of the IT job postings specified no experience or one year of experience required. While it is not uncommon for a job posting to be silent on the number of years of experience expected, typically such postings are highly specific about the candidate having experience in various systems, processes, or computer languages – many of which students may not encounter in school. This data corroborates what employers told us through focus groups and interviews about the value of experience in terms of effectiveness on the job.

IT students generally have to traverse this "experience gap" with hands-on workforce or experiential learning opportunities, such as internships, fellowships, projects, or other industry-supported programs. Over half of the IT employers we spoke to in this study indicated that they do not hire permanent employees straight out of college. The majority of those who have hired someone straight from college indicated that the candidate had significant internship experience beforehand.

While IT careers require significant knowledge, hard work, and attention to detail, our respondents to Tech Collective's IT Practitioner Survey overwhelmingly would recommend IT careers to someone thinking about entering the field. Some of the comments shed light on barriers to entry into IT careers: 1) needing experience to get your first job, 2) the essential nature of IT in business and the shortage of IT professionals means workloads are demanding, and 3) keeping current takes time, effort, and money. The challenge is worth the reward, however, as one respondent commented: "IT is something you can apply across industries to work that is motivating and meaningful to you."

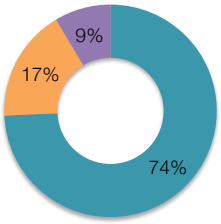
Should I Pursue a Career in IT?

If you know someone thinking about entering the IT industry, what advice would you give?

74% *Great idea! Plenty of opportunities and career paths to pursue.*

17% *It's as good as any other job*

9% *I would discourage it. IT is a difficult industry to enter and succeed in.*



Encouragement

There is a lot of opportunity in IT; though in order to succeed, you will have to work hard; in order to enjoy working hard, you have to be passionate about the subject.

You also should think about what else you're passionate about so you can use your IT skills to support work you really care about.

Pick a technology area you are interested in and keep digging deeper into it; specialize.

And Caution

Keeping current can require money and time. Acknowledge and accept that you will be required to put in your own time/effort/resources to gain the skills and knowledge needed.

Despite high demand, it is not necessarily easy to get into the IT industry. Knowing how to write scripts is rarely enough; you need the analytic capability to see how a system or process will benefit the organization.

Source: Tech Collective IT Practitioners Survey 2013.

The Hiring Gap

Too Few in IT

Rhode Island has a numerical gap in its IT workforce supply. There are high quality education programs in IT fields, but there are simply not enough individuals with technology education and experience in the job market. Those individuals who have IT skills and the knowledge, motivation, and confidence to keep learning are in high demand to fill IT positions across occupational sectors.

Through our focus groups and interviews we heard that students coming out of 2-year degree, 4-year degree, and graduate Computer and Information Science (CIS) programs at Rhode Island colleges and universities have a solid technical foundation relative to what can reasonably be expected at each level. Education institutions were recognized by employers for the work they are doing in response to the employer-identified need for increased emphasis on communication skills, relationship skills, getting work done, and problem-based learning.

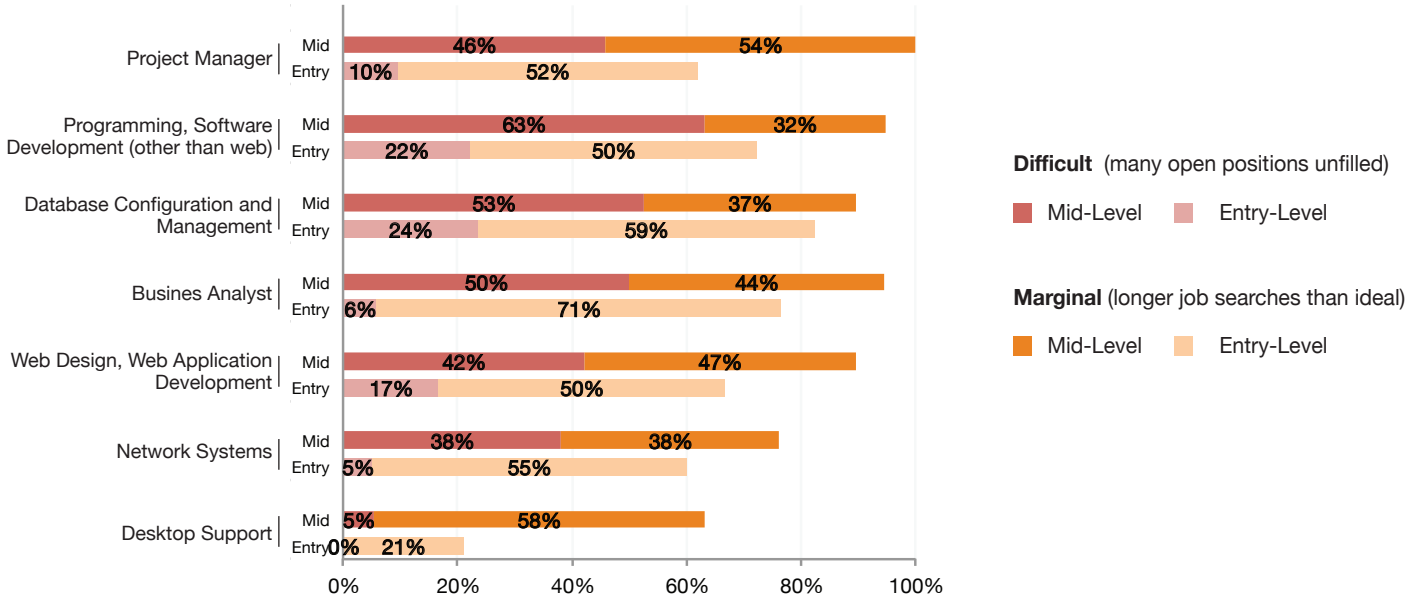
Across all practice areas, and at the entry and mid-level, IT employers report high levels of hiring difficulties. Project Management tops the list of hiring difficulty, as it requires a combination of IT knowledge, domain knowledge, and management skill. Programming, Web Design, and Software Development followed closely by Business Analysts are also in very short supply. At the entry-level, Database positions are hardest to fill.

With the exclusion of entry-level Desktop Support, **Rhode Island IT employers reported all IT positions are marginal or difficult to fill at least half the time.** These figures speak to an industry where skill availability is a severe constraint to productivity and growth.

Programs that train for desktop support and network administration are closest to meeting the current need. Employers are confident in the technical skills of applicants with industry certifications in these areas, and therefore focus on identifying candidates with strong work ethics

Difficulty of Searches for Mid-Level and Entry-Level IT Professionals

Looking at the skill sets below, how would you describe your company's ability to find and hire the right Mid-Level (not less than 3 years experience) or Entry-Level (1-3 years experience) talent at your Rhode Island location(s)?



Source: Tech Collective 2013 IT Employer Survey.

and demonstrated customer service, problem solving, and professional communications skills. Yet even in these areas there is need.

The gap between the demand for IT professionals and the supply means that many IT employers are "continually looking" for candidates across most IT fields whether they have open positions posted or not. In our IT Employer survey, only 65% of respondents rated their overall current IT staffing technical talent base as "adequate." About half of survey respondents indicated they are continually recruiting for at least one IT position.

Hard to Find Combinations of Skills

High value IT professionals need to have a range of mission-critical professional skills complementing their **technical knowledge** as illustrated to the right. Central to all these skill areas is **knowing how to learn**.

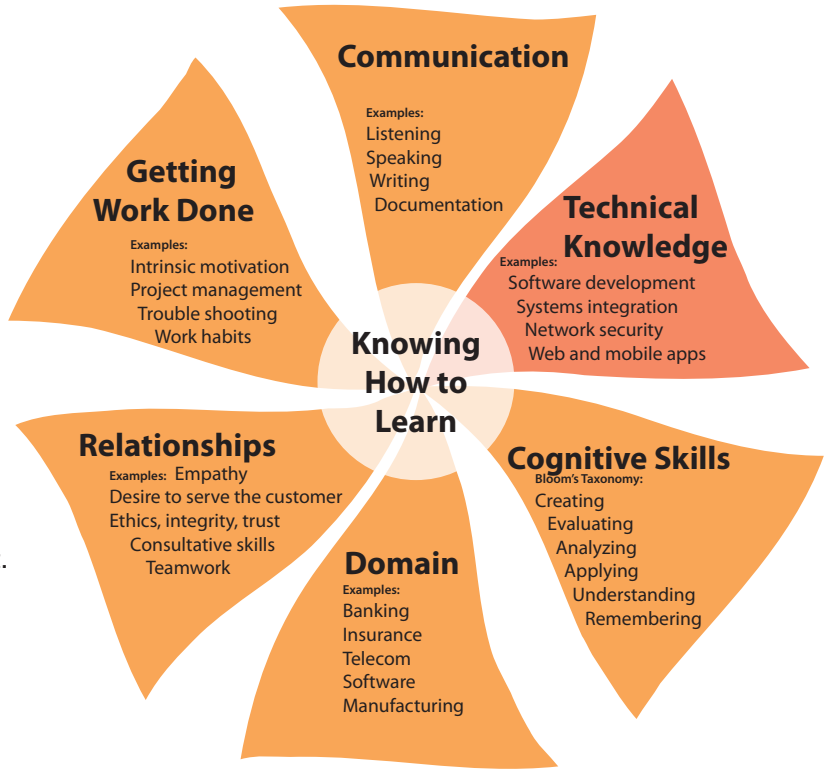
Employers are looking for internal motivation and the character traits that are associated with **getting work done**. **Relationship** skills include desire to serve the customer, emotional intelligence, trust, and teamwork. **Communication** skills include listening, speaking, and writing. Employers told us that when projects fail or contracts are lost, it is typically a communication failure, not a failure of technology capability. These communication failures can take place between technical teams, but the most common communication failures are between technology teams, non-technical business teams, and clients.

