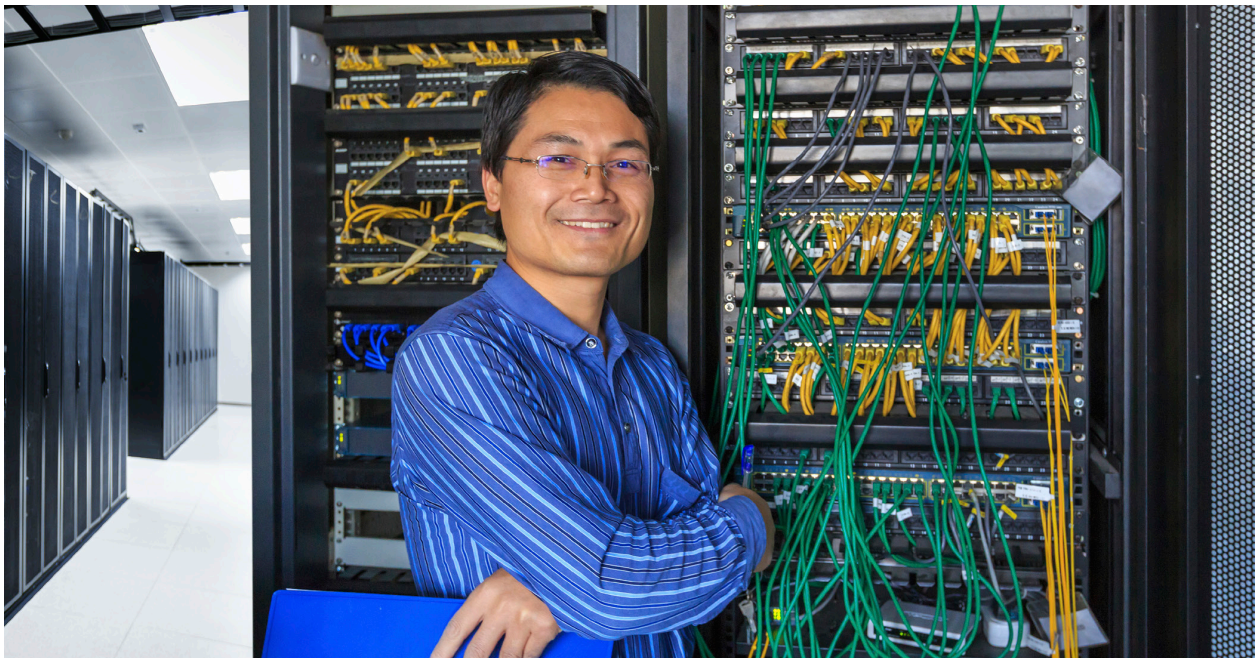
THE NEW HAMPSHIRE TECHNOLOGY TALENT PARTNERSHIP

Asset Map and Recommendations: December 2016



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Jobs for the Future researched and wrote the report. The work included writing by Deborah Kobes; additional research, analysis, and editing by Thomas Hooper, Sara Lamback, and Patricia Maguire; editing by Nomi Sofer; and research and logistical support by Jessica Toglia.

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NH Works promotes life-long learning by partnering with businesses, agencies, and organizations to bring the state's education, employment and training programs together into a workforce development system that will provide the means for residents of New Hampshire to gain sufficient skills, education, employment and financial independence.
www.nhworks.org

JOBS FOR THE FUTURE

Jobs for the Future (JFF) is a national nonprofit that builds educational and economic opportunity for underserved populations in the United States. We develop innovative career and educational programs and public policies that increase college readiness and career success, and build a more highly skilled workforce. With over 30 years of experience, JFF is the national leader in bridging education and work to increase economic mobility and strengthen our economy.
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PREFACE

This report is part of the New Hampshire Sector Partnerships Initiative (NH SPI), which is an industry-driven, statewide initiative to help businesses in targeted industries address their workforce needs, while also helping workers prepare for and advance in careers in these critical sectors. This initiative is initially focusing on four industries: **manufacturing, hospitality, health care,** and **technology**. These growing and in-demand sectors were selected based upon in-depth discussions with New Hampshire stakeholders regarding high-leverage sectoral opportunities in the state as well as an initial labor market analysis that examined each industry's importance to the New Hampshire economy, its concentration in New Hampshire relative to the country, and the number of middle-skill jobs available in the state that require more than a high-school diploma but less than a four-year degree.

NH SPI is funded through a U.S. Department of Labor Sector Partnership National Emergency Grant targeted to assist states in the transition to a Workforce Innovation and Opportunity Act sector partnership approach to workforce development. In New Hampshire, the WIOA service delivery system is managed through a consortium approach known as NH Works.

The NH WORKS system consists of the following partner agencies:

- Office of Workforce Opportunity;
- New Hampshire Employment Security;
- New Hampshire Department of Education;
- New Hampshire Vocational Rehabilitation;
- New Hampshire Economic Development;
- Community Action Agencies of New Hampshire;
- Community College System of New Hampshire; and
- New Hampshire Department of Health and Human Services.

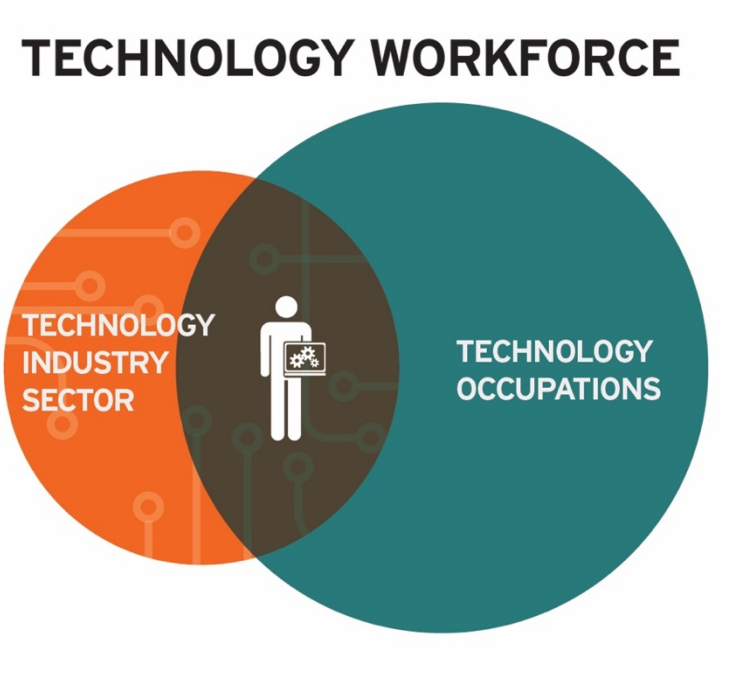
The goal of NH SPI is to assist New Hampshire in connecting the various existing initiatives and build seamless education, career readiness, and training pathways that result in sector strategies that work for all individuals, and to create a well-educated populace and a highly-skilled, strong workforce for the region.

NH SPI has contracted with Jobs for the Future to provide a suite of services to support the success of sector partnerships in New Hampshire, which include labor market analyses, asset mapping, workforce planning, and sector launch events. JFF works nationally to design and scale creative education and workforce strategies that respond to labor market demands.

For this report, JFF collected information from a range of stakeholders to determine asset strengths, challenges, and opportunities to be considered by the state team and manufacturing sector partnership in building, strengthening, and coordinating the education and training pipeline through a sector-driven approach for the manufacturing industry. This report includes recommendations that the state team and sector partnership can use as a starting point for planning and action. JFF will work closely with the state and a team of local leaders with the motivation and "muscle" needed to help them develop and implement a sector partnership action plan.

STATE OF THE SECTOR

Technology is not a traditional sector like manufacturing, health care, or hospitality, in which businesses are jointly classified by their common activities or services. Instead, the technology workforce includes both that traditional type of industry sector and an occupational cluster[1] that is found in virtually every other sector (see Appendix 1 for detail). Given the workforce's common skill needs, it is valuable for talent development efforts to consider these two parts of the technology workforce together. Technology occupations contribute significantly to New Hampshire's economy, accounting for approximately 26,793 workers.[2] If the technology workforce were measured as a traditional sector, it would be among New Hampshire's top 10 industries and around the same size as construction.[3]



> Throughout the report, references to the industry or sector describe *businesses*, while descriptions of occupations (e.g., computer programmer) describe *workers.* Except where noted, this report's analysis is based on the occupations found both within technology businesses and other sectors in order to provide the comprehensive analysis of technology skills needed within the state's workforce. These occupations broadly align with those used by the New Hampshire High Tech Council, New Hampshire Economic and Labor Market Information Bureau, and Burning Glass Technologies' Labor Insight, with differences noted in Appendix 1.

Overall, the density of technology jobs across most of the state is slightly lower than the average national per capita concentration of technology jobs. However, Hillsborough County's concentration is 30 percent higher than that of the nation.[4] In

[1] Advance CTE, National Career Clusters Framework. https://www.careertech.org/career-clusters

[2] CTE, National Career Clusters Framework. https://www.careertech.org/career-clusters
Employment in 2015. Emsi Analyst. 2016.3 data series. Extracted by Sara Lamback.

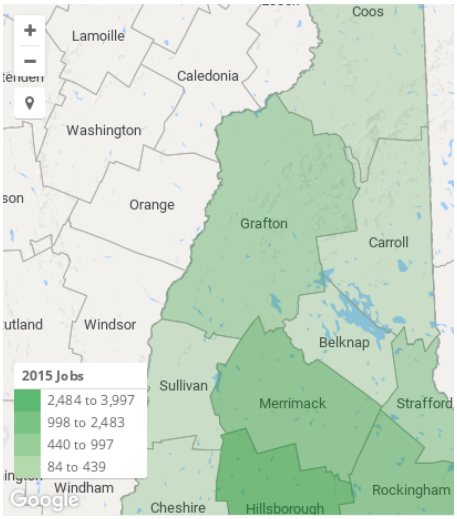
[3] Based on Emsi Analyst analysis of 2-digit NAICS codes.

