



Creating Employer-Driven Information Technology Skill Standards, the Process, and the Results

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Ann Beheler has been in the Information Technology industry for over 30 years, and she currently leads several National Science Foundation grants including the IT Skill Standards 2020 and Beyond project, the National Convergence Technology Center (a National IT Center), and the Building Pathways to Innovation project. All work builds on many previous NSF and DOL grants. Ann has corporate experience at Rockwell, Raytheon and Novell; has led her own consulting firm; created and taught in the first vendor-specific networking degree program in Texas, and previously led IT-related divisions and grants for community colleges in Texas and California. Previously, she was Vice President of Academic Affairs for Porterville College, responsible for all instruction at the college, and prior that she was a Dean at both Orange Coast College in California and at Collin College. Among other things, Ann is known for effectively bringing together business and industry using a streamlined process called the Business & Industry Leadership Team Model (BILT) to identify with them the knowledge, skills, and abilities (KSAs) they predict will be needed by "right-skilled" job candidates in the future. She then works with faculty to align curriculum such that those who complete certificates and degrees in IT have the knowledge, skills, and abilities that will make them readily employable in high-paying IT positions. Ann holds a PhD in Community College Leadership from Walden University, a MS in Computer Science from Florida Institute of Technology, and a BS in Math from Oklahoma State University.

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The National Workforce Center for Emerging Technologies (NWCET), based at Bellevue College and funded by the National Science Foundation (NSF), produced a comprehensive and detailed printed manual of IT skill standards in 2003. The NWCET 2003 Skill Standards were created with strong input from both IT employer thought leaders and practitioners and were created to provide a common language for employers and educators to use in training students and incumbent workers [1]. This document has subsequently informed IT applied curriculum programs at colleges nationally for over 17 years even though the rapid pace of IT innovation meant that many of the standards were arguably obsolete shortly after publication. During those 17 years, other professional organizations such as the National Initiative for Cybersecurity Education (NICE) and the Association for Computing Machinery (ACM) created their own standards. These groups' standards often focused on specific areas like Cybersecurity and overall Information Technology. In other words, community and technical colleges who have long been aligning their entire two-year applied technical degrees and certificates to employer needs as outlined by NWCET have been without updated comprehensive, industry-wide skill standards since 2003.

The ITSS project's overarching aim is to help colleges nationally widen the pipeline of well-qualified candidates for the many well-paying IT unfilled jobs both now and anticipated in the future. Indeed, workforce demand for IT technician jobs remains high. The Department of Labor's Bureau of Labor Statistics reports that employment in computer and IT occupations will "grow 13% from 2020 to 2030, faster than the average for all occupations" and add up to 667,000 jobs [2]. Further, a CNBC survey reported that 57% of tech executives say "finding qualified employees is the biggest concern for their company." That concern ranked higher than supply chain issues and cybersecurity threats. [3] Clearly, there is a booming need for skilled IT workers, driven in part by the fact that, as IT executive Josh Prewitt says, "companies need IT brainpower everywhere." [4] The IT worker is no longer part of a siloed team working in a dark server room of a technology company; they are integral to all aspects of every kind of business.

To help address this worker shortage and help better align curriculum with current and future job market needs, the ITSS project was funded in 2018 by the NSF's Advanced Technological Education program to create an updated contemporary set of employer-driven, future-facing skill standards for approximately eight to ten of the most difficult-to-fill IT job clusters. While the ITSS project's processes were informed by the NWCET work, a simple revision was not possible. The jobs, skills, and technologies have simply changed too much since the 2003 NWCET publication. Since employers determine whom they consider to be well-qualified job candidates, employers were intentionally allowed to drive the work. This industry-led approach aligns with a report by Boston Consulting Group entitled "Fixing the Global Skills Mismatch" that acknowledged the problem of colleges "producing many workers who lack the skills the labor market demands" and recommended a closer collaboration between educators and employers so colleges might better prioritize "job skills and career readiness." [5]

Project Design

At a high level, the project consists of three significant efforts, detailed in the “Project Implementation” section below:

1. **Identification** of the top critically-needed IT job clusters by IT Thought Leaders (mostly Chief Technology Officers, Chief Information Officers, and Company Strategists) with a view of the future skills needed to keep their company in business and competitive.
2. **Skill Analysis and Verification** through convenings of employers and educators to examine each job cluster area identified by the Thought Leaders. These convenings employed a modified DACUM process developed and refined by the NSF’s National Convergence Technology Center (CTC).
3. **Dissemination** of all created products, broadly and nationally, to employers and educators through webinars, conferences, and training events.