Domain knowledge refers to applying IT to a specific industry sector such as insurance, healthcare, or manufacturing. Employers understand that domain knowledge is acquired on the job, but value candidates with education that incorporates strategic thinking about applying IT to business opportunities. What distinguishes the best IT professionals is their interest in understanding how a company competes within its business sector.

IT employers are articulate about the importance of **cognitive skills**. Bloom's Taxonomy offers a framework to understand cognitive skill levels – from remembering technical knowledge to utilizing that knowledge to analyze, evaluate, and create. The higher-level abilities in Bloom's taxonomy are in highest demand but are hardest to find.

Leadership is also an ability that employers prize in

Range of Mission Critical IT Professional Skills



employees at all levels of experience. Even looking at perceived skill gaps in the applicant pool for entry-level IT positions, employers rated "big-picture perspective," "leadership," and "ability to understand business needs" as the highest priority skill gaps. These skills are both important and very hard to find, as they require the integration of the six mission-critical skill areas.

Compensation Trends

Proximity to the technology-intensive Boston Metro creates advantages and disadvantages for Rhode Island IT employers and professionals. This proximity gives Rhode Island employers the ability to draw on an extraordinary range of talent and experience in the southern half of the Boston Metro, but only by matching the salaries of these higher cost areas. Average Boston IT compensation is 5% to 13% above Providence depending on the specific occupation. The lower cost of living and commuting in-state more than compensate for the salary differentials for those workers living in Rhode Island. However, Rhode Island employers feel they are at a disadvantage in recruiting workers who have been offered Boston-

Finding the Right Candidates

Example Employer Interview Questions to Job Candidates on non-Technical Skills

1. Motivation, passion for the chosen technical field

- ***What motivates you about IT?***
- ***If you didn't work in IT what would you be doing?***

2. Ability to work in teams

- ***Do you prefer to work independently or as part of a team?***
- ***If a team member is not contributing on their assignments or missing deadlines, how would you address the issue?***

3. Problem solving in a business context – ability to understand the client's problem and develop solutions that make sense from a business as well as a technical perspective

- ***When resolving a business issue, how do you determine the best technical solution? What factors do you take into account?***
- ***How do you work with the project sponsor if your proposed solution is rejected for a lesser solution?***

4. Communication and customer service skills – consultative skills, empathy and desire to service the customer, ability to communicate across generations i.e. Millenials communicating positively with senior staff or clients

- ***How do you communicate information to individuals that may not understand technology?***
- ***How do you handle management comments about technology that are inaccurate?***

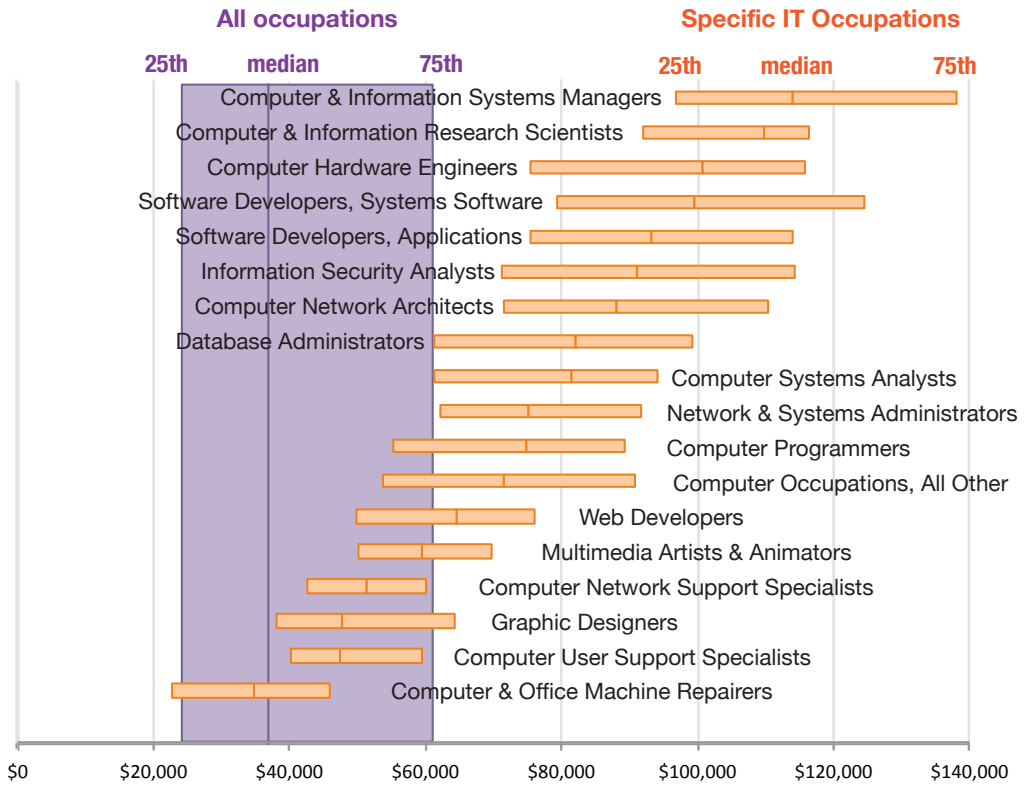
Skills Gaps in the Entry and Mid-Level Workforce

Reflecting upon IT positions you have recently hired, what skills gaps have you perceived in the applicant pool?
Ordered by Entry-Level skill gap priorities

	High-Priority Skills Gap skill is important and very hard to find		**Somewhat of a Skills Gap** required skill set is challenging to find	
	Entry-Level IT Jobs (1-3 years experience)	**Mid-Level IT Jobs** (not less than 3 years experience)	**Entry-Level IT Jobs**	**Mid-Level IT Jobs**
1. Big-picture perspective	48%	18%	43%	82%
2. Leadership / ability to lead team efforts in a multi-task environment	48%	36%	38%	45%
3. Ability to understand business needs	43%	18%	48%	36%
4. Technical writing / documentation skills	29%	9%	57%	55%
5. Ability to communicate with customers	29%	18%	38%	64%
6. Teamwork / ability to communicate with coworkers	24%	9%	52%	18%
7. Critical thinking / problem solving / innovation	24%	9%	48%	55%
8. Openness to career transitions & acquiring cross-functional skills	19%	0%	33%	45%
9. Ability to work independently /self-starter	14%	0%	52%	27%
10. Comfort with virtual and distance work	10%	0%	33%	27%

Source: Tech Collective 2013 IT Employer Survey.

Median Pay by IT Occupation with 25th and 75th Percentile Pay, Rhode Island, 2012



Source: Bureau of Labor Statistics, Office of Occupational Statistics

area salaries, unless those individuals have a personal preference for working in Rhode Island.

Nearly all IT occupations have median pay that is above average (average shown in purple). At the lower end of the scale are computer and office machine repairers and computer support specialists. At the high end of the scale are managers, research scientists, engineers, and software developers. **Compensation in IT occupations has risen faster than the average of all occupations in the last five years for workers in the bottom quartile and median of the pay range.** This upward shift in wages is consistent with a shortage of talent to fill these positions.

Regional Annual Average Wage Comparison in Five IT Occupations, 2011

	Analysts	Software Developers, Applications	Software Developers, Systems Software	Database Administrators	Network & System Administrators
Providence Metro	$80,130	$91,720	$95,900	$79,770	$76,430
Worcester Metro	$82,960	$88,080	$124,930	$83,180	$79,720
Boston-Cambridge-Quincy	$90,290	$98,820	$106,650	$83,860	$85,290
Boston Premium over Providence	13%	8%	11%	5%	12%
Worcester Premium over Providence	4%	-4%	30%	4%	4%

Source: BLS Occupational Employment Statistics. Metropolitan Area Cross-Industry estimates. Boston-Cambridge-Quincy is the MA NECTA Division.

Women and Minorities

Employers see their potential recruitment pool defined by the population earning degrees and certifications in IT fields. Therefore, **the lack of women, Blacks and Latinos in computer science programs translates directly into a lack of workplace diversity.**

We heard from employers in focus groups and interviews that it has become harder to recruit women for entry and mid-level positions compared to five years ago. Employers observe that fewer women are applying for IT positions even in organizations with women in IT leadership roles. Responding in our employer survey, 47% of employers indicated that less than 20% of their IT staff are women. Despite low numbers overall, about a third of responding companies have assembled IT teams that are at least 40% women.