[4] Hillsborough's "location quotient" is 1.3. The location quotient is the per capita concentration of an industry or occupation in a region as compared with the national average. A value above 1 indicates an above average

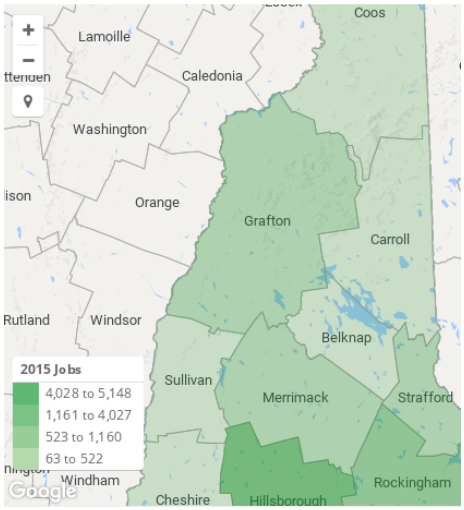
addition, technology occupations are projected to grow 11.6 percent from 2015 to 2021, at pace with nationwide growth projections of 10.8 percent.[5] Technology employers have noted an increasingly dynamic technology network in the state, with southern New Hampshire and the Seacoast region serving as a growing technology hub. These technology occupations are significant to New Hampshire not only because they are expected to remain strong in the coming years, but also because they pay well: median hourly earnings across these occupations is $37.08[6], well above the state's living wage of $21.69 for a family of four.[7]

Technology Occupational Clusters

FIGURE 1. TECHNOLOGY JOB DENSITY IN NEW HAMPSHIRE[8]



Networking and Professional Services



Software Developers and Programming

Technology workers fulfill many of the same responsibilities no matter who their employer. Technology workers can be grouped into two families of occupations: 1) software and app development or programming; and 2) networking and professional services (Table 1). These two occupational clusters differ along a variety of dimensions, including the education and skills they require and potential career pathways. Both occupational clusters are concentrated in the counties of Hillsborough, Rockingham, and Merrimack (Figure 1).[9] These counties represent 40

concentration. The industries highly concentrated in an area are usually critical to the health of its economy and serve as a guide to understanding what makes that area's labor market unique.

[5] Emsi Analyst. 2016.3 data series. Extracted by Sara Lamback.

[6] Emsi Analyst. 2016.3 data series. Extracted by Sara Lamback.

[7] Glasmeier, Amy K. MIT Living Wage Calculator. 2016. Data is for a family of two adults (one of whom is working) and two children. access from: http://livingwage.mit.edu/states/33

[8] Emsi Analyst. 2016.3 data series. Extracted by Sara Lamback.

[9] Emsi Analyst. 2016.3 data series. Extracted by Sara Lamback.

percent, 9 percent, and 8 percent of software developers, respectively. Similarly, the counties account for 36 percent, 22 percent, and 10 percent of networking jobs, respectively.[10]

TABLE 1. TECHNOLOGY OCCUPATIONAL CLUSTERS[11]

Networking and IT Professional Services

SOC	Description	2015 Jobs	2015 - 2020 % Change	Median Hourly Earnings
15-1151	Computer User Support Specialists	2,756	10%	$25.42
15-1121	Computer Systems Analysts	2,322	18%	$37.18
15-1142	Network and Computer Systems Administrators	1,928	8%	$35.55
11-3021	Computer and Information Systems Managers	1,887	11%	$58.07
15-1152	Computer Network Support Specialists	625	10%	$28.46
15-1143	Computer Network Architects	469	11%	$40.96
17-2061	Computer Hardware Engineers	346	4%	$55.47
15-1122	Information Security Analysts	345	17%	$45.54
43-9011	Computer Operators	296	(5%)	$21.17

Software and App Programming/Development

SOC	Description	2015 Jobs	2015 - 2020 % Change	Median Hourly Earnings
15-1132	Software Developers, Applications	4,822	13%	$44.42
15-1131	Computer Programmers	2,034	1%	$33.04
15-1133	Software Developers, Systems Software	1,559	13%	$56.34
27-1024	Graphic Designers	1,384	10%	$20.44
11-9041	Architectural and Engineering Managers	1,144	0%	$61.60
15-1134	Web Developers	881	22%	$24.38
15-1141	Database Administrators	476	11%	$39.31
15-1111	Computer and Information Research Scientists	181	11%	$66.21
27-1014	Multimedia Artists and Animators	158	8%	$19.74
51-4012	Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic	127	6%	$27.73

Software Development and Programming. As the larger of the two technology occupational clusters, software and application programming and development accounted for 13,080 workers and 4,888 job postings in 2015.[12] The occupation with the most workers within this cluster is software developers, at 4,822 (Table 2). Other top occupations, employing a half to a quarter as many workers, include computer programmers, graphic designers, systems software

[10] Ibid.
[11] Emsi Analyst. 2016.3 data series. Extracted by Sara Lamback.
[12] Emsi Analyst. 2016.3 data series and Burning Glass Technologies' Labor Insight. Job posting data is for full year of 2015 in the state of New Hampshire for occupations within the software development and programming. Extracted by Sara Lamback. Note: 511 postings were excluded from the skills analysis because they didn't include specific skill information.

developers, and web developers. Each of these occupations projects growth over the next five years, with an average projected growth slightly above the national average for these occupations. The cluster posts a particularly strong projected growth of 22 percent for web developers as well as software developers in both applications and systems software, at 13 percent. The median wage for these occupations is above that of technology as a whole, at $41.26 per hour.[13]

TABLE 2. DEVELOPMENT AND PROGRAMMING OCCUPATIONAL DATA[14]

SOC	Description	2015 Jobs	2015 - 2020 % Change	2015 Location Quotient	Regional Completions (2013)	Annual Openings	Median Hourly Earnings	Typical Entry-Level Education
15-1132	Software Developers, Applications	4,822	13%	1.36	206	203	$44.42	Bachelor's degree
15-1131	Computer Programmers	2,034	1%	1.42	94	57	$33.04	Bachelor's degree
15-1133	Software Developers, Systems Software	1,559	13%	0.84	201	64	$56.34	Bachelor's degree
27-1024	Graphic Designers	1,384	10%	1.07	95	65	$20.44	Bachelor's degree
11-9041	Architectural and Engineering Managers	1,144	0%	1.36	699	36	$61.60	Bachelor's degree
15-1134	Web Developers	881	22%	1.15	490	51	$24.38	Associate's degree
15-1141	Database Administrators	476	11%	0.89	259	21	$39.31	Bachelor's degree
15-1111	Computer and Information Research Scientists	181	11%	1.45	427	7	$66.21	Doctoral or professional degree
27-1014	Multimedia Artists and Animators	158	8%	0.73	84	6	$19.74	Bachelor's degree
51-4012	Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic	127	6%	1.07	4	6	$27.73	High school diploma or equivalent

Software development and programming jobs are generally highly skilled. Eighty-seven percent of the jobs advertised in these occupations in 2015 required a Bachelor's degree, with only 7

[13] Emsi Analyst. 2016.3 data series. Extracted by Sara Lamback.
[14] Emsi Analyst. 2016.3 data series. Extracted by Sara Lamback.

percent posted for workers with a high school or vocational degree.[15] Based upon job posting data, the most frequently requested specialized skills include SQL and Java (Table 3).[16] Other in-demand skills include Microsoft C#, Oracle, .NET Programming, and Linux.[17] Employers find it particularly hard to hire within this occupation cluster, noting that when a client need emerges, they must be able to immediately identify workers who already have the specific skills required. In addition, despite the close interplay between graphic design and technology, a stigma remains that the arts are not a path to high-quality careers, making it more difficult to draw that talent into the pipeline.

TABLE 3. DEVELOPMENT AND PROGRAMMING REAL-TIME LMI SKILLS DATA[18]

TOP TITLES	TOP SKILLS		
	Baseline Skills	**Specialized Skills**	**Software Skills**
Software Development Engineer	Communication Skills	Software Development	SQL
Java Software Developer	Writing	Software Engineering	Java
Software Developer	Troubleshooting	JavaScript	Microsoft C#
.Net Developer	Problem Solving	Microsoft C#	Oracle
Database Administrator	Team Work/Collaboration	Web Development	.NET Programming
Web Developer	Research	Object-Oriented Analysis and Design (OOAD)[19]	Linux
Java Software Engineer	Planning	Project Management	Extensible Markup Language
Applications Developer	Quality Assurance and Control	Application Service Provider (ASP)[20]	C++

Networking and Professional Services. Representing approximately 41 percent of the state's overall technology workforce, there were 10,976 networking and professional services workers and 2,759 job postings across New Hampshire in 2015.[21] The largest occupations in this cluster are computer user-support specialists, computer systems analysts, computer and information systems managers, and network and computer systems administrators (Table 4). As with programmers, these occupations' 10.9 percent projected growth rate over the next five years is

[15] Burning Glass Technologies. Labor Insight.
[16] Burning Glass Technologies. Labor Insight. Data for full year of 2015 in the state of New Hampshire for occupations within the networking and IT professional services group. Extracted by Sara Lamback. Note: 1,061 postings were excluded from the skills analysis because they didn't include specific skills information.
[17] Burning Glass Technologies' Labor Insight.
[18] Burning Glass Technologies. Labor Insight.
[19] OOAD is one approach to software design; it is the process of planning a system of interacting objects for the purpose of solving a software problem. (Wikipedia)
[20] ASP is a type of company within the software industry that allow users to pay a monthly or yearly fee for use of software without having to install it on a local hard drive (e.g., customer relationship management software).
[21] Emsi Analyst. 2016.3 data series and Burning Glass' Labor Insight. Job posting data is for full year of 2015 in the state of New Hampshire for occupations within the networking and IT professional services group. Extracted by Sara Lamback.

