THE SOUTH CAROLINA INFORMATION TECHNOLOGY WORKFORCE 2017 CHALLENGES & OPPORTUNITIES

Commissioned By:

IT-oLogy
SC Coordinating Council for Workforce Development
SC Department of Commerce

Information Technology Workforce Development Research Report

The South Carolina IT Workforce 2017 Challenges and Opportunities

Executive Summary

Introduction

Concerns related to the supply and demand for jobs in Information Technology (IT) have been building as the shift to the Information Age positioned technology as a primary driver for economic growth. In October 2012 Peter Sondergaard, Senior Vice President at Gartner and Global Head of Research, stated that, "By 2015, 4.4 million IT jobs globally will be created to support Big Data, generating 1.9 million IT jobs in the United States (US). In addition, every big data-related role in the US will create employment for three people outside of IT, so over the next four years a total of 6 million jobs in the US will be generated by the information economy." The latest 2017 CompTIA report sets the average annual tech sector growth in South Carolina (SC) at 9% compared to the national growth of 12%.

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# Tech Employees	62,360
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Q4 2016 Open Jobs	6,424
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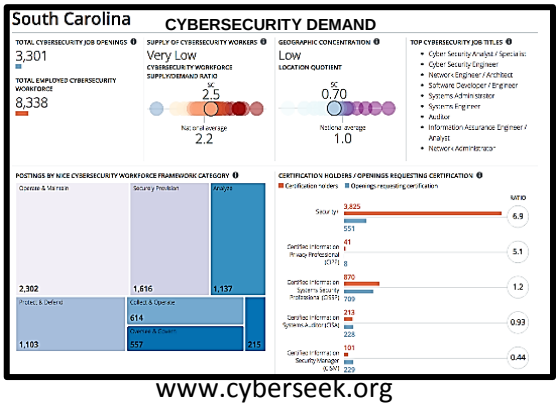
Tech Job Growth 2016	3.3%
Economic Impact	4.6%
	CompTIA 2017

According to Steve Morgan, Forbes contributor on cybersecurity, more than 209,000 cybersecurity jobs in the US are unfilled, and postings are up 74% over the past five years based upon an analysis of 2015 numbers from the Bureau of Labor Statistics by Peninsula Press, a project of the Stanford University Journalism Program. A report from Cisco, "Mitigating the Cybersecurity Skills Shortage", puts the global figure at one million cybersecurity job openings. The report further refers to projections by Michael Brown, CEO at Symantec, the world's largest security software vendor, that the demand is expected to rise to 6 million globally by 2019, with a projected shortfall of 1.5 million.



www.cyberseek.org

The shortage of skilled workers has impeded the projected rates of growth. In a review of August 2017 employment data, Mark Roberts, CEO of TechServe Alliance, the trade association of the IT and engineering staffing and solutions industry stated, "For the past three months, the rate of IT jobs growth has been sluggish. While it still represents an increase in IT employment, the rate of growth has generally been on a downward trajectory for the past year. Given the extremely low unemployment rates in many high-demand IT and engineering skill sets, the shortage of supply is clearly impeding the growth rate of the US technical workforce."

Beginning in March 2017, 500 SC companies from across the state representing diverse industry sectors were invited to complete workforce surveys either by mail or online. One-hundred seventeen (117) responses were received representing a 23% return rate. An additional 40 employers were interviewed

representing large and small employers across all regions of the state, education leaders and workforce development and training resources. In order to provide recommendations for strategies to bridge identified gaps between the workforce supply and demand, current SC workforce data, industry projections and data, and internal state and external resources for potential best practices and innovative solutions were reviewed in depth.

Six (6) gaps emerged from the research relative to the Information Technology workforce supply and demand.

1. A limited supply of trained and experienced IT employee candidates across all occupations resulting in vacancies, recruitment of out-of-state talent, or positions being outsourced.
2. The number of students pursuing training, certification and/or degrees in IT will not meet the projected industry needs in SC.
3. Women and minorities, particularly African Americans and Hispanics, are underrepresented in the national and South Carolina IT workforce.
4. The demand for cybersecurity professionals is rapidly accelerating at three times the rate of IT jobs in general. A concentration of demand was noted for employers in the SC metro areas and the I-77 corridor particularly for companies that provide security services.
5. In addition to technical skills and experience, employers are seeking stronger "soft skills", i.e., interpersonal skills, internal and external customer service, critical thinking and problem solving, professionalism, and business acumen.
6. A shared, consistent, statewide culture for innovation and entrepreneurship is needed to support technological advancement and economic growth throughout SC.

Regardless of the company size or location, the following common themes emerged. These themes contribute to each identified gap.

1. Non-technical "soft skills" that enable the employee to be productive in a business environment, establish good customer relationships, work well on a team, and apply critical thinking and problem-solving skills are as important to the employers as the information technology skills.
2. There is a growing need for a talent pool of mid-career IT professionals especially full stack developers, multiple language skills and knowledge of front-end and back-end development as employers face waves of retirements of key, experienced employees. This creates a knowledge drain, as well as a management and leadership vacuum.
3. Employers are giving significant attention to the importance of corporate culture.
4. The higher salaries commanded in the IT sector due to the competitive, tight market contribute to the inability of firms to fill positions and add to the cost of doing business in SC.
5. A strong K12 IT curriculum is considered to be critical in building a sustainable talent pipeline.

RECOMMENDATIONS

To develop the IT workforce as a key component of the infrastructure to support and grow South Carolina's overall IT economy, the research identified potential long-term and short-term strategies to bridge the identified gaps.

Recommendations include, but are not limited to the following:

- Broaden existing networking, mentoring and apprenticeship programs with expansion into underserved areas.
- Create or identify a Champion Group, Board, or Council at the SC State level to drive accountability and to support systemic change/needs, i.e., K12 education, accessibility, two-year and four-year college degree programs, emphasis on graduating "work ready" candidates, and the focus on building an innovation culture.

- Expand outreach of technical college training, IT events and programs to underserved areas.
- Consider teacher incentives to attract and retain qualified IT teachers.

The research and recommendations provide a platform for discussion and identify areas for further attention. An intentional, collaborative effort with key stakeholders from across industry, government and education could leverage the collective assets and resources of all stakeholders and provide the necessary vision and structure to measure and to sustain progress.

CONCLUSION

In order for South Carolina to assume a leadership role in the information technology economy, key stakeholders from across the State must join together with a laser commitment to address South Carolina's IT talent gap. The development of a sustainable, skilled information technology talent pipeline is critical to positioning South Carolina as a leader in the information economy.

The State has resources and programs producing promising results. Leveraging those resources will place South Carolina as one of the top knowledge-based economies in the southeast United States as measured by information technology job growth. The vitality of the information talent pipeline and retention of information technology talent is key. Both short-term and long-term strategies are needed. Leveraging and aligning current programs and strategies can accelerate the immediate talent pipeline. Long-term strategies require an integrated, state-wide, intentional focus and commitment of resources in the ever-evolving environment of information technology.