Rhode Island has experienced a decline in women participating in computer science at the high school and college level that parallels the decline in New England. Women in high school computer programming courses declined from 47% in 2011 to 44% in 2012. Women earned 30% of CIS degrees in 1990, but by 2010 the share had dropped to 20%. This decline in enrollment in CIS is at a time that overall college completion by women has risen and women comprise half of the workforce.

Rhode Island's fastest growing demographic group is Latinos. Latinos are now 15% of Rhode Island graduating high school seniors, but only 4% of college graduates with CIS degrees. Blacks are somewhat underrepresented in IT with 8% of the graduating high school class and 7% of CIS degree recipients. Asians have the highest participation in CIS degree programs and in the IT workforce. Because of the high participation of Asians, "minorities" as a group, are well represented in CIS.

Employers who have hosted interns from school-to-career programs that connect diverse urban youth to knowledge-economy careers, such as Year Up, MET School, or ACE Academy, had positive things to say about these experiences. Most IT employers seem to be lacking large recruitment channels for women and minorities. However, they are articulate about the importance of creating a workplace where people of all nationalities and identities feel valued.

Minorities Earning Degrees in Computer and Information Science (CIS) by Institution, Rhode Island, 2008-2010

U.S. Citizens or Permanent Residents who are Native American, Asian, Pacific Islander, Black or Hispanic

Bachelor's Degrees	Number of "Minority" CIS Graduates	Percent "Minority" in CIS*	Percent "Minority" all majors*
Johnson & Wales University	79	21%	23%
New England Institute of Technology	37	12%	12%
Brown University	36	21%	30%
University of Rhode Island	11	10%	10%
Bryant University	8	7%	10%
Rhode Island College	5	9%	11%
Providence College	3	17%	6%
Salve Regina University	2	10%	6%
Roger Williams University	0	0%	5%
Total Annual Bachelor's Degrees	181	15%	14%
Associates Degrees			
New England Institute of Technology	108	15%	14%
Johnson & Wales University	91	27%	25%
Community College of Rhode Island	28	17%	15%
Total Associate's Degrees	227	18%	19%

Source: National Center for Education Statistics. Completion Survey. * Percent Minority is calculated as a three year average, 2008-2010.

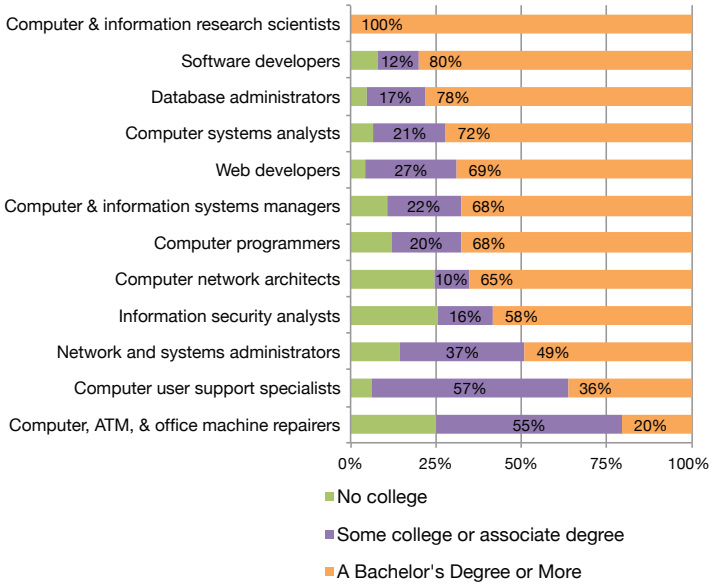
Entering the IT Workforce

IT Career Pathways are Diverse

Successfully entering the IT workforce requires a combination of technical, communication, relationship, organizational, and cognitive skills. This knowledge and experience can be garnered through multiple pathways, as illustrated by our IT Practitioner Survey question, "With what level(s) of IT education did you enter the IT field?" Twenty-nine percent of respondents entered with IT certifications, 23% with a degree in an area other than IT/CIS, and 14% and 31% with an Associate's or Bachelor's degree in IT/CIS, respectively. Twenty-three percent started their first job as an IT professional without a certification or a degree.

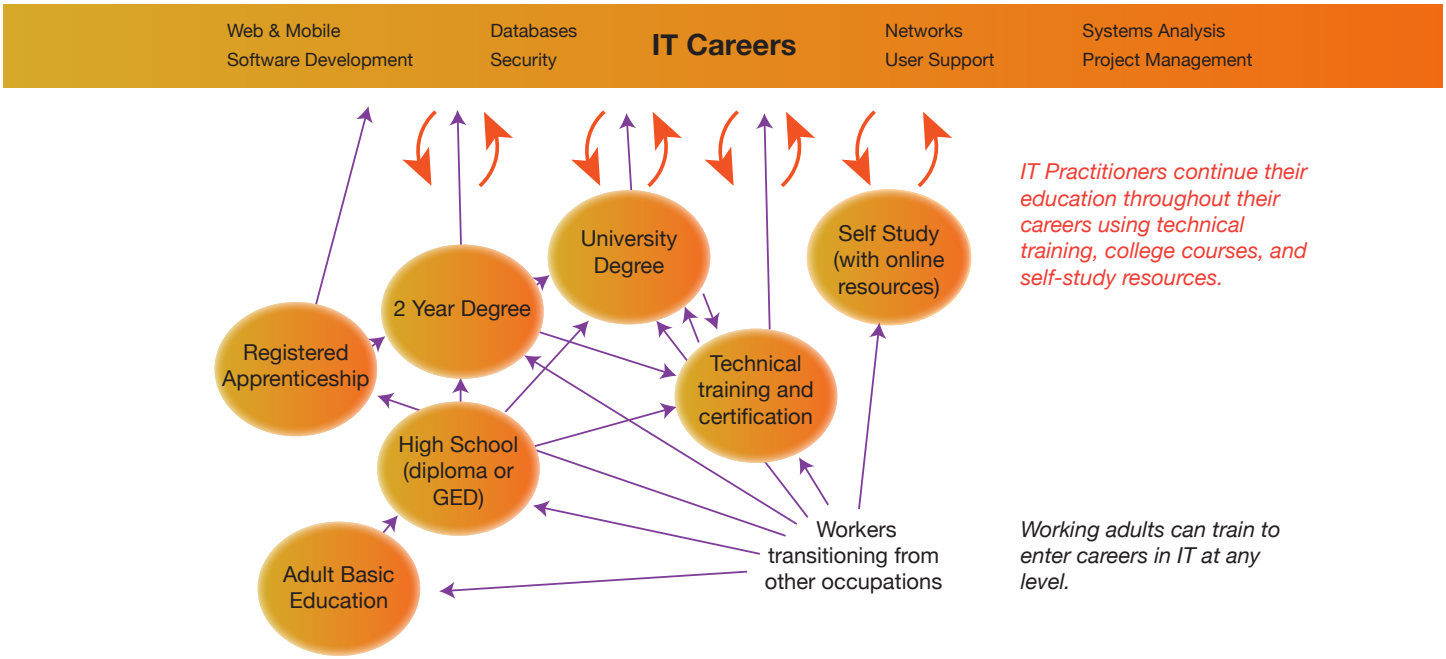
The fast-changing nature of IT demands a workforce that both has a strong foundational skill set as well one that is always adapting and learning. As such, the majority of IT professionals garner valuable foundational knowledge from 2 and 4-year college/university degrees. They then

Educational Attainment by IT Occupation, Rhode Island



Source: U.S. Census Bureau, American Community Survey, EEO Tabulation 2006-2010. Educational Attainment includes degrees in any field, not just IT.

Multiple Education Pathways and Multiple Entry Points to IT Careers



continue their professional development and career growth though industry-recognized IT certifications. Employers most highly value workers with a combination of these broad and specialized skill sets.

Often created and managed by leading technology vendors, IT certifications are short-term, classroom or self-study trainings which allow a worker to demonstrate knowledge around specific technologies or practice areas. (*See examples of IT certifications on pages 14-15 - "Technical Skills and Certifications by IT Practice Area."*)

In some cases, industry certification pathways have been created to enter an IT profession. For example, computer repair, user support specialists, and networks and systems administrators are three IT occupations most commonly entered into with IT certifications and no Bachelor's degree because of the highly developed industry certification pathways.

In addition, the IT industry provides opportunity for short-term (2-12 month) IT training programs. The need for such training programs has grown from a combination of social and economic factors, including shortage of IT talent, high unemployment rates outside of IT occupations, rising higher education tuition, and an increased focus on workforce innovation.