slightly above the national average.[22] While computer systems analysts have the highest projected growth at 18 percent, information security analysts are close behind at 17 percent.[23] Moreover, reflected by the 759 job postings in 2015 for cybersecurity in New Hampshire, employers cite the growth of data security as already driving an unmet need for cybersecurity workers, whom they describe as already particularly difficult to find.[24]

TABLE 4. NETWORKING AND PROFESSIONAL SERVICES OCCUPATIONAL DATA[25]

Description	2015 Jobs	2015 - 2020 % Change	2015 Location Quotient	Regional Completions (2013)	Annual Openings	Median Hourly Earnings	Entry-Level Education
Computer User Support Specialists	2,756	10%	0.92	102	95	$25.42	Some College
Computer Systems Analysts	2,322	18%	0.87	385	115	$37.18	Bachelor's degree
Network and Computer Systems Administrators	1,928	8%	1.10	259	56	$35.55	Bachelor's degree
Computer and Information Systems Managers	1,887	11%	1.16	442	65	$58.07	Bachelor's degree
Computer Network Support Specialists	625	10%	0.67	102	22	$28.46	Associate's degree
Computer Network Architects	469	11%	0.68	490	19	$40.96	Bachelor's degree
Computer Hardware Engineers	346	4%	0.97	24	10	$55.47	Bachelor's degree
Information Security Analysts	345	17%	0.83	490	16	$45.54	Bachelor's degree
Computer Operators	296	(5%)	1.14	0	2	$21.17	High School diploma

This occupational cluster includes more opportunities that are accessible to individuals with diverse technical backgrounds, when paired with in-house training. Almost one quarter of job postings were for those with an Associate's degree or less.[26] Computer operators are the most entry-level position in this cluster, requiring only a high school degree and offering a median wage of $21.17. Computer network support specialists pay a higher rate of $28.46 and

[22] Emsi Analyst. 2016.3 data series. Extracted by Sara Lamback.
[23] Ibid.
[24] Burning Glass Technologies. Labor Insight.
[25] Emsi Analyst. 2016.3 data series. Extracted by Sara Lamback.
[26] Burning Glass Technologies. Labor Insight.

generally require an Associate's degree.[27] The highest-paying occupation, computer and information systems managers at $58.07, generally requires a Bachelor's degree.[28] Part of the difference in educational requirements likely reflects a greater reliance among employers on third-party certifications when hiring for networking jobs rather than for programming jobs. Among the 18 percent of networking jobs that listed a required certification, the most common were Cisco Certified Network Associate, Certified Information Systems Security Professional (CISSP), Certified A+ Technician, and SANS/GIAC Certification. The skill requirements for SQL, Java, Oracle and Linux overlap with programmers and developers, with additional popular skills including UNIX, VMware, and Windows Server (Table 5).[29]

TABLE 5. NETWORKING AND PROFESSIONAL SERVICES REAL-TIME LMI SKILLS DATA[30]

TOP TITLES	TOP SKILLS		
	Baseline Skills	**Specialized Skills**	**Software Skills**
Business Systems Analyst	Communication	Technical Support	SQL
Systems Analyst	Troubleshooting	Customer Service	Linux
Systems Administrator	Problem Solving	Project Management	Microsoft Office
Network Engineer	Writing	Business Process	Oracle
Help Desk Analyst	Planning	System Administration	UNIX
Senior Systems Administrator	Team Work/Collaboration	Business Systems Analysis	VMware
Geek Squad Agent	Research	Information Systems	Windows Server
Network Administrator	Detail Orientation	Web Development	Java

Technology and Other Sectors

Aggregating the talent needs in technology can be challenging because workers are spread across many unrelated businesses rather than being concentrated in a single industry. In fact, only 11.3 percent of the technology workforce is employed by technology companies.[31] Within these technology companies, workers are most heavily concentrated in the computer systems design and related services, which accounts for approximately 13 percent of all technology workers.[32]

Outside of technology companies, workers are widely dispersed across sectors but most concentrated in insurance, management, manufacturing, educational, and professional services

[27] Emsi Analyst. 2016.3 data series. Extracted by Sara Lamback.
[28] Emsi Analyst. 2016.3 data series. Extracted by Sara Lamback.
[29] Burning Glass Technologies. Labor Insight.
[30] Burning Glass Technologies. Labor Insight.
[31] New Hampshire Economic and Labor Market Information Bureau. Occupational Employment and Wages data. http://www.nhes.nh.gov/elmi/index.htm
[32] Emsi Analyst. 2016.3 data series. Extracted by Sara Lamback.

(Table 6). In fact, 28 percent of job postings for technology occupations are by insurance companies. Liberty Mutual's 481 job postings in 2015 were the most of any non-technology employer, and Fidelity Brokerage Services posted the fourth most postings at 144. Depository credit intermediation, security and commodity contracts intermediation and brokerage, colleges, universities, professional schools, and general medical and surgical hospitals each accounted for four to six percent of job postings. Consistent with this pattern, BAE Systems, Key Technology, and Anthem Blue Cross round out the top five non-technology employers for technology occupations with 323, 144, and 95 postings, respectively.[33]

TABLE 6. EMPLOYER DEMAND FOR IT WORKERS IN NON-IT INDUSTRIES[34]

NAICS	Industry	Occupation Group Jobs in Industry (2015)
5241	Insurance Carriers	917
5511	Management of Companies and Enterprises	985
3345	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	996
3344	Semiconductor and Other Electronic Component Manufacturing	547
3341	Computer and Peripheral Equipment Manufacturing	540
6113	Colleges, Universities, and Professional Schools	543
5413	Architectural, Engineering, and Related Services	537
5414	Specialized Design Services	494
5171	Wired Telecommunications Carriers	520
5416	Management, Scientific, and Technical Consulting Services	458
5613	Employment Services	459

The technology demand in the non-technology sector is concentrated in software and app development and programming. Non-technology companies posted 1,206 jobs for software development engineers, software developers, and Java software developers in 2015, with software developer engineers accounting for 70 percent of the postings. The other 30 percent of postings were fairly evenly distributed among the top three networking titles—systems administrators, systems engineer, and network engineer—and totaled only 552 postings.[35]

[33] Burning Glass Technologies. Labor Insight.
[34] Emsi Analyst. 2016.4 Data Series. Extracted by Sara Lamback. Top IT-related industries included Computer Systems Design and Related Services (NAICS 5415), Software Publishers (5112), and Data Processing, Hosting, and Related Services (5182).
[35] Burning Glass Technologies. Labor Insight.

Overall Technology Talent Pipeline Trends

Several common technology talent trends cross sectors and occupational clusters. Technology employers are not facing the same impending retirement wave as other occupations and industries in the state. Instead, workers are distributed fairly evenly by age.[36] Employers and educators note that although technology does not have the same stigma as sectors such as manufacturing, enrollment in technology courses in the community college system is declining. While the full explanation is not known, this is in part because students are hired before they complete their courses. The challenges for technology employers center on gender and geography. Three-quarters of technology workers in New Hampshire are male, and efforts to attract girls and women to the technology field have not translated into greater gender parity.

Southern New Hampshire's proximity to greater Boston's robust technology economy has complicated the talent pipeline in the state. The Boston area is more appealing to many younger workers than New Hampshire, and salary disparities reinforce the ability of Boston area employers to recruit talent: The New Hampshire median wage of $37.08 is only 83 percent of the Massachusetts median wage for these occupations ($44.77).[37] While many employers look toward initiatives highlighting the low cost of living and high quality of life in New Hampshire, those seeking to keep salaries down continue to struggle to find qualified workers. In contrast, those employers who have raised their salaries for their most in-demand occupations to Boston-area wage levels have noted that they are able to successfully recruit from the Boston area's wider talent pool. Greater Boston's draw—and accompanying wage pressure—progressively declines when moving north. Median hourly wages for technology occupations are lowest in the northern Carroll and Coös counties, at $28.88 and $29.47, respectively.[38] However, even when recruiting workers already living in the state, fierce competition and the movement of highly skilled technology workers across companies can drive up salaries.

Technology employers in both the software development and networking occupational clusters also noted that it is particularly difficult to fill positions that require a blend of skills. Employers have trouble finding individuals with both the technical and business skills needed for technical sales, sales engineer, and many management positions. Companies tend to hire technical experts with the capacity for learning the other portions of the job but bemoan the lack of job candidates that already possess this skill balance. Similarly, employers frequently post requirements for soft skills such as collaboration but have some difficulty hiring workers that meet those expectations.

[36] Emsi Analyst. 2016.3 data series. Extracted by Sara Lamback.
[37] Emsi Analyst. 2016.3 data series. Extracted by Sara Lamback.
[38] Emsi Analyst. 2016.3 data series. Extracted by Sara Lamback.