Information Technology Workforce Development Report 2017

The South Carolina IT Workforce Challenges and Opportunities

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INTRODUCTION

Concerns related to the supply and demand for jobs in Information Technology (IT) have been building as the shift to the Information Age positioned technology as a primary driver for economic growth in the world and in the United States (US). Recognizing that the workforce is a critical component of the infrastructure supporting the growth of South Carolina's information economy, the SC Coordinating Council for Workforce Development of the SC Department of Commerce partnered with IT-oLogy to commission a study of the current and projected needs of SC employers in IT and the capacity of the workforce to fill those needs. The resulting information will be used to develop a proactive plan to ensure that the South Carolina (SC) workforce is prepared to take advantage of the increasing demand in IT.

Beginning in March 2017, 500 SC companies from across the state representing diverse industry sectors were invited to complete workforce surveys either by mail or online. One-hundred seventeen (117) responses were received representing a 23% return rate. An additional 40 employers were interviewed representing large and small employers across all regions of the state, education leaders and workforce development and training resources. In order to provide recommendations for strategies to bridge any identified gaps between the workforce supply and demand, current SC workforce data, industry projections and data, and internal state and external resources for potential best practices and innovative solutions were reviewed in depth.

This report summarizes the research findings and outlines six (6) gaps in the IT workforce supply and demand that emerged from an analysis of the findings. Recommendations and potential strategies within a variety of promising practices also are included for each gap.

OVERVIEW

In October 2012 Peter Sondergaard, Senior Vice President at Gartner and Global Head of Research, stated that, "By 2015, 4.4 million IT jobs globally will be created to support Big Data, generating 1.9 million IT jobs in the United States. In addition, every big data-related role in the US will create employment for three people outside of IT, so over the next four years a total of 6 million jobs in the US will be generated by the information economy." The latest 2017 CompTIA report sets the average annual tech sector growth in South Carolina (SC) at 9% compared to the national growth of 12%.

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DISCUSSION OF GAPS AND RECOMMENDATIONS

The remainder of the research findings section is organized to highlight the important aspects and insights associated with each gap. From the assessment of the six gaps, recommendations for specific actions have been developed and included.

The data and information collected spread across a wide variety of areas that include but are not limited to academic, corporate, municipal, economic development, students, service providers and community supporters. The gaps identified below are present in every major region of the state. Specific needs and opportunities, however, varied among regions, corridors and cities within the state. These are recognized within the analysis associated with each gap.

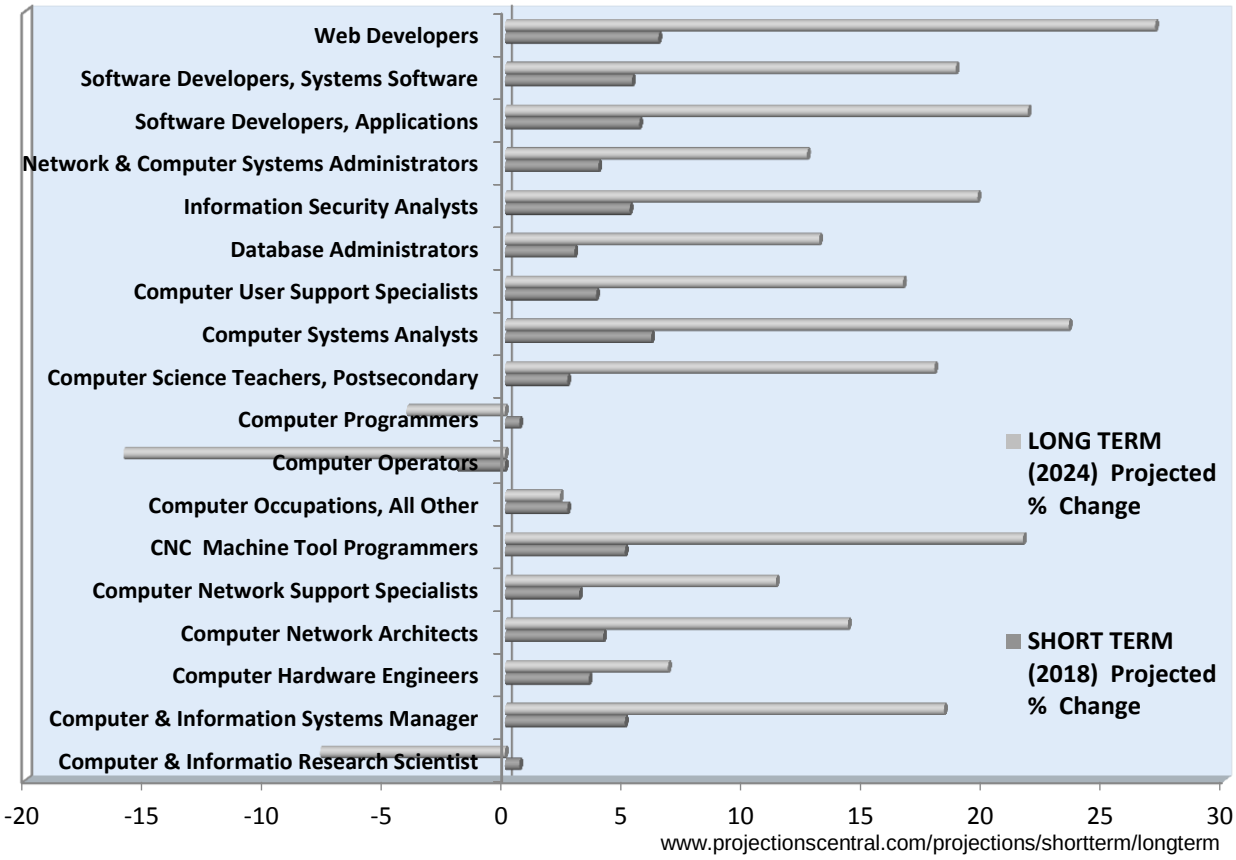
GAP 1: ***A limited supply of trained and experienced workers resulting in vacancies, recruitment of out-of-state talent, or positions outsourced***

South Carolina CS/IT Job Openings (9/2017)	
Position Title	**Job Openings**
Computer/Electronic Product Manufacturing	367
Computer/Peripheral Equipment Manufacturing	38
Computer Systems Design/Related Services	1819
Computer Training	60
Information Technology	1025
Data Processing, Hosting, Related Services	101
Total Positions Open	3410
Source: https://jobs.scworks.org/vosnet/analyzer/drill/drill.aspx	

According to SCWorks, 3,410 positions were open in SC specifically related to computer science and information technology in September 2017. According to Code.org, this is three times the average demand rate in SC. These numbers vary from month to month as positions are filled and new positions are posted. The numbers also may reflect multiple postings for the same positions. The Projections Managing Partnership (PMP) supported by the US Department of Labor, Employment and Training Administration provides both short-term and long-term state occupational projections.