Entry into the IT Workforce

Education Channels:

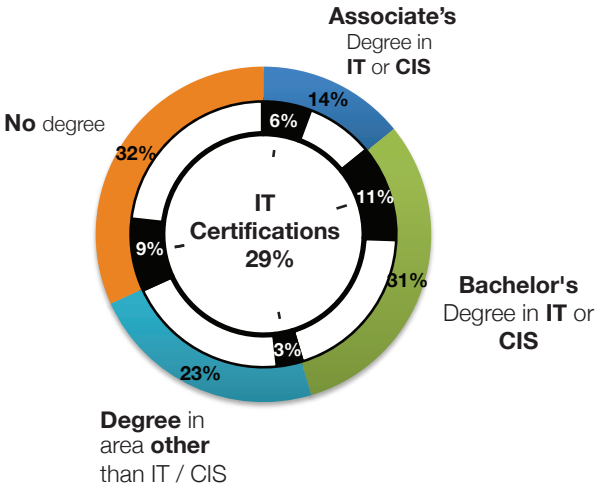
- 2-year Associates Degree
- 4-year Bachelors Degree
- Registered Apprenticeship in IT
- Industry-Recognized IT Certifications
- Short-Term Training Programs
- Experiential Learning (internships, fellowships, real-world projects)

Innovative Short-Term IT Training Programs:

- IT Boot Camp (Tech Collective)
- IT On Demand (Tech Collective)
- IT Graduate Fellowship Program (Tech Collective)
- PACE program, IT track (CCRI)
- Year Up

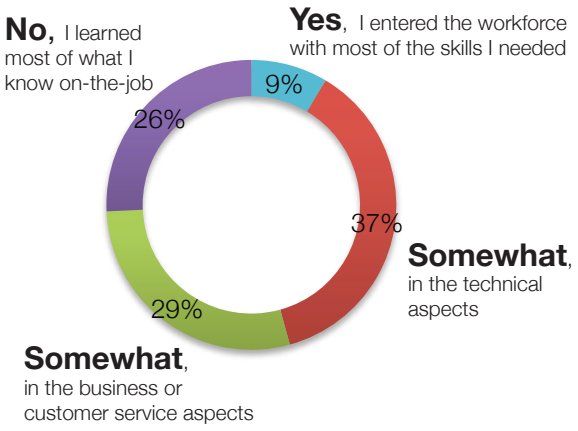
Education Entering an IT Profession

With what level of IT education did you enter the field?



Perception of Preparedness for Entering IT Career

Do you feel your education prepared you to enter the IT workforce?



Source: Tech Collective IT Practitioner Survey 2013.

In many cases, IT employers themselves are driving the curriculum for alternative training programs and/or hosting experiential learning opportunities. This has ensured programs address the full range of mission-critical IT professional skills.

1. **Technical Skills** – training and certifications focus on either a suite of entry-level technical skill sets, or, for IT professionals with previous experience, a specific technology skill set or practice area.
2. **Communication, Relationships, Getting Work Done, and Critical Thinking (Professional Skills)** – including customer service, project management, independent and collaborative working skills, designing technology solutions, troubleshooting, and problem solving.
3. **Experiential Learning** – this can vary from students creating marketable products/services; a class solving a problem or taking on a real-world project from an IT employer; or placing participants in on-the-job learning internships.

With IT employer buy-in and participation, these training programs provide practical, flexible channels of entry into the industry. (*See examples of non-traditional IT training programs on page 11*).

Two-Year Learning Curve

No matter what combination of education pathways a person has completed prior to entering an IT career, there is generally a very steep learning curve in the first two years of full-time work. The skills IT professionals acquire in their first few years of employment are highly valued by IT employers.

In our IT Practitioner Survey only 9% of respondents felt they entered the IT workforce with most of the skills they needed. Most respondents felt somewhat prepared with a split between those feeling under-prepared in the business aspects and in the technical aspects. One quarter (26%) of practitioners felt they were not adequately prepared to enter the IT workforce, learning most of what they know on the job.

This learning curve is recognized by employers. While they would prefer – and often write job descriptions requesting – IT practitioners who have experience with specific technologies, such candidates can be hard to find. Out of necessity, half of IT employers responding to our Employer Survey agreed that “Our company is good at identifying job candidates with transferable skills even if they do not have experience with the specific systems, programming languages, or software used at our company.”

IT Professional Development

The Need to Learn is Continuous

Employers rely on their IT staff to keep up to date with changing technologies and business needs. Similarly, IT practitioners recognize this need to be effective and successful in their careers. Even as IT certifications can play a compelling role in entering the IT workforce, they play an even more critical role in remaining current. The majority of respondents to the IT Practitioner Survey (62%) intended to earn an additional IT certification or degree within the next two years. Even very experienced workers encounter skill deficits as they approach new tasks, new systems, or new technologies. More than one respondent indicated that IT practitioners can never have enough of certain skills. In order for practitioners at any level to build upon their knowledge base and remain current, they must know how to access information, solve problems, and figure out how to accomplish new things.

Training Priorities

Responding to our Employer Survey, 75% of IT employers reported their company "hires for attitude and aptitude, and continually invests in training employees." Two-thirds of employers report operating with a professional development budget. Others try to allocate money for training as needed. **Only 29% of IT employers surveyed indicated their professional development budgets are adequate to meet their IT staffing needs.** Additionally, allocating employee time to training is the greatest barrier to training for employers at all levels. With IT professionals in short supply, demanding workloads and burn-out are among the greatest challenges employers see impacting their company. In such an environment, it is hard to set time aside for training. Cost is the second ranked barrier to training, followed by ensuring learning content meets workforce requirements.

The need for IT workers to "be up to date with the latest

Employer Priorities for IT Professional Development

Which types of professional development / training do you currently offer in-house or send your staff to, and which would you like to send them to if you had no resource constraints?

	Currently Offer/ Send Staff To	Would Offer/Send Staff To If Resources Allowed
1. Be up to date with latest version of technologies, software tools, and languages	67%	25%
2. Project management	54%	38%
3. Be up to date with industry-specific protocols or regulations (e.g. H7 in health care)	33%	54%
4. Be knowledgeable on a broad range of technologies to help select appropriate solutions	29%	50%
5. Communication, collaboration, or customer relationship management	29%	46%
6. Information assurance or cyber security	29%	46%
7. Leadership skills	29%	58%
8. Writing and documentation	17%	50%
9. Be knowledgeable about business strategy and how IT supports overall business value proposition	13%	67%

Source: Tech Collective 2013 IT Employer Survey.

version of technologies, software tools, and languages" was the top training priority identified by employers. Project management was identified second. Additionally, **employers cited training priorities they would like to send their staff to if resources allowed.** They include: knowledge of how IT supports overall business strategy and operations; leadership skills; writing and documentation; and knowledge of a broad range of technologies to help select appropriate solutions.

In identifying professional development training employers currently send their staff to and would like to send their staff to if resources allowed, being "up to date with industry-specific protocols and regulations" (such as healthcare or banking) ranked third highest on both lists. This indicates slim margins between what might otherwise be labeled as an employer's training "must-have list" and "wish list." **The lack of training resources faced by employers is a recognizable hindrance to the growth of their IT employees and the innovation of their company.**

Specific technology and certification needs identified by employers varied by business focus and technology practice area. Below we have attempted to summarize in-demand technology skills and certifications by practice area based on input from Rhode Island IT employers.

Business Leaders with IT Skills

Employers are articulate about the need for business leaders within the IT realm. Employers validated the statement of one focus group participant who said: "We need to coach IT professionals to aspire to be 'top-notch business leaders who do IT' rather than just 'leaders in IT.'"

Employers report that when their entry-level employees cannot cross the "barrier" into mid-level roles, it is less often due to the employee's lack of technical skills than it is their business skills. Employers struggle to hire or develop employees with strong project management and teamwork skills, effective communication and customer interaction, an understanding of business strategy, and who are able to explain complex technical concepts to non-technical audiences.

Employers are less likely to feel they have a good grasp of how to support or develop intrinsic motivation, attitude, and leadership characteristics through training. In the words of one respondent, "Career- and goal-oriented training, mentoring, and peer group interaction need to be actively encouraged. Developing a keen understanding of career goals and the paths to achieve them are the biggest gaps I notice among my peers in the IT industry."