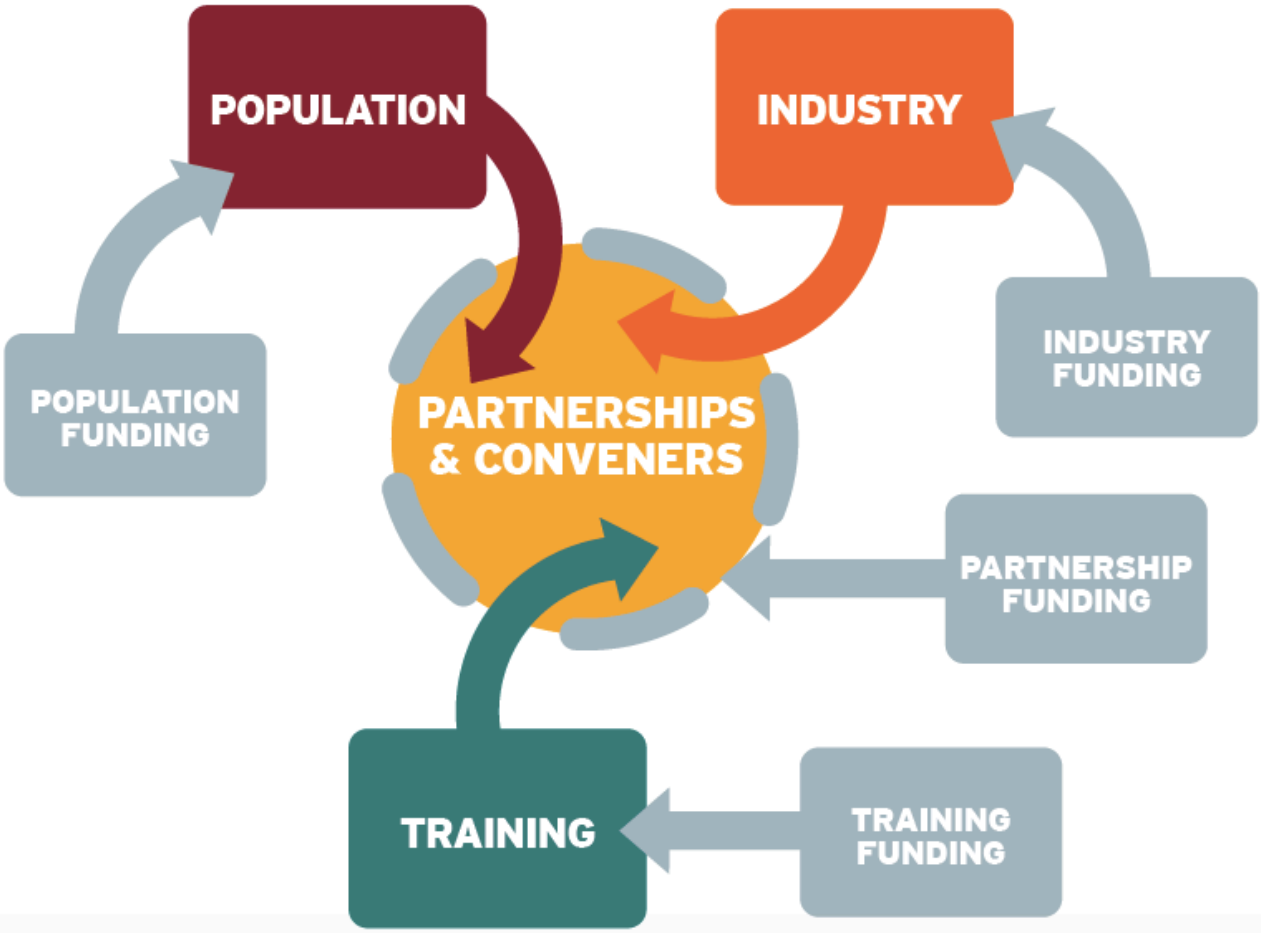
KEY AREAS OF FOCUS: ASSETS AND RECOMMENDATIONS

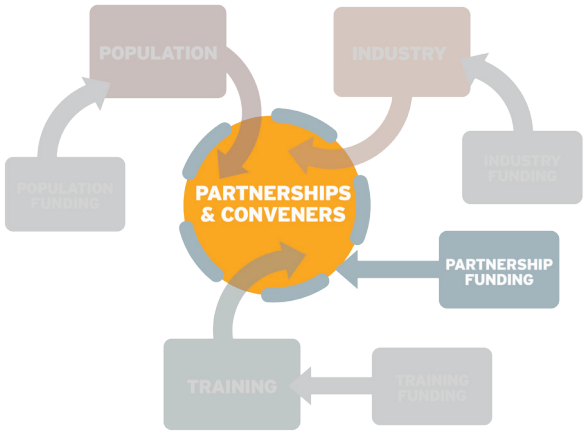
An industry-led talent partnership can bring together critical technology stakeholders to introduce cohesive approaches to the development of a skilled technology workforce.[39] Leading educational institutions and employers already offer many strong education and training programs, and a statewide effort can leverage the many assets and resources already available (Table 7). This report outlines key issues and provides recommendations for consideration as New Hampshire takes the critical next steps in launching the technology talent partnership. It examines significant challenges and opportunities identified by a range of key technology leaders representing business, education and training providers, the workforce system, policymakers, and other critical partners. A key theme across all of the featured topics is the need for more standardization in activities ranging from curriculum design to work-based learning opportunities to relationship and network building. This report offers five broad recommendations:

1) Standardize educational preparation for technology career pathways
2) Deepen employer input in technology curriculum
3) Standardize and expand technology work-based learning opportunities
4) Create new pathways for incumbent technology workers
5) Build relationships across technology employers and educators

[39] This type of partnership is more commonly referred to as a "sector partnership," and New Hampshire is currently launching manufacturing, health care, and hospitality sector partnerships. Because the technology workforce encompasses both the technology sector and technology workers in other sectors, this report instead calls for a broader "talent partnership."

TABLE 7. SUMMARY OF MAJOR ASSETS FOR THE TECHNOLOGY TALENT PIPELINE





PARTNERSHIPS AND CONVENERS

Statewide Economic Development

- NH Department of Resources and Economic Development/Division of Economic Development
- Office of Workforce Opportunity/NH Works
- NH Works Interagency Business Team (IBT)
- NH State Workforce Innovation Board
- NH Coalition for Business and Education (NHCBE)
- 65 by 25, Community College System of NH (CCSNH)
- Guided Pathways
- Business and Industry Association (BIA)
- Stay Work Play

Statewide STEM

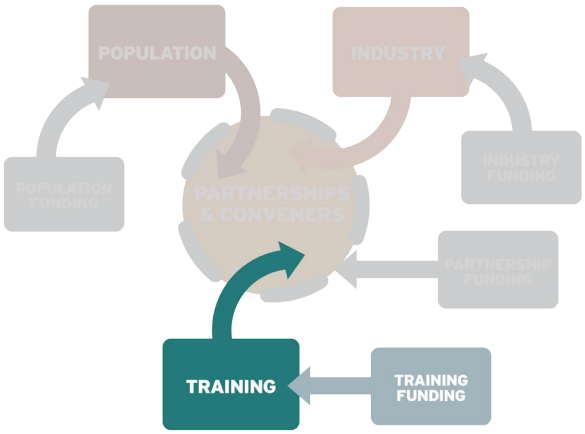
- Governor's Pre-Engineering Technology Advisory Council (PETAC)
- Governor's Task Force on STEM Education
- Live Free and Start
- NH High Tech Council
- STEM Smarter Pathways (NH Charitable Foundation)
- University of NH Manufacturing Tech Council

Regional

- STEAM Ahead NH
- River Valley Workforce Institute
- Industrial Development Corporations
- 10 Regional Development Corporations
- Chambers of Commerce

Partnership Funding

- NH Charitable Foundation
- Federal Apprenticeship Planning/Accelerator Grant
- Federal Apprenticeship Expansion Grant



TECHNICAL TRAINING

K-12 and CTE

- Running Start
- New Skills for Youth
- School-to-Work NH
- eStart
- Southern New Hampshire University in the High School
- Career & Technical Education Industry-Focused Training
- Project Lead the Way® Curriculum

Community College System of NH (CCSNH)

- Great Bay Community College
  - Associate Degrees in Computer Technology, Digital Media/Technology, Health Information Technology, Information Systems Technology
  - Certificates in Digital Design & Animation, Information Systems Technology, Linux Programming, Practical Data Science, Programming, Software Development
- Lakes Region Community College:
  - Associate Degrees in Computer Technology, Health Information Technology
  - Certificates in Application Developer, Computer Networking, Database Administration, Gaming and Automation Developer, Network Administration, PC Systems Management, Web Development/Programming/Design
- Manchester Community College:
  - Associate Degrees in Computer Science, Computer Science and Innovation, Cybersecurity Investigations
  - Certificates in Programming, Web Development/Programming/Design
- Nashua Community College:
  - Associate Degrees in Computer Networking, Cybersecurity Networking, Software Development, Web Development/Programming/Design
  - Certificates in Computer Information Systems, Internet Developer, Web Development/Programming/Design
- River Valley Community College:
  - Associate Degrees in Computer Networking, Computer Technology, Cybersecurity/Healthcare IT, Web Development/Programming/Design
  - Certificates in Computer Networking, Computer Technology, Cybersecurity/Healthcare IT, Web

TECHNICAL TRAINING (continued)

Community College System of NH (CCSNH) (continued)

- Development/Programming/Design New Hampshire Technical Institute (NHTI):
  - Associate Degrees in Automation and Graphic Game Programming, Computer Engineering Technology, Information Technology
  - Certificates in Advanced Software Development, Computer Technology Programming, Entry-Level Software Development, Entry-Level Networking, Microsoft Servers, Network Associate, Security, Virtualization, VoiP (Voice Over IP), Software Development, Networking, Tech Support
  - Programs in CISCO Networking Academy, Computer Applications and Skills, Customer Service Specialist
- White Mountains Community College:
  - Associate Degree in Information Technology
  - Certificates in Cybersecurity and Healthcare IT, Information Technology

Four-Year Colleges

- University of New Hampshire - Durham:
  - Bachelor of Science Degrees in Computer Science, Bioinformatics, Information Technology
  - Master's in Computer Science
  - PhD in Computer Science
- University of New Hampshire - Manchester:
  - Bachelor of Science Degrees in Computer Information Systems, Computer Science & Entrepreneurship
  - Master's of Science in Information Technology
- Keene State College:
  - Bachelor of Science Degree in Computer Science, Minor in Computer Science for non-Computer Science majors
- Dartmouth College:
  - Bachelor of Science in Computer Science, Minor in Computer Science for non-Computer Science majors
  - Master's of Science Degree in Computer Science
- Granite State College:
  - Bachelor of Science Degrees in Information Technology, Computer Science Innovation, Technology Management
- Southern New Hampshire University:
  - Associate of Science Degree in Information Technologies
  - Bachelor of Science Degrees in Health Information Management, Information Technologies, Management Information Systems, Data Analytics, Bachelor of Science Degree in Information Technologies, Bachelor of Arts Degrees in Game Art & Development, Graphic Design & Media Arts, Information Technologies Master's of Science Degrees in Cyber Security, Health Information Management, Information Technology, Master's of Business Administration in Information Technology Management