The short-term projected growth in SC for the period 2016 – 2018 for 18 specific IT occupational positions ranged from 2% (Computer Programmers) to 6.4% (Web Developers) with an overall average increase of 3.6%. The following chart details the short term and long-term projections for key positions.

SOUTH CAROLINA OCCUPATIONAL PROJECTIONS



- The majority (90.6%) of survey respondents reported having 1 - 5 open positions. 57.3% responded that they plan to increase the number of IT positions over the next 1 – 5 years. Interestingly, 72% reported using "word of mouth/employee referrals/social media" for recruiting. This indicates that the numbers using only employment postings may not capture the complete picture of the IT labor market. Interview respondents report that positions take up to six (6) months to fill.
- The larger employers interviewed including Blue Cross Blue Shield of SC, SCANA, Comporium, Red Ventures, and BlackBaud recruit nationally for their IT positions. With national recruitment, the companies offer nationally competitive compensation packages. While salaries for IT positions vary widely, national recruitment and competition for local talent contributes to the SC technology industry wage average of $81,100 which is more than twice as much as the average private sector wages in SC. (CompTIA 2017 Cyberstates Report SC). Of the smaller IT firms interviewed. 64% cited the inability to be competitive on compensation as the top challenge in filling positions and retaining employees. Interest in employer incentives, like those offered by Louisiana in the Technology Commercialization Credit and Jobs Act, that could provide a nationally competitive IT professional salary rate was significant among all employers interviewed. The Louisiana program provides a 40% refundable tax credit for companies that

Skills employers expect to be most difficult to fill over next 5 years

1. ***Programmers***
2. ***Web Developers***
3. ***Sales/Customer Service Skills***
4. ***Soft Skills***
5. ***Computer Engineers***

IT Workforce Survey Data

invest in the commercialization of Louisiana technology and a 6% payroll rebate for the creation of new, direct jobs.

- The post-secondary and K12 education institutions also reported challenges in recruiting and retaining IT and Computer Science teachers due to salary limitations and high industry demands. Specifically mentioned is the need for qualified instructors for cybersecurity, FTE, and PTE. Although salaries vary according to school districts, the SC Department of Education reports the starting teacher salary averages $32,389 with an overall teacher salary average at $50,751. This is 63% of the average IT salaries and 48% of the average salaries of open positions at $67,821 as reported by Code.org. According to the interview with the SC Department of Education representative, it also is difficult to gain approval for industry professionals to teach IT classes.

Reasons employers expect skills to be difficult to fill over next 5 years

1. ***Competition***
2. ***High wages***
3. ***Small market***
4. ***High demand***
5. ***Need more training***
6. ***Lack of soft skills***

IT Workforce Survey Data

- Both in the surveys and interviews, a number of respondents cited Clemson, the University of SC, and Trident, York and Greenville Tech as good sources of potential candidates and new hires. According to SCWorks.org, however, as of May 2017 the total number of students graduating with degrees in computer science from 71 of 108 degree granting SC institutions offering computer science or IT related programs was 529. This represents an in-state supply of 12%. For a regional comparison, according to the Code.org data for Georgia and North Carolina the in-state supply rate is 8% and 6.9% respectively. This reinforces the importance of factoring in the regional demand on the SC workforce. The lack of supply in all three states shows that the task of meeting information technology demand is a shared problem as states grow their innovation economies in the Southeast United States. Those who successfully implement workforce development strategies and effectively market the quality of life within their communities will have a winning position in the competition for talent.
- Beyond the in-state supply rate there are challenging skills and experience deficits according to the respondents. Twenty-three (23) of the 40 employers interviewed (including the small IT service firms) were significantly more interested in what IT skills potential hires can demonstrate and their non-technical skills rather than their completed degree work.
- Fifty percent (50%) of the interviewed companies cited that recent graduates were not “work ready” and lacked experience. Fifteen (15) of the 40 employers interviewed were seeking mid-career or experienced professionals and would not hire new graduates. The smaller IT service firms reported hiring new graduates particularly from the technical colleges. The smaller firms provide an entry into the industry to gain certifications and experience.

The following are specific immediate current IT workforce needs cited by employers:

- Fourteen of the 40 interviewed companies relayed that many of the university computer science graduates lack the experience, “soft skills” or non-technical work skills, and specific programming language knowledge to be immediately productive employees.
- Larger employers in the I-77 corridor (Midlands from Columbia to Rock Hill) have substantial legacy mainframe computing environments and are constantly trying to maintain their mainframe environment and require Cobol expertise. This is cited as an increasingly critical concern as professionals with these skills are nearing retirement.
- Along the I-77 corridor, .net and Java enterprise software development skills were identified as an important current need.
- Eleven (11) of the 40 employers interviewed were seeking mid-career or experienced professionals and would not hire new graduates whom they perceive as not “work ready”.
- Two (2) of the interviewed employers that are IT services firms raised concerns over the past reliance on foreign, lower cost H1B talent to fill IT talent gaps from both a quality standpoint and with regard to the full expectation of new restrictions on the use of H1B foreign talent.
- Outside of the metro areas, there is a need for IT support services.

- As in healthcare and banking, advanced manufacturing and IT are blending such that the workforce will need more than equipment operators.

Recommendations:

1. *Expand Internship and Apprenticeship programs*

   Respondents identified strong apprenticeship programs as critical in accelerating the workforce development pipeline. BCBSSC, BMW, Denny's, SCANA, Blue Acorn, and MadMonkey were among the companies cited for their use of apprenticeship programs. These programs provide students with an opportunity to build a portfolio that demonstrates application of skills to future employers as well as to develop non-technical workplace skills which are needed to address the issue of entry level employees who are not "work-ready". Generally, apprenticeships and mentoring are extended through larger employers. Identifying opportunities through small IT service companies may address development needs to underserved areas and provide work experience required for professional growth.

2. *Leverage public/private partnerships to maintain access to relevant courses of study, training and certifications in a rapidly changing environment*

   Participants from the SC Department of Education, SC Independent Colleges and Universities, Clemson University and Greenville Tech agreed with the employers that curriculum and training program alignment with workforce needs are important in building the IT workforce pipeline. Mike LeFever, SCICU President, stated that projections of workforce needs would be helpful in shaping the curriculum and integrating IT skills within more traditional Liberal Arts institutions. While program offerings are increasing in the technical colleges some struggle to find qualified instructors particularly in high demand areas like Greenville.

   The State Workforce Development Board funded a number of programs in 2017 including Incumbent Worker Training and EvolveSC which targeted training for employees to increase skills, retool, or gain certifications. Expanding those programs with demonstrated success could provide increased access and assist employers in addressing skills deficits.