Project Implementation

Identification

The project began by recruiting over 100 IT Thought Leaders from the industry to characterize the specific job clusters of focus for the entire project. To do this, the ITSS team’s experienced professionals first networked with their personal employer networks to connect with Chief Technology Officers, Chief Information Officers, and strategists for companies of all sizes. The Thought Leader candidates were vetted through their LinkedIn profiles, personal recommendations, and resumes. The Thought Leaders were then invited to attend one of four two-hour structured focus group sessions in the spring of 2019.

Each Thought Leader session was facilitated by principal investigator Dr. Ann Beheler using metrics gathered through Burning Glass’ Labor Insights products regarding the most in-demand job clusters over the six months before the focus group discussion. Both a lively verbal discussion (which was recorded) and an equally lively discussion in “chat” occurred simultaneously. After the meetings, the ITSS project team used a qualitative analysis approach to identify key themes and statements across all four of the recordings and chats. A Delphi-like survey method was then used to gain consensus on the top-most critically in-demand job clusters as well as the description of each job cluster. Notably, a consensus was obtained for seven job clusters:

- Infrastructure Connectivity Management and Engineering,
- Technical Support,
- Technical Project Management,
- Data Management and Engineering,
- Data Analytics and Predictive Modeling,
- Software Development and Engineering, and
- Cybersecurity.

Consensus beyond these seven areas was not obtained. Given the amount of work involved in developing skill standards for these first job clusters, the ITSS project team decided to proceed with the first seven and reconvene the Thought Leaders later to obtain further guidance. Note

that, ultimately, Cybersecurity was not addressed as a job cluster. This decision will be explained in the section below entitled “Transitioning from Full Skill Standards to Skill Sets.”

Skill Analysis and Verification

Once the job clusters of focus were agreed upon, the project team, with guidance from the project evaluator Dr. Deborah Hecht, City University of New York, began systematically working through the clusters. For the cluster meetings, 20 to 40 subject matter experts (SMEs) – identified and recruited like the Thought Leaders – were invited to attend one of several meetings per job cluster. The original plan specified holding the SME meetings in person with one meeting on the East Coast, one in the Central portion of the nation, and one on the West Coast. This approach minimized travel time for the SMEs to make it easier to obtain a commitment from the most desired SMEs. Participation online was also provided for these in-person meetings. The ITSS team specifically focused on holding in-person meetings to ensure that the SMEs would be fully present for the discussion, something that cannot always be ensured with totally online meetings. The in-person approach worked until COVID-19 restrictions precluded meeting in person; since March 2020, all SME meetings have been held online as an alternative to holding no meetings at all. Hosting online meetings allowed the project to continue with minimal disruption due to COVID. In-person meetings have yet to resume due to continuing variant outbreaks.

Each of the SME job cluster meetings, whether in person or online, capitalized on the process for prioritizing future-facing Knowledge, Skills, Abilities, and Tasks (KSA+Ts) that was developed through the National CTC’s Business & Industry Leadership Team (BILT) Model. The BILT Model has been used and promoted by that group for almost 18 years. [6] The BILT model puts employer leaders in a co-leadership role for curriculum that parallels the Brookings Institution’s Elizabeth Mann Levesque’s belief that strong partnerships between educators and employers are a “crucial strategy” in helping workers “develop the requisite skills and knowledge.” [7] To begin each job cluster meeting, the SMEs were provided a pro forma list of KSA+Ts to kick-start the discussion. Pro forma lists of KSA+Ts were created by searching for any existing lists of competencies and working with key employers. The SMEs first voted electronically on the pro forma list of KSA+Ts and then discussed the voting results together. Educators from across the nation were invited to attend all meetings, but the focus of the meetings was on obtaining employer quantitative and qualitative input. During the discussion, SMEs suggested additions or changes to the pro forma list. Items with a low average of votes would be recommended for removal. The discussion from each SME meeting was recorded.

Once all SME meetings for a cluster were complete, the ITSS project team synthesized the quantitative results of the vote and the qualitative results obtained from a review of the discussion. The synthesized data was then reviewed with attendees from all SME teams to gain consensus.

Note also that in addition to voting on and discussing content-specific KSA+Ts, the employer SMEs at each meeting, whether in person or remote, voted on and discussed 12 key employability skills for each job cluster, which included topics like teamwork, ethics, and critical thinking.

The final step for each job cluster involved developing two supplemental resources. The ITSS team first drafted Key Performance Indicators (KPI) for the prioritized Tasks, which were ultimately verified by the SMEs. And finally, educators who attended the SME meetings created Student Learning Outcomes (SLO) for the KSAs to make it easier for colleges to implement the KSA+Ts into course curriculum.