Employer-led

- Pre-Apprenticeships
- Registered Apprenticeships (including sponsored by other entities including NH Department of Education)
- On-the-Job Training

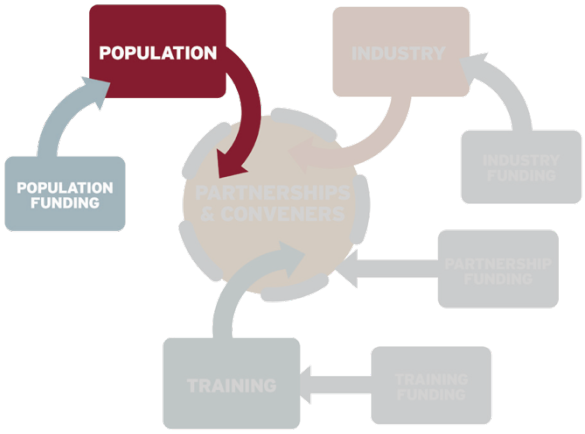
TECHNICAL TRAINING (continued)

Other

- NH Job Corps - Manchester
- 10,000 Mentors
- National Governors Association Work-Based Learning Initiative
- Workplace Success Program

Training Funding

- Office of Workforce Opportunity
- Company benefits: tuition reimbursement
- Department of Labor National Emergency Grants
- NH Job Training Fund
- National Science Foundation (NSF) Advanced Technical Education
- NSF (for UNH K-12 teacher training)
- ApprenticeshipUSA State Accelerator Grant
- ApprenticeshipUSA State Expansion Grants (awarded 10/21/2016)
- Housing and Urban Development (HUD) Community Development Block Grant
- NH Department of Education English Language Learner Training for Employers
- PETAC grants
- New Skills for Youth Grant

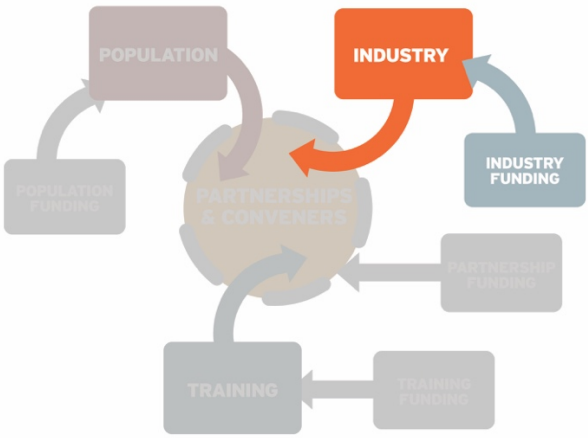


TARGET POPULATIONS
Unemployed and Underemployed
• WorkReadyNH • NH Works Career Centers
Veterans
• NH Employment Security Veterans Representatives (services for vets and their families) • Department of Veterans Affairs • U.S. Department of Labor (DOL) Veterans' Employment and Training Service • NH Employer Support of the Guard and Reserve (Concord) • Veterans Count, Easter Seals
Women
• Women in Technology (BAE Systems) • TechWomen | TechGirls (NH High Tech Council) • Girls Technology Day • Center for Women's Business Advancement • Center for Women and Enterprise
Immigrants and Refugees
• NH Refugee Program (U.S. HHS Office of Refugee Resettlement) • Southern New Hampshire Services, English for New Americans • Ascentria Care Alliance • International Institute of New Hampshire • Concord Multicultural Project • Laconia Human Relations Committee
People with Disabilities
• State Vocational Rehabilitation agency • Easter Seals • Goodwill Industries • Work Opportunity Unlimited • HHS ServiceLink Aging & Disability Resource Center • The Moore Center

TARGET POPULATIONS (continued)

Population Funding

- Pell grants (and other federal student aid)
- Medallion fund of NH Charitable Foundation
- U.S. Department of Labor Workforce Innovation & Opportunity Act (WIOA) Adult, Dislocated Worker, and Youth Funds
- U.S. Department of Agriculture Supplemental Nutrition Assistance Program, Employment and Training
- U.S. Department of Health and Human Service Temporary Assistance for Needy Families
- Return to Work
- NH Women's Foundation
- U.S. Department of Veteran's Affairs, Education and Training Benefits and Programs
- NH Scholar Program
- Charitable Foundation STEM Scholarship Fund



INDUSTRY

- Human Resources Groups - local and national (Society for Human Resource Management)
- Trade associations (IEEE Computer Society)
- NH Aerospace and Defense Export Consortium

Industry Funding

- Community Development Finance Authority (CDFA)

OTHER RESOURCES

- BIA Strategic Economic Plan for NH
- NH Division of Economic Development Strategic Plan
- WIOA State Plan
- NH Economic & Labor Market Information Bureau

1) STANDARDIZE EDUCATIONAL PREPARATION FOR TECHNOLOGY CAREER PATHWAYS

As technology has evolved, associated career opportunities have expanded and taken on new forms. Individuals who specialize in hardware, networking, software and app development, and even graphic design face differing job expectations, education, and training requirements. In this complex landscape, a disconnect has emerged between what educators and employers view as the skills students must develop and career pathways for a technology workforce. Even within educational systems, wide variation exists in how individual high schools, community colleges, and four-year colleges prepare technology students. For example, Manchester Community College is the only community college in the state to offer a cybersecurity investigations Associate's degree, and other community colleges offer their own mix of technology courses and degrees. At the four-year level, program goals also differ. Even within the University of New Hampshire, the curriculum at UNH-Manchester emphasizes theory, while UNH-Durham's is more applied.

The educational system is currently designed around an educational pathway that culminates in a Bachelor's degree and emphasizes technology theory. High schools have not been deeply involved in postsecondary pathway preparation and design, but they do emphasize preparation for four-year colleges. Colleges seek to expand science, technology, engineering, and math (STEM) literacy for high school graduates, and emphasize a need for stronger math education, because two-thirds of students entering college require math remediation. College faculty note that high school and career and technical education (CTE) graduates are more likely to know a programming language than understand the fundamentals of computer science, but faculty would prefer the reverse. Two-year and four-year colleges have worked closely together to create strong articulation agreements and a more seamless pathway across the systems. While some curriculum gaps remain, faculty at both levels emphasize the transition from two-year to four-year colleges as the best way to prepare students for many technology careers.

While educators emphasize the need for a four-year degree to succeed in technology, and this is reflected in data indicating that four out of five of these jobs require a Bachelor's degree, many employers also prefer the focus of the two-year degree on applied technology skills over the focus on computing principles in a Bachelor's degree. In fact, some employers prefer a recent Associate's degree graduate with those technical skills still fresh in students' minds over a Bachelor's graduate, who has lost some technology focus within other requirements of the four-year degree. Industry representatives also express support for short-term certificates for incumbent and other workers, but note that community colleges do not offer them in technology as they do in other sectors. Employers do not appear to have much interaction with CTE schools or awareness of how CTE graduates could fill their technology talent needs.

The specific opportunities for different educational and career pathways must be defined in response to the particular needs of different types of technology careers. For example,

employers continue to predominantly require a Bachelor's degree for software and app developers. In contrast, the Associate's degree has more potential value for several types of technology workers: Both educators and employers see greater opportunity for an Associate's degree in networking, which does not require as much specialization early in a career. One employer suggested that a shorter community college networking certificate would be equally valuable and expressed disappointment that they are not available in New Hampshire. Associate's degrees are also more likely to provide sufficient preparation for technology workers employed in other sectors, such as manufacturing or hospitals, in which the technology skills are more user-focused and emphasize customer service.

By continuing to work together, employers and educators can more clearly define the educational requirements for different technology career opportunities and jointly design clear career pathways for technology. Technology educators and employers agree that because there is enough similar demand across the state for technology skills, educational institutions should not specialize in different technology pathways but should instead begin by defining standardized technology core pathways. Foundational STEM skills in math, coding, computer science fundamentals, and basic technology can then be built out with consistent curriculum for the most in-demand technology careers. JFF recommends that these career pathways be mapped out and connected to career counseling for students unsure of their career options and preferences.

Assets

New Hampshire high schools, community colleges, and four-year colleges have a strong foundation in building educational pathways across institutions.

- Over 20 high schools throughout the state are implementing the STEM programming of the national nonprofit Project Lead the Way. While all these high schools are implementing PLTW's engineering modules, implementation of its biomedical and computer science modules is currently very limited, indicating opportunities for increased implementation in these two areas.
- Running Start, administered by the Community College System of New Hampshire, allows high school students to enroll and receive both high school and community college credit. Manchester Community College has found that the program design, requiring the college to review class curriculum and instruction, has deepened its technology relationships with Pelham High School and Pinkerton Academy.
- STEAM Ahead similarly brings together the Manchester School District, Manchester Community College, University System of New Hampshire, and employers to provide dual enrollment in technology and other STEM education so that high school students can earn up to one year of college credit aligned with postsecondary technology pathways.

- At the postsecondary level, articulation agreements from two- to four-year colleges have led to a steady stream of community college graduates into the UNH system. While the preparation varies across colleges, many students from New Hampshire Technical Institute and other community colleges arrive well prepared for their final two years.

Numerous successful programs exist in New Hampshire that could serve as a basis for building technology educational pathways that meet the needs of employers. Community college certificate and degree programs already exist that can be replicated across the community college system to provide the content for consistent technology pathways statewide.