Promising Practices

IBM

To address the talent shortage, IBM is creating "new collar" jobs. These roles, primarily in cybersecurity, prioritize skills, knowledge, and willingness to learn over degrees and the initial career fields. The program is designed to capture the identified characteristics of successful cybersecurity professionals: "unbridled curiosity, passion for problem solving, strong ethics, and an understanding of risks." The technical skills are built through on-the-job training, industry certifications, community college courses, and modern vocational and skills education programs.

www.ibm.com/press/us

SC Codes - Greenville

SC Codes Greenville is a 12-week software development training that combines online learning and regular in-person meetings to teach basic computer programming skills. Advanced tracks are available for students to specialize. Students complete assigned online coursework and participate in weekly meetings with volunteer mentors from the Greenville Technology Industry. The goal of SC Codes is to train and mentor potential software developers through a curated experience. SC Codes gives an opportunity to individuals that cannot access this training due to various barriers, including time and financial limitations.

https://sccodes.org

The creation of an IT Workforce Council at the state level including employers, leaders in K12 and post-secondary education, IT program leaders, economic development leaders, and policy makers (Director of IT Education and Innovation from the University or Community College System, Department of Commerce, Department of Education, State Workforce Development Board, Director of Economic Development, Department of Employment and Workforce, etc.) is recommended to provide strategic focus and underscore the importance of addressing the identified gaps. The primary purpose of the Council would be to ensure that the South Carolina workforce has the opportunity for the education and/or training to develop the level of skills needed to meet the growing requirements for IT. Specific strategies and partnership goals may vary according to regional and community needs and opportunities at the local level.

3. Implement strategies to increase enrollment in IT degree programs in technical colleges, colleges and universities with specific targets

   The New York Times cited South Carolina as one of the southern coastal states gaining college graduates with 6,955 students coming to the state to attend college with a relatively low number of students going out of the state to college. For comparison 3,962 students came to NC for college and 3,310 left NC for college in other states based upon 2016 data. The advantage is that the number of young graduates going out of state can be replaced by the number of new out-of-state students coming in to the state. Focusing on incentives with apprenticeships for those pursuing IT related two or four-year degrees as an economic investment may serve to increase the workforce pipeline. Encouraging a minor in computer science or an information technology area for non-technology majors is also an opportunity.

Promising Practices

Apprenticeship Carolina

Apprenticeship Carolina™, a division of the SC Technical College System, works to ensure all employers in South Carolina have access to the information and technical assistance they need to create demand-driven registered apprenticeship programs.

At no cost to the employer, apprenticeship consultants are available to guide companies through the registered apprenticeship development process from initial information to full recognition in the national Registered Apprenticeship System.

www.apprenticeshipcarolina.com

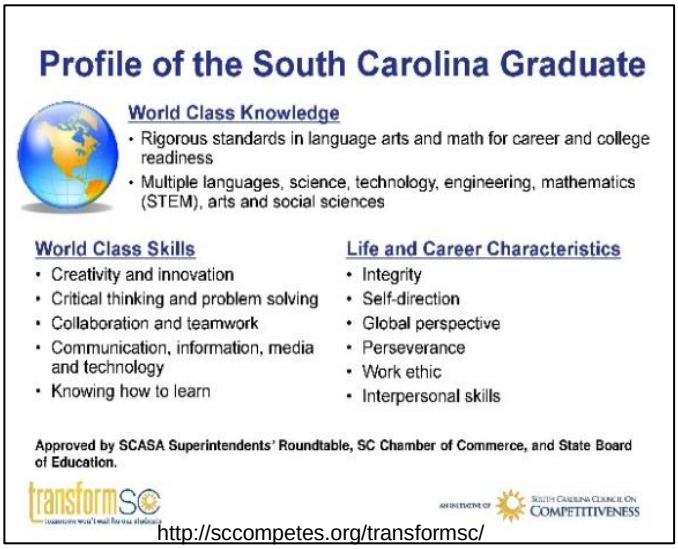
GAP 2: ***The number of students pursuing training, certification and/or degrees in IT will not meet the projected industry needs in SC***

The discussion of the first GAP, ***"Limited supply of trained and experienced workers resulting in vacancies, recruitment of out-of-state talent, or positions outsourced"*** focuses on the immediate needs and the recommendations are designed to accelerate the talent pipeline. GAP 2 responds to the identified future needs; therefore, recommendations are long-term strategies to build a sustainable talent pipeline for a well-trained, highly skilled and work ready IT workforce.

While the PMP short-term projected growth in SC for the period 2016 – 2018 for 18 specific IT occupational positions ranged from -2% (Computer Programmers) to 6.4% (Web Developers) with an overall average increase of 3.6%, the long-term projection through 2024 ranges from -15.9% (Computer Operators) to 27.1% (Web Developers) with an average overall change of 12.11%. While the survey respondents predicted that Computer Programmers will be the most difficult positions to fill, PMP projects an overall 4.1% reduction in those positions. Frost & Sullivan (ISC) project that the global cybersecurity workforce will have more than 1.5 million unfilled positions by 2020 continuing the growing demand. Without significant increases in the number of skilled workers, the gap between demand for workers and the pool of available talent will continue to widen at an accelerated rate.

IT Positions Placement Among Fastest Growing Jobs in SC				
Rank	**Job**	**Growth %**	**Avg Wage**	**Jobs 2024**
3	Computer- Controlled Machine Tool Operators	31.54%	$37,490	4,880
6	Web Developers	26.92%	$58,710	1,320
12	Computer Systems Analyst	23.36%	$74,210	7,500
16	Software Developers, Applications	21.71%	$83,800	3,980
29	Information Security Analysts	19.05%	$71,600	1,250
33	Software Developers, Systems Software	18.35%	$78,530	2,580
43	Computer Users Support Specialists	15.62%	$45,360	7,700
73	Network and Computer Systems Administrators	11.89%	$72,140	4,610
97	Computer Network Support Specialists	9.95%	$55,520	2,320
	www.zippia.com/advice/fastest-growing-jobs-in-south-carolina			
	Department of Labor and Bureau of Labor Statistics			

Interview participants identified K12 as crucial to engaging and exposing the future IT workforce. Respondents applauded the deployment of career academics in K12 but believe that the shortage of teachers who can teach STEM and IT are major challenges. They also expressed concern about the access and exposure to IT education in rural schools. According to TM Floyd President, Terry Floyd, SC needs better success in retaining experienced talent in SC rather than having to attract people to SC. He stressed the importance of developing a sustainable pipeline.



http://sccompetes.org/transformsc/

The South Carolina Department of Education (SCDE) has defined the profile of the South Carolina Graduate: World Class Knowledge, World Class Skills and Life and Career Characteristics. Each of the areas refers to the qualities of ideal candidates described by the participants in IT Workforce Survey and the interviews and reflected in this report. Technology is specifically identified as an area within World Class Knowledge. In 2017, standards for computer science were approved.

Although research supports the assertions by those interviewed that students with more consistent and early exposure to computer technology are more confident in learning computer science as well as other subjects and are more likely to choose computer science careers, there are mixed opinions on the prioritizing of computer science in schools. According to a 2015 national Gallup study, 90% of parents surveyed believe that teaching computer science is a good use of school resources and 80% of students expect to learn about computer science at some point in their progression through school. Only 25% of principals said that their schools offer computer science coding or programming classes. The challenges cited were lack of time in the schedule due to standard testing requirements and the lack of funding for computer science teachers and technology implementation and maintenance including hardware and software.