Technical Skills and Certifications by IT Practice Area

User Support

Technical Skills
Microsoft Office
Customer service
Microsoft Active Directory
Mobile device support
Cloud computing

Example Certifications
CompTIA A+
Microsoft Certified Desktop Support Technician
Microsoft Certified IT Professional
Microsoft Certified Solutions Associate (MCSA)
Microsoft Certified Solutions Expert (MCSE)
Microsoft Certified Systems Engineer
Cisco Certified Network Associate

Networks

Technical Skills
UNIX, Linux, WAN, LAN
VMware Software, Microsoft Active Directory
Firewall, SonicWALL, Windows Powershell
Virtualization, Transmission Control Protocol
Windows Servers, MS Exchange Servers
IPv6, VPN
Wireless perimeter security

Example Certifications
System Administrator
Cisco Certified Network Associate (CCNA)
Cisco Certified Network Professional (CCNP)
Cisco Certified Internetwork Expert (CCIE)
Microsoft Certified IT Professional
Microsoft Certified Solutions Associate (MCSA)
Microsoft Certified Solutions Expert (MCSE)
Microsoft Certified Systems Engineer
VMware Certified Professional
Top Secret Sensitive Compartmented Information
Certified Info. Systems Security Professional
ITIL Certification

Security

Technical Skills
Risk management
Project Management
Firewall
UNIX, Linux
Penetration testing
Intrusion prevention system
MS SharePoint

Example Certifications
Certified Information Systems Security Professional
Certified Information Security Manager
Health Insurance Portability & Accountability Act
Global Information Assurance Certification
Top Secret Sensitive Compartmented Information
SANS Certified
Governance, Risk, and Compliance systems
GIAC Security Essentials Certification
Certified Ethical Hacker
Cisco Certified Network Associate

Web & Mobile

Technical Skills
Java, JavaScript, jQuery
PMP, HTML5
SQL, XML, .NET, SQL Server
MS SharePoint
Asynchronous JavaScript and XML
Web content management systems
Cascading Style Sheets
Graphical User Interface design
Adapting websites for mobile devices
Digital marketing

Example Certifications
Business Process Management Programming Languages
Solution demonstration lab
Certified Scrum Coach
CMMI Level 3 certifications
Health Insurance Portability & Accountability Act
Apple Certified Pro - Final Cut Pro

As people move up in management they rarely will remain as proficient in the latest new tools and technologies. Learning to manage effectively despite aging technology experience is a common challenge for managers who are IT practitioners.

Training Formats

IT Professionals responding to our survey ranked short-term classroom training and college-level courses as the highest value types of professional development to support their effectiveness as an IT practitioner. Area colleges and universities are valued to fill this need locally. For basic IT skills training or more widespread IT certifications, local trainers from outside academia are commonly used. IT employers and practitioners tend to look nationally for vendor-specific IT training resources, certifications, or online learning.

Trade shows were noted by a small number of respondents for their value in providing line of sight into capabilities that are over a 5-year horizon. One respondent noted: "you can't learn about emerging ideas through a training module."

Effective Professional Development Formats

Which professional development/training formats provide you with the best value in terms of supporting your effectiveness as an IT professional?

69% Short-term classroom training

46% Tuition or tuition reimbursement for approved courses at colleges or universities

43% Tuition or tuition reimbursement for approved online courses

43% Mentoring by a senior (non-supervisory) colleague

37% Customized on-site training

37% Educational resources and time for self-study (Including using web resources that are not in the form of an online course)

26% Professional conference

3% Trade show (for professional development purposes)

Source: Tech Collective IT Practitioner Survey 2013.

Databases

Technical Skills
Relational Database Management Systems
Creating scripts and procedures (SQL, Oracle procedural language, Perl, C+)
Data analytic software tools (SAS)
UNIX, Linux

Example Certifications
Oracle Certified Professional
Crystal Reports
LiteSpeed Web Server
Microsoft Certified IT Professional
Microsoft Certified Database Administrator
Microsoft Certified Technology Specialist
CMMI Level 3 certifications
Information Assurance Technicians
Top Secret Sensitive Compartmented Information
Business Process Management Programing Languages

Systems Analysis

Technical Skills
Relational Database Management System, SQL, Oracle
Software development
Systems development lifecycle
Quality assurance
Analytics tools
Cloud computing

Example Certifications
Crystal Reports
Business Process Management Programming Languages
Project Management Professional, PMI
Top Secret Sensitive Compartmented Information

Software Development

Technical Skills
Java, JavaScript
SQL, XML, HTML5
Linux
Microsoft Visual C# .NET
Microsoft ASP .NET
Quality assurance
Cloud computing

Example Certifications
Application Developer
Business Process Management Programming Languages
Top Secret Sensitive Compartmented Information
Society of Quality Assurance
Computer Aided Design
IBM Rational Unified Process
Certified Scrum Coach
Learning Management System
Crystal Reports
Certified Information Systems Security Professional

IT Project Management

Technical Skills
Project Management
Business requirements gathering
Software development
Quality assurance
Adobe LifeCycle ES
Systems Development Lifecycle
Microsoft Office
Microsoft Project

Example Certifications
Project Management Professional
Project Management Institute
IBM Rational Unified Process
Top Secret Sensitive Compartmented Information
Society of Quality Assurance
Health Insurance Portability & Accountability Act
Business Process Management Programming Languages
Certified Project Manager
Certified Scrum Master

Sources: Tech Collective 2013 IT Practitioner Survey, Employer Survey, focus groups, interviews, and job postings July 2013.

Education Pipeline

Engaging Grades 6-12 in the STEM Fields

At a foundational level, preparation for STEM fields starts with developing students' critical thinking and engagement with learning. As students continue through the education pipeline, STEM engagement is a key factor in their decision to pursue STEM fields. Many programs have been successful in exposing high school students to STEM subjects and possible career paths. However, those programs are limited – not having not had the capacity or resources to reach all students; not always having strong IT or computer science components; and not usually reaching in to include middle schools where students can be reached before they have made career-specific course or college choices.

CompTIA, the global IT industry association, published a study, "Youth Opinions of Careers in Information Technology" (2012). In it, 61% of teens report they "do not know someone who works in the IT industry or an IT occupation." Thirty-five percent report "their school does not provide any career guidance for IT careers."

When asked "What are the main reasons you are not likely to consider a career in IT?" responses were:

47% - Don't know enough about the IT field

44% - Not interested in the field of IT

24% - Not good at math/science

21% - Don't want to job sitting behind a desk all day

16% - Too expensive to go to school to get the required training/qualifications

11% - Career in IT will be too boring

17% - No specific reason, just not interested

School Computer Science and Information Technology Education Programs, Grades 6-12, Rhode Island, 2013

High Schools and Career and Tech Centers with Three-Year IT Programs – 300 students	Integrated or After-School Programs	Special Events / Workshops / Camps
Cranston Area Career and Tech Center, CISCO, Networking, Cyber Security & Forensics, Interactive Digital Media, Pre-Engineering Robotics	*FIRST* Junior LEGO League *8 teams from 4 school districts*	STEM in the Middle (Tech Collective) *90 students from 3 schools*
Chariho Area Career and Tech Center, Information Technologies and Game Design Program, Cyber Security	*FIRST* LEGO League *58 teams from 15 school districts*	GRRL Tech Interactive Technology Expo (Tech Collective) - *500 students from 30 schools*
Coventry Area Career and Tech Center - Computer Technology and Game Design	*FIRST* Robotics Competition *6 teams from 4 school districts*	Marine Biology Workshops (RI NSF EPSCoR / URI Graduate School of Oceanography) *99 students*
Exeter/West Greenwich High School - Social Media for Marketing, Robotics, and Computer Programming	*FIRST* TECH CHALLENGE *32 from 17 schools districts*	SMILE Program (University of Rhode Island)
Hope High School, Providence, Academy of Information Technology	Cyber Foundations Competition (U.S. Congressman Langevin, New England Institute of Technology, Tech Collective) *120 students from 8 schools*	Starship Poseidon (Naval Undersea Warfare College) - *24 high school students*
Warwick Area Career and Tech Center, CISCO Networking Academy, Cyber Security	Junior Achievement of Rhode Island	Introduce a Girl to Engineering Day (Ximedica) *35 girls*
Newport Area Career and Tech Center, Academy of Information Technology (AOIT), Cyber Security	SkillsUSA RI - Technical Computer Applications - *6 students from 2 schools districts*	Junior Achievement of Rhode Island Job Shadow Day - *50 participants*
Woonsocket Area Career and Tech Center, Academy of Information Technology & Game Design (NAF Certified) and Digital Media	Student Tech or STEM clubs	Computer Camp, Summer Engineering Academy, Chemistry Camp (URI)
AP Computer Science - *60 students in 2012*		Community College of Rhode Island Kids' College - *230 students age 8-14*

Three Concepts of Technology in Education

Technology benefiting education.

Educational Technology

Educational technology is about using technology to support teaching and learning.

Educational technology can bring rich interactive resources to students, differentiate instruction for individual students, provide practice exercises with instant feedback, and free up teachers to be coaches and facilitators.

Technology knowledge for full-participation in our technology-enabled world.

Digital Literacy

Digital Literacy is the ability to use information and communication technologies to find, evaluate, create, and communicate information, requiring both cognitive and technical skills.(American Library Association).

Foundational knowledge for the IT workforce.

Computer Science

The ability to create and adapt new technologies distinguishes computer science from digital literacy, which focuses on using existing hardware and software. Computer science starts with computational thinking: the thought processes involved in formulating problems and their solutions so that they are represented in a form that can be effectively carried out by an information-processing agent.