- NHTI has used a TAACCCT grant to develop 10 new technology certificates with distinct pathways in networking and software development as well as computer engineering and game programming, with Associate's degrees offered for each track. The certificates were designed in response to surveys of employer demand and span introductory and advanced content.
- River Valley Community College offers a cybersecurity and health care IT Associate's degree program that is highly regarded and has sufficient demand for growth around the state.
- Manchester Community College demonstrated that community colleges can quickly develop strong degree programs in response to employer need, taking only one year to develop and secure course approval for its cybersecurity degree.

Lessons from collaborative models in the state beyond technology can serve as the basis of similar strategies within technology. For example, the manufacturing sector has benefited from a number of boot camps and targeted, short-term certificates developed jointly by New Hampshire community colleges and employers. In addition, investment in technology education fits within a broader statewide effort to build a STEM workforce. These efforts can leverage the NH Charitable Foundation's Smarter Pathways initiative, which has provided STEM scholarships and funded program development in partnership with a wide range of public and private partners to expand education and training pathways to succeed in STEM careers.

Strategic Recommendations

- *Create a core technology curriculum at the secondary and postsecondary levels*. Despite common technology needs statewide, there is little consistency in technology offerings across educational institutions statewide. As a first step toward greater consistency, community colleges throughout the system have already aligned their introductory personal computer hardware and software courses and agreed to articulate credit. Rather than each community college pursuing a strategy completely independent of the other, JFF recommends replicating successful programs to continue to build core technology curricula and in-demand pathways across the state, with community college specialization for more advanced coursework. These efforts could be folded within the

system's growing guided pathways work, providing an accessible starting point for coordinated educational design that meets the applied skill needs of technology employers.

- *Collect and analyze data about student progression along technology pathways.* We recommend that high school, CTE, and college systems use data on student outcomes to evaluate whether their technology programs advance students along a career pathway as expected. These findings can be a critical part of continual improvement in curriculum development and a starting point in discussions with employers about their talent needs. Educators and employers concerned about the outflow of young people from the state can also analyze the data to identify factors that contribute to individuals leaving the state at key points in their educational and career pathway progression.
- *Design statewide certifications for software and app development.* National third-party networking certifications provide a way for individuals to demonstrate that they have learned the skills and competencies most valued by technology employers. In contrast, programmers have no clear way to signal to employers that they have obtained competencies highly valued in the technology field, and educators lack clear guidance on which competencies are most sought after in programmers and software or app developers. These certifications must be widespread in order to serve as an effective signpost for employers. We recommend that New Hampshire educators and companies work together to identify core competencies and assessment protocol that could translate into statewide, stackable certifications or short-term certificates for developers. Already, the SEE Science Center and Dyn University have created a "Software Development Fundamentals" certificate for middle-schoolers that could be more widely adopted and that could build toward more advanced and specialized certifications at the secondary and postsecondary levels.
- *Leverage nonprofits and other workforce development agencies to include women and minorities in the talent pipeline.* Educational institutions serve as the cornerstone for developing a technology talent pipeline. However, community-based organizations and workforce development agencies can complement secondary and postsecondary institutions with programs that are designed to increase the access and success of target populations in technology fields. We recommend that educators partner with those organizations to create a more robust and inclusive technology workforce. New Hampshire can look to innovative programs from across the country for program design and curriculum ideas. For example, Girls Who Code is a national nonprofit to engage middle and high school girls in programming, with five club chapters in New Hampshire. Similar to the manufacturing boot camps offered by New Hampshire community colleges, Code Louisville in Kentucky has two 12-week programming tracks that combine in-person and online training with mentoring to prepare individuals from groups that are underrepresented in the technology sector for programming careers.

2) DEEPEN EMPLOYER INPUT IN TECHNOLOGY CURRICULUM

Both educators and employers recognize a disconnect between them in shaping technology curriculum, and both seek to bridge that gap. Colleges have had trouble consistently engaging employers, noting that industry advisory boards are less active in technology than in other industry sectors and admitting to little sense of how to increase employer interest. The challenge has been compounded because colleges perceive technology companies to be primarily smaller employers that appear to have their own specific needs. At the same time, employers are frustrated by the technology curriculum offered in the state but do not know how to impact curriculum design beyond time consuming, one-off conversations with individual college faculty or administrators. A system-wide approach to standardizing curriculum development can efficiently incorporate employer voice. Employer input is likely to result in a greater emphasis on applied knowledge, as employers would like less time spent on foundation skills and computer science theory and prefer that technology be approached more as an applied trade.

Developing systems for deeper, continuous employer input on technology education can begin by focusing on integrating hands-on and project-based learning into technology curriculum. Applied learning is a priority for technology employers, and this is a way in which they are uniquely positioned to enrich high school and college technology programs. Employers are already eager to promote technology and STEM to high school students, and they are interested in working to promote technical education throughout the high school system, not just in CTE programs. At the community college level, educators have expanded training in specific programming languages based on employer requests, but do not yet have similar direction from employers on how to introduce more applied learning for data analytics and other networking curricula. Employers disappointed that there are often fewer technical courses in four-year than two-year programs can introduce real-life higher-level technical content in Bachelor's degree programs.

Employer input on technology curriculum would provide predictable value to a technology degree that is currently missing. This value is evident in the IT networking sector, which is a national industry leader in the prevalence of, and employer value for, third-party industry-recognized credentials such as CompTIA's A+ certification and Cisco's series of certificates. However, because software and app development does not have parallel certifications that are as universally recognized, employers instead rely on work experience as an indicator of expertise for their programmers. If employers help define a consistent and hands-on curriculum for technology programs across the state, they will be more confident that program graduates have acquired the skills and knowledge they need to succeed on the job.

Assets

Companies throughout New Hampshire are already partnering with middle and high schools to create hands-on learning experiences in technology and introduce people to the field. For

example, Dyn hosts a Hack-A-Palooza, and numerous companies host students within the two-year Dr. Thomas J. Brennan Jr. Computer Science Career Exploration high school program. At the postsecondary level, employer input in curriculum design will strengthen technology programs that employers already recognize as creating high-quality graduates. New Hampshire Technical Institute (NHTI) is particularly highly regarded by technology companies, but employers also cite numerous other community and four-year colleges as reliable sources of employees. In addition, employers already influence individual technology programs because their skilled workers serve as faculty. For example, the CEO of SilverTech teaches at Merrimack College, and UNH-Manchester draws on adjunct faculty from companies including Dyn and Adobe.

Strategic Recommendations

- *Bring industry into the classroom.* The most direct way for employers to ensure that a technology education reflects real-world needs is for employers to provide those opportunities within classes. We recommend that employers make regular commitments to visit classrooms and discuss their workplace, provide technical challenges as the basis for class projects, and identify other opportunities to incorporate their companies' technology challenges into curricula.
- *Cultivate faculty with current industry knowledge.* We recommend that employers host high school, CTE, and college faculty in externships, such as Indiana Department of Education's Teachers in Industry Project, so that full-time faculty can gain insight into the latest technology that could improve technology curriculum. This will build on colleges' current use of adjunct faculty from technology companies; colleges not only benefit from industry relationships, but also gain access to cutting edge instructors in in-demand occupations.
- *Integrate applied technology skills and industry certifications valued by employers into college curricula.* Colleges can align curriculum with employer expectations by integrating the networking certifications that are frequently requested by employers in job postings into their training programs. For example, Manchester Community College has obtained a 50-percent testing discount for A+ and other credentials incorporated into their technology programs. For areas that are not nationally credentialed, technology programs can develop courses or course modules that focus on discrete topics identified by employers as major hiring assets, such as LAMP, Demandware, and Microsoft Azure.

3) STANDARDIZE AND EXPAND TECHNOLOGY WORK-BASED LEARNING OPPORTUNITIES

Both employers and educators consistently and emphatically express a desire for more work-based learning and work experience for students. Work-based learning, such as job shadowing, internships, or apprenticeships, is a program of structured activities within the workplace that

help students and workers gain knowledge and skills important to a career. There is widespread agreement that students graduate without enough work experience and that integrating work-based learning into degree programs could bring real-world skills to technology education. Yet work-based learning opportunities in technology lag behind those for students preparing for other careers: Faculty cite other academic departments in their colleges as having more formalized internship programs, and the Work-Based Learning Policy Academy led by the National Governors Association does not include technology as a focus in New Hampshire.

Integrating work-based learning into technology education would require overcoming several hurdles. Technology faculty have found it difficult to maintain the consistent relationships with technology employers needed to formalize internships and similar programs, while employers that do host interns have found that those faculty relationships are the most reliable way to ensure that students are a strong match for employer needs. Employers would be more willing to host students if their skills were more predictable, because they lack the time to bring a student missing required skills up to speed when a client has immediate needs. Student value to and involvement in real-world projects is also hampered by schedules built around the academic calendar rather than the business cycle as well as by restrictions on assigning interns to billable projects.

While internships are most frequently discussed as a current and potential form of work-based learning, employers are open to instituting a wide array of programs, including job shadowing, co-ops, and Registered Apprenticeships. At the high school level, visits to the workplace would also provide useful exposure to technology careers. We recommend more standardized structures for implementing each of these types of work-based learning programs to make it easier for educators and employers to participate, establish clear roles for partners, and connect students to the opportunities that match their skills and interests.

Assets

New efforts to expand work-based learning can build on an existing formal internship program in the state for high school students as well as numerous informal programs between colleges and employers. For example, in its 200 by 2020 Initiative, the Belknap Economic Development Council is connecting high school students to employers to enrich their career exposure. As part of this effort, Mainstay Technologies facilitated employer engagement through a searchable database of internship and job shadow opportunities in technology and other fields (www.lakesregioninternships.com).