"Computer science is a liberal art. It's something that everybody should be exposed to and everyone should have a mastery of to some extent."

Steve Jobs

The eighth grade has been identified as the critical time when a student embraces or rejects the possibility of a career in computer science. Although working in IT has become more "cool", parental attitudes, peer attitudes, and self-perception continue to play a dominant role in the decision. (http:/news.gallup.com/poll/184637/parents-students-computer-science-education-school)

According to the SC Joint Task Force on Computer Science and Information Technology presented in 2016, "as in other states, the opportunity for students in South Carolina to take a computer science course appears to be severely limited, with female students, students in poverty, and African-American and Hispanic students, disproportionately underrepresented in the courses that are offered." This finding also is consistent with the interview data in which participants cited that attracting qualified women and minorities is a challenge.

Ted Pitts, SC Chamber of Commerce President, stated that there is a real need to develop, attract and retain skilled talent in order for SC to be competitive as a state. Rebecca Hartley and David Clayton with Clemson University Center for Workforce Development suggested that a focus on two-year technologist and support tech is needed to develop that talent. Peggy Anderson, VP of Global Talent Acquisition at BlackBaud agrees that Tech colleges may be the key. York, Greenville and Trident Tech were cited as having strong IT programs by interview participants. Building the pipeline to these programs begins in K12.

From the research, the following points emerged relative to training and the IT workforce:

- Tactical educational programs offered by technical colleges and workforce development agencies such as SC Codes have begun to address the need for shorter cycle IT skills training but the focus on language is minimal.
- South Carolina's two-year technical institutes are beginning to respond to IT talent demands in a similar fashion to the focus that has been given to automotive, advanced manufacturing but the need still exceeds the supply.

- Expanding career academies in K12 focused on information technology is seen as an opportunity but attracting and retaining skilled teachers is an ongoing challenge.
- Of the 108 degree-granting institutions of higher education in South Carolina, 77 Computer Science or IT-related programs were identified (See Appendix C). Tactical and flexible, non-degree programs like SC Codes, can provide the skills training to meet the immediate demand for talent.
- During the course of the qualitative interviews, it was clear that not all large employers were looking to maintain IT talent staffing in aggregate by replacing those that are retiring, etc., but are not actively increasing IT workforce numbers. Boeing's workforce in Charleston was a specific example of this point.
- Emerging, growth-stage ventures and startups are actively looking to add IT talent. This further reinforces that Kauffman and SBA assertions on job creation.

Recommendations

1. Endorse the implementation of the recommendations of the Joint Task Force on Computer Science and Information Technology.

   While training programs can be leveraged to target near term workforce supply needs, it is important that South Carolina also take a long-term approach to developing an IT workforce for the future. A long-term approach that is systemic and sustainable must focus on education. It is critical to engage students at an early age to generate awareness and excitement, develop fundamental skills (critical thinking, problem solving, creativity, science, math, engineering, and communication) to enable success, and provide academic pathways that lead to meaningful careers. It is critical to create students that are both willing and able to enter the IT workforce upon graduation – whether that is right out of high school or an institution of higher education.

   A critical component of developing a future IT workforce is focusing on teacher professional development. Teachers are the key to systemic and sustainable change. A single teacher's influence has a multiplier effect. He/she engages classrooms of students each year that he/she remains in the classroom. To better support teachers, IT related curricula and programs

PROMISING PRACTICES

SC Department of Education and the Education Oversight Committee formed a Joint Task Force on Computer Science and Information Technology

The Task force identified specific and comprehensive strategies to implement a Computer Science Initiative with clear pathways in grades 9 – 12 to Computing and Information Technology careers.

www.eoc.sc.gov/reports

South Carolina Palmetto Program- Rural County Schools Digital Teaching and Learning Initiative

During the 2016 – 17 school year Learning.com provided EasyTech and Inquiry digital literacy curriculum (including Foundations of Coding and EasyCode lessons), 5th grade 21st Century Skills student digital literacy inventory, Wayfind teacher digital literacy skills inventory, and teacher training and support to 33 schools with the goal of building a pipeline of elementary and middle school students who are prepared to engage in content leading to industry computer and technology certifications.

www.learning.com/press-releases

should also map to state and national standards and 'embed' in the everyday classroom. This approach will increase adoption rates as it reduces the 'barriers to entry' for the teacher, who is already overburdened with testing, standards, and regulations.

Over 20 states have passed legislation, enacted policies or taken steps to create an educational environment in which teaching computational thinking and coding in schools is more accepted. While SC has adopted standards for K8, computer science is not taught in all schools nor is it considered a core course for graduation. (Learning.com) According to Code.org, thirty-two schools (11%) offered the AP Exam in Computer Science. The South Carolina Department of Education (SCDE) and the Education Oversight Committee (EOC) convened a joint task force on computer science and information technology. The key findings reported by the Task Force were:

- National and state data demonstrate a high demand for and significant job growth over the next decade in computer science, information technology, and related fields including cybersecurity.
- As in other states, the opportunity for students in South Carolina to take a computer science course appears to be severely limited, with female students, students in poverty, and African-American and Hispanic students disproportionately underrepresented in the courses that are offered.
- Also, as in other states, South Carolina has few postsecondary teacher preparation programs in computer science and few opportunities for teachers to acquire computer science content knowledge and pedagogical skills.
- As in other states, South Carolina's citizens are limited in their awareness of career opportunities in computer science and the importance of computer science education.
- The SCDE is taking action to expand access to computer science education.

71% of new STEM jobs are in computing yet only 8% of STEM graduates are in computer science. Students who take computer science in high school are 6 times more likely to major in computer science in college and women are 10 times more likely.

www.code.org

Based on these findings, the Task Force presented the following recommendations for action by the South Carolina Department of Education and key agents in the public and private sector.

1. The SCDE, with the assistance of Task Force members, should develop and implement a Computer Science Initiative including a broad reaching communication plan.
2. The SCDE should create clear pathways in grades 9–12 to computing and information technology (IT) careers.
3. The SCDE and State Board of Education should approve computer science as a recognized field of teacher certification.
4. The SCDE, with the assistance of Task Force members, should identify measures of successes and challenges in expanding opportunities for all students to access computer science education.
5. South Carolina should offer a variety of learning opportunities for students, educators, and parents based on the new K8 computer science standards.

In its recommendations, the Joint Task Force proposes strategies to equip educators to teach digital literacy, computational thinking, and computer science, and to increase student enrollments in and completion of computing courses such that the computational skills of all students, as defined in the *Profile of the South Carolina Graduate*, and interest in and pursuit of computer science and information technology careers are significantly increased.

By the Numbers
2016 Computing Workforce

26%
Women

3%
African-American women

5%
Asian women

2%
Hispanic women

www.ncwit.org

2. Leverage public/private partnerships to maintain access to relevant courses of study, training and certifications in a rapidly changing environment

Many employers are finding that non-IT degrees can translate with training into IT career positions and often bring the needed business and management skills that can be missing in the training for the technical IT degrees. Study participants identified filling positions in IT management as a concern with one participant company projecting that 40% are eligible for retirement in five (5) years.