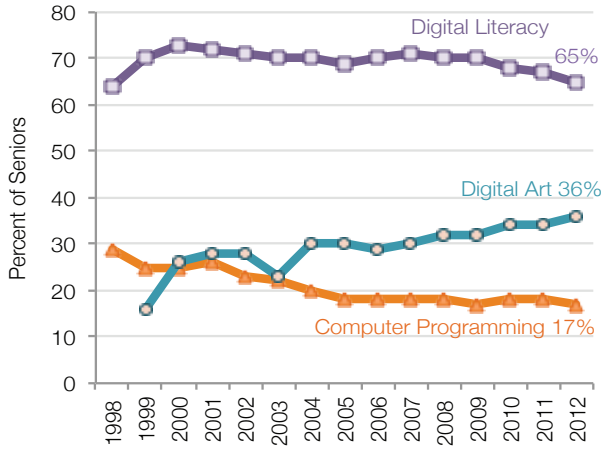
A major push to improve STEM curricula in classrooms is underway. In Rhode Island, the Rhode Island Department of Education (RIDE) is working to elevate career education programs in IT, medical, and pre-engineering/robotics studies. RIDE supports articulation agreements between high schools and area colleges as well as opportunities for high school students to earn industry-recognized credentials. Rhode Island state incentive funding for Career and Technical Education is proposed to scale up incrementally from $3 million per year in 2013 to $10 million per year. These incremental state resources are critical to offset the expected decline of federal Perkins money for career and technical education.

Across youth engagement opportunities, the quality of computer science programs is key to student interest and persistence. Students enjoy computer science learning when following their passion and being challenged to create something that is meaningful to themselves and to others. Computer science learning tools such as LEGO Mindstorms, *FIRST* robotics, Scratch, and Alice engage a spirit of playfulness while building skills in computational thinking and foundational concepts of computer science.

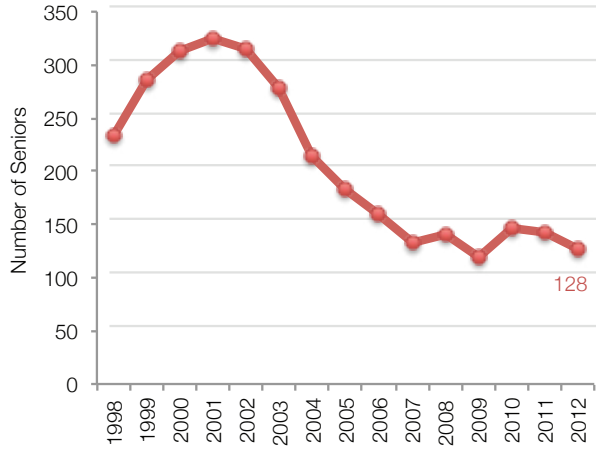
Digital Literacy for Everyone

All students today need to use and interact with computers and the Internet. The use of educational technology across the curriculum is a growing priority, and schools have become more adept at embedding digital literacy in core subjects starting in elementary grades. However, it is important to distinguish digital literacy from computer science.

Coursework Experience of RI College-Bound Seniors



Rhode Island College-Bound Seniors Intending to Major in Computer & Information Science & Support Services



College Board. College Bound Seniors taking the SAT. State Profile Reports.

As concluded by research funded by the National Science Foundation, barriers to computer science learning arise when computer courses have learning objectives that do not go beyond keyboarding, word processing, Internet use, and digital literacy. Students who took such courses were not exposed to computational thinking, problem solving, or creating and modifying software and hardware solutions. They tended to believe that "computer science" was using computers and were unlikely to aspire to IT careers or enroll in a college-level Computer and Information Science (CIS) course.

Computer Science Education

At a time when IT jobs are a growing percent of all jobs – up 36% over the past decade – computer science studies are declining in participation at all levels of education. Factors working against computer science in schools include limited course offerings, crowding out by competing demands on students' schedules, a decline in student interest in the courses offered, and a lack of overall awareness of computer science.

At the K-12 level, computer science is not a core subject. Computer science classes are offered as electives in some high schools and career and tech centers, but not all. Declining numbers of Rhode Island high school students are taking coursework in computer programing. Less than 1% of Rhode Island high school students participate in AP computer science. According to College Board, the percent of Rhode Island students intending to major in computer science declined in the early 2000s and has leveled off at 2%.

To reverse the decline in computer science learning, the National Science Foundation, ACM, and the Computer Science Teachers Association have developed recommended computer science education standards. The standards and supporting curricula first introduce the relationship of computer science to individuals, community, and the globe. In grades 9-12, those topics are combined with technical principles and technologies as they prepare students to enter CIS studies in higher education. Additionally, a new AP Computer Science Principles course is being piloted. The new course is intended to have broader student appeal as well as incorporate a more comprehensive foundation of computational learning. These initiatives are part of the National Science Foundation's "Computing Education for the 21st Century" initiative which supports teacher professional development, dissemination of best practices, program development, educational research, and implementing programs for youth from populations underrepresented in IT professions.

Recommended Computer Science Education Standards and Information Technology

ACM/Computer Science Teachers Assoc. Academic Standards			Career and Technical Curricula
These college-prep courses provide foundational knowledge recommended for students aspiring to a college degree in a STEM field.			These courses provide technical knowledge and hands-on skills for college or entry-level jobs in computer networking and desktop support.
Grades K-6	Grades 6-9	Grades 9-12	Grades 9-12
Computer Science and Me	Computer Science and Community	Computer Science in the Modern World Computer Science Principles (AP) Topics in Computer Science	Software and Systems Basics Cisco Networking Interactive Digital Media Game Design, Computer Animation Programming Languages
Students are introduced to foundational concepts in CS by integrating basic skills in technology with simple ideas about computational thinking. Learning experiences are inspiring and engaging, helping students see computing as an important part of their world.	Students begin using computational thinking as a problem-solving tool. They begin to appreciate the ubiquity of computing and the ways in which CS facilitates communication and collaboration. Students experience computational thinking as a means of addressing community-relevant issues. Learning promotes student perceptions of themselves as proactive and empowered problem solvers.	Through a series of courses, students can master more advanced CS concepts and apply those concepts to develop virtual and real-world artifacts. The learning experiences focus on the exploration of real world problems and the application of computational thinking to the development of solutions.	Students learn vendor-neutral fundamentals and also gain direct experience with specific software and systems. Some CTE courses prepare students directly for industry-recognized certification exams, providing a credential that can qualify students for an entry-level IT position or prepare them for more advanced studies.

Sources: ACM/CSTA, CAITE, and RIDE.

In Rhode Island, teachers have launched a Rhode Island Chapter of Computer Science Teacher's Association. The Next Generation Science Standards finalized in 2013 include computational thinking for everyone. Educators will be discussing if and how to translate these standards to curriculum. Their efforts will benefit from support and engagement from IT industry leaders.

In high schools, digital art is a growing area. Carrying over into higher education, digital design programs have been developed at RISD, Johnson & Wales University, and the New England Institute of Technology. Digital design degrees granted have increased since 2003. **The appeal of more artistically styled graphic and web design may attract a broader range of students and be an entry point into IT careers.** IT employers recognize design as an important aspect of many IT projects and want digital designers who are IT professionals as well as artists.

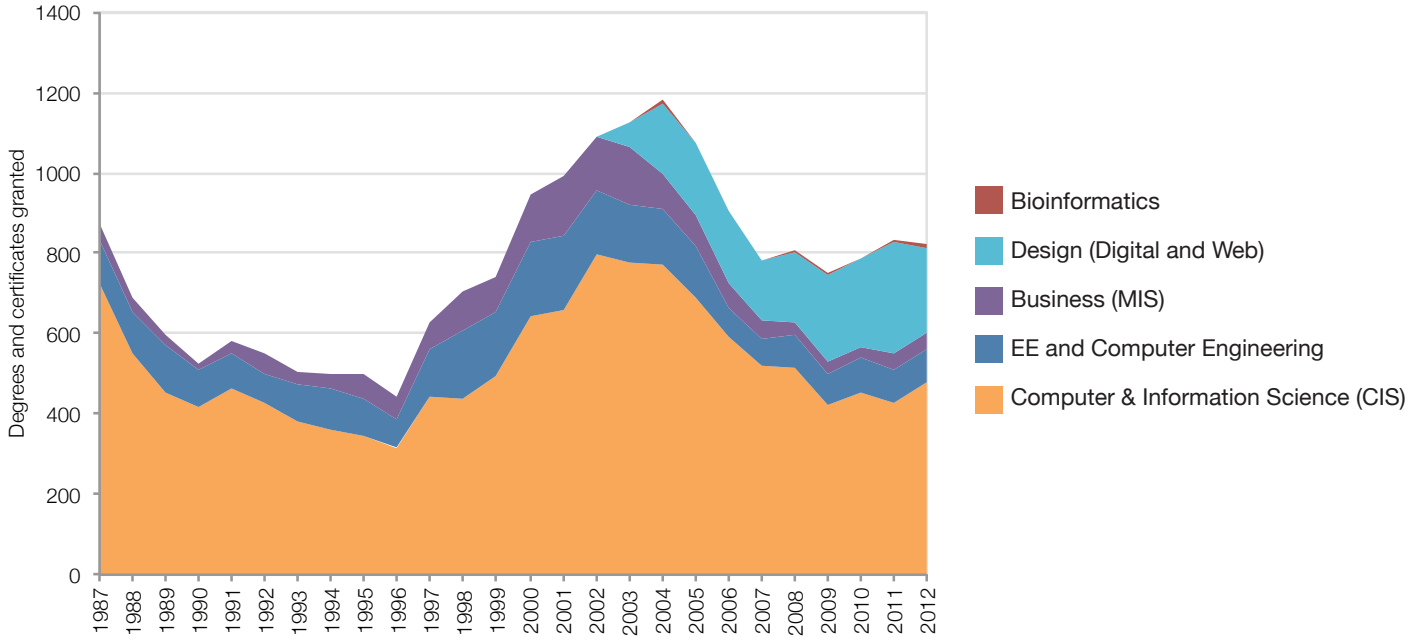
At the higher education level, Rhode Island ranks in the top ten states for degrees granted in CIS per capita. However, the overall pattern is one of decline. Degrees that map to IT careers are down 32% since 2004. CIS graduates declined from 2004 through 2009 and increased after 2009. Since the early 2000's there has also been a drop in annual completions of Management of Information Systems (MIS) degrees at Rhode Island colleges and universities. During our employer interviews, the impact of this drop was noted as not only affecting the ability to hire IT professionals at the entry level, but also at the mid-level (3-5 years of experience).