These kinds of programs and technology tools could be replicated across the state or expanded to the college level. Many internship programs are already informally established between community colleges or four-year colleges and employers, with faculty taking the lead on making referrals that match the skill needs of a company. The success of these matches is evident: many employers note that they frequently hire interns as full-time employees.

Some colleges have already formally incorporated work-based learning into their technology offerings. UNH-Manchester has integrated internships into its technology programs, requiring students to complete a one-semester internship in order to graduate. As an employer within an educational institution, UNH Enterprise University Systems hosts many UNH students as interns assigned to a discrete project, and then frequently hires them as part-time employees to be involved in day-to-day operations through graduation. This kind of work-based learning pathway can serve as an example for other employers interested in multiple avenues to incorporate work experience into educational programs.

Strategic Recommendations

- *Create standardized tools for engagement in work-based learning*. Templates, guidelines, documentation worksheets, and other tools can be used to provide clear and consistent expectations for students, educational institutions, and employers participating in work-based learning programs such as internships. We recommend that employers and educators agree to use the same tools across programs so that commitments are commonly understood across the state.
- *Coordinate work-based learning program design and recruitment among schools.* Employers are more likely to participate in work-based learning programs if they can quickly interview and select students that meet their needs. We recommend that schools work together to recruit, prescreen, and prepare students for their internship or other work experience. Joint efforts across schools widen the pool of talent and maximize the likelihood of a match with employers. Online platforms such as the Belknap EDC searchable database could further support this process.
- *Pair formal work-based learning with recommended extracurricular activities*. Many employers seek job candidates who not only excel within their technology program but also take the initiative to learn and demonstrate their passion for technology on their own. We recommend that career counselors or faculty members work with employers to identify the types of activities that would best complement their formal work-based learning to demonstrate that students can succeed in the workplace.
- *Introduce Registered Apprenticeships in technology.* Registered Apprenticeships are a premier form of work-based learning, allowing apprentices to learn while they earn, with progressively increasing wages as they advance through structured work experiences and related technical instruction. While frequently used for incumbent workers, Registered Apprenticeships also have excellent potential to connect jobseekers to technology careers. See Appendix 2 for a description of the USDOL Registered Apprenticeship in Information Technology in New Hampshire.

4) CREATE NEW PATHWAYS FOR INCUMBENT TECHNOLOGY WORKERS

Technology employers currently balance two competing trends that shape the career development opportunities for their workers. On one hand, short-term training tied to specific in-demand skills is widespread across the industry, and many technology employers work with their employees on professional development plans. On the other hand, employers are perceived as not wanting to invest in workers likely to end up working for a competitor, particularly in high turnover occupations. This tension seems to result in employers providing ongoing training for technology workers to stay current in their existing responsibilities, or even to grow, but few employers intentionally advance workers in order to fill a company's skill gaps.

The most consistent training practice described for incumbent workers is the use of third-party vendors, often software suppliers, on the use of specific software packages. Many companies also use online courses to train workers in skills needed for the company to continue to provide cutting-edge services and products to clients. Companies do not typically rely on community colleges for technical training for their workers, although community colleges do play a role in leadership training and other development of business skills.

Opportunities for incumbent worker training vary across technology professions. The perception among educators is that companies are more willing to provide tuition reimbursement for their Associate's degree-level programmers to earn a Bachelor's degree than they are for workers in cybersecurity or networking. Employers, however, noted that they are more willing to invest in their incumbent networkers and cybersecurity workers because they have less turnover than programmers, and employers expect to retain these workers as they advance. Some occupations are caught between training costs and turnover. For example, growing a business development representative into a sales representative requires a lot of training, but sales representatives are difficult to retain. Incumbent training is further hampered by the small size of many technology companies as well as the small technology staffs within non-technology firms. We recommend that employers and community colleges work together to identify strategies that can most efficiently support the advancement of technology workers into a company's most difficult-to-fill technology positions.

Assets

Several companies universally create professional development plans with each employee, identifying training and other opportunities to acquire skills for advancement.

- Dyn aligns its in-house training with those professional development plans and has formalized offerings to include internal certifications that assist in promotions.

- Fidelity's Leap program for recent college graduates provides several months of technology training and targeted assignments, followed by professional development support in the participants' early years of employment.

Other technology companies use incumbent training specifically to advance their workers into their hardest-to-fill positions.

- After struggling to hire experienced technology engineers, Mainstay has adopted a strategy of hiring recent Associate's degree graduates and training them to become senior staff.
- Similarly, after needing to outsource engineers because of hiring challenges, Ziftr launched a program to train its non-engineer technology staff to become engineers in up to nine months.

Strategic Recommendations

- *Consider incumbent worker pathways into occupations that combine business and technical skills.* Technology employers note that it is particularly challenging to find workers who bring both technical and business knowledge to positions such as technical sales representatives. We recommend that employers partner with community colleges to build the business, management, and customer service knowledge of their technical staff. This approach complements the technical training already offered by employers in-house and through vendors, while building on the content expertise of community colleges that frequently provide leadership and soft skills training to companies.
- *Use underutilized public funds*. JFF recommends that technology employers access the New Hampshire Job Training Fund to partner with community colleges to upskill their workers. The Fund provides $1 million per year in training support to companies, yet few technology employers have accessed the funding. We also recommend that employers work with the public workforce system to draw on Workforce Innovation and Opportunity Act (WIOA) funding for customized incumbent worker training and Registered Apprenticeships. This may require finding a way to ease the burden of reporting requirements, which have led some technology training providers to leave the WIOA Eligible Training Provider List.
- *Introduce Registered Apprenticeships in technology*. While internships serve as a touchstone for work-based learning among technology stakeholders, Registered Apprenticeships are not yet established in this sector. Registered Apprenticeships meet the need expressed by employers for a combination of technical instruction and applied learning on the job, and they are accessible to adults balancing numerous responsibilities because they provide a progressive wage scale throughout training. We recommend that employers work with the U.S. Office of Apprenticeship to identify and adapt the technology Registered Apprenticeship program standards being developed

around the country. These efforts would also support the goal of the NH WIOA Combined State Plan for 2016-2020 to expand apprenticeships in the state. The ApprenticeshipUSA Expansion Grants announced on October 21 will provide capacity and resources intended to develop Registered Apprenticeships in three sectors, one of which is IT.

5) BUILD RELATIONSHIPS ACROSS TECHNOLOGY EMPLOYERS AND EDUCATORS

Employers, educators, and other technology stakeholders want to collaborate with each other, and each of the strategies described in this report relies on relationships among multiple partners to succeed. The dynamic nature of technology makes it all the more important for educational institutions to have relationships with employers who can ensure that program content remains current. Yet representatives of each of these types of organizations consistently say that they do not know where to go to build those relationships and that they need facilitation to broker these connections. Relationship building is made all the more challenging because so many technology employers are small companies that do not yet work together to identify their common talent needs or develop joint strategies to promote technology and build a talent pipeline.

Building relationships across technology stakeholders will require addressing several challenges. High school and college faculty do not usually have time available to focus on building relationships nor the funding to use the summer for program design with employers. Faculty also need support in navigating the industry's small firms and identifying non-technology companies with relevant technology needs and opportunities. On the employer side, many companies do not have an individual tasked with the responsibility of building and maintaining these relationships with partners and so they are lost among more pressing priorities. Employers will be more willing to engage in these partnerships if they can efficiently target their time and resources around their talent needs rather than in complying with the burdensome or time-consuming requirements of education and workforce systems. A streamlined hub can build and maintain a technology network, brokering targeted relationships on an ongoing basis.

Assets

Even as many individual high schools, colleges, and employers struggle to build connections with each other, two entities have emerged as focal points for networks focused on creating a coordinated talent pipeline. The New Hampshire Charitable Foundation has convened a wide range of public and private partners to expand STEM pathways at the high school level as well as to expand access to and attainment of postsecondary degrees and credentials. The High Tech Council, and especially its workforce development committee, convenes both small and large employers to identify common industry challenges and work toward collective solutions. While both of these entities focus broadly on the high-tech industry, they serve as the only place

that technology stakeholders regularly come together from across the state. The assets and efforts of the New Hampshire Charitable Foundation and High Tech Council could be leveraged to support efforts forging relationships among technology educators, employers, and other stakeholders.

Strategic Recommendations

- *Coordinate larger conversations between colleges and employers*. Employers and educators cite time as the key barrier to deeper partnership. We recommend a streamlined conversation about the recommendations throughout this report, in the form of a Technology Talent Partnership, across these stakeholders to minimize redundant conversation and maximize common points of need.
- *Engage more employers of all sizes.* Educators and employers interviewed about New Hampshire's assets in building a technology talent pipeline consistently highlighted the same companies as engaged partners. We recommend that technology partnerships reach beyond these leading employers to get a more robust understanding of the variety of technology needs across the state. Informal networks and public data, such as the database of companies requesting H-1B visas filtered for technology occupations, can be leveraged to identify companies with pressing technology hiring needs.
- *Change in technology employer culture to one of engagement*. As a whole, technology employers are not as engaged in the development of a statewide talent pipeline as those in other sectors, such as manufacturing. Yet, each of the recommendations in this report relies on significant employer input or participation. JFF recommends that companies identify ways to encourage their technical experts and other senior employees to engage in technology partnerships to co-design or review college curricula, host and mentor work-based learning students, teach incumbent workers, or otherwise improve their talent pipeline.

ESTABLISHING A TALENT PARTNERSHIP

A technology talent partnership that convenes the leadership across all the stakeholders invested in the success of a technology workforce would be uniquely positioned to advance strategies to strengthen that workforce's talent pipeline and to identify emerging areas for future action. While existing informal relationships already bring together many of these stakeholders, employers agree that they do not yet regularly convene and jointly address challenges in the technology field. An industry-led talent partnership can add value to statewide efforts to promote technology while also helping individual companies network and share ideas to address their own needs.