3. Increase awareness in K12 and post-secondary students of the job opportunities available in IT

According to STEM Premier CEO, Casey Welch, with an awareness of potential job opportunities, students can take the necessary course and earn appropriate certifications. Participating in a program like STEM Premier also can be a catalyst to engage parents/guardians in the career planning process.

Partnerships with local companies to provide speakers to introduce IT careers across multiple levels in conjunction with the mentoring suggested in the recommendations for GAP 1 also would increase exposure to and encouragement for students to consider IT careers.

GAP 3*: Women and minorities, particularly African-Americans and Hispanics, are underrepresented in the national and South Carolina IT workforce*

Based upon an abundance of available research data, implementing strategies to increase and retain women and minorities particularly African-Americans and Hispanics offers a significant opportunity to increase the pipeline for the IT workforce nationally and in SC. Of the 529 Computer Science graduates from SC degree programs in 2015, 25% were females. As discussed earlier, the decision not to pursue IT careers, begins in K12. Of the 374 SC high school students taking the AP Computer Science Exam in 2016, only 19% were female. The numbers for minorities are even fewer with 27 African-American students and 12 Hispanic or Latino students.

In 2014 Google conducted a study to identify and understand the factors that influence young women's decisions to pursue degrees in Computer Science. The study identified encouragement and exposure as the leading factors in influencing this choice. Moreover, 60.5% of the influencing factors are associated with pre-college experiences. The interdependence of associated requirements and course work once students enter college are so tightly integrated that change is difficult. The top four influencing identified factors are:

1. Social Encouragement: Positive reinforcement of Computer Science pursuits from family and peers (not a nerd).

Word Associations for Students Unfamiliar with CS

Boring
Technology
Hard
Difficult
Computers
Interesting
Math
Nerd(y)
Technical
Challenging
Future
Internet
Fun
Geek
Smart
Complicated
Science

https://staticgoogleusercontent.com/media/edu.google.com/en/pdfs/women-who-choose-what/really.pdf

By the Numbers
African-American
2016 Computing Workforce

1%
Technical workers at Google, Microsoft, Facebook, Twitter

6%
Computer science/engineering graduates with BS or Advanced degrees

www.nytimes.com/2016/02/26/upshot/dont-blame-recruiting-pipeline-for-lack-of-diversity-in tech-jobs

2. Self-Perception: An interest in puzzles and problem solving and a belief that those skills can be translated to a successful career (smart enough).
3. Academic Exposure: The availability of and opportunity to participate in structured (e.g., grades studies) and unstructured (e.g., after-school programs) Computer Science coursework.
4. Career Perception: The familiarity with and perception of Computer Science as a career with diverse applications and broad potential for positive societal impact.

The study also found that the other factors of ethnicity, family income, parental occupations, and objectively measured proficiency is significantly less controlling for having familial and peer encouragement and a positive self-perception of the student's own proficiency. (Women Who Choose Computer Science- What Really Matters, Google 2014)

In the **US News & World Report** article, **African-American Men: The Other STEM Minority**, Allie Bidwell states that African-American males as a proportion of all science and engineering Bachelor's degree recipients remained relatively unchanged from 6.1% in 2002 and at 6.2% in 2012. (May 7, 2015) In 2015 higher education administrators, students and industry professionals gathered in Washington, D.C., to speak to Congressional staffers and representatives about the need to attract more African-American men to STEM. (African-American Men: The Other STEM Minority, US News and World Report, May 2015). As with females and other minority groups, the solutions are complicated, but the needs are similar- support and encouragement from family and peers, a perception that an IT career is possible, all coupled with exposure and opportunity during the critical K12 years.

Recommendations

1. Endorse the implementation of the SC Joint Task Force on Computer Science and Information Technology (See Gap 2, Recommendation 1)

   Ensure a balance of Computer Science coursework opportunities with workshops and clubs designed for exposing students to possible careers and developing self-confidence.

Promising Practices

⭐ SCANA's Program for Diversity and Inclusion

The CEO Action for Diversity & Inclusion™ aims to rally the business community to advance diversity and inclusion within the workplace by working collectively across organizations and sectors. It outlines a specific set of actions to cultivate a trusting environment where all ideas are welcomed and employees feel comfortable and empowered to discuss diversity and inclusion.

www.scana.com

⭐ Riley Institute at Furman

DLI class members are identified through a rigorous process including a nomination, application and interview. Individuals are selected to join the class based on their capacity to impact their organizations and communities. Over the course of five months, participants will learn about diversity and inclusion "blind spots" and how to suspend assumptions. Participants will also work in small, cross-sector groups to respond to real issues and opportunities in their communities through service projects.

https://riley.furman.edu/diversity

Coursework is often determined by a student's academic achievement and/or assessed capabilities. Beginning in middle school students self-select based either on interests or self-perception. Implementation of strategies of outreach for inclusion is recommended with programs in K8.

2. Rebrand computer science and IT courses

   Providers outside of the K12 and post-secondary school setting have become creative in branding their programs in order to attract a diverse group of participants. Girls Who Code and SciGirls are two examples.

   Colleges have had similar success with rebranding. Harvey Mudd's introductory computer class, "Green", as a judgment free class became among the school's most popular. Whereas female enrollment was at 10%, the number of women computer science majors now ranges between 40% and 50%.

Promising Practices

100 Girls of Code

With programs in Charleston, Columbia and Greenville, the mission of 100 Girls of Code is to achieve gender parity in STEM fields by introducing more young women to code and computer engineering at a young age. We seek to inspire young girls to pursue a future in STEM by providing young women an opportunity to create and gain confidence in what they create.

www.**100girlsofcode**.com/**columbia**

   Concerned about the low ratio of women to study computer science relative to the high career potential, Jane Margolis, an education researcher at UCLA began a four-year study of Carnegie Mellon in 1994. Seven percent of computer science majors were women at that time. "It was not a question of capacity or ability" Margolis says. "It was a question of women feeling that they weren't welcome or that their existence was suspect."

   To address the concerns, Carnegie Mellon instituted a series of reforms including the creation of a women's computer club to provide networking and support for the students. The school also increased requirements for admission to the computer science major. The requirements continued to maintain proficiency in math and science but applicants also had to show they had leadership qualities. The ratio of female enrollment increased to more than 40%. (NPR All Tech Considered, August 2017)

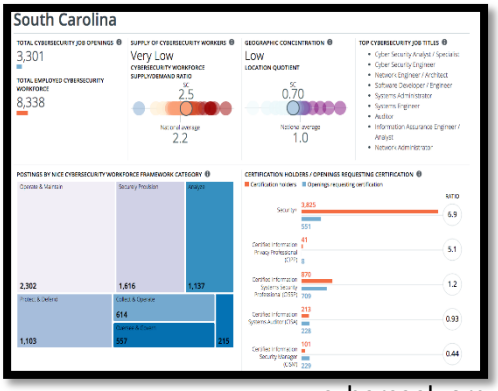
   The success with the Carnegie program underscores the importance of creating strong support networks and mentors for women and minorities entering the field.