Best practices in this area include targeted recruitment, redesigning STEM majors to engage a broader range of students, and supporting student success. The University of Maryland Baltimore County (UMBC) led the way in redesigning introductory courses in STEM majors to provide the foundational knowledge and skills that most college-bound students do not gain in high school. Along these lines, the University of Rhode Island is part of the national Gateways to Completion program working to overhaul introductory STEM courses to attract and retain students and boost learning outcomes. For recruitment and student support programs, the URI College of Engineering's Minority Student Recruitment and Retention Office is a strong model.

IT knowledge is relevant to many fields of study and can be woven into curricula. Besides CIS and MIS, several majors heavily engage IT concepts in the fields of business, design, engineering, and bioinformatics (*see p.20*). Employers expressed a need for graduates of IT degree programs who have interdisciplinary experience – for example, a minor in business management, finance, or healthcare management. In our survey, 83% of IT employers feel there is a need for a combination of coursework in business and technology.

Evolving Picture of the IT Education Pipeline, Rhode Island 1987-2012

Annual number of degrees earned that map to IT Occupations at RI Institutions



Source: National Center for Education Statistics. Completions Survey. Degrees by majors (CIP) aligned with IT Occupations (SOC) in the SOC-CIP Crosswalk.

Degrees from Many Fields Map to IT Careers

Degrees that Align with IT Careers

Computer & Information Science

Computer & Information Sciences
Computer Graphics
Web, Digital Design
Web Management
Information Technology
Math & Computer Science
Software Engineering
Security/Information Assurance
Systems Analysis
Computer Systems Networking
System, Networking Management
Computer Engineering Technology

Design

Graphic Design
Design & Visual Communications
Multimedia
Digital Arts
Game & Interactive Media Design
Animation, Interactive Tech, Video Graphics

Business

Management Information Systems
Technical, Business, & Scientific Writing
Information Resources Management

Bioinformatics

Computational Biology

Engineering

Electrical Engineering
Computer Hardware Engineering

Degree and Certificates Earned in Rhode Island 2012

Degrees Offered in Rhode Island

480

Brown University –
BS, Master's and PhD in Computer Science
University of Rhode Island (URI) –
BA/BS Master's and PhD in Computer Science (with configurable interdisciplinary tracks, for example, Web Development, Cognitive and Information Science, 3D Game Development)
Minors in Computer Science, Digital Forensics, and Cybersecurity; Student declared minors (i.e. Web Development, or Bioinformatics)
Graduate Certificates in Digital Forensics and Cybersecurity
Johnson & Wales University –
BA Electric Engineering Technology
BA Robotics Engineering Technology
BA Network Engineering
BA Computer Programming
BA Software Engineering
New England Institute of Technology –
BA Game Development & Simulation Programming
BA Cyber Security
BA Network Engineering
BA Software Engineering
Associates Game Development & Simulation Programming, Information Technology, Video Game Design Technology, Software Engineering, and Network Engineering & Computer Servicing
Providence College, RIC, Roger Williams– BA Computer Science
Community College of Rhode Island (CCRI) –
Associates Computer Science (URI and RIC tracks), Computer Programming, General Microcomputing, IT Support Specialist, Networking, Web Technologies.
Certificates Computer Programming, General Microcomputing, IT Support Specialist, Networking, Web Technologies, and Office Automation

210

RISD – BFA in Graphic Design (includes digital + interactive media)
BFA in Film/Animation/Video
MFA in Graphic Design (includes digital + interactive media)
MFA Digital + Media
Johnson & Wales University – BA Graphic Design + Digital Media
New England Institute of Technology – Associates Graphics

40

Bryant University – BA in Information Technology
BA in Business with minor in Computer Information Systems
RI College & Roger Williams University – BA MIS
Salve Regina – BA Information Resource Management
Multimedia and Web Design

9

URI – BS, MS and PhD in Computer Science – Bioinformatics
Brown University – Bachelor's Computational Biology

80

University of Rhode Island – BS in Computer Engineering (College of Engineering); Graduate degrees in Electrical, Computer, and Biomedical Engineering
Brown University – BS Engineering (Concentration in Computer Engineering); Graduate degrees in Computer Engineering

Recommendations

Based on feedback from Rhode Island IT employers, Tech Collective makes the following recommendations. These recommendations are interrelated, building upon previous work. They are strategic in nature and, in many ways, also require a cultural shift in the way technology, education, and employment pathways are perceived and operated. The successful 21st century workforce pipeline is certainly one of many opportunities, but one that also demands flexibility, expansion of public education offerings, monetary investments by local and national workforce agencies, and time and knowledge investments by employers and senior leaders.

Many of the components of a 21st century workforce pipeline are already in place, and rather than be re-invented, they need to be better connected, expanded in scale, and made more broadly accessible. The following recommendations aim to do that work. Where appropriate, related activities corresponding to the recommendation have been noted as an "Action" item. In many cases, these actions are one course among many rather than stand-alone solutions.

1. Inspire and Engage Youth

Increase the number of middle school and high school students engaging in fun informational technology and computer science learning in-school, after-school, and/or during the summer.

Awareness and engagement in STEM disciplines at the 6-12 education level is essential to students' future pursuit of a STEM career. It is unlikely and more difficult for students to succeed in a college computer science major without prior experience and foundation in the discipline.

There are many successful in-school and after-school programs aimed at garnering student awareness and interest in the STEM fields, particularly at the 6-12 education level. These programs are often hands-on, creative, connected to student interest, and involve real-world problem solving, computational and critical thinking. (*See page 16 "School Computer Science and Information Technology Education Programs"*)

Recommendation: Whether during the school day, after school, or during summer programs, more Rhode Island students need access to high-quality STEM programs including computer science and information technology. Existing programs need to be developed and expanded and new opportunities created. Overall, these opportunities need to be more consistently available to all Rhode Island students.

Action: The Rhode Island Department of Education (RIDE) Career and Tech office is currently working to increase student access to STEM electives within their school/course of study. Tech Collective will be working with

RIDE to advise and assist in delivering IT electives. These courses would be conducted in high school career and technical centers with the goal of eventually making them accessible to all high school students.

Action: The Rhode Island STEM Center at Rhode Island College is working to create STEM educational and professional development opportunities for educators. Tech Collective will be working with the STEM Center to advise on programming and contribute industry perspectives.

Action: Rhode Island teachers have launched the Rhode Island Chapter of the Computer Science Teachers Association. On a national level, the National Science Foundation continues to provide competitive funding for "Computing Education in the 21st Century." Through collaborative insights and support, the initiative supports teacher professional development, dissemination of best practices, program development, educational research, and implementing programs for youth from populations underrepresented in IT professions. This includes the development of the recommended computer science education standards. (*see page 18 "Recommended Computer Science Education Standards and Information Technology"*)

2. Experiential Learning

Experiential learning activities will broaden the diversity and increase the number of students who pursue IT education and careers.

Internships allow emerging workers to gain hands-on experience with technologies applied in a business context and facilitate their entry into long-term employment.

Registered Apprenticeships in IT will provide a learn-while-you-earn pathway to IT careers.

Experiential learning has proven to be one of the most effective workforce training models. This is true for IT, where experiential learning can generate interest and then engage students and practitioners.

For K-12 students, experiential learning includes industry tours, classroom speakers, job shadows, and hands-on expos or career days. These experiences help students gain confidence and perspective as they begin to imagine themselves on an IT career pathway.

For higher education and workers looking to enter the field, experiential learning opportunities, such as internships, fellowships, apprenticeships, and "boot camp" style short-term training can be equal in value to classroom learning. College programs are moving toward more experiential learning through research experiences and internships.

Particularly at this level, experiential learning is a critical aspect of the participant's career development, providing hands-on experience to real-world technology solutions and business needs. Such opportunities are most effective when they range across the industry spectrum – from startup through enterprise – and expose students to environments they might not otherwise consider.

For employers, experiential learning serves as a long-term interview in an applied setting. However, it takes a significant investment in time and resources for employers to create and support high-quality, successful experiential learning opportunities. Although their investment level might be high, employers' return on that investment in knowledge, skills,

and oftentimes loyalty holds heavier weight. It can also offer leadership opportunities to staff as supervisors and mentors.

Recommendation: Continue to support and incorporate experiential learning opportunities across the K-12 curriculum. Engage industry for classroom tours, workshops, curriculum development, and other engagement initiatives.

Recommendation: Continue to support and expand existing experiential learning programs for those looking to enter the IT fields as well as throughout the workforce pipeline where appropriate. With industry input, develop and adopt new program opportunities. (*See page 11 "Innovative Short-Term IT Training Programs"*)

Recommendation: Working with industry and academia, design and implement a Registered Apprenticeship program with employer-identified career pathways (such as networking, database, and desktop support). The apprenticeship program should be articulated with an academic institution(s) enabling the earned credits to be transferable toward a college degree.

Recommendation: Ensure "ease-of-use" for employers. Employers have largely been receptive to experiential learning models, but in order to make this a part of standard industry and education practice, we need to continue to work to make the programs accessible for employers and easy to navigate.

3. Pipeline Progression / Incumbent Worker Training

IT employers will have consistent access to incumbent worker training funds to advance their workforce at the technical, professional, and leadership levels..

Throughout the course of this study, employers continually voiced a need for access to training opportunities and funds for their current workers (also called incumbent workers). They cited this as a substantial factor in progression of the workforce pipeline. IT employers make substantial investments in IT professional training, and the benefits of training flow both to the workers and the employer. As employees are continually educated, they are not only able to meet ever-evolving industry demands, but also advance both personally and professionally into new, higher roles. This creates new opportunities for growth within the company and the pipeline.

Through employer-paid taxes that go into the Rhode Island Job Development Fund, resources have become available to Rhode Island employers for incumbent employee training over the past several years. Some of these resources are open to IT employers only, others to all Rhode Island industries. They include:

- Industry Partnership Incumbent Worker Training Funds (Funded by the Governor's Workforce Board Rhode Island (GWBRI), administered by Industry Partners)
- Monthly Incumbent Worker Training Express Grants (GWBRI)
- Annual Incumbent Worker Training Grants (GWBRI)

Recommendation: Continue to support and expand the allocation of incumbent IT worker training funds. With industry collaboration, develop new

opportunities or funding sources for training. This includes making public, group, and customizable training opportunities available to employers to best suit their need. While the cost of IT training tends to be higher than training in other occupational sectors, this training also yields high benefits: above-median salary levels, accelerated company growth, expanded technical offerings, increased revenue, the ability to meet evolving client needs. These outcomes not only benefit the individual, but the company and its clients.

Recommendation: Provide communication, relationship, organizational, and leadership skills training to incumbent workers in addition to technical training. This will help employers be able to promote qualified entry-level workers into mid-level roles.

Recommendation: Make available to employers more consistent access to incumbent worker training funds.

Action: In 2013, GWBRI created its Incumbent Worker Training Express Grant program. As a rolling monthly submission period, employers can submit their funding request application at a time best suited to their needs. This means employers no longer have to wait to request funding and can also receive a more timely response. The creation of a monthly Express Grant application is a strong example of being more flexible to the needs of employers.

4. Pipeline and Resource Assessment

Rhode Island industry, workforce, academia, and stakeholders will have a clearer view of IT education and workforce programs, pathways, and resources.

The assessment will identify gaps which can then be addressed.

There are currently many programs and resources contributing to the continuum of the Rhode Island IT workforce education pathways. The issue arises, however, that employers and practitioners are not always aware of these programs and resources, or do not have the time or ability to explore them to adequately meet their needs.

Recommendation: Create one central resource to identify and make available the services of these programs to the industry, employers, and the IT workforce at large.

Action: Tech Collective is in the planning stages of an assessment of the IT workforce pipeline and supporting programs, initiatives and resources. This includes:

1.) Identifying all existing training programs and supporting resources available to the Rhode Island IT industry and workforce.

2.) Evaluating the success, sustainability, and employer perception of each program and resource (*Does it meet employer needs? Is it an employer-recognized program?*)

3.) Developing a plan to lessen any gaps in these programs, resources, or the pipeline itself; working with appropriate parties to execute; developing and sustaining collaborative, supportive partnerships.

4.) Educating employers and practitioners of the programs available to them throughout the pipeline; fostering engagement in these opportunities.

5. Digital Literacy

Because of its growing role in community, government, communication, commerce, and work, the social and economic disadvantages of not knowing how to use computers and the Internet are growing. Access to opportunities to gain digital literacy skills is critical for students and adults at all levels. Examples of basic skills include keyboarding, computer and Internet navigation, and using computer applications, such as Microsoft Office Suite.

Recommendation: Ensure digital literacy skill development and application is incorporated into student coursework across the K-16 curriculum (art, science, language arts, etc.). Use industry input to demonstrate how digital literacy is applied across industries and occupations.

Recommendation: Incorporate digital literacy foundations into job readiness and training/re-training programs and throughout the workforce system as necessary.

Action: The Rhode Island Department of Education has efforts underway to embed digital literacy skill development across student curriculum, including providing every student with 1:1 access to digital technologies, as set by the move to online testing (PARCC).

Action: Digital literacy training is an on-going initiative of Broadband Rhode Island (BBRI). These training opportunities are offered to adults with any education level and range from basic Internet skills to advanced topics like digital skills for the new GED. They include free trainer workshops, access to a network of certified trainers, and class offerings at public libraries and community organizations. The BBRI Internet Basics curriculum is available for use by other organizations around the state.

Rhode Island students from all schools and all socioeconomic backgrounds will graduate from high school as independent computer users able to participate in the 21st century as citizens, learners, and workers.

Greater numbers of Rhode Islanders will be able to use computers and the Internet to increase productivity, enhance quality of life, and benefit society (Source: Broadband RI).

6. Badges and Stackable Certificates

Badges and stackable certificates are emerging as credentials that indicate achievement in specific skill and knowledge sets. The modular nature of badges and stackable certificates particularly resonates for non-traditional students, working adults, transitioning workers, and college students who are majoring in other fields but have in interest in the IT industry.

Badges and stackable certificates have the potential to be part of a course of study, serve as a pre-requisite, or stand alone as elements of continued education. An example of badges is the Mozilla Open Badge infrastructure, a framework allowing organizations to create and issue customized badges. “Stackable credentials” is a term indicating students may “stack” short-term training courses toward the attainment of a larger certificate or degree. Employer validation is key to creating badges and stackable certificates with value in the labor market.

Recommendation: Explore the potential of expanding the use of badges or stackable certificates to help students and workers build a portfolio of demonstrated skills.

Students’ and workers’ ability to use technology to support their education will be accelerated by the opportunity to earn IT skill “badges.”

Stackable certificates will enable more working adults to earn industry recognized credentials on their way to completing a certificate or degree.

Action: The Providence After School Alliance (PASA) is creating a series of badges designed to build student skills. The badge infrastructure lends itself to self-directed learning, provides a motivational structure, and validates skills with potential value to employers.

7. Renewed Industry Partner – Commerce RI Collaboration

Tech Collective and Commerce RI will work together to support the growth of the IT sector in Rhode Island.

A state's economic development agency plays a complex and important role in enabling business growth and job creation. For several years, Rhode Island's key economic development agency, the Rhode Island Economic Development Corporation, now Commerce RI, had been in flux. Its lack of stability came at the cost of decreased effectiveness in meeting the needs of existing and potential business. Economic development leadership and collaboration are a renewed state priority.

Recommendation: Strengthen Commerce RI's partnerships with the state's Industry Partners. Designated by the Governor's Workforce Board Rhode Island (GWBRI), Industry Partners represent the collective voice of the state's high-growth, high-wage industries. A deeper collaborative relationship between Commerce RI and the Industry Partners will better-align efforts and initiatives to support existing companies in Rhode Island as well as attract new companies.

8. Entrepreneurship

Rhode Island will continue to grow a supportive and vibrant entrepreneurial community.

IT is a field conducive to innovation and entrepreneurship. There are several organizations and initiatives focused on supporting the Rhode Island entrepreneurial and innovation environment. These include: Betaspring, The Hatch, The Hive, The Founders League, Gateway Offices at Quonset Business Park, KLR Emerging Business Center, Startup Weekend Providence, and UP Global.

Recommendation: Continue to raise awareness and support the efforts of organizations and initiatives serving the Rhode Island entrepreneurial space.

Get connected at www.tech-collective.org