The talent partnership will have the dual role of convening stakeholders in a way that can evolve alongside an evolving technology field as well as spearheading the design and implementation

of individual collaborative education and training programs. Because few of these coordinated programs already exist, the talent partnership has the opportunity to develop programs in a systematic way that can be scaled for statewide impact. We recommend that the talent partnership balance a high-level systems-change agenda with the need to have a measurable impact in preparing technology workers to meet employer skill needs.

We recommend that the talent partnership be structured to facilitate widespread participation among stakeholders while ensuring deep engagement and time commitment from its members. The talent partnership can clarify forms of engagement and expectations of members early to ensure effective participation. We recommend that:

- The talent partnership include members that represent businesses of all sizes, secondary and postsecondary educational institutions, third-party training vendors, Registered Apprenticeship providers, the workforce system, state and local agencies including economic development agencies, community-based organizations, and policymakers;
- Three business leaders co-chair the partnership to ensure that the efforts are industry-led and represent the three key types of companies with technology demand: 1) programming and development firms; 2) networking and professional services firms; and 3) non-technology companies such as hospitals and financial services providers with large numbers of technology workers;
- An executive committee guides the talent partnership agenda and recruits partners to the effort;
- The Department of Resources and Economic Development serves as a temporary intermediary to convene and staff the partnership and manage projects between meetings while the talent partnership builds employer support to invest in the High Tech Council to serve as the long-term intermediary. The High Tech Council brings the benefits of already serving as a technology convener, credibility and respect within the employer community, and has an existing mission to advance the industry.
- The partnership structure incorporates a formal relationship with other sector partnerships to serve as a conduit for non-technology employer input on technology skill needs and to support the adoption of technology program priorities within their companies. Possible designs include co-hosting meetings in rotation with other sectors, creating a non-technology subcommittee comprising representatives who are also members of other sector partnerships, or relying on the intermediary to coordinate with other sector intermediaries.

APPENDIX 1. DEFINING TECHNOLOGY

The occupations used as a basis for the analysis of the technology sector matches the set of occupations that the New Hampshire Economic and Labor Market Information Bureau (ELMI) typically uses for analysis as well as the Information Technology Occupational group defined by Burning Glass Technologies' Labor/Insight application.[40] ELMI's *Industry Staffing Patterns for Occupations in the Information Technology Career Cluster* provides additional information about the relationship between technology-related industry sectors and occupations.[41]

The occupation list used in this report also aligns closely with a subset of the 79 occupations identified by the New Hampshire High Tech Council, which also includes a variety of engineering occupations (e.g., aerospace engineers, electrical engineers), scientists (e.g., hydrologists, chemists), and occupations related to advanced manufacturing (e.g., cutting, punching, and press machine setters; computer-controlled machine tool operators) in addition to computer occupations. Our analysis only includes those related to technology, and it adds three occupations used in other technology analyses and cited by New Hampshire employers as relevant to this analysis.

Technology Occupations Included in the NH Technology Sector Analysis

SOC	Title	Included in NH High Tech Council	Included in ELMI Analysis
15-1132	Software Developer, Applications	Y	Y
15-1199	Computer Occupations, All Other	Y	Y
15-1121	Computer Systems Analyst	Y	Y
15-1151	Computer User Support Specialists	Y	Y
15-1142	Network and Computer Systems Administrators	Y	Y
15-1134	Web Developers	Y	Y
11-3021	Computer and Information Systems Managers	Y	Y
15-1133	Software Developers, Systems Software	Y	Y
15-1131	Computer Programmers	Y	Y
15-1122	Information Security Analysts	Y	Y
15-1141	Database Administrators	Y	Y

[40] New Hampshire Employment and Labor Market Information Bureau, *Information Technology Occupations in New Hampshire*, October 2016. www.nhes.nh.gov/elmi/products/documents/sp-inform-tech-article.pdf

[41] New Hampshire Employment and Labor Market Information Bureau. 2016. Industry Staffing Patterns for Occupations in the Information Technology Career Cluster. Accessed at: http://www.nhes.nh.gov/elmi/products/documents/it_cluster_chart.pdf

15-1143	Computer Network Architects	Y	Y
15-1111	Computer and Information Research Scientists	Y	Y
15-1151	Computer Network Support Specialists	Y	Y
43-9011	Computer Operators	Y	Y
17-2061	Computer Hardware Engineers	Y	Y
51-4012	Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic	Y	Y
11-9041	Architectural and Engineering Managers	N	Y
27-1041	Multimedia Artists and Animators	N	Y
27-1024	Graphic Designers	N	Y

APPENDIX 2

ApprenticeshipUSA

NEW HAMPSHIRE

USDOL Registered Apprenticeships in

Information Technology

NH Office of Apprenticeship

Lauren M. Smith
Wynn B. Young

Cleveland Federal Building
55 Pleasant Street
Concord, NH 03301

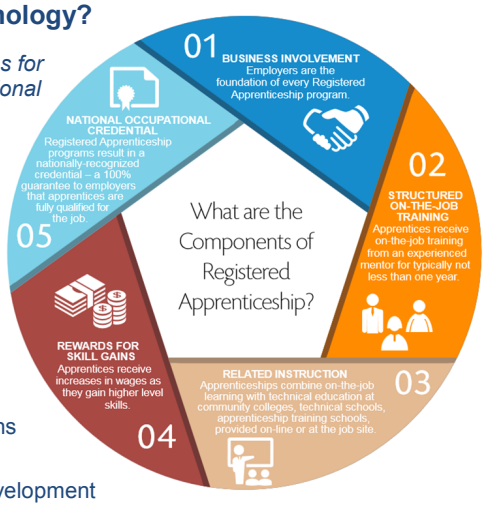
Phone: 603-225-1444
Fax: 603-226-7761

smith.lauren.m@dol.gov
young.wynn.b@dol.gov

https://www.dol.gov/featured/apprenticeship

What is Information Technology?

Building linkages in IT occupations for entry level, technical and professional careers related to the design, development, support and management of hardware, software, multimedia and systems integration services.



IT Pathways

- Network Systems Pathway
- Information Support & Services Pathway
- Web & Digital Communications Pathway
- Programming & Software Development Pathway

Retrieved from https://www.careertech.org/information-technology

REGISTERED APPRENTICESHIP

OCCUPATIONS

- Application Developer
- Communications-Computer Systems
- Communications-Computer Systems Planning and Implementation
- Computer Peripheral Equipment Operator
- Computer Programmer
- Database Technician
- Help Desk Technician
- Information Assurance Specialist
- Information Assurance Technician
- Information Management
- Information Technology Generalist
- Information Management Specialist
- Information Security Analysts
- Information Technology Specialist
- Internetworking Technician
- E-Commerce Specialist
- Network Support Technician
- Network and Computer Systems Administrators
- Programmer, Engr. and Scientific

Retrieved from https://www.onetonline.org/find/career?c=11&g=Go and https://www.doleta.gov/OA/occupations.cfm

EMPLOYERS

- Most areas of business, government and nongovernmental organizations including:
  - Financial institutions
  - Insurance companies
  - Consulting firms
  - Manufacturers
  - Computer companies
  - Telecommunications companies
  - Retailers
  - Healthcare organizations
  - Hotels and restaurants
  - Entertainment companies
  - Environmental management firms
  - Education institutions
  - City, state and federal government
- Consulting firms
- Corporation
- Internet-related companies including:
  - Browsers
  - Search engines
  - Website design services
- Non-profit organizations
- Software, hardware and systems developers
- Technical service providers

Retrieved from http://www2.isu.edu/career/majors/html/managementinformationsystems.html

NH CAREER & TECHNICAL EDUCATION

Computer Engineering Technology

- Concord Regional Technical Center

Computer Installation and Repair

- The Cheshire Career Center, Keene
- Hugh J. Gallen Career & Technical Ctr., Littleton
- R.W. Creteau Regional Technology Ctr., Rochester

Computer Programming, General

- Mt. Washington Valley Career Tech Ctr., Conway
- Pinkerton Academy Center for CTE, Derry
- Seacoast School of Technology, Exeter
- The Cheshire Career Center, Keene
- Milford HS & Applied Technology Center, Milford
- Region 14 Applied Technology Center, Peterborough

Computer Software & Media Applications

- Berlin Regional Career & Technical Center
- Salem HS, CTE Center, Salem

Computer Systems Networking & Telecommunications

- Sugar River Valley RTC, Claremont
- Pinkerton Academy Center for CTE, Derry
- Dover Career Technical Center, Dover
- Nashua Technology Center, Nashua
- Region 14 Applied Technology Center, Peterborough
- Salem HS, CTE Center, Salem
- River Valley Technical Center, Springfield, VT
- Hartford Area Career & Technology Ctr., WRJ, VT
- White Mountains RHS , Whitefield

NH COMMUNITY COLLEGE CONNECTIONS

D=Diploma
C=Certificate
A=Associates

COMMUNITY COLLEGE system of New Hampshire

	GBCC	LRCC	MCC	NCC	NHTI	RVCC	WMCC
Animation and Graphic Game Programming					A		
Application Developer		C					
Computer Engineering Technology					A		
Computer Information Systems				C			
Computer Networking		C		A/C		A/C	
Computer Science			A				
Computer Science and Innovation			A				
Computer Technology	A	A				A/C	
Computer Technology Programming					C		
Cybersecurity & Health Care IT						A/C	C
Cybersecurity Investigations			A				
Database Administration		C					
Digital Design and Animation	C						
Digital Media Communications	A						
Gaming & Animation Developer		C					
Health Information Technology		A					
Information Systems Technology	A/C						
Information Technology					A		A/C
Internet Developer				C			
IT Applications Development					C		
IT Networking					C		
IT Tech Support					C		
Linux	C						
Network Administration		C					
PC Systems Management		C					
Practical Data Science	C						
Programming	C		C				
Software Development	C			A			
Spreadsheet Certificate				C			
Web Development/Website Design		C	C	A/C		A/C	