3. Consider and proactively address access and language barriers for low income and English as a second language (ESL) students and families

   Rural and low-income students may have less access to technology than more urban and affluent students. Although SC is one of the states in which all schools are connected, broadband coverage varies among cities and counties in the state from 100% in West Columbia to 60.9% in Seneca. (Appendix B)

GAP 4: ***The demand for cybersecurity professionals is rapidly accelerating at three times the rate of IT jobs in general. A concentration of demand was noted for employers in the SC metro areas and the I-77 corridor particularly for companies that provide security services.***

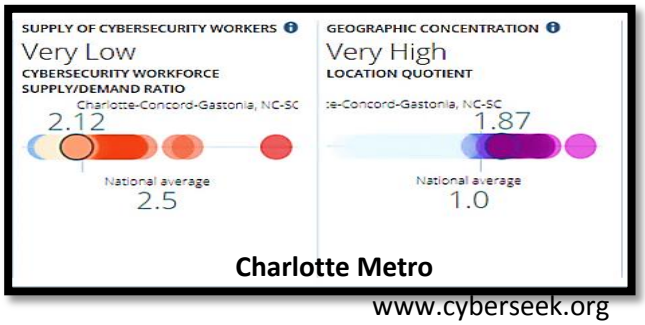
CyberSeek.org reported 3,301 cybersecurity positions open in SC in June 2017. Of the representatives from the small IT services firms; cybersecurity was cited by 64% as the service most in demand. The following points offer additional insight into this growing demand:



www.cyberseek.org

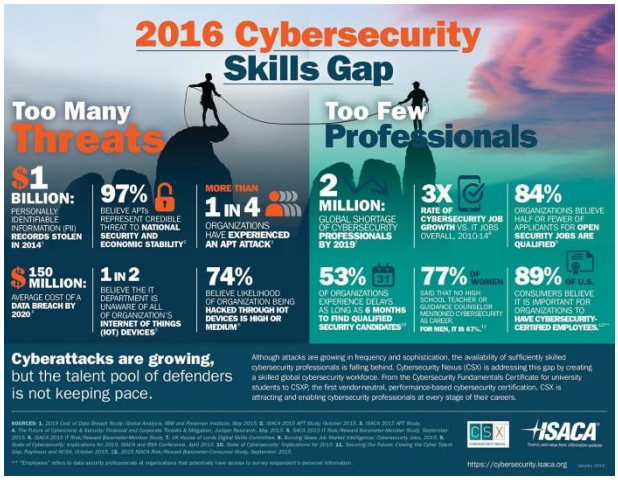
- A Burning Glass Cybersecurity Jobs Report (see http://burning-glass.com/) highlighted the reason for separate discussion of job growth in this sector. The report indicated cybersecurity positions are increasing at three times the rate of information technology jobs in general, take longer to fill, and are commanding higher salaries per position on average. According to the report the need for cybersecurity talent crosses all industry sectors.

- An important consideration in calculating the demand for cybersecurity talent in SC is that substantial demand exists in the Charlotte metro area that includes York, Chester, and Lancaster counties from SC. Also, the growing cybersecurity presence in Georgia represents an additional competition for local talent.



www.cyberseek.org

Although the jobs data and industry projections clearly point to the critical shortage of cybersecurity professionals, the employer respondents cited the importance of cybersecurity professionals but they did not identify cybersecurity as a skill in the list of projected positions that will be difficult to hire over the next five (5) years except in the case of those who are involved directly in providing those services to other firms. This indicates that most see this as an outsourced service separate from operational IT positions.



www.isaca.org

Recommendations

1. Build awareness of the needs and opportunities for potential cybersecurity professionals.

   Based upon the IBM model this area is a "career crossover opportunity" for those with the "curiosity, passion for problem solving, strong ethics, and an understanding of risks." The increase in awareness with constant renewal also is important for education and training sources.

2. Initiate the recommendations for Gaps 1 and 2 to develop a pipeline of cybersecurity professionals.

   Although apprenticeships may be difficult in this area due to security and associated risk, mentoring programs may work well to encourage interest.

Promising Practices

★ SC Cyber

SC Cyber is a statewide initiative, based at the University of SC and with partners across all levels of academia, industry, and government, with a mission to develop the talent, techniques, and tools to defend critical, connected infrastructure within South Carolina and the United States. In support of this mission, SC Cyber offers programs for training and workforce development, education, advanced technology development and commercialization, and critical infrastructure protection..

www.sccyber.org

GAP 5: ***In addition to technical skills and experience, employers are seeking stronger non-IT specific "soft skills", i.e., interpersonal skills, internal and external customer service, critical thinking and problem solving, professionalism, and business acumen***

A recurring theme in every employer interview concerned the importance of soft skills in new hires and the impact that deficiency creates in team productivity. These skills were viewed as at least equally important to the technical skills and in some cases more important. Increasingly employers are adding assessments for these "soft skills" to the pre-employment screening process. According to the interview participants, employers are looking for problem solvers who can sell ideas, work in teams, communicate, are willing to document, and who can test with discipline. For the computing services providers, the ability to understand the business model and embrace the importance of customer service is critical. To the interviewed employers, these skills are critical and missing in new graduates. This deficit contributes to the employer assessment that the candidate is not job ready.

National Research supports the trend found among the survey and interview data:

"The two words information *and* communication *are often used interchangeably, but they signify quite different things. Information is giving out; communication is getting through."*
Sydney Harris
Cartoonist- Math Science, Technology

www.brainyquote.com

- Work ethic continues to be the most important trait for employee success in most managers' views. Prestigious schooling and/or degrees is the least important consideration in the hiring process. (Instructure, Workforce Readiness Survey, 2015)

- Personal and cultural alignment, not skillsets, are the most important factors in a talent search. Flexibility, creativity, drive and value-based decision-making matter more when it comes to producing high-quality work. (Hyper Island, Talent Trend Report 2011)
- Management, leadership and mentorship are the most important skills for employees to have in the coming years. (Udemy for Business, "The State of Corporate Training Programs in America" 2015)

According to Davis Bell, Vice President of Corporate Markets at Instructure, "The hard skills required for a company's success are ever-changing, while the most critical soft skills remain constant."