To recap, each job cluster Skill Standard Package includes:

- The verified KSA+Ts, together with the SME average vote,
- The Employability skills, as voted upon in the SME meetings,
- The Key performance indicators (KPIs) for the Tasks, and
- The Student Learning Outcomes (SLOs) for each of the KSAs created by educators.

All these artifacts are posted and available for download and use. [8]

Dissemination

Recognition and Dissemination of the Full Skill Standards for the Six Job Clusters

In Spring 2021, the Texas Skill Standards System (TSSS) contacted the ITSS project, offering to review and consider recognizing the six completed skill standards. Skill standards for all but the Software Development job cluster was submitted in time to be recognized in September 2021, and skill standards for Software Development were recognized in December 2021. Recognition means that the TSSS posts the standards on their website and endorses them for use by educational institutions across Texas. This noteworthy recognition assists in the dissemination of the skill standards and helps further validate the overall work. [9]

The project has begun training faculty members across the nation to use the skill standards, beginning with two introductory webinars and several conferences presentations. The project is beginning to contact over 2500 college administrators to launch an in-depth training initiative in that will publicize the availability of the standards packages and deliver detailed support on how to use the skill standards as well as supporting documents like KPIs and SLOs – to affect curricular change locally. That is, faculty can use the ITSS materials and the BILT model approach to better discuss the unique local needs of their region as identified by their advisory council. Just as the ITSS team worked with SMEs to vote and validate KSA+Ts, faculty members can do the same with their employers.

Transitioning from Full Skill Standards to Skill Sets

The Thought Leaders reconvened in late 2020 to work toward identifying the remaining one to three job clusters for which skill standards were originally planned to be developed. During that reconvening, however, the Thought Leaders expressed interest in ITSS identifying no additional job clusters; instead, they proposed that the project identify a more limited set of skills that can be layered onto many other careers. The “skill sets” recommended include topics such as Artificial Intelligence and Machine Learning, Augmented Reality/Virtual Reality, IT Automation, Internet of Things, and 5G.

At about the same time, the ITSS team had several collaborative discussions with NICE that revealed the breadth and depth of NICE’s work developing cybersecurity skill sets. Given that NICE’s mission includes developing and maintaining extensive skill sets and materials to train Cybersecurity professionals and that they have continuing funding, the ITSS team decided in consultation with the NICE leadership to convert Cybersecurity from a job cluster to this new skill set category as described above. [10] The team felt it was unwise to duplicate work from NICE and instead that ITSS should complement their work and steer others towards the NICE materials for full cyber-security curriculum purposes.

Therefore, as guided by the Thought Leaders, the ITSS project transitioned in 2020 into developing skill sets for emerging areas using the same BILT-style, employer-led methodology although adjusted to focus on broader, more universal skills that could apply to many careers, not solely even to IT careers. Like the skill standards developed for the job clusters, these skill sets will be posted for public download when complete and featured in online training for faculty across the nation.

Conclusion

Lori Sparger and Dave Jarrat point out that not only must employers and educators “explore practical ways to broker improved alignment and communication with one another” but that colleges must “encourage employers to better articulate just what technical and human skills they desire.” [11] The ITSS project, using the successful BILT model to identify in-demand technical skill and to directly engage employers in conversations to identify essential human job skills, embodies this notion. Educators nationwide are expected to be able to use work provided by the ITSS project to strengthen their curriculum through alignment to future workforce demands, build a strong connection with their own employer councils, and deliver skilled graduates ready to fill in-demand IT jobs.

[1]

<https://www.tssb.org/sites/default/files/wwwpages/repos/pdffiles/NWCETSkillStandards03.pdf>

[2] <https://www.bls.gov/ooh/computer-and-information-technology/home.htm>

[3] <https://www.cnbc.com/2021/10/29/labor-outranks-cyber-threats-as-biggest-concern-for-tech-companies-.html>

[4] <https://venturebeat.com/2021/07/21/the-changing-role-of-it-teams-3-major-evolutions/>

[5] <https://www.bcg.com/en-us/publications/2020/fixing-global-skills-mismatch>

[6] <https://connectedtech.org/business-industry-leadership-team/>

[7] <https://www.brookings.edu/research/the-role-of-employers-in-addressing-the-skills-gap/>

[8] <http://itskillstandards.org>

[9] <http://tssb.org>

[10] <https://www.nist.gov/itl/applied-cybersecurity/nice/about/strategic-plan>

[11] <https://www.the74million.org/article/sparger-jarrat-colleges-and-employers-are-not-communicating-about-the-skills-students-have-or-need-to-how-they-can-bridge-this-gap/>