Recommendations

1. Incorporate coursework to enhance non-technical, soft skills as part of the technology degree curriculum as well as career development programs. In a recent blog on the IBM jobs site, IBM captured what they seek in candidates:
    - Creative Problem Solving
    - Adaptability
    - Customer Insight
    - Career Aspiration / Motivation / Drive to Achieve
    - Taking Ownership
    - Teamwork/Collaboration
    - Leadership
    - Actions
    - Results

    (Source: https://blog.ibm.jobs/)

2. Include attention to the non-technical "soft skills" in mentoring programs (See Gap 1, Recommendation 1)

Promising Practices

IT-oLogy/Furman University's Career Development Workshops

Through a partnership with Furman University, IT-oLogy offers courses that engage professionals in Career Development workshops with a focus around soft skills specific to the IT industry. Participants will learn the mindsets, skillsets, and technology toolsets to execute with excellence. These workshops are ideal for managers, project managers, technicians, programmers, developers, analysts and those looking to pursue a career in IT. Soft skills are foundational to creating strong employees, teams, leaders, and organizations.

www.it-ology.org

GAP 6: *A shared, consistent, statewide culture for innovation and entrepreneurship is needed to support technological advancement and economic growth throughout SC*

According to Cyberstates data, SC ranks second in the growth of technology establishments. There are strong pockets of dynamic, innovative entrepreneurial activity. Important considerations relative to this research are:

- Although Charleston is recognized for building a vibrant innovation and entrepreneurship base, employers continue to face obstacles in attracting the desired level of talent from national sources. Salaries have not risen at the accelerated rising rate of the cost of living.

- In Charleston, many of the smaller tech employers point to the lack of safe and reliable public transportation as an issue. A 2014 study by the Global Strategy Group, funded by the Rockefeller Foundation provides valuable insight into the real issue of transportation. The research found that millennials think it is important for their city to offer opportunities to live and work without relying on a car (86 percent agree in mature cities, 82 percent in growing cities, and 77 percent in aspiring cities). According to Michael Myers, a managing director at The Rockefeller Foundation, "Young people are the key to advancing innovation and economic competitiveness in our urban areas, and this survey reinforces that cities that don't invest in effective transportation options stand to lose out in the long-run. As we move from a car-centric model of mobility to a nation that embraces more equitable and sustainable transportation options, millennials are leading the way."
- Larger employers are able to recruit nationally and are having significant success as Charleston is now viewed as a more favorable destination for millennial professionals than popular locations such as Nashville, Tennessee.
- Data suggests that a majority of the startup and growing venture leaders are unprepared to attract, develop, and retain key technology talent.
- With the presence of several key attributes (state capital, centrally located within the state, a major university, vibrant downtown, etc.) that Columbia offers the innovation and entrepreneurial development would be more robust. The current pace of innovation and entrepreneurial event and program activity lags behind Greenville and Charleston within the state.

Promising Practices

★ Clemson Deep Orange Partnership

Clemson University partners with car companies for the Deep Orange Project, an innovation partnership. The 2017 – 2018 partnership is sponsored by Toyota Technical Center. As part of their curriculum, students build a concept car over a two year period doing the same work as if they were working for a car company.

http://cuicardeeporange.com

★ SCRA

SCRA fosters the growth of SC's Innovation Economy by supporting entrepreneurs, enabling academic research and commercialization, and connecting industry to innovators.

https://www.scra.org

★ NEXT

NEXT attracts and grows high-impact, knowledge-based companies by developing an entrepreneurial ecosystem and connecting entrepreneurs to it. NEXT is a program of the Greenville Chamber and currently supports over 100 knowledge-based companies in Upstate South Carolina.

https://nextsc.org/

What makes a SmartState smart?

It happens when great minds come together to dream bigger, work together, and invest in ways that make our world better.

www.sccommerce.com

In 2002 the SC General Assembly established SmartState as a visionary program that could be a catalyst to move the state's economy into a more prosperous future. The SmartState Program brings research universities together with businesses in search of innovation, collaboration, and talented, well-prepared employees. Since inception, the program has generated $2.4 billion in economic activity and created 12,000+ jobs. This program appears to be a strong platform to continue to promote entrepreneurship and innovation in the State.

The Workforce Development Director at Clemson University cited the private partnerships to support innovation in Advanced Manufacturing and Robotics and the Walt Family Innovation Center. The Vice President of SCRA, a supporter of the Walt Family Innovation Center, noted that through the University of SC's Office of Economic Engagement in conjunction with the McNair Center the university is moving toward a more engaged approach to innovation and entrepreneurship.

In order to be competitive in attracting and retaining the best candidates, companies are recognizing that while they are looking for culture fit, the candidates are looking for culture and preferred work environments as well. This means employers are rethinking how they manage the workforce and looking for innovative strategies to stand out among the competition and create loyalty. Red Ventures described their culture and campus as a "hip" environment in which employees are empowered, have autonomy and enjoy amenities like basketball and bowling on-site. As a result, turnover is low and they are experiencing 25% growth per year.

Promising Practices

★ Charleston Digital Corridor

The Charleston Digital Corridor is a community-sourced initiative to attract, nurture and promote the regions tech economy through an array of impactful programs, products and events while leveraging Charleston's renowned livability. The CDC is focused on creating the business, education and social environment that is attractive to tech and tech-related companies. Then, the CDC leverages its carefully nurtured relationships, program elements, legislative access, and contacts, to assist companies with integrating them into community.

The debate may continue but the number of telecommuters for example is growing particularly in the IT world. The millennials tend to increase churn. A 2016 Gallup poll concluded that millennials (those born between born between 1980 and 1996) "are the 'job-hopping generation'." They also comprise the generation who value work/life balance and want to know that what they do makes a difference in the world.
Both for communities and organizations, building a culture of innovation and entrepreneurial spirit means embracing change and risk because the future is not always clear.

Recommendations

1. Continue to build upon the momentum of the SmartState initiative and the progress in the key metro areas of Charleston, Greenville and Columbia expanding to support growth of new IT service firms in underserved areas of the state.

   There are many programs and initiatives producing positive results within the state. Harnessing and aligning those efforts in an intentional process could create the synergy required to accelerate progress.

   Appendix C includes Princeton's compiled list of key performance measurements of some of the top-rated collegiate innovation and entrepreneurship programs in the country. The US Small Business Administration and Kauffman Foundation studies have shown that up to 85% of all net new job creation over the past 20 years has come from startups. Information technology jobs are a significant component of this trend. University systems are typically an integral component of the best regions.

CONCLUSION

This research and recommendations provide a platform for discussion and identify areas for further attention. An intentional, collaborative effort with key stakeholders from across industry, government and education could leverage the collective assets and resources of all stakeholders and provide the necessary vision and structure to measure and sustain progress.

In order for South Carolina to assume a leadership role in the information technology economy, key stakeholders from across the State must join together with a laser commitment to address South Carolina's IT talent gap. The development of a sustainable, skilled information technology talent pipeline is critical to positioning South Carolina as a leader in the information economy.

The State has resources and programs producing promising results. Leveraging those resources will place South Carolina as one of the top knowledge-based economies in the Southeast United States as measured by information technology job growth. The vitality of the information talent pipeline and retention of information technology talent is key. Both short-term and long-term strategies are needed. Leveraging and aligning current programs and strategies can accelerate the immediate talent pipeline. Long-term strategies require an integrated, state-wide, intentional focus and commitment of resources in the ever-evolving environment of information